

A CRITICAL INVESTIGATION
OF THE
SEMANTIC AND MORPHOLOGICAL ASPECTS
OF TERMINOLOGICAL INCOMPETENCE
(with special reference to
the English-speaking student of
Physical Science and History
in Cape Education Department high schools)

by

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Words, words, mere words ...

- Troilus and Cressida, V:iii

For my wife, Morag,
and my children, Stephen and Bronwyn,
for their endless patience

TIGER

By Bud Blake



S E C T I O N A

I N T R O D U C T I O N

CHAPTER 1

SCOPE AND BACKGROUND OF THESIS

The aim of this chapter is to provide a brief account of the scope and background of the Thesis. It must be pointed out at the outset that it is not possible in an introductory chapter to deal with issues in any detail - to do so would be to write the whole Thesis in the introduction. Certain terms and concepts will have to be dealt with very briefly here and expanded on later in the Thesis.

1.1 THE SCOPE OF THE THESIS

The title of the Thesis suggests that it is concerned with a limited set of issues concerning one particular aspect of the problem of language in learning. This can be best explained by analysing certain words and phrases in the title in some detail.

1.1.1 'INCOMPETENCE'

'Incompetence' is a word which has become very popular in linguistic and educational circles. It was coined for use in a linguistic sense as a derivative of the term 'competence' introduced in the 1960's by Chomsky. This latter term refers basically to the knowledge which a speaker-hearer has of his language. 'Incompetence', however, is not a straight antonym for the term 'competence' - despite the fact that it is derived by means of adding a prefix to the term 'competence' - since it refers to 'faulty' knowledge and as such is in fact part of a speaker's 'competence'. It is used here, then, to mean the faulty aspects of an individual's 'competence'.

1.1.2 'TERMINOLOGICAL'

The adjective 'terminological' in the phrase 'terminological incompetence' indicates the specific area of linguistic competence that is the sphere of study in this Thesis. It can be argued (even if somewhat simplistically) that the vocabulary of a language can be divided into two main types, viz 'general' and 'technical' vocabulary (Flood:1957:5). These two categories form part of

the broader distinction between what Sager et al (1980) call 'general' and 'special' languages. If this distinction is accepted, then 'terminologies' can be seen as specific manifestations of the second of these two vocabulary types, viz 'technical vocabulary'. This Thesis is, therefore, concerned only with the lexical aspects of competence, and only with technical lexical competence.

1.1.3 'MORPHOLOGICAL' AND 'SEMANTIC'

These terms suggest, in the first place, that the Thesis is concerned only with what might be considered the 'linguistic' aspects of terminological incompetence. The other factors - eg the quality of teaching, the quality of textbooks, the social backgrounds of the learners, etc - are obviously important and will have to be referred to in passing. The focus, however, of the investigation is on the linguistic issues involved in the use and understanding of terminology and on the inherent linguistic causes of incompetence.

If one examines the lexical aspects of competence, one finds that there are two main components of this knowledge, viz the 'semantic' and the 'formal'. The latter includes the following:

1. Morphology
2. Syntax
3. Graphemics
4. Phonology

In this Thesis, the semantic and morphological aspects have been singled out for the following reasons. In the first place, it was found necessary to limit the scope for practical reasons. In determining which aspects to focus on, it was decided to select the semantic aspects because terms are basically vehicles of the concepts which comprise the various subject disciplines; it can therefore be argued that this is the key aspect of terminology. As regards the formal side of terminology, it was felt that the morphological aspects were more essentially lexical in nature and, furthermore, that the morphology of terms included certain aspects of syntax anyway (eg word classes, inflexions) and certain aspects of graphemics (eg spelling, punctuation). It was felt that these two aspects provided a sufficiently manageable yet sufficiently broad area of study. It is, furthermore, in the semantic and morphological aspects that technical vocabulary differs most from general vocabulary.

1.1.4 'PHYSICAL SCIENCE' AND 'HISTORY'

'Physical Science' here refers to the subject which is available to South African pupils in standards 8 to 10 and consists of both Chemistry and Physics. This subject was chosen along with History for a number of reasons. In the first place, because 'Physical Science' is in effect a combination of two sciences, the terminologies of two similar types of subjects could be examined. Secondly, because History and historical terminology are very different from Science and scientific terminology, the similarities and differences between the terminologies of two very different subjects could also be explored. The varying terminological demands of different subjects that can be made upon one pupil could thus be illustrated effectively.

1.1.5 'ENGLISH-SPEAKING'

This Thesis is concerned only with mother-tongue speakers, which means that the problems of non-mother-tongue speakers having to learn History or Science through the medium of another language are not relevant here. It can be assumed that many of the problems will be the same, but that each group will also have problems which are peculiar to their own situation.

A further implication of the restriction to 'English-speaking' pupils is that we are not concerned with the problems of mother-tongue Afrikaans-speaking pupils studying these subjects through the medium of Afrikaans. It can be assumed, however, that what is said here is relevant to the child whose mother tongue is Afrikaans (or any other language, for that matter); however, at the same time, it has to be accepted that there will be differences resulting from the peculiar characteristics of each group's respective language, pupils, schools and educational philosophies.

1.1.6 'CAPE EDUCATION DEPARTMENT HIGH SCHOOLS'

This Thesis is concerned only with the high school (ie standards 6 to 10; ages 12 to 17). Therefore there will be no discussion as such of the junior school situation. Furthermore, the investigation is limited to the Cape Province only. Thus what is said here is not necessarily true in all respects of the other provinces. Much of what is said about the senior school is, of course, relevant to what precedes it in the junior school; furthermore, what is said

of the Cape is also in varying degrees applicable to the other provinces - and, indeed, to other countries as well.

1.1.7 'CRITICAL' INVESTIGATION : SUPPORTING DATA

The word 'critical' here is meant to suggest that the Thesis is based on argument and research rather than on actual experimentation. This does not mean that the investigation is not data-based. It has, in fact, a very firm data base which can be specified as follows:

1. A survey of the terms used in the following standard 8 texts, one History and two Science, which are in common use in Cape schools:
 - a) Brink & Jones (undated): Physical Science 8
 - b) Pienaar & Walters (1973): Senior basic Physical Science 8
 - c) Smit, et al (1974): History for standard 8

The corpus of terms from this survey is recorded in Appendix B.
2. A scrutiny of examination scripts of standard eight pupils in a high school in Cape Town which has pupils with a wide variety of social and cultural background and academic ability. Altogether 310 Science and 100 History scripts were scrutinised from three different examinations written in 1981 and 1982.
3. A survey of standard eight examination papers of 1980-2 including 20 Science papers from 15 Cape schools and 10 History papers from 10 schools. These are included in Appendix H.
4. An analysis of Questionnaires sent to the following:
 - a) Science teachers: 1981 (70 respondents from 36 schools)
 - b) History teachers: 1982 (56 respondents from 28 schools)
 - c) Science pupils: 1983 (116 standard 8 pupils from two schools)
 - d) History pupils: 1983 (28 standard 8 pupils from one school)

The data thus gathered was used to investigate and illustrate terminological problems experienced by pupils. It is not claimed that these particular

examples are necessarily the most common amongst pupils - to establish that would involve a far more scientific joint investigation by a linguist and a subject expert. The types of problems can, however, be taken to be typical of what pupils experience. The inherent linguistic complexities of terminologies, furthermore, make it possible to anticipate and confirm the kinds of problems involved here - which means that a data-approach is not the only means of investigating terminological incompetence.

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The originality of this investigation is as follows: To my knowledge, no major investigation of the terminological problems of school pupils has been undertaken anywhere; and no investigation of any type has been conducted in Cape schools. Furthermore, I am not aware of any study of the relative problems of different subjects, and in particular of Science and History.

1.2 BACKGROUND TO THESIS

1.2.1 PROBLEMS OF LANGUAGE AND LEARNING

It has been said that 'educational failure is language failure'. It can be argued here that there are many other factors which could cause educational failure and that language failure does not necessarily result in lack of academic success. However, it is no doubt true that the schoolchild who does not attain a certain type of language competence will be handicapped as regards academic performance.

The underlying reason for this is the fact that our educational system is heavily reliant on language - and especially the written language - as a medium of learning as opposed to the 'direct learning' experiences advocated by certain educationists today such as Ivan Illich in America and John Holt in Britain. Language is the basis both of learning and of communicating what has been learnt. From the moment the child steps into his first period class in the morning till he leaves the last five hours later the child is involved in what is primarily a verbal experience.

It is clear, then, that in order both to learn effectively and to express what

has been learnt, the child requires a certain type of language competence which enables him to perform at the level demanded by textbook authors, teachers and examiners. The type of language involved here is both conventional and academic/linguistic in origin. As regards the former, textbooks tend to be written and examinations set in a style which has over the years come to be tacitly accepted as the norm. Pupils are, furthermore, expected (ideally at any rate) to write their answers in a similar style, although (as responses to certain questions in the Questionnaires to teachers indicate) a range of tolerance is allowed, especially in the sciences. As regards the academic/linguistic causes of the type of language we see in schools, we can say that academic study demands a different type of language. Sager et al (1980), as already indicated, distinguish between what they call 'general' and 'special' languages. 'Special' language reflects a specialised type of knowledge which is qualitatively different from what might be called 'general' knowledge. The underlying difference is between what Johnson-Laird and Wason (1977) call the 'intuitive and implicit categories of daily life' and the 'more self-conscious and cold-blooded categories of an explicit classification system such as one finds in a science' (p 169).

It is essential, then, that the child learn to cope with the demands of the language of education, which is an amalgam of what has conventionally come to be regarded as the 'right' kind of language for teaching, learning and examining and the specialised or technical language of academic discourse. In addition to the general language of education, the child needs to learn to adjust to a number of special languages. Each of these special languages belongs to a different discipline or 'subject' and reflects what Flood (1957:6) calls 'specialised subject matter' or what Sager et al (1980:70) refer to as 'a bounded subsystem of the knowledge structure'. The curriculum in our schools is such that each child must take at least six subjects. The Official Languages (English and Afrikaans) are compulsory throughout the child's schooling. In the first few years of the high school the child must also take General Science (Physics, Chemistry and Biology), Mathematics, History and Geography; to these are added various optional subjects. In standards 8 to 10, there is greater freedom of choice of subjects, which varies from school to school; nevertheless, there are restrictions which compel the child to follow a fairly varied curriculum. The 'inter-disciplinary' approach to subjects which has been propagated and practised in Britain in certain areas for a number of years has not found favour here.

The typical school timetable is such that it divides the schoolday into about

9 periods of approximately 35 minutes. Subjects are arranged in a haphazard order to suit staffing allocations and other practical considerations rather than to ensure any kind of continuity for the child. The pupil may therefore move from English to Science to History, then back to English, on to Woodwork and finally to Afrikaans, his day being interspersed with instruction in the 'non-examination' subjects. While this certainly helps to counteract boredom, it also places great strain on the child who has continually to adapt to the very different language demands of each subject, and in particular the terminological demands.

We have already commented on the fact that the linguistic complexities of terminologies are such that any child is likely to experience difficulties in coping with any terminological system. If one adds to this the fact that one child has to cope with a number of terminologies throughout his schoolday, it is not surprising that morphological and semantic (and other) problems in the use and understanding of terminology are the order of the day.

1.2.2 SOLUTIONS TO THESE PROBLEMS

The difficulties the child faces as a result of the linguistic demands of education in general have been highlighted in recent years. The vital role of language in learning has been explored in various quarters. Slogans such as 'Every teacher is a teacher of English' and catch-phrases such as 'language across the curriculum' have become the order of the day. The need for every teacher to be aware of the linguistic problems that pupils experience in each subject is one of the recommendations of the much-quoted Bullock Report of 1975, but was in fact propounded at least as early as 1921 in the Report on the Teaching of English, and has been popularised in publications of writers such as Creber (Lost for words), John Holt (How children fail), James Britton, Douglas Barnes and others. In South Africa a nascent awareness of these problems has manifested itself in the calling of a conference on 'language across the curriculum' at the Johannesburg College of Education in 1981 and again in 1983; in the inclusion of a small section on the language of Science in the programme of the Conference of Science Teachers held in Cape Town in 1981; in the production of an M Ed thesis on the readability of Science textbooks at UCT in 1981; and in the scattered passing references to 'language across the curriculum' in the draft of the new syllabuses for English.

Consensus on how to implement a whole-school language policy has not, however,

been reached. The architects of the British Schools Council projects on the role of language in learning have proposed that the answer lies not in helping the child to cope with the specialised demands of the language of education but rather that the language of education itself should be changed to suit the child. It is argued, therefore, that there should be more verbal interaction in the classroom and that written work should be more informal and should allow for a mixture of a personal, creative style with a formal, objective style - at any rate, in the early years of the high school. The 'audience' for such writing should be either the child himself or the teacher as 'facilitator'. These suggestions are accompanied by the calls for greater 'relevance' in education and an attack on the presentation of school subjects as separate compartments of knowledge and on seeing 'knowledge' as something to be handed down to the child. Boundaries between disciplines are therefore regarded by some as irrelevant and artificial, and 'knowledge' becomes child-centred. The significant implication from our point of view is that the need to use and understand the 'special languages' (including the terminologies) of education is therefore rejected.

In South Africa, this so-called 'progressive' approach to education has not had any significant impact. The traditional, subject-orientated approach, which is hotly defended by many in Britain, is still very much the order of the day. Textbooks and teachers as purveyors of knowledge are much in evidence and examinations are couched in a language which is formal and technical. The responses of teachers to the two Questionnaires indicate a demand for this type of language in pupil writing. All this means that terminology is firmly entrenched in our educational system. The sheer number of terms a child has to cope with (about 430 in History and 920 in Science in standard 8) is evidence enough of this fact.

The Schools Council answer, therefore, to opt for a more informal type of language and to avoid the use of terminology, cannot be advocated holus-bolus for Cape schools: the traditional type of language of education is here to stay. Ways and means must thus be sought to assist teachers and textbook writers to improve their presentations and to guide teachers as to how to assist their pupils to cope with the problems arising from this type of language. Various publications on the general principles involved here have appeared in recent years. Texts to assist pupils with specific subjects have also been published, the Oxford English in focus and Reading and thinking in English series being significant examples in point. There are, however, two limitations in these publications for our purposes. In the first place, they

are aimed at non-mother-tongue speakers. In the second place, they focus on the sentence and the text and neglect the question of terminology.

The fact that education in the Cape makes great demands upon pupils as regards technical terminologies and the fact that investigations into the language of education have not explored the problems of terminology in any detail suggests that an investigation into the problems of technical vocabulary and into solutions as to how to cope with these problems is urgently needed in South Africa. This is the key motivation behind this Thesis.

1.3 OUTLINE OF THESIS

The structural outline of the rest of the Thesis is as follows:

SECTION B

This is a short section which provides an account of the nature of linguistic competence and incompetence in general and of lexical (and especially technical lexical) competence and incompetence in particular.

SECTION C

This section is concerned with the details of 'conceptual' competence and incompetence, ie the aspects of semantic competence relating to the use and understanding of vocabulary. The differences between the demands of general and technical vocabulary are discussed and the problems issuing from the overlap between general and technical vocabulary as regards the use of common words as well as the specific demands of technical vocabulary are dealt with in some detail.

SECTION D

This is a parallel section to Section C dealing with the morphological aspects of technical competence and incompetence.

SECTION E

The final section analyses the proposed solutions of the Schools Council to these problems in greater detail. It is suggested that an alternative approach is needed in our situation - an approach which assists pupils in coping with the problems of terminology rather than one which advocates the avoidance of terminology. Two basic issues are dealt with in regard to the proposed approach.

Firstly, there is the question of direct intervention to assist pupils versus an 'exposure' or 'osmosis' approach to the matter. It is suggested that the latter is not adequate, that teachers need to intervene directly to provide pupils with guidance regarding terms and terminologies. Secondly, the question of the role of explicit linguistic knowledge in helping pupils to cope with problems in the use and understanding of terms is examined. The conclusion is reached that this kind of knowledge has value and should therefore be made available to pupils in schools. A fairly detailed lexical programme for schools as a means to this end is included at this stage of the Thesis.

A question which arises from the above is that of who is meant to implement a programme of direct intervention based on explicit knowledge - the English teacher or the subject teacher? It is argued that the matter cannot be left to either but that a collaborative effort is required. Problems in attempting to implement such a 'whole-school' policy are examined (the lack of training of teachers in language, the problem of lack of time, and the content and approach of current and prospective English syllabuses) and tentative long-term proposals for overcoming these obstacles are suggested. In the meantime, it is suggested that steps could be taken along the lines suggested in the Thesis once schools have become convinced of the vital role played by language in general and terminology in particular in the process of learning.

S E C T I O N B

LEXICAL COMPETENCE AND
INCOMPETENCE

CHAPTER 2

LEXICAL COMPETENCE AND INCOMPETENCE

In order to investigate the linguistic problems pupils can and do experience in coping with terminologies at school, it is necessary to examine the linguistic demands made by terminologies upon the pupils. These, as will be seen, are extremely complex, because terminologies are themselves inherently complex. For this reason alone, it is to be expected that pupils would experience problems in using and understanding terms.

This introductory chapter, then, begins with a brief overview of the concept of lexical competence. As will be indicated later, this cannot be seen in isolation from general language competence; but it is nevertheless possible to separate lexical competence as a particular component of general language competence. Following this, there will be an overview of the parallel concept of lexical incompetence. The rest of this and sections C and D of the Thesis will take up specific aspects of lexical competence in greater detail, with special reference to the problems that pupils experience as a result of the special demands of lexical competence, and to the fact that they all experience in varying degrees, the effects of lexical incompetence. Many of the problems result from aspects of lexical incompetence which equally affect their performance regarding the use and understanding of general vocabulary items. Others are the result of the insufficient grasp of special insights which are necessary to cope with technical vocabulary in particular.

The discussion of problems in the later chapters is based on two types of argument, one hypothetical and the other empirical. Because of the inherent complexities of vocabulary in general and technical vocabulary in particular, certain problems can be predicted and anticipated. These and other problems can also be seen in pupils' performance, in particular their written work, which forms the basis of our educational system. Illustrations of problems are, therefore, based on one or other of these types of 'evidence' or both.

2.1 LEXICAL COMPETENCE

This section is concerned with the process involved in the acquisition, understanding and use of technical terms by standard eight pupils, with particular

reference to Physics, Chemistry and History. What the pupil has to acquire in order to cope with terminologies is an extension of what might be called his 'lexical competence', which is an integral part of his broader 'communicative competence' which underlies language performance in general.

2.1.1 COMMUNICATIVE COMPETENCE

(a) Competence and performance

It is necessary, before proceeding further, to clarify the terms 'competence' and 'performance' as used in this discussion, since there is no real agreement among linguists as to what these terms mean.

The term 'competence' has come to be an accepted term for labelling a speaker's knowledge of his language. It was introduced in the 1960's by Chomsky, who arrived at a distinction between what he called 'competence' and 'performance' as a result of his somewhat violent rejection of the behaviourist-empiricist view of psychology and language as propounded in particular by B F Skinner. Chomsky was instead a strong adherent and exponent of what has come to be called 'cognitive psychology'. Since this theory underlies the concepts of 'competence' and 'performance' as well as many of the current views on learning and the role of language in learning, a brief comment on cognitive psychology is necessary here. 'Cognition' refers to the various aspects of the 'conscious' life. Therefore the cognitive approach to psychology can be said to accept the idea that the human being has a special set of abilities that play an important role during learning and behaving. Instead of the human being being passive during these processes, as suggested by the behaviourists, it is believed that he makes use of a set of faculties to which we normally give the name 'mind'. This mind processes input information during learning. Chomsky argues this view in his Language and mind (1968), the title of which sums up his attitude towards language and psychology:

... normal human intelligence is capable of acquiring knowledge through its own internal resources, perhaps making use of the data of sense, but going on to construct a cognitive system in terms of concepts and principles that are developed on independent grounds.

Cognitive psychology thus accepts the seventeenth century rationalist psychological doctrine of innate abilities - our perception and understanding of the external world (and therefore learning) depends on a number of 'ideas', 'schemes' or organising principles of interpretation. These cognitive psychologists differ as regards the relative roles played by nature and nurture in learning and behaving; but all accept that there is an active mind involved in these processes. Therefore these psychologists, rather than being concerned primarily with input and output of the behaving organism - the observable events of the environment and their relationship to behaviour - are more concerned with the nature of this behaviour and the structure of the organism that lies between.

As far as language study in particular is concerned, Chomsky has opposed the behaviourist approach that concentrates on language behaviour and that regards 'knowledge' merely as 'knowing how' to respond appropriately to stimuli. Chomsky maintains that the mind plays a dynamic role both during language acquisition and language use. Therefore the real emphasis in language study should be on the structure of the mechanism that underlies language ability. His main objections to behaviourism as a framework of linguistic description are based on the lack of correlation between the various aspects involved in language use and acquisition. Whereas the behaviourists stress that input (language experience) equals 'knowledge' of language and that output (language use) is also equivalent to this knowledge (and therefore to input as well), Chomsky maintains that there is a vast discrepancy between both input and knowledge on the one hand, and between output and knowledge (and therefore between input and output) on the other.

On the basis of these arguments, Chomsky concluded that, in order to understand language acquisition and language behaviour, it is necessary to distinguish between a speaker's competence and his performance:

It has, I believe, become quite clear that if we are ever to understand how language is used or acquired, then we must abstract for separate and independent study a cognitive system, a system of knowledge and belief, that develops in early childhood and that interacts with many other factors to determine the kinds of behaviour that we observe; to introduce a technical term, we must isolate and study the system of linguistic competence.

(1968:4)

This 'competence' contrasts with 'performance' - the particular acts of

construction and interpretation in particular places and at particular times. Competence he defines (1965) as 'the speaker-hearer's knowledge of his language' an abstract, virtual potential - while performance is defined as 'the actual use of language in concrete situations' - concrete, actual reality.

Chomsky himself uses the term 'competence' in two different ways in his writings - in a strong sense and a weak sense. It was the weaker sense that he propounded in Aspects of the theory of syntax (1965):

Linguistic theory is concerned primarily with an ideal speaker-listener, in a completely homogeneous speech-community, who knows its grammar perfectly and is unaffected by such grammatically irrelevant conditions as memory limitations, distractions, shifts of attention and interest, and errors (random or characteristic) in applying his knowledge of the language in actual performance.

(p 31)

He goes on to stress that the grammar he has devised 'does not, in itself, prescribe the character or functions of a perceptual model of speech production'. Competence is seen here as a Platonic Idea, an abstract, idealistic concept, complete and in actual practice unattainable by any individual member of a speech community. Munby (1978) points out that on other occasions Chomsky adopts 'the stronger claim that the rules of grammar are internalised in the head of the speaker and provide the basis for his understanding of linguistic relations'. He quotes Chomsky as saying that

A person who has learned a language has acquired a system of rules that relate sense and meaning in a certain specific way. He has, in other words, acquired a certain competence that he puts into use in producing and understanding speech.

(p 8)

Green (1975) makes the same point:

... Chomsky tends to fluctuate between two definitions of competence. The weaker, more neutral definition is that transformational grammar provides the best analysis of language..... The stronger definition is that **transformational grammar** ... is part of the actual mental equipment inside our heads which we use to produce and understand language.

(pp 129-130)

It is the stronger view which has been adopted and developed by subsequent linguists, psycholinguists and sociolinguists. While accepting the fact that one needs to keep in mind some general, corporate, 'essential' competence, they argue that we should also be concerned with the Platonic Shadow, with the fact that each individual possesses a psychologically real version - incomplete and imperfect - of the essential competence. It was Hymes who in 1972 advocated the need to consider 'a differential competence within a heterogeneous community' (1972:274). This concept of a differential, dynamic competence manifests itself in a number of ways. Firstly, there are the differences between the 'competences' of individuals in the speech community and between groups of individuals. In the school situation, there will therefore be differences in the competence possessed by each individual - no two, say Smith and Wilson (1979), will in fact have exactly the same competence. There will also be groups of individuals who have certain aspects of competence in common because of certain common factors they all possess (eg social class background, age, ability, etc). Secondly, one individual's competence will vary itself at both a diachronic and synchronic level. Diachronically, his competence is seen as knowledge which develops as the child matures and acquires more knowledge - hence Pit Corder (1975)'s term 'transitional competence'. At the synchronic level, it manifests itself in the various 'functional varieties', in the 'repertoire of speech acts' (Hymes:1972) which enable the child to cope with the problems of adapting his language to the context, subject discipline, etc.

A further, related, development since Chomsky's introduction of the term 'competence' has been the broadening of the reference of the term, and the corresponding narrowing of the reference of the term 'performance'. The combined pressure of psychologists, sociologists, philosophers, computer scientists and linguists has led to a questioning of the narrow, purely 'linguistic', considerations of Chomsky. Lyons (1970) comments on the effect of this move as follows:

Although a distinction of this kind is undoubtedly both a theoretical and methodological necessity in linguistics, it is by no means certain that Chomsky himself draws it in the right place. It can be argued that he described as a matter of 'performance' (and, therefore, irrelevant) a number of factors that could be handled in terms of 'competence'.

(p 115)

Linguists have not reached unanimity on exactly which 'factors' should be

transferred from 'performance' to 'competence'. Among the two most important are the psychological processes involved in actually producing and understanding language (ie how competence is converted into performance) and the role of context in the acquisition and use of competence. In terms of the first of these, a great deal of experimental work has been done in psycholinguistics on the perceptual and other psychological factors involved in sentence-production and sentence interpretation. It is, however, the other aspect which has had the greater impact on the definition of the term 'competence'. While not returning to the behaviourists' view of a passive dependence on context, these linguists nevertheless argue that context is a relevant factor in linguistic performance and that any individual needs a 'pragmatic' component in his 'competence' to enable him to use his purely 'linguistic' competence appropriately and to acquire it in the first place. The term 'communicative competence' was introduced to describe this broader type of competence. The term 'performance' was accordingly narrowed to refer only to actual utterances.

The term 'competence' is used in this Thesis in the stronger sense mentioned earlier and the broader sense commented on above. Furthermore, we are particularly concerned with those aspects of competence which enable the child to understand and to communicate his understanding of scientific and historical concepts.

(b) Grammatical and lexical competence

The 'communicative competence' of a speaker can be regarded as comprising two main components, both of which have built-in contextual variants, restraints and determinants - ie the 'grammar' of the language and the 'lexicon' of the language. Smith and Wilson (1979) point to the difference between these two components as follows:

By contrast with the lexicon the grammar proper deals with the phonological, syntactic and semantic properties of the sentence rather than the word.

(p 58)

The key point here is that the 'lexicon' is concerned with the word, while the 'grammar' involves the rules concerning the sentence (or, as some contemporary linguists argue, the 'text'). A further difference between these two components is mentioned by Leech (1974). This point relates to a fact mentioned earlier,

viz that 'competence' today is viewed as a growing, dynamic phenomenon. Leach points out that, after the age of five, this is in fact probably more true of lexical knowledge than of grammar knowledge. The lexicon, he says, is 'open-ended in a way that grammar is not'. He continues as follows:

Whereas we have learned the grammatical rules of English in all essentials by the age of five, we continue the process of acquiring vocabulary and new uses of vocabulary right the way through our lives. The store of lexical information we carry with us is continually undergoing development and modification, through the written and spoken communications that we receive.

(p.203)

The knowledge a speaker possesses concerning the lexicon of his language may be called 'lexical competence'. Since terminology deals with words (and word combinations), the acquisition of a terminology is merely an extension of the process which every speaker experiences as regards general lexical competence. It does, however, bring in new and different aspects of lexical competence as well - aspects relating to the particular characteristics of technical vocabulary. Thus, not only does the child have to acquire a whole new set of words (terms), but he also has to learn to cope with the particular demands of technical vocabularies and also to transfer the skills acquired earlier in the acquisition and use of general vocabulary to technical vocabulary. We shall be using the term 'technical lexical competence' to indicate the competence required to cope with terminology; This is obviously not a separate component of competence but rather consists of those aspects of a speaker's competence which enable him to cope with technical terms and to transfer the skills he uses regarding general vocabulary to technical vocabulary.

2.1.2 THE DEVELOPMENT OF LEXICAL COMPETENCE

There are two questions which arise here:

1. What are the skills that need to be developed ?
2. How do they develop ?

(a) Lexical competence skills

Basically there are two skills involved in lexical performance that need to be

developed in the child: using and understanding terms. The first involves the process of 'encoding', ie being able to use an acquired word correctly or to be able to produce another form of an acquired word correctly (eg another word-class or a change in number, tense, etc) in order to convey the concepts the child has learnt in the subject. 'Correctly' here includes both 'formal' correctness and 'semantic' correctness. The first involves such matters as spelling (eg the fact that generator is not spelt 'generater'); pronunciation (eg the fact that the stress falls on the first syllable of the term monarchy); the appropriate use of affixes (eg the fact that the verb derived from solid is solidify and not 'solidise'); and the correct use in sentences (eg the fact that the term monarchy can only be used as a noun and not as a verb). Correct semantic encoding involves being able to use an accepted term to convey a particular concept. The second skill, 'decoding', involves the act of interpreting the terms produced by someone else in order to arrive at the meaning he or she is trying to convey to us. This skill also involves two aspects. The 'formal' aspect is concerned with the need to deduce the morphological structure of the term (and sometimes the syntactic structure where composite terms are involved) and the syntactic status of the term. The 'semantic' aspect involves being able to deduce (or recall) the sense of the term as well as its relations to other relevant terms. Further details concerning both these skills will be dealt with in later chapters in the Thesis.

This two-way communication act (encoding-decoding) can be transmitted either through the medium of sound (speaking, listening) or by means of scratches on paper (writing, reading). In our schools, only three of these four sub-skills feature strongly, viz listening (to the teacher), writing (especially examinations) and reading (examinations, textbooks, worksheets). Nevertheless, the pupil still needs to be able to pronounce the term in order to learn it adequately or to answer a question orally in class.

The skills, then, that need to be developed are those of using and interpreting terms through the spoken and written media; the processes necessary to perform these skills are respectively called encoding and decoding. Both these processes involve two aspects, viz formal and semantic.

(b) How the skills are developed

How does the child acquire the lexical competence necessary to be able to perform the processes necessary for him to be able to use and understand terms? 'Every child,' says Fraser (1969), 'has language as his birthright.' Utilising his inborn 'language acquisition device', claims Chomsky, he gradually acquires the language of the society into which he has been born. Recent evidence has suggested that this picture is not entirely accurate: the 'nature-nurture' controversy, as suggested earlier, seems to have settled on a compromise combination of an interaction between both. One can therefore say that from the moment the child can perceive and produce sound, his internal device begins interacting with his linguistic environment to develop his competence, which becomes more and more evident in his growing performance. There are, then, two catalysts in this process. Firstly, there is the child's own natural initiative. Fraser (1969) puts it thus:

The child early on starts to generalise from his language experience and with a fair measure of success predict and produce structures he had not been taught.

(p 121)

Secondly, his parents and other interested bodies also teach him what he may not acquire on his own (or, at any rate, may take long to acquire on his own) and they correct erroneous information he may have acquired.

As a result of this double action, by the time the child reaches school he usually has a remarkably sophisticated lexical competence and a well-developed performance. His vocabulary, according to one estimate, is about 5 000 to 6 000 words. At this stage, however, he is usually only able to use these words orally. Widdowson (1972) describes his level of development at this stage as follows:

This knowledge or competence (in Chomsky's terms) happens up to this point in the child's development to have been realised exclusively through the reception and production of speech.

(p 207)

Widdowson goes on to explain that the child has now to be taught to transfer his competence to a different medium - he has to be taught to read and write words. After the initial teaching of this skill, his own initiative once

again comes into play to develop these skills even further.

Thus by the time the child reaches standard eight, he has a well-developed lexical competence, which manifests itself in the child's ability to use an extensive number of words in both the spoken and written medium. By this stage he has also begun to acquire various sets of technical vocabulary through his contact with the relevant disciplines. He will also be able, in a limited way, to relate general to technical vocabulary where there are overlaps as well as to see and cope with the special demands of technical vocabularies.

2.1.3 THE NATURE OF LEXICAL COMPETENCE

(a) The lexicon

We turn now to the details of the content and nature of lexical competence. In addition to what has been called 'grammatical competence', 'communicative competence' also includes what Leech (1974) calls a 'theoretical dictionary' (as opposed to the reference works which he calls 'practical dictionaries'). This is the "inbuilt" dictionary which every one of us carries around as part of his mental equipment as a speaker of the language' (Leech:1974:202-3). This is obviously an important component of 'communicative competence'. Smith and Wilson (1979) comment on this internal lexicon as follows:

While a language cannot be considered as a set of words, but must also contain principles of sentence-formation and interpretation, it is obvious that knowledge of a language includes knowledge of its vocabulary.

(p 51)

The same can be said of knowledge of a technical language - while it cannot be limited to knowledge of technical terms, it cannot be denied that lexical knowledge forms a highly significant part of this knowledge.

(b) Lexical 'entries' and lexical 'rules'

If one turns to the character of lexical competence, one finds that there are two main components of this knowledge, viz 'lexical entries' and 'lexical rules'. Leech (1974) suggests that the lexicon can be considered as containing 'an unordered list or set of lexical entries' (p 266), and he defines a lexical

entry as 'the body of information given ... about an item' (p 202). Simon (1980) compares this type of knowledge to the data bank of a computer, ie the 'bits' of information about words which are registered in the computer/brain. By contrast with this, the lexical rules can be compared with the program of a computer - they constitute the procedural knowledge which Leech calls the "'productive" or "creative" aspect of the lexicon'. Utilisation of lexical rules involves operations performed on the information contained in lexical entries. They enable the individual to 'generate' words in a way which is similar to the way in which sentences are generated and to judge what is acceptable and what is not. Miller (1964) regards this type of knowledge as one example of what Wittgenstein called 'rule-governed behaviour':

Wittgenstein remarked that the most characteristic thing we can say about 'rule-governed behaviour' is that the person who knows the rules knows whether he is proceeding correctly or incorrectly. Although he may not be able to formulate the rules explicitly, he knows what it is to make a mistake.

(p 334)

Thus, for example, the suffix -ise/-ize can be used to form verbs from nouns such as colony and centre (colonise; centralise) but not from class or code (*classise; *codise), both of which use instead -fy (classify; codify), which in turn cannot be used with colony or centre (*colonify; *centrify).

Despite the generative nature of lexical rules, however, their creativity is limited in comparison with the level of creativity of the rules of grammatical competence. Leech (op cit) comments as follows:

What chiefly distinguishes lexical rules from grammatical rules is their limited productivity; that is, a lexical rule does not apply equally to all the cases to which it in theory may apply.

(p 211)

This point will be enlarged upon in the chapters which follow. What is important here is, firstly, that there is a generative aspect to lexical knowledge (which, as will be seen later, affects lexical incompetence and also the question of assisting pupils to overcome incompetence) and, secondly, that the rules are limited (which leads to certain problems in using and understanding terms and in seeking means of assisting pupils with these problems).

(c) Formal and semantic

If one turns to the content of lexical entries and lexical rules, one finds that they both cover the same areas - and, in fact, also correlate with the components of knowledge involved in grammatical competence. Commenting on the latter, Smith and Wilson (1979) point out that, according to Chomsky, grammatical competence involves 'knowledge of meaning, or semantics, knowledge of pronunciation, or phonology, and the knowledge of what is traditionally referred to as grammar, or syntax'. They then go on to note that the lexicon contains all three:

Despite this separation of linguistic knowledge into different types, there is one domain in which all of them converge: the lexicon or dictionary.

(p 51)

As was suggested earlier, this information may alternatively be viewed as consisting of two aspects based on the traditional distinction between 'meaning' and 'form' or 'content' and 'expression' (Lyons:1968:55). If one adds to what has already been mentioned the details concerning the written language, one can specify the content of lexical entries and rules as follows:

1. SEMANTIC

2. FORMAL

2.1 Structure

- (a) Syntactic
- (b) Morphological

2.2 Transmission

- (a) Phonological
- (b) Graphemic

Involved in all of these, of course, are the restraints placed by context, both linguistic and situational. The details of semantic and formal aspects of lexical competence will be handled in Section C and D respectively. Here we are concerned merely with the basic distinction between the two types of lexical knowledge and with the nature of lexical entries and lexical rules in these two areas of lexical knowledge. The examples concerning the latter issue which follow are exclusively morphological and are given merely to illustrate the basic issues involved regarding lexical entries and rules. What is said

concerning morphological competence is, of course, equally true of semantic competence.

Despite the differences between lexical entries and lexical rules, it is not always possible in practice to separate the two. One of the reasons is the fact that, as has been mentioned, they both cover the same type of information. A further problem is that they interact to a great extent in actual practice. The result of this is, firstly, that it is not always clear as to whether to assign knowledge to an entry or to the operation of a rule. For example, does one list derivatives and inflexions as part of the entry for a word (as is the practice with 'practical dictionaries') or to see them as being derived by lexical rules operating on the more limited information supplied by the entry? The fact that different dictionaries follow different policies (at least as far as derivatives are concerned) is indicative of the dilemma involved here.

Secondly, it is difficult to know in practice how an individual actually acquires a term or uses it - whether he is drawing upon a lexical entry or a rule or both. For example, even if in the description of the language certain aspects are stated as involving rules, this may not necessarily occur in the performance of an individual, which suggests that we must allow for differences between the theoretical competence devised by linguists and actual competences of different individuals. An illustration in point here is the fact that most linguistic accounts of lexical competence would indicate that the verb revolutionise is derived from the noun revolution by means of a lexical rule which allows one to add the verb-forming suffix -ise to the end of another word. However, in 'real life' it could happen that an individual first encounters the verb; to derive the noun he then deletes the suffix. Or it could happen that the individual acquires both words on separate occasions, in which case he may not utilise any lexical rule to derive one from the other. A further distinction needs to be drawn between the operation of rules in the mind of the producers or inventors of terminology (eg scientists) and the consumers (or users) of technical vocabularies. Whereas the former most definitely use lexical rules to form new words or create new forms of words, the latter may learn them and use them in the manner suggested above.

There can be no doubt, however, that lexical rules do form part of every individual's competence. There are times where people do derive one form from another, even if (as was suggested above) in different orders. An individual sometimes also coins his own derivative, for example by the addition of the negative prefix non- to a word to which it is not usually attached or to a word

to which he has never heard it attached. A student of History might, for example, declare that someone who had been suspected of being an agitator had been found to be a 'non-agitator'. This level of creativity, however, is probably more likely to occur in History than in Science, which tends to have more assigned or pre-determined forms.

The existence of lexical rules also means that, where an individual encounters a new derivative of a word he already knows, he will more easily understand and assimilate that form if it is derived according to a regular lexical rule. Thus, for example, the child who reads that 'Britain wanted to colonise Africa' would, even if he had not previously encountered the verb colonise, find it easier to deduce the meaning of the word and to use it himself (either in this form or with the singular inflexion or with an auxiliary, as in 'was colonising') because it is formed by means of a regularly occurring suffix which can be added to nouns to create verbs. If he then read that something had been decolonised, he would also have less of a problem than if he had not already assimilated the prefix de- in such words as detrribalised, etc. The existence of lexical rules, that is, makes it generally easier to cope because they fulfil expectations when the speaker encounters new derivatives and also make possible the use of a wider range of forms of words.

It is fortunate that the whole problem of entries vs rules does not need to be settled here but can safely be left to theoretical linguists to sort out (if they so wish). In the later chapters in this section the principles of convenience and simplicity have been implemented in describing lexical competence in general and technical lexical competence in particular.

2.2 LEXICAL INCOMPETENCE

The above section has dealt with lexical competence - ie what the child needs, ideally, from a purely lexical point of view, to know about terms in order to be able to understand and use them appropriately. However, if we examine children's actual performances in Science and History, we find that terms are often not known or are not understood or used appropriately. This section aims to give a very brief overview of the underlying lexical incompetence which could be responsible for the imperfect performances of children in the school situation.

2.2.1 RANDOM vs ESTABLISHED ERRORS

Pit Corder (1973) makes the following observation concerning the typical speaker's linguistic performance:

All learners make mistakes. This is not confined to language learners. We all make mistakes when we are speaking our mother tongue.

(p 256)

Some of these 'mistakes', continues Corder, are simply 'lapses' that occur when a speaker is applying his knowledge in actual performance - 'slips or false starts or confusions of structure' (p 259). These are caused by such factors as memory limitations, distraction, emotional states, shifts of attention, etc. There is, however, a second class of mistakes made by native speakers - those that seem to proceed from an imperfect competence on the part of the speaker; and, since, as has already been suggested, a 'perfect' competence is an abstract construct which no speaker ever attains, it is to be expected that all children using terms will make mistakes of this second type.

2.2.2 DEFICIENCY vs DEFECTIVENESS

There are two ways in which a child's lexical competence may be inadequate. Firstly, it may be deficient - ie certain aspects of the child's competence may be lacking. Secondly, it may be defective - ie certain aspects of the knowledge which the child has acquired may be defective. These two types of lexical incompetence will be explored later in greater detail, but a simple example might be given at this point to illustrate the difference. In a standard eight Physical Science examination, the following question was put to the pupils:

Name the term given to a reaction where energy is taken up.

The required answer was : an exothermic reaction. Of the 57 candidates who wrote the examination, 42 gave the correct response. However, there were five who did not know the term at all and therefore left it blank (ie they were deficient in their competence), while the remaining ten supplied incorrect terms (ie they were defective in their competence).

2.2.3 SEMANTIC vs FORMAL; DATA vs RULES

If one turns to the actual content of a child's lexical incompetence, one can see two different sets of inadequacies. Firstly, the child may be deficient or defective as regards either the semantic or the formal (or both) aspects of a particular term. Secondly, the problem may either be as regards the 'data' base of their competence (ie the 'bits' of information referred to earlier) or as regards the 'rules'. Hewson (1980) makes the point that too often we concentrate only on the data-type problem rather than the errors regarding rules, which Brown and Burton (1978), using the computer analogy, call 'bugs' in the child's program. These involve 'consistently following the same, incorrect procedure' (Hewson:1960:400) - ie defective rule knowledge - or not knowing the rule at all - deficient rule knowledge.

2.2.4 NATURE vs NURTURE

These inadequacies can be ascribed either to factors of nature or of nurture or of both. Although all children are born with the capacity to learn language, certain children are born with a better 'flair' for language learning in general and/or a superior predisposition for acquiring the kind of lexical competence required for the use and understanding of technical terms. It is probable - although this is mere speculation - that these two are in fact closely related; however, it is possible, too, that certain children who have similar general potentials may differ as regards technical potential or may vary as regards the competence necessary to cope with particular terminologies (eg arts vs sciences). Research in this area could prove of considerable value to those involved in assisting children to improve their technical lexical competence.

In addition to the child's general cognitive/linguistic level, there are the inhibiting factors relating to the child's stage of cognitive development. We mentioned earlier the concept of a 'dynamic', growing competence: the child's competence does not simply arrive fully-fledged; it develops over a long period of time. Psychologists (Piaget in particular) have shown that cognitive competence in general and linguistic competence in particular develop in 'stages' and that there are points of 'readiness' involved for each stage to begin. Thus, the child who cannot use or understand a particular term appropriately may simply not be able to do so because he has not reached the stage of cognitive, linguistic or affective development required at the time that he is called upon to do so.

There are also other factors which are inherent in the child. An important one is the question of motivation, which may vary from child to child. It must be borne in mind that the basic subjects are compulsory up to the end of standard seven and that even in the last three years of high school there is a limited choice of subjects, which means that children are not always studying subjects of their choice. Varying aptitudes for different subjects can also affect the child's motivation.

Heredity, however, is not the only factor here: a child's linguistic environment also plays a role: some children have a richer linguistic environment than others, from which they acquire more words and their meanings; some are also more strongly encouraged and helped by others, both at school and at home. The quality of teaching is particularly important in the acquisition, use and understanding of technical terms - more so, that is, than in the case of general vocabulary, since he is more likely to encounter the latter in daily life and, furthermore, he does not need as precise a knowledge as with technical vocabulary. As will be seen in due course, subject teachers are not always aware of the linguistic complexities of technical vocabularies and do not always take the necessary action to prevent and correct errors in the use and understanding of terms. The quality of textbooks can also be an important factor in the child's learning environment. A piece of research into the readability of Science textbooks in Cape Schools by Wegerhoff (1981), for example, revealed the fact that many of the textbooks currently in use are beyond the readability level of the average child.

Whatever the fundamental cause of lexical incompetence, the situation may be further aggravated by the fact that an inadequate performance may also arise from the fact that children cannot always transfer knowledge that they have at either an unconscious, intuitive level or at a conscious, theoretical level into actual speech acts - many of their resources remain an untapped potential. Sociologists and sociolinguists have stressed in recent years the fact that the context in which the child operates can strongly influence whether the child can convert passive linguistic knowledge into active practice.

2.2.5 Conclusion

Lexical incompetence is, then, common to all children in varying degrees at varying stages. It is the result of various factors which affect the

acquisition of sufficient and correct knowledge of words in order to cope with the use and understanding of those words. The inadequacies may occur as a result of these factors operating directly upon the development of lexical competence as such (eg the child may not encounter a particular word or may be given the wrong meaning for a term). However, the same types of inadequacies in other aspects of communicative competence (grammatical and pragmatic) may also be responsible for lexical incompetence (eg the child whose syntactic ability is limited would not easily be able to use words or terms he has acquired in acceptable sentences). The various aspects of communicative competence, as has already been suggested, are closely interrelated and therefore mutually influence each other.

Since all children vary as regards communicative competence in general, it is therefore to be expected that they will also vary as regards lexical competence in particular. It follows from this that they would also vary as regards technical lexical competence. It is, however, probably true to say that the risk of lexical incompetence is far greater than the risk of general lexical incompetence because of the greater degree of linguistic complexity inherent in technical vocabulary and therefore the more sophisticated lexical competence required to cope with these complexities. This will become evident in the chapters which follow.

S E C T I O N C

CONCEPTUAL INCOMPETENCE

CHAPTER 3

CONCEPTS AND COMPETENCE

In this and the next three chapters we shall be dealing with the 'content' aspects of terms and the competence which is necessary to cope with these aspects. Cluver (1980:52) makes the point that 'The vocabulary of a specific field of knowledge can be regarded as a collection of linguistic tags for the concepts of that field'. We can, on the basis of this, suggest that what is required here is something which might be called 'conceptual competence', which forms part of a more general 'semantic competence'. The latter term is used here to include semantic knowledge on two levels - the lexical and the grammatical. Whereas the former is concerned with the meanings of words or composite phrases (what Lyons:1977 calls 'lexemes'), the latter is concerned with the meanings of sentences and texts. 'Conceptual competence' here refers to the lexical aspects of semantic competence. This is, in some ways, merely a term of convenience, since there are, obviously, also concepts which are non-lexical. The two aspects of semantic competence (lexical and grammatical) obviously inter-relate with each other - and, indeed, with the other, non-semantic, aspects of both lexical and grammatical competence, as well as with the pragmatic aspects of communicative competence.

In order to perform at the level of conceptual competence, the child needs to acquire both the concepts involved in the body of knowledge concerned and the words/phrases that denote these concepts. He needs also to be able to encode and decode concepts via the lexemes attached to them. Encoding involves the expression of a concept by means of the appropriate lexeme, while decoding involves recognising the concept which is attached to the lexeme when the latter is encountered in discourse and well as understanding the concept thus recognised.

In this and the next three chapters we shall be analysing the nature and complexities of conceptual competence and the types of conceptual incompetence which result from the particular characteristics of technical concepts. We shall see that problems arise from either defectiveness or deficiency as regards either the rules or the data required for an adequate conceptual competence.

3.1 THE NATURE OF CONCEPTS

3.1.1 THE CONCEPT OF THE 'CONCEPT'

Felber (1980) defines a 'concept' as follows:

A concept ... is any unit of thought, generally expressed by a term, a letter symbol or by any other symbol. It represents the same of common characteristics observed by man in a number of objects and is a means for mental ordering.

(p 6)

A very useful working definition along the same lines is provided by Rameshur (1982):

Concepts are ideas, usually expressed in words, to describe classes or groups of things, people, feelings, actions or ideas having something in common.

(p 13)

These definitions point to the fact that concepts and concept-formation involve the process of 'classification'. One of the basic requirements in thinking, learning and using language is for the individual to be able to cope with the fact that the world as perceived by the individual consists of an infinite number of unique phenomena. It can be argued that we never encounter exactly the same event twice. If the individual did not have some system of ordering and organising the world by identifying recurrent regularities he would never be able to cope with life in general or with formal academic studies in particular; he would be left in what the psychologist William James called 'the booming buzzing world of confusion' of the infant who is dominated by his sensory impressions.

Behaviourist psychologists have a very simple explanation for the fact that the individual learns to perceive these underlying regularities. They argue that a person comes to associate individual stimuli with individual responses as a starting point and then, through conditioning, learn to transfer these associations to new situations. This view has been rejected in recent years by cognitive psychologists, who maintain that the behaviourist view does not really answer the question as to how the individual learns to cope with a startling variety of phenomena in such a short time. Nor does it begin to explain the mental processes involved. The cognitive psychologists explain concepts and concept-formation in terms of a more complex, dynamic and 'mentalist' process, ie the

process of classification. What the individual learns to do is to categorise phenomena into 'classes' or sets. The abstract representation of such a class is then called a 'concept'. Turner (1975) puts it thus:

In order to understand that Class A is distinct from Class B, the 'concept' of Class A must be formed; for example, a child may initially distinguish the class of animals from the class of objects, later make finer distinctions between types of animals, and finally be able to pick out breeds of dog as sub-classes of the class 'dog'.

(p 68)

By constructing concepts the individual gradually builds up a 'representation' of the world, a kind of internal map. Then, in order to be able to use this internal map, he has to learn to relate present instances to past experiences, ie particular exemplars of a class to his 'concept' of a class. It is this ability to distinguish between exemplars and non-exemplars which forms the crux of concept acquisition. Osborne and Gilbert (1980) comment as follows on this:

The views of Klausmeier et al (1974) and Markle and Tiemann (1970) suggest that concept attainment is closely related to the ability of an individual to categorize instances not previously encountered, as instances or non-instances of a particular concept.

(p 312)

Watson (1974) comments similarly as follows:

Establishing a concept usually involves the learner in generalization (extending the bounds of the concept so that examples other than those which have already been met can be recognized), discrimination (excluding plausible non-exemplars) ...

(p 34)

In order to acquire and use the concepts that belong to a particular subject, then, the child needs to be able to cope with the process of classification. As will be seen below, this is sometimes very demanding; furthermore, as Dillon (1977) suggests, people probably vary as regards their ability to categorise, which means that some children will have greater difficulties than others.

3.1.2 TYPES OF CONCEPTS

It was suggested in Chapter 1 that the vocabulary of a language can be divided into two main types, viz 'general' and 'technical' vocabulary. We need to turn now to the semantic differences between these two types of vocabulary with a view to specifying the special demands that technical vocabulary makes upon pupils and the problems that can result from these special demands. Certain aspects of these differences and the types of incompetence that pupils experience regarding these aspects will be dealt with in this chapter; the next two chapters will then deal each with a further aspect of the differences involved.

3.2 MEANING: TYPE AND STRUCTURE

Technical concepts differ from general concepts both as regards the type of meaning involved as well as the way in which the meanings of the various concepts interact with one another.

3.2.1 DESCRIPTIVE MEANING

An important difference between technical and general concepts is that, whereas technical terms convey what Lyons (1981) calls 'descriptive' meaning (otherwise called 'denotative' or 'cognitive' meaning), general vocabulary items most often also include 'non-descriptive' (or 'connotative') meaning in their concepts. This latter type of meaning is defined by Leech (1974) as 'the communicative value an expression has by virtue of what it refers to over and above its purely conceptual content' (p 14). Technical terms are not meant to refer to the 'additional non-criterial properties' that are attached to referents of general concepts by individuals or groups. A technical term is intended rather to be a label for a clearly defined, objectively viewed, concept which excludes 'peripheral' or personal and stylistic elements.

Sutton (1980) sums up the position as regards Science in particular as follows:

... it is useful to distinguish the denotative meaning of a word (how we might try to define it, eg water as a compound of H and O, or as a liquid with such-and-such properties) from its connotative meaning (all the things it implies to us: a myriad of associations which we have in our minds). Some of those give added reality, eg its fluidity and wetness. Some are emotional in

character - the pleasure of cool streams, or the fear of drowning. Science has traditionally rejected these latter aspects.

(pp 47-48)

Later on he elaborates as follows:

A person may associate fruit with goodness, or force with fear. Science is usually not concerned with these, nor with any of the other connotations, and it has been characteristic of language development in Science to play down the importance of that part of the meaning altogether and to emphasise denotations only - the public, definable part.

(p 50)

In History a similar attitude prevails - one of the reasons often advanced for the teaching of History is to train pupils to think and argue objectively.

This, however, is not always the case. One type of conceptual incompetence is the tendency to carry over connotations from general vocabulary to technical vocabulary. Pupils can either fail to strip a term of its generally accepted connotations or may add particular ones of their own. This is a far greater risk in History than in Science for a number of reasons. Firstly, more terms in History are derived from general vocabulary than in Science. Secondly, as will be indicated in greater detail later, historical concepts are more familiar to the pupil than scientific ones, as they are closer to everyday concepts. Thirdly, historical discourse (eg textbooks) contains far more emotively loaded words in the general vocabulary part of sentences than does scientific discourse. The following sentences from a History textbook and a Science textbook respectively illustrate the typical difference in this regard between the type of language the pupil encounters in each discipline:

HISTORY: The philanthropists suspected the Voortrekkers of enslaving and oppressing the Bantu and urged their protection.

SCIENCE: Compounds such as the metal oxides and the non-metal oxides are treated with water in a similar way to form alkaline and acidic solutions.

This does not, of course, mean that school Science textbooks will never use words with emotive overtones. The following, for example, occurs in Brink and Jones:

In pure oxygen phosphorus and sulphur burnt more energetically and with brighter flames. The beautiful blue colour of the sulphur flame was more distinctly visible.

(p 211)

However, this type of language is more typical of History textbooks, and is a feature of style which is being encouraged by some current writers on the teaching of History. This is further reinforced where the textbook writer includes his own personal comments on situations and people. Partington (1980) refers to a very famous History textbook in this connection as follows:

Richards and Hunt in An Illustrated History of Modern Britain castigate 'the spendthrift Ismail', 'the fanatical Sikhs' and 'that unscrupulous adventurer', Mahomet Ali, but the respectively comparable Edward VII, Afrikaners and Cecil Rhodes escape such opprobrium.

(p 203)

Emotively charged language also features in historical documents included in History texts. The following extract from the Manifesto of Piet Retief is a case in point here:

We despair of saving the colony from those evils which threaten it by the turbulent and dishonest conduct of vagrants, who are allowed to infest the country in every part; nor do we see prospect of peace or happiness for our children in a country thus distracted by internal commotions.

The language of History, as a result, does not seem as remote from the language of general discourse as does the language of Science. The tendency to call up unwanted connotations seems more natural in History than in Science.

A fourth reason for this situation is the increasingly popular approach to the teaching of History which encourages an affective involvement in the subject-matter, which is even more likely to foster the carry-over of associations. Pupils are urged to develop a 'feel for the past' (Watts:1972).

Finally, History, by its very nature, involves feelings and biases more than does Science. In this connection, Stephens (1974) comments as follows:

The physical scientist can be reasonably objective because he can manipulate and control the materials with which he works. The geologist can also be objective because he works with inanimate substances, with objects. But if either of these scientists enters the realm of values - for example, the social implications for

particular discoveries - his degree of objectivity or impartiality may be considerably lessened. Once he enters the domain of human activities - and that is the domain of the historian - objectivity and impartiality are harder to attain precisely because he is a human being looking at human events. Perhaps the truth is as Eric Dardel believes: 'We ourselves are in history. It is what happens to us and our reaction to events ... To write History is also to realise its existence, to "historicise one's self."'

(pp 50-51)

Semantic incompetence in this area in History can, therefore, be expected to occur. Many of the terms in History are likely to "conjure up" associations which are dependent upon the previous experience of the learner' (Bernbaum : 1972:45). Coltham (1960), for example, mentions the example of a pupil who thought of the term king in the light of pomp and ceremony rather than of power. Gunning (1978) refers to an investigation which revealed that pupils studying the French Revolution thought that peasant meant 'a foolish man, improvident, feckless'. In South Africa, with its cleft ideology (Afrikaans-English) in white schools, it is not surprising that pupils bring associations that derive from their home backgrounds to terms used in the study of South African History. Whereas the term Voortrekker is likely to stir feelings of patriotism and pride in the minds of Afrikaans-speaking pupils, English-speaking pupils would tend to be either neutral or negative in their attitudes. Afrikaans-speaking pupils are likely to agree with Piet Retief that the vagrants in the Cape Colony were creatures that should never have been allowed to 'infest' the Colony and that certain missionaries were 'dishonest persons' who operated 'under the cloak of religion', whereas English-speaking pupils are, once again, likely to be either neutral or sympathetic towards these people. Terms such as black, kaffir, liberal are loaded terms for all our pupils because of their connotations in South Africa. The last of these, for example, is often used in a derogatory sense to mean 'anarchist, communist', etc. Less politically loaded but nevertheless also likely to evoke connotations are terms such as church, common (people) and heathen.

Science, as we have said, tends to shy away from anything that smacks of the personal or the emotive. As Diack (1966) puts it:

Since it is one of the aims of science to cancel out the vagaries of human experience, these individual experiences have here less importance and so it is in the sciences that words come nearest to being mere labels.

(p 138)

Nevertheless, even here connotations can intervene and possibly obscure meaning. Watson (1974), for example, quotes the following example of pupils' misunderstanding of the term atom:

Pupils in a secondary school where little science had been taught, but in which the words 'atom' and 'molecule' were used freely by teachers, were asked, 'What do you think an atom is like?'

One of the answers given by a pupil was as follows:

... An atom is a kind of bomb its size is a long round thing and has gas inside and if you light a match it will have flames around it and may explode.

(p 431)

It is likely that this child could see the atom as something fearful, something about which people demonstrate in the streets. An example of how connotations of words can lead to further misconceptions by association of thought is the answer given by a pupil to a question in a Science examination in the survey conducted in Cape Schools in 1981/2. The question was as follows:

1. Draw two separate graphs to show the differences in wave form of the following vibrations. Draw the graphs to cover a time interval of 1 second and label your axes.
 - 1.1 amplitude 15mm, frequency 8Hz
 - 1.2 amplitude 25mm, frequency 4Hz
2. If the vibrations above cause audible sounds, state how 1.1 differs from 1.2 when you listen to them.

The answer in the teacher's memorandum was as follows:

1.1 is higher in pitch
1.2 is louder

One candidate wrote as follows:

1.1 is softer with a higher pitch
1.2 is louder, but more peaceful type of music

It is clear that the idea of 'high pitch' is associated in the pupil's mind with something unpleasant to the ear, 'screechy', as in: 'I can't stand that woman's high-pitched voice'. Therefore, lower pitch is associated with quiet peaceful music. There were a number of other answers which suggested similar

connotations and therefore similar misunderstandings.

3.2.2 SEMANTIC FIELDS

Technical vocabulary always refers to one particular area of experience, human activity, knowledge, etc - ie to one particular semantic field. The term 'semantic field' is used here to mean an area of experience, etc which is conceptualised through, and given expression in, language. Typical examples of semantic fields that confront us in our everyday lives are: advertising, love, law, poetry, sport, Geography, Science, and so on. Each of these fields has its own typical type of language and language use; thus one speaks of 'the language of advertising', 'legal language', 'the language of Science', etc.

There is a difference, however, between the 'semantic field' of an area of experience such as 'love' or 'advertising' on the one hand and Science and History on the other - a difference which results in the vocabulary items belonging to the semantic fields of the first two being 'general' and the vocabulary items belonging to the other two being 'technical'. The key point here is that the semantic field of a technical vocabulary must be one which has been systematised into what Flood (1957:6) calls 'specialised subject matter' or what Sager et al (1980:70) call 'a bounded subsystem of the knowledge structure'. These particular areas of knowledge are usually known as 'subjects' or 'disciplines'. The Longmans dictionary of contemporary English (1978) defines the word 'technical' as used in the phrase 'technical vocabulary' as follows:

of or related to a particular and especially practical or scientific subject

belonging to a particular art, science, profession, etc

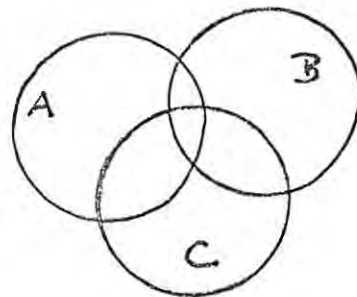
(pp 1138-9)

The crux of the matter is the notion of specialised knowledge, whether it be of practicalities or abstract concepts. The 'terms' of a particular discipline or area of activity are, then, words or phrases regularly used to refer to aspects of or notions belonging to that discipline or area of activity. It is on these grounds, then, that one can claim that the vocabulary of one semantic field is technical while that of another is general.

The Longmans definition suggests that technical terms are more typical of scientific disciplines than of, say, the arts. The reason is that the sciences

have a more definite, consciously derived body of knowledge than does a subject like History. Nevertheless, there is a body of knowledge which has, almost by tradition, come to be accepted as 'historical knowledge'. The child has to learn to cope with the different degrees of clear definition regarding the notion of a 'body of knowledge'; it is also the fact that History is less clear that causes some of the problems referred to later in this chapter.

It should be noted in passing that it is not always possible to separate disciplines on the basis of their respective semantic fields. If one considers that the overall conceptual structure of knowledge is a continuum and that the demarcation of this conceptual structure into semantic fields is sometimes fairly arbitrary, one must expect to find an overlapping of semantic fields that can be illustrated diagrammatically as follows:



Thus one finds, for example, that there is considerable common ground between the concepts of Physics and Chemistry. Both are, for example, concerned with such concepts as 'heat' and 'electricity'. History also shares many common concepts with other disciplines such as Political Theory, Economics and Sociology. It also happens that, even where disciplines do not share concepts as such, they borrow concepts which are used in passing to expound their own concepts. Thus, for example, Physics refers to chemical compounds which are relevant to the explanation of physical phenomena, eg carbon dioxide, in the account of the behaviour of sound. History uses concepts such as 'bankruptcy' in a similar way.

It follows from this, too, that there is no total congruency between semantic fields and terminologies. Different semantic fields (and therefore different disciplines) will share terms either because of shared concepts or because of borrowed concepts.

The fact that semantic fields and terminologies overlap does not, however, detract from the fact that terminologies reflect semantic fields which relate to specific disciplines. The basic distinction between the semantic fields of general vocabulary and of technical vocabulary remains relevant and viable.

Concepts, then, do not exist as discrete, independent entities. On the contrary, they are closely inter-related. Another way of putting this point is to state that terminologies typically constitute lexical systems, ie sets of inter-related units with corresponding inter-connected concepts. Lyons (1968) makes the point that this is in fact typical of much of the vocabulary in general:

... we will simply assume that at least some vocabulary-items fall into lexical systems, and that the semantic structure of these systems is to be described in terms of the semi-relations holding between the lexical items.

(p 429)

In a later publication (1977), Lyons, while rejecting the narrowness of the 'field theory' which, in its strongest form, regards all lexical items in a vocabulary as forming part of a closed, tightly-structured system, argues that it is nevertheless true to say that many of the 'lexemes' of a language are linked together by various types of sense relations. He also makes the point that this is more typical of technical vocabularies:

... the elaboration of many-numbered lexical sets (eg, the words denoting the elements in chemistry or the different species in botany) is more typical of specialized taxonomies than it is of language in general; and it is noteworthy that specialized taxonomies, even when they make use of everyday words, will often tend to impose upon lexical sets in the taxonomy a more rigid structure than is characteristic of the vocabulary of everyday usage.

(p 288)

A technical vocabulary, then, is a particular and more definite manifestation of a general linguistic phenomenon. We can say that a technical vocabulary consists of a lexical system which reflects the basic characteristic of a lexical system to a higher degree. It is probably also true to say that Science terminology exhibits a tighter lexical system and comes closer to manifesting the characteristics of the stronger version of the field theory where all concepts are inter-related with one another than does History. The latter tends to operate more on the basis of smaller sub-sets of terms and concepts.

Johnson-Laird and Wason (1977) sum up this question of inter-relationships which can be discerned between terms by pointing out that these inter-relationships are the result of the corresponding relationships that exist between the concepts to which the terms refer. They comment as follows:

Concepts are organised into semantic fields that have a conceptual core. A conceptual core is an abstract entity that in reflecting a deeper conceptualisation of the word integrates the different concepts within the semantic fields. It underlies the paramount fact that concepts do not come in isolation but are organised in a taxonomy that enables entities within a field to be correctly categorised.

(p 183)

It is to be expected that the lexical systems which reflect these semantic fields should also be integrated into organised structures. In fact, it is probably true to say that these two aspects influence each other mutually: the fact that concepts are linked causes the lexical system to be structured; and the more the lexical system is structured, the clearer become the links between the concepts that they reflect.

3.3 LEXICAL RELATIONS

It is necessary for the child to develop the necessary rules both for relating concepts to each other and for relating terms to each other; and it is also necessary for him to perceive the particular relationships between concepts and between terms. These links have been described from two points of view - from the conceptual point of view by psychologists and terminologists, and from the linguistic point of view by linguists. The account below is based on two main sources, viz Felber (1979a) of the Vienna School of Terminology, and Lyons (1977, 1981), a leading British semanticist. It is not proposed to handle all the details here, but merely to provide a description which can highlight the intricacies involved in the competence required to cope with this aspect of technical vocabulary and to provide a theoretical basis for a discussion of some of the errors of incompetence resulting from these complexities.

For convenience, it can be argued that the semantic relations that hold between terms can be divided into two main types - collocations and lexical sets. The two types overlap to some extent but can nevertheless be distinguished.

3.3.1 COLLOCATIONS

Halliday et al (1974) define collocation as 'the tendency to co-occurrence'. Branford (1967) similarly refers to the collocation of a word as being 'its propensity for particular neighbours and environments'. One finds numerous examples of this in technical terminology. In Physics, for example, one expects to find the following terms in the same context:

light - focus - lens - image - object

Similarly, in History the following are likely to co-occur:

divine right - king - monarch - queen - reign - royal - palace - decree

The child needs to acquire the competence to use these terms in their own writing and to interpret discourse in the light of their tendency to co-occur.

3.3.2 LEXICAL SETS

A 'lexical set' as used here is similar to a collocation in that it also involves a set of words which tend to co-occur. Branford (1967) explains the difference in that a lexical set is a group of 'mutually defining terms'. A collocation does not have this quality. Terms can therefore collocate even though they belong to different lexical sets (eg light & image; palace & monarch above); on the other hand, one would expect words of the same lexical set to collocate.

If one examines the notion of 'lexical set' more closely, one finds that there are various types of semantic relations that pertain between the items in a lexical set. It can be argued that the sense relations between terms and the semantic links between concepts can be categorised into two main types:

- Relations based on contrast
- Relations based on other criteria

3.3.3 RELATIONS BASED ON CONTRAST

Contrast is a relation based on what Lyons calls 'contrast in similarity'. He continues as follows: 'When we compare and contrast two objects with respect to

their possession or lack of one or more properties, we do so generally on the basis of their similarity in other respects' (1977:286). Branford (1980) also makes the point that 'before words can register as clear "opposites" they must have a good many features of meaning in common' (p 351). Falber (1979a) actually calls these relations 'logical relations', which he defines as 'relations of similarity'.

Contrasts can be divided into two types - binary and non-binary. We shall deal first with binary contrasts, which Lyons calls 'opposition' and then with non-binary contrasts, which Lyons calls 'incompatibility'.

(a) Opposition

Lyons suggests a number of sub-categories of relations based on opposition, three of which are relevant here:

(i) Antonymy: Lyons reserves this term only for opposites which are 'gradable', which involves degrees of comparison. Lyons (1977) sums up this concept as follows:

When we compare two or more objects with respect to their possession of a certain property (this property being noted typically in English by an adjective), it is usually, though not always, appropriate to enquire whether they have this property to the same degree or not.

(p 271)

The following are a few examples of gradable pairs from the corpus of terms:

PHYSICS

diminished (image)	-	enlarged (image)
rare (medium)	-	dense (medium)

CHEMISTRY

strong (acid/base)	-	weak (acid/base)
soluble	-	insoluble

HISTORY

moderate	-	radical
conservative	-	liberal

(ii) Complementarity: Lyons uses the term 'complementarity' to describe opposites which are ungradable, ie they form dichotomous 'either-or' pairs. Some examples from the corpus are as follows:

PHYSICS

real (image)	-	virtual (image)
primary (colours)	-	secondary (colours)

CHEMISTRY

metal	-	non-metal
endothermic	-	exothermic

HISTORY

alienable	-	inalienable
monarchy	-	republic

(iii) Converseness: While antonymy and complementarity deal with two related types of oppositeness, 'converseness' is concerned with oppositeness of a different type altogether, ie pairs of terms which are reciprocally related in sense. Some selected examples are as follows:

PHYSICS

image	-	object
input (terminal)	-	output (terminal)

CHEMISTRY

anion	-	cation
anode	-	cathode

HISTORY

master	-	servant/slave
monarch	-	subject

(b) Incompatibility

Lyons (1977) defines incompatibility as 'a lexical relation which, like opposition, is based on contrast within similarity' (p 286). The main differences between the two concepts are as follows:

- Incompatibility does not necessarily involve oppositeness of sense, but may simply be based on the concept of mutual exclusiveness which results, like oppositeness, in contradictoriness.
- Incompatibility is a non-binary contrast, ie it involves more than two terms.

Lyons suggests that there are two types of incompatibility - 'serially ordered' and 'cyclically ordered'. He distinguishes them as follows:

In a serially ordered set there are two outermost members (if the set is determinate), and all other lexemes in the set are ordered between the two others; in a cyclically ordered set every lexeme is ordered between two others.

(p 289)

(i) Serially ordered sets: Here there are two types, ie 'scales', which involve gradable opposites (antonyms) and 'ranks', which involve ungradable opposites (ie complementaries'). Examples of scales are as follows:

SCIENCE

transparent - semi-transparent/translucent - opaque
absorption - selective absorption/transmission - transmission

HISTORY

left - centre - right
ultra-liberal/radical - liberal - moderate - conservative
- ultra-conservative

The following are some examples of 'ranks':

SCIENCE

solid - liquid - gas

HISTORY

revolution - rebellion/revolt - uprising

(ii) Cyclically ordered sets: The most obvious set here is from Physics, ie the colour spectrum:

violet - indigo - blue - green - yellow - orange - red

A further example from Physics is the types of rays involved in the process of refraction: incident (the ray which strikes the refracting medium) - refracted (the ray which has been deviated from its original path by the medium) - emergent (the ray which emerges from the medium after refraction).

In Chemistry, the names of chemical compounds which indicate the number of atoms present in a molecule are obvious examples:

carbon monoxide - carbon dioxide ...
monovalent - divalent ...

Less obvious are the names of elements which are ordered according to atomic number or valency.

In History, this type of ordering of non-binary contrasts is most evident in the names of events, people, etc numerically ordered. The kings of France are examples here:

Louis XIV - Louis XV - Louis XVI - (Louis XVII) -
Louis XVIII

In the following examples, there are only two members in each set; the names, however, allow for further additions:

First Treaty of Paris - Second Treaty of Paris -
First British Occupation of the Cape - Second British Occupation -

(iii) Non-ordered sets: One problem with Lyon's categories of non-binary contrasts is that he does not allow for mutually exclusive terms which are neither serially ordered nor cyclically ordered. It is perhaps necessary to introduce a third category here which might simply be labelled 'non-ordered'. An important and complex set of sense-relations involving incompatibility, for example, are those which exist between names of chemical compounds. The following terms illustrate these relationships:

sodium chloride
sodium sulphate
sodium chloride
calcium sulphate
sodium chlorate
calcium chlorate

Here the following sets of incompatibility, each of which has a different chemical basis, can be seen:

chlorides vs sulphates	(type of acid involved)
chlorides vs chlorates	(presence of oxygen or not)
calcium vs sodium compounds	(metal involved)

A further example is the names of instruments in Physics. The relevant terms here are as follows:

telescope
spectroscope
oscilloscope
microscope

Here the sets of incompatibility result from the nature or purpose of the instrument (to see (scope) or measure (meter) and from the contrast between the various things which are seen or measured (eg temperature, spectrum) or the nature of the seeing (afar (tele) or enlarged (micro)).

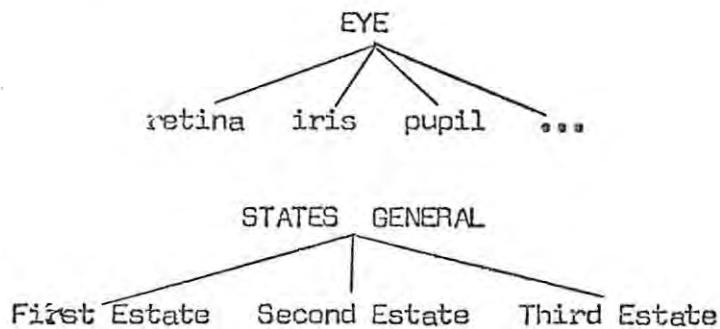
Certain terms are incompatible because of what Falber (1979a) calls 'overlap' between the concepts. Two examples are as follows:

1. The terms political, social, economic in History. As will be shown later, these terms refer to certain aspects of society which, though different, nevertheless overlap to a considerable degree.
2. The terms amplitude and frequency in Physics: both refer to wave motions of sound, but one refers to the 'magnitude' of the waves and the other to the 'velocity'.

3.3.4 RELATIONS NOT BASED ON CONTRAST

(a) Part-whole relations

Falber (1979a) refers to these relations as 'partitive relations, ie relations between the whole and its parts as well as between the parts themselves'. He sees these as one of the types of 'ontological relations', which he defines as 'relations of contiguity'. Two simple examples, one from Physics (borrowed from Anatomy) and the other from History (French Revolution) are as follows:



(b) Hyponymy

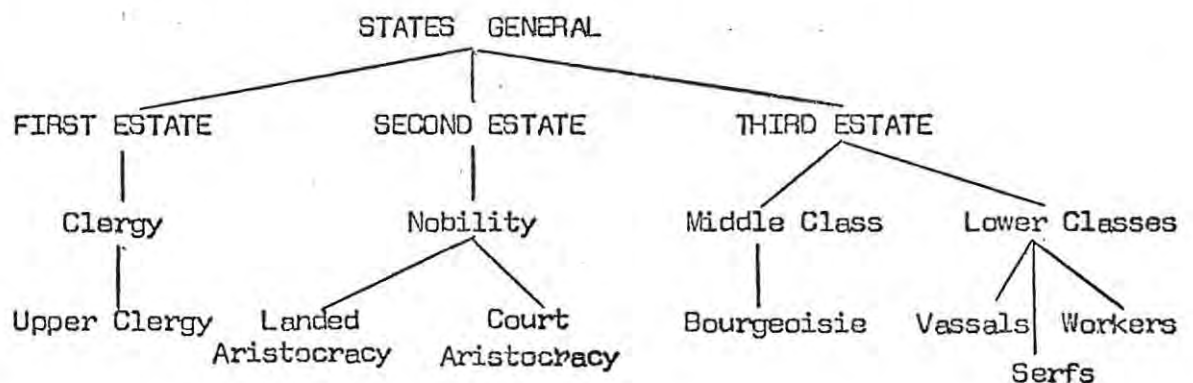
This is a relationship which cuts across most of the others. The relations mentioned above have all been along a horizontal plane. Hyponymy, by contrast, consists of vertical relations.

Lyons (1968) defines this type of sense relationship as 'the "inclusion" of a more specific term in a more general term' (p 453). In his later publication, (1977), he refers to it as 'the relation which holds between a more specific, or subordinate lexeme and a more general, or superordinate, lexeme' (p 291). Hyponymy, then, involves terms which are arranged hierarchically in a taxonomy of classes. Dillon (1977) points out that a hierarchical ordering of vocabulary items is typical of language in general:

There seems to be a human ability and tendency to arrange things into genera-and-species groupings, usually called taxonomic hierarchies ...

(p 14)

Technical vocabularies exhibit the same tendency, but to a greater and more self-conscious degree. These taxonomies can be fairly complicated at times, thus making extreme demands upon the child's conceptual competence. The following example from French Revolution history illustrates this fact:



Any child who fails to grasp this social hierarchy which existed in pre-Revolution France will fail to grasp the causes and results of the French Revolution.

3.4 PROBLEMS WITH LEXICAL RELATIONS

In order for a child to acquire a new concept fully, it is necessary that the new concept be assimilated - and assimilated correctly - into the system of concepts that form the body of knowledge of the discipline concerned. This inter-connectedness is particularly crucial in complex concepts such as work in Physics. Bolton (1972) refers to Gagné as saying that certain concepts are so integrated that they form what are really composite concepts or 'principles'. Bolton continues as follows:

With the principle of work, for instance, a subject must learn that

$$\text{work} = \text{force} \times \text{distance}.$$

The subject who is to understand this principle must identify several concepts and their proper sequence. He must identify a member of the class 'force' (a concept), a member of the class 'distance' (another concept) and an instance of the class 'product' or 'multiply' (a third concept). Their sequence must also be identified in order to obtain the product.

(p 106)

The complexities of the relationships between concepts, between terms and between concepts and their terms within these relationships make considerable demands upon the child, both from the point of view of understanding the conceptual inter-relations and of establishing correct term-concept links within sets of inter-related terms. What follows is a selected list of some of the types of problems which occur in pupils' use and understanding of terms as a result of incompetence regarding inter-relations between terms.

3.4.1 KNOWING THE RANGE

At the simplest level, problems can arise if the child does not know the range of terms in a collocation or lexical set. For example, in expressing thoughts about constitutions in History, he needs the following sets of collocative terms at his disposal:

draft - ratify - annul/abolish - clause/provision

When dealing with organisations that meet, he needs such terms as the following:

summon - convene - assemble - adjourn - dissolve

It cannot be assumed by teachers that pupils will always have the collocative sets at their fingertips. For example, in a questionnaire to 28 standard eight History pupils (Addendum G), the following question was set:

Fill in the missing word in the following:

Just before the Revolution of 1789 France still was, as in the time of Louis XIV, an monarchy.

The answer sought here was the term absolute. This is probably one of the most established sets of collocations in French Revolution history; and, furthermore, the fact that the article 'an' was included in the sentence also made recall easier. Yet, despite this, 14,3% of the respondents were either unable to supply an answer or supplied the wrong answer. A sizeable number of the candidates, therefore, had not established the collocation clearly enough in their minds to be able to respond appropriately.

As regards lexical sets, it is also clear that pupils often lack the necessary terms to form sets. In the same History Questionnaire, the following questions were set, each of which revealed lack of knowledge of lexical sets on the part of a number of pupils:

1. Give an antonym (word of opposite meaning) for the word liberal.
2. The king had all the, executive and judicial power.

The answer which was sought for (1) was conservative; however, the term reactionary was suggested by three respondents and was also accepted. Of the 28 respondents, 14 (50%) supplied an acceptable answer. Of the remaining 14, 4 (14,3%) produced no response while the other 10 supplied answers of a wide variety (social; socialist; communism; national; fascist; prisoner). Question (2) was looking for the term legislative (which can also be regarded as a collocative of the other two terms in the set). 17 pupils (60,7%) supplied the correct response, while the remaining 39,3% of the respondents either provided the wrong answer or no response.

That pupils are expected to know the various terms in sets such as these can be

seen by looking at some of the examination questions which will be discussed later in this chapter. It is also illustrated by the responses of History teachers to a question in the History Questionnaire to teachers (Appendix E). The following was the question and the first part of the passage to which the question refers:

You are asked to imagine that the following passage is an answer written by a Standard 8 HG pupil in a History examination. Please indicate what (if any) features of language you would criticise, i.e. what you would underline and possibly discuss with the pupil. Please amend only those items that you would normally object to. Indicate any criticism you may have by underlining the relevant word(s) and placing your preferred version above the word(s), or filling in anything which you feel is missing. If you wish to comment on why you object, please place a number next to the alteration and then write this number and your comment on the page opposite.

Question: Comment briefly on the political causes of the French Revolution.

Answer: I think one of the principle causes were the inefficient type of government. Just before the Revolution France was still an absolute monarch, that means that the king had all the different sorts of power.

Altogether 10 of the 56 respondents objected to the phrase 'all sorts of power' in line 4. Of these, 9 objected on the grounds of register. The remaining 11 objected on the grounds that the pupil should have stated the three types of power involved, viz legislative, executive and judiciary.

It is clear, then, that there are numbers of pupils who do not know the various collocative and lexical sets that form part of the terminologies with which they have to work in school. This type of incompetence can handicap the child's understanding (to understand the issues involved (eg when reading a text) it obviously helps to know the related terms) and his use of terms (to express ideas in these areas it would become tedious and result in vagueness if the related terms were not available to the child).

3.4.2 MISMATCHED SETS

It is not, however, enough merely to know the range of terms applicable to an issue of the basis of either collocation or lexical sets; it is also necessary to know the correct term for each concept in a set. It is clear from a number of children's answers to examination questions and questionnaires that they often know certain concepts and the relations between these concepts and they know that a certain set of terms relates to these concepts, but a mismatch has occurred in their minds or they simply cannot recall the correct matchings. Sometimes the problem is compounded by a confusion of the concepts or the relations between concepts in the sets as well. This leads to misinterpretation on the part of the child when reading textbooks or examination questions or to incorrect expression in response to examination questions.

The following are a few examples of this type of error:

(a) Pupils were asked the following question in a Science examination paper:

Q S1 Name the term given to a reaction where energy is taken up.

In response to this, 42 of the 57 candidates supplied the correct answer (ie endothermic); 5 supplied the complementary term exothermic; while 10 left the question blank. This means that 30% of the candidates either knew neither of the terms in the set or knew them but had them confused. It can be deduced from this that if these candidates were faced with a question which required knowing the terms and knowing which was which in order to answer the question, they would have supplied confused answers.

(b) In History, the problem often occurs that pupils confuse names of people, places, etc. For example, in one History examination the following three questions were put:

Q H1 (1) The Batavians took over the Cape after the signing of the ...

- (a) Treaty of Papendorp
- (b) Treaty of Amiens
- (c) Treaty of Woodstock

(2) The Pass Law of 1809 was introduced by ...

- (a) Caledon
- (b) Somerset
- (c) Cradock

(3) The leader of the Zulu forces at the Battle of Blood River was ...

- (a) Dembuza
- (b) Dingane
- (c) Ndulala

In order to answer these questions, pupils had to sort out which, from a number of incompatible names, was correct. The results were as follows:

	Correct (%)	Incorrect (%)
(1)	66,7	33,3
(2)	14,3	85,7
(3)	4,8	95,2

These results indicate that there were many pupils who simply could not identify the correct names in the sets. This could lead to further problems since anyone, for instance, who assumed that Somerset (rather than Caledon) had introduced the Pass Law could be misled in dealing with other aspects of either of these men's policies or of the timings of their governorships at the Cape.

(c) The following was a question set in a Science paper :

- Q 52 A diverging (concave) lens forms an image of 30mm from the lens. The size of the image is 20mm and $f = 50\text{mm}$.
1. Construct a ray diagram to show how an image of the object is formed.
 2. Measure (a) the size of the image
(b) the distance of the object
 3. What is the nature of the image ?

One of the prime requirements in answering this question was knowing the set concave - convex (or diverging - converging) and to have the correct links between concepts and verbal labels. It was clear that, in a number of cases, candidates understood the concepts (ie they knew the two shapes of the lenses) but had confused the terms. This meant that they drew a diagram for a convex lens; and this resulted in their supplying the wrong answers for the rest of the questions.

(d) In a Science examination, the following question was put to the candidates:

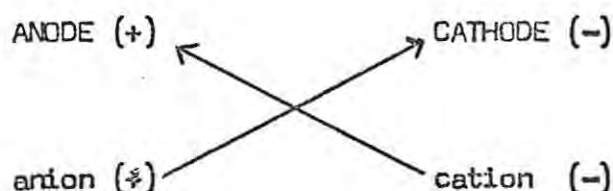
Q 53 When molten lead bromide is electrolysed between carbon electrodes, the following products will result:

- (a) lead at the anode and bromine at the cathode
- (b) lead at the cathode and bromine at the anode
- (c) lead at the cathode and oxygen at the anode
- (d) hydrogen at the cathode and bromine at the anode
- (e) no products as electrolysis does not take place

In order to answer this question, the pupil needs two sets of scientific information:

- (1) The details of the reaction involved, ie the fact that electrolysis does in fact occur (which eliminates (e)) and that in the process lead bromide is disassociated into lead and bromine (which eliminates (c) and (d)).
- (2) The fact that the lead ion is a positively charged ion (ie an anion) and that the bromine ion is a negatively charged ion (ie a cation). Also that positively charged ions are attracted to the negatively charged electrode and, conversely, that negatively charged ions are attracted to the negatively charged electrode.

One further piece of information was, however, needed in order to decide between (a) and (b), the remaining options, viz the fact the negative electrode is called the cathode and the positive one the anode. Some of the many candidates who chose the wrong answer could have done so on the basis of ignorance of either or both of the above sets of scientific knowledge. However, it can be assumed that, even if they had been clear regarding this knowledge, there would be some who chose the wrong answer because they had confused the 'converse' set of terms, anode and cathode. To sort out what was the actual cause of a wrong answer would require interviews with the candidate or requiring them to give a reason for their answers. It can be taken for granted, however, that there were at least some who understood the concepts involved and the inter-relations between them but did not know the correct labels. One of the reasons for the confusion is that the pupils sometimes tend to think that anions are attracted to the anode because of the similarity in name, whereas in fact the similarity in name is meant to suggest parallel polarity and the position is therefore as follows:



(e) The previous example shows how confusion of terms in sets sometimes results from the nature of the terms themselves. Further case in point here is the set of terms concerning images in Physics. The following are the terms used in connection with the description of images:

1. Basic distinction : IMAGE vs OBJECT

The main points of difference are as follows:

- (a) Real image: Formed at a point through which the rays of light entering the observer's eye actually pass, which means that the image is actually at the point where it is seen.

Virtual image: Seen at a point from which the rays of light appear to come to the observer but do not actually do so, which also means that the image is not actually to be found at that point.

- (b) Real images can be cast onto a screen, whereas virtual images cannot.

2. Nature of images

- (a) erect vs inverted
 (b) enlarged vs diminished
 (c) laterally inverted

A considerable number of the pupils have problems regarding the use and understanding of these sets of terms. The following four questions are taken from two different examination papers and are typical of the type of questions normally asked in connection with images:

Q 54 (1) See question above under (a).

(2) (a)



Complete the ray diagram of the sketch above to show where and how the image is produced. Only two rays are necessary. Label your sketch, especially 1F and 2F points.

- (b) Mention three facts in connection with the image produced in 2 (b).

- (3) Compare real and virtual images by mentioning at least two points of difference.

- (4) You stand in front of a mirror and lift your left hand.
Your image lifts its left hand.
We say the image is
- (a) vertically inverted
 - (b) laterally inverted
 - (c) diagonally displaced
 - (d) right handed

Some of the problems which were revealed in the answers to these questions were as follows:

(i) Confusion of the term REAL and VIRTUAL: The answer to question (1) (a) was as follows:

virtual; erect; diminished

A number of the candidates were able to draw the diagram correctly and do the calculations but labelled the image a real image. It would seem from these and other answers in their scripts that they understood the concepts of the two types of images but were confused regarding the names. This is hardly surprising. In the first place, the term real as applied to an image is almost a contradiction in terms. The noun 'image' is related to the verb 'imagine', which means 'to form a mental picture of'. The word is used in a variety of ways in general vocabulary:

- The image of his mother came to mind.
- He is the image of his father.
- An image of the Virgin Mary was broken.
- He has a negative self-image.

In each case, the word is used to mean something which is not real (which can be defined as 'actually existing as a thing' - Longmans Contemporary), ie it is a mental picture, a copy of something, something which represents the real thing. In Physics, this is the same - the image represents the object. On these grounds, then, to call an image a real image must seem strange to the child. It is only 'real' in the following senses:

- It can be cast onto a screen, and thus appears to be 'really' there.
- It is 'really' where it is seen, ie it occurs at the point where one can see it.
- The image occurs at a point through which the rays of light entering the observer's eye actually passes.

If the term is seen in this light, then it makes sense. However, this is obviously not how these candidates have thought about the term, which means that they do not easily remember which type of image can be called real and which virtual. This latter term also does not make matters easier, since it is not a word used very commonly by school pupils and, once again, it is a strange word here in that the term virtual image seems tautologous. When it is reasoned out in terms of the opposite to all the qualities listed above in connection with real images, then it is not so difficult to grasp and remember. In both cases, then, the terms are strange in their use yet logical - if the logic is explored; and the pupil's answers to questions suggest that it is not.

(ii) Confusion regarding the terms ERECT, INVERTED and LATERALLY INVERTED:

A number of problems arose here. In some cases it was simply a matter of not knowing what the terms laterally and vertically meant. They thus chose at random between 4(a) and (b). However, when one compared their answers here to their answers to other questions one could discern a pattern of misunderstanding regarding the mismatch of terms within this set. Certain aspects of the terms themselves help to explain these problems:

- The term inverted on its own means 'vertically inverted' in school Science textbooks. In fact, the term vertically inverted is practically never used. Since the term erect is used as an antonym for (vertically) inverted, an image cannot be both inverted and erect. A number of candidates who showed images which were laterally inverted in their diagrams, however, used the term inverted to mean right-left inversion and therefore did not see the contradiction between calling an image both erect and inverted, since these are not antonyms if inverted is meant to be (laterally) inverted in this context. The inconsistency of the terms inverted vs laterally inverted, therefore seems to create problems.
- The term inverted (ie vertically inverted) has an antonym, ie erect; however, the term laterally inverted does not have an antonym which means 'the right way round laterally'. This is a 'lexical gap', as Lyons calls it, and adds to the confusion. If it is seen as an antonym for vertically inverted, this could be misleading, since the contrasting words then occur in complicated

set as follows:

ERECT vs VERTICALLY INVERTED

vs

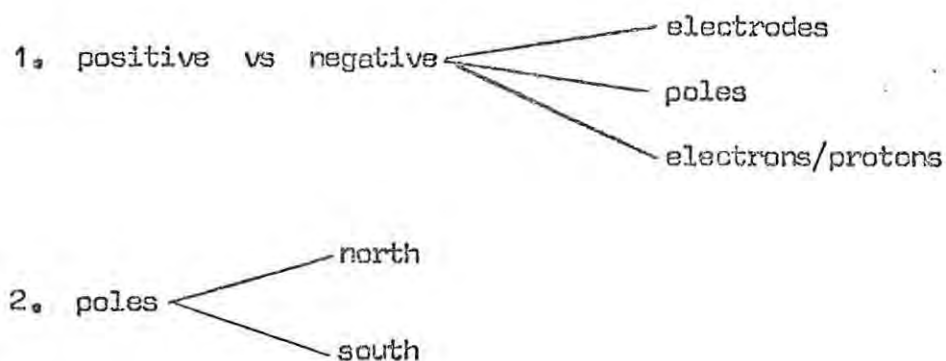
LATERALLY INVERTED

Furthermore, since there is no antonym for laterally inverted from the point of view of whether the image is inverted or not, this quality of the image (ie lateral inversion) is only mentioned when an image is laterally inverted; when it is not, then the issue is not mentioned. The question of vertical inversion vs lateral inversion is not regarded as an issue: an image is described as either inverted or erect, and if laterally inverted, then a comment to that effect will be made.

- The term erect as used here also seemed to lead to confusion. The answer to question 2(b) was that the image was real, inverted and enlarged. A number of candidates who drew their diagrams in such a way as to show the image as vertically inverted stated that the image was inverted (ie vertically inverted) and erect. These candidates had not, in other words, seen these two as an antonymous pair. One of the reasons for this is probably the fact that they are not obvious antonyms. The term erect as used here has one component of meaning in common with the general use of the word - in both cases, it refers to something which is upright, vertical. However, in light terminology, there is a further component of meaning which does not form part of the meaning of the word in general vocabulary - here it also has the component 'the right way up', ie the same way round as the object in terms of top and bottom. Hence the fact that these candidates had not seen the contradiction of labelling an image both erect and inverted in a diagram showed that they did not understand the concepts involved.

(f) Problems with sets of terms can also arise where the terms belong to more than one set, since pupils can confuse the two sets as a result of the overlap. An example in point here is the complementary set positive and negative in Science. These are used in collocation with certain other terms, viz electrodes, poles and

electrons/protons. The term, pole, is also used in collocation with another set of complementary terms, viz north and south. The picture is thus as follows:



The problems which can result from this can be seen by examining the answers to the following question from an examination paper:

Q 55 Describe how conduction of electricity occurs in metals.

The following was the answer provided in the teacher's memorandum:

Current consists of 'free' electrons which drift to positive end when a potential is placed across conductor. Free electrons move from atom to atom. A cell provides the p.d.

Three of the answers which all reveal the same confusion resulting from the fact that the terms positive and negative apply to both poles and electrodes:

- (1) The electrons are all in random order. When a current is added they all line up. When electricity is added to a metal the electrons move through that metal from the positive pole to the negative pole.
- (2) The electrons in metals are randomly exposed, but when a current flows through the conductor it causes them to co-incide and flow from the north pole to the south pole. The north pole gives off -electrons and the south pole gives off +electrons.
- (3) Metals consist of a number of small particles called atoms which consist of a number of parts including electrons. Electrons are able to move freely between atoms and thus when a cell is connected a magnetic field is created and the cells are aligned in one direction (usually north) and the electrons move from north to south and therefore another has to move to its place and so on.

Some of these answers also suggest that the confusion of sets result from (or in) a confusion of concepts concerning magnetic fields and electric currents.

Other answers revealed confusion resulting from the fact that the pair positive and negative can be used both with electrodes and with protons/electrons. The facts are as follows: In an electric circuit, one electrode will be positively charged and the other negatively charged. At the same time, there will be atoms in the conducting wire which have protons (which are positively charged) and electrons (which are negatively charged). A principle involved here is the fact that negative charges are attracted towards the positive electrode. When the current flows, the 'free' electrons move (from one atom to the next) towards the positive electrode. The confusion which can result from the 'double' set of charges involved here can be seen in the following answer to the same question quoted above:

Electricity is conducted in metals by the electrons which move or at least vibrate and therefore pass electricity into the next molecule which again does the same.

Metals all have positive and negative charges which attract each other (pos-neg) and repel each other (neg-neg). This causes movement within the metal which causes the flow of the current in it.

This pupil sees the flow of a current as an interaction between the charges of atoms (or, in fact, as she wrongly puts it, the molecules) in the conductor rather than as a result of the potential difference in charge between the two electrodes at either end of the conductor.

(g) It was mentioned at the beginning of this section that mismatches can also involve confusion regarding the relations between terms in sets. It is not always easy to distinguish between cases which involve this and cases of straight mismatches. However, the following are clear examples of cases where confusion of relations is also involved: (Some are based on an examination of pupils' writings while others are hypothetical.)

(i) A set of terms which occurs in the discussion of certain aspects of the behaviour of sound in Physics is the following:

amplitude - frequency - pitch - loudness

In order to understand the relationships between these terms it is necessary first of all to see the first two as a pair of terms which deal with different aspects of the wave motions set up by vibrations. Amplitude refers to the degree of displacement of a particle from its rest position (ie the 'size' of the wave)

and frequency to the time intervals between the compressions of waves (ie the 'velocity' of the wave motions). The cause-and-effect relationships that exist between amplitude and loudness and between frequency and pitch also have to be seen: As the amplitude increases, so does the loudness; as the frequency increases, so the pitch rises. The confusions that can arise in connection with these terms can be seen by examining the responses of pupils to the following question in an examination:

- Q 56 1. Draw two separate graphs to show the difference in wave form of the following vibrations. Draw the graphs to cover a time interval of 1 second and label your axes.
- (a) amplitude 16mm; frequency 8Hz
 - (b) amplitude 25mm; frequency 4Hz
2. If the vibrations above cause audible sounds, state how (a) differs from (b) when you listen to them.

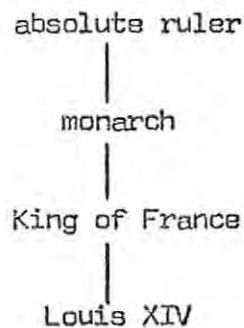
A considerable number of the candidates could not draw the graphs because they had confused the terms amplitude and frequency. Many could also not answer (2) correctly, as they had not understood the connections between amplitude and loudness on the one hand and between frequency and pitch on the other: they either had the terms wrongly linked or they had misunderstood how the cause-and-effect relationships operated.

(ii) Another cause of confusion is the fact that terms can be arranged differently in different sets. The reason for these differing classifications is the fact that, as Cohen (1977) puts it, 'we select the defining features most appropriate to the context in which the classification takes place', and this will vary from context to context. Two examples from History are as follows:

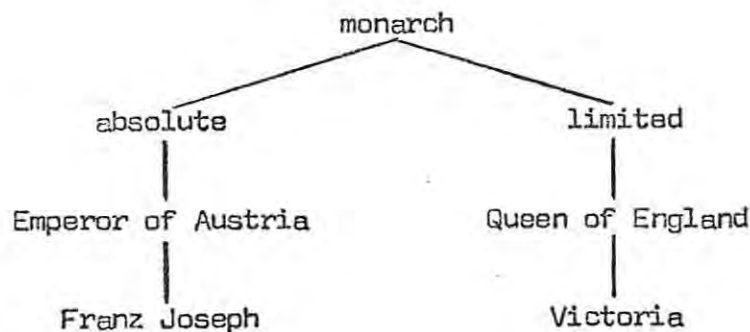
1. Monarchs can be classified in a number of ways:
 - Diachronically (cyclical ordering): Eg Louis XIV, Louis XV, Louis XVI.
 - Synchronically (non-ordered incompatibility): Eg Louis XIV, James II.
 - According to type (antonymy): Eg absolute (eg Louis XIV) vs limited (eg Elizabeth I).

2. Certain facts about society can be classified as either social or political or economic since these terms overlap to a large extent in their meanings. The fact, for example, that the lower classes had to pay certain taxes from which the nobility were exempt in France before the Revolution can be seen as either economic, social or political. Examples of confusion regarding these terms will be given in a later section.

(iii) Relating to the previous point but different in certain respects is the fact that the time dimension involved in History can result in terms belonging to a set being arranged differently within the set in different contexts. For example, any student of History needs to know that, at the time of Louis XIV, when all monarchs were absolute rulers, the following would represent an adequate description of Louis XIV:



Three centuries later, however, once the concept of a limited monarch had taken root in Europe, a different type of classification would be needed:



All sorts of permutations can be drawn up surrounding these and other related terms. A pupil who cannot establish these varying sets clearly will have problems in understanding the issues involved in a particular period or the development of ideas and concepts over the ages.

(iv) The particular relationships between terms can, similarly, vary in time in History. A lack of understanding of the context-based relationships on the part of the pupil can lead to and indicate a confusion regarding his understanding of the people, events and issues he is dealing with. In dealing with the events in Europe in the 1790's, for example, it is essential for the pupil to grasp the fact that the term liberal was closely associated with the term republican, since the monarchs of Europe were seen as the upholders of the Old Order with its lack of freedom and rights; this therefore meant that the terms liberal and royalist were regarded almost as antonyms. A further example that can be cited here is the fact that the term nationalism sometimes refers to an inward-looking approach to the nation and forms a set with the term unity ie the key point involved in nationalistic movements is the desire for the unity of like peoples; on other occasions the term refers to an outward-looking approach and is more akin to imperialism, ie the desire of a united group to acquire, administer and develop less materially advanced territories. A lack of awareness of the differences affected pupils' answers to the following questions in a History examination:

- Q H2 1. Discuss the part played by Cavour in the unification of Italy.
2. Discuss the political causes of the 'Scramble for Africa'.

Some answers, for example, showed a lack of awareness of the fact that, while Cavour was involved in a struggle to bring together fragments of a potentially unifiable set of states, the imperialist powers in Africa were reaching out beyond their boundaries to bring areas outside their national boundaries under their control without an sense of wishing to make these an integral part of their national states. In many cases pupils' essays lacked coherence and the sense of an underlying theme, and one of the reasons seemed to be the fact that they were unaware of the different aspects of the term nationalism and their relationship to other terms such as imperialism.

(v) In a Questionnaire to 166 Physical Science pupils from two schools, the following question was put:

Q S7 By inserting A,B,C,D or E in the blocks, indicate which of the diagrams below show:

- a) a vertical line meeting an oblique line
- b) a vertical line meeting a horizontal line
- c) a perpendicular line meeting an oblique line



The responses were as follows (the correct answer is ringed):

(a)	Correct	114	(66,7%)	A	24
	Incorrect	46	(27,7%)	B	8
	No response	6	(3,6%)	(C)	114
	TOTAL	166	(100,0%)	D	13
				E	1
				NR	6
(b)	Correct	159	(95,8%)	A	4
	Incorrect	7	(4,2%)	B	0
	No response	0	(0,0%)	C	3
	TOTAL	166	(100,0%)	(E)	159
				NR	0
(c)	Correct	110	(66,3%)	(A)	110
	Incorrect	54	(32,5%)	B	9
	No response	2	(1,2%)	C	29
	TOTAL	166	(100,0%)	D	10
				E	6
				NR	2

The figures reveal the following:

1. The majority of the candidates seem to understand one of the terms in the set, viz horizontal, since 95,8% of them chose E, the only diagram containing a horizontal line, as the answer to (b).
2. A sizeable number, however, did not know the meanings of two other terms in the set, viz vertical and perpendicular. This can be seen by examining the responses to (a) and (c). Since both of these involved the use of the term oblique and since all diagrams except E included an oblique line, the only issue at stake in (a) and (c) was the question of whether they understand the terms vertical and perpendicular. Of these candidates, a considerable number showed through their responses that they simply had little idea as to the meanings of these terms. The large number who suggested A for (a) and C for (c) suggests, however, that there were a considerable number who had confused the terms perpendicular and vertical. The fact that so many did so could be the cause of grave misunderstandings in discussions of the behaviour of the reflection of light in Physics.

(h) The confusion can also be compounded where pupils do not merely confuse the concepts involved in a lexical set - as in the above examples - but where they also misunderstand the nature or basis of the relations between the concepts in the set. A simple example here is the type of 'contrast' relation which might exist between terms, eg whether they are gradable or ungradable. It is necessary, for example, for a pupil to realise that terms such as positive and negative in Science are ungradable (unlike the use of these words in certain contexts in general vocabulary). This is so despite the fact that a term neutral is used to indicate neither positive nor negative. A number of answers to questions on conduction of electric currents suggested that pupils sometimes thought of a conductor as varying from 'very negative' at one end to 'very positive' at the other. They thus described the negatively charged 'free' electrons as moving along the increasingly positive conductor to the positive electrode. This shows, amongst other things, a lack of understanding of such concepts as 'potential difference'.

It is, by contrast, essential for pupils to realise that the following scientific terms are gradable binary contrasts:

1. alkaline	-	acidic
2. dense	-	rare
3. reactive	-	non-reactive
4. soluble	-	insoluble

The child who does not understand that the first pair is gradable does not understand the whole system of pH measurement:

pH 7	=	neutral
pH > 7	=	alkaline (Higher the number, greater the degree of alkalinity)
pH < 7	=	acidic (Lower the number, greater the degree of acidity)

In order to answer the following question, a pupil needs, inter alia, to understand the nature of the relationship between the terms alkaline and acidic:

Q 58 The pH values of a number of solutions have been determined with indicator paper and are as follows:

Solution	A	B	C	D	E	F	G
pH	3	4	9	6	8	5	7

1. Which is the strongest alkaline solution ?
2. Which is the strongest acidic solution ?

A pupil in History who does not perceive that the terms liberal and conservative are gradable could fail to understand the shades of difference between the 'liberal' groups that operated in France in the 1790's (Girondins, Fusillants, Jacobins, etc). The fact that these terms are often used in everyday life as absolutes to express people's prejudice makes matters worse for the child.

A further aspect of the nature of the relations is the asymmetry which can exist between apparently parallel pairs of terms. The list of gradable contrasts can be used to illustrate this point. Numbers 1 and 2 are pairs of terms whose concepts are both gradable and can be seen as med terms in a larger set as follows:

1. very alkaline - fairly alkaline - neutral - fairly acidic
- very acidic
2. very dense - fairly dense - fairly rare - ~~very rare~~

However, in the case of the following two, as the prefixes suggest, one of the terms is gradable and the other not:

3. non-reactive - fairly reactive - very reactive
4. insoluble - fairly soluble - very soluble

CHAPTER 4THE NATURE OF TECHNICAL REFERENCE

So far we have looked at certain differences between the semantic aspect of general vocabulary and technical vocabulary -- is the fact that technical vocabulary refers to a semantic field which constitutes a body of knowledge which is cognitive (rather than affective) in nature and in which the various concepts and terms are more tightly bound into inter-related systems than is the case with general vocabulary. We have also examined the nature of the conceptual competence which is necessary to cope with the demands made by these aspects of technical vocabulary as well as some of the problems which can arise as a result of incompetence in these areas.

We turn now to further aspects of the conceptual competence required to cope with a further difference between general and technical vocabulary, viz the nature of the reference involved. Sager et al (1980) make the following point in this regards:

The question arises whether we are dealing with a different kind of reference, and whether the semantic difference between general and special reference is not only quantitative but also qualitative.

(p 4)

The authors answer their question later on in the affirmative as follows:

Special subjects are therefore differentiated from general knowledge firstly by the nature of the reference and only secondly by the fact that they contain additional concepts not needed in general knowledge.

(p 74)

There are two aspects of the nature of the reference that need to be examined:

- The degree of precision of the delineation of the concepts.
- The degree of multiplicity of reference.

We shall deal with the first of these aspects in this chapter, and the other in Chapter 5.

4.1 DEGREE OF PRECISION INVOLVED

4.1.1 PRECISION AND EXPLICITNESS

As regards the precision involved, Sager et al (1980) make the following point:

There is thus a difference in degree between the structure of the concepts in the bounded subspace of a discipline and the less well defined, less 'disciplined' structure of general knowledge. We do not maintain that general knowledge cannot contain well-defined 'facts' but claim that within a special subject there are more rigorous constraints on the overall delineation of items of knowledge.

(p 74)

Another aspect which is relevant here is the one of explicitness. We have already referred to the distinction made by Johnson-Laird and Wason (1977) between the 'more self-conscious and coldblooded categories of an explicit classification system such as one finds in a science' and the 'intuitive and implicit categories of daily life'.

What the child, then, has to learn is to acquire an awareness and understanding of the more precise and explicit nature of technical concepts and also to acquire the actual concepts with a greater degree of precision and explicitness. Without these requirements concepts become either vague or inaccurate. The rigorousness of the demands of technical concepts in this respect can be seen by examining the responses of teachers of History and Science to certain questions in the Questionnaires to teachers (Appendix D and Appendix E).

In the Science Questionnaire, the following question was put:

What mark (out of 3) would you give the following as a definition of valency ?

By valency we mean that the number of electrons in an atom tell you how many bonds the atom can make with other atoms.

Mark (circle choice): 0 1 2 3

The responses can be summarised as follows:

0	25	35,7%
1	25	35,7%
2	14	20,0%
3	4	5,7%
NR	2	2,9%
TOTAL	70	100,0%

These figures suggest a wide range of opinions, with over 70% assigning either 0 or 1 out of 3. It is clear that the majority of teachers did not feel that the definition was acceptable. The main reason, according to their comments, was the lack of precision in that an important component of meaning was missing from the definition. The following is the account of the term in a school textbook:

THE CONCEPT 'VALENCY'

In all the examples of compounds discussed in this chapter, we emphasized the ratio in which atoms combine with each other. It appears that the hydrogen atom, with its single unpaired electron, always has the ability to form one bond with another atom. Oxygen, with two unpaired electrons, may form two covalent bonds. This 'bond-eventuality' of the atoms is called their 'valency'. In the examples named above, oxygen thus has a valency of 2 (divalent) and hydrogen has a valency of 1 (monovalent).

We have already pointed out that even in the days of Dalton it was known that elements always combine in a fixed ratio to form compounds. From the model that we built using the various types of bonds, we time and again came up with the same experimentally determined ratio. Thus these models are acceptable.

In general, we may say that the number of valency electrons that participate in the formation of a bond is numerically equal to the valency of the element concerned.

(Brink & Jones (no date):179)

What was missing was the fact that it is the number of unpaired (or 'valency') electrons that are crucial to the definition. As stated in the Questionnaire, it implied that it was all the electrons that determined the valency of an element. Lack of precision such as this could lead to misconceptions concerning the term valency as well as misunderstandings of other terms that are related to it (eg bonding). (In passing it can be noted here that the textbook definition is not well written - in fact, the definition given in the Questionnaire was based on the textbook account of the term. This raises the general question as to whether the cause lies in the pupils or in the textbooks and teachers that so many pupils are terminological underlings. This in turn raises the question

as to whether pupils should be trained to cope with the inadequate presentations of teachers and textbook authors or whether the latter should instead be trained to improve their presentations. These issues will be taken up in a later chapter which deals with the language training of teachers.)

In the History Questionnaire, the parallel question was as follows:

What mark (out of 3) would you give the following definition of nationalism?

Nationalism means that the people in a country want to run their own affairs on their own. They don't want others to rule them.

Mark (circle choice): 0 1 2 3

The responses were as follows:

0	2	3,6%
1	31	55,4%
2	17	30,3%
3	6	10,7%
TOTAL	56	100,0%

These figures also suggest a fairly wide range of opinions, but the majority assigned less than 3 and of these the most gave only 1. Some of the comments made by teachers on the definition were as follows:

- Vague idea - obviously does not know exactly what he is talking about.
- There is a vague idea only!
- Very vague - he has only remembered the general drift of the explanation. No real insight to speak of.
- The pupil has the basic idea but it lacks clarity and definition.

These suggest a lack of precision; in particular, it was mentioned that no reference had been made to the unifying forces of nationalism, ie language, culture, etc.

Both of these sets of responses indicate the fact that pupils are expected to achieve a high degree of precision and explicitness. As will be seen below, the above definitions are typical of many pupils' failure to cope with this aspect of technical vocabulary.

There are possibly two reasons for pupils' incompetence in this area:

(a) Tall order

In the first place, it has to be accepted that the level of precision is so much higher than that which is required in general vocabulary that it is not surprising that pupils experience difficulty. It is also a fact that pupils are not accustomed to the degree of explicitness required either.

(b) Lack of precision in concepts

Secondly, there is the fact that the concepts themselves are not always as clear in their delineation as academics would like them to be. This is particularly the case in History, the concepts of which have not been as self-consciously derived as those of Science. However, even scientific words often lack the clarity that it is assumed they have. In this respect, technical terms are different from general vocabulary items only in degree; they do not escape what Lyons (1981) calls the 'indeterminacy of meaning' of most everyday words. They simply suffer less from what Wittgenstein called 'blurred edges' than do the concepts of general vocabulary. One of the reasons for this is what Ullmann (1962) calls the 'generic character of our words', is the fact that, except for 'proper names and a small number of common nouns referring to unique objects, words denote, not single items but classes of things or events bound together by some common element' (p 126). The fact that classification is involved means that there will always be, in varying degrees, an element of indeterminacy. Another way of putting this is to say that it is the fact that all terms are 'abstract' in varying degrees that causes lack of precision and also that is responsible for the high demands made upon pupils with regard to terminology. The question of abstractness will therefore be analysed in some detail below.

4.1.2 ABSTRACTNESS

All terms must, by their very nature, be 'abstract' in their denotation by comparison with their referents since classification of phenomena of necessity involves ignoring certain individual differences between the referents. One of the causes of problems with terms is the fact that pupils cannot always identify the essential common elements between referents and therefore either

find themselves with imprecise concepts or are so bewildered that they cannot see the wood for the trees. More common, however, is the vagueness caused by the lack of sufficient experience of the referents. Concepts are usually presented to pupils as fait accompli classifications, as package deals. They therefore cannot see the variety of 'instances' which form the data on which the classification is based. What they receive is the abstraction of common elements without the experiential base which the academic who has classified the phenomena has at his disposal. Rosen (1967) puts it thus:

... it [a textbooks definition] is a high-order abstraction, the components are themselves abstractions. It is language at the apex of a pyramid of experience, thought and verbalizing. All that was offered to you was this apex, but the vast range of human activities, details of which you could respond to with comfort and interest and which constitute the base of the pyramid, were hidden from you, as indeed were all the intervening tiers between base and apex.

(p 100)

It can therefore be expected that most terms in Science and History have the potential to cause problems as regards imprecise understanding. However, it is likely that certain terms will cause more problems than others because of the degree of abstractness involved. It is a fact that, although all terms are abstract in a sense, the concepts attached to terms vary along a continuum from concrete to abstract; certain terms are therefore said to be 'more abstract' than others. Bernbaum (1972) points out that there are two factors which cause differences in the degree of abstractness between terms. Firstly, there are those terms 'where it is not the words that are the abstraction but the referents'. Thus at the concrete end of the continuum are 'those concepts that are defined in terms of their physical characteristics, like a particular kind of flower or make of car' (Cohen:1977:128). At the other end of the continuum are those referents which refer to what Lyons (1981) calls 'non-physical entities'. Thus the terms absolutism in History has an abstract referent, whereas the term king refers to a concrete entity. Secondly, there are the varying levels of abstraction that result from 'classifying in terms of common characteristics ... at different levels' (Bernbaum:1972). Of this latter concept of a hierarchy of classification of entities Brown (1958) writes as follows:

We ordinarily speak of the name of a thing as if there were just one, but in fact, of course, every referent has many names.

. . .

The dog on the lawn is not only a dog but it is also a boxer, a quadruped, an animate being, it is the landlord's dog, named Prince.

(p 82)

This second point takes us back to the issue of hyponymy mentioned earlier.

Studies of concept development in children indicate that abstractness is more difficult to cope with than concreteness in general and that the ability to cope with abstractness is related to ability, age and social background. Speaking of History in particular, Bernbaum (1972) makes the following point in this connection:

... the evidence suggests that all young people are likely to face difficulties in attaching correct referents to words, and that these problems might be acute in schools or classes which contain a high proportion of working class children. The abstract features of the study of History are likely to present the most difficulties in this respect, and there is evidence from the psychological research that this is, indeed, the case.

(p 43)

Some writers on History (eg Steele:1976; McBride:1979) have pointed out, further, that it can happen that the level of abstractness of the concepts with which a child can be faced in the study of an academic subject at school can be beyond his level of cognitive development in this regard. Steele (1976), for example, comments as follows:

It is particularly complex in History because most of the vocabulary in common use in the History classroom is of an abstract nature while the majority of children in secondary school are thinking at a concrete operational level and depend largely on their immediate experiences for understanding.

(p 17)

Good (1980) similarly points out that many of the scientific concepts presented to school pupils 'require a type of abstract thinking which is simply not available to the students' (p 110). The question of level of cognitive development will be dealt with in greater detail later. At this stage, the key point is that many of the terms used in Science and History are very abstract and that such terms are more likely to cause problems than are terms which are more concrete in nature. What follows are some examples taken from pupils' scripts to illustrate problems that arise with abstract concepts either because of the nature of the referents or because of the level of abstraction involved.

(a) The nature of the referents

It has been suggested that where terms have abstract referents the problems of understanding and using these terms are likely to be greater than where the referents are concrete. The reason is simply that concrete referents can be seen, heard, etc - either in reality or via pictures, models, and so on. The following are some examples of cases where pupils struggled to cope with the demands of terms with abstract referents:

(i) HISTORY

An example which occurred on a number of occasions in the sets of scripts which were scrutinised was the lack of clarity of fundamental abstract concepts of terms such as political, social, economic and administrative. These are terms which occur very frequently in textbooks and examination papers and are required on many occasions by pupils in their examination answers. The effects of conceptual incompetence concerning the understanding and use of such terms upon pupils' performance can be illustrated by the following four questions.

(1) In one examination paper candidates were asked to write 'good paragraphs of between 10 and 15 lines in length' on a number of topics, one of which was 'The political causes of the Mfecane'. In addition to having to know what the Mfecane was (ie the rapid and violent movement of black peoples down the eastern coast of South Africa as a result of pressure from other black peoples in the rear in the early nineteenth century) as well as the word 'cause' (and, of course, the actual facts involved), the child, in order to answer the question, needed to know exactly what was meant by the abstract term political. A number of candidates were unable to answer the question adequately, partly, presumably, because they could not select and focus on political (as opposed to social or economic) factors behind the movement. It has already been suggested that it is not always easy to demarcate social, political and economic facts as the terms overlap in their concepts. Nevertheless, there are certain facts which are clearly not one or the other. For example, the fact that the Bantu had a custom which made sure that women had as many children as possible (ie the custom of marrying widows to husbands' brothers or encouraging them to live with other men called 'seed-raisers' to bring up children in the dead men's names) - a custom which led to a rapid increase in population and therefore the need for expansion - is clearly social rather than political.

It might be noted in passing here that it was clear in the case of the above question that the candidates who wrote the examination had been given a class note on this very topic, since many of the answers were very similar in wording to the examiner's memorandum and not the textbook (which dealt with the causes in general terms). The problem was, therefore, obscured - as, indeed, it often is - by the fact that the pupils were reproducing pre-prepared answers learnt by rote. Some of the same pupils answering other question on the same paper that required an understanding of the term political but where they had not been provided with a model answer in advance fared far worse in these questions.

A further point worthy of note here is the question of whether political is, in fact, an appropriate term in the black context of the Mfecane. Here again the terminological competence of the teacher-textbook comes into question. Maybe the question in the first place is terminologically dubious, which in turn helps to explain the pupils' inability to cope with it unless they had been prepared directly to answer the question concerned.

(2) Another question (Question 1 in Appendix A) called upon pupils to classify facts regarding the same even mentioned above as political, social or military. The question read as follows:

The M'Fecane was essentially a process of social, political and military change within African society which took place with explosive rapidity during the rule of Shaka.

Discuss the above statement in an essay in which you expand on the ideas stated above.

The relevant section of the textbook appears in Appendix A, along with the essays written by four of the candidates who sat the examination. The results of these candidates for this essay were as follows:

Candidate A	:	87%
Candidate B	:	37%
Candidate C	:	27%
Candidate D	:	18%

It is usually very difficult to isolate the factors responsible for variations in the performances of different pupils in the quality of their essays. These can include, inter alia, the child's level of intelligence, the quality of the teaching, his knowledge of the subject matter, level of communicative

competence, etc. In these examples it is therefore not claimed that misconceptions regarding these abstract terms is the only reason for inadequacies in their answers. It would require control-experimental situations or interviews with candidates to prove that understanding of these terms actually affected their performance; it is, however, a reasonable assumption to make, especially since a number of the candidates indicated that they had some idea of what they ought to say but were unable to organise their facts according to these three terms.

In the case of Candidate A, it can be seen that he has selected facts and classified them according to the three concepts mentioned in the question. Candidate B indicates an intuitive attempt at the beginning to group facts - paragraph 2 deals with social changes, while paragraph 3 deals with military and political changes. Paragraph 4 could possibly be construed as being concerned also with politico-military changes. In paragraph 5, however, it is not clear how most of the points mentioned can be said to be relevant to any of the three terms.

Candidate C obviously did not know this section of History very well, but also lacked an understanding of the three terms, with the result that irrelevant facts are included and political facts are presented in a vague and implicit manner. Candidate D was obviously in the same boat. We can note, too, how he mentions social factors in paragraph 2 and then states later (paragraph 6) that 'social changes were hardly noticable (sic) at all', which not only contradicts what he had said earlier but also indicates that he was not aware that what he had said in paragraph 2 was in fact concerned with social change and therefore related to the point he was making in paragraph 6. His understanding of the term social was obviously very limited.

We can see from these examples that a lack of understanding of such fundamental concepts affects pupils' essay writing in two ways. Firstly, it affects the selection of material for the essay: vague notions lead to the inclusion of irrelevant facts. Secondly, it affects the nature and structure of the discourse: those pupils who lacked clarity regarding these concepts tended to produce what Stephens (1975) calls 'narrative' historical discourse rather than 'analytical' historical discourse; and, furthermore, they tended to arrange their points either only implicitly and loosely according to these concepts or to produce unstructured or jumbled discourse.

(3) A further example which illustrates the detrimental effect of a lack of comprehension of abstract terms such as these were the responses to the following question in an examination paper:

Read the following brief extract and answer the questions which follow:

11 February 1823

My Lord

The subscribing colonists in South Africa who emigrated to the Eastern districts in the year 1829 are compelled to lay before your Lordship a statement of the real circumstances and grievous difficulties which have led to our present sorry plight ...

- (i) Who were the subscribing colonists referred to ?
- (ii) Who was the Governor of the Cape at the time ?
- (iii) In what ways had the emigrants suffered in the political sense by coming to the Cape ?
- (iv) Describe some of the material problems suffered by the Settlers.

The required answer to (iii) and three of the answers of pupils are printed in Appendix A. Some of the answers clearly indicated that the candidates concerned did not understand the term political as used here. Candidate A, for example, included economic losses, while Candidate B included both economic matters and matters of social security (all mixed up together). Candidate C saw political as referring only to conditions of social security. The question was looking for an understanding of the loss of political rights, ie the rights of the Settlers to protest against the actions of the government.

(4) Sometimes problems arise where the question itself does not use a particular abstract term but where the pupil needs to use the term (or at any rate the concept) in order to answer the question. An example in point here is Question 3 in Addendum A which reads as follows:

In 1843 and 1848 attempts of the Trekkers to establish independent republics in Natal and Transvaal were blocked by the British annexations of these two territories. Discuss the causes which led to both annexations.

The memorandum (which was a section of the textbook) indicates that the examiner expected pupils classify causes according to such terms such as political, strategic, economic and philanthropic. The candidate's answer printed

in the Appendix indicates once again how a lack of awareness or understanding of these terms can (together with other factors) affect the quality of a piece of historical discourse: only economic and strategic factors were mentioned in connection with the annexation of Natal and these were not separated clearly.

(5) A final example here, also of the need to be aware of terms in order to answer certain questions, is Question 4 of Appendix A. In commenting on the reforms of Janssens and De Mist at the Cape, pupils were required to classify them as administrative, economic and social. Candidate A shows no awareness whatsoever of such a classification, while Candidate B has moments of insight.

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When History essays are marked, half the marks per question are assigned to what is called 'insight', and it is clear that, in addition to the need for general understanding of the period concerned and an understanding of the question as a whole, an understanding of abstract terms such as those mentioned above is essential in order to obtain a reasonable 'insight' mark. It also affects the content mark, since it has a controlling effect over the selection of points for inclusion.

It is clear, then, that incompetence in this area can handicap a child's ability to express his understandingⁱⁿ in a relevant, analytical and coherent manner as well as his comprehension of what he reads (since he needs an understanding of these terms to see relations between facts in the text).

(ii) SCIENCE

If we turn from History to Science, we can take a term such as potential difference in Electrochemistry as an example of an abstract term which can cause grave problems for pupils. Pitt (ed)(1977) defines this term as follows:

potential difference. Symbol: V , U . The line integral of the electric field strength between two points. The work done when a charge moves from one to the other of two points (by any path) is equal to the product of the potential difference and the charge. See electro-motive force.

Not only is the term itself very abstract, but it involves other terms which are also abstract. One of these, the term work, is particularly abstract - which can be seen if one looks at the definition of this term in the same dictionary:

work. Symbol: w , H . Work is done when a *force moves its point of application. The amount of work is measured by the product of the force and the distance moved by the point of application in the direction of the force. Work is measured in joules, i.e. the work done when a force of 1 newton moves through a distance of 1 metre.

(p 414)

This term in turn involves the understanding of other abstract terms, one of which is force, defined as follows by Pitt:

force. Symbol: F . Any action that alters or tends to alter a body's state of rest or of uniform motion in a straight line. (See Newton's laws of motion.)

(p 155)

Thus, in order to answer a question requiring the understanding and use of the term potential difference, a whole host of other, equally abstract, terms also needs to be understood. The fact that many fail to grasp such abstract terms can be illustrated by the answers given to a question mentioned earlier, viz:

Explain how conduction of electricity occurs in metals.

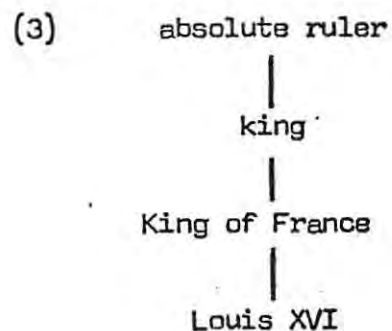
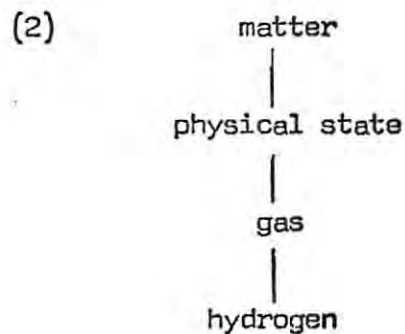
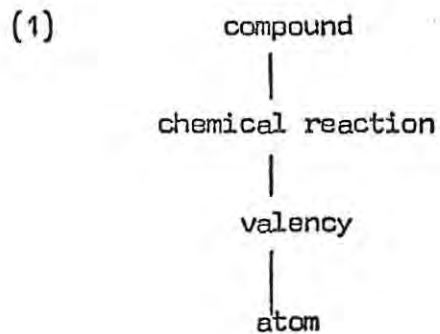
The fact that very few of the candidates were unable to answer this question adequately can be ascribed partly to the factors commented on earlier and partly to a lack of understanding of the abstract concept potential difference which underlies the explanation of the abstract concept conduction.

It might be noted in passing here that one would expect pupils to find the term conduction (- concrete) more difficult to grasp than conductor (+ concrete); and that the same would apply to magnetism (- concrete) as opposed to magnet (+ concrete).

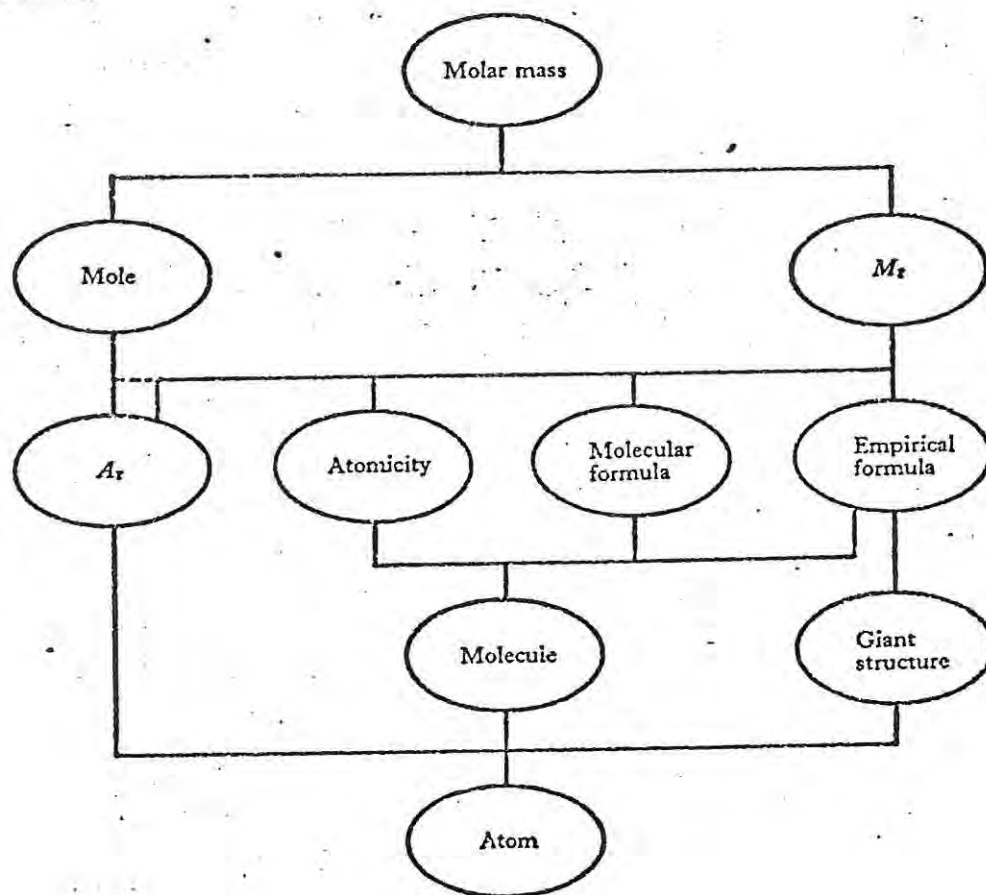
Further examples of problems with abstract concepts in Science will be implicitly dealt with under some of the later sections of this Chapter.

(b) Abstractness and hierarchical ordering

We have been dealing so far with abstractness caused by the nature of the referents. We turn now to the other cause of abstractness, ie the fact that concepts are arranged on various levels. Some examples here are as follows:



The complexity in terms of the number of levels and the nature of the relations between these levels can be seen by looking at the following example from Gower et al (1977:287):



Gower et al comment that 'the higher a concept appears in the hierarchy, the harder it will be to learn' (p 289). They cite experimental evidence based on the hierarchy presented above to prove that pupils struggled more with the concepts mentioned higher up the tree than with those at the lower end. There are at least two reasons for this phenomenon. Firstly, the higher the concept in the hierarchy, the more inclusive it becomes - each concept is wider than and includes the concept referred to by the term below it (Lyons:1968:453). Secondly, the fact that each concept is included in a higher concept means, as Gower et al point out, that in order to understand higher-order concepts, 'all the subsidiary concepts must be learned first'.

An example of incompetence resulting from the need to understand all lower-order concepts in order to cope with higher-order concepts is the problem which many pupils experienced in trying to answer the following question in a Science examination:

The element boron (atomic number 5) occurs in nature as two isotopes with mass numbers of 10 and 11 respectively.

What do you understand by the terms isotopes and mass number ?

In order to answer this question, pupils needed to have a hierarchy of concepts something like the diagram on the next page, as well as an understanding of the concepts as defined by Uvarov(1979) on the same page. In fact, many of the pupils concerned were unable to define mass number correctly either because they had confused it with atomic number or because they had confused neutrons with nucleons. This meant that they were unable to define isotope correctly. It is also to be expected that they would have had difficulty in defining the highest-order term element as well.

(c) Subject-related abstractness

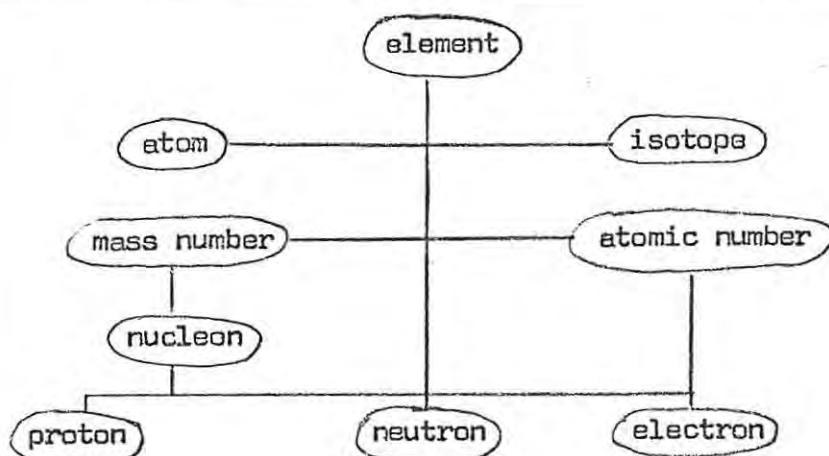
An interesting point that relates to both types of abstractness is the fact that different subjects may be abstract in different ways: the nature of the concepts involved may be abstract for varying reasons. This is one of the reasons why, as will be discussed later, research indicates that different subjects may vary both as regards the level of difficulty they present for the child as well as in the level of cognitive development required of the child in order to cope with the concepts of the different subjects (eg one subject may demand the development of operational thinking sooner than another). By way of illustration, we can compare the concepts of Physics and History in this regard.

Of physical concepts, Helm (1969) comments that the pupil has to realise that

physical concepts are not just 'there' in Nature, waiting to be recognised and used - instead they are constructed by a sophisticated process of abstraction from experience and selected for their usefulness, ie their ability to be incorporated within the framework of a physical theory.

(p 118)

It is to be expected, then, that such terms as mole, work, force and energy mentioned earlier would cause grave problems for a pupil unless he can, as Helm suggests, develop 'some feeling for the nature of physical concepts'. He has to be able to think in a different kind of abstract realm than he would if the referents involved formed what Lyons (1968:426) calls a 'natural class'. A comment by Lyons (1977) is also relevant here:



element (chem.) A substance consisting entirely of *atoms* of the same *atomic number*.

atom The smallest portion of an *element* that can take part in a *chemical reaction*. See *atom, structure of*; *atomic theory*.

atom, structure of The *atom* consists of a positively charged central core, the *nucleus*, surrounded by one or more negatively charged planetary *electrons*.

isotopes *Atoms* of the same *element* (i.e. having the same *atomic number*) that differ in *mass number*. The isotopes of an element are identical in chemical properties, and in all physical properties except those determined by the *mass* of the atom. The different isotopes of an element contain different numbers of *neutrons* in their *nuclei*. Nearly all elements found in nature are mixtures of several isotopes. See *atom, structure of*.

mass number *Nucleon number*. *A*. The *integer* nearest to the *atomic mass* of an *isotope*, i.e. the number of *nucleons* in the *nucleus* of an *atom*.

atomic number *Proton number*. *Z*. The number of *electrons* rotating round the *nucleus* of the neutral *atom* of an *element*, or the number of *protons* in the *nucleus*.

nucleon A constituent of the atomic *nucleus*, i.e. a *proton* or a *neutron*.

electron An *elementary particle* having a *rest mass* of $9.109\,558 \times 10^{-31}$ *kilogram*, approximately 1/1836 that of a hydrogen *atom*, and bearing a negative *electric charge* of $1.602\,192 \times 10^{-19}$ *coulomb*. The radius of the electron is $2.817\,77 \times 10^{-15}$ *metre*. The electron is a constituent of all atoms (see *atom, structure of*). The positively charged *anti-particle* of the electron is the *positron*, and the word 'electron' is sometimes used to include both negative electrons (negatrons or negatons) and positive electrons (positrons or positons). A *free electron* is one that has been detached from its atomic orbit.

neutron An *elementary particle* that is a constituent of all atomic *nuclei* except that of normal hydrogen. The neutron has no *electric charge* and a *mass* only very slightly greater than that of the *proton* ($1.674\,92 \times 10^{-27}$ *kilogram*). Outside a nucleus a neutron decays, with a *half-life* of 12 minutes, into a *proton*, an *electron*, and an *anti-neutrino*. Neutrons and protons may be considered as different aspects of the same particles and the name *nucleon* is used to describe both of them.

proton A stable *elementary particle* with *electric charge* equal in magnitude to that of the *electron* but of opposite sign, and with *mass* 1836.12 times greater than that of the *electron* ($1.672\,614 \times 10^{-27}$ *kilogram*). The proton is a *hydrogen ion* (i.e. a normal hydrogen atomic *nucleus*) and is a constituent of all other atomic nuclei. See *atom, structure of*.

The point being made here is simply that, although there are certain perceptual continua in the external world, there are also more or less clearly distinct objects and classes of objects.

(p 260)

Where a discipline deals with objects and classes of objects that are distinct in the natural world, whether they be concrete or abstract, the concepts are far easier to comprehend than where they are, so to speak, 'referentless', as in Physics. Thus, even though a term such as evaporation in Geography and Chemistry is abstract, one can nevertheless see the water disappearing from one's pool and say that 'evaporation has caused this'. However, it is difficult to 'see' force (work x distance) or a mole (see earlier definition) in phenomena.

In History, the problem arises largely from the fact that History deals with concepts which have a diachronic dimension. The Schools Council project History 13-16 (1976) quotes Fine (1977) as follows in this regard:

It is important to remember that when children are doing History they are operating at a vastly different level from when they are doing mathematical and physical concepts. In History the child is dealing with everything at one remove, coping with facts that are not directly observable, and with techniques that must be evolved by himself in conformity with those evolved by his mentors. In History nothing is truly concrete, nothing can be handed or passed down in any real sense, for even the 'facts' do not become facts for the operator until he has worked on them in such a way as to recognise them as such.

(pp 42-3)

Thompson (1979) refers to Coltham (1960) who suggests that 'because history cannot be directly experienced but has to be imagined, it is to be expected that the child's understanding will be more limited than in subject areas in which it is easier to build on concrete experience'. The referents of History, in other words, do not, by definition, exist any longer. It is this fact that makes even the most concrete of terms more abstract than would be the case in general vocabulary. The term king, for example, in referring to a king of the past, is not the same as the word 'king' which refers to a present-day monarch.

It is clear, then, that abstractness can cause problems in all subjects because of the demands that this quality of many technical terms make on children's conceptual competence; but it is also clear that each subject may have its own basis for abstractness and may therefore present problems and difficulties of its own.

CHAPTER 5

MULTIPLICITY OF MEANING

We have dealt in the previous chapter with one aspect of the nature of the reference of technical terms, viz the question of delineation. We have shown that the child needs a conceptual competence which enables him to cope with a higher degree of precision and explicitness than is required in the case of general vocabulary. At the same time, the high degree of abstractness of many technical terms militates against precision and leads to conceptual incompetence. We turn now to the other aspect concerning the nature of the reference, viz the degree of multiplicity of meaning of terms.

5.1 FIXED SIGNIFICATION

A source of vagueness in the meanings of words in general vocabulary is the fact that most words do not have one set, unchanging meaning. In the first place, there are the contextual variations which result from what Ullmann (1964) calls 'multiplicity of aspects of meaning' - the fact that the meaning of a word can be seen to be composed of a number of 'features' or 'components' of meaning all of which may or may not be relevant in a particular situation. As Ullmann puts it, 'even the simplest and most monolithic [words] have a number of different facets depending on the context and situation in which they are used, and also on the personality of the speaker using them'. As an example, one can take the word 'rare' as used in the following two sentences:

- a. That was a rare event.
- b. He collects rare books.

In these two sentences the word is used in similar but slightly differing ways. In both, the word means 'uncommon'; however, (b) also implies 'valuable', a component not suggested by (a). Furthermore, (b) could connote either 'uncommon because old' or 'uncommon because limited edition', ie in each case a different component of meaning could be intended by the speaker.

A more extreme semantic variation is that of polysemy, which involves multiplicity of meanings as such and is typical of many words in general vocabulary. This can be illustrated by the word 'accommodation', which has at least four meanings:

1. the act of changing something so that it suits new conditions
2. a place to live; room, flat, house, hotel room, etc
3. the act of settling a business disagreement or the ending of a disagreement
4. something that helps, or makes an action easier

(Longmans dictionary of contemporary English: p 6)

The tendency towards multiplicity of meanings of words in general vocabulary is less typical of technical terms. Technical terms aim to have what Potter (1950) calls 'fixed signification', from both a synchronic and a diachronic point of view. While it is true that technical terms also refer to meanings which comprise a number of components, it is also true that the components tend to be more cohesive and more constant. While context plays an important part in our attempts to deduce the meaning of a term and in using it, it does not influence which of the components of meaning will be relevant in a particular situation - all are relevant at all times. This can be seen by comparing the varying uses of the word 'rare' in sentences a. and b. above with the use of the term rare in the following two sentences:

- c. Air is a rare medium.
- d. Light is easily transmitted through a rare medium.

In both c. and d. the term rare is used with exactly the same sense - ie not dense, a low amount of matter in relation to the space in which matter is packed.

A further aspect of synchronic monfunctionalism is the tendency for technical terms to avoid polysemy. As Felber (1979b) put it, 'Unambiguous communication presupposes a permanent assignment term-concept'. Flower (1966) comments as follows on this as the aim of scientific terminology:

When the time came to adapt the vernacular languages of Europe to the purposes of scientific communication, the scientists attempted to build a language within a language, stripped down to its essentials, restricting as far as possible each element of the lexicon to a single referent ...

(p 91)

We can see this contrast with general vocabulary by noting that, whereas the word 'accommodation' has, as indicated above, at least four different meanings in general vocabulary, the term has only one in Science (a more restricted version of the first meaning listed above).

From a diachronic point of view, it seldom occurs that scientific terms change meaning. A rare example of diachronic change is the term emf, which is no longer related to the term electromotive force, since emf is now seen not as a force any longer but as energy (Brink & Jones:107).

What has been said so far is not, however, as true of all terminologies. History, for example, does not have a terminology which measures up to these demands to the same extent as does the terminology of Science. At a synchronic level, the various components of meaning are not as 'fixed' in all contexts as are those of Science. This can be illustrated by examining the meaning of the term people as used in the following:

- a. Van Rensburg's people were murdered.
- b. Government by the people ...
- c. The peoples of Europe insisted on a greater share in government.
- d. They were defeated by a people's army.

In each case, the term refers to a group of persons. However, they vary in the breadth of reference involved: a. refers to a small party; b. refers to all the persons who form a State; c. refers to nations; and d. refers to the ordinary (common) people. One of the reasons for the variation in breadth of reference is that the term people contains components in its meaning which are not all relevant each time. These include :

- + ADULT (applicable to a.); ± ADULT (applicable to b.,c.,d.)
- + COMMON (applicable to d.); ± COMMON (applicable to a.,b.,c.)

Polysemy is also more commonly found in historical terminology than in scientific terminology. For example, the term court is used in at least three different senses:

- 1. a room or building in which law cases can be heard and judged
Eg The people tried to burn down the court.
- 2. the chief royal palace
Eg '... they lived in luxury at the court of Versailles ...'
(Smit et al:1974:3)
- 3. the officials, noblemen, servants, etc, who attend a king or queen
Eg The court objected to the behaviour of the rabble.

In a similar way, the term convention is used both to mean 'a formal agreement' (as in 'The Bloemfontein Convention') and a 'group of people gathered with a shared, often political, purpose' (as in 'The National Convention').

Diachronically, too, historical terms vary. For example, the term people (as in sentence b. above) would have included the feature + MALE in terms of voters until the latter part of the nineteenth century, whereas this is no longer the case in most democratic countries. The diachronic variation in History results from the fact that historical terms which refer to concepts that are still relevant today have a 'then-now' distinction built into them. Bernbaum (1972) makes the point as follows:

The situation and contexts in which a word is used vary and change with the times. For example, the word 'party' and 'factory' have different referents today from those that existed in the eighteenth century.

(p 44)

It can be seen then, that, whereas scientific terminologists strive to maintain a system of terms with 'fixed signification', this is not the case in historical terminology. Furthermore, if one views the whole corpus of terms used in disciplines in the high school from the point of view of the child who is involved in a number of these disciplines and is also involved with non-technical language, one can see that there is a far greater degree of multiplicity of meaning involved in the learning situation. In the first place, some of the terms which are so carefully assigned only one meaning in Science are also used in general vocabulary with one or more different meanings - eg accommodation and rare above. Secondly, the same term can be used in different technical vocabularies with differing meanings. For example, when the chemist speaks of water he is thinking of a chemical compound (H_2O) which can participate in chemical reactions, etc; when the physicist uses the term to refer to a liquid with a certain degree of density which acts as a medium to transmit or refract light or sound. A third possibility is where the same lexical item occurs as a word in general vocabulary and as a term in one or more technical vocabularies. An example in point here is the noun radical which can be used as follows:

1. General vocabulary: a person who wishes to make great and rapid changes in the government of a country
2. History: similar to general vocabulary, but varying according to the particular context

3. Chemistry: A group of atoms, present in a series of compounds, that maintains its identity through chemical changes affecting the rest of the molecule, but that is usually incapable of independent existence.
4. Mathematics: the square root of the quantity

In order, therefore, to develop the necessary conceptual competence to cope with this situation, the child has to acquire both the specifically assigned concepts attached to the scientific terms and the various concepts that can be assigned to historical terms. He also has to perceive the links, the comparisons and contrasts, of meaning that exist between terms that occur in both general and technical vocabulary or in general, technical 1 and technical 2. In addition to this level of 'data' competence, he needs to develop the 'rules' necessary to understand these relationships.

It is clear from pupils' writings and from the information supplied by questionnaires to pupils that all of them reveal, in varying degrees, conceptual incompetence in this area. In the rest of this chapter we shall be examining the types of incompetence that arise from the fact that the same word may occur in general and technical vocabulary and in more than one technical vocabulary. A particular problem in History arising from the general-technical overlap, sometimes called 'presentism', will also be dealt with.

5.2 GENERAL AND TECHNICAL

5.2.1 FROM GENERAL TO TECHNICAL

If one examines the technical vocabularies in a language in relation to the general vocabulary of that language, the following points emerge:

(a) The extremes

There are two extremes involved here:

(i) There are those lexical items which exist in general vocabulary but which do not form part of certain technical vocabularies. Thus, for example, the following words which are to be found in general vocabulary do not form part of the terminology of either Chemistry or Physics or History:

love; hate; joy; apron; doorknob

Whether or not such words form part of a technical vocabulary depends, of course, on the discipline to which the technical vocabulary is attached. Each of the above words could, in fact, occur in a technical vocabulary other than those of Science or History:

love, hate, joy	-	Psychology
apron	-	Home Economics
doorknob	-	Woodwork

(ii) On the other hand, there are those special lexical items which do not exist at all in general vocabulary but belong to a special technical vocabulary. Where they are used in everyday situations, they are used as technical terms:

<u>Chemistry</u> :	ion; pipette; carbon tetrachloride; anhydrous
<u>Physics</u> :	diffraction; umbra; ampere
<u>History</u> :	gabelle; serfs

(b) Between the extremes

Between the two extremes, there are those lexical items which exist both in general vocabulary and in the technical vocabulary of one or more disciplines. Sager et al (1980) make the following point in this connection:

Since the number of lexical elements is finite and the ergonomy of language is such that the same signs are used with different functions, and since there is a continuity on the scale between general and special reference as well as overlap between sub-systems of knowledge, some lexical items do multiple duty.

(p 75)

These terms could either be technical terms which have come to be used in general vocabulary or general language items which have been taken into a technical vocabulary. In connection with this second possibility, it can be argued that there are two main sources whereby technical terms enter the vocabularies of disciplines. These two methods can respectively be designated adaptation and invention. The two methods are distinguished on the basis of the resources which are used - 'adaptation' means the use of existing words in the language or from other languages, while invention involves the formation of new words by the use of various elements.

It is difficult to assess exactly how many of the terms in our corpus are derived from words in general English vocabulary without establishing the exact date of entry of the words into the English Language and establishing at the same time whether the first meaning was technical or non-technical. Certain items are obviously not derived from general vocabulary as they are very unlikely ever to be used in everyday discourse. Examples such as astigmatism in Physics and endothermic in Chemistry come to mind here. Others such as molecule and the names of chemical compounds (eg carbon dioxide) although occurring in general conversation on a fairly regular basis, are obviously so technical in meaning that one can assume that they were not derived from general vocabulary but entered general vocabulary from Science. For the rest, one cannot easily decide which way the word moved without conducting the kind of investigation mentioned above.

Flood (1960) maintains that terms derived from general vocabulary form by far the minority in scientific terminology:

There are not many words of this kind, but, unfortunately, most of them stand for concepts of fundamental importance.

(p x)

Some examples of scientific terms which are derived from this source are as follows:

converge; force; power; wave; salt; base; strong

In some cases, the scientific use of the words came many years after the word had first entered the language as part of its general vocabulary. An example here is the word 'wave', for which the Shorter Oxford Dictionary records 1526 as the date of its earliest known use, while it was only in 1832 - more than three centuries later - that the word was incorporated into the terminology of Physics. It can also be noted here that different sciences vary in the extent to which they derive terms from general vocabulary. It would seem, for example, that Physics has far more terms taken from general vocabulary than does Chemistry. Seger et al (1980) state that 'of the fundamental sciences only physics has not developed an independent nomenclature and relies on general language means of word formation' (p 242).

If one turns from Science to History, one finds that, by contrast, the vast majority of terms are derived from general vocabulary - even those which are

taken from other disciplines are terms which those disciplines culled from general vocabulary for technical use. This is one of the reasons why many children find History difficult to cope with.

5.2.2 CONCEPTUAL COMPETENCE IN THIS REGARD

When the child encounters a word from general vocabulary in a technical context, it is necessary for him to be able to adapt his existing knowledge to suit the new conditions. The first step is to establish whether the word and the term are related in meaning or not. Occasionally one finds scientific terms which have a meaning that bears no relation to, or which is a very vague shadow of, its meanings in general vocabulary. Two examples of this are as follows:

- (1) An extreme case is the term incident, which is used in Physics in the phrase incident ray, where it means 'incoming' or 'approaching' and where it contrasts with reflected or refracted. This has no connection with the general meaning of 'an event or occurrence'.
- (2) The term base in Chemistry refers to the concept of an 'acid destroyer', ie a substance which deprives an acid of its properties. This meaning bears no obvious relation to any of the everyday meanings of the word.

In most cases, however, there is a relation between the meanings. In these cases, it is necessary first to establish to which meaning in general vocabulary the term's meaning is related where there is polysemy in general vocabulary. Secondly, it is necessary to be able to isolate the similarities and differences of meaning between the item in general vocabulary and in a terminology. The basic need is to perceive the effect of the underlying process which Potter (1950) calls 'specialisation', ie the process whereby the general meaning is narrowed, becomes more specific and narrower in reference. From Physics, one can take the term accommodation referred to earlier as an example. One of the senses listed above for this word in general vocabulary was as follows:

the act of changing something so that it suits new conditions

The 'something' which can be changed could be one's habits, one's way of life, one's views, etc. The 'new conditions' could be a new inter-personal relation-

ship, a new living area, etc. In Physics, however, this term refers only to one particular type of adaptation, ie the adjustments which the lens in the eye makes to suit the differing intensities of light or the varying distances of objects from the eye. Two further aspects of this process of restriction of reference can also be seen here. Firstly, a technical term loses its potential for metaphorical use. In general vocabulary, for instance, one could use the word 'accommodate' figuratively, whereas in Physics it is used only in a literal sense. Secondly, when a lexical item from general vocabulary is used as a technical term, it is stripped of its connotations and has, therefore, as indicated earlier only a 'cognitive' meaning. In adapting to the word 'accommodating' in a technical context, then, the child has to remove the positive connotation of the word that it has in general vocabulary (as in He's a very accommodating person').

The following are some further examples of the effect of specialisation. In each case, it can be seen that the effect is typical of the particular discipline concerned.

- (1) Chemistry: The word 'salt' in general vocabulary means 'a substance that gives sea-water its characteristic taste, got in crystal forms from strata consisting of it or by evaporation of brine pumped from these or of sea-water, and used for seasoning or preserving food and other purposes, sodium chloride' (Concise Oxford Dictionary: 1976:997). The chemist sees salt from the point of view of its chemical composition, as a 'class of compounds, which he defines as the products of replacing the hydrogen of an acid, wholly or in part, by a metal or a metallic radicle' (Savory:1967:32).
- (2) Physics: Sager et al (1980) comment as follows on the terms power, force and energy, which, because of their higher degree of specificity, are different in meaning in Physics but not in general vocabulary:

In general reference, force, power, energy are often used synonymously and their extensions overlap. In special reference, their definitions are exclusive and their relationships are made clear by associating force with weight, energy with weight and distance, and power with weight, distance and time.

The use of these words in Physics is also made more specific by the practice in Physics of expressing concepts quantitatively. Force is thus usually defined as the product of mass and acceleration.

- (3) History: Here the process of specialisation operates in two ways. Firstly, there is the consistent narrowing of terms to a particular semantic area. For example, the following terms tend to be used almost exclusively in a political sense in History:

adjourn (parliament, political meeting)
ally (political ally)
authority (political authority)
central (government)
divine right (to rule)

Secondly, there are those terms which are restricted by the context of the time to which they refer. Thus, the term church in French Revolution times means 'Roman Catholic Church', while the term Great Powers depends for its reference at any period in history on which were the leading countries of the world at that stage.

The amount of adaptation and narrowing that the child has to perform on these words will depend on the degree of proximity of meaning between the term and the word. The meanings of some common items are very close. For example, the term medium in the language of Physics refers to a substance through which light travels. In general vocabulary, this is also an accepted meaning for the word. Similarly, a term like annex in History has a similar meaning in general vocabulary. On the other hand, the word 'black' in general vocabulary refers to a dark colour which is the opposite of white, whereas in Physics the term black refers to the absence of colour. The meanings are related in that they both refer to concepts connected with colour; however, they are different in their specific colour references. A wide gap also exists between many historical terms which occur as items of general vocabulary because of the difference in reference resulting from the change over time of certain concepts. Terms such as monarch, rights, etc do not have exactly the same meaning today as they had, say, in the nineteenth century.

A further adaptation that is required when the child is confronted with a word in a technical context is that he has to slot it into new collocative and lexical sets. Whether the words have the same (or related) meaning or not, the inter-relationships between the concepts attached to these words and to those attached to other words within the respective bounds of general and technical vocabularies further separate the meanings of these common words. The widely different lexical sets and collocations into which these words fall in general and technical vocabularies is nicely illustrated by the terms dense, rare and medium:

- (1) General vocabulary: Here the word 'dense' has two main meanings and therefore two lexical sets and two sets of collocations:
 - (a) Meaning thick or copious: Here the word collocates with words such as 'forests', 'fog' (ie non-human nouns). These nouns also typically form part of the lexical set to which the word belongs. Further words in its lexical set include synonyms such as:

thick; impenetrable; copious; massed; solid;
heavy; close; condensed; compact

Antonyms involved in the lexical set here include the following:

thin; sparse; faint
 - (b) Meaning stupid: Typical collocative words include 'person', 'fellow', 'boy' (ie nouns which are + HUMAN). These nouns, together with adjectival synonyms such as the following, are typical of this word's lexical set:

stupid; ignorant; dull; foolish; slow; thick;
crass; unintelligent

The following antonyms would also feature in this set:

clever; intelligent; bright
- (2) Physics: Here, as was mentioned before, one would expect a more limited reference. In the first place, the term dense has only one meaning. Furthermore, the term has a very limited collocation, viz with the noun medium. The lexical set of this word is equally narrow, viz the noun medium and the antonym rare. There are no synonyms.

When one realises that all this applies equally to the other terms used here, viz rare and medium, one realises that technical terms which are also used in general

vocabulary are bound up in a narrow web of conceptual inter-relationships which isolate the terms from the words in everyday use and make them very difficult lexical items in the end. On the surface, then, the adaptation on the part of the child may seem minimal; but underneath there is a highly complex process involved.

5.2.2 INCOMPETENCE IN THIS REGARD

Competence in this regard, then, involves the ability to adapt the meaning of words in general vocabulary for technical use and to see the links between the general and technical senses. Incompetence can take various forms. Deficiency may take the form of the child's not knowing the meaning of the word in general vocabulary. In this case, he would lose out on the advantages of general vocabulary as a source of technical terms, viz the fact that such terms do not seem totally unfamiliar either in form or meaning and provide a starting-point for the development of technical meaning and use. On the other hand, this very familiarity can be the source of problems and result in defective competence. Here there are two possibilities:

- (1) Vagueness: Because of the familiarity of the term, the child may not realise the need to seek more precise, conscious understanding of the term. Therefore he may understand and use it in terms of the more diffuse, intuitive knowledge that is typical of non-technical concepts. It is for this reason that Flood (1960) regards such words as 'unsatisfactory scientific words'. He elaborates as follows:

Although the scientist may give them precise meanings, they are liable to be interpreted more loosely (or even differently) by the non-scientist.

(p x)

If this is true of Science, it is likely to be even more true of History, which has a far larger number of terms derived from this source.

- (2) Inaccuracy: Here the understanding of the term is inadequate because of the interference of the general meaning of the word - a process similar to the interference of L1 in L2 or vice versa.

The extent of the resulting misinterpretation is a matter of degree; however, whatever the degree, the child in these cases arrives at an inaccurate definition for the term because of the transfer of irrelevant or contradictory aspects of the meaning of the word in general vocabulary to the technical meaning. Writing of Mathematics in particular, (but, in effect, of any discipline), Austin and Howson (1979) comment as follows on this point:

... many mathematical terms are common words used by mathematicians in a special, often limited form. There is the danger that the child by arriving at his own definition by osmosis will arrive at the wrong one.

(p 181-2)

The types of problems that arise as a result of this type of lexical incompetence can be illustrated by the following examples from Science and History:

(a) Science

It has been mentioned that terms taken from general vocabulary form the minority of scientific terms. Their significance in the subject, on the other hand, makes up for their lack of frequency. The comment made by Flood (1960) in this regard can be repeated here:

There are not many terms of this kind but, unfortunately, most of them stand for concepts of fundamental importance.

(p x)

The following are some examples of misconception resulting from this situation:

(i) Johnstone and Cassels (1978) report that they conducted an investigation into the use of language in Science examinations over the period 1976-1977 among about 4 000 pupils in secondary schools in Scotland and England. One of their findings is relevant here:

The words which give the most trouble are not so much those which are purely technical (eg 'isotope') but those which are in normal English usage, but which have a specific meaning in science ...

(p 433)

They quote the following example from their survey:

For example, the word 'fused' is used quite correctly in science to mean 'melted', but in common parlance we apply 'fused' to electric lights or appliances not functioning. It is little wonder that a question about 'fused salts' proves puzzling to pupils.

(p 433)

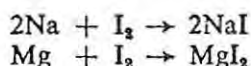
(ii) We have already cited the example from Watson (1974) of the child who defined the term atom as a 'kind of bomb'. There we were concerned with the effect of the connotation of the word 'bomb' on their understanding. It can be noted here that grave confusion could arise in the child's mind as he deals with the atom if he is picturing a bomb the whole time.

(iii) Some examples from the examination scripts of standard eight pupils are as follows:

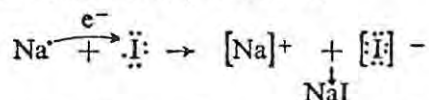
1. QUESTION: You want to investigate the reaction of iodine with a metal like magnesium in the laboratory.
 1. What measures would you take to ensure a reaction between the two substances ?
 2. Write a balanced equation for the reaction. Which substance is being reduced ? Why ?

ANSWER TO 2: The relevant section of the textbook used by the pupils who wrote the examination paper in which this question occurred is reprinted at the top of the following page:

In both reactions the metal iodides were formed according to the reactions:

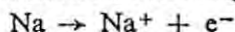


The formation of these products may be explained on the basis of our ionic bond model, as follows:



We have evidence of electron transfer and, as in the case of the reactions between metals and metal salts, we are dealing once more with reactions of the oxidation-reduction type.

Sodium donates an electron according to the half-reaction



and forms a sodium ion.

According to our definition, sodium is oxidized.

The iodine atom accepts this electron

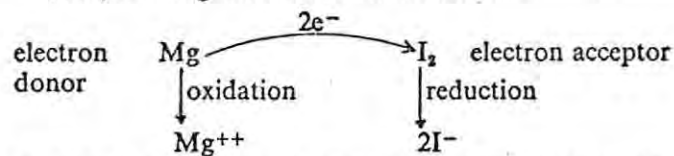


to form an iodide ion.

Iodine is thus reduced.

The substance that is reduced (iodine) is known as the oxidizing agent and the substance that is oxidized (as sodium above) is called the reducing agent.

Thus, for magnesium and iodine we have:



Magnesium is oxidized because it donates electrons. It is therefore the reducing agent.

Iodine is reduced because it accepts electrons. It is therefore the oxidizing agent.

(Brink and Jones: p 213)

The problems which arose with many of the answers was the fact that pupils tended to transfer the general meaning of 'reduced' to this context, ie the concept of diminishing, bringing to a smaller number or quantity. Thus, even where they had coped with the equation, many were confused as to whether the magnesium or the iodine had been reduced. It is contrary to one's intuition based on general vocabulary to think that reduction involves gaining; that the substance that is reduced gains electrons; that the substance that loses electrons is called a reducing agent. One answer which was typical of many was as follows:



The Mg is being reduced as it loses (sic) electrons.

The situation is aggravated by the fact that, as used here, the terms reduction and oxidation are a strange pair of converse opposites; one of them seems to suggest a connection with oxygen and the other not; furthermore, as used here, neither is defined in terms of a relationship to oxygen. When used in the context of reactions involving oxygen, they make more sense, since the reduction means the removal of oxygen and oxidation the addition of oxygen. This, however, is only one of the uses of these terms. Uvarov et al (1979) state that the term reduction is 'also used more generally to include any reaction in which an atom gains electrons'.

It might be added here that questions concerning the terms acceptor and donor as used in the textbook extract quoted above are equally likely to lead to confusion: the electron acceptor is reduced, while the electron donor is oxidised.

2. QUESTION: Describe how conduction of electricity occurs in metals.

ANSWER: Current consists of 'free' electrons which drift to positive and when a potential is placed across the conductor, the free electrons move from atom to atom. A cell provides the potential difference.

This example has been referred to twice before, once to illustrate the problems that can arise from abstract concepts and once to indicate the problems resulting from the fact that certain terms can occur in more than one set. The example is deliberately repeated here to show that the cause of problems can be manifold. Here we are concerned with the term potential, which is drawn from general vocabulary. Brink and Jones define potential difference as follows:

The Potential Difference between two points in a circuit is the energy transferred when one coulomb of charge moves from one point to the other.

(p 101)

The word 'potential' is defined as follows in its general sense by the Longmans dictionary of contemporary English (1978):

(the degree of) possibility for developing or being developed

(p 850)

The concise Oxford dictionary (1976:865) similarly suggests the word 'latent' as a synonym. Yet in the scientific context it is used to suggest something actual - it is the amount of energy transferred from one point to another. In general vocabulary one might think of a child having the potential to grow to six feet in height; if he is at present four feet, we might say that the potential difference is two feet. Once, however, he has reached six feet, we no longer talk of his 'potential' except in the past tense - he has fulfilled his potential, and the concept of a 'potential difference' is no longer relevant. In Science, however, the fact that the potential difference has been fulfilled by the transference of x coulombs of energy is the very basis for talking about the difference.

It is very probable that, in addition to the other factors involved here, the transfer of general meaning to technical meaning of the term potential could account for the fact that very few candidates were able to answer the above question.

3. QUESTION: How can the pH value of a solution be determined ?

ANSWER: By using the universal indicator.

One candidate wrote: 'Using the international indicator'. One of the meanings of the word 'universal' (done, found, etc in all parts of the world), which relates indirectly to the word 'international', had obviously interfered here in the child's mind. The confusion of universal and 'international' suggests a complete lack of understanding of the adjective as used in the compound term universal indicator, ie something which can be widely used for testing certain properties of solutions.

4. QUESTION: 1. Draw two separate graphs to show the difference in wave form of the following vibrations. Draw the graphs to cover a time interval of 1 second and label your axes.

- a) amplitude 15mm, frequency 8Hz
- b) amplitude 25mm, frequency 4Hz

2. If the vibrations above cause audible sounds, state how (a) differs from (b) when you listen to them.

This example has also been cited before for a different reason. Here it can be noted that there were some pupils who tended to see frequency as suggesting

'many times'. The reason is probably the fact that, in general vocabulary, there is an adjective 'frequent' which does refer to the concept of 'many times'; these pupils, then, could have transferred the meaning of the adjective to the term which in itself is neutral in this regard. If this is so, then one could expect similar problems to arise with other terms such as the following:

heat (adjective: hot)
energy (adjective: energetic)

(b) History

McBride (1979) comments that it is the 'ordinary common words' in History that 'often cause the most trouble'. He continues as follows:

They do this precisely because they are very common and pupils already have in their minds many associations and referents for them.

(p 20)

Edwards (1978) makes a further point in this connection:

... most of the terms in historical narrative are not esoteric but are part of 'normal educated usage'. Despite the basic problems of comprehension which some pupils may experience, they are much less likely to be taught than are similarly salient terms in other subjects. Pupils are therefore unusually dependent on the language they 'bring with them'.

(p 59)

The problem in History, then, is not merely the co-occurrence of the terms in general vocabulary, but also the fact that historical concepts on the whole are more 'common sense' in their nature than scientific ones and that the meanings of the terms are more similar to the meanings of the words in general vocabulary than is the case in Science. The result is that the teacher and the pupil are less likely to be aware that the term is a term and that it therefore needs closer examination. The familiarity of historical concepts contrasts with the foreignness of scientific concepts, which means that the problem of interference of knowledge of the terms as items of general vocabulary is more likely to arise in History than in Science. The greater frequency with which they occur in History, of course, also multiplies the chances of this type of problem occurring.

Thompson (1972) sums up the types of problems that arise very succinctly as follows:

Many ... [terms] like 'war', 'church', 'king' and 'field' occur everyday language. This can be a considerable advantage, but it can also lead to vagueness, a too limited interpretation based on a particular connotation in the child's experience, or a serious misrepresentation because meanings words had in the past may have changed significantly over time.

(pp 25-26)

Thompson mentions three problems, the first two of which are common to all disciplines which share terms with general vocabulary and the third of which is peculiar to History. Each of these will be dealt with by way of illustrations below.

(i) Vagueness: The tendency not to realise the need to 'tighten up' on the meaning of a word from general vocabulary, the need to seek a more precise and exact meaning for it, is very common in History. Two examples taken from the scripts of standard eight pupils are the terms vagrancy/vagrant and reform:

VAGRANT/VAGRANCY: One question was based on Retief's Manifesto, namely the statement of grievances published in The Graham's Town Journal by the leader of one of the Voortrekker parties in 1838. The first of the grievances read as follows:

We despair of saving the colony from those evils which threaten it by the turbulent and dishonest conduct of vagrants, who are allowed to infest the country in every part; nor do we see any prospect of peace or happiness for our children in a country thus distracted by internal commotions.

The question based on this extract was as follows:

Describe what the vagrancy problem mentioned in the Manifesto was and discuss the legislation that had created this problem.

The concise Oxford dictionary (1976) defines a 'vagrant' as follows:

The first sense refers to the way of life of the vagrant and the second to the acts which follow from this way of life. In order to understand the complaint of Retief and his men it is necessary to see both these senses as relevant. The fact that they 'infest the country in every part' is the result of their lack of fixed abode; and the 'evils' which threaten the colony are the stock thefts, etc which took place as they wandered about. One answer, which is typical, omits what is probably the more important aspect of the complaint, ie the 'evil' acts:

The vagrancy problem was a result of the legislation which announced that Hottentots would receive equality with the Whites. As a result of this the Hottentots wandered where they wanted and there was a large amount of vagrancy.

Another question asked the pupils to 'Write an explanatory sentence' on each of a set of items, 'to make the meaning clear in its historical context'. One of these was the term vagrancy. The teacher's memorandum reflected both aspects of the dictionary meaning:

Vagrancy = shifting sociological pattern observed by the Hottentots - no fixed homes + social evils which flow.

The teacher's definition here is rather questionable in terms of wording. ('shifting sociological pattern'), reflecting the point made earlier about terminological incompetence on the part of the teacher. Nevertheless, the teacher concerned was obviously looking for both aspects of the dictionary definition of the term 'vagrancy'. By contrast, a typical answer from the pupils was the following, which reflects only one component:

Vagrancy means to be without a job and without a dwelling.

REFORM: The concise Oxford dictionary gives as one of the senses of this word the following:

Make (person, institution, procedure, conduct, oneself), or (of person or body of persons) become better by removal or abandonment of imperfections, faults, or errors

(p 940)

There are two aspects of meaning involved here:

- change
- which is regarded as being an improvement, for the good

One question required pupils to write 'good paragraphs of between 10 and 15 lines in length' on a number of subjects, one of which was 'the reforms of Janssens and de Mist' - a question which has previously been referred to and the relevant textbook section of which appears in Appendix A (p A4). It is clear that a number of the candidates were obviously very vague as to what the term reform meant, with the result that they were unable to select the relevant facts to present in their answers. Others did not score very high on the marks allocated to 'insight' because they had not grasped the two aspects of the term reform. If one examines the answer produced by Candidate A, one finds that a number of changes which are not improvements are mentioned, eg the printing of more money, which led to the devaluation of the rixdollar, which was in fact the opposite of an improvement. The fact that two new districts were formed and that field-cornets were appointed are not explicitly related to the idea of improvement; the fact that the first change meant smaller districts so as 'to improve the administration' and the fact that the second was aimed at ensuring that there was someone 'to maintain order in each ward' - points specifically commented on in the textbook - are not mentioned by the candidate. Candidate B, on the other hand, indicated in his answer that he was not aware that reform involves change: many of the points he makes are simply statements of what was and not what was changed to what. In both these cases, various factors could have militated against good answers; it is reasonable to assume that one of these factors was a vague understanding of the term reform.

(ii) Inaccuracy: The fact that knowledge of the general meaning of a term can interfere with the strictly technical meaning of a term is obviously a greater problem where the term is used in a slightly different or restricted way from the way it is used in general vocabulary. The term balance of power is a case in point here. Van Rensburg et al (1976) define this term as the

international policy of preventing one state, or group of states, from becoming powerful enough to attack other states.

(p 137)

One question which involved this term was as follows:

Write a sentence on each of the following principles adopted by the leaders at the Congress of Vienna. Show that you understand

clearly the meaning of each: hereditary legitimacy;
absolutism; balance of power

One of the candidates had not fully grasped the technical use of the term, ie the fact that it refers to balance between states only and not between any groups. His answer reveals a lack of awareness of this restriction of the meaning:

It is to make sure that there is a balance of power between groups.
If one has more power, he will therefore beat the other power.

In general vocabulary, one thinks in terms of any group which might be fighting to become the most powerful. Two others used the term in a sense which is perfectly logical if taken as a mere phrase in general vocabulary:

1. This meant that there had to be a balance between freedom and authority.
2. This was one of the aims of the French Revolution. This means the abolition of privileges; the nobles having no feudal rights or privileges. Equality among all; and that applies to equal taxation. The middle class can also air their point of view.

Both of these 'common sense' uses of the phrase are not only out of line with the technical use of the term in History but are also totally contradictory to the principles adopted by the Congress of Vienna, which aimed to set the clock back, to revert to the Old Order of privilege and inequality.

In the History Questionnaire to standard eight pupils (Appendix G), pupils were asked to define the term popular as used in the phrase popular ballot. Of the 42 candidates, only 6 (14, 36%) were able to supply the correct answer (a ballot open to the general public) and 2 recorded a non-response. The most common meaning in general vocabulary was the one which was supplied by nearly all the others. The following definitions were typical:

liked by the majority of the people
well known, famous

(c) 'Presentism'

A particular problem of the general-technical overlap in History is one which arises from the nature of a subject which has a body of knowledge based on the broad concepts of time and change. Whereas in Science denotations of terms are based on synchronic classification, this is not entirely the case in History: here phenomena vary not only as regards the different referents which we find around us today, but also as regards differences between the phenomena as they were then and as they are now. The following account of the varying meanings of the term sovereignty, issued by the Rhodes University Department of History illustrates this point very well:

This may be defined as the ultimate repository of power in a defined territorial area. In theory it is absolute. In practice it is often tempered by tradition, ritual, procedures and conventional common sense.

Many Americans regard their constitution as sovereign in this sense. In Britain, the Crown-in-Parliament, is King, Lords and Commons, is regarded as the sovereign authority. In France, the theory is the post-revolutionary concept of the sovereignty of the people.

In the late 19th Century, sovereignty can usually be identified by the exercise of the functions of sovereignty - ie does a country make its own laws and impose them? Has it power and status to conclude treaties with other sovereign states?

Whether there is or ought to be sovereignty of this type is a matter of debate. In practice, in international relations in the 19th Century the above were the assumptions of sovereignty, and it was assumed that one country should not interfere with the internal policies of another state.

Defective competence can result from the fact that the child has a concept which is based either on the phenomena as they are now or as they are generally. The first of these leads to a problem which Partington (1980) calls 'presentism', which is, in effect, a kind of retrospective overgeneralisation resulting in a concept which is too restricted as regards its reference. Partington comments as follows:

There are real dangers in a 'presentism' which forces students to approach the past through the analogy of contemporary thought or institutions ... students at any given moment of time have a specific range of experiences and concepts which must shape their assumptions and expectations when they encounter new experiences, directly or of the past.

Bernbaum (1972) pinpoints the problem by indicating what ought to be realised by any student of History:

The historian and teacher ... must always remember that the word in the document is only a symbol, and may well have a different range of possible referents today. The situation and contexts in which a word is used vary and change with the times.

(pp 43-44)

The problem of 'presentism' can be illustrated by examining the responses of pupils to the following question in the History Questionnaire (Appendix G):

The following are three statements relevant to the causes of the French Revolution. Read them, and then answer the question which follows:

- A. The French Parliament was called the 'States General'. It consisted of three parts - the First, Second and Third Estate.
- B. The French Parliament had not met since 1614. Since then, the king had had absolute power.
- C. The Third Estate consisted of the ordinary citizens, professional people, vassals, workers and serfs who constituted (made up) 90 per cent of the French population.

State whether the following statement is TRUE or FALSE. Give a brief but clear reason for your answer:

In view of these facts, it is to be expected that the members of the Third Estate would resent the fact that they had been deprived of their former political right - the right to the major say in the governing of the country.

The answer which was sought here was FALSE, on the following grounds:

- 1. Although the Third Estate made up 90% of the population, they formed only one third of the States General.
- 2. Since the voting was carried out according to Estates, the Third Estate was usually outvoted by 2 to 1.
- 3. The States General had, in any case, only wielded limited power.

Of the 42 respondents, 2 did not respond at all, while of the remaining 40 only 5 provided the correct answer. The reasons given by these five varied considerably in accuracy and only one, in fact, commented that 'The Third Estate had never had the major say in the governing of the country'.

The aim of the exercise was to test the extent to which pupils interpreted the term parliament according to modern views. In order to answer the question adequately pupils needed background knowledge - but this should not have been a great problem as they had just written an examination on this work when the Questionnaire was presented to them. It was also necessary to deduce a fair amount. However, the fact that most assumed that the underlined statement was true is probably largely due to the fact that they had assumed that, because the Third Estate had participated in a parliament and formed the majority in the country, they had had the major say in the running of the country.

Presentism sometimes occurs with the use of the names of places that have changed. For example, a pupil writing of Bismarck's role in the unification of Germany referred to Prussia as Germany, though the whole point of Bismarck's efforts was that there was no Germany at that stage, there were only a number of states of which Prussia was the leading one.

The other possibility here is where terms are defined generally rather than with specific reference to the particular period. An example of this type of error, which Partington (1980) calls 'ahistoricism', is the following definition by a pupil of the term absolutism in the eighteenth century:

It means the ruler has all the power.

What is missing is the reference to a monarch, since at that stage all absolute rulers in Europe were monarchs: absolutism therefore refers to the rule by an absolute monarch. This may possibly be regarded as a mere quibble, but the definition could reflect a pupil's lack of understanding of the nature of the ruler of the eighteenth century, which in turn reflects a lack of understanding of developments in political authority in subsequent periods of history.

5.3 OVERLAP BETWEEN TECHNICAL VOCABULARIES

A further type of polysemy with which the child has to contend is that which results from the same term occurring in more than one technical vocabulary. It is unlikely in these cases that the pupil will confuse the meanings as such. Each arises in a different context and is either distinctly different or has a type of difference which is unlikely to lead to confusion despite the overlap in meaning. Nevertheless, there could be puzzlement on the part of the child involved in the various disciplines when he first meets a known term in another

discipline, and he has consciously to register the similarities and differences. There are also general adjustments in thinking that are required when using the same term in different disciplines which relate to the underlying differences between these disciplines. A failure to do so could lead to a lack of full understanding of the concepts involved or, more seriously, a lack of understanding of the general differences between the types of knowledge and methods of inquiry of the different disciplines. These potential problems can be illustrated by reference to two examples of technical overlap.

5.3.1 CHEMISTRY AND HISTORY

The term reaction occurs in both Chemistry and History. In both cases the concept involves one thing responding to another; however, each discipline uses the term in its own particular narrow sense. In Chemistry, it refers to 'the interaction between two or more substances, resulting in chemical changes' in them (Uvarov et al: 1979:928). In History, it is used in the same sense as one of its general senses, viz to refer to 'the tendency to oppose change' (Concise Oxford dictionary: 1976:928). The differences are, that in one case, the two items concerned must of necessity affect each other, whereas in History it is only a tendency involved, and that it is a unilateral affair rather than a reciprocal one. For example, if a metal reacts with an acid, both substances are affected, but if Metternich tried to stop the revolutionary ideas, this did not mean that they had any impact upon him as such.

The main problem here, however, is the difference in the underlying conception of these two terms which relates to the difference between historical and scientific thinking. In Chemistry, the reaction, given the appropriate substances and the appropriate conditions, is both predictable and analysable; it is almost inevitable as it is governed by scientific 'laws'. In History, on the other hand, unless a Marxist view is adopted, the situation is not so clear-cut; there are too many unpredictable variables involved. This is not, however, always realised by the child generally in coping with the two subjects and in particular dealing with common terms. The Schools Council History 13-16 project cites examples of schoolchildren's tendency to use scientific analogies in historical explanation, which would lead them to see someone's reaction to change or the cause of something as determined by 'fixed' laws as in Science.

In History, the child has to avoid the danger of misinterpretation which can arise from the transfer of scientific thinking to historical concepts and

historical explanation. He has to realise that predictability is more difficult: just because an individual happens to hold conservative views, or views contrary to the progressive views propounded by the regime, does not mean that he is necessarily a candidate for reactionary behaviour. Furthermore, just because X held those views in opposition to regime A does not mean that Y, who holds the same views in opposition to a similar type of regime B, will necessarily indulge in reactionary behaviour just because X did so. From the other point of view, one cannot necessarily interpret opposing actions on the part of an individual to be reactionary in motive - they could be indicative of personal ambition; machievellians may well oppose regimes whose changes they support simply for the sake of personal power.

This difference relates to two other differences between scientific and historical thinking which the child has to perceive. Firstly, whereas in Science it is possible to prove generalisations by means of experimentation, this is not so in History. Stephens (1974) comments as follows in this connection:

The interactions and relationships [in History] are not testable in the same way as physical matters are: We cannot experiment with them; we cannot replicate events, circumstances, and conditions to see if the same results will be produced.

(p 73)

Linked to this is the fact that, in scientific matters, once a reaction has been observed and verified or a substance or phenomenon has been identified, it is deliberately labelled and generally agreed upon to be the label for that concept. Anything which can subsequently be proved to be an instance of that concept will then automatically be called by that term. In History, however, ~~even~~ where the same set of actions recurs from time to time, historians may differ as to which of these they would regard as instances of a particular concept.

The first difference mentioned here takes us to the second point, which is closely related to the first. And that is the question of bias in History, a matter which, on the whole, is not relevant to scientific interpretations. The labelling of $H_2 + O = H_2O$ as a reaction is beyond question since it is based on objective criteria which can be demonstrated or can be illustrated by logic. However, the argument that 'Metternich was involved in the reaction in Europe to the ideas of the French Revolution' is not thus provable and could be based on bias. This can also be seen in the different answers which different people might give to a question such as, 'Was Piet Retief a reactionary or a man

of principle ?' Terms such as agitator, radical, moderate, leftist, rebel, liberal, conservative, etc are all subject to biased application.

The differences between the uses of terms common to different disciplines are, then, related to underlying differences between the disciplines in general. This does not mean that History is untestable, that it is based on bias. It does mean that matters are not a clear-cut and require different kinds of arguments and 'evidence'; and it means that the child has to learn to adapt to these different kinds of thinking and beware of transferring one type which is relevant to one discipline to another.

5.3.2 CHEMISTRY AND PHYSICS

An example in this connection has already been cited and can merely be repeated briefly here to illustrate the point of the need for adjustment when a term occurs in more than one discipline's terminology. In Physics, the term water is used almost in a non-technical sense to refer to, for example, a type of medium for the transmission of light and sound. In studying Physics, therefore, the child sees 'water' as a liquid which has the property of being able to transmit light and sound according to certain laws. In Chemistry, on the other hand, the term water refers to a different concept, viz a liquid compound composed of two part hydrogen and one part oxygen.

Moving from one discipline to another here should not cause problems as such but it does call upon the child to make conceptual adjustments which are demanding enough.

5.4 CONCLUSION

It has been suggested in this chapter that one of the semantic ideals of terminology is to achieve a fixed signification, both synchronically and diachronically, for each term. It has also been pointed out that in practice this is not always achieved. The resulting multiplicity of meaning causes problems for the pupils who have to work with these terms. In particular, the fact that the same word may occur in general and technical vocabulary creates problems for pupils. The fact that far more historical terms are derived from general vocabulary - as well as the fact that historical terms and concepts

are notes self-consciously established as are scientific terms and the fact that historical terms also have a diachronic dimension - means that the problem of multiplicity of meaning is far more likely to occur in History than in Science. That this is so is clear from the fact that far more examples of incompetence in this regard can be found in pupils' work in History than in Science.

CHAPTER 6ASPECTS OF THE DEVELOPMENT OF CONCEPTUAL COMPETENCE

We have been dealing so far with the characteristics of conceptual competence and the problems resulting from incompetence in this area. We turn now to the development of conceptual competence. It is not proposed to give a detailed psychological account of the whole process involved in the acquisition of conceptual competence but rather to provide a brief description of certain aspects which are relevant to the problems already mentioned and to the solutions which will be discussed in due course. Two issues in particular will be dealt with, viz the development of concepts and the development of concept-term links.

6.1 THE ACQUISITION OF CONCEPTS6.1.1 THE FORM OF CONCEPTS

An important question which has always occupied those who have explored the nature and acquisition of concepts is the question of the actual representation of the class of entities a concept refers to. The issue here is the basis on which entities in a category are regarded as 'having something in common', an issue which affects the manner in which the individual arrives at a classification of entities. There are currently two competing theories in this connection. These are as follows:

(a) Prototypes

The prototype theory instituted by Eleanor Rosch is gaining popularity as an account of the nature of concepts and the process of concept attainment. Bourne et al (1979) described this theory as follows:

Rosch's fundamental hypothesis is that categories have an internal structure - that is, categories are composed of a core meaning (prototype or best example) and a distance dimension defined by the decreasing similarity of other instances of the prototype.

In other words, what is stored in the person's mind is 'prototypes for natural categories, with instances being arranged in order of deviation from the prototype' (Cohen:1977:150). Cohen mentions, for example, that the prototype theory argues that 'The category of chair is defined, not by a set of criterial features, but by a distribution of overlapping features which are shared by most instances, and are incorporated into the prototype' (p 152). On these grounds, then, say Bourne et al (1979), Rosch argues that 'what a subject generates when he hears a category name is not a list of features shared by all members of the category, but rather a representation of the best category member' (p 208).

(b) Features

The theory of Rosch was a reaction against the feature list theory, in which 'a concept is defined in terms of some relation among a set of relevant features' (Bourne et al:1979:215). Concepts are therefore represented and processed mentally in terms of a common list of features which are critical for category membership, and concept attainment means seeking the critical list of features which distinguish one concept from another. Rosch criticises the feature list theory on the grounds that it does not allow for degree of category membership, for instances to be seen in terms of distance from the prototype. Bourne et al (1979) comment as follows on the grounds of her objection:

It may be that Rosch has taken too simplistic a view of the feature list theory of concepts. While it is true that, in many laboratory situations, critical features are perfect predictions of category membership, that is not necessarily the case nor is it strictly implied by the feature list theory.

(p 214)

These authors point out that the two theories are not necessarily contradictory. The prototype can be seen as the image which contains all or the maximal number of defining features. Their conclusion is as follows:

There is no way of knowing at the present time whether a prototype or a feature list theory will serve the science of cognitive psychology better.

(p 215)

The compromise possibility is also mentioned by Cohen, but from a different point of view: she suggests that it is possible that 'not all concepts are

represented as mental prototypes'.

Fortunately, it is not necessary to try to resolve the conflicts and the problems surrounding these two competing theories here. All that we need note is that both theories have implications for the acquisition of concepts and the teaching of concepts. The prototype theory suggests that the traditional way of teaching concepts in academic disciplines by the use of definitions (ie where it is assumed that a knowledge of the features which are regarded as being common to all instances of a concept is equivalent to an understanding of the concept) is not in keeping with either the nature or the natural means of concept attainment. On the other hand, it is a fact that a learner in an academic subject is required to have explicit, conscious knowledge, ie knowledge about a concept as well as knowledge of a concept. In daily life one does not often stop to reflect upon the difference between a dining room chair and a kitchen chair; nor does one usually have to justify to others the distinction; in dealing with school subjects, however, this is necessary. Pupils are called upon to explain why they see an instance as an instance or a non-instance and to give general descriptions of what determines the distinction between concepts. This they can do only on the basis of a conscious set of defining features - which means that the feature list theory is necessary at least at this stage.

6.1.2 EXISTING KNOWLEDGE

An important aspect of concept attainment which is increasingly being stressed today is the fact that concepts are not acquired by a process of 'accumulative fragmentation', which Watts, Gilbert and Pope (1982) define as the 'notion that knowledge is a growing collection of substantiated facts - "nuggets of knowledge"' (p 5). When a new concept is attained, it is not received as an integrated whole, but is reconstructed by the individual. This reconstruction is performed in relation to the individual's existing knowledge structure; and the concept as actually acquired is not an inviolable entity which is absorbed holus-bolus - it is reconstructed in terms of his existing knowledge structure. Each person's internal 'map' or representation of reality, his coherent 'worldview', is unique; which means that there are likely to be differences between each person's version of the 'same' concept. This view is based on the theory of the interconnectedness of the cognitive system propounded years ago by Piaget and the theory of 'personal constructs' of the psychologist, G Kelly (eg The psychology of personal constructs) whose views are enjoying considerable popularity in psychological and educational circles today.

When one speaks of the child's 'existing knowledge' here one is referring to three basic aspects: there are the concepts which form part of the same semantic field, which we have already indicated are closely inter-related; there are the concepts which belong to other semantic fields or disciplines; and there are the concepts of general knowledge. In order for a child to assimilate a new concept in a particular subject properly, he needs to relate it, firstly, to the other relevant concepts in the subject and, secondly, where appropriate, to link it up with concepts in other subjects and with concepts in general knowledge.

If one examines the writings of pupils and takes into account experimental evidence concerning pupils' acquisition of concepts one can see that this ideal of meaningful assimilation does not always occur. There are two types of defective competence which can occur here. In the first place, the child may compartmentalise knowledge - either acquire concepts in a subject without relating them to others or relate them to concepts in the discipline but not to relevant concepts in other disciplines or general knowledge. Hewson (1980) comments as follows in this connection:

Knowledge of science is then used to pass examinations, for example, but judgement on its plausibility is suspended.

(p 402)

Osborne and Gilbert (1980) give the following report on this phenomenon:

We gained the impression that 16-18-year-old physics students tended to answer the questions in terms of what they considered to be a rather strange, idealised world of physics largely unrelated to their real world and to their early intuitive understandings. In this physics world, intuition is ignored and rules are applied without qualifications being made.

(p 315)

The other possibility is that the concept may be assimilated, but assimilated incorrectly - something which can result partly from the lack of trying to link up properly in the first place. We have already cited examples of pupils who tend to link up technical concepts incorrectly with everyday concepts where the concepts are attached to lexical items common to both the discipline and general knowledge. This is not the only reason for faulty assimilation: any concept is potentially capable of faulty assimilation. The problem is

aggravated by the fact that the child is then caught in a vicious circle: when assimilating new concepts into existing, faulty, concepts, the new concepts will in turn also most likely be defective. An example in point here is the common misconception among Chemistry pupils whereby they think of temperature as being directly proportional to volume. This, in turn, leads to misunderstandings about other concepts, eg evaporation and cooling. This can be illustrated by the responses to the following question put to standard eight Science pupils in an examination:

Explain how evaporation causes cooling.

The relevant facts are as follows:

1. Temperature = average kinetic energy
2. Molecules with greater kinetic energy can break surface tension; therefore they escape first
3. Molecules with less kinetic energy are left behind
4. Therefore average kinetic energy decreases
5. Therefore temperature decreases

The following answer was typical of a number of answers (original spelling retained):

When a liquid boils the molecules move around vigourously until they break away from the serface tention and thus there is less of the liquid molecules and therefore they bump against less molecules and therefore the molecules settle down and the liquid gets cold.

In addition to the confusion regarding boiling liquids, there is the fact that the candidate has assumed that the greater the quantity of the liquid the higher the temperature.

6.1.3 STAGES OF COGNITIVE DEVELOPMENT

It is generally accepted that the ability to assimilate new concepts depends to a large extent on the child's 'stage' of development. In this connection Steele (1976) comments as follows:

In recent years much attention has been paid to the idea that children pass through various stages as their thought processes

develop. The most influential contribution in his field has been made by Piaget working in Geneva ...

(p 14)

Piaget's conclusions have been questioned and challenged on various grounds; yet his argument that the child's mind goes through recognisable stages has been generally accepted, and his actual account of these stages forms the basis of most thinking and research in the area of cognitive development. Thompson (1972) comments that 'Piaget's analysis of the child's developing capacity to learn, despite criticisms of over-rigidity, remains a basic contribution in this field' (p 12).

This is not the place to enter into details of these 'stages'. A brief summary of the periods relevant to the high school child is, however, necessary. The two stages involved here are as follows:

- (1) Middle childhood (about 8 - 11 years): This period is referred to as the period of 'concrete operations', since it is now that the child learns to perform 'operations' upon concepts, but these operations are only able to be performed in concrete situations. As Zaccaria (1978) puts it, 'Thought ... is still tied to the concrete, limited to the immediate evidence available, and it is centered on the world of sense experience' (p 324). This new ability (ie the ability to perform operations) makes it possible for him to perform two new cognitive tasks - firstly to think about things (he now internalises actions which make it possible for him 'to do in his head' what before he could only accomplish through overt actions); secondly, he can deal with relations between classes of things.
- (2) Adolescence (12 - 15 years): This period is known as the period of 'formal operations' because during this period the child moves from operations which are 'formal' in the sense that he is now able to deal not only with the reality before him but also with the world of pure possibility - the world of abstract, propositional statements, the world of 'as if'. He is now able to cope with deductive reasoning, ie to draw conclusions from pure hypotheses and not merely from observation.

The fact that children pass through various stages of cognitive development can cause problems in concept acquisition for one of two reasons: either the concepts could be above the level of thinking typical of the stage of development that a particular group of pupils generally ought to have reached by then; or, since not all children progress at the same pace, it could be that the concepts are too difficult for certain children only. Either way, there is the possibility that the demands being made on the pupils are unrealistic and conceptual incompetence is bound to occur. This point will be dealt with in greater detail in a later section.

6.2 CONCEPTS AND TERMS

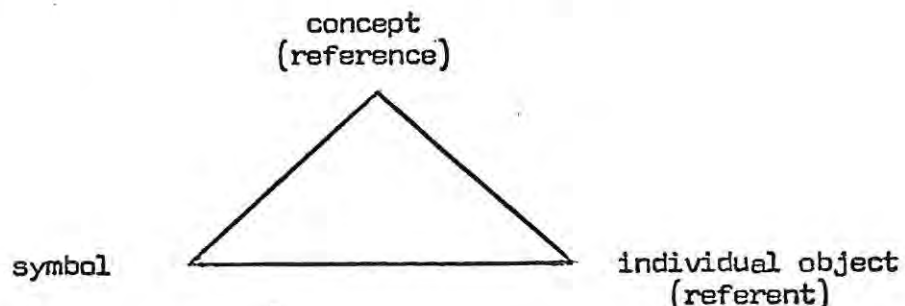
6.2.1 RELATIONS BETWEEN TERMS AND CONCEPTS

So far we have looked at conceptual competence mainly in terms of the concepts involved. However, as stated at the outset, conceptual competence involves not only knowing and understanding concepts but also knowing the appropriate labels to express concepts and to recall concepts when others use the labels. We turn now to the question of the relations between labels (terms) and concepts.

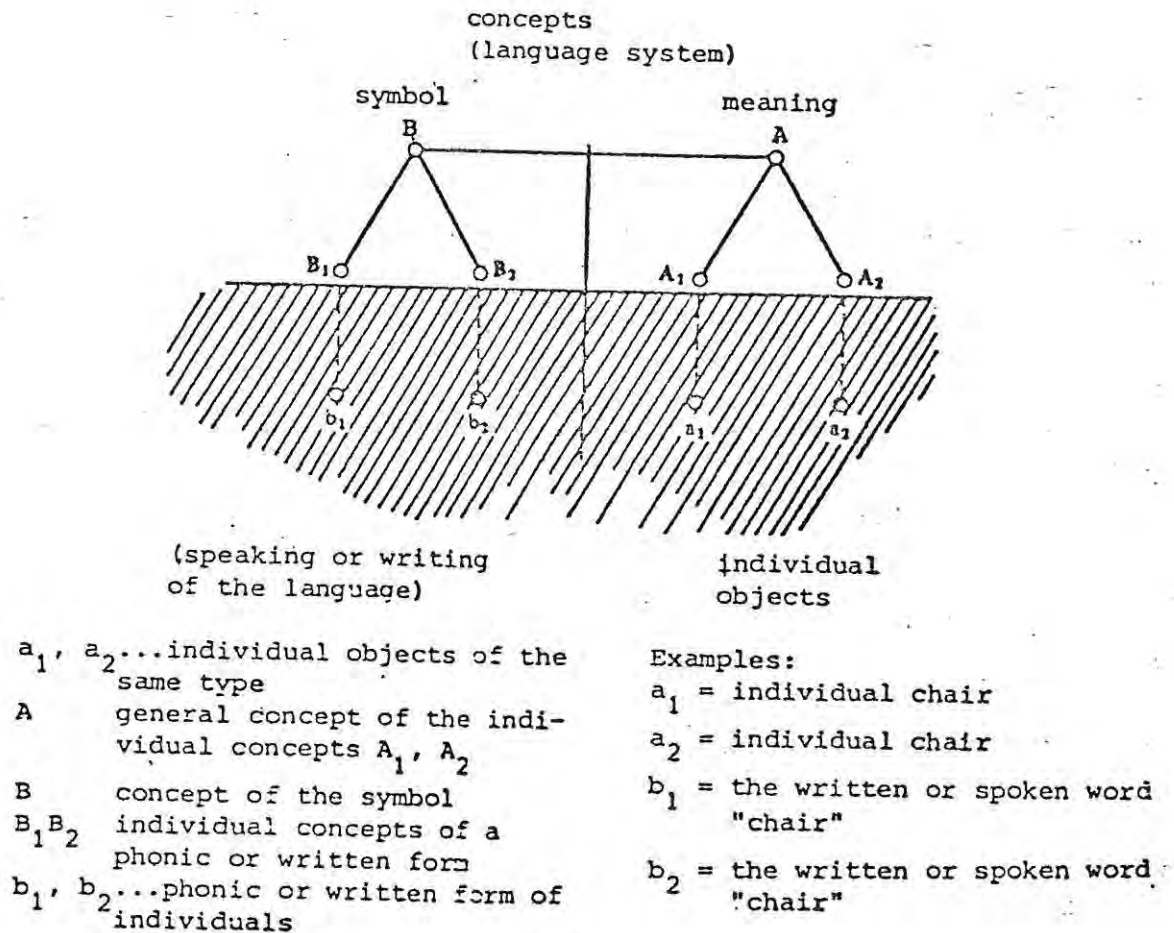
There are three aspects involved in the acquisition, use and understanding of terms as regards their meanings:

1. the 'class' or concept
2. the term itself
3. the referents in the outside world which are regarded as 'instances' of the concept

The relations between these three aspects was summed up by Ogden & Richards, Gomperz and others in the form of a triangle as follows:



Wüster (1959/60) later revised the picture on the basis of this triangle and de Saussure's theories as follows:



Felber (1979a) explains the diagram as follows:

The upper half of the schema represents the realm of concepts corresponding to the language system. The lower half of the schema depicts the perceptible reality. A number of individual representations (called "realisations") correspond to each concept.

Individual concepts (A₁, A₂) correspond to individual objects (a₁, a₂), and the individual concepts are under certain conditions summarised in a general concept (A).

Concept B, being a symbol, is permanently assigned to concept A, i.e. concept B is the general concept of the individual concepts of a phonic or written form (B₁, B₂). The symbol is objectified in

speaking or writing through the phonic or written form of individuals (b_1, b_2). Each form differs slightly from the other, for example, the written word "chair" will differ slightly from one writer to another.

The child has to learn to establish various relationships here: one of these, the relationships between the 'concept' and the 'referents' (or 'instances'), has already been discussed. Two other relationships also have to be established:

1. between term and referents
2. between class and term

The first of these, which is an indirect relationship via the concept-referents link, involves two types of relationships, one of them a standing relationship and the other a situational one. In the first place, there is the relationship between the group of referents and the term that is used to refer to these, a relationship which Lyons (1977) calls 'denotation' and which he defines as follows:

By the denotation of a lexeme ... will be meant the relationship that holds between the lexeme and the persons, places, properties, processes and activities external to the language system.

(p 207)

Secondly, there is the relationship between a particular occurrence of a term and the particular referents to which the term refers in that context, a relationship which Lyons calls 'reference'. He distinguishes between 'denotation' and 'reference' as follows:

The denotation belongs to the lexeme independently of its use on particular occasions of utterance; the reference of a referring expression will usually vary from one context to another.

(1981:57)

The child has, therefore, to learn to establish standing links between terms and referents and also to use contextual clues to establish the particular referent intended on particular occasions.

The other relationship - that which exists between class and term - is merely

a matter of labelling or 'naming': the child needs to establish a memory link between the concept and term used to express or recall that concept.

6.2.2 DEVELOPMENT OF TERM-CONCEPT LINKS

A question which arises here is: How does the child arrive at a term-concept relationship? We can probably say that there are two basic means that operate in general everyday situations. In the first place, there is what Stemmer (1979) refers to as exposure to an 'ostensive pairing situation' - ie a situation in which a person hears the utterance of a verbal expression while paying attention to a particular aspect of his environment'. He goes on to say that:

the generalisation classes that operate in ostensive learning processes are determined by certain features of the entity of or the situation that is paired with the utterance of an ostensive expression.

(p 320)

An alternative process, a non-ostensive one, is the one which Dillon (1977) calls 'decontextualisation'. He describes this process as follows:

Decontextualisation is the term Dwight Bolinger (1965) used to describe how word meanings are learned. The notion in the broadest terms is that one can get the gist of what he hears or reads even though that may include unfamiliar words. One can match up parts of meaning with individual words and arrive at a conjecture about the meaning of the unfamiliar word. The word meaning is decontextualised in that the word is assumed to carry it outside of the context of its use. One can file it away, try to use it, and revise it as further contexts may induce one to.

(p 26)

In a school situation, a third possibility enters the scene, especially with Science, viz the process of learning by means of verbal explanations of concepts - either exclusively or in addition to either of the other processes. It is, in effect, an artificial situation in that the learner is not acquiring the concepts gradually over a period of time but rather instantly and formally. Whatever the shortcomings of the use of definitions to learn concepts and terms, the fact is that the individual needs to acquire, as indicated earlier, explicit knowledge of the criterial features of a concept in many school situations, and to do this, he needs definitions. This is not to say that these terms are actually learnt this way; but the definitions do help to clarify and sharpen

knowledge and make it explicit.

Not all technical concepts, however, are acquired in this formal way. Especially in History, but also in Science, many concepts are not specially taught or defined and the child has to deduce the meaning from the context. We have already commented on some of the problems that can arise in this type of situation, especially where the term is also a word in general vocabulary. There is, furthermore, the problem of polysemy vs homonymy: when the child encounters a term used in a way which is obviously different in its context from its use in general vocabulary or another technical vocabulary, he has to decide whether to modify the meaning of the word as he knows it (or one of its meanings if he already knows more than one) or to leave it unmodified and postulate a completely new meaning.

Dillon points out that, having decontextualised a word, it is necessary to contextualise it once again. This means that the individual has to learn to use the context to decide which meaning, if there is more than one possibility, is intended in a particular situation. Leach points out that context is necessary to 'eliminate certain ambiguities or multiple meanings in the text' by providing a 'narrowing down, or probabilistic weighting, of the list of potential meanings available to the user of the language' (1974:77,79). When using the term, the individual has to bear in mind the contextual restraints on their use, ie the 'selection restrictions' involved.

6.2.3 TERM-CONCEPT INCOMPETENCE

As regards knowledge of terms and their concepts, a child's competence could either be deficient or defective. Deficiency here entails a number of possibilities:

1. The child could lack both the concept and the term attached to the concept.
2. The child could lack the term but not the concept.
3. The child could lack the concept but not the term.

In the first place, the child would not be able to use or respond to a particular term at all. This could lead to other problems; for example, trying to cope with other concepts which are inter-related. The second type of

deficiency involves being familiar with the concept but either not having encountered the term before or having forgotten it. In the third case, the child would have encountered the term but would not know the concept at all, once again either because of lack of experience or because of lack of memory.

Defective competence in this area involves a lack of clear link between concept and term. In the first place, this might involve not being able to recall the term attached to a known concept or recalling the wrong term. Dolan and Clarke (1979) comment as follows on this issue:

Vygotsky has pointed out that although many adolescents can form and use many concepts correctly, they may often have difficulty in expressing them in words.

(pp 344-5)

In the second place, he may recognise the term but may not recall the concept related to the term or may recall the wrong concept. Knowing a concept does not necessarily mean that the child will recognise the concept by the term. Barass (1978) comments as follows in this regard:

When a writer uses technical terms, he makes two assumptions, which are not always justified: that the reader is familiar with the concept, and that he recognises the concept by its technical name.

(p 62)

In either case here, the child may either draw a blank - ie he finds himself unable to identify the concept or supply a term. Or, alternatively, he may have the wrong concept attached to the term, ie he has a number of concepts and terms but he has confused the connections between them. He thus responds inappropriately in response to a term or provides the wrong term to express a concept.

It is difficult to distinguish in most cases between deficiency and defectiveness here without further investigation. For example, in the standard eight History Questionnaire (Appendix G), pupils were asked to give one word for the phrase in brackets in the following sentence:

The king was forced to (give up his throne).

Of the 28 respondents, 23 (81.1%) were able to supply the correct term abdicate.

Of the others, 3 gave a non-response, which could either mean that they did not know the term at all (ie defective competence) or could not recall it (ie deficient competence). The two who said dethrone had obviously established incorrect term-concept links.

S E C T I O N D

MORPHOLOGICAL INCOMPETENCE

CHAPTER 2MORPHOLOGICAL ASPECTS OF COMPETENCE AND INCOMPETENCE

We have, up to now, been dealing with the semantic aspect of lexical competence and the problems related to incompetence in this area. We turn now to the formal component of lexical competence, and to morphological aspects in particular. This means, too, that we turn from viewing words as a whole, ie as lexical units to be produced and understood, as lexical structures that form parts of sentences and texts, to viewing words as structures composed of one or more meaningful units or 'morphemes'.

Morphological competence, in common with all other aspects of competence, has two basic components, viz 'data' information and 'rules' information. The former consists of a host of recurring morphemes, ie morphemes which tend to occur in a number of different words. It is on these grounds that Leech (1974) suggests that 'apart from the lexicon seen as a set of lexical entries, there must also be a morpheme index, which lists morphemes together' (p 206). Morphological 'rules' are the rules which govern the combination of morphemes. Together this information is used both for productive and interpretive skills in language: the former involves using morphological knowledge to form the basic structure of words, to convert words from one part of speech to another, to inflect words for tense, number, etc; the latter involves using this knowledge to deduce meanings (including the meanings signalled by tense, number, etc) and syntactic function.

It is on these grounds, then, that Leech (1974) argues that, in order to use or understand a word or term, it is necessary for the user to arrive at a morphological specification of the word/term. In the rest of this chapter we shall be examining morphological competence in greater detail as well as certain aspects of morphological incompetence. In the next chapter, we turn to a very specialised aspect of morphological competence relevant to Chemistry, viz the naming of chemical compounds.

7.1 THE NATURE OF MORPHOLOGICAL COMPETENCE

7.1.1 MORPHOLOGICAL COMPLEXITY

Morphological competence involves being able to produce and understand lexical forms of varying complexity. Lyons (1977) points out that a word (and thus a term) can be morphologically either 'simple or complex'. Simple terms are those which are 'not further analysable into grammatically functioning parts', whereas complex terms are those that can be analysed into elements. Some examples of 'simple terms' are as follows:

acid; air; argon; atom; beaker; base; act; ally

Complex terms are in the majority, and may, in varying degrees, be considerably complicated - which potentially could lead to problems of understanding, pronunciation, spelling and mere memorising. Complex words are composed of two types of morphemes, viz 'stems' and 'affixes'. Quirk and Greenbaum (1973) define a 'stem' as 'the part of the word remaining after every affix has been removed' (p 431). Complex terms can be either mono-stemmed or poly-stemmed and can, together with their affixes, be considerably complicated in their structure. The following are some examples of the various permutations here:

absolut - ism	(stem - affix)
ab - sorb	(affix - stem)
bi - con - cave	(affix - affix - stem)
civil - is - ation	(stem - affix - affix)
de - magnet - ise	(affix - stem - affix)
re - volut - ion - ary	(affix - stem - affix - affix)

In addition to this, the child has to be able to produce and understand composite structures comprising simple and/or complex forms. These composite forms, called 'compounds', differ from complex forms in that they involve the combining of independent lexical items (what Lyons (1977) and others call 'free forms'). Compounds can vary considerably as regards degree of complexity and order of items. Some examples are as follows:

ray box	(stem + stem)
aluminium chloride	(stem + stem - affix)
carbon tetrachloride	(stem + affix - stem - affix)

evaporating dish	(affix - stem - affix - affix + stem)
national assembly	(stem - affix - affix + stem - affix)
electrical potential difference	(stem - affix - affix + stem - affix + stem - affix - affix)

7.1.2 PURPOSES OF DERIVATION

The term 'derivation' is used here to mean the combination of lexically meaningful items which cannot stand on their own ('bound' forms - roots and affixes) to form new lexical units. A distinction is thus made between 'derivation' and 'compounding'. At the same time, it must be realised that derivation affects compounds as well in that affixes can be added to compounds and in that compounds most often contain complex units which were formed by means of derivation.

An important aspect of morphological competence is to be able to use the process of derivation for various purposes. There are three such purposes involved:

(a) Forming and understanding terms

In the first place, the child has to be able to form and understand terms by combining stems and affixes. This involves the following:

(i) Using recurring morphemes to form and understand words. The fact that the same root occurs in a number of words, for example, means that the child does not necessarily have to remember whole words but can re-create them when needed and also that he can deduce meanings of words in varying degrees by means of these morphemes. This point will be elaborated on below.

(ii) Recategorising words in terms of word classes. Some words are recategorised by mere conversion which involves no morphological changes to the word, but the majority of recategorisations are achieved by means of affixation. In particular, this involves the use of suffixes: prefixes can be used as well (eg the verb-forming prefix en- as in enfranchise), but, as Quirk and Greenbaum (1973) point out, Prefixes do not generally alter the word-class of the base' (p 431). A further point here is the fact that not only do most recategorisations require affixation but also, from the opposite point of view, as Leech (1974:215)

puts it, 'Usually the morphological change is accompanied by a change of syntactic function'. An example of the process involved here is as follows:

revolution	⇒	revolutionise	(NOUN ⇒ VERB)
REVOLUTION	⇒	REVOLUTIONARY	(NOUN ⇒ ADJECTIVE)

The fact that the term revolutionary can also function as a noun (as in 'He's a revolutionary') indicates that the recategorisation can sometimes be only partial, which involves converting the word into another form which has the same syntactic function but has differing syntactic 'features'. In the above example, the noun revolutionary can be compared with its derivative noun revolution as follows in terms of feature-categorisation:

REVOLUTION	REVOLUTIONARY
+ common	+ common
+ count	+ count
- concrete	+ concrete
- living	+ living
- animate	+ animate
- human	+ human

The child has, then, to be able to derive one word-class from another or convert in terms of feature-combinations by means of affixation; he needs to be able to recognise the word-class by the typical suffixes used to form the derivation and to see the relation of that term to its other derivatives. Sets of derivatives such as ion; ionise; ionic in Chemistry and liberal; liberation; liberator; liberate in History need to be seen to be sets and need to be available as sets to the child if he is to use and understand terminology adequately.

(b) Forming lexical sets

A further function of the process of derivation is the formation of the members of lexical sets. Sometimes these are simply other words: often, however, they are derivatives of each other. This can be seen, for example, in the formation of certain terms of opposite meaning:

converge	-	diverge
conductor	-	non-conductor
alienable	-	inalienable

In each case, the child has to have at his disposal the particular prefix and the knowledge of which prefix is used with which word. Sets of incompatible terms are also formed on this basis. The following is an example of a cyclically ordered set derived in this way:

monoxide - dioxide - trioxide

(c) Making inflexional modifications

A third aspect of the process of derivation is being able to perform inflexional modifications to indicate such semantically and syntactically relevant matters as number, tense and voice. The complexities of the English tense system as well as the various rules regarding the formation of plurals especially in nouns are such that they are likely to cause problems for the child.

7.1.4 GENERAL AND TECHNICAL DERIVATION

So far we have talked of technical terms and general vocabulary items as if they were identical as regards their demands on morphological competence. There are, however, a number of differences. Bares (1972:134) comments that 'the general laws (principles) of word formation used in current and technical languages are basically much the same'; however, technical vocabulary differs from general vocabulary in the particular ways in which these principles are applied in practice. We shall see that it is actually far more true of Science than History; the latter tends very much to be based on general language practice.

There are two basic aspects of the derivation of scientific terms which distinguish the process of technical derivation from general derivation. These are summed up by Sager et al (1980) as follows:

Unlike gneral language, where the arbitrariness of the sign is accepted, special languages strive to systematise principles of

designation. General language fully exploits polysemy, metaphor, and adjectival determination when required; word creation in general language is based on the experiences of everyday life and thus represents a pre-scientific approach to knowledge. The process of scientific observation and description includes re-examination of the meanings of words. The tools for the analysis are mathematical method and logic.

The overall aim of designation in special language is to achieve transparency and consistency ...

(p 243)

The two aspects here are the degree of transparency and the degree of consistency, which are inter-related but can be separated for descriptive purposes here.

(a) Transparency

Roller (1947) points out that scientific terms aim to be 'more or less self-explanatory'. He elaborates as follows:

Many technical terms that have been coined from classical languages are somewhat self-explanatory because their component parts are words in the original language that have been selected with regard for meaningfulness.

(p 182)

The recurrence of certain roots and affixes, many of them taken from classical languages, makes it possible to remember terms and deduce meanings more easily. An example in point here is the chemical term anhydrous:

an-	=	without
-hydr-	=	water
-ous	=	adjective-forming suffix

Although History does not have a deliberately transparent terminological system, the child can learn to see the transparency of certain terms derived from foreign roots. A term such as autocratic, for example, is just as transparent as a term like anhydrous:

auto-	=	self
-crat-	=	rule
-ic	=	adjective-forming suffix

(b) Consistency

Technical vocabulary aims at greater consistency than is the case with general vocabulary. There are two aspects of this greater consistency that need to be examined here and that affect morphological competence:

(i) Linguistic patterning: Technical terminologies reveal a far greater degree of linguistic patterning in the reflecting of semantic inter-relationships by patterns of designation, than does general vocabulary. Once again, this is also much more typical of scientific terminology than of historical terminology. Formal indications of links in sense in History occur only where the terms are based on general vocabulary items which happen to be linked in their origin. The fact that democrat and autocrat both contain the root 'crat' has nothing to do with the fact that these words are used as terms of opposite sense in History. Similarly, the presence of the prefix de- as in dethrone, depose and devalue is also not the result of any decision on the part of historians.

Scientific terminology, then, is more typical of technical terminology in that it makes definite and conscious efforts to indicate inter-relationships between concepts in the nomenclature system. Patterns are created by the recurrent use of certain roots and affixes. Roller (1947) states that 'closely related concepts should have similar names' and that 'concepts not closely related should have names that differ markedly in appearance and sound'. Examples of the use of prefixes in the formation of terms that form members of incompatible sets have already been given. Another common example is the use of the root scope to indicate instruments which are used to see and the root meter to indicate instruments that are used to measure:

telescope	thermometer
spectroscope	spectrometer
oscilloscope	voltmeter
microscope	radiometer
	calorimeter
	ammeter

Beres (1972) sums up this phenomenon very neatly as follows:

Having this systemic force, the affixes assume a semantically distinct function of the common characteristic feature for the whole semantic series constituting (a) horizontal series with all members of the series having the same affix of identical meaning, (b) vertical series in which each member of the series has the same basis and a different affix, but the affixes class all members into a self-contained sub-system; and (c) antonymic series, where the antonymy of the series is expressed through the antonymy of applied affixes.

(p 138)

In the case of scientific terminology, the child has to acquire not only the particular roots and affixes but also an understanding as to how they are employed in the terminology concerned. The systematic naming of chemical compounds is a highly specialised example of this and will be dealt with in a separate chapter.

(ii) Monofunctionalism: The ideal in terminologies would be to achieve a level of monofunctionalism, ie where the affixes and roots could be used with only one meaning or function. Attempts are made to attain this ideal, but in practice it cannot happen. Beres (1972) comments that 'The polysemy of affixes is not suppressed in terminology either'. He elaborates as follows:

It cannot be entirely uprooted because this would destroy the tolerable limit of the number of morphemes used. Thus the loss of polysemy and narrowing to one specialized meaning is an ideal requirement for the use of an affix in technical style.

(p 139)

This point will be taken up below.

.....

In order to attain these two ideals of transparency and consistency, technical vocabularies make use of roots and affixes in certain ways. Firstly, where technical vocabularies make use of affixes from general vocabulary, they are used with what Beres (1972) calls 'a deeper semantic intensity'. He goes on to elaborate as follows:

Owing to their deeper intensity of meaning, the terminologically used derivative morphemes shift closer to basic morphemes; in this respect, the boundary between the basic and derivative

elements is comparatively hazy. Nevertheless, these derivative morphemes do not cease to be dependent, synsemantic elements. The semantic depth of a terminologically used derivational affix exceeds that of general word-forming affixes, such as -ed, -ic, -ive commonly denoting property. Thus the terminological affix helps to name quite new concrete concepts ...

(p 133)

In these cases, then, the child has to learn to use and understand these affixes in terms of the intrinsic characteristics of the terminology concerned. Secondly, there are the affixes which are peculiar to particular terminologies. The prefixes endo- and exo- (as in endothermic and exothermic) and the suffix -ol (as in alcohol and ethanol) in Chemistry are examples in point here. In these cases, the child has to acquire new affixes which he would otherwise not know. Thirdly, there is the fact that scientific terms tend to make greater use of foreign roots and affixes than does either the terminology of History or the words of general vocabulary. Finally, technical terminologies tend to prefer forming terms to describe concepts rather than to use syntactic structures as such. Bares (1972), for example, points out that technical languages prefer to use prefixes such as -ultra in a system of 'derivational graduation' to the comparison of adjectives. Thus in History one speaks of an ultra-liberal person rather than a 'very liberal' person. Similarly the term dioxide is used in Chemistry in preference to a phrase such as 'double oxide'.

7.1.5. THE REALITY OF MORPHOLOGICAL COMPETENCE

We have been speaking up to now of the nature of morphological competence, both of general vocabulary and technical vocabulary. We have mentioned previously that morphological competence, as in the case of other aspects of communicative competence, is composed of two main aspects, the data and the rules. The former involves the 'morpheme index' mentioned earlier, which will contain morphemes both from general vocabulary and those peculiar to particular disciplines, together with the meanings and functions of these morphemes. We need now to look a little more closely at the 'rules' of morphological competence. These can be regarded as falling into three classes. Firstly, there are the rules which govern the actual use of morphemes, which consist of rules from general language use as well as special rules pertaining to a particular technical vocabulary. These involve such issues as the use of prefixes and suffixes, the effects of assimilation on spelling (eg in + possible = impossible), etc.

Secondly, there are the rules governing the order of morphemic combinations. These can be illustrated by the derivation of the historical term enlighten-ment:

(1)	light	NOUN	(OR VERB)
(2)	light-en	NOUN	⇒ VERB
(3)	en-light-en	VERB	⇒ VERB
(4)	en-light-en-ment	VERB	⇒ NOUN

An interesting point which is illustrated here is the fact that the principle of ordering does not necessarily work from left to right. Thirdly, there are the rules governing the formation of compounds. Here there are various possibilities; in fact, compounds can be formed by joining together almost any part of speech. Some examples of the various types are as follows:

- (a) Adj + N
 universal indicator
 atomic mass
 divine right
- (b) Participle + N
 Pres Part: magnifying glass
 Past Part: landed aristocracy
- (c) N + N
 product solution
 wave pulse
 commissie treks
- (d) Verb + N
 wenkommando
 vlugkommando
- (e) Adj + Part
 short-sighted
 near-sighted

(f) N + Adj

light-sensitive

heat-resistant

(g) Adv + Adj/Part

electrically charged

optically dense

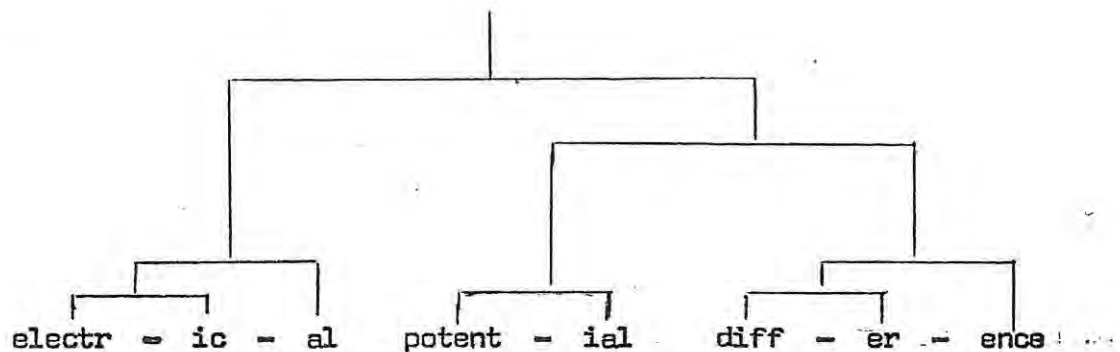
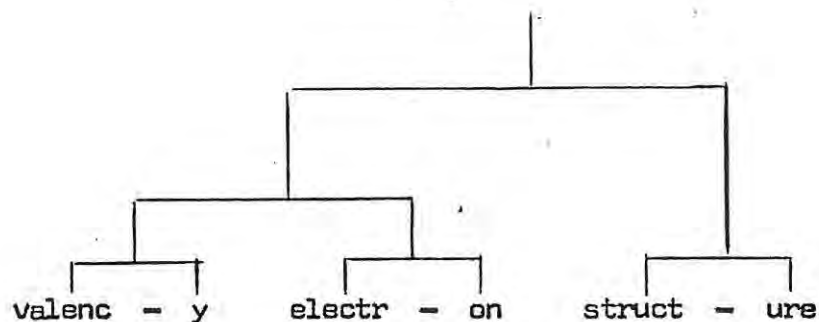
It can also happen that more than two terms can combine to form compounds. Some examples are as follows:

atomic mass number

electrical potential difference

peace-keeping force

Morpho-syntactic rules are needed here both to form appropriate derivatives and to combine these to form the compound. The following two examples illustrate two different combinations of terms in compound structures:

(1) electrical potential difference:(2) valency electron structure:

A question which arises here is : To what extent do speakers of a language actually use morphological rules ? There seems to be no doubt about the fact that sentences are constructed on the basis of syntactic rules rather than on the basis of recall of whole structures. However, when it comes to the level of the word, it is not always clear to what extent words are produced and understood as wholes and to what extent they are produced and understood in terms of rules that govern the synthesis and analysis of the word in terms of morphemes. There is no doubt that certain aspects of word structure do operate in terms of morphological rules, eg the conversion from singular to plural or from present to past tense. Certain antonymic pairs can also be assumed to be formed and interpreted according to the use of certain prefixes. However, it is not always certain that speakers use morphemes which have been 'decontextualised' in the same way that whole words have been. The polysemous nature of certain affixes, for example, makes one question the extent to which these affixes can be regarded as morphemes which speakers use to form a number of words. One such affix is the prefix re-, which occurs in 27 words in the corpus of historical and scientific terms. The concise Oxford dictionary (p 927) lists nine uses of this prefix, of which at least seven occur in our corpus:

- | | |
|-------------------------------------|-------------------|
| 1. In return, mutual (ly) | eg reaction |
| 2. Opposition | eg rebellion |
| 3. Retirement | eg refugee |
| 4. Off, away, down | eg resolution |
| 5. Frequentative or intensive force | eg reinforcements |
| 6. Once more, again, afresh | eg recognise |
| 7. Back | eg reflect |

Similarly, certain roots are polysemous in use. An example in point here is the root hydro. Flood (1960) provides the following entry for this morpheme in his dictionary of scientific word elements:

This root is found in a large number of scientific terms. In some it has its basic meaning of water. Sometimes it denotes a liquid in general. In chemical terms it often denotes the element hydrogen.

(p 81)

Two points of confusion can arise here. Firstly, when does this root denote water and when does it denote hydrogen ? In our corpus it is used more often to denote hydrogen than water. Examples of terms where it refers to hydrogen

are as follows:

hydrochloric acid	(HCl)
hydronium (ions)	(H ₃ O ⁺)
hydroxyl (ions)	(OH ⁻)
hydroxide	(OH)

In the term anhydrous, on the other hand, as has already been noted, the root denotes 'water'. The only way, however, that one can know whether the root refers to water or hydrogen is to know the formula in advance - which cancels the value of the use of the root other than to indicate that the substance concerned contains either hydrogen or water. The fact, secondly, that this root is used in a common word in general vocabulary ('hydro-electric') to denote water does not make matters easier since it could lead the child to assume that the same always applies to chemical names. Thirdly, it could be puzzling as to why this root should be used to refer to both water and oxygen. It is only if the child knows that the term hydrogen means 'water producer' (Uvarov et al:1982) that he would see the connection.

The fact that morphological information seems at times to be a dubious aid to encoding and decoding has led Dillon (1977) to question whether morphemes are acquired and used by the same process of 'decontextualisation' as whole words. He raises the query as to whether parts of words are in fact decontextualised in this way and whether a speaker can, for example, 'predict from the structure of a word its precise sense (or senses)' (p 44). He notes that, whereas 'speakers expect that the meaning of phrases and words can be made out by certain generative rules from the sense of the individual words, and they honor that assumption in their meaning', 'they do not equally assume that meanings of words can be predicted from their "parts"' (p 46). He suggests that there is a 'transparency gradient or cline' involved here - some words can be easily predicted on this basis while others can only be vaguely predicted or wrongly or not at all. Despite all this, however, Dillon concedes that 'the structure provides clues to the sense of words' (p 44). If we take into account the other uses of morphological rules which are more obviously part of morphological competence, then we must accept that an important part of technical lexical competence is the ability to cope with the morphological specification of terms.

7.2 MORPHOLOGICAL INCOMPETENCE

Dillon (1977) makes the following point about the creative use of affixes:

... It is plausible on the face of it that learners might differ in the degree to which they actually decontextualise sense for affixes, as opposed to coding the meanings of words as unsystematised wholes, and, further, that the degree to which they do this might correlate with verbal aptitude.

(p 48)

If we make this more general, we can say that pupils possess 'differential' morphological competences in much the same way that they vary as regards other aspects of competence. Incompetence can occur either in those areas of morphology which are common to both general and technical vocabulary (eg the spelling of ordinary plurals; formation of tenses, etc) or in those aspects of morphology which are peculiar to a technical vocabulary (eg the use of foreign words; the tendency to systematise designation - and the inconsistencies that occur within these systems; particular use of prefixes, etc). By the time the child reaches high school many of the basic problems of morphology have been ironed out; nevertheless, no child possesses a perfect competence in this regard more than in any other.

If we turn to examine pupils' writing with a view to investigating their morphological performances, we find that problems are often obscured, once again, by two factors in our examination system: firstly, the fact that, especially in Science, many of the questions are multiple-choice or call for diagrams and calculations, with the result that morphological problems are not always evident; secondly, the tendency to learn sections of work by rote also hides the fact that pupils who appear to be coping adequately would not do so as easily in a situation where they were called upon to write something which is not based so directly on a text.

The rest of this chapter will be dealing with some examples of morphological incompetence in the three areas mentioned earlier as the three main uses of morphological competence:

- Derivatives
- Lexical patterning
- Inflexions

Examples are taken from the examination scripts of pupils as well as two questionnaires, one to History pupils (Appendix G) and one to Science pupils (Appendix F).

7.2.1 DERIVATIVES

Marland (1977) comments as follows on this aspect of morphological incompetence:

The way a word can be changed to give the sense of a variety of uses (noun, adjective, adverbs) ... I call this the family of words. Pupils frequently know only one from each family, and are not used to recognizing, yet alone using, the rest of the family.

(p 182)

Incompetence in this area can be illustrated by reference to responses to questions in the History Questionnaire to Pupils (appendix G) as well as pupils' answers to examination questions. The relevant questions in the Questionnaire and the responses are as follows:

1. Write down, in the space provided, the correct form of the word in brackets in each of the following:
 - (a) Somerset wanted to (anglicisation) the Dutch.
 - (b) There are still many people in France with (monarchy) sympathies.
 - (c) They were fighting for a (parliament) form of government.
 - (d) He was a (tyrant) ruler.
 - (e) A new political force called (liberal) swept Europe.

The responses were as follows:

	CORRECT	INCORRECT	NO RESPONSE	TOTAL
(a)	23 (82,1%)	3 (10,7%)	2 (7,2%)	28 (100%)
(b)	0 (0,0%)	20 (71,4%)	8 (28,6%)	28 (100%)
(c)	22 (78,6%)	6 (24,1%)	0 (0,0%)	28 (100%)
(d)	16 (57,1%)	7 (25,0%)	5 (17,9%)	28 (100%)
(e)	26 (92,9%)	2 (7,1%)	0 (0,0%)	28 (100%)

2. Add a prefix to the front of the word liberal to make it mean 'extremely liberal'.

The responses were as follows:

CORRECT	INCORRECT	NO RESPONSE	TOTAL
0 (0,0%)	16 (57,1%)	12 (42,9%)	28 (100%)

3. How many

- (a) chambers in a 'unicameral' parliament ?
(b) people in a triumvirate ?

The responses were as follows:

	CORRECT	INCORRECT	NO RESPONSE	TOTAL
(a)	8 (28,6%)	13 (46,4%)	7 (25,0%)	28 (100%)
(b)	19 (67,9%)	5 (17,9%)	4 (14,2%)	28 (100%)

These figures indicate that it cannot be assumed by the teacher that pupils who know one form of a term will necessarily be able to derive the other forms in the same 'family' correctly or that they will be able to use morphological information for interpretive purposes. Pupils can be expected to display instances of morphological deficiency and defectiveness:

(a) Deficiency

The non-responses indicate a deficient competence - there are certain derivatives which pupils simply do not know or cannot form.

(b) Defectiveness

Defective competence here takes various forms.

(i) Unacceptability: In the first place, there are the cases of pupils who produce forms which are unacceptable for one reason or another. The following are the main incorrect responses in the Questionnaire to Questions 1 and 2 above

with one addition (in brackets) from an examination script:

1. (a) ANGLICISE: anglicisation (3); (anglize (1))
 (b) MONARCHIC/MONARCHICAL: monarchistic (2); monarchist (2);
 monarchial (3); monarchan (1)
 (c) PARLIAMENTARY: parliamentarian (1); parliamentary (1)
 (d) TYRANNICAL: tyrantous (1); tyrantial (2); tryanial (1);
 tyrantic (1)
 (e) LIBARALISM: liberals (1); liberation (1)
2. adliberal (2); pro-liberal (6); pre-liberal (1); re-liberal (1);
 deliberal (2); tri-liberal (1)

The incorrect responses can be divided into two groups in terms of the following scheme of 'graded acceptability' propounded by Leech (1974:211-212):

- (1) The *ACTUAL ACCEPTABILITY* of lexical entries which have attained institutional acceptance.
- (2) the *POTENTIAL ACCEPTABILITY* of any lexical entry that can be generated by a lexical rule.
- (3) the *UNACCEPTABILITY* of a lexical entry not allowed for in the lexical rules at all. For example **sheepable* (where the deverbal suffix *-able* is added onto the noun stem *sheep*) is not a possible English word at all—unless we imagine that *sheep* has been already converted into a verb.

It can probably be argued that most of the above fall (in varying degrees) into the category of 'potential acceptability'. Morphological defectiveness here, then, takes the form of either a tendency towards overgeneralised use of lexical rules or inadequate use of the rules.

Other examples of 'potential acceptability' errors in pupils' examination scripts are as follows:

- (1) Africa was of great strategical value to Britain. (STRATEGIC)
- (2) They are called alkalinity. (ALKALIS)
- (3) Use an alkaline. (ALKALI)
- (4) Use an alkalide solution. (ALKALINE)

Two examples of 'unacceptability' in this respect from pupils' scripts are as follows:

- (1) The Wales were granted land around the Bavians river. (WELSH)
- (2) The angle of refractince is 30°. (REFRACTION)

It can be noted that, both with errors which are potentially acceptable and those which are unacceptable, there are degrees of seriousness in the error. For example, the reference to a person as 'tyrantic' does not suggest any great misunderstanding of either the concept or the linguistic aspects of the term; on the other hand, to say that someone wanted to 'anglicisation' certain people or that certain substances are called 'alkalinity' (Non-count Noun) does suggest a more serious level of misunderstanding.

(ii) Confusion of forms

A further type of error arises where pupils confuse two forms which both belong to the same word class but which differ in meaning. Some examples from the Questionnaire and from pupils' scripts are as follows:

- (1) A new political force called liberals swept Europe.
(LIBERALISM)
- (2) A new political force called liberation swept Europe.
(LIBERALISM)
- (3) The incidence led to better relations between Britain and France. (INCIDENT)
- (4) C is the point of incident. (INCIDENCE)
- (5) Another cause for the annexation of Natal which cropped up was the economical situation. (ECONOMIC)
- (6) The vagrancy problem was a result of the legislature which made Hottentots equal to whites. (LEGISLATION)
- (7) The legislation that caused this was the British government.
(LEGISLATURE ?)

In some cases it can be argued that the confusion of forms indicates a lack of proper understanding of the concepts; but even where this is not the case, the use of the wrong form certainly makes a bad impression on the reader.

(iii) Misspelt Forms

Another form of incompetence here is the spelling errors that occur when pupils derive one word from another. There are two types of defective spelling involved here. Firstly, there are the misspellings that result from the actual process of derivation, eg the addition of suffixes. Some of the types of problems here can be illustrated by examples taken from the History Questionnaire, pupils' scripts and from a Spelling Test administered to 150

standard eight pupils:

1. Doubling of consonants: tyranical
2. Final consonant + suffix: goverment; magnifing
3. -our + suffix: vapourise
4. Ad hoc errors: anglisise

Secondly, there are the errors that result from the confusion of similar suffixes:

1. -ery; -ary; -ory: hereditary; parliamentary
2. -or; -er: governer; conductor; indicator
3. -ible; -able: combustable; visable; responsable;
susceptable
4. -ent; -ant; -ence; -ance: independant; emergant;
resistence

(iv) Inability to interpret

The responses to question 3 on page 142 indicate that, in addition to not being able to produce acceptable derivative forms, some pupils are also defective in their knowledge of how to interpret meanings by deducing meanings on the basis of morphological knowledge (in this case knowledge of prefixes). It must be assumed that those who gave incorrect responses to (a) or (b) (and the responses varied from 1 - 1200 for (b) and 6 to 100 for (a)) were either unable to separate (or even notice) the prefix or did not know the correct meaning of the prefix, or both.

7.2.2 LEXICAL SETS

We turn now to the errors that consist of a confusion of the derivatives that form sets, in particular those that are similar in form. We have already referred to the suggestion of Roller (1947) that terms with similar meaning should be similar in form. There are advantages to this system, but the disadvantage is that pupils sometimes confuse the forms because of the similarity of prefixes or suffixes. Some examples from pupils' scripts are as follows:

1. converging/diverging; concave/convex: We have already cited an example of a question where pupils were required to draw a ray diagram to show the object produced by a concave (diverging) lens and where many drew a diagram with a convex (converging) lens.
2. deflected/reflected: In a diagram showing the reflection of light a pupil labelled one ray the 'deflected ray' instead of the 'reflected ray'.
3. conduction/induction: In a question previously mentioned where pupils were asked to explain how electricity is conducted in metal, a number of the candidates wrote answers which included references to such concepts as magnetic fields, which clearly indicated that they had taken the question to be calling for a description of induction.
4. nucleons/neutrons: We have already cited the case where pupils confused these two terms and were therefore unable to define atomic mass and isotope.
5. Immigration/emigration: The following sentence is fairly typical in history essays: 'The immigration of the 1820 Settlers to the Cape had important results for the history of this country.'

7.2.3 INFLEXIONS

Some of the types of inflexional errors resulting from morphological incompetence are as follows:

(i) Tenses of verbs: By the time a pupil has reached standard eight, he can usually cope with most of the inflexional demands of English verbs. Where they are irregular, however, errors can occur. The following example is typical of many pupils:

A virtual image cannot be casted onto a screen.

(ii) Formation of the genitive case of nouns: One of the most frequent errors in pupils' writings is the misuse of the apostrophe in forming the genitive case of nouns. Some of the types of errors which occur are as follows:

1. Use of apostrophe to indicate plurality:

Eg The European powers wanted more colony's.

2. Omission of apostrophe:

Eg That was Hitlers greatest mistake.

3. Misplacing of apostrophe:

Eg Britains' economy was declining.

(iii) Formation of plurals: The normal spelling rules concerning -s and -es sometimes trip pupils up. The following type of error therefore occurs:

He would not listen to his allys.

Errors occur where nouns are taken from foreign languages and where the plural forms have not yet been anglicised. Some examples here are words such as heemraad (heemraden) and drostdy (drostdys) in History and focus (foci) and radius (radii) in Science.

CHAPTER 8

COPING WITH THE NAMES OF CHEMICAL COMPOUNDS

We turn now to the problems related to coping with the names of chemical compounds. This has been left for a separate chapter partly because it involves a highly specialised system of nomenclature and partly because it illustrates very well the pros and cons of a highly systematised pattern of technical designation.

8.1 METHOD OF NAMING COMPOUNDS

The naming of chemical compounds is based on a system which names the elements which have been combined to form the compound. Two methods of naming these elements are used:

1. Using the actual names of the elements.
2. Using suffixes to indicate these elements.

As regards the use of suffixes, we have already mentioned that morphemes used in a technical language tend to be used with what Bares (1972) called 'a deeper semantic intensity'. He comments as follows on this aspect of the use of suffixes in naming chemical compounds:

Thus the terminological affix helps to name quite new concrete concepts, see, eg, in chemistry, in the names of substances belonging to a given series of chemical compounds. In such a case the derivational morpheme is a relevant element of the given name and is almost equal to the basis of that word because both of them are equally semantically important for the newly coined word; for instance, silic (ium) plus -ate, alumin-(ium) plus -ide; -ium = here suffix denoting 'chemical element', -ate = here suffix denoting 'salt', -ide here = suffix denoting 'a kind of compound with metal'.

(p 133)

The underlying method involved here is what Seger et al (1980) call 'packing'. They elaborate as follows:

The system also permits the specialist to 'pack' complex

relationships into simple concepts in such a way that less specialised users can 'unpack' them according to specific rules.

This system of naming results, then, in a greater degree of transparency than one finds anywhere else in the terminologies we have been dealing with. An example can illustrate this clearly:

CALCIUM SULPHATE

1. The suffix -ate suggests that the compound is a salt, and that it is a salt containing more oxygen than a salt the name of which ends in, say, -ite.
2. The stem sulph- (together with the suffix) indicates that the salt is derived by means of a reaction with sulphuric acid.
3. The noun calcium indicates that the salt was produced by means of a reaction between the acid and the metal calcium.

The system of naming compounds also helps to indicate relationships between compounds. The names of the following salts can be used to illustrate this point:

zinc chloride
zinc sulphate
calcium chloride
calcium sulphate

Two types of horizontal relationships can be discerned here, depending on which word (the first or the second) in the name is taken as the link. Thus zinc chloride and zinc sulphate are both salts formed as a result of a reaction between an acid and zinc (or zinc compound); while calcium chloride and calcium sulphate are similarly related. From the other point of view, one can relate zinc chloride and calcium chloride, and similarly zinc sulphate and calcium sulphate - in each case, the two salts in the pair are similar despite the difference in the metal each contains in that each is formed by the reaction of the same acid. Not only do they relate to the same acid in each case; but the names they are given also indicate exactly which acid - hydrochloric or sulphuric - which once again illustrates the transparency of this system of nomenclature.

Matters are not, however, always as simple as this. In the first place, explaining the whole system is not an easy matter and is not always done at all or done very well. This is not the place to enter into a detailed evaluation of textbook descriptions of this or any other matter; however, a brief reference to the account of the system of naming chemical compounds in a popular school textbook can indicate how the linguistic problems involved (which we shall be examining shortly) can be compounded by poor presentations. This is how Pienaar and Walters (1973) describe the system:

1. Compounds having polyatomic ions: The names of these compounds are obtained by simply coupling the names of the element and the ion, e.g. Na_2SO_4 - sodium sulphate; CaCO_3 - calcium carbonate; NH_4NO_3 - ammonium nitrate.
2. Binary compounds are compounds containing only two kinds of atoms. Their names usually end in -ide, e.g. CaCl_2 - calcium chloride; Li_2O - lithium oxide; Al_2S_3 - aluminium sulphide; HBr - hydrogen bromide.

(pp 270-1)

This description is confusing in at least two respects:

- (i) Part (1) speaks of the combination of the name of an 'element' (eg calcium) with an 'ion' such as carbonate. This, however, is inaccurate in terms of their earlier comments on chemical reactions in that, in such a compound, both of these constituents are in fact ions. This is substantiated by the following statement on the same page regarding the compound calcium nitrate:

Calcium + nitrate

$$\left. \begin{array}{cc} \text{Ca} & \text{NO}_3 \\ (2) & (1)^3 \end{array} \right\} \text{The formula therefore contains 2 nitrate ions for every calcium ion: } \text{Ca}(\text{NO}_3)_2$$

What they obviously mean in part (1) of their description of the naming of compounds is: 'the coupling of the single-element ion (eg Ca) and the multi-element ion (eg CO_3)'.

Not only is their wording misleading as regards what is involved in the compound as such but it also contradicts the whole basis of compound-formation, ie 'bonding', which involves

ionic reactions and which means that a compound is not merely $X + Y$.

- (ii) The second part of their description is incomplete in that it does not indicate, other than by the use of the suffix -ide, how the names of binary compounds are derived. In fact, they are derived in the same way as are polyatomic compounds. The difference is the one already mentioned in the above re-wording of part (1) - the fact that the second ion involved is multi-elemental when the compound is polyatomic and mono-elemental when the compound is binary. The basic problem is that the authors have not in fact defined 'binary' and 'polyatomic' compounds.

Although this Thesis is concerned with the underlying linguistic problems inherent in the nature of terminology, it should be borne in mind that these are compounded by the fact that, as mentioned earlier, textbook and teacher presentations are sometimes extremely poor and confusing, thus compounding the inherent linguistic complexities.

We turn now to some linguistic problems surrounding the naming of compounds that arise from the system of naming compounds as such (ie faults in the system itself as opposed to faults in the above description of the system):

1. The method of naming polyatomic acids mentioned in the quotation above, while useful as a guide concerning the chemical names of acids, does not, however, apply to the common names of such acids, eg sulphuric acid. In order to see the patterning in the naming of compounds and to use the names as cues to meaning, it is necessary that the pupil use the more technical names of these acids, all of which begin with the name of the element common to them all, viz hydrogen. Thus sulphuric acid would be called hydrogen sulphate. These names are, however, not used very frequently in school textbooks.

2. The second part of the authors' statement above gives a useful guideline regarding the naming of binary compounds, viz the fact that the names usually end in -ide. It can be assumed, for example, that while hydrogen sulphate (H_2SO_4) is a polyatomic compound (does not end in -ide), hydrogen sulphide (H_2S) is a binary compound. However, problems can arise as a result of over-

generalisation since not all binary compounds end in -ide and some compounds ending in -ide are not binary. An example of the first is the common name for the binary acid hydrochloric acid - and, as has already been suggested, turning to its chemical name (hydrogen chloride) is not entirely satisfactory either. An example of a non-binary compound ending in -ide is the compound sodium hydroxide, the formula of which (NaOH) indicates that it contains three types of atoms, viz sodium, oxygen and hydrogen.

3. The suffix -ic is also used as a means of indicating certain aspects of the composition of chemical compounds. Flood (1960:84) writes as follows on the special meanings of this suffix in chemical nomenclature:

- (a) In the naming of acids, it denotes an acid which has a greater proportion of oxygen than another, similar acid, e.g. nitric acid HNO_3 , nitrous acid HNO_2 ; sulphuric acid H_2SO_4 , sulphurous acid H_2SO_3 .
- (b) In the naming of salts, etc., it indicates that the metal has a higher valency (joining-power) than in another, similar compound, e.g. ferric (iron) chloride FeCl_3 (in which iron has a valency of 3), ferrous chloride FeCl_2 (in which iron has a valency of 2). So also stannic oxide SnO_2 , stannous oxide SnO .

There are at least two problems that arise from this basically consistent method of naming. Firstly, the common name hydrochloric acid, although ending in -ic, contains no oxygen at all, and its corresponding -ous form, hypochlorous acid (HClO), does contain oxygen. It is only by turning to its rather dubious chemical name, hydrogen chloride, that one can tell that it contains no oxygen (-ide indicates a binary compound, here consisting of hydrogen and chlorine). With the non-binary acids (eg sulphuric acid), either the common name or the chemical name can be used to indicate relative amount of oxygen, since the chemical names use the suffixes -ate and -ite which also respectively indicate a greater or less amount of oxygen. A second problem is that the suffix -ic can also be used to form adjectives as in general vocabulary.

4. There is a very neat parallel between the names of salts and the acids which can be used to produce those salts by means of chemical reactions on metals. Firstly, since the metals replace the hydrogen of the acid, it is to be expected that the name of the resultant salt should be the name of the metal plus the other ion of the acid. Thus sodium nitrate is a salt produced by the action of the acid hydrogen nitrate on the metal sodium. However, this is only clear if the chemical name of the acid is used - the common name does not reveal that there is hydrogen to be replaced by the metal; only non-linguistic knowledge (ie the fact that all acids contain hydrogen) can be used to arrive at this conclusion. The common name, that is, is less transparent in this respect. Secondly, there is the fact that the amount of oxygen is indicated by the suffixes -ate and -ite (the former indicating more than the latter) which parallel the use of the same suffixes in the chemical names of acids. Thus we see the following pattern in action:

sodium nitrate = sodium + hydrogen nitrate
sodium nitrite = sodium + hydrogen nitrite

This in turn parallels the suffixes -ic and -ous mentioned earlier:

sodium nitrate = sodium + nitric acid
sodium nitrite = sodium + nitrous acid

Despite this neat patterning, however, the connection between the name of the acid and the amount of oxygen in the product salt is not as transparent if the chemical names are not used because of the lack of phonetic correspondence.

Here, once again, it is clear that the child needs to operate in terms of both sets of names for acids and to learn how to use which to discern the patterning of designation and therefore the concepts involved. The two textbooks analysed in this investigation, however, do not make any attempt to make this explicit and tend to use the common names most frequently and also in relation to the names of salts.

5. A further example here is the fact that the names of many metals end with the suffix -ium. Some common examples are as follows:

lithium; sodium; potassium; beryllium; magnesium; calcium;
strontium; barium; cadmium; chromium; aluminium; helium;
radium; uranium

The suffix is, therefore, a useful morphological clue as to the nature of the elements thus named.⁴ However - as ever - matters are not as simple as this. In the first place, there are metals whose names do not end in -ium. One of these, platinum, comes close to this. However, there are others which do not. Some examples are:

tin; lead; zinc; iron; mercury; manganese; copper; nickel;
bismuth; silver; antimony

This should not create great problems where the names are those of well-known metals anyway (eg tin, lead, etc). However, the lesser-known ones cannot be deduced as being the names of metals because of the lack of the -ium suffix (eg bismuth, antimony, cobalt). A second problem is that of the danger of overgeneralisation - the assumption that all names ending in this suffix are the names of metals. This is not true - the terms hydronium and oxyonium are cases in point here. The fact that there are not many of these does, however, militate against the chances of inaccurate intuitions here.

6. Finally, there is the role played by prefixes denoting number. The following examples from our corpus illustrate this use of prefixes in the naming of chemical compounds:

- 1: monoxide
- 2: dioxide; bisulphide; disulphide
- 3: trioxide
- 4: tetrachloride
- 5: pentoxide

There is no doubt that they do provide one with a considerable degree of predictability regarding the meanings of the terms to which they are attached. Even here, however, there are a few problems lurking for the child. In the first place, scientific terminology has borrowed a prefix to mean 'two' from both Latin and Greek. Hence one finds the confusion of the terms bisulphide and disulphide occurring as alternatives in the name of a compound such as carbon bi/disulphide. Furthermore, the child has to remember to speak of binary compounds (as well as of biconcave, biconvex and binoculars in Physics) along with dioxide (and other chemical terms such as divalent) in Chemistry. Confusion could also arise from the fact that the prefix di- elsewhere does not always mean 'two' (eg as in the physical term diverge, where di- comes from dis-).

In the second place, there is the fact that number prefixes are used in some cases but not in others. For example, the term copper sulphate, while indicating the presence of oxygen by the suffix -ate, does not indicate how much. This can only be deduced by reference to the formula (CuSO_4) or one's knowledge of the amount of oxygen contained in the sulphate ion. By contrast, the term carbon dioxide does indicate the amount of oxygen. Then, again, terms like magnesium oxide (MgO) and calcium oxide (CaO), each of which refers to compounds containing only one atom of oxygen do not indicate this in their names, whereas a term such as carbon monoxide (CO) does. (It should be noted, incidentally, that -oxide without a number prefix does not always refer to one atom of oxygen (as in calcium oxide) - aluminium oxide (Al_2O_3) has three.) The inconsistency of these terms can only be understood in the context of the existence of incompatible terms such as carbon monoxide and carbon dioxide - by contrast with which there is no such term as magnesium dioxide, which makes the need for the use of the prefix mono- in compounds containing magnesium and only one atom of oxygen redundant.

A similar problem arises with terms such as sodium chloride (NaCl) and carbon tetrachloride, where there is no prefix to indicate the existence of only one chlorine atom in the first. This also indicates a further problem, viz the absence of the in-between number prefixes of a series - there is no carbon dichloride or trichloride.

The final problem with number prefixes is the fact that there are sometimes alternative terms for the same compound, one of which indicates number and one of which does not. Two such examples are:

carbon (IV) sulphide - carbon bisulphide (CS_2)
 carbon (IV) chloride - carbon tetrachloride (CCl_4)

8.2 COMPETENCE AND INCOMPETENCE

Competence in this area involves, as in other cases, both data and rule information. The latter requires, in effect, a conscious awareness and knowledge of the regularities underlying the system as well as the inconsistencies. As with the study of literature (but for different reasons), it requires that the user be more aware of the medium as opposed to the message than would normally be the case.

If one examines pupils' answers to examination questions it is clear that this is one of the most pronounced areas of morphological incompetence. The poor presentations of textbooks, the complexities of the system and the many inconsistencies are probably the major factors underlying this fact. Incompetence takes the form of either defective or deficient knowledge regarding the system of nomenclature involved here. This incompetence can operate at the level ... of either data or rule information. As regards the latter, there are two main types of problems that can be expected to arise. Firstly, there is the misunderstanding or lack of understanding of chemical issues and questions resulting from an adequate knowledge of the system of designation. Secondly, there is the problem of overgeneralisation mentioned earlier. The latter problem did not reveal itself in the scrutiny of pupils' examination scripts. The reason is that there were so many errors of the first type that it would seem that pupils have very little understanding of the system involved here with the result that they do not fall into the trap of overgeneralising. However, it can be assumed that, if pupils were made more aware of this system in order to overcome the problems of the first type, problems of the second type would have to be anticipated and prevented.

In the rest of this chapter two examples of pupils' ignorance regarding the system of naming chemical compounds leading to their inability to answer certain questions will be given as illustrations of incompetence in this area. Both examples are taken from pupils' examination scripts.

QUESTION 1: You want to prepare crystals of sodium sulphate in the laboratory. Which carbonate and which acid can be used ?
Write a balanced equation for the reaction.

ANSWER: Sodium carbonate (2 marks) and Sulphuric acid (2 marks)

$$\text{Na}_2\text{CO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + \text{CO}_2 + \text{H}_2\text{O} \quad (2 \text{ marks})$$

It can be seen here that a knowledge of the system of naming chemical compounds could have earned pupils at least the first four marks and would have helped them on the way to earning the other four marks. The point is that knowledge of this system would have made it possible to deduce the names of the carbonate and the acid involved as follows:

1. sulphate in the name sodium sulphate indicates that the acid concerned must be sulphuric acid (hydrogen sulphate).
2. The carbonate must, then, be sodium carbonate.

Very few of the candidates got anywhere near the answer, indicating a lack of understanding of the system involved here. There were some answers which were completely wrong, which suggested an abysmal ignorance. In the first place, there were those answers which did not include an acid. For example:

sodium carbonate + magnesium sulphate

Secondly, there were answers which did not include a carbonate:

ammonium chloride + sulphuric acid
sodium + sulphuric acid

Thirdly, there were even answers which included neither an acid nor a carbonate:

sodium + carbon dioxide
magnesium sulphate + sodium chloride

These answers revealed an inability to read the question. There were also answers which suggested that the pupils understood the question but were unable to reason ~~their~~ way through the answer because of ignorance of the nomenclature system. Some of these had the wrong acid. The following acids were mentioned:

nitric acid
carbonic acid
hydrochloric acid
sulphurous acid

The first three indicated that the pupils had not seen that the second word in the name of the salt compound always relates to the name of the acid. They had not realised that the acids they had named would produce the following salts instead:

sodium nitrate
sodium carbonate
sodium chloride

The last mentioned acid (sulphurous acid) would produce a salt compound called sodium sulphite. The pupils who suggested this acid, therefore, did not realise the connection between -ic acids and -ate salts and between -ous acids and -ite salts.

There was also a pupil who suggested the following acid:

hydrochloric acid (hydrogen carbonate)

Not only does this reveal a confusion regarding the pairing of chemical and common names for acids (hydrogen carbonate is the chemical name for carbonic acid) but it also suggests further misunderstandings, eg the fact that hydrochloric acid (hydrogen chloride) is a binary acid and contains no oxygen - which means that this acid could not produce a salt containing oxygen (and a salt ending in -ate like sodium sulphate would be expected to contain oxygen).

QUESTION 2: What will happen to the pH of solution D when sodium hydroxide is added ? Why ?

ANSWER: The pH increases because the solution becomes more alkaline.

In addition to having to know the relation between pH level and acidity and alkalinity, the pupil also needed to know that sodium hydroxide was an alkali. There were a number of pupils who answered questions preceding the above correctly in terms of the relationship between alkalinity and pH level but who answered this question incorrectly, which meant that they did not know that sodium hydroxide was an alkali. Once again, they could have deduced this from the name. Uvarov et al (1979) define an 'alkali' as 'A soluble hydroxide of a metal'. The hydroxide section of the name should, therefore, have been their first clue; and secondly, the -ium suffix would have told them that sodium was likely to be a metal.

S E C T I O N E

SOLUTIONS TO PROBLEMS AND
PROBLEMS OF SOLUTIONS

CHAPTER 9PROBLEMS AND SOLUTIONS

We have, in Sections B and C, been dealing with some of the semantic and morphological problems resulting from, inter alia, the inherent complexities and inconsistencies of technical vocabularies. It is clear that all high school pupils, in varying degrees, reveal lexical incompetence in their performance when dealing with issues that involve the use and understanding of scientific and historical terms.

The question which now arises is: What is to be done to overcome the problems which pupils face as a result of technical lexical incompetence? In this and the remaining chapters the various types of solutions to these problems will be considered and evaluated.

9.1 THE BASIC OPTIONS

There are two basic possibilities here: either abolish the cause of the problems or help pupils to cope with the problems. These two options are summed up by Marland (1977) as follows:

The 'left-wing' approach is to solve the problems by dramatically adjusting the language requirements of each subject area
The 'right-wing' approach is to attempt to teach the pupils how to cope.

(p 76)

We can see that Marland relates the two types of solutions to different educational philosophies. The trends in educational thought in the past few decades is very succinctly summarised by Halliday (1982) as follows:

Educational theory has moved away from formalism and excessive structure It's been through a period of child-centered liberalism which often took the form which I used to call benevolent inertia: the theory that, provided the teacher puts his feet up and does nothing to stop it, learning will take place by magic of its own accord. It is now searching for a new kind of structure which will, in some way, re-instate the teacher in his or her traditional dual role as a source of authority and wisdom, but one which, this time, will be justified in terms of some prevailing theory of human learning or child development.

(p 11)

The two approaches mentioned by Marland relate to the second and third of these three movements in education. This is not the place to evaluate the respective philosophies qua philosophies; however, a brief examination of the similarities and differences between these two philosophies is necessary since no educational programme or educational solution operates in a vacuum - it is therefore necessary to take into account the ideas underlying the various proposed solutions as well as those underlying the various approaches to the teaching of English, and to establish the prevailing educational philosophy in South Africa in order to evaluate the applicability and feasibility of the various solutions.

The latter two movements in educational thought mentioned by Halliday above can be respectively labelled the 'progressive' school (what Marland called the 'left-wing' school) and the 'neo-traditional' school (Marland's 'right-wing' school). The following are the main points of similarity and difference between the two schools of thought.

9.1.1 SIMILARITIES

Halliday's comment suggests that what the original traditional approach lacked was an understanding of 'human learning and child development'. This formed the basis of the reaction of the 'progressives' to the traditional approach and is an important factor in the compromise policy of the neo-traditionalists.

Both the progressives and the neo-traditionalists, furthermore, base their arguments on the views of the cognitive psychologists. They therefore reject the old 'empty bucket' approach to learning, the approach which saw education as a matter of 'drumming facts and judgements into the pupil's head - facts and judgements which he passively records and regurgitates' and which leads to a situation where 'many pupils leave school with the naive belief that most matters have been settled once and for all, that they have been given the final solutions' (Venter:1969:8). The emphasis today is on the child's active involvement in the learning process and on the need for him to assimilate what he learns in a meaningful way into his existing knowledge structure.

9.2.2 DIFFERENCES

Each school of thought has a very different aim in education, which leads to different views regarding the curriculum - both the content and methods of the curriculum.

(a) Aims

The progressive theorists start with the child in formulating their goal of education - hence the term 'child-centred education'. The key word is 'growth', which is regarded as a descriptive, value-free term and is based on what Allen (1980) calls 'the optimistic view that development to fullness is natural - only inhibiting, restricting factors will interrupt that development' (p 23). Allen points out that the neo-traditionalists are also concerned with growth, but that they see 'growth' as a normative concept. They are concerned with 'right growth', ie growth as a teleological concept rather than an open one. They have in mind certain characteristics of adulthood that they would like the child to acquire in his growth to maturity.

(b) Curriculum content

The progressive viewpoint starts, naturally, with the child rather than with the subject-matter of the curriculum. They reject the idea of a 'body of knowledge' which must be acquired by the child. Instead, learning should centre round the child's interests and his everyday experience of life - a view which leads to the rejection of the concept of separate subjects. By contrast, the neo-traditionalists adopt a normative approach to the content of the curriculum: they maintain that there is a non-common-sense type of knowledge that the child ought to acquire and that there are different perspectives and different modes of thinking involved in the acquisition of this body of knowledge, which results in the traditional separation of the curriculum into a number of different subjects.

(c) Methods

The differences as regards methods follow from the differences in the other two areas above. The progressives place their stress on learning and tend to underplay the importance of teaching. The teacher is meant to be merely a catalyst or 'facilitator' who promotes the child's 'discovery' of knowledge.

Role play, inductive discovery methods, projects, first-hand experience are the basic methods advocated. The neo-traditionalists, by contrast, maintain that 'learning' and 'teaching' are not mutually exclusive; that there is no necessary connection between meaningful learning and a 'discovery' approach. They maintain that there are various roads to this goal - and these include both discovery and teacher-based instruction.

The educational philosophy which one adopts affects the type of answer which one gives to the problems discussed in Sections B and C of the Thesis. The progressive approach leads, in the extreme, to the adoption of Marland's first option - the view that the answer lies not in helping the child to cope with the specialised language of education but rather that the child should be allowed to adapt the language to suit himself. At a more moderate level, the progressive view offers a particular approach to the second option mentioned by Marland. In the rest of this chapter, we shall be briefly examining Marland's first alternative; the rest of the Thesis will deal with the second option.

9.2 THE SCHOOLS COUNCIL ANSWER

The programme of 'language across the curriculum' drawn up by the various authors working under the auspices of the Schools Council in Britain (eg Nancy Martin and James Britton) is a concrete embodiment of Marland's first option. Williams (1977) points out that their approach is firmly based on progressive educational views and on the related 'growth through English' movement which followed the Dartmouth Conference of 1966. It is not proposed to evaluate the whole programme here, but merely to describe its basic approach and to indicate why it would be unsuitable to our situation in South Africa.

These authors, along with others such as Barnes and Rosen, advocate, in the first place, that greater stress should be placed on pupil talk, especially talk in small groups. Where pupils use writing as a mode of expression, it should be of the type they call 'expressive' writing, which is a rather vague concept referring to a mixture of impersonal and personal, informal and formal, with the greater proportion of the mixture consisting of the personal and the informal. 'Correctness' of language, furthermore, is not regarded as particularly important.

This approach to language flows quite naturally from a view of education which rejects the idea of education as involving a body of knowledge to be acquired by the child: the type of language use advocated allows for the child to explore his thoughts, to mingle his personal feelings with information he acquires from his environment. The important corollary of this approach for this Thesis is that such an approach leads to a de-emphasis on terminology: if terms reflect technical concepts that form part of a body of specialised knowledge, then it is to be expected that the advocates of this approach would tend to ignore the child's use and understanding of terminology.

It is clear that this solution is not the whole answer to the problems which confront the pupil in the Cape Education Department high school. In a subsequent chapter, some of the merits of the above approach will be examined. At this stage it is necessary to point out why a wholesale adoption of this approach would not be suitable to our present needs. The major reasons are as follows:

1. In the first place, it is true to say that South Africa is very traditional in its educational philosophy. The system of national syllabuses and the types of examinations which our pupils have to write indicate clearly an approach to education which expects the pupils to acquire certain types of specialised knowledge.

2. Following from the first point is the fact that, in order to cope with the textbooks and the examination papers with which our pupils are confronted, they need to be able to use and understand a considerable number of technical terms. In the survey of terms of textbooks in current use on Cape Education Department schools, the following are the numbers of terms that are used in the standard eight year:

History	:	433
Physics	:	430
Chemistry	:	490

This means that any pupil in standard eight who takes both History and Physical Science has to be able to cope with a total of 1353 terms. From a purely practical point of view, then, the Schools Council approach would simply not be applicable.

3. The reason for the use of terminology on a large scale is, then, necessitated by the approach to education which emphasises school subjects as bodies of specialised knowledge. In this context, terminology is indispensable for the following reasons:

- (a) Knowing a label for a concept helps to 'fix' the concept in the child's mind - it is easier to be aware, in the first place, that a particular concept actually exists, and, secondly it is easier to recall the concept once acquired. Billings (1978) suggests that, in the early years of school, concepts are better acquired by concrete experience without the introduction of verbal labels. However, it is very likely that in the high school it is not easy for a concept to be fully understood, developed or refined until it has received a designation. The Billings view would, therefore, be opposed by many who believe that verbal labels facilitate and are often indispensable for the manipulation of concepts. This is true not only for the understanding of individual concepts but also for perceiving relations between concepts - which is, of course, often necessary for understanding individual concepts since concepts tend to be closely inter-related. Suzanne Langer (1937/67: Introduction to Symbolic Logic, Dover) points to the liberating effect of a well-formed symbolic system:

There is something uncanny about the power of a happily chosen ideographic language: for it often allows one to express relations which have no names in natural language and which have therefore never been noticed by anyone.

It can be argued that the same applies to language. The structuring role of terminology, and hence its indispensability for Physical Science and History, cannot be denied.

- (b) The fact that some terms are transparent in meaning also helps the pupils to cope better with concepts.
- (c) Terminology provides what Carter (1982:40) calls a useful 'shorthand' system for expressing technical concepts.

It can also be argued that the demand for 'correctness' (eg spelling, use of apostrophe in genitive cases, etc) which is more typical (as will be indicated in greater detail later) of our educational system serves useful purposes:

- (a) Misspellings can sometimes indicate a lack of understanding. For example, the child who writes 'highdrometer' for 'hydrometer' has not perceived the underlying conceptual connections between this word and the others such as 'hydrogen', 'anhydrous', etc. To leave him with such misspellings is to encourage misunderstanding.
- (b) To allow for idiosyncratic variations on the English spelling or punctuation system is to foster misreadings and poor communication.
- (c) The rules of spelling, grammar and punctuation are conventionally accepted in society and it has to be accepted that pupils who break these rules do so at the risk of mockery or disapproval.

It can be argued, then, that partly for the simple fact that our educational system expects pupils to cope with terms in school subjects and partly for the fact that the neo-traditional and traditional approaches to education necessitate the use of terms, the Schools Council approach is not the answer to our problems. We shall see later that certain aspects of their approach do, however, offer some useful possibilities for dealing with certain problems.

CHAPTER 10INTERVENTION TO IMPROVE LEXICAL COMPETENCE AND PERFORMANCE

We turn now to Marland's second option in our reaction to pupils' problems with terminology, viz the approach which aims to 'teach the pupils how to cope'. The question which now arises is: How exactly do we go about assisting the pupil to cope with the problems which confront him? How do we ensure that he develops an adequate lexical competence (both general and technical) to cope with the demands of his various high school subjects?

10.1 NATURE AND NURTURE

Some of the problems and inadequacies will, in time, sort themselves out, both as regards general vocabulary and as regards technical vocabulary as the child participates in language activities at home and school. By talking, writing, reading, listening, defining and arguing, the child will strengthen, clarify and correct the concepts he acquires both for words and technical terms. Adjustments will be made to what he categorises as 'instances' and 'non-instances' and concepts will become more explicit, more clearly defined, while misconceptions and inadequate or incorrect lexical relations will be ironed out. Terms will be acquired for concepts and concepts for terms, while the ability to recall the one with the other will be fortified. On the formal side, misspellings will be eliminated, new words will be derived from others, and inflexions for tense, number, etc will be acquired and corrected.

This natural growth in competence and performance is the result of increasing maturity in both linguistic and cognitive ability. On the linguistic side, there is the child's natural inclination to acquire language by means of a two-prong programme which Gleason (1965) refers to as 'copious experimentation'. From the cognitive point of view, there is a similar tendency, the tendency to want to make sense of the natural world. Hewson (1980) comments as follows:

... people strive to make sense of the natural world. They seek to find meaning in their varied experiences. They wish to differentiate the undifferentiated and incessant flow of information they receive. They look for structure in the world around them, and attempt to construct conceptions of these experiences. These conceptions, these models, these theories are attempts by individuals to provide an explanation of the meaning and purposes of their perceived world.

(p 397)

The implication of the statements by Gleason and Hewson is that the child is naturally curious and when confronted with new concepts or terms or with anomalies regarding terms or their concepts (ie terms or concepts which seem to contradict what he already knows), he tends to adapt his existing competence, either consciously or unconsciously. Continual practice in using terms and concepts also ensures that the child's competence is firmly established and that his performance will advance with his growing competence.

Both general and technical vocabularies initially grow in this way. The influence of development in general vocabulary on the development of technical vocabulary - and possibly also the reverse - is also a factor here. As the child acquires greater control of general vocabulary he deduces more and more lexical rules which are then at his disposal for helping him to cope with the ever-increasing burden of technical vocabulary.

But all this is not enough - neither at the level of general nor at the level of technical vocabulary. Even in the early years, as mentioned previously, parents and other interested adults work on the assumption that a purely spontaneous linguistic development is a limited, hit-and-miss affair. At home and school, it is therefore felt that adult intervention is essential for the child on his journey to linguistic maturity - it is felt that the child needs to be taught what he may not acquire naturally (or, at any rate, any take long to acquire on his own) and that erroneous information already acquired needs to be corrected. Language development cannot, thus, be left to osmosis; deliberate and conscious intervention is essential to ensure adequate linguistic development.

10.2 THE NATURE OF NURTURE

While there is general agreement about the need to intervene to ensure the adequate acquisition, use and understanding of both general and technical lexical items, there is not consensus about either the aspects that need special attention or about the type of intervention that is most effective. Certain of the controversies here are more relevant to the teaching of general rather than technical vocabulary. However, these issues are also indirectly relevant to the teaching of technical vocabulary for the following reasons: the child needs a sound general vocabulary in order to cope with the academic discourse in which he encounters technical terms; most of the rules and details of information concerning general vocabulary are equally relevant to the use and understanding

of technical vocabulary; and, finally, if there is to be a policy of general instruction in vocabulary across the curriculum, then what is done in the English class regarding general vocabulary is important for the procedure adopted in subject classrooms for the teaching of technical vocabulary.

There are two main issues at stake here:

- (1) The question of exposure vs instruction.
- (2) The question of the role of theoretical knowledge in a programme of instruction.

We shall be dealing with the first of these controversies in the rest of this chapter, while the second will be taken up in the remaining chapters.

The first and most fundamental issue, then, is the question of an approach based on 'exposure' as opposed to an approach based on 'instruction'. The first involves simply continuing and extending the 'natural' learning situation by providing more and more opportunities for children to use language - to speak, write, read and listen. There is no doubt that this is necessary. As regards general vocabulary development, the fact of the situation is that it is impossible for any English teacher to be able to teach every item of English vocabulary that a normal person will require to be linguistically competent; the child therefore needs to absorb new items and to modify existing items of his own accord by exposure to the language. However, the child's linguistic environment is not sufficient to ensure adequate development by means of exposure alone. As regards technical vocabulary, this is even more the case, since most of the terms will never be encountered - not in a technical sense at any rate - in normal language situations, and to expect the child to acquire these terms by leaving him at the mercy of a textbook is also expecting far too much of most children.

If the teacher does not intervene in a more direct manner, the following types of disadvantages of a pure 'exposure' approach would emerge:

1. Deficiencies in competence:

- (a) Certain items would not be encountered, since it is impossible to manipulate the materials to ensure this. As regards technical vocabulary, this is easier, since

textbooks do include most of the required terms. However, if a child did not acquire certain terms in a previous year it cannot be assumed that these will necessarily be dealt with in his current textbook. (Most textbooks cover only one year's work.)

- (b) Certain items would simply not be noticed even when they are encountered. It is a fact that children frequently read or hear new words and terms but do not necessarily absorb them.

(2) Defectiveness of competence

- (a) Even where children do absorb new words and terms, they do not always absorb all that is necessary to use and understand those words and terms properly. Nor do they necessarily absorb correct information.
- (b) Many of the models from which they obtain information in this way are themselves defective. If children talk to each other, they may receive incorrect information either consciously or unconsciously because they assume that their peers are accurate in their use. Textbooks have also been known to be inaccurate as regards the use and explanation of terms.
- (c) Not all children will notice where they are defective - in fact, none will notice always where this is so. The result is that they will not always feel the need to modify existing information when they encounter contrary information.
- (d) Not all children are sufficiently motivated to change even when they do perceive discrepancies between their own knowledge and that which they experience around them.
- (e) Left to themselves, then, children often merely reinforce their defectiveness of competence.

This can be illustrated in a number of ways. At the simple level of spelling - one of the skills most often left to be acquired through mere exposure - there is evidence to suggest that spelling is not always acquired naturally, at least, not by most children. Since the publication in 1897 of an article entitled 'The futility of the spelling grind' by Rice, a great deal of experimentation has taken place, some of which has concluded that spelling is 'caught' and some that it needs to be 'taught'. Nisbet (1939) estimated that every child 'picks up' the spelling of only one new word in every 25 he needs. Peters (1967) observes that 'there are many well-read and literary people who cannot spell' (p 11) and argues, furthermore, that 'ability in spelling cannot be acquired just by writing - as well we know from the creative writing of young children' (p 49). Peters therefore comes to the conclusion that, while spelling might be 'caught' by a small minority of children who possess certain highly developed skills and are strongly motivated, this is not the case with the majority of children. On these grounds, then, The Bullock Report (1975) stated that the compilers of the Report did not accept 'that all children will acquire spelling ability as an automatic and natural outcome of a healthy environment. Certainly every child will have an excellent foundation if he is interested in language and curious about its working, but he needs more than just the right climate' (p 183).

Another aspect of the 'formal' side of words and terms which is not always acquired automatically is the derivation of one from another. We have already cited cases such as the inability of some children to derive the verb anglicise from the noun anglicisation by means of 'back-formation' or the adjective alkaline from the noun alkali by means of the addition of an adjective-forming suffix. Errors in the use of the apostrophe to form the possessive case, errors of tense and number - the examples are too numerous to leave any doubt that it cannot always be assumed that these aspects will be 'caught'.

On the semantic side, we have seen the misconceptions that arise from the 'osmosis' acquisition of technical meanings from general meanings where technical terms are derived from general vocabulary and where teachers have taken it for granted that children will acquire these without much comment. Lexical relations are not always clearly understood, largely because teachers have not made links explicit but have dealt with terms in isolation or have dealt with the links implicitly. It also happens, as we have seen, that wrong labels become attached to concepts and children are sometimes unable to recall concepts when confronted with labels.

CHAPTER 11

WHOSE RESPONSIBILITY ?

Before moving on to examine what a programme of intervention would involve, a further question needs to be broached, viz the question as to who is meant to effect the improvements in the pupils' lexical competence. The two groups of teachers involved in the school programme who could be considered are the English teachers on the one hand and the subject teachers on the other.

11.1 THE BARGAIN

It is clear that the whole matter cannot be left to the English teachers alone. In the first place, English teachers are not necessarily trained in other subject subjects, especially Science subjects. 'Few teachers,' says Stevens (1973), 'have a scientific training' (p 229). We are faced very clearly with C P Snow's 'two cultures'. It cannot be assumed either that every English teacher is necessarily trained in any - and certainly not all - of the humanities. In the second place, it has to be accepted that English teachers cannot merely be servants of other departments - they have other aims, objects and curriculum content which need to be taken into account.

It is also clear, on the other hand, that the matter cannot merely be left to the subject teachers either. In the first place, they have no training or even interest in language - the 'two cultures' syndrome has ensured that they are very unlikely to have this. Secondly, they are primarily interested in their subjects and have very full syllabuses which would prevent them from providing the language background and skills required for their subjects on their own.

Not does it seem desirable merely to leave the matter to each set of teachers to do as they wish. This would mean lack of co-ordination, which would lead to overlapping, gaps and contradictions between the English Department on the one hand and the subject departments on the other, as well as between subject departments.

The obvious answer seems to be a collaboration between the English Department on the one hand and the other departments on the other, as well as between the

other departments. The slogan 'language across the curriculum' needs practical realisation in the form of what Marland (1977) calls a 'whole-school policy'. He comments as follows:

If the strength of the comprehensive school is variety, the challenge is to avoid fragmentation, retain that variety and achieve coherence. Coherence in a school does not necessarily mean integrated areas; it certainly does not mean that every, or even some, parts of the whole should be moulded to feel the same, so that Housecraft, Social Studies, and English are interchangeable. It means that, whilst each aspect of work in the comprehensive school should be encouraged to be different, to retain its special contribution, there should be properly worked out agreements amongst staff on a number of 'whole school policies'.

(p 9)

One such whole-school policy would, then, be a language policy for the school. Marland suggests that this can be organised on the basis of a 'bargain' between the English Department and the other departments based on the fact that 'difficulties with language hamper understanding and growth in most areas of learning, and, conversely, those areas of learning could provide real contexts for language growth' (p 3). Marland therefore concludes as follows:

The aim of a 'language across the curriculum' policy is simply to face that basic educational problem by endeavouring to create a 'virtuous circle': if a school devotes thought and time to assisting language development, learning in all areas will be helped; if attention is given to language in content and skill subjects, language development will be assisted powerfully by the context and purpose of those subjects.

(p 3)

Marland also makes the point that any 'whole-school policy' can be implemented either on a 'disseminated' or 'specialised' basis. The first approach is based on the argument that it is necessary to avoid artificial isolation, and the second that it is necessary to avoid the matter being mishandled by unqualified people or being neglected. Marland points out that there are pros and cons of both, and concludes that 'A whole-school language policy is likely to demand both approaches' (p 10). This would mean, generally, that English teachers would be responsible for teaching basic language theory as well as certain specific details of language usage, while subject teachers would build on and apply this knowledge as well as amplify and modify according to the particular demands of their subjects. The awareness and understanding of polysemy, for

example, would need to be inculcated by the English teacher, but this could be used by the subject teacher to help his pupils to anticipate and overcome problems with certain terms.

All this means that the school will have to organise the co-ordinated system whereby language teachers would have some insight into the language demands of other subjects and whereby teachers in other departments would agree to adopt a language policy within their departments and would be aware of what the pupil was being taught in the English class regarding the use and understanding of language.

This concept of 'language across the curriculum' has been bandied about for a long time now. As early as 1918, the Report on Natural Science Education in England commented as follows:

The Science master cannot be allowed to repudiate responsibility for the English in which the work of his class is written.

(Quoted in Newberry:1958:201)

The 1921 Report of English in England pointed towards the same idea, and in the same year George Sampson coined his now famous dictum: 'Every teacher is a teacher of English'. A discussion document entitled 'A language policy across the curriculum' was published in Britain in 1969 following upon a series of conferences organised by the London Association for the Teaching of English. The Writing across the curriculum project conducted for the Schools Council at the University of London Institute for Education subsequently published numerous documents on this topic. Following on all this, The Bullock Report made the following much-quoted statement:

To bring about this understanding every secondary school should develop a policy for language across the curriculum. The responsibility for this policy should be embodied in the organisational structure of the school.

(p 529)

Despite this recommendation and the many recommendations issued subsequently on the strength of The Bullock Report, very little has in fact been done to implement such a policy in schools. The scattered projects in British schools have not been echoed in this country. In the rest of this chapter we turn to the reality of the situation in Cape schools, looking first at the question of

such a policy from the point of view of subject teachers and then from the point of view of English teachers.

11.2 SUBJECT TEACHERS

The fact that the concept of language across the curriculum has not really taken root amongst Cape Science and History teachers can be gleaned from some of the comments made by teachers in the two Questionnaires sent to them. There are the occasional hints of teachers' feeling the need for some such policy. The following two comments from Science teachers indicate this clearly:

- Language usage seems to deteriorate amongst pupils. A firm stand in all subjects can only help to convey the message of a proper expression in English.
- Physical and General Science must not be seen as completely separated from other subjects, including languages, and therefore I feel that it is important that the pupils realise that 'correct English' must be used in this subject as it should be in others such as history, geography, literature, etc.

These, however, were only tentative and were very much the exception. If one analyses the responses of teachers to the passages in the Questionnaire in which they were called upon to correct anything which, from a linguistic point of view, they would normally correct in the course of marking a child's piece of work, one finds that the following points emerge: Firstly, it is clear that the responses of individual teachers most often show no pattern; a teacher will object to an error in one place but ignore it in others. This lack of consistency suggests that very few Science and History teachers have devised a language policy for themselves. Secondly, even where these teachers have adopted some sort of policy, there were only a very few indications that these individual approaches formed part of a departmental policy: the responses to the passages varied considerably amongst teachers in the same subject department and, with a few exceptions, comments indicated clearly that they were personal views and not those of a department.

Where hints are given of the need for a language policy in a department, there are limitations regarding the teachers' concept of such a policy. In the first place, it is usually seen merely as a question as to whether marks should be deducted for spelling and grammatical errors in examinations. The following comment from a science teacher is typical here:

Policy we take is - spelling OK as long as word recognisable;
grammar: accept most things as long as meaning not changed.

The deeper questions of language as a means of conceptualisation, the complexities of terminological systems and the problems arising from these, are not included in such a policy. In the second place, the policy is not seen as one based on Marland's idea of a 'bargain': subject teachers tend to view such a policy as one in which the English Department is expected to serve the needs of other departments. There were three comments from History teachers which suggested that subject teachers should also play their part. Their comments were as follows:

- To a certain extent it is our fault (poor English). Some of us have let the standard drop. If a child knows he/she will get the same mark for spelling 'Napoleon' or 'Nipoleon' then he/she might not be bothered to learn the correct spelling. 'What does it matter- it's not English?' might be the attitude. We have to show them that it DOES matter.
- I teach my pupils - right up to and including standard 10 - to write a sentence, sequence of tenses, there/their etc.
- The History teacher should also teach the following aspects of language (teaching ACROSS THE CURRICULUM):
 1. Paragraphing
 2. Summary
 3. Writing interesting sentences (eg loose, periodic)
 4. Essay writing

Too often this is left to the English teacher who has to take the blame for all ills.

The fact that these comments came from History - not Science teachers - is possibly due to the fact that many teachers of History are also teachers of English. These comments, however, were the exception. The following, the first from a History teacher and the second from a Science teacher, seem to be more typical of the prevailing attitude:

- History essays should be marked by the English teacher as a kind of cross-curriculum exercise.
- Perhaps English teachers should receive lists of scientific words that pupils have difficulty spelling and interpreting so that science teachers can have more time for teaching science apart from language.

This view is further borne out by the number of comments which suggested that

the current approach to teaching of English which stresses 'creativity' is undermining the success of pupils in Science and History. The following two comments, one from a Science teacher and one from a History teacher, are relevant here:

- English teachers encourage 'free expression'. Pupils try to use this when answering science questions!
- Because of the modern emphasis on 'creative English', children lack the tools of language (grammar, spelling, vocabulary). They are, therefore, less able to communicate what they know.

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There are a number of reasons for the fact that Science and History teachers do not generally see it as their task to assist in developing pupils' language ability, that they feel that they can teach their subjects 'apart from language'. One of these is the practical question of time: Syllabuses, as we have already suggested, tend to be very demanding in terms of sheer quantity of work to be covered. There is, however, a further reason which causes subject teachers to display little interest in introducing language policies across the curriculum and which would limit their ability to implement such a policy even if they were interested, and that is their lack of training in language. In section 11.3 we shall be commenting on the lack of school language background of English teachers. At this stage we can merely state that the same obviously applies to subject teachers. To this must be added the fact that these teachers have had no post-matric training in language either. The Bullock Report made the following recommendation in this connection:

A substantial course on language in education (including reading) should be part of every primary and secondary school teacher's training, whatever the teacher's subject or the ages of the children he or she will be teaching.

(p 515)

Carter (1982) points out that, since the beginning of the 1970's, there have been language-in-education programmes in many British colleges of education. He criticises them for being too limited; however, at least there have been such courses available. No real move in this direction has been made in this country. The recommendation of The Bullock Report needs to be implemented as soon as possible, while in-service courses should be introduced in the meantime

to make up for the backlog.

If these measures were introduced, a number of benefits would arise. Firstly, teachers might be able to improve their own presentation and examining techniques, as well as possibly having an impact on the quality of textbook presentations. This would mean that, rather than merely expecting pupils to cope with inadequate texts and teachers, many problems related to terminology could be removed to begin with. In the second place, teachers would be better prepared to assist their pupils in coping with the problems posed both by the inherent complexities of terminologies as well as by inadequate textbook presentations. In general, an understanding of the deeper issues involved in language competence referred to earlier could lead subject teachers to realise that the idea of teaching their subjects 'apart from language' is, in fact, nonsense, since any subject is language dependent.

11.3 ENGLISH TEACHERS

If there is no real move on the part of subject teachers to take cognisance of language problems faced by pupils in their subjects or to seek collaboration with the English Department on these problems, it is just as true to say that little interest has been shown amongst English teachers for the idea of a language policy in schools. English teachers regularly complain about the fact that pupils tend to feel that correct language use is not important when dealing with other subjects and that subject teachers seem to agree with this attitude. Beyond that, there is no awareness of the deeper language issues involved and no move towards setting up whole-school language policies.

There are various reasons for this state of affairs. One of the major obstacles is the lack of time in view of the ever-growing syllabuses and the excessive marking demands. The Bullock Report quite accurately describes English teachers as 'hard-pressed'. The subject 'English', like love, is a 'many-splendoured thing', which means that the English teachers are being called upon to do justice to a number of equally demanding components. It would be necessary for a school to consider bringing in outside assistance or to release one English teacher in order to devise a language-across-the-curriculum programme for a school.

Beyond this practical problem, there are at least two other stumbling blocks here, viz the English syllabuses and the training of teachers of English. We

shall examine each of these in turn.

11.3.1 English syllabuses

Syllabuses are not drafted and implemented in a vacuum. Any syllabus must be seen in the light of the educational theories current at the time of its compilation, since these influence the content of the syllabus and the proposals for its implementation. We have already commented on prevailing educational theories. Here we shall look at the three English syllabuses in the Cape in the past two decades to see how emphases have changed, how these affect English language programmes in schools, and the implications of all this for a possible language-across-the-curriculum programme for schools.

Dixon (1967/9), in his influential book Growth through English, mentions three aims for the teaching of English: firstly, the imparting of knowledge (handing down our cultural heritage); secondly, the developing of skills (in order to be able to communicate effectively); thirdly, the fostering of personal growth (the development of the child as an intellectual, social and emotional being). These different aims relate to different theories of education and can be seen as underlying the following three syllabuses in the Cape:

- a) 1963/67
- b) 1973
- c) 1983 (currently in draft form; due for implementation in 1985)

The preamble to the first of these syllabuses reads as follows:

The importance to the pupil of sound instruction in the mother tongue cannot be over-estimated. His mother-tongue is his main means of communication with his fellow-man, and without it community life and civilisation (sic) would be impossible. It is the key to literature, the treasure-house of wisdom, beauty and humour accumulated (sic) through the centuries by his race. It is the instrument by which men must carry on the activities of a democratic people, which demand intelligent participation in the social, the economic and every other sphere of public life. Full participation is possible only to such as develop the capacity to speak, read and write with understanding and fluency.

Thus, for the fundamental purposes of civilised living, literary understanding and the democratic way of life, effective use of the mother-tongue is a vital necessity. It should be the central purpose of the language teacher's life to equip his pupils, as fully as he

may, in the use of their own language. Indeed, the language of all teachers should be beyond reproach and correct expression should be required of pupils at all times.

The emphasis here is clearly on the first two aims mentioned by Dixon - the imparting of cultural knowledge and the development of linguistic skills - and is based on traditional educational thought. This can be contrasted with the 'General Aim' of the 1973 syllabus:

The general aim is to promote the pupil's intellectual, emotional and social development.

This can be regarded as the end product of education as a whole, almost all subjects in the curriculum being directed towards it; it should be emphasised, however, that the relationship between a child's linguistic skill and his personal development is a unique one. It must, therefore, be recognised that the teacher of English is merely contributing to a process that begins in infancy and continues throughout life.

The emphasis in all aspects of the syllabus is on the child's experience, his personal development, as the starting point and the goal of the subject - clearly the third aim mentioned by Dixon - and clearly based on the progressive education educational philosophy, which so influenced English teachers in the early 1970's while not having much impact on the rest of the curriculum.

These two different sets of aims lead to very different views as regards the content and approach of the language aspects of the syllabus. The earlier syllabus was based on two assumptions - firstly, that it was important to develop language skills; and secondly, that explicit knowledge would assist the pupil in this process. The later syllabus, on the other hand, plays down the first assumption and rejects the second. The result is that one finds a fairly detailed, even if simplistic, language section in the 1963/9 syllabus, consisting of comprehension, precis and formal grammar. The formal grammar section is as follows:

1. Structure:

- (a) The grammatical functions in their contexts of words, phrases and clauses. The study under this heading includes synthesis and the formal analysis of sentences into clauses.
- (b) Punctuation.
- (c) Tenses.
- (d) Subjunctive Mood.

2. Word Study

- (a) Parts of speech.
- (b) Prefixes, suffixes.
- (c) Vocabulary.

3. Usage

The following is a summary of the language items listed in the 1973 syllabus:

- 1. Punctuation
- 2. Spelling
- 3. The basic parts of speech
- 4. Sentence and paragraph construction
- 5. Vocabulary
- 6. Idiomatic expression and figurative language
- 7. Tense, sequence of tenses, concord
- 8. Acceptable English usage
- 9. Subjective and objective language

Three points of difference should be noted here. Firstly, the later syllabus does not mention 'word study' as such; thus the analysis of the word in terms of roots and affixes is not required of each pupil. This is obviously relevant to the question of English language studies designed to help pupils to cope with problems in terminology. The result has been that in the past decade the old idea of calling upon pupils to learn lists of prefixes and suffixes, to examine common roots, etc has ceased to be practised in schools. Secondly, there is the fact that the 1973 syllabus does not have a section specifically labelled 'language study'. In the Junior Secondary Syllabus there is a small sub-heading under 'written English' which reads as follows: 'Note: language Study'. In the Senior Secondary Syllabus, however, language study is simply mentioned in passing as a tail-end to the syllabus under the heading 'General Notes'.

Thirdly, while the details of the later syllabus are not so different from the earlier one, the emphasis on these details is played down by the injunction in the 1973 syllabus that these items are to be taught only 'in action' - by ad hoc discussion in the context of the pupil's own writing and appreciation of literature. For example, the Senior Syllabus states that pupils 'must be acquainted with the commoner forms of grammatical terminology (i.e. parts of speech), insofar as they are relevant to the discussion of their work. These must be treated in context and not as isolated exercises ...' The basic view suggested in the 1973 syllabus is that, in order to counteract the previous

fragmentary and isolated approach to the teaching of formal grammar, it is advocated that all grammar teaching must be done incidentally rather than in specific grammar lessons. It can be noted in passing here that this approach cannot possibly work in practice. The child will never really understand the terms and concepts if they are taught ad hoc on different occasions; since the terms are inter-related, unless there are definite grammar lessons in which these are first taught with illustrations, and then applied to the child's own writing and reading, he will not know what they really mean and therefore cannot possibly use them - one of the requirements for transfer mentioned earlier was the intelligibility of the knowledge.

The layout and tone of the 1973 syllabus, therefore, tends to discourage the teaching of explicit knowledge about language in general and the lexicon in particular. This has been further discouraged by examination stipulations and trends since the implementation of the new syllabus. The earlier Cape Senior Language papers usually contained a question on parts of speech, analysis, synthesis, vocabulary, word structure, etc. In the papers since 1976 'language' aspects have been practically ignored, except for a few questions on punctuation and vocabulary. The statement in the Senior Syllabus that '... (parsing, formal analysis, and synthesis required knowledge of specifically named clauses, will not be examined)' tended to produce examination papers in which no questions requiring any explicit knowledge of any aspects of language were set. This statement, together with the layout and tone of the syllabus, was taken as an indication that knowledge about language was not important and that testing of such knowledge was outlawed from the external examination. The result has been, naturally, that these aspects of the syllabus as well as the aspects omitted from the earlier syllabus (eg word study), have been neglected in schools. That this is so can be seen from the woeful ignorance which was revealed by candidates in the 1980 Senior Certificate Paper, which for the first time since 1975, introduced questions requiring this kind of knowledge. The Examiner's Report published in the Education Gazette of April 1981 contained the following comments in this connection:

It was particularly pleasing to note that a considerable number of the candidates had not adopted the fatalistic approach of so many pupils and teachers that 'you can't learn for this paper'. They had obviously been well prepared as regards the basics of the English Language and produced papers that were a delight to mark. Unfortunately, however, these candidates were in the minority. What was most distressing was the large number of obviously intelligent candidates who had practically no knowledge of certain aspects of the syllabus. It is necessary to reiterate the concern expressed

in the past two Examiner's Reports about the fact that too little time is being spent on language work in schools.

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The general impression gained this year by the Examiner and Sub-examiners was that many of the candidates had been taught very little - if any - grammar. There were candidates who could not even begin to answer some of the questions requiring a knowledge of the basics in grammar. Others made such statements as : 'The sentence is in the possessive (sic) tense.'

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The following points should be noted in particular:

1. According to the syllabus, candidates are required to have a knowledge of the basic parts of speech and their functions. Many candidates showed no understanding, however, of even common terms such as noun or verb. Statements such as '"the" is a common noun' were not uncommon. . . .
2. Features of certain parts of speech (eg case and tense, the latter of which is listed separately in the syllabus as an item to be taught and examined) should be taught. It was clear that many candidates could not cope with the questions on 'concord' because they knew nothing at all about grammatical 'agreement', 'number' or even the term 'subject'. A number of candidates obviously thought that 'thinks' was plural - possibly because it ends in s.

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4. The question on the use of the apostrophe, one of the most common punctuation marks, was very badly answered on the whole. It became clear as a centre was marked whether the candidates had been drilled in the basic rules concerning the apostrophe or not. It was obvious that many did not even know what an apostrophe was - they merrily corrected errors concerning the use of the comma.

The re-introduction of questions requiring formal knowledge (syntactic and lexical) was based on a re-interpretation of those sections of the syllabus which seem to outlaw the examining of formal grammar. Schools had been warned in 1979 that a change was on its way in terms of the new interpretation of the syllabus which was again summed up in the Education Gazette of April 1982 as follows:

It is possible that there are still teachers who have been misled by a statement in the syllabus which certainly seems to outlaw the examining of formal grammatical knowledge:

... (parsing, formal analysis, and synthesis requiring a knowledge of specifically named clauses, will not be examined);

The officially accepted interpretation of this ambiguous statement is that questions which require merely a mechanical knowledge of the structure of the language will not be set; but questions which require an application of these terms and rules to language in action may be set. It is hoped that this ambiguity will be cleared up in the new syllabuses. In the meantime, teachers are urged to take note of the above interpretation of the current syllabus.

The result of this return to the examining of the more formal aspects of the syllabus has been a corresponding return to the teaching of these aspects. The Examiner commented as follows in the same Gazette:

It is pleasing to note a considerable improvement in certain areas of the syllabus this year - it was clear, for example, that the more 'formal' aspects of the Syllabus received more attention.

The situation has not, however, yet reached a satisfactory state. The Examiner commented as follows in this connection:

Although there was definitely an improvement in this area this year, there was still a large number of candidates who were clueless as regards the rules of language and basic terminology. ...

In order for matters to improve any further, it will be necessary for changes to be made to the syllabus. The new syllabuses are, in fact, being devised at present and are in final draft form. Certain advancements in the 1973 syllabus can be noted. Firstly, the new syllabus, which seems to be based on the neo-traditional approach to education referred to earlier, combines the basic aims of the 1962/9 and the 1973 syllabuses - both skills and personal growth are given their due. This can be seen by examining the 'General Aim' of the syllabus:

The general aim should be to promote the pupil's intellectual, emotional, social and cultural development through developing his competence in using the language and through enriching his experience in and enjoyment of the language. The underlying assumption of the syllabus is that the receptive skills (listening and reading) and the expressive skills (talking and writing) cannot be acquired in isolation but need to be developed in an integrated process including the pupil's own experience and including the rest of his school experience (language across the curriculum) as well as his experience and needs beyond school.

However, the progressive bias is still there: 'competence' in language is seen merely as a means of promoting the pupil's personal growth. The details and

the order of the 'Global Aims' that follow also suggest this:

1. To encourage the natural enthusiasm, vitality, spontaneity and originality of the pupil through his active participation in meaningful language activities.
2. To enrich the pupil's ideas, to stimulate his thoughts and feelings and to develop his understanding of himself and his own emotional and moral responses to life and the world around him, so that he may live more fully, more consciously and responsibly.
3. To develop the language skills which contribute to effective expression and communication.

Secondly, there is now a separate section called 'Language Study'. Thirdly, this section places greater stress on the need for more definite language study programmes and acknowledges the role of explicit knowledge albeit cautiously. This can be seen by examining the Introduction and Goals of the section on Language Study:

INTRODUCTION

While it must be stressed that at this level [Standards 5 - 7] linguistic competence rather than the academic study of language should be the aim, an understanding of language will help pupils to appreciate the principles underlying their own speech, reading, and writing more fully. Such understanding will, in turn, help them to communicate more effectively, to appreciate literature more fully, and to cope with the demands of language across the curriculum and outside the classroom.

GOALS

1. To increase the pupil's ability to comprehend how language works.
2. To have the beginnings of a language about language and an ability to apply it in an analysis of sentences and paragraphs in a manner which reveals the communicative functioning of parts and coherence of the whole.
3. To extend vocabulary range so that the pupil will be able to use words easily, appropriately and fluently in widening diversity of situations.
4. To spell well.
5. To punctuate well.
6. To produce and understand the structures of acceptable sentences and of their component parts within a coherent whole.
7. To encourage an awareness of the continuum of functional modes of sentences.

The language syllabus is also spelt out in far greater detail. From the point of terminology, certain additions should prove to be of value, viz:

1. Semantics: synonymy; antonymy; denotation; connotation
2. Morphology: knowledge of roots, prefixes and suffixes; spelling rules; the use of the apostrophe

There are, however, certain limitations from our point of view in this new syllabus:

1. The 'incidental' approach is still demanded of teachers: '... the emphasis must be on language in action, which implies an incidental approach which is based on the error analysis of pupils' written work'.
2. The regular warnings that teachers must not spend too much time on 'formal' aspects of language study, eg 'The teacher should exercise great discretion when deciding on the amount of time to devote to these concepts. He should stress different items according to the needs and abilities of the pupils' - a salutary injunction which surely applies to all aspects of the syllabus.
3. The suggestion that formal knowledge will not be examined in the Final Examination: 'The examination will be designed to test competence and skill in handling language tasks, not language about language'.
4. The semantic component of the syllabus is quite inadequate as a means of helping pupils to cope with the conceptual aspects of terminology. The nature of meaning and the variety of lexical relationships between lexical items are not featured.

In spite of the improvements and the occasional references to the concept of 'language across the curriculum', then, the new syllabus does not hold great prospects for finding solutions to the problems pupils face regarding terminology.

11.3.2 THE TRAINING OF ENGLISH TEACHERS

One of the most established tenets of our educational system in South Africa is the idea that a teacher must, amongst other things, be someone who is properly trained in his or her subject. The educational authorities, for example, lay down very definite requirements as to what courses at university may classify as 'school subjects' for a degree leading to an educational diploma. Furthermore, in recent years, the system of 'payment according to qualifications' has encouraged the idea that if a teacher pursues his subject further, this will be to the advantage of the teacher, the school and the educational system in which he functions.

A further manifestation of this attitude is the attempts of the various educational departments to upgrade teachers' knowledge of their subjects by means of in-service courses, which may be either of a general nature or may deal more specifically with a new approach to a subject (eg the New Maths). The Cape Education Department has also decided that a one-year course is not sufficient to teach subjects which at school level combine a number of university courses into one subject - eg Physical Science, which consists of Physics and Chemistry. Teachers who have, say, Physics I and Chemistry III are required to attend 'crash courses' which aim to correct what is regarded as an imbalance in such teachers' knowledge of their subject.

All this suggests that, in order to cope with the teaching of a subject, a high school teacher ought to be fully trained in that subject at university level; and that means he must have more than a first-year course in the subject. The one strange anomaly, however, is English. It is a fact that the vast majority of English teachers are trained in only one aspect of the English syllabus, viz literature. In 1973, for instance, a survey was conducted among 61 English teachers (First Language, High School) in the Cape. The following two tables based on this survey are relevant here:

TABLE I
N = 61
DEGREE COURSES IN ENGLISH

English V (M.A.)	2
English IV (Honours)	4
English III	44
English II	5
English I	6
No Degree Course	0
TOTAL	61

TABLE II

. N. = 61.

EXTENT TO WHICH DEGREE COURSES INCLUDED
GRAMMAR

Extensively	1
Superficially	24
Not at all	34
No Response	2
TOTAL	61

These figures indicate that the majority of English teachers have a Bachelor's Degree and that most of their degrees include at least a third year qualification in English. However, very few of these English courses include much grammar: only one studied grammar extensively while more than half studied no grammar at all. It would seem then that while most teachers have a sound background in English literature, there are very few who have a corresponding background in English Grammar. If 'grammar' is taken here in its broadest sense, then these teachers can be assumed to be lacking in explicit knowledge not only of the syntactic but also of the lexical aspects of language - the nature of meaning, morphological and etymological issues, etc. A number of respondents mentioned that they had studied Latin Grammar at school. Thus, with most English teachers, it seems that the only basis on which they teach English Grammar is the Latin and/or English Grammar they themselves were taught at school.

It is probably true, too, that the situation is worse today than it was in 1973. In the first place, there are far fewer English graduates today who even have a Latin background, simply because the takers for Latin are now fewer. In the second place, we have a generation of English teachers entering the profession who were at school during the anti-grammar period and who therefore have never done any grammar of any kind.

The question which arises is: Why should this have been allowed to happen? A number of reasons could be postulated: The fact that nearly all university courses in English are entirely literature-based (the only major exception being Rhodes University); that most universities do not offer courses in Linguistics; that the educational authorities do not recognise Linguistics as a 'school subject' for degree purposes. But the main factor seems to be that the matter has never even been considered.

A question which follows from the previous one is : What can be done about it ? There are certain steps which can be taken by the authorities to remedy the situation:

- organise in-service courses dealing exclusively with language work
- recognise Linguistics as a 'school subject' for teaching purposes
- prevail upon those who deal with teachers' training and qualifications to insist upon a language component in an English course for teaching purposes (in which case universities would have to change from their current literary bias)

CHAPTER 12

TEACHER AWARENESS

It has been argued that, in order to ensure adequate knowledge of technical concepts and the terms attached to them, it is necessary for the teacher to intervene directly in the learning process. In this chapter we shall be examining the practical implications of this stipulation.

Many of the suggestions made here are, in fact, a matter of common sense and seemingly obvious. However, if one takes into account the inadequate model answers and definitions of terms provided by teachers in memoranda to examination papers and the rather dubious examination questions dealing with terms referred to earlier, one realises that the type of awareness and approach to learning presented here is certainly not the norm in teaching. The underlying reason was suggested in 11.2, viz the very limited view which teachers have of language in learning - the fact that they tend to think of 'language' as being merely a matter of correct spelling and grammar rather than as a means of conceptualisation. It is this which leads subject teachers to think that they can, as one Science teacher put it, teach their subject 'apart from language'. Subject teachers, therefore, clearly need the kind of guidance suggested in the rest of this chapter. It is also evident that textbook authors need this type of guidance: the fact that so many of the definitions of terms in textbooks are inadequate and the lack of awareness on the part of textbook writers of the need for glossaries of terms both point to their lack of understanding regarding the fact that learning a subject is, in fact, basically a linguistic experience.

12.1 FIRST STEP : AWARENESS

The first step in the process of instruction here involves the teacher's being aware of the concepts and terms which he wishes his pupils to acquire - both at the beginning of a new year and, more specifically, at the beginning of a new section of work. The most practical way here would be for the teacher, before beginning a new section, to draw up a list of the terms he will be using and which he will expect the pupil to understand and to be able to use after that section has been taught. Coltham (1971) comments that it is

certainly worthwhile for teachers when selecting any materials or topics for study, to consider listing the particular terms which will be required ...

This will have to be done on the basis of a survey of the relevant section of the textbook, since in our system, pupils are very dependent on textbooks. To the list thus derived the teacher would add any others which he feels are necessary.

Since terms are not isolated units but are linked in webs of terms by various types of relationships, it is also necessary for the teacher to consider also the relationships that exist between the members of the corpus of terms he has drawn up. It is also necessary to establish what other terms and concepts not included in the corpus are presupposed by these terms – very often terms that the child should have acquired previously. This can be done by trying to draw up lexical sets by seeking, for example, the antonyms, hyponyms, etc for the terms in the corpus; this would reveal not only the internal relationships between the terms in the corpus but also which terms outside the corpus should be included in the list. Gunning (1978) suggests another practical way of answering Gagné's (1969) question: What concepts must the learner already understand before he can learn another specified concept? Gunning proposes that the teacher draw up, with the list of terms, an explanation for each term, since, as he puts it, 'Giving an explanation of an abstraction often involves using other abstractions'. He continues as follows:

You might find, for example, that you cannot sensibly explain 'revolution' without using the term 'government'.

(p 26)

It can be noted in passing here that Science teachers are more likely to show a greater awareness of the terms that their pupils will need to cope with in a section of work. This can be seen by examining the respective responses of Science and History teachers to a common question in both Questionnaires, viz 'What would you regard as the greatest language problem for your pupils?' In each case five possible problems were listed and respondents were asked to place a number next to each, starting with (1) to show the greatest problem. The responses (expressed in percentages) are printed on the following page.

SCIENCE QUESTIONNAIRE

	1	2	3	4	5	NR	TOTAL
A Defining laws	7,1	7,1	11,4	25,8	38,6	10,0	100
B Describing procedures/ processes	21,4	30,0	20,0	12,9	5,7	10,0	100
C Using appropriate 'scientific style'	20,0	30,0	22,9	11,4	8,6	7,1	100
D Expressing things in their own words	24,3	15,7	20,0	15,7	18,6	5,7	100
E Terminology	27,2	10,0	15,7	21,4	18,6	7,1	100

HISTORY QUESTIONNAIRE

	1	2	3	4	5	NR	TOTAL
A Arguing logically and coherently	57,1	29,6	9,3	5,7	0,0	0	100
B Describing a series of events	7,1	3,7	14,8	18,9	56,6	0	100
C Using an appropriate 'historical style'	3,6	12,9	31,5	35,8	15,1	0	100
D Expressing things in their own words	30,4	47,0	12,9	3,8	5,7	0	100
E Historical terminology	1,8	7,4	31,5	35,8	22,6	0	100

These figures clearly indicate that Science teachers regard terminology as a greater problem for their pupils than do History teachers. The figures are, of course, relative to the other problems in the list; nevertheless, it is a fair conclusion to draw that History teachers do not see terminology as a particularly significant language problem for their pupils whereas Science teachers do: whereas as many as 37,2% of the Science teachers rated terminology as the greatest or second greatest language problem and 40,0% rated it as fourth or fifth, only 9,2% of the History teachers rated terminology as first or second, while as many as 58,4% placed it fourth or fifth. The fact that historical terminology tends to depend on general vocabulary for both terms and concepts to a far greater extent than does scientific terminology could be one of the reasons for this difference in viewpoint.

12.2 SECOND STEP : ANTICIPATE PROBLEMS

It is not enough merely to be aware of the list of terms the child has to acquire. It is also necessary to examine the concept list for possible 'danger areas'. It is possible to predict, on the basis of the linguistic complexities inherent in terminologies, on the basis of past experience, that there are certain types of problems that are likely to arise and also, to some extent, which terms are more likely to cause problems than others. The following sorts of issues, for example, could be considered:

12.2.1 LINGUISTIC PROBLEMS

(a) Semantic aspects:

Here the teacher might look at such issues as the following:

(i) Polysemy: It is necessary to examine which terms are likely to cause confusion on the grounds of polysemy - which includes the question of technical terms derived from general vocabulary and the problem of 'presentism' in History.

(ii) Abstractness: Teachers should also decide which words are more abstract than others, bearing in mind that the terms with abstract referents or which occur at a higher level of abstraction are more likely to cause confusion.

(iii) Lexical relations: Certain lexical relations might be more difficult than others, eg the question of gradability vs non-gradability, the complexities of detailed hyponymous set, etc.

(b) Formal aspects

Teachers need also to consider the fact that there are a number of formal aspects of the terms to be acquired that could give rise to problems for the child. Certain words, for example, have a higher probability of being misspelt; certain derivatives may be more difficult to form than others; and so on.

12.2.2 CONSIDER THE CHILD / PSYCHOLOGICAL ASPECTS

We have, up to this point, been considering the question of assistance to the child from the point of view of the subject only. The danger of an exclusive emphasis on the needs of the subject is that teaching could lapse into the teaching strategy which was typical of the traditional approach to education, which Hewson (1980) sums up as follows:

In these [common teaching practices] the ideal is to present the desired material in a logical sequence, bolstered by suitable experiences of which appropriate explanations are provided.

(p 394)

He comments that 'This approach starts with axioms and definitions and proceeds deductively to the required results' (p 399). That this approach is unsatisfactory, he argues, is shown by the frustration which most teachers experience at the fact that many pupils fail to grasp new information despite the teacher's careful, logical presentation. It is clear that the teacher must take into account the child's present level of development and his current knowledge. This does not mean swinging the pendulum to the opposite extreme - the approach of the progressives who, as we have already indicated, advocate an abandonment of the consideration of the integrity of the subject and maintain that all knowledge is relative and that each child's conception of the material is equally acceptable. Hewson (1982) argues that 'it is necessary to assume that conformity to the currently accepted dogma of a scientific [and historical] discipline is a worthy curricular goal' (p 394), but that this target body of

concepts and logical structures can only be properly assimilated by the child if the teacher takes into account the child's existing cognitive structures. A compromise between the demands of the subject and the demands of the child must be struck.

We have already looked at the effects of taking into account the terminological demands of the subject. If we turn to consider the child, we can see that there are two main aspects involved, viz the level of development of the child and his existing knowledge. Each of these will be dealt with in turn in the rest of this chapter.

(a) Level of development

The ideal here is to follow the advice of Campbell (1977) who comments as follows:

Make sure the meaning of the terminology falls within the cognitive experience of the children.

(p 23)

This, however, is far more difficult than it seems at first sight. In the first place, how does one know what the 'cognitive level' of the children in the class is? Good (1977) comments as follows:

Since a 2-to-3-year range in developmental thinking ability is not uncommon at any grade level, it is a risky business to determine the appropriate level of selected science concepts.

(p 159)

Zaccaria (1978) also points out that it is very possible that children may vary as regards their ability to think according to the subject, ie certain subjects may demand different levels of thinking ability. 'It should be noted,' says Zaccaria, 'that being able to perform at the formal operational level in one area does not guarantee that a person can perform at that level in another' (p 325) - a view propagated by Piaget himself. Zaccaria cites the research of two historians in this connection. Firstly, he mentions that Peel's studies (1965 and 1971) indicate that children learn to think about historical content at the formal operational level considerably later than they are able to think at that level when working with scientific and mathematical materials (p 325)

Secondly, he refers to Hallam (1970), who stated that 'students, on the average, develop the ability to think at formal abstract levels with historical content up to four years earlier than they do in mathematical and scientific content' (p326). These findings have been disputed by others (eg Partington:1980). The details do not concern us here; the point to be noted is at least the possibility of differences between the subjects as regards their cognitive demands.

A second problem here is: What exactly does a teacher do if he comes to the conclusion that a particular term is conceptually beyond the cognitive level of his pupils? Reeves (1980), commenting on the teaching of History, suggests that 'for ages up to about thirteen and fourteen we should, as a rule, eschew altogether ... abstract words' such as 'policy, administration, organisation, development, influence, process and the like' (pp 57-9). Gunning (1978), on the other hand, points out the academic and practical problems of such a facile solution:

We cannot avoid the use of abstractions, even if we try. We might say 'king' instead of 'monarch', 'farmer' for 'peasant', but there are limits to such a process. Even if we could both simplify our vocabulary and yet not sound as if we were addressing eight-year-olds, there is still the matter of the language the class will meet in textbooks and reference books. We do not really want to sidestep the problem of concepts such as 'peasant' anyway, because they are very useful for understanding many historical matters besides. The French Revolution and perhaps even more to the point, understanding of them can transfer to a huge number of other situations and contexts of a social, economic or political nature.

(p 16)

There is a further problem which relates to the question of what one would teach at high school if one were to try to avoid anything which was felt to be beyond the child's cognitive level. Partington (1980) comments as follows on the suggestion by Hallam that this be the solution:

The first suggestion that we should avoid the 'over-abstract', if more than a vacuous reminder not to overdo anything, implies that most children of compulsory school age should be taught little, if any, religious or political history, since they are too abstract and adult to be understood before operational thinking has been reached.

(p 28)

It can also be argued that Piaget's view that the teacher needs to wait until the child is 'ready' for a particular level of thinking is only one view. Lawton (1973) refers to Bruner's opposing argument that 'the learning process can be speeded up or slowed down by appropriate or inappropriate learning or pre-learning situation' (p 53).

It would seem that the most realistic approach to the problem is as follows:

1. Curriculum planners and teachers should be urged, where possible, to avoid terms which are conceptually beyond the cognitive level of most children in a particular standard or class.
2. Teachers should be aware of the fact that a child's cognitive level determines his ability to cope with terms and should, therefore, in their presentation, take into account their pupils' cognitive limitations when dealing with terms.

(b) Present knowledge

It is an accepted fact that if a child's competence is either defective (ie he has incorrect information or has certain misconceptions) or deficient (ie certain information is lacking) and if this information is required in order to use and understand further terms and concepts, then the child will have problems in trying to cope with new information presented to him. It is on these grounds that a growing number of educationists are calling today for the teacher to take into account what the child already knows; it is argued that the child's existing knowledge should be the starting-point for deciding which concepts to present, when and how. Coltham (1975), referring specifically to History, comments as follows:

Children's previous experience is an important key to the possible development of understanding, without which they cannot construct and use schemes effectively ...

(p 42)

Watts, Pope and Gilbert (1982) therefore point out that many writers on educational issues 'have argued that it is time that recognition be given to

the perspectives of the people engaged in classroom interaction' (p 31). They refer to Blumer (1966) who wrote as follows:

Since action is forged by the actor out of what he perceives, interprets and judges, one would have to see the operating situation as the actor sees it, perceive objects as the actor perceives them, ascertain the meanings in terms of the meanings they have for the actor, and follow the actor's line of conduct as the actor organises it - in short, one would have to take the role of the actor and see the world from his standpoint.

(p 542)

The implication here is that the teacher, having drawn up the list of concepts and terms that the child needs to know and understand in order to cope with the next section of the work, needs to ascertain where there is deficiency or defectiveness of competence as regards these terms.

12.3 THIRD STEP : ACT ACCORDINGLY

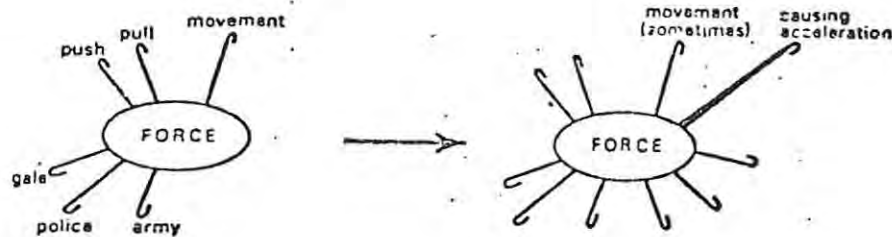
The next step is succinctly summed up by Ausubel (1968) as follows:

The most important factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.

It is now necessary for the teacher to attempt to overcome incompetence - to modify defective knowledge and to add knowledge where there is deficiency. In order to deal with defectiveness, the teacher needs to know 'how to effect a conceptual exchange from the student's alternative conception to that which is generally accepted by the discipline' (Hewson:1981:394). Hewson argues, too, that in order to do this, 'these conceptions need to be explored in order to expose their limitations'. It is necessary to create a sense of dissatisfaction with the existing conception so that the child will be motivated to want to exchange the old for the new.

In modifying or adding new concepts, it is essential that the teacher explicitly link up with what the child already knows. The teacher must start with the concepts the child knows or with the child's misconceptions and then proceed to work from there to add, modify and develop his knowledge. Sutton (1980) shows how, in practical terms, teachers can start with the children's views and work from there by triggering a few associations which the child already knows.

'Thereafter their meaning can be gradually enriched by making more and more connections' (p 48). He presents the growth pictorially in the form of 'burr diagrams'. The following is his burr diagram for developing knowledge of the physical term force:



Similarly, in History Gunning (1978) comments that 'Very often ... the pupils have an understanding, but not an adequate one' (p 28). He goes on to say that 'The ideal to aim for is to accept and use whatever understanding the pupil already has'. He cites the example of the pupil who gave the following definition of the term parliament:

Parliament was the King's friends, they went about with him.

In dealing with this misconception, says Gunning, one should not say 'No, no, it's nothing to do with the King, it's like this ...', but rather to comment as follows:

Suppose there was something we wanted to tell the King, like there's a great many robbers round here causing trouble — we wouldn't all go to London to tell him, we would choose one of us to go, perhaps the best talker. The one chosen would go to London and talk to the King and tell him about the robber problem; all the other towns would send a person too, to tell the King things he ought to know. The whole gathering of men from the various places, talking to the King, was called 'Parliament'.

(p 28)

A final point that needs to be noted in passing here is the fact that it is necessary to address not only concepts as such but also broader views which the child holds. In Science, for example, Hewson (1981) points out that pupils'

understanding of concepts is determined by 'metaphysical commitments which are often implicit but serve to anchor different alternative conceptions' (p 395). The Schools Council History 13-16 project similarly shows how pupils' understanding of broader concepts (or 'hidden assumptions' or 'key concepts') such as 'evidence', 'empathy', 'causation', 'continuity' and 'change' influences their thinking in History.

12.4 TESTING

It has been argued that the teacher should test pupils to establish their existing knowledge. It is also necessary to test continually while teaching concepts in order to establish how pupils are developing these concepts and the terms attached to them. The question which arises is: How does the teacher go about testing this knowledge? There are two basic methods involved here - tests and interviews.

12.4.1 TESTS

These can either take the form of informal questions directed at pupils during a lesson or the form of formal tests devised to test specific terms and concepts. The following points should be borne in mind here:

(a) Tests of recall are useful in that they can be used to ascertain whether pupils have established term-concept links. Thus tests, for example, which ask for the name of a reaction in which energy is liberated (exothermic) or the name of the King of France at the time of the French Revolution (Louis XVI) have their place here. However, where the teacher wishes to know whether a pupil has grasped a concept fully, the test should be such that it calls for more insight and application. Stephens (1974) gives the following example in History:

Too frequently, teachers simply ask for recall in a completion question, as for example:

(Anthropomorphic): The name for the belief that gods have human qualities.

The question can be phrased differently to test for both knowledge and application, as in the following item:

- (e) The people 'imagine their gods to be born, and to have raiment clothing, voice, and body, like themselves ...' This description by an ancient writer suggests that the people mentioned conceived of their gods as
- a. mythological
 - b. supernatural
 - c. humble
 - d. democratic
 - e. anthropomorphic

The purpose of such a question is to test if students can go beyond definitions to transfer to knowledge.

(p 260)

Another example would be to ask pupils to separate the facts in a piece of historical discourse into political, social, economic, etc. Or, alternatively, Bernbaum (1972) suggests that pupils be asked to provide their own headings for a list of facts or a section of discourse. Both of these approaches have the advantage that they test proper understanding of a term without demanding recall of knowledge - ie they can test whether the pupil understands the concept rather than whether he can remember the section of work concerned (as would be the case with a straight essay question).

Tests can be devised to check up on anticipated misconceptions. In History, for example, it is necessary to test for misunderstanding arising from the problems of polysemy and the 'then-now' dichotomy. An example of this is Question 8 in the History Questionnaire to Pupils (Appendix G) already referred to:

8. The following are ~~three~~ statements relevant to the causes of the French Revolution. Read them, and then answer the question which follows:
- A. The French Parliament was called the 'States General'. It consisted of three parts - the First, Second and Third Estate.
 - B. The French Parliament had not met since 1614. Since then, the king had had absolute power.
 - C. The Third Estate consisted of the ordinary citizens, professional people, vassals, workers and serfs who constituted (made up) 90 per cent of the French population.

State whether the following statement is TRUE or FALSE. Give a brief but clear reason for your answer:

In view of these facts, it is to be expected that the members of the Third Estate would resent the fact that they had been deprived of their former political right - the right to the major say in the governing of the country.

Barber (1978) suggests an alternative type of question, ie 'thought-provoking exercises dealing with past events, yet drawing on transactions present in daily life or easily recreated in the classroom'. He therefore proposes that questions which 'involve the children and encourage a thoughtful response' be drawn up, exercises which call upon them to express what they would feel, how they would react, if they were in the same position as a certain individual or group (eg the peasants in France in 1780). The following question from a History Paper set in a Cape Town school is an example in point here:

'Like that of other Continental countries, French Society was characterised by rigid class distinction.' (A N Boyce)

Imagine that you are a Frenchman living in Paris during the rule of Louis XVI and that you are writing to a friend in England. Explain to him what the existing Social Conditions are like.

Brandon (1976:15) suggests the contextual-type question as another way of testing for this type of problem. He gives the following example:

Looking for the precise meaning of words is extremely important in the examination room. Here is a question which demands careful thought before an answer is attempted.

'Consider the view that Elizabeth's first great task was to settle religion.'

'Religion' is a much-used word, but what exactly does it mean in this context? Which of the following suggested meanings would you use in your answer?

- (a) Elizabeth's own beliefs about God.*
- (b) What English people were required to state as their beliefs about God.*
- (c) The forms of worship which would be made compulsory in English churches.*
- (d) The methods by which the English Church would be ordered and governed.*
- (e) The attitude which the Supreme Governor of the English Church would adopt towards the Pope.*
- (f) The obligation of English people to attend for regular worship in their parish churches.*

(b) As regards the form of the test, it is clear that one-word answers and multiple-choice tests, although able to test insight, are limited in their capacity to achieve this. This can be seen, for example, in the following question:

Temperature = average energy.

The required answer here is the term kinetic. If a pupil gives the wrong answer (eg mechanical), then he is revealing that he has not grasped the relationship between temperature and kinetic energy. If, on the other hand, he supplies the correct answer, a teacher cannot be sure that he has grasped this relationship properly. He may merely be recalling an association of terms and concepts without any real understanding. By contrast, if a pupil is asked to provide a descriptive answer, it is more likely that misconceptions will be revealed. We have already referred to a question in which pupils were asked to 'Explain how evaporation causes cooling'. A number of pupils indicated that they understood that temperature involved energy and that the energy involved was kinetic energy. However, they had not understood the concept of average kinetic energy; they tended to think of temperature in terms of the number of molecules involved. Such pupils would, therefore, have supplied the correct term kinetic in the question above but it would have been a false assumption on the part of the teacher to think that this indicated an understanding of the concept temperature. It has also been suggested earlier that there are cases where pupils supply the correct words in completion questions or choose the correct answer in a multiple-choice question but indicate in descriptive answers elsewhere in their examination papers that they do not understand the concepts involved in these questions. It is on these grounds that a Science teacher commented as follows in the Science Questionnaire to Teachers:

The type of question set is determined by the marking. It's easier to avoid descriptive answers because you can test the same concepts in a way where you can more easily get the facts you are looking for. It has been found, however, that if you asked for descriptive answers, pupils don't actually know what you thought they knew.

It is, therefore, also necessary to ask questions which require pupils to write and explain. This is not typical of Science tests and examinations. Cooley (1980) comments as follows on the situation in America:

Learning is largely evaluated through short-answer questions on tests. Requiring students to demonstrate an understanding of science through writing has been all but eliminated. Writing, the reflection of understanding, has nearly disappeared from the science curriculum.

(p 15)

The same is certainly true of Science examinations in Cape schools. In Appendix H, details are given of the survey of Science and History examination papers in order to establish written demands upon the pupils. The findings clearly indicate that there are differences between History and Science examination demands, in particular insofar as History demands more verbal answers, and more descriptive answers. From this it would seem that History examinations lend themselves to greater diagnostic use for testing concept understanding. That, however, is not the case, since the emphasis is more on narrative and argument - both of which expect an underlying understanding and use of terms, but do not test knowledge of terms directly.

There are, furthermore, limitations in the Science questions which do require descriptive answers, limitations which also affect History questions, with the result that the value of these questions as tests of insight is reduced. These limitations may be specified as follows:

There is a tendency to ask questions which do not call upon the pupil to explain how he sees a concept, but rather to give someone else's (the teacher's or the textbook author's) account of this. Questions set for homework tend to be closely keyed to the text. As Cooley (1980) puts it:

A student soon learns that some fast skimming of many textbooks reveals the location of an adequate answer.

(p 16)

In a survey of the types of writing done by pupils in Science lessons in certain schools in Britain, Dolan and Clarke (1979) found that "'copying' is the most frequently observed writing activity" (p 343). The same appears, from a brief survey of writing assignments in certain Cape schools, to be typical of the writing done in Science classes there and, though to a slightly lesser extent, of History classes. In examinations, the same applies - the only difference being that pupils are (hopefully) not 'copying' but 'recalling' sections of textbooks

or notes. We have already referred to cases where pupils writing on certain topics in History which required an understanding of terms such as political and social were able to obscure their misconceptions by being able to reproduce sections of the textbook or class notes dictated by the teacher.

The 'copying' or 'recalling' often takes the form of merely reproducing formal definitions, which cannot be regarded as a valid test of understanding. This can be illustrated by analysing the responses of pupils to the following question in the History Questionnaire to pupils (Appendix G):

11. Read the following two pieces of information and then answer the question that follows:

- A. A 'radical' in politics may be defined as a person who wants to change society in a far-reaching manner.
- B. In 1791 the Feuillants tried to persuade the King to accept the Constitution drawn up by the Constituent Assembly. They also encouraged the Emigres (ie nobles who had fled from France) to return home.

The Brissotins set about repressing the reactionaries (ie those who wished to restore the Old Order in France) and to intimidate (threaten) the Emigres.

In terms of the above information, state which of the following you would classify as the radicals in France in 1791. (Underline the answer you choose.)

- (a) Feuillants
- (b) Emigres
- (c) Brissotins
- (d) Reactionaries

Each of the terms in the list provided is defined formally in the question and could have been reproduced by any pupil in a question which called for formal definitions. The fact that only 16 out of the 28 respondents (ie 57.16%) were able to supply the correct answer (ie the Brissotins) and that the remaining 41.9% suggested either the Fauillants or the reactionaries shows that knowing a formal definition does not guarantee that the child understands the term concerned. The fact that the majority of those who responded incorrectly suggested the reactionaries as the answer indicates a misconception in these pupils' minds which resulted in a confusion of the terms radical and reactionary.

It would seem, then, that there are certain changes in examining and testing

techniques that are needed in order to be able to use these examinations and tests for diagnostic purposes. These are as follows:

- (i) More questions requiring descriptive answers should be set.
- (ii) A change in attitude and objective regarding these questions is also needed. It is necessary for teachers to use tests and examinations not only for the purpose of obtaining a grading for pupils but also for the purposes of advancing learning. In this respect, the Schools Council pamphlet entitled Why Write ? (1976) comments as follows:

In other words, in schools - institutions of learning - the single most important use for writing appears to be as a means of testing, of monitoring knowledge and performance. This writing is seen not as part of the learning process but as something which happens after the learning.

(p 5)

What we are saying here is that it could be regarded as both a means of testing and as part of the learning process - as a means of testing in order to foster the learning process. The various Schools Council projects therefore propose that the audience for writing in schools should not be only the 'Examiner audience'. They continue as follows:

We felt very strongly that the 'Examiner audience' situation inhibited thinking and speculation and that the child needed what he wrote to be read with interest and sympathy rather than to be judged as the performance of a task.

(p 5)

One of the implications here is that teachers should allow for children to write in a more formal, personal manner - what the Schools Council projects call 'expressive' writing. There are, however, certain problems involved here. Firstly, there is the fact that it is often very difficult to express certain ideas in one's own words without falsifying the content; and even more so if the style one uses is a fairly informal style. This can be seen by examining the responses of teachers of Science and History to the definitions provided in the two Questionnaires. The teachers were asked to assign a mark (up to 3) for each of the following definitions:

NATIONALISM: Nationalism means that the people in a country want to run their own affairs on their own. They don't want others to rule them.

VALENCY: By valency we mean that the number of electrons in an atom tells you how many bonds the atom can make with other atoms.

The responses can be summed up in the following two tables:

NATIONALISM		
0	2	3,6%
1	31	35,4%
2	17	30,3%
3	6	10,7%
NR	0	0,0%
TOTALS	56	100,0%

VALENCY		
0	25	35,7%
1	25	35,7%
2	14	20,0%
3	4	5,7%
NR	2	2,9%
TOTAL	70	100,0%

The figures suggest a wide range of opinions, but the majority assigned either 0 or 1 out of 3. It is clear, as was mentioned earlier, that neither definition is complete. Neither of the statements was intentionally designed to be inaccurate but each was meant to be a genuine attempt on the part of the compiler of the Questionnaires to draw up a definition in simple words based on textbook definitions. The fact that in both cases the definitions turned out to be inaccurate suggests that it is difficult to express certain technical ideas in simple language. The fact that teachers are aware of this problem can be seen by examining the tables on page 191: both Science and History teachers listed the problem of 'expressing things in their own words' as the second most difficult language problem. (What is interesting is the fact that, if one takes the figures across from 1 to 5 for the problem in each table, one can see that History teachers see this as a greater problem than do Science teachers. This seems surprising, since historical discourse is closer to everyday discourse than scientific. The reason is most likely that, because History examinations

demand more descriptive answers than do Science examinations, the problem is faced more often by the pupil in History.)

It would seem that teachers prefer their pupils to use a more formal, textbook style of language even where the content is not affected. This can be seen from comments that some of the respondents made in connection with the above question on definitions. Many of them stated that the given definitions were 'totally vague' or that the writer 'had no idea of what he was talking about'. This is not true - in each case, the definition had the basic truth in it but lacked certain qualifications.

The result of all this is that the pupils tend to learn definitions by heart - sometimes encouraged by teachers. This, then, leads to a vicious circle - the pupil then never learns to express ideas in his own words or to explore the extent to which he really understands formal definitions. One Science teacher summed up the position as follows:

There is difficulty in expressing things in their own words as the children are taught to learn so many unnecessary definitions off by heart that they get into the pattern of learning by heart without understanding.

The fact that, as mentioned earlier, so many of the questions are closely keyed to the pupils' textbooks makes this possible.

The solution, however, is not so simple. If pupils are merely encouraged to start expressing ideas in their own words, they will run the risk of inaccuracy and will not cope with certain examination questions and teachers who expect them to be able to give formal definitions; and in an examination which aims more to provide a pupil with a grading than to ascertain the extent of his understanding for remedial purposes a pupil would lose marks for not providing the expected kind of answer and also would run the risk of exposing his misconceptions and thereby lose marks. It is also a fact that textbooks tend to express concepts in the form of formal definitions; and pupils are very reliant on their textbooks. If, on the other hand, pupils are encouraged to learn textbook definitions by heart, these could be merely parroted without full comprehension. It would seem that a two-prong compromise approach is necessary: Pupils should be encouraged to explore their understanding of concepts by expressing their thoughts in their own words but should be taught to analyse formal definitions and to paraphrase them. Then, even if they do learn them

off by heart, they are more likely to understand what it is they have learnt in this manner.

In other words, pupils should learn to operate at varying levels of formality as regards definitions. Teachers could either present the pupils with formal statements which, as Iona (1975) suggests, 'are not completely comprehended immediately' and then encourage them to analyse these carefully, or they could use more informal descriptions of concepts first and then provide pupils with formal definitions and indicate the relationship between these. Some examples of such varying levels of formality are as follows:

1. FORCE: (a) 1. An external agency capable of altering the state of rest or motion in a body.

(Uvarov et al:1979:168)

2. Push and pull.

(Iona:1975:25)

(b) *Radical (nineteenth century)*

(a) 'Radicalism involved making more fundamental attacks on institutions and putting forward more far-reaching plans for reform.'

(b) 'Suppose a man had the idea that, say, Wales ought to have its own Parliament and make some of its own laws and suppose a second man said Wales ought to be entirely separate from Britain and make all its own laws. We would say that the second man was taking a more radical line.'

(c) 'Suppose the bus fares went up a lot. Suppose some of you said, "Let's write to the council and complain the fares are too high" and suppose others said "No, let's write and say that school students should travel free on the buses anyway" - we could say the second lot were being *radicals*.'

(Gunning:1976:27-8)

Examination questions could call for more informal definitions when pupils are first learning new concepts or could call upon pupils to provide a formal definition and an explanation in their own words of what they mean by the definition. Questions which test pupils' ability to apply definitions could also be set in order to test their understanding of these definitions. The question on the term radical given earlier in this chapter (taken from the History Questionnaire to pupils) is an example in point here. A further

example is the following one from Stephens (1974:254-6):

- I. DIRECTIONS: For each quotation listed below (Nos. 1-7) identify the civilization which is correctly associated with it. Record the letter of the civilization by the appropriate number on your answer sheet. Any one of the civilizations may be used more than once or not at all.

- A. Egyptian
- B. Hebrew
- C. Mesopotamian
- D. Minoan
- E. Persian

- (C)1. "From above in heaven/ One could no more make out man and man./ The gods were afraid before the stormflood,/ Fled, and mounted up to the heaven of Anu."
- (A)2. "Hail to thee mighty god, lord of Righteousness! I am come to thee, oh my Lord: I have brought myself that I may look upon thy glory. I know thee, and I know the name of the forty-two gods who make their appearance with thee in the Hall of Righteousness. . . ."
- (C)3. "Who is there who can grasp the will of the gods of heaven?/ The plan of a god is full of mystery—who can understand it?/ How can mortals learn the ways of a god? He who is still alive at evening is dead the next morning. . . ."
- (E)4. "Now the two primal Spirits, who revealed themselves in vision as Twins, are the Better and the Bad in thought and word and action. And between these two the wise one chose aright, the foolish not so."
- (B)5. "Assemble yourselves and come; draw near together, you that are escaped of the nations: they have no knowledge that set up the wood of their graven image, and pray unto a god that cannot save."
- (A)6. "During the flood, the people shows its joy; every heart is happy . . . , the divine cycle speaks through you. . . ."
- (C)7. "If a man has stolen ox or sheep or ass or pig or ship, whether from the temple or from the palace, he shall pay thirtyfold; if he stole from a commoner, he shall render tenfold. If the thief cannot pay, he shall be put to death."

12.4.2 INTERVIEWS

A far more satisfactory method of investigating pupils' understanding of concepts is the approach introduced by Osborne and Gilbert (1980) called the 'Interview-about-instances technique' (IAI). Watts, Gilbert and Pope (1982) comment as follows:

In outline, the IAI consists of tape-recorded dyadic discussions with a pupil, using a series of pictures as a focus. ... Each picture card represents a line drawing of a situation which may, or may not, represent an example of the concept. The method elicits a wide range of responses and, whatever the response, further explorations are made using the language of the pupil wherever possible.

(p 11)

The method falls within the research framework of 'case studies'. The authors describe the actual procedure involved as follows:

Early use of fairly open-ended questions allows the session to develop into a discussion where meanings are negotiated, and where evaluation and critical comment are avoided. The recordings are transcribed and annotated to be as faithful as possible to the exchanges. Each transcript is scored and analysed on the basis of the context of each utterance.

(p 12)

The advantage of this method is that a teacher can follow an individual's train of thought, can perceive his premises and the hypotheses based on these, thus arriving at an understanding of why an individual may have arrived at a misconception (eg because of misconceptions regarding other terms involved in the understanding of the concept in question) rather than merely being presented with the fact that the pupil has an inadequate understanding of the concept. It is also possible, on the basis of one's experience with using this approach with a number of pupils, to predict where misconceptions will arise with others as well as the typical reasons for these misconceptions.

The approach is, however, very time-consuming and is still in its infancy. Nevertheless, it provides considerable promise for future investigations.

CHAPTER 13THEORETICAL KNOWLEDGE

So far we have considered what guidance the child needs regarding specific terms and concepts, both from a semantic point of view and a formal point of view. A controversial issue which arises from this is the question of the value of general, theoretical, knowledge about language and terminology. Does it help the child improve his competence and his performance ?

13.1 EVIDENCE REGARDING EXPLICIT KNOWLEDGE

The answer of the authors of The Bullock Report (1975) is one of scepticism:

There is no evidence to show how far an explicit knowledge of the rules governing language can reinforce knowledge or substitute for it.

(p 152)

Carter (1982) responds to this statement with the comment that "the fact that "there is no satisfactory evidence" of the connection between teaching rules of language and the developing of language skills does not preclude such evidence" (p 8). Speaking of the relationship between such knowledge and competence in writing in particular, he adds the following:

No one has yet demonstrated that conscious awareness of language structure improves pupils' own writing, but that is not to say that no such links exist or cannot be made to exist.

(p 169)

13.1.1 RESEARCH

There do not appear to be any major published research findings regarding the value of theoretical lexical knowledge as a means of improving a child's lexical competence and performance. There is, however, a large body of research which has been conducted in the field of syntax. This research gap parallels the fact that Linguistics, in general has, until recently, over-invested in work on syntax and under-invested in work on vocabulary. In order to ascertain the role

of explicit lexical knowledge as a means of improving lexical competence and performance, one has to turn to the evidence available regarding the role of explicit syntactic knowledge in improving syntactic competence and performance. This research has relevance to the question of the value of theoretical lexical knowledge since it deals, after all, with a comparable issue, and since there is clearly an overlap between syntactic and lexical competence.

For many years, the controversy regarding the role of explicit syntactic knowledge in improving written composition skills was waged purely on the basis of personal experience, reasoning and deep-set traditional prejudices. Fries (1952) points out that during the early years of this century the defenders of 'grammar' won hands down. However, with the 'coming of the measurement movement in education' at the beginning of this century, there came 'the first really effective challenge of the asserted connection between grammar and good English' (p 19). Since then there has been a spate of experiments which have sought to investigate whether there is a connection between explicit syntactic and the ability to write well. The results are at present not entirely conclusive. Many of the experiments which purport to prove a lack of correlation can be questioned on the basis of certain important criteria - criteria which would also have to be considered in any experiments dealing with lexical competence. Since these are vital to the use of theoretical knowledge in the improving of competence, they need to be examined here. They are as follows:

(a) Firstly, it is important to decide how much correlation one expects to find and, even more, in what length of time one expects a correlation to become evident. Smith (1938) argues that, if one were to exclude grammar on the grounds that it cannot effect a total elimination of errors, then one would have to exclude the teaching of all skills. He says:

On that basis, most teaching of skills and dexterities would be condemned because those who are studying them are not perfect performers. To look at a novice fencing or in golf, or to watch a green football squad blunder through team formations, does not inspire enthusiasm in the spectators. But those who have played these games and who know how difficult they are, do not rush to the conclusion that the whole coaching system is a failure and should be abolished. Grant a little more time and practice, and then look at the same players. They may not be world-wide champions ..., but they will most emphatically show more skill than their classmates who have not been coached.

It is expected, furthermore, that one might succeed more with one than with another. Not every teacher expects every child to turn out a Churchill any more than a golf coach expects every child to become a Gary Player. But just because we cannot achieve perfection does not mean that we abandon the whole idea of coaching. We go ahead fully realising that no one will ever achieve perfection and that there are many who will never even be particularly good; but we also realise that, without training, they would be even worse.

(b) A further point is that explicit knowledge about language cannot be considered as the only means of improving competence. It has already been mentioned that, in addition to instruction (whether specific or theoretical), a child needs to be exposed to the language, to be given opportunities to read, write, speak and listen. Any programme which consists exclusively of theoretical knowledge is not likely to succeed. Some of the experiments tend to set a group of pupils given training in theoretical knowledge against a group given practice in writing. A programme which called upon pupils to do both might yield more positive results.

(c) The content of the theoretical knowledge is also important. An essential requirement for generalisations about language to have any impact on competence and performance is that it must be clear and intelligible - the rules must be simple enough to be applied. If one examines the type of grammar taught in schools (as I in fact did for my Master's Thesis on The teaching of English Grammar: 1976), one finds that much of it is confusing and confused. It is also important to note that most of the experiments which suggest no correlation have been done on the basis of traditional school grammars. In this respect The Bullock Report states that: 'What has been shown is that the teaching of traditional analytic grammar does not appear to improve performance in writing' (p 171). Even if this is true, this does not mean that an improved version of traditional school grammars or that some other type of grammar might not be more successful. Bateman and Zidonis (1966), for example, contend that 'statistical analysis suggests ... that there is a connection between a knowledge of generative grammar and an ability to produce well-formed sentences of greater structural complexity'.

(d) The method of teaching is another factor here. There is very little experimental evidence as to the effects of teaching methods upon the ability of the child to transfer generalisations about language he has been taught to his own language use. There are, however, experiments in other fields of learning

which seems to suggest that methods can affect transferability. Woodrow (1927), for example, comments as follows on his findings in this connection:

In short, the experiment shows that in a case where one kind of drilling - undirected drill - produces amounts of transference which are sometimes positive and sometimes negative, but always small, another kind of training with the same drill may result in transference, the effects of which are uniformly large and positive.

Experimental evidence by Ruediger (1908) suggested the same conclusion. Theoretical Psychology, according to Pulliam (1931), also corroborates this contention. He quotes Judd (1915) as follows:

The first and most striking fact that is drawn from school experience is that one and the same subject matter may be employed with one and the same student with wholly different effects according to the mode of presentation. If the lesson is presented in one fashion it will produce a very large transfer, whereas if it is presented in an entirely different fashion, it will be utterly barren of results for other phases of mental life..... Formalism and lack of transfer turn out to be, not characteristics of subjects of instruction, but rather products of the mode of instruction in those subjects.

In this connection, at least the following requirements are necessary for transference to take place:

- (i) The theoretical knowledge must be related to the aspects of competence and the skills which are meant to be improved. In this connection, Evans (1957/69) comments as follows:

My conclusion is that grammar has failed to do what, at best, it can do because our methods have not been designed to establish and maintain a sufficient connection between grammatical knowledge and practice in writing.

(p 113)

- (ii) The child must see the reason for following a 'correct' rule. This means that pedantry - which is often typical of traditional English teaching - must be avoided and the child must not be encouraged to believe that there is only one 'correct' type of English but that there are various types which are appropriate to different contexts.

- (iii) The child must be given sufficient practice in applying the rules he had been taught. Teachers cannot merely refer to the rule and then expect the child to apply it at all times of his own accord. It would appear that this has often been the case.

Evans (1959/67) concludes as follows regarding this point about the importance of method:

Either grammatical knowledge really has little connection with problems of writing, or it has latent bearings which our methods of teaching have failed to exploit and which our students have therefore failed to translate into practice. I take the latter view.

(p 113)

Not much research has been conducted regarding the role of theoretical knowledge in interpreting language. A A Evans (1953), however, maintains that conscious knowledge can play a part here too:

It is through hearing good speech and through intelligent and critical reading that one grasps and comprehends the sentence with all its subtle variations and, through those variations, the intention of the speaker or writer. Nevertheless, a familiarity with and a training in sentence-structure, built up through the simple sentence and through sentences of simple or loose structure is of great help in reading, particularly in the grasp of the involved complex or or compound-complex sentence.

13.1.2 LEXICAL COMPETENCE AND THEORETICAL KNOWLEDGE

What can be concluded from all this in connection with the question of explicit knowledge in the improvement of lexical competence and performance? Assuming that, as Carter (1982:156) points out (perhaps a little optimistically), 'lexis is a level of language which can be studied in a clear, systematic and accessible way', one can argue as follows. In the first place, if explicit syntactic knowledge can improve syntactic competence, then it is highly probable that at the micro level conscious knowledge would also play such a role. After all, a similar type of knowledge and transfer is involved. Furthermore, as was suggested earlier, lexical competence is only part of a larger 'communicative' competence in which the various components are integrally related. Thus, for example, syntactic knowledge at the lexical level (knowledge of word classes and functions)

is, in effect, both syntactic and lexical. It can also be argued that, in order to be able to perform at the micro level, it is necessary to be able to cope at the meso (sentence) and macro (text) levels: thus, anything which can assist in improving competence at the higher levels is bound to effect improvements at the lower levels as well.

A further point to be noted here is that, if a generative-based grammar - one which is based on rules rather than ad hoc prescriptions and bits and pieces of knowledge - is likely to have greater success in improving syntactic ability (and there is some evidence which suggests that this is so, : see p 213), then it may well also be that a 'generative' approach to the word (what is sometimes referred to as 'the grammar of the word') might also be preferable to the traditional approach. This point will be amplified later.

13.2 A LEXICAL PROGRAMME

We turn now to examine the position of explicit knowledge regarding the lexicon in the light of the above comments.

13.2.1 MORPHOLOGY

Marland (1977) argues that 'pupils need to be taught word building' (p 182). This includes the following types of information:

(a) The basic morphemic structure of words and how morphemes are combined to form words. They should be able to divide words into morphemes and perceive the relationships between and the function of the parts as well as the rules of order of combination. They should then be shown how to use this knowledge for certain purposes:

- To discover the meaning of a word. For example, if a child analyses the term Protestant into its stem (protest) and its suffix (-ant), he will be able to see more easily that, in its early use, the term referred to people (and still does, though less consciously) who 'protested' against certain Christian practices and doctrines.

- To form derivatives. The term demagnetisation, for example, can be used to demonstrate the process involved. This information can be used to prevent the types of morphological unacceptability referred to on page 144.
- To use this information to memorise and spell words more easily.

(b) Related to the first point is the teaching of the morphemes which occur regularly in a corpus of terms, or at any rate are significant in some way or other. The prefix trans, for example, can be useful in dealing with terms such as transfer, transducer, transmit, transformer, translucent, transparent. Certain roots (eg fer, mit, luc) that occur in these words would also prove to be of value, as would certain suffixes (eg -er, -ent). Milligan and Orlich (1981) suggest that 'students should be made aware that words have structural elements which can serve as clues to the meaning of unknown words' (p 34). Similarly Marland (1977) comments as follows:

Pupils should be taught to tackle an unfamiliar word by examining it for familiar parts. If they know the meaning of that part, they apply it. If not, they deduce the meaning from the known word in which the familiar part appears.

(p 183)

Milligan and Orlich refer to the research of Thompson (1958) which suggests that 'learning the meaning of prefixes, suffixes, and roots improves general vocabulary' (p 34) - ie it has a general impact on vocabulary development. The efficacy of this approach lies in the fact that knowing a relatively small number of morphemes makes it possible to master a large number of words. Milligan and Orlich add the following as regards technical vocabulary:

Since so many more science terms contain Greek and Latin roots, it would follow that teaching root elements of science terms would be an especially productive technique for improving students' science vocabulary.

(p 34)

Pupils could therefore be supplied with lists of the roots and affixes that occur in the corpus of terms in the various subjects. The list of prefixes and suffixes that are used in our corpus are included in Appendix C. An examination of these could prove useful as a means of comparing certain features of the affixes

of different terminologies. For example, it can be noted that all three technical vocabularies involved here use the same three negating prefixes (in- ; non-; un-), which one would expect since all refer to concepts which have binary opposites. Certain points of difference regarding prefixes and suffixes are perhaps significant. The following, for example, can be noted:

- (1) Scientific terminology makes much more use of prefixes indicating number than does historical terminology. These can be seen, firstly, in the fact that Science uses a greater variety of such prefixes than History. The former utilises the following number prefixes:

bi-	(5)
di-	(8)
mon(o)-	(4)
poly-	(2)
tri-	(1)
tetra-	(4)
uri-	(1)
TOTAL:	(25)

By contrast, only the following three occur in our History corpus:

mon(o)-	(2)
tri-	(2)
uri-	(4)
TOTAL:	(8)

Secondly, these prefixes occur more often in the total Science corpus because there are more of them. Thirdly, the scientific set presents a more systematic case of 'cyclically ordered incompatibility'. The reason for the more extensive use of number prefixes in Science is probably related to the fact that scientific concepts tend to be more quantitative than do historical concepts.

- (2) The fact that History and Physics tend to use the suffix -er/-or far more than Chemistry is perhaps indicative of the fact that

these subjects are more concerned with agents performing actions than Chemistry, which deals more with reactions between substances.

- (3) The fact that suffixes -ism and -ist are far more common in History than in either of the Sciences is possibly the result of the fact that these suffixes are most frequently used to form nouns which respectively refer to theories, beliefs, approaches and a believer in a theory, belief or approach - concepts which are not generally relevant to Chemistry and Physics.
- (4) The use of specialist prefixes (eg cat-; endo-; exo-) and suffixes (eg -ine; -ol and -ene) as well as the use of certain affixes in the naming of chemical compounds needs also to be noted.

Pupils need, further, to be encouraged to see connections between the morphemes that occur in general vocabulary and technical vocabulary (eg PHOTOgraphy/PHOTOsynthesis) and across technical terminologies (eg caloriMETER/baroMETER). The limitations in the use of recurring morphemes referred to in an earlier section need also to be considered by the pupils.

(c) The formation of compound structures - the typical patterns and especially the role of the head and the modifier in relation to each other.

(d) Spelling: Peters (1967) stresses the need to teach children to 'attend carefully to word-structure, to look for "hard spots", to identify familiar word sequences within long words, to syllabize, to examine visual imagery' (p 30). This approach involves, firstly, what The Bullock Report calls 'the concentration of attention on the internal structure of words' (p 168). This requires a knowledge of the morphemic and phonological structure of words and an ability to analyse words into morphemes and syllables. An examination of commonly confused morphemes (eg de-, di-) and suffixes (eg -ary, -ery, -ory) could also be of value here.

An even more theoretical approach can be pursued as regards the following:

- Training pupils to understand the linguistic causes of spelling problems (eg the relative numbers of letters vs sounds).
- Fostering an understanding of the fact that the English spelling system is not as chaotic as it appears to be.
- Providing spelling rules. In this connection The Bullock Report comments as follows:

We believe that in the course of their writing children should acquire a knowledge of the spelling rules and an ability to generalise about words ...

(p 168)

In order for spelling rules to be effective, says Peters (1967), the following must be borne in mind:

- a) The rules must apply to a large number of words.
- b) They must have few exceptions.
- c) The statement of the rules must be simple and easily comprehended while being sufficiently exact to cover the appropriate words.

(p 46)

(e) Punctuation: Here the only issue regarding terminology is the use of the apostrophe. This can easily be taught by means of the basic rules. Once again the rules need to be simple enough and the pupil needs to be given practice in applying these.

It would seem that this type of information would not only help a child to deal with specific terms but would make him more aware of words as structures, to make him aware of the medium and not merely the message. This is important today when very few pupils study Latin; they do not know the Latin roots and are not accustomed to conscious awareness of the grammar of words.

13.2.2 SYNTAX

Although the specific focus of this investigation has been on the morphological and semantic aspects of terminological competence and incompetence, it has been suggested that these aspects cannot be separated from another important component of linguistic knowledge, viz syntactic knowledge. The latter underlies much of what has been said in 13.2.1 about morphological knowledge and is closely related to certain aspects of semantic competence. We turn here, then, to look at the kind of theoretical knowledge about the syntactic status and functioning of terms that could be used to develop a child's terminological competence.

(a) Word classes and their functions: Leech (1974) comments on the syntactic aspect of a lexical entry as follows:

The SYNTACTIC SPECIFICATION of an item consists in a set of features which classify it in terms of primary categories like 'Noun', 'Verb', 'Adjective' (ie parts of speech), and the secondary categories within these categories, such as 'Countable' (noun), 'Transitive' (Verb), 'Predicative' (Adjective), and so on.

(p 207)

This kind of knowledge is obviously essential for the use and understanding of any term and is used in conjunction with morpho-syntactic lexical rules as well as the rules which form part of the syntactic component of grammatical competence. It is necessary to know (intuitively, at any rate), for instance, that the term democratic is an adjective and can therefore be used with intensifiers such as 'more' and 'most' and can be used to modify nouns (as in 'A more democratic form of government was introduced in due course.');

that liberate is a verb which can therefore function as the key part of a predicate and can be inflected for tense, number and aspect (as in 'Mazzini helped to liberate his people.');

that acid is a noun and can consequently be used as subject, object, etc and can inflected for number (as in 'All acids contain hydrogen.').

One would aim, then, to develop an understanding of the following:

- (i) The various word classes to which terms can belong, especially, nouns, adjectives, verbs and adverbs.

(ii) The process and rules of recategorisation of terms, ie the process of changing a term from one part of speech to another. This can be achieved by two means. Firstly, there is the process of affixation, which involves the recategorisation of a term as a different part of speech by means of morphological changes, ie the use of prefixes and, especially, suffixes. The child needs to understand the various word classes in order to be able to use the morphological information referred to earlier. In this way one can correct the child who wrote that Somerset wanted to 'anglicisation' the Dutch.

Secondly, there is the process of conversion, a type of recategorisation which leech (1974) defines as 'a lexical rule which involves a change of syntactic function without a change of morphological specification' (p 215). The child needs to understand that there are terms, for example, which can be used as either nouns or verbs (eg revolt, focus). He also needs to realise that conversion can be either partial or total - the latter involves using a term as different parts of speech, while the former involves no change in the word class as such but changes as regards some or other syntactic feature(s) (ie a change in sub-category, eg +concrete to -concrete).

It is also essential that the pupil understand that conversion brings with it other changes, ie the fact that the word is used with a new set of inflexions. Thus, for example, if the noun revolt is converted to a verb, it loses its typical noun inflexions and acquires typical verb inflexions.

A further aspect of the process of conversion which the child needs to understand is that when a word from general vocabulary is used as a technical term it undergoes what might be called a 'technical conversion'. This is necessary where the term is used as a different part of speech from the word in general vocabulary. Two such examples are as follows:

INCIDENT: noun-modifier in Physics
 noun in general vocabulary

OCULAR: noun in Physics
 adjective in general vocabulary

What makes this more difficult is the fact that the second word has a typical suffix which normally suggests the word-class as it occurs in general vocabulary: ocular corresponds to adjectives such as nuclear, molar, etc.

Two further less drastic possibilities that can occur here as well should be noted:

Firstly, a technical term may be used as a part of speech which is rare in general vocabulary and may in fact be unknown to the child. One such example from Chemistry is the term melt, which is usually used as a verb in general vocabulary, although it is listed in the dictionary also as a noun. The latter, rare, usage is more likely to occur in Chemistry along with the more common usage as a verb. This can be seen in the following extract from Pienaar and Walters (1973):

Another way in which the ions in an ionic crystal can become mobile is to disrupt the crystal lattice by melting the substance. Salts and alkalis, which already consist of ions, are converted in this way to the liquid phase and the ions can move in the melt (liquid).

(p 328)

The second possibility here is the restriction of a form to only one part of speech in a technical vocabulary by contrast with its occurrence as different parts of speech in general vocabulary. It happens on most occasions that the other parts of speech are irrelevant to the technical vocabulary and can often in fact not occur in the technical vocabulary with any kind of related meaning, a point which should be noted. Some examples in point here are as follows:

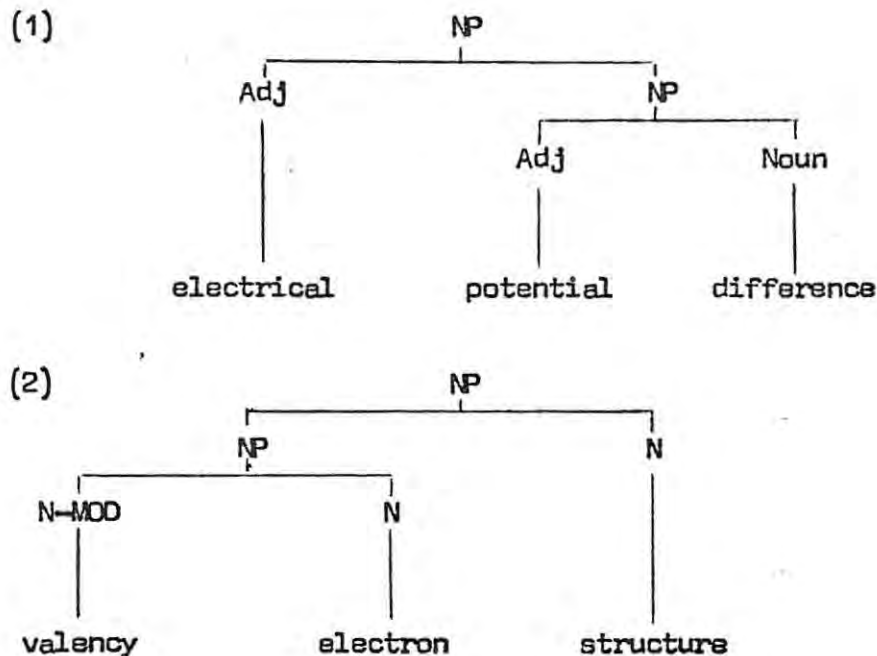
- | | | |
|-----|-------------------|------------------------------------|
| (1) | <u>General:</u> | noun and verb |
| | <u>Technical:</u> | noun only |
| | <u>Examples:</u> | Physics: work; force; wave; object |
| | | Chemistry: base; matter |
| | | History: say; class |
| | | Chemistry & History: state |
| (2) | <u>General:</u> | noun and verb |
| | <u>Technical:</u> | verb only |
| | <u>Example:</u> | Physics: project |
| (3) | <u>General:</u> | adjective and verb |
| | <u>Technical:</u> | adjective only |
| | <u>Example:</u> | Physics: erect |
| (4) | <u>General:</u> | adjective and noun |
| | <u>Technical:</u> | verb only |
| | <u>Example:</u> | History: act |

It can, of course, happen that these technical terms can be used as different parts of speech in technical discourse; however, they are not then being used as technical terms but as general vocabulary items.

(b) Compound terms: Here the child needs to understand the nature of the functions of the various word classes that are combined to form compound phrases as well as the overall syntactic structure and function of such a phrase as a whole. The following two compound terms referred to in 7.1.5 are cases in point here:

- (1) electrical potential difference
- (2) valency electron structure

In order to understand these terms fully, the child needs to be able to establish the following syntactic specification for each:



Establishing such information is not merely necessary to understand these compound phrases but also to understand that, while there is no such compound term as electron structure or electrical potential (although in each case the two terms may collocate with each other), there are compound terms such as valency electron and potential difference which have to be known and used as such and which are necessary to be understood as the starting point for understanding the compound phrases referred to above. What the child needs also to realise here

is that, as Sager et al (1980) point out, it is often not possible to interpret composite phrases without context and without knowledge of the subject matter. In order to establish the underlying syntactic structure of the above phrases, one needs to take into account certain scientific knowledge:

As regards (1): One finds that there is a term potential difference in Physics, and that electrical potential difference is therefore merely one particular type of potential difference.

As regards (2): Here one finds that the term valency electrons is used in Chemistry to mean 'the electrons occurring in the electron groups with the highest energy' (Brink and Jones:168). From this one deduces that the term valency electron structure therefore means 'the structure in terms of the valency electrons'.

There is a kind of circular process involved here: In order to understand the terms fully, one needs to establish the syntactic structure of these terms; but in order to establish the syntactic structure of the terms, one needs to understand certain facts about the component parts of the terms. This is largely the result of the close inter-relationship of terms commented on earlier.

Certain other aspects of the syntactic nature - as well as certain semantic implications - of terminological phrases need also to be noted by the child.

(a) From a structural point of view, the following points could be pointed out to the pupil:

Firstly, there is the fact that the vast majority of compositions centre round the noun as the nucleus. Sage et al (1960) comment as follows:

In special languages the vast majority of compounds are nouns and are formed by linking one or several nouns, names or adjectives to the nuclear noun.

(pp 267-8)

Secondly, there is the fact that the majority of compositions involve pre-modifier rather than post-modifier constructions. It should be noted, however, that History does incorporate more phrases with post-modification than does Science, especially where the names of events, institutions or documents are

involved. Examples here are:

American War of Independence
 Declaration of the Rights of Man
 League of Nations
 First Treaty of Paris

This kind of knowledge can help them to analyse compounds and to perceive the typical underlying structures.

(b) From a semantic point of view, it can be said that the creation of new linguistic units by means of composition 'corresponds to refining and narrowing the knowledge structure by means of relating notions and concepts to each other, thus creating new concepts /compounds' (Sager et al:1980:257).

If one turns to the semantic relations between the concepts attached to the various parts of a composition, one notes the following:

In those kinds of compounds that most frequently occur, the last element expresses a general meaning, which the prefixed element renders less general.

(Bradley:1948:112)

Sager et al (1980) concur as follows:

The nucleus of the compound, usually the last element, indicates the category to which the concept belongs, and the determinant indicates the criterion for the subdivision of the category.

(p 268)

Some typical examples here are as follows:

ray-box	= box used for (experiments with) rays (of light)
evaporating dish	= dish used for evaporating
magnetic coil	= coil which is magnetic
sodium hydroxide	= hydroxide with a sodium base
werkommando	= kommando which won (<u>het gewen</u>)
divine right	= right granted by the divine
loan farm	= farm granted on loan

In a multiple composition, the nucleus is specified by two or more determinants which themselves vary as regards the degree of specificity they lend to the nucleus. In (1) mentioned above, for example, one finds the following semantic relationships:

electrical potential difference:

- 'potential' specifies the type of difference involved
- 'electrical' specifies in turn the type of potential difference involved - ie. there can be different types of 'potential differences'

Within the framework of this general tendency of a determinant to narrow the reference of the nucleus, the complexity of the semantic relationships between the parts of compounds can vary considerably. In this connection Francis (1977) makes the following point:

The semantic relations between the parts of compounds is very varied. If compounds are thought of as implied earlier as the product of a transformation process, this variety can be revealed by reconstructing the phrase from which the compound might have been created.

(p 154)

He points out that the simplest relation in the deep structure may be that of simple modification, ie in the deep structure the noun is modified by a relative clause which, through transformation, is then compressed and re-ordered. An example of this would be the following:

<u>Term:</u>	negative charge
<u>Deep structure:</u>	charge which is negative
<u>Transformations:</u>	deletion - charge negative re-ordering - negative charge

Through transformations, then, we arrive at a term the determinant of which specifies the property of the nucleus which distinguishes it from other examples with the same nucleus. The determinant also expresses a contrasting set of properties in that the term negative charge contrasts with positive charge.

Some compounds, however, have a far more complicated system of transformations involved in their derivation - more deletions, re-orderings, etc. The following examples illustrate this fact:

(1)	energy charge	= change of/in energy
(2)	electron transfer	= transfer of electrons
(3)	wave motion	= motion of a wave
(4)	magnifying glass	= glass for magnifying
(5)	product solution	= solution which is produced
(6)	ripple tank	= tank with ripples (?)
(7)	test tube	= tube for testing
(8)	evaporating dish	= dish for evaporating
(9)	loan farm	= farm granted on loan
(10)	divine right	= right granted by divine authority

An understanding of the types of semantic relations between parts of compound phrases would help the child to learn and understand composite terms.

(c) Inflexions: We have referred already to the question of inflexions under the section dealing with morphological information about vocabulary. In order to understand and use these inflexions, one needs certain syntactic knowledge in the first place, for example, the concept of number, case, etc. The close relationship between syntactic and morphological rules in language is, once again, very evident here.

13.2.3 SEMANTICS

It is clear that an explicit knowledge of the semantic aspects of lexical competence can be of assistance in helping the pupils to anticipate and overcome some of the problems discussed earlier in this Thesis. Some examples are as follows:

(a) Types of meaning: By acquiring knowledge about the two types of meaning referred to earlier - cognitive and emotive - the child can become aware of the emotive aspects which can interfere in his understanding of terms which are used in general vocabulary as well. It is necessary to understand, for example, that, while in South Africa the word 'liberal' has, for many, unfavourable connotations and is associated with the word 'communist', this is not necessarily the case in History.

(b) Relationship between a term and its meaning: We have seen that a simple one word/one meaning relationship is most often not the case with words in general vocabulary and is also often not the case even in scientific terminology; and that if terms are taken from general vocabulary, then the relationship between word and meaning turns into polysemy from the point of view of the learner. A lack of awareness and understanding of polysemy can cause problems in the use and understanding of polysemous words. It is not only the lack of knowledge of the multiple meanings that are attached to particular terms that causes problems: it is also the lack of understanding or even awareness of the concept of polysemy itself that can also cause problems. Chatman (1956/7) comments as follows on situations where pupils know only one meaning for a word and tend automatically to use or interpret the word with that meaning:

Not only doesn't the student understand the word, but far worse, he doesn't even know that he doesn't understand it. And the astonishment and disbelief in his eyes when you tell him that words often have more than one meaning!

(p 501)

This applies both within general vocabulary and with terms derived from general vocabulary. It also applies to historical contexts where the referents of words have changed in time. The way to overcome this general problem is not to try to give the pupil all the possible meanings of each term - an impossible task - but to make him aware of the concept of polysemy by means of selected examples and exercises. In this way the child can come to realise what Chatman calls 'the perniciousness of taking the first meaning that comes to mind'. He aptly describes the aim of the exercise as 'sensitising students to a higher degree of semantic awareness'.

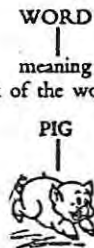
The child needs, therefore, to be presented with the type of information which I included in a standard 8 English textbook published in 1978 (Comprehensive English Practice 8:p 324):

RELATIONSHIP BETWEEN WORDS AND THEIR MEANING

1. Simple Meaning

We tend very often to think of a word related to its meaning in the following way:

For example, we think of the word *pig* as follows:



However, the relationship is not always so simple. There are at least two complications:

- polysemy;
- synonymy.

2. Polysemy

This means that *one word* may have *more than one meaning*. (The word *polysemy* is formed from the Greek words for *many* and *meaning*.)

For example, the word *record* as a noun can have, amongst others, the following meanings:

- an official report of something;
- the best performance;
- a round, black, groovy disc that plays back music.

There are, then, at least *three meanings* to this *one word*. Thus the situation is as follows:



Normally it is quite clear from the sentence or situation which meaning is intended. Polysemy can, however, lead to misunderstanding if a word comes to have two very different meanings which can occur in the same situation: the listener might not be sure as to which is intended. Such double-meaning is known as *ambiguity*.

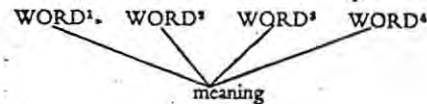
However, there is one great advantage of polysemy. Language would be highly complicated if we had a separate word for every meaning.

Polysemy is sometimes used to create humour by means of *puns*, where one deliberately plays on the multiple meanings of words. In Shakespeare's *Romeo and Juliet*, Mercutio, bleeding to death, says: 'Ask for me tomorrow, and you shall find me a *grave* man.'

3. Synonymy

It is possible to have *two or more words* that can express *one meaning*. For example, to express the idea of being *happy*, there are numerous words: happy, genial, blithe, gay, etc.

Here we have the following situation:



Each of these words of similar meaning is called a *synonym*. It is important to note that there are very few words which mean *exactly* the same. The way to test for synonyms is to see if one word can be substituted for another in a sentence without altering the meaning of the sentence in any way. There are very few such words. It is really only scientific terms referring to the same idea which can be interchanged without risk. For example, the words *caecitis* and *typhlitis* both mean *inflammation of caecum and vermiform appendix*. Thus, most synonyms are similar, but not identical, in meaning.

We have pointed out that the advantage of polysemy is that it is economical—it cuts down on the number of words needed in the language. It can be seen that synonymy actually counteracts this advantage: it *increases* the number of words in the language.

However, the fact that synonymy increases the number of words in the language is what makes it valuable. By having more than one word to express basically the same meaning, we gain the following advantages:

- (a) We can avoid **monotony**. It would become boring if a writer continually used the same word over and over:

It was a fantastic session—the music was fantastic and I had the most fantastic partner.

The writer could have avoided the monotony of *fantastic* by using such words as *marvellous*, *terrific*, *thrilling*, *tremendous*, or *slang* words such as *groovy*.

- (b) Synonymy makes it possible to express **one's meaning more clearly**. Note the verb in the following sentence:

Cecil nipped round the corner when he saw the principal arriving.

It would have been possible to use another word of similar meaning (e.g. *ran*), but the word *nipped* is more precise in this situation, as it suggests not only fast, but *furtive* action.

- (c) Synonymy makes it easier to adapt **one's language to the situation**. In chatting informally to a friend, the verb in this sentence is acceptable:

I must zap round to see Emily.

However, it would not be acceptable to use this verb in a *formal* situation—for example, a history essay:

Napoleon then zapped across Europe to Russia.

If there were only one word to each meaning, this adaptation would not be possible.

(c) Lexical relations: Pupils can be encouraged to look for and understand more explicitly the relationships between terms by examining the various types of lexical relations (referred to earlier) that can pertain between terms. He also needs to be made aware of the fact that technical concepts are far more closely inter-related into formalised bodies of knowledge. Exercises using 'branching-trees' along the lines suggested by Cluver (1980) could be used here.

(d) Classification and concepts: By giving the child some information about the nature of 'concepts', he can come to understand how concepts often overlap to form what Wittgenstein called 'word families'. He can also, by being made aware of the fact that a concept is an image or hypothesis based on the distinction between 'instances' and 'non-instances', be taught to test his own understanding of concepts by seeking to disprove his hypotheses (Popper's approach) or to verify them (Kuhn's approach).

An understanding of the difference between technical and general concepts could also be useful, as it could lead the pupil to be aware of the need to seek a more explicit, precise understanding of a technical concept. Conscious knowledge of the techniques of defining terms could also be of value here.

The following basic information regarding the writing of definitions could, for example, be provided:

Definitions generally give:

- A the class to which a particular concept belongs
- B the specific characteristics of the concept which make it different from other members of the same class.

This means that the thing to be defined is usually described first in terms of its general class, and then in terms of its particular properties, qualities, uses, etc.

The following type of exercises could then be based on this:

1. Analyse each of the following definitions into

- A the general class of things
- B the particular characteristics:

- (a) CLIMATE: The average weather conditions of a place or region throughout the seasons. It is governed by latitude, position relative to continents and oceans, and local geographical conditions.

- (b) DESERT: An almost barren tract of land in which the precipitation is so scanty or spasmodic that it will not adequately support vegetation. The three main types of deserts are : rock deserts, stony deserts and sandy deserts.
- (c) GRASSLANDS: Those regions of the world where the natural vegetation consists of grass. (The rainfall is too light to permit forest growth, but is less scanty and irregular than that of the deserts, and the grasslands are thus normally situated between the forest belts and the arid regions.)

2. a) Give a clear definition of each of the following:

- i) miscreant
- ii) sycophant
- iii) charlatan

(b) What do all these have in common ?

3. Read the following definitions and then answer the questions which follow:

ASTRONOMY: The science of the heavenly bodies

ASTROLOGY: The study of the effect of the heavenly bodies upon our lives.

A definition usually states

- I. the general class to which a particular concept belongs
- II. the specific characteristics of the concept

(a) What do these terms have in common as regards

- i) general class
- ii) specific characteristics ?

(b) How do they differ as regards specific characteristics ?

4. Read the following passage and then answer the questions which follow:

LIMNOLOGY

"Limb what?" is the first question asked by most people hearing the word limnology for the first time. No, it isn't the study of limbs.

Limnology is basically the study of the ecology of fresh waters - rivers, lakes, reservoirs and swamps. It derives from the Greek prefix limn meaning 'marsh', and the familiar suffix ology, meaning 'Study of'. Contemporary usage of the term denotes the study of the physics, chemistry and biology of inland waters, which by implication are mostly fresh, although in reality inland saline lakes

are nearly as voluminous as their freshwater counterparts. Flip-
pantly, limnology might be termed the landlubbers' version of
oceanology.

Apart from obvious differences in the size and saltiness of their
respective systems of study, oceanologists and limnologists share
a great deal of common ground - such terrestrial prejudice! - in
terms of the basic similarity in the ecological structure and bio-
logical functioning of aquatic ecosystems. Water is the common
denominator, even though oceanographers and limnologists are
operationally distinct entities in most cases.

A definition usually states

- i) the general class to which a particular concept belongs
- ii) the specific characteristics of the concept.

a) What do the terms LIMNOLOGY and OCEANOGRAPHY have in common as
regards

- i) the general class to which they refer ?
- ii) their specific characteristics ?

b) How do they differ as regards their specific characteristics ?

5. A. 1. To which general class of things does each one of the
following belong ?

- a) Geology
- b) rat
- c) table
- d) anger

2. Supply the word being defined in each of the following:

- a) A is someone whose beliefs deviate from the
orthodox.
- b) A is someone who always expects the worst to
happen.
- c) A is someone who has the power to experience
objects and events beyond the senses.
- d) A is someone who is over-anxious about his
health.

B. The following is an acceptable definition of a BAROMETER:

The instrument used to measure atmospheric pressure.

The following is the description of a good definition:

"A good definition must include a reference to the general
class of things to which something belongs, and it must
indicate the characteristics of the particular thing clearly
enough not to be either too general or too limited."

In terms of the above, why is each of the following NOT a
good definition of a barometer ?

1. A barometer measures atmospheric pressure.
2. A barometer is an instrument which measures atmospheric pressure in low-lying areas.
3. A barometer is a measuring instrument.
4. A barometer is an instrument.

Exercises involving working with formal and informal definitions along the lines mentioned earlier could be combined with the above exercises. So could exercises which combine the defining of terms and examining lexical relations. The following exercises, for example, would be relevant here:

In each of the following, give the general class and the particular characteristics involved in the definition, as well as answering the other questions which follow the definitions:

- a) AUTOCRAT: A ruler who takes all power into his own hands and pays no attention to the wishes of his subjects.

How does an autocrat compare with a dictator ? a tyrant ?
 What is the etymology of the word 'autocrat' ?
 What is the antonym for 'autocrat' ? What is the etymology of this word ?

- b) SUFFRAGE: the right to vote.

Give a synonym for the term 'suffrage' beginning with f_____.

- c) REACTIONARY: Someone who wants conditions to return to what they were in an earlier period.

What term is used in SAE to describe such a person ? What is the SAE antonym for this word ?

- d) COUP D'ETAT: A sudden change of government brought about by force.

How does a coup d'etat differ from a rebellion ? a revolution ?

Pupils should also be encouraged to use this knowledge to evaluate definitions presented to them by teachers and textbooks.

The advantages of explicit knowledge regarding definitions is as follows:

- Pupils can more easily grasp concepts presented to them in the form of definitions or see how a definition sums up concepts they have been exploring.
- The tendency to learn definitions parrot-fashion could be overcome.

- Pupils could realise that some of the definitions presented to them are inadequate.

13.2.4 CONCLUSION

It would seem, then, that conscious knowledge about how words are formed and spelt, how they function in sentences, how they are derived from one another and how they relate to meaning can help the child to cope with the problems arising from certain deficiencies and defective aspects of his lexical competence; the aim being not to try to deal with each problem in turn but to provide the child with a general means of overcoming these problems when they arise. This type of knowledge also makes the child generally more aware of the types of problems that can arise and alert to the whole issue of technical terminology.

CHAPTER 14SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

- 14.1 It is clear that the morphological and semantic complexities of terminologies place great demands upon the cognitive and linguistic competences of school pupils. If one adds to this the terminological incompetence sometimes displayed by teachers and textbook authors, one is not surprised that pupils display lexical incompetence in their linguistic performances in Science and History.
- 14.2 It is clear that, in order to assist pupils to overcome the problems that arise from the demands of technical terminologies, schools need to adopt a programme of 'language across the surriculum' - a programme of general guidance and training in the use and understanding of technical terminology as well as assistance regarding the specific technical terms that are used in particular school subjects. This policy needs the support of both the English teachers and the subject teachers in a school. There are, however, at present certain factors which hamper the implementation of such a policy. In particular, there is the fact that English syllabuses and examinations tend to play down the importance of formal knowledge about language and the need for a systematic approach to the teaching of language. This means, then, in particular, that issues regarding the vocabulary of the language are neglected. There is also the fact that both language teachers and subject teachers have little or no training in language in general and in the lexical aspects of a language in particular.

These obstacles call for certain steps to be taken to overcome them:

- (a) Prevail upon syllabus compilers to amend certain aspects of the language section of the syllabus.
- (b) Require all teachers to take a course in language which will provide them with a comprehensive knowledge of the nature of language, of language acquisition and language

learning, as well as the linguistic aspects of the terminologies of their own particular subjects. English teachers should also be required to take more intensive courses in language study.

- (c) Organise in-service courses for both English teachers and teachers of other subjects on the study of language.

This could have a double value for the pupils. In the first place, it could lead to an improvement in the presentation and teaching of terms by teachers and textbook authors. In the second place, it could enable teachers to provide better assistance to pupils to cope with the problems presented by terminologies.

- 14.3 In the meantime, there is no reason why an approach to the question of a programme of language across the curriculum should not be propagated and implemented as can best be done under the circumstances. This would involve a two-prong attack upon the problems of terminological incompetence. In the first place, teachers should be encouraged to become aware themselves of the types of problems in general and the specific problems of specific pupils in particular, and to take steps to assist pupils by anticipating and analysing problems and taking into account the pupil's present level of cognitive development and his existing knowledge. More effective methods of testing for comprehension could also be devised. In the second place, the pupil could be provided with a definite lexical programme which could provide him with certain theoretical knowledge about vocabulary in general and technical vocabulary in particular which he could apply to his own situation. Such a programme could be devised for a school by a group consisting of linguists, English teachers and subject experts. The problem of implementing such a programme may be great, but it is not beyond the bounds of possibility that such a programme could be devised and implemented with success. Where there is a will, there is a way.

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A P P E N D I C E S

A CRITICAL INVESTIGATION
OF THE
SEMANTIC AND MORPHOLOGICAL ASPECTS
OF TERMINOLOGICAL INCOMPETENCE
(with special reference to
the English-speaking student of
Physical Science and History
in the Cape Education Department high school)

by

MALCOLM GORDON VENTER

NOTE: Since the Questionnaires were originally devised to obtain information in a wider field than the final topic of the Thesis, some of the questions and the findings are not directly relevant to this Thesis. A detailed analysis of the findings is, therefore, not included here. Relevant tables of responses are instead included in the text of the Thesis itself.

C O N T E N T S

APPENDIX A	PUPILS' ANSWERS TO EXAMINATION QUESTIONS
APPENDIX B	LISTS OF TERMS
APPENDIX C	LISTS OF PREFIXES AND SUFFIXES
APPENDIX D	QUESTIONNAIRE TO SCIENCE TEACHERS
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A P P E N D I X A
=====

PUPILS' ANSWERS EXAMINATION
PAPERS

QUESTION 1QUESTION:

The M^hFecane was essentially a process of social, political and military change within African society which took place with explosive rapidity during the rule of Shaka. Discuss this statement in an essay in which you expand on the ideas stated above.

MEMORANDUM:

The following is the relevant section of the textbook which was used as the memorandum:

i) Social causes

The area of Zululand and Natal is a fairly narrow strip between the escarpment and the sea. It is known to have supported a large Bantu population at least as early as the 16th century. The healthy climate and the fertile soil, together with the marriage customs of the Bantu which made sure that women had as many children as possible, (i.e. the custom of marrying widows to their husbands' brothers or encouraging them to live with other men called "seed-raisers" to bring up children in the dead men's names) suggest that the population would increase very quickly. If we study the tribal histories of the first *decades** of the 19th century, they show that all over Bantu South Africa the population increased at a *rapid rate**. The only outlet for such expansion in the Zululand area was either into the interior plateau to the west or southward down the coastal strip. Although some westward expansion took place, the migration out of the rich coastlands on to the plateau with its icy winters and its population of strange Sotho tribes, would not be undertaken willingly. As far as the southward migration was concerned the Zululand tribes were faced with a great bloc of peoples in Natal and the Transkei lying between them and the unoccupied country. Whether the frontier at the Fish River had been opened or closed would not have changed the fact that before reaching it they would have had to go across land occupied by other people. This brings us back to the fact that there developed in Zululand an area of high population pressure. Coupled with cultural contact between the Sotho and Nguni-speaking peoples in the area where the escarpment loses its sharp linear character, this provides the first cause of the Mfecane.

ii) *Political causes*

During the 18th century, under pressure of land hunger and stronger intertribal conflict, the small tribe of the first settlement phase (little more than an expanded clan) began to give way to large *multitribal blocs* which competed for the allegiance of the remaining independent tribes. As this took place a process of institutional change also began, probably brought about by contact between the tribes belonging to the two major divisions of the Southern Bantu (Sotho and Nguni). Conflict between the new groupings increased the pace of change still further and between 1818 and 1828 it reached a revolutionary climax in the Zulu kingdom of Shaka.

iii) *Military Causes*

The essential characteristics of the revolution in its centre of origin were the adaptation of the initiation ceremonies to military purposes and the creation of a permanent standing army organised in age-regiments. This was a reaction to conditions of frequent and severe warfare and was probably stimulated by contact with the rudimentary age-regiment system of the Sotho peoples.

It implied much greater internal unity within tribes, as the age-regiments made up of youths from all parts of the tribal territory took the place of the territorial chieftaincies as the immediate foci of political loyalty. It also went with a greater concentration of power in the hands of the ruler. As the balance of power which had given meaning to the traditional system of consultation disappeared, true despotism began to appear. This in turn went together with an important administrative change. There was a transition from a bureaucracy of "royals" to a situation where administrative authority passed into the hands of commoner *indunas* personally chosen by the ruler and dependent on him. We can also see this change in the emergence of the modern European state where there was a development in the direction of greater political centralization and more active government.

Candidate A

The Mfecane as mentioned had social, political and military changes. The social change was brought about mainly as the result of the increase in population in the small strip of lands of Natal and Zululand between the escarpment and the sea. Overpopulation resulted from the healthy climate, rich soil in this area and marriage custom of the tribes living there. Expansion was an absolute necessity. The outlets for expansion could be to the west across the plateau or down the coastal plane. Migration to the west was not taken willingly because of the icy winters and infertile soil. (Though some expansion in this direction did take place.) Expansion to the west was a problem as they were faced with a bloc of people in Transkei and Natal between them and the open uninhabited land. Even if the boundary of the Fish River had been closed they would still have to go across land occupied by other

people. They were greatly influenced by the Sotho and Nguni tribes as a result of this contact.

2 Politically there was great changes. Small tribes gave way to multi-tribal blocs who in turn fought for the allegiance of remaining independent tribes. An institutional form of government appeared and the old system of consultation fell away. Mainly as a result of contact between the Sotho and Nguni tribes.

3 Military changes were as follows. There was the introduction of initiation tests which was for the purpose of military power alone. Young men from all the tribes (under the multitribal bloc system) were brought together and divided into age regiments. This formed a closer unity within the tribes on the military point of view. These youths replaced the immediate foci under the form of political loyalty. They controlled the administration of the different tribes. Under Shaka's rule the political system was changed a little further. He united multitribal bloc's with himself as paramount he appointed indunas to keep control of each bloc, they were responsible to him. He continued the age-regiment system, but became stricter, his men had special barracks where they lived until the age of 40. They were unmarried.

Candidate B

1 The Mfecane was a process of social, military and political change which took place with explosive rapidity.

2 During the 16thC the bantu population in Natal & Zululand was expanding rapidly due to the fertile soil, healthy climate and the Bantu marriage systems. Problems broke out when the tensions developed between the Nguni & sotho tribes. There was cultural problems. This was the first cause which was social of the Mfecane.

3 Tribes became hungry and there was confrontation. A revolutionary atmosphere prevailed. Tension ran high and it all came to a head in the reign of Shaka. New systems where introduced by which large army's were formed. Indunas were divided up into age regiments. This gav? the tribe a sense of unity and put much more powers in the hands of the leader. This lead to absolutism. Also commoner man were able to obtain

ranking. This led to the military causes.

4 In the Matwetwa tribe Dingiswayo and his brother planned to overthrow their father who was king. The plot was discovered and he fled. On his way he met a white man with a gun & horse and successfully through his brother from power and became king. He started an expansion programme by which smaller tribes were invaded and put under his control. A incident developed when the tribes had a fight over a piece of farmland. The Nguni tribe one and was left to face Dingiswayo. But a new and more powerful power was developing under Dingiswayo called Shaka.

5 Shaka's father had made a girl from another tribe pregnant. His father refused responsibility but eventually took the girl into his tribe. Due to the girl's behaviour she was expelled from the tribe and Shaka grew up fatherless. He was teased and bullied in his youth. He obtained a strong cruelty streak in him and with his high intelligence felt he had to prove himself by ruling over his fellow man. He was courageous and did not care for the suffering of others. He became chief of the Zulus and was known for his bravery.

6 Shaka played a big part in causing the Mfecane with his reign of cruelty. This coupled with Social, Political & Economic factors led to the Mfecane.

Candidate C

1 The Mfecane started when Shaka, a powerful king who had already wiped out most of the tribes in Central Africa, moved southward. He was scared of the whites in Southern Africa as they had more sophisticated equipment. Shaka tried to make contact with the British Government but he never managed to reach them.

2 Shaka's tribe, the powerful Zulu nation, started a chain reaction. They wiped out all the tribes in their way. This caused an effect of other tribes killing each other. Soon tribes moved northwards. The Nguni tribe moved northward into Tanzania. Mantatise a woman, had her own powerful tribe which wiped out a few tribes. All in all 28 tribes were wiped out. The tribes became spread apart. They did not mix very well any more because they were scared of each other. The whites on the

frontiers had more of problem because of the blacks on the eastern frontier. The Mfecane caused the tribes to form into a semi-circle in and around the middle of Africa.

3 The army of Shaka's was tough. He had strict measures and his soldiers had to stick to him otherwise he persecuted them. Shaka had great military power. On the battlefield he was a genius.

4 The tribes were spread apart because of the fighting that had been going on. Something had to be done to unite the tribes into an all powerful nation. Shaka was very clever in the way he went about uniting the tribes after what his tribe had done. The other tribes, I think, had great respect for Shaka. The whites were well aware how powerful the Zulu nation were but they were frightened about the eastern frontier although the tribes were scattered all over Africa. Shaka tried to unite tribes. He succeeded with some of them. He divided them into age groups. They would learn how to fight, even if they were young boys. He divided them into blocs. Each had its own head. The tribes got on well like this and Shaka had a lot of power and a very strong army. The tribes were together again and they got to understand each other better.

5 Although this wasn't too popular with the whites I think it was a good thing. Instead of being bunched up on the borders eg Pondoland; the tribes scattered and moved out of the South African section. The tribes were united and could, I think have overthrown the white man's rule at the Cape and on the eastern frontier. Although it meant a lot of change to the African society it was a worthwhile operation. The 'Mfecane' means the 'crushing'.

Candidate D

1 The Mfecane was essentially a process of social, political and military change which took place with explosive rapidity during the rule of Shaka.

2 This is due to the population growth of the blacks at this particular period and tensions between the tribes. Shaka as a young boy was always fatherless as his mother was sent back to her original tribe due to her tempers as Shaka grew up. Heir to the throne as a boy he was always tested for superiority and was ridiculed wherever he lacked it. This

This made him a crule and ruthless warrior when he joined into the Zulu Regiments of impi's.

3 His fighting skills and bravery earned him the title dingeshwayos hero. He soon became paramount chief of the Zulu's and started attacking smaller tribes, burning there villages restoring woman and children to his tribe, not used by his predecessors. His army increased as well as his wealth in cattle and popularity in his own people.

4 His enemy's were left defenceless to his crescent shaped tact in battle, this was the military adjustments he made.

5 Politicly his aim was to unite as many tribes into his own as possible by means of force as himself as paramount chief his hostile neibours were chased from all around him. Very often he had tried to make an agreement with the British goverment, but they had continually refused his gesture. Each time politcly he was very stable and secure.

6 Social changes were hardly noticable at all. This caused very little change during this period the few changes were that there was a much greater comunity but very little social contact with the neighbouring parties this was the same in every tribe.

7 What can be conclude is that there was a great deal of politicle and millitary change but a very small margin of social change during Shakas rule thout the M'Fecane.

QUESTION 2

QUESTION:

In what ways had the British Settlers suffered in the political sense by coming to the Cape ?

MEMORANDUM:

Suppression of right to protest - press issue - lack of political freedom; pass system.

Candidate A:

- (a) He had enjoyed greater freedom as opposed to the pass laws which were introduced.
- (b) England was in a depression when he left and he arrived to find a depression at the Cape.

Candidate B

The 1820 Settlers had many problems. Many of them were not ever farmers and they had to get used to farming and farming conditions in the Cape. The farms were also too small. There was a great labour shortage and they were not allowed to use slave labour. They suffered great problems from the invading Xhosas, and many children were killed. They arrived at the Cape during an economic depression and had left Europe in a depression. There were many political factors which made the settlers suffer.

Candidate C

The frontier wars.
The Zulu could easily raid.
There were many raids.

QUESTION 3QUESTION:

State the causes which led to the annexation of Natal and Transoranje.

MEMORANDUM:

- (a) Natal : There had been attempts to get recognition for the Trekker state in Natal - Charters' attempt - taken over by Britain in 1842 and ceased to exist the following year. Reasons :
 - (i) Strategic : east coast of Africa important for Britain - foreign powers a threat to Britain's sea route: Voortrekkers had sought contact with Netherlands, Brazilia, etc. Coal deposits had been discovered.
 - (ii) Economic: rivalry among coastal merchants - cotton and sugar discoveries.

(iii) Political: formation of Republic in Natal a blow to British prestige; native 'reserves' affected the eastern frontier of Cape Colony.

(iv) Philanthropic: Natal Republicans accused of maltreating natives - the Ncapayi affair - Smith sent to take over.

(b) Transoranje: British Resident, Major Warden, stationed in Bloemfontein to maintain peace between white and non-white; thus Britain's intention to interfere unable to keep peace between such various groups. Smith ended treaty state system in 1848 - wanted to follow policy of annexation and direct military rule. Smith gave out that all whites wanted annexation but only Oberholtzer's group was in favour.

Candidate's answer

In Natal before Natal had actually been annexed, there had been another attempt before that. The first annexation had failed because of the monetary expenses and Britain first thought the interior was useless.

Later when the British realised that the climate in Natal was excellent for barley and sugar, products needed in the Cape, the British started serious thinking about annexing Natal. The British also realised that Natal had her own port and could maybe start ties up with her mother country, Holland. British Cape could also use the port to their own advantage for transporting goods to overseas markets. Finally when two trade ships were sighted off the Natal coast the British decided that Natal was too important and annexed it after a clash with troops from Natal.

The reasons for annexing Transoranje was a bit different from the Natal reasons.

First of all there were four groups of people living in the Transoranje region and Smith, in-charge of the region couldn't cope with dealing with all four groups. When the boers proclaimed the area for themselves, Smith went to the Cape and told the British officials that it would be no trouble at all to annex the Transoranje and it would cost practically nothing. Smith also said that the people of Transoranje wanted to be annexed, but only the Oberholzer group wished for this. Smith granted time to let

Pretorius have a meeting to see if they weren't going to leave. While the meeting was in process, Smith annexed the Transorange and now called it the Orange River Sovereignty - O.R.S.

QUESTION 4

QUESTION:

Write a paragraph of between 10 and 15 lines on the reforms of Janssens and de Mist.

MEMORANDUM:

The following is the relevant section of the textbook which was used as the memorandum:

ii) Administrative reforms

Both de Mist and Janssens were men of ability and firm believers in the principles for which the French Revolution originally stood, though they did not like the methods later adopted by the French Republic. Liberals as they were, they nevertheless believed in strong government, and though much attracted by the ideas of equality and brotherhood, they were shrewd and practical men. On the whole they were well received at the Cape, but their work was handicapped by a shortage of officials and money, and a lack of time.

The period of Batavian liberalism ended after three years, but before 1806 many reforms were effected:

- A strong and uncorrupted *central government* was established consisting of a governor, assisted by a council of four nominated members, two of whom were *burghers**. This body had full legislative and administrative powers.
- The High Court of Justice was made independent of the governor and his council and consisted of a president and six other members, all professional lawyers. The powers of the Court were to be purely judicial and an attorney-general acted as public prosecutor.
- The system of *local government* was not changed, but the duties of the *landdrosts** and *heemraden** were more clearly defined. The *landdrost*, as the representative of the governor in his district, had to protect the interests of Hottentots and slaves, to maintain peace with the neighbouring Black tribes, to collect *revenue** and to try *minor criminal cases**. The *heemraden* were burghers over the age of 30 who lived in the district. They supervised the upkeep of the roads and public buildings and, with the landdrost, tried *minor civil cases**.
- In 1805 each district was divided into wards. A *Field-cornet*, *nominated** by the landdrost, and appointed by the Governor, had to maintain order in each ward, call up the burghers in times of trouble, take *census** and make known the laws.
- In 1805 the first *postal system* in the Colony came into existence.

tence. It was a weekly system intended to link Cape Town and the *drostdys** (landdrost offices) of the outlying districts.

- To improve the administration, the four large districts were subdivided, i.e. Stellenbosch and Graaff-Reinet were subdivided to form the two new districts of Tulbagh and Uitenhage (named after the de Mist family).

iii) Economic policy

Free trade was maintained within the Colony, and exports to other Batavian possessions were allowed on payment of a *moderate duty**. Efforts were made to improve the quality of local wool by the importation of sheep; to improve the local wine and to grow olives. All these attempts were unsuccessful because of the shortage of labour and money. So more paper money was printed, causing the 40c rix-dollar to fall in value to 33c in English silver.

iv) Social Reforms

Three important reforms in which the influence of the Revolutionary ideas were obvious, were

- the establishment of a Board of Education to bring education under the control of the State;
- the recognition of the principle of *religious toleration** – through only the ministers of the established church received their salaries from the government, and
- following the practice in France, a landdrost and two heemraden were given authority to perform civil marriages.

Candidate A

Jansens and de Mist decided that the whites could obtain land in an area. Those that did not own land but moved from grazing area to grazing area, Jansens gave reserves along the Gamtoos river, where they could live and have land of their own. The Black people were allowed to go back to the Zuurveld back in Xhosaland. De Mist was instructed to go and examine the relationship between Cape and Netherlands and a memorandum was set up & it led to the appointment of de Mist as commander-general and Lt Jansens as Governor. Money and labour was a shortage & more money had to be printed allowing the 40c rix-daller to fall in value of 33c in English silver. The High Court of Justice was introduced. A strong central government was established. The duties of the laddrost & meenraden were more clearly defined. A field-cornet was established. The first postal-system came into being.

Stellenbosch & Graaff-Reinet was formed into two new districts named Tulbagh & Uitenhage.

Janses & de Most were members of the Asiatic Council.

Candidate B

A government was made up of a governor and two executives. This government had complete executive power but not judicial. The Court of Justice was replaced by the Supreme Court. It consisted of a judge and six other men, all professional lawyers. The judge had complete judicial power and could not be influenced by the governor. A states-general acted as public prosecutor. De Mist wanted to stop slavery and emancipate them. Importation of slaves stopped because De Mist thought it would be better to use 'imported' whites than slaves to build up the country. They had to work out a new frontier policy. Commandos were not allowed to go after Xhosa raiders. The farmer had to take soldiers to the village where the head of the village would have to give him his cattle back. More soldiers were stationed in forts built along the frontier. He established an Asiatic Council for the Cape and other Far Eastern colonies of which De mist, a famous lawyer was a member. School and churches were English. Postal system linked Cape to other districts. Established a drostdy at Graaf-Reinette. Move Dr Kemp's missionary station to Bethelsdorp. Better communications. Transport developed rapidly. He gave the Hottentots a reserve along the Gamtoos River. Hottentots had to have a contract which was signed and witnesses at the landdrost's office with his employer. As he now had protection he was more prepared to work. Declared the Fish River the boundary (frontier). Telecommunications introduced.

A P P E N D I X B

L I S T S O F T E R M S

STANDARD 8 CHEMISTRY TERMINOLOGY

absorb	atomic number
acetate	attract (+ attraction)
acetic acid	Avogadro number
acid (+ acidic, acidity)	barium
agent	barium carbonate
air	barium chloride
alcohol	barium sulphate
alkali (+ alkaline, alkalinity)	base (+ basic)
alpha	battery
aluminium	beaker
aluminium chloride	behaviour
aluminium hydroxide	benzene
aluminium nitrate	benzoic acid
aluminium oxide	beryllium
aluminium sulphide	blue vitriol
ammonia	binary
ammonium chloride	bismuth
ammonium hydroxide	bisulphide
ammonium nitrate	bombard
ammonium sulphate	boiling point
ammeter	bond (+ bonding)
anhydrous	brine
anion	bromide
anode	bromine
antimony	bromothymol
apparatus	bunsen (burner, flame)
aqueous	burette
argon	cadmium
asbestos	calcium
associate (+ association)	calcium carbonate
astatine	calcium chloride
atmosphere (+ atmospheric)	calcium hydroxide
atom (+ atomic)	calcium nitrate
atomic mass	calcium oxide
atomic mass number	calcium phosphate
atomic mass unit	calcium sulphate

carbon (+ carbonic)	conserve (+ conservation)
carbon bisulphide	(convert) (+ conversion)
carbon chloride	constituent
carbon dioxide	copper
carbon disulphide	copper carbonate
carbon monoxide	copper chloride
carbon oxide	copper nitrate
carbon sulphide	copper oxide
carbon tetrachloride	copper sulphate
carbonate	coolant
carbonic acid	core
cathode	coulomb
cathode ray tube	covalent (+ covalently)
cation	coverslip
catalyst	crocodile clips
caustic soda	crucible
cell	crystals (+ crystalline, crystallise, crystallisation)
centre-zero (voltmeter)	crystal lattice
charge (+ charged)	cubic centimetre (cm ³)
chlorate	current
chloride	cyanide
chlorine	cylinder (+ cylindrical)
chlorine-water	decompose
chloroform	deflagrating (spoon)
chromate	dense (+ density)
chromium	deposit
circuit	diatomic
citric acid	dichromate
cobalt	diffraction
cobalt chloride	dilute (d)
coil	(diminish)
collide (+ collision)	dioxide
combustible (+ combustibility)	discharge
compose (+ composition, composite, component)	displace (+ displacement)
compound	dissociate
concentrate(d) (+ concentration)	dissolve
conduct (+ conductor, conducting, conductivity)	distilled (water)

divalent	fission
(donate)	flow
dry cell	fluorescence
effloresce	fluoride
effervesce (+ effervescence)	fluorine
electric (+ electricity, electrically)	formic acid
electric potential difference	force
electrode	formula
electrolysis (+ electrolyse)	friction
electrolyte (+ electrolytic, electrolytically)	fume cupboard
electron (+ electronic)	(fundamental)
electron transfer	fuse
electro-chemical (cell)	galvanic cell
electro-chemistry	galvanometer
electro-plate (+ electro-plating)	gas (+ gaseous)
electrostatic	gas-discharging tube
electrovalent	generate (+ generation)
element (+ elementary)	gram
emit	granulated
empirical force	helide
endothermic	halogen
energy	helium
Epsom salts	(horizontal)
(equation)	hydrochloric acid
equivalence	hydrogen
ether	hydrogen acetate
evaporate (+ evaporation, evaporating (dish))	hydrogen bromide
evolve	hydrogen carbonate
(external)(circuit)	hydrogen chloride
extrovalent	hydrogen citrate
exothermic	hydrogen nitrate
(extract)	hydrogen nitrite
field	hydrogen oxide
filter	hydrogen sulphate
filtrate (+ filtration)	hydrogen sulphide
	hydrogen tertrate
	hydronium

hydroxide	manganese
hydroxyl	manganese chloride
ignite	manganese dioxide
(immerse)	manganese oxide
indicator	magnesium
induction (coil)	magnesium carbonate
insoluble	magnesium chloride
iodate	magnesium hydroxide
iodide	magnesium iodide
iodine	magnesium nitrate
ion (+ ionic, ionize)	magnesium oxide
iron	magnesium sulphate
iron carbonate	magnetic
iron chloride	mass
iron nitrate	matter
iron oxide	medium
iron sulphate	melt (+ molten)
isotope (+ isotopic)	melting point
jar	mercury (+ mercuric)
joule	mercury oxide (or mercuric oxide)
krypton	metals (+ metallic)
(law)	meter
lead	methyl orange
lead bromide	(migrate)
lead chloride	mixture
lead iodide	(mobile)
lead nitrate	model
lead oxide	mole (+ molar)
liberate (+ liberation)	molar atomic mass
liquids	molecule (+ molecular)
lime (water)	monatomic
line spectra	monovalent
lithium	monoxide
lithium oxide	mortar
litmus	motion
luminous	naphthalene
manganate	nature

negative	permanganate
neon	pentoxide
net equation	periodic table
net ionic equation	pestle
neutron	pH
neutralise (+ neutralisation)	(penetrate)
neutron	phenolphthalein
nickel	(phenomenon)
nitrate	phosphate
nitric acid	phosphoric acid
nitride	phosphorus
nitrite	phosphorus pentoxide
nitrogen	platinum
nitrous acid	pole (+ polar, polarity)
noble	polyatomic
non-conductive (+ non-conductor)	positive (+ positively)
non-electrolyte	potassium
non-equivalent	potassium bromide
non-luminous	potassium carbonate
magnetise	potassium chlorate
non-metals	potassium chloride
notation	potassium fluoride
nucleus (+ nuclear)	potassium hydroxide
oleic acid	potassium iodate
orbit	potassium iodide
orbital	potassium nitrate
ortho-phosphoric acid	potassium nitrite
oxalate	potassium permanganate
oxalic acid	potassium sulphate
oxide	potassium sulphide
oxidise (+ oxidising, oxidation)	potassium thiocyanate
oxonium	potential chemical energy
oxygen	potential difference
paired (+ pairing)	precipitate
paraffin	pressure
(parallel)	(principle)
particles	produce (+ product, production)

(properties)	sodium chloride
(proportional)	sodium hydroxide
proton	sodium hydrogen carbonate
radical	sodium hypochlorite
radioactive	sodium iodide
radium	sodium nitrate
radium bromide	sodium oxide
(radius)	sodium sulphate
rarefied	sodium sulphide
(ratio)	sodium sulphite
ray	soluble (+ solubility, solution)
react (+ reaction, reactive, reactivity, reactant, reacting)	source
rectilinear	space
redox	spark
reduce (+ reduction, reducing)	spatula
relative atomic mass	spectator
relative formula mass	spectrometer
relative molecular mass	spectroscope
saltpetre	sphere (+ spherical)
saturate (+ saturation, saturated, over-saturate)	spontaneous (+ spontaneously)
scattering	spot-test tile
secondary	stable
sediment	state (physical-, chemical-)
seried	strong (acid, base)
short-circuit	stronium
sign	substance
silver	sulphate
silver bromide	sulphide
silver nitrate	sulphite
silver iodide	sulphur
silver oxide	sulphur oxide
solids	sulphur dioxide
slaked lime	sulphur trioxide
sodium	sulphuretted hydrogen
sodium bromide	sulphuric acid
sodium carbonate	sulphurous acid
	suspension
	symbol

(symmetrical)	voltmeter
tartaric acid	(volume)
temperature	washing-soda
terminal	water
test tube	water-bath
tetrachloride	wave
thermal (energy)	weak (acid,bases)
thermometer	wet cell
thiocynate	xenon
thiosulphate	X-rays
tin	zinc
tin chloride	zinc sulphate
tin nitrate	zinc chloride
tin oxide	
tongs	
transfer (of electrons)	
(treat) (+ treatment)	
track	
trioxide	
trough	
turpentine	
undilute(d)	
unit	
universal indicator	
unpaired	
unreactive	
unsaturated	
uranium	
valency (+ valence)	
(validity)	
value	
vapour	
velocity	
(vertical) (+ vertically)	
vinegar	
volt (v)	
voltaic cell	

STANDARD 8 PHYSICS TERMINOLGY

absolute	benzol
absorb (+ absorption)	biconcave
accommodation	biconvex
accumulator	bifocal
acoustics	binoculars
air	black
air pressure	body
alloy	boiling
alternating current (a.c.)	boiling point
alternating current dynamo	boiling tube
aluminium	brass
ammeter	bulb
ampere	bunsen burner
amplitude	calorimeter
angle	cancellation
aperture	carbohydrate
apparatus	carbon
apparent	carbon brush
aqueous	carbon dioxide
argon	cathode
armature	celsius (scale)
astigmatism	centimetre
astronomical (telescope)	centre-zero
atmospheric pressure	charge
atom	chemical energy
attract (+ attractive, attraction)	chlorophyll
audibility	circle
axis	circuit
axle	cobalt
base	coil
battery	collide (+ collision)
beaker	commutator
beam	compass
(behaviour)	complementary
bell jar	complex resultant vibration
benzene	(component)

compound (microscope, telescope)	displace (+ displacement)
compression (+ compressed)	diverge (+ diverging, divergent)
concave	domain
concentric (circle)	dynamo
conduct (+ conduction, conductor)	eardrum
cone	echelon (echo)
constant	echo
constructive (interference)	eclipse
contact	elasticity
converge (+ converging, convergent)	electric (+ electrical)
convection	electrical potential difference
convert (+ conversion)	electromagnet (+ electromagnetic (induction))
convex	electron
cooling curve	electrostatic
copper	element
cornea	electro-motive force (EMF)
corona	emergent (ray)
corpuscular	emit (+ emission)
corresponding (angle)	energy
coulomb	equation
critical (angle, point)	equilateral
current	equivalent
cylinder (+ cylindrical)	erect
deflect (+ deflection)	ethyl alcohol
demagnetise	evacuate
dense (+ density)	evaporate (+ evaporation)
destructive (interference)	external circuit
detect (+ detection, detector)	eye-piece
develop (+ development)	Faraday's Law
deviate (+ deviation)	far-sighted
diamagnetic	ferro-magnetic
diameter	filament
diffraction	film
diffused	final (steady) temperature
diminished	filter
discharge	first harmonics
disc stroboscope	First Law of Thermodynamics
disperse (+ dispersion)	

flask	input (terminal)
Felming's Left-hand Dynamo Rule	insulated (+ insulator)
flaw	interference
fluctuation	internal (energy, heat, reflection, resistance)
fluorescent	ion
flux	iron
focal (point, length)	iron filings
focus (+ focal)	invert (+ inverted, inversion)
force	iris
formula	joule
freezing point	kaleidoscope
frequency	Kelvin Scale (K)
frequency generator	kilogram
friction	kilometre
fundamental	kinetic (energy, motion, vibrator)
fusion	laser
galvanometer	latent heat
gas (+ gaseous)	lateral inversion
generator	(law)
glycerine	Law of Conservation
graph	Law of Energy
gravity (+ gravitational)	lead
harmonics	Lenz's Law
heat	liquid (+ liquify)
heat capacity	light
heat-resistant	light-sensitive
helium	linkage
Hertz	longitudinal (waves)
(homogeneous)	long-sighted (+ longsightedness)
(horizontal)	lost volts (Ir)
humor	luminous
hydrogen	magenta
illuminate	magnet (+magnetic)
image	magnetic field
incident	magnetic flux
induce (+ induction, inducting)	magnetism
infinity	magnification (+ magnifying, magnifier)
initial temperature	

magnifying glass
magnitude
mass
material (medium)
maximum
mechanical energy
medium
melting (process)
meter
metre
metallic
methylated spirits
mercury
microphone
microscope
millimetre
mirage
mirror
molecule
monochromatic
motion
motor (effect)
moving cell galvanometer
musical note
mutual induction
naphthalene
near-sighted
negative
nichrome
nickel
nitrogen
noise
non-magnetic
normal (+ normally)
north (pole)
nuclear (reaction, explosive)
object

objective
oblique
ocular
ohm
opaque
open circuit
opposition form (F)
optical
oscillation
oscilloscope
output
overtones
paddle-wheel
parabola (+ parabolic)
paraffin
parallel
paramagnetic
particle
peak
penumbra
perception
periscope
(perpendicular (+ perpendicularly))
perspex
phase
(phenomenon)
photographic exposure meter
photosynthesis
plane
plot
pneumatic drill
physical (change)
pitch
pole
positive
potential (difference, energy)
porcelain boat

pressure	right angle
primary (colours, coil)	ripple tank
principal (focus)	rotational energy
(principle)	saturated (+ saturation)
prism	saturation vapour pressure
produce (+ production)	screen
project	second harmonics
propagate (+ propagation)	secondary (colours, coil)
(property)	seismograph
protractor	selective (reflection, transmission)
pulse	self-induction
pump	semi-conductor
pupil	semi-circular
pure	sensitive
radiate (+ radiation)	series
radio (transmitter, waves)	sextant
radiometer	shadow
rare	short-sighted (+ short-sightedness)
rarefied (+ rarefication (pulse))	S I units
(ratio)	signal generator
ray	silver nitrate
reaction	simple (microscope)
real	slip ring
receiver	sodium chloride
(rectangular)	solenoid
rectilinear	solid (+ solidify)
reflect (+ reflective, reflection, reflector)	solution
refract (+ refraction)	sonar
regular	sound
reinforcement	source
(relative)	south (pole)
resistance (+ resistor)	space
retina	speaker
reverberation	specific heat
retentivity	specific heat capacity
revolution	specific latent heat
rheostat	spectroscope
	spectrum (+ spectral)

sphere (+ spherical)	valve
state	vane
steam	vapour (+ vaporise, vaporisation)
step-down (transformer)	velocity
step-up (transformer)	vertical (+ vertically)
stimulation	vibrator (+ vibration)
substance	virtual
subtenol	visible
suction pump	v I t
sulphur	volt
surface tension	voltmeter
susceptibility	(volume)
symbol	water
(symmetrical)	wave (motion, pulse)
telescope	wave equation
temperature	wave motion
terminal	wave pulse
terminal potential difference	wavelength
test-tube	wire gauze
thermal (energy)	white
thermos (flask)	work
total energy	
transfer	
transducer	
transformer	
transmit	
translucent	
transparent	
tripod	
trough	
tuning fork	
tungsten filament	
turpentine	
umbra	
unaccommodated	
(unit)	
vacuum	
vacuum pump	

STANDARD 8 HISTORY TERMINOLOGY

abdicate (+ abdication)	Bonapartist (+ Bonapartism)
Aborigines	Bourbons
abolish (+ abolition)	bourgeoisie
absolute (+ — monarchy, absolutism)	buffer state
act (of parliament)	bund
(adjourn)	burgher (+ free —, — council)
administration (+ administrative administrator)	bywoner
advisory (+ — council)	cabinet
agitator	cahier
alienable	canton
ally	Cape Patriots
alliance (+ Holy —, Quadruple —)	capital (+ capitalist, capitalism)
American Revolution	capitulate
American War of Independence	Carbonari
Ancien Regime	cattle raids
anglicize (+ anglicisation)	cause
annex (+ annexation)	cede
annul	central (government)
arbitration	centre
aristocracy (+ court —, landed —)	chamber
armistice	charter
article	Chartists
assemble (+ assembly)	chieftain
assignats	church
assegai	citizen
authority	civil (— service, servant, code, constitution, marriage, case)
autocratic	circuit courts
balance of power	civilisation
ballot (+ secret —, popular —)	class
bankruptcy	clan
ban	clergy (+ upper —, lower —)
banish	club
bantu	coalition
bill	code
blockade	colony (+ colonist, colonial)
body	

coloured	department
commander (+ commander-in-chief)	deportation
commandant	depose
commando	depreciate
commissie (treks)	depression
commission (+ — of inquiry) (+ commissioner)	deputy
common (people)	demonstration
commune	despotic (+ despotism)
Communist	dethrone
concordat	detrribalised
confederation	devalue
congress	developed
conscription	diplomat
conservative	director (+ Directory)
constitution (+ constitutional)	district
consul	dissolve
Continental System	divine right
contract (+ — labour)	domestic (affairs, servant)
convention	domination (foreign —)
cordeliers	draft
corvée	drostdy
council	duchy
counsellor	duke
coup d'etat	duty
court (+ — of law; royal —) (+ courtier)	economy (+ economic, economics)
creditor	edict
crescent formation	eighteenth century
criminal (case, code)	elect (+ election, electoral)
Crown (+ Crown Colony)	emancipation
cultural	embargo
customs (duties, barriers)	Emigres
debt (+ national —, war —)	emperor
decree	enfranchise (+ enfranchisement)
declaration	enlightened
(delegate)	Enlightenment
democratic	entrenched
	equality

estate	heemraden
ethnic	hereditary
executive	hide-shield
exile	high commissioner
expel	homeland
exploitation	house
extradite	(hostilities)
extremist	humanitarian
faction	impi
federal union	inalienable
factory (acts, system)	independent (+ independence)
feudal (+ — system)	induna
finances (+ financial)	industrial revolution
fiscal	insolvent
force	insurgent
foreign	insurrection
franc	intendant
franchise	interest (+ interests)
fraternity	internal affairs
free (+ — enterprise, trade) (+ freedom) (+ — of speech, conscience, trade)	international
Free Black	intervention
French Revolution	Jacobins
frontier (+ frontiersman)	judiciary (+ judicial)
Fueillants	jurisdiction
gabelle	jury (system)
Girondins	justice of the peace
government (+ governor)	kafir
grand duchy	king (+ kingdom)
Great Powers	knopkierie
Great Trek	kommando (+ bees —, wen — , vlug —)
Greek Orthodox Church	kraal
(guerilla)	krygsraad
guild	labour (+ — contract; child —, manual —)
guillotine	landdrost
half-way house	landlord
head of state	landowner
(heathen)	law

League of Nations	municipal
left	nagmaal
legal (system)	Napoleonic
legislation (+ legislative)	national (+ nationalism)
lettres de cachet	native
liberal (+ liberation, liberator, liberalism)	nature (+ natural)
liberty	negotiate
limited (power)	negro
loan farm	nineteenth century
lobola	nobility
local government	nominated
lower classes	non-Christian
lycées	non-white
magistrate	oath (of allegiance, the covenant)
manifesto	occupy (+ occupation)
martial law	office (+ official) (+ — language)
(massacre)	(offensive)
masses	Old Order
master	oppression
mayor	order (+ orders)
medieval	ordinance
medium of instruction	(outlaw)
member of parliament	overthrow
mercenary	ox-waggon
Metternich System	pandour
middle class	papal
migrate (+ migration, migratory (labour))	parliament (+ parliamentary)
minister	paramount (chief) (+ paramountcy)
minority	party
missionary (+ missionary society)	pass
mob	patriotic
(mobilise)	peace
moderate	peace-keeping force
monarch (+ monarchy)	peasant
monopoly	penal (colony)
(mortgage)	people
	petition
	philanthropist (+ philanthropic)

philosopher
 political
 Pope
 popular ballot
 post
 pound
 power
 president
 priest
 prime minister
 prince
 princess
 private ownership
 privilege (+ privileged)
 proclamation
 protest meeting
 provision (of a treaty)
 professional
 (prosecutor)
 protestants
 province
 provisional government
 public opinion
 puisne judges
 punitive expedition
 quitrent
 raad (+ volks —, krygs —)
 racial
 radical
 ratepayer
 ratify
 reaction (+ reactionary)
 rebellion
 recognise
 (recruit)
 referendum
 reform

refugee
 regime
 reign (+ — of terror)
 reconnoitring expedition
 relieve
 representative (+ representation)
 reprisal system
 republic (+ republican, republicanism)
 reserve
 responsible
 resolution
 restoration
 retreat
 revival
 revoke
 revolt
 revolution (+ revolutionary)
 right (+ rights)
 rixdollar
 Roman Dutch Law
 royal (+ royalist)
 ruler
 say
 scorched earth policy
 seat
 secondary education
 self-determination
 self-government
 senate
 segregation
 separation
 serf (+ serfdom)
 servant
 settle (+ settler, settlement)
 siege
 Slagtersnek Rebellion
 slave (+ slavery)

(slum)	truce
social (+ socialism)	tzar
sovereign	twentieth century
spoor system	tyrant (+ tyranny, tyrannical)
state (+ statesman)	ultra-royalist
stock farmers	unemployment
{strategic}	unicameral
(stronghold)	unification
subject	unit
suffrage	United Nations
suiwers	universal male suffrage
summon	unrest
superintendent	uprising
suppression	vagrant (+ vagrancy)
supreme (+ supremacy)	vassal
(surrender)	vest
suspend (+ suspension)	veto
synod	vierkleur
taille	volksraad
tax (+ taxation, taxpayer)	Voortrekkers
tenure (land —)	vote
terms	wages
throne	warrior
tithes	whigs
title	warrant
toll	western (culture)
^o t _x leration	white
training college	will
(traitor)	(witchdoctors)
treasury	worker
treaty (+ — system)	working classes
trek (+ trekker)	
trial (+ summary —)	
tribe (+ tribal, tribesman, inter-tribal)	
tricolour	
triumvirate	

A P P E N D I X C

L I S T S O F P R E F I X E S

A N D S U F F I X E S

SUFFIXES

SUFFIX	HISTORY	PHYSICS	CHEMISTRY
-al	central constitutional continental criminal judicial legal cultural electrical federal feudal fiscal internal international local martial municipal national natural official papal penal political professional provisional racial royal rural social tryannical radical revival tribal unicameral	bifocal focal critical electrical potential equilateral fundamental internal lateral longitudinal material normal optical physical potential principal terminal thermal vertical virtual	cylindrical chemical spherical symmetrical thermal radical terminal orbital
-ance, -ence -ant, -ent	alliance ordinance independence Protestant servant independent vagrant insolvent insurgent parliament superintendent	resistance interference constant apparent convergent current divergent emergent equivalent filament fluorescent incident translucent	effervescence equivalence fluorescence coolant reactant agent component constituent covalent current divalent electrovalent monovalent
-ar		corpuscular nuclear ocular rectilinear regular sonar	molar molecular nuclear polar rectilinear

SUFFIX	HISTORY	PHYSICS	CHEMISTRY
-ary, -ery	hereditary judiciary missionary mercenary reactionary revolutionary secondary slavery	complimentary primary secondary	complementary primary secondary
-ate	capitulate depreciate migrate moderate negotiate triumvirate	deviate evacuate evaporate illuminate propagate	associate dissociate evaporate liberate generate precipitate saturate
-ble	alienable responsible	visible	combustible crucible insoluble soluble
-dom	kingdom serfdom		
-er, -or	byowner commissioner landowner administrator creditor counsellor director emperor liberator governor mayor prosecutor warrior master minister philosopher ruler settler taxpayer trekker worker	burner cylinder filter laser receiver speaker transducer transformer transmitter accumulator commutator conductor detector generator insulator protractor reflector resistor vibrator	cylinder conductor indicator spectator
-fy		liquify solidify	
-ic	autocratic democratic despotic ethnic Napoleonic patriotic philanthropic	atmosphere concentric diamagnetic electric electromagnetic electrostatic kinetic	acidic atomic diatomic electric electrolytic electronic electrostatic

SUFFIX	HISTORY	PHYSICS	CHEMISTRY
-ic (ctd)		magnetic metallic monochromatic	endothermic isotopic magnetic mercuric metallic monatomic periodic polyatomic
-ide		collide	collide
-ion	constitution declaration confederation conscription administration coalition commission deportation depression demonstration domination election emancipation exploration faction insurrection intervention jurisdiction legislation liberation migration occupation petition proclamation provision reaction rebellion representation resolution restoration revolution self-determination segregation separation suppression suspension taxation toleration unification	absorption accommodation attraction cancellation collision compression conduction convection conversion deflection detection deviation diffraction dispersion emission equation evaporation fluctuation friction fusion induction inversion magnification motion oscillation perception production radiation reaction reflection refraction reverberation revolution saturation solution stimulation vaporisation vibration	association attraction composition concentration conservation conversion crystallisation collision diffraction equation evaporation fission friction generation induction liberation motion neutralisation oxidation production reaction saturation solution suspension
-is		photosynthesis	electrolysis
-is(z)e	detrribalise enfranchise enterprise franchise mobilise recognise	demagnetise vaporise	

SUFFIX	HISTORY	PHYSICS	CHEMISTRY
-ism	absolutism despotism liberalism republicanism socialism	astigmatism	
-ist	communist extremist philanthropist royalist		
-ite			composite ignite
-ive	administrative legislative offensive punitive representative	attractive constructive destructive objective positive reflective sensitive	negative non-conductive reactive
-ment	enlightenment government president settlement unemployment	development displacement	displacement sediment
-our			vapour
-ous		aqueous gaseous luminous	anhydrous aqueous gaseous luminous spontaneous
-ure		armature pressure temperature	moisture temperature
-y	bankruptcy clergy duchy duty economy equality fraternity factory jury liberty minority monopoly nobility occupy party ratify supremacy treasury tyranny	audibility battery energy density elasticity frequency gravity infinity retentivity susceptibility velocity	acidity alkalinity battery combustibility conductivity density electricity energy polarity reactivity solubility valency velocity

PREFIXES

PREFIX	HISTORY	PHYSICS	CHEMISTRY
ab-	abdicate	absorb	absorb
a-, at-, ac-		accommodation astigmatism attract	
ad-	adjourn administer advisory		
an-			anhydrous
bi-		biconcave bifocal binoculars	binary bisulphide
cat-		cathode	cathode cation
co-		corresponding	covalent
col-		collide	collide
com-		commutator complementary compound compression	compose compound
con-	confederation congress conscription constitution contract convention	concave concentric conserve constructive contact converge convection convert convex	concentrate conduct constituent
de-	declaration delegate deportation depose depreciate depression deputy dethrone detrified devalue	deflect demagnetise destructive detect deviate	decompose deflagrating deposit
di-		diamagnetic diameter diminished diverge	diatomic dichromatic dioxide divalent

PREFIX	HISTORY	PHYSICS	CHEMISTRY
diff-		diffraction diffused	diffraction
dis-	dissolve	discharge disperse displace	discharge displace dissociate dissolve
e-	edict elect emancipation	emergent emit erect evacuate	emit evaporate evolve
en-	enfranchise enlightened entrenched		
endo-			endothermic
ex- (etc)	expel extradite	external	external extrovalent exothermic
il-		illuminate	
in-	inalienable insolvent independent insurgent insurrection internal	incident induce initial input infinity invert	induction insoluble
inter-	international intervene	interference	
mon(o)-	monarch monopoly	monochromatic	monatomic monovalent monoxide
non-	non-Christian non-white	non-magnetic	non-conductive non-electrolyte non-equivalent non-luminous non-metals
ob-		object	
over-	overthrow		
para-		paramagnetic	
pen-		penumbra	
pent-			pentoxide
poly-			polyatomic

PREFIX	HISTORY	PHYSICS	CHEMISTRY
pro-	proclamation protest provision professional prosecutor protestant	produce project propagate protractor	produce
re-	reaction rebellion recognise recruit referendum reform refugee reconnoitre relieve representative reprisal responsible resolution retreat revival revolve revolt revolution	reaction receiver reflect reinforcement reverberation revolution	redox reduction
semi-		semi-conductor semi-circular	
super-	superintendent		
tele-		telescope	
tetra-			tetrachloride
trans-		transfer transducer transmit transformer translucent transparent	transfer
tri-	tricolour triumvirate	tripod	trioxide
ultra-	ultra-royalist		
un-	unemployment unrest	unaccommodated	undiluted unpaired unreactive
uni-	unification unicameral united universal		universal
up	uprising		

A P P E N D I X D
=====

QUESTIONNAIRE TO SCIENCE
TEACHERS

QUESTIONNAIRE

THE ROLE OF LANGUAGE IN THE TEACHING OF PHYSICAL SCIENCE

I would be very grateful for your advice and co-operation in a research project on the role of language in the teaching of Physical Science.

I realise the limitations of questionnaires; at the same time it is vital to explore the experience and opinions of teachers of Physical Science on this matter. Consequently, I would be most grateful for your comments and responses. If you need more space for comments than can be provided on this form, please add notes or comments on a separate sheet.

Question 01 is optional; however, all responses will be treated as confidential, and in no circumstances will the source of any individual opinion be divulged.

Please note that the aim of the questionnaire is not to test Science Teachers' knowledge of English, but rather to ascertain what kind of language usage Science Teachers would be prepared to accept from their pupils in written assignments and examinations. You are therefore urged to feel free to overlook anything which you may regard as unimportant in a child's written communication of what he has learnt. You may in fact choose to make no amendments whatsoever. Please note, too, that this questionnaire is valid only if each respondent completes it on his/her own without consulting other colleagues.

It would greatly assist my analysis if you could complete the questionnaire within one week of the date of arrival and post it back together with those of your colleagues in the Science Department of your school. Please return to:

Mr M G Venter
The Settlers High School
P O Box 599
Bellville
7530

SECTION A : Personal Information

01 SURNAME: _____ INITIALS: _____

02 SCHOOL: _____

P T O

SECTION B : The role of language in the teaching of Physical Science

1. You are asked to imagine that the following passage is an answer written by a Standard 8 HG pupil in a Physical Science examination. Please indicate what (if any) features of language you would criticise, i.e. what you would underline and possibly discuss with the pupil. Please amend only those items that you would normally object to. Indicate any criticism you may have by underlining the relevant word(s) and placing your preferred version above the word(s), or filling in anything which you feel is missing. If you wish to comment on why you object, please place a number next to the alteration and then write this number and your comment on the page opposite.

Question: Write a brief description of the structure of atoms and molecules.

Answer:

An element is a substance which can't be broken down into other substances.

Elements are made up of atoms. - - -

I think that the structure of the atom is absolutely fascinating. In the middle of each atom you find a nucleus in which you find mainly protons which have a positive charge and neutrons which don't have no charge. You also find electrons which rotate very quickly and carries a negative charge.

The number of protons is the same as the number of electrons, therefore the whole atom is neutral in electricity. When we say this we mean its got no charge. The atom of each element is differant to the atom of every other element in the size and in the mass of the nucleus and number of it's electrons. The simplest atom is the atom of the element hydrogen, this only has one electrons, other elements have got more complicated atoms with a bigger nucleus and more electrons eg uranium which has got a lot. Most substances are made up of two or more elements sort of combined together as mollecules so that they form compounds, the compound most found is water. Its made up of 3 atoms, 2 atoms of hydrogen and 1 oxygen. You write it like this in chemistry; H_2O . To think that such an ordinary thing can be so complicated in the way its made up!

- Adapted from D E Royds-Irmak: Beginning Scientific English (2)

2. What mark (out of 3) would you give the following as a definition of valency ?

By valency we mean that the number of electrons in an atom tell you how many bonds the atom can make with other atoms.

Mark (circle choice): 0 1 2 3

3. To what extent do you think that language problems play a part in preventing pupils from successfully learning and expressing what they have learnt in Physical Science ?

COMMENTS (if any): _____

Highly significant	
Fairly significant	
Slightly significant	
Insignificant	

4. What would you regard as the greatest language problem for your pupils ? Please number the boxes alongside, starting with (1) to show the greatest problem.

COMMENTS (if any): _____

Defining laws	
Describing procedures/processes	
Using an appropriate 'scientific' style	
Expressing things in their own words	
Terminology	
Any other (specify)	

5. How important would you say 'correct English' (i.e. spelling, punctuation, grammar) is in pupils' writing in Physical Science ?

COMMENTS (if any): _____

Extremely important	
Important	
Relatively important	
Unimportant	
Undecided	

6. GENERAL COMMENTS (if any): _____

A P P E N D I X E
=====

QUESTIONNAIRE TO HISTORY

TEACHERS



Department of Linguistics and English Language

Rhodes University Grahamstown 6140 South Africa

Questionnaire:

THE ROLE OF LANGUAGE IN THE TEACHING OF HISTORY

The Department of Linguistics and English Language of Rhodes University would be grateful for your advice and co-operation in a research project on the role of language in the teaching of History in the Senior School.

We realise the limitations of questionnaires; at the same time it is vital to explore the experience and opinions of teachers of History on this matter. Consequently, we would be most grateful for your comments and responses. If you need more space for comments than we can provide on this form, please add notes or comments on a separate sheet.

Please note that the aim of the Questionnaire is not to test History Teachers' knowledge of English, but rather to ascertain what kind of language usage History Teachers would be prepared to accept from their pupils in written assignments and examinations. You are therefore urged to feel free to overlook anything which you may regard as unimportant in a child's written communication of what he has learnt. You may in fact choose to make no amendments whatsoever. Please note, too, that this Questionnaire is valid only if each respondent completes it on his/her own without consulting other colleagues.

It would greatly assist our analysis if you could complete the Questionnaire within 10 days of the date of arrival and post it to the following address:

Mr M G Venter
The Settlers High School
P O Box 599
Bellville
7550

1. You are asked to imagine that the following passage is an answer written by a Standard 8 HG pupil in a History examination. Please indicate what (if any) features of language you would criticise, i.e. what you would underline and possibly discuss with the pupil. Please amend only those items that you would normally object to. Indicate any criticism you may have by underlining the relevant word(s) and placing your preferred version above the word(s), or filling in anything which you feel is missing. If you wish to comment on why you object, please place a number next to the alteration and then write this number and your comment on the page opposite.

Question: Comment briefly on the political causes of the French Revolution.

Answer:

I think one of the principle causes were the inefficient type of government. Just before the revolution France was still an absolute monarch, that means that the king had all the different sorts of power. The French parliament only met last in 1614. The king was not responsive to no one, except a few ministers who he appointed himself. He also made all the laws, he even controlled the courts of law. Louis XVI wasn't as strong a ruler as his precedecessors, he was a lot more oppressive and inefficient. He was also unselfconfident, he was'nt able to make up his mind and married to an unpopular women, Marie Antonette. The middle classes were influenced by the French philosophers. They were also influenced by the American revolution. French soldiers helped the Americans. When they asked for reforms they were ignored. I think its a pity Louis couldn't see the need for change. You often have to change if you want to survive. Its almost as if he didn't really care.

2. What mark (out of 3) would you give the following as a definition of nationalism ?

Nationalism means that the people in a country want to run their own affairs on their own. They don't want others to rule them.

Mark (circle choice): 0 1 2 3 4

COMMENTS (if any): _____

3. What would you regard as the greatest language problem for your pupils ?
Please number the boxes alongside, starting with (1) to show the greatest problem.

COMMENTS (if any): _____

Arguing logically and coherently	
Describing a series of events	
Using appropriate 'historical' style	
Expressing things in their own words	
Historical terminology	
Any other (specify)	

4. To what extent do you think that language problems play a part in preventing pupils from successfully learning and expressing what they have learnt in History ?

COMMENTS (if any): _____

Highly significant	
Fairly significant	
Slightly significant	
Insignificant	

5. How important would you say 'correct English' (i.e. spelling, punctuation, grammar) is in pupils' writing in History ?

COMMENTS (if any): _____

Extremely important	
Important	
Relatively important	
Unimportant	
Undecided	

6. GENERAL COMMENTS (if any): _____

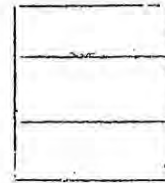
A P P E N D I X F

QUESTIONNAIRE TO SCIENCE
PUPILS

QUESTIONNAIRE : SCIENTIFIC TERMS

1. By inserting A,B,C,D OR E in the blocks, indicate which of the diagrams below show :

- a) a vertical line meeting an oblique line
b) a vertical line meeting a horizontal line
c) a perpendicular line meeting an oblique line



2. Give a brief definition of each of the following words :

- a) ignite :
.....
- b) liberate :
.....
- c) orbit :
.....
- d) converge :
.....

3. What is the antonym (opposite) of converge ?

A P P E N D I X G

QUESTIONNAIRE TO HISTORY PUPILS

HISTORY QUESTIONNAIRE

1. In each of the following, underline the odd word out.
State very briefly why you see that word as the odd one out.

(a) democracy absolutism socialism despotism

Reason: _____

(b) liberal republican conservative socialist royalist

Reason: _____

2. Write down, in the space provided, the correct form the word in brackets in each of the following:

(a) Somerset wanted to (anglicisation) the Dutch. _____

(b) There are still many people in France with (monarchy) sympathies). _____

(c) They were fighting for a (parliament) form of government. _____

(d) He was a (tyrant) ruler. _____

(e) A new political force called (liberal) swept Europe. _____

3. Underline the correct word in the following sentence:

The (reactive/reactionary) forces lined up against the new regime.

4. State very briefly what you understand by underlined word in each of the following:

(a) a popular ballot: _____

(b) the social causes of an event: _____

5. (a) Give an antonym (word of opposite meaning) for the word liberal.

- (b) Add a prefix to the front of the word liberal to make it mean 'extremely liberal'.

6. Write down one word for each of the phrases given in brackets in each of the following:

- (a) X was a (person who was neither very liberal nor very conservative).

- (b) The king was forced to (give up his throne).

7. How many

- (a) chambers in a 'unicameral' parliament ?

- (b) people in a triumvirate ?

8. The following are three statements relevant to the causes of the French Revolution. Read them, and then answer the question which follows:

- A. The French Parliament was called the 'States General'. It consisted of three parts - the First, Second and Third Estate.
- B. The French Parliament had not met since 1614. Since then, the king had had absolute power.
- C. The Third Estate consisted of the ordinary citizens, professional people, vassals, workers and serfs who constituted (made up) 90 per cent of the French population.

State whether the following statement is TRUE or FALSE. Give a brief but clear reason for your answer:

In view of these facts, it is to be expected that the members of the Third Estate would resent the fact that they had been deprived of their former political right - the right to the major say in the governing of the country.

9. Fill in the missing word in the following:

Just before the Revolution of 1789 France **still** was, as in the time of Louis XIV, an monarchy. The King had all the, executive and judicial powers.

10. The term equality as used in the French Revolution meant

- (a) equality of income
- (b) equality of ability
- (c) equality of land ownership
- (d) equality before the law.

(Underline the correct answer.)

11. Read the following two pieces of information and then answer the question that follows:

- A. A 'radical' in politics may be defined as a person who wants to change society in a far-reaching manner.
- B. In 1791 the Feuillants tried to persuade the King to accept the Constitution drawn up by the Constituent Assembly. They also encouraged the Emigres (ie the nobles who had fled from France) to return home. The Brissotins set about repressing the reactionaries (ie those who wished to restore the Old Order in France) and to intimidate (threaten) the Emigres.

In terms of the above information, state which of the following you would classify as the radicals in France in 1791. (Underline the answer you choose.)

- (a) Feuillants
- (b) Emigres
- (c) Brissotins
- (d) Reactionaries

12. Which of the following words would you pair up with the word right-wing in politics? (Underline the word of your choice.)

- (a) extremist
- (b) moderate
- (c) conservative
- (d) liberal

A P P E N D I X H

EXAMINATION PAPERS

NOTE: This section consists of an analysis of the examination papers followed by copies of the actual examination papers includes in the analysis.

1. A close study was made of the following:
 - (a) 20 examination papers for Physical Science Standard 8 (Higher Grade and Standard Grade) from 15 Cape Senior schools (1980, 1981)
 - (b) 10 examination papers for History Standard 8 (Higher Grade and Standard Grade) from 10 Cape Senior schools (1981, 1982)
 - (c) The memoranda of certain of these papers
 - (d) Two sets of scripts, one History and one Science, of candidates for one History and one Science paper.

2. In the study, Higher Grade and Standard Grade were handled together, for the following reasons:
 - (a) Most schools do not differentiate -- or differentiate only minimally -- in Science examinations at the Standard 8 level.
 - (b) The History examination papers were first of scored separately on the grounds that schools seem to differentiate more in History examinations than in Science. However, the two sets of scores proved to be so similar that it was decided, for convenience' sake, and to be able to make a straight comparison with Science, to add them together.

3. The aim of the survey was to establish the kinds of demands made on school pupils in terms of writing examinations. The survey is obviously not an exhaustive one; the detailed results are not, therefore, meant to suggest definitive findings. For our purposes, all that was needed was an indication of definite trends. ..

4. The questions of the 30 papers were classified according to the types of answers expected of the pupils rather than in terms of the types of questions. Thus, for example, the following question, though phrased in words, requires an answer which is a set of diagrams:

Draw diagrams to illustrate how the models of a fluorine atom differ according to (i) the Thompson (ii) Bohr (iii) Orbital model.



The following question, on the other hand, though expressed mainly in symbols, requires an answer consisting of a word:

You are given the symbol $\begin{smallmatrix} 27 \\ 13 \end{smallmatrix} \text{Al}$.

Write down the name of this element.

Similarly, the following question, though consisting mainly of words, requires an answer expressed in symbols:

Write balanced chemical equations for the following where reactions occur. If no reactions occur explain why.

- (i) Sodium is added to water.
- (ii) Nitrogen and hydrogen are used to prepare ammonia.
- (iii) An iron nail is dipped into a solution of silver(I) nitrate.
- (iv) Bromine is added to a solution of potassium chloride.
- (v) Hydrochloric acid is added to calcium carbonate.
- (vi) Sodium hydroxide is titrated against dilute sulphuric acid until an end point is reached.

5. The questions were classified as follows:

A Non-verbal

(a) Multiple-choice: Here the candidate was required to write down a letter or number or merely to ring the appropriate letter or number. A typical example of such a question would be the following:

When a ray of light passing through a more dense optical medium towards a less dense optical medium strikes the interface at the critical angle

- (a) it is refracted at 90° to the surface;
- (b) it is reflected at 90° to the surface;
- (c) it is refracted at 90° to the normal;
- (d) it is totally internally reflected;
- (e) it is not refracted.

Included here were those questions where two lists of items were given and the candidate was required to match these and list a number in one column and a letter in another column. The following is an example of such a question:

Each item in the first column matches an item or description in the second column. Write down the number of the first column and next to it only the letter of the most suitable matching description.

- | | |
|----------------------|---|
| (1) Atomic mass unit | (a) probable spaces in which electrons can be found |
| (2) Hydronium ions | (b) one twelfth of the mass of an atom of C-1 |
| (3) Mole | (c) number of atoms in 32 g of O ₂ |
| (4) Orbital | (d) responsible for acidic property |
| (5) Lithium | (e) group of atoms in 1 g of hydrogen gas |
| | (f) group 1 |
| | (g) alkali earth metals |

(b) Calculations: Here the candidate was expected to answer by means of mathematical calculations or formulae involving symbols. Eg:

Calculate the approximate mass of an α particle, if the mass of a proton = $1,6 \times 10^{-27}$ kg.

(c) Diagrams/sketches: Here the answer would consist of a diagram.
For example:

An object, size 12mm is examined through a magnifying glass. The image is 15mm from the lens and $f = 20$ mm. Construct a ray diagram to show how the image is formed.

B. Verbal

(a) One-word answers: These were questions where all that was required was to write down one word or a list of single words in order to answer the question. These included questions where the candidate was required either to fill in a missing word or to give the answer in one word. An example is as follows:

Complete each of the following by writing down only the missing word(s):

- Early in the twentieth century scientists discovered that radio-active elements emitted small particles called _____ and _____.
- One twelfth of the mass of an atom of carbon-12 is called a(n) _____.
- A molecule of oxygen has _____ unpaired electrons.
- In the compound CO the valency of C is _____.

(b) Descriptive answers: These were questions where the candidates were expected to answer in phrases, sentences or paragraphs. A typical example would be:

Give a description of the test you would use for a sulphate.

6. Once the questions had been classified in this way, the marks for the questions in each category were added up and worked into a percentage of the total mark for the paper. (This was necessary in order to reflect proportions of marks allocated to different types of questions for the simple reason that the papers were not always out of the same total - they varied from 150 to 400.)
7. Some problems were encountered in the process of classifying some of the Science questions and calculating proportions of marks. These were as follows:
 - (a) It was not always easy to categorise questions in terms of the types of answers expected, since there were questions which required hybrid answers. For example, the following question requires an answer which is a mixture of calculations (equations), descriptive comments and one-word answers:
 - (i) Describe what you would observe if a deflagrating spoon containing sulphur is heated and then put into a gas jar containing oxygen.
 - (ii) Write a balanced equation for the reaction.
 - (iii) If the gas jar is shaken up with some water, write a balanced equation of what takes place.
 - (iv) Name the substance which is formed.

In such cases the question was either assigned to the more obvious category or the marks were assigned to more than one category. In some cases, it was of no consequence in terms of this study - eg where there was doubt as to whether to assign the question to the calculations or the diagrams category, the main point was that either way they were ultimately assigned to the non-verbal category anyway.

(b) Sub-dividing questions in this way, however, sometimes leads to a further problem, viz the allocation of marks to the sub-questions. In

these cases, allocations were estimated in terms of allocations shown on other papers for similar questions, or Science teachers were consulted.

If, in the end, a few arbitrary decisions were made as a result of (a) or (b), this was not serious in that they would affect the overall average percentages only minimally.

8. The findings of the survey can be summed up in the following two tables:

(1) Average percentage allocations:

	Average %		Highest %		Lowest %	
	Science	History	Science	History	Science	History
Non-verbal	66,4	7,0	89,5	16,7	42,0	0,0
Verbal: Total	33,6	93,0	58,0	100,0	10,5	83,3
One-word	15,7	10,3	39,0	25,5	1,3	0,0
Descriptive	17,9	82,7	35,0	93,5	3,5	67,5

(2) Distributions (in percentages) per paper (History doubled to equate 20 Science papers):

	Non-verbal		Verbal			
	Science	History	Total		Descriptive	
			Science	History	Science	History
0 - 9		16			2	
10 - 19		4	1		14	
20 - 29			5		2	
30 - 39			10		1	
40 - 49	1		3			
50 - 59	1		1		1	
60 - 69	12					4
70 - 79	5					6
80 - 89	1			4		2
90 - 100				16		8

(First column = % of marks allocated to the different types of questions; other columns = number of papers that allocated that percentage to the different types of questions.)

9. Some of the conclusions that can be drawn from these figures are as follows:

(a) There is a wide range from paper to paper as regards the proportion of marks allocated to different types of questions. If one looks at the figures relating to verbal vs non-verbal, one sees, for example, that the highest percentage allocated in a Science paper to non-verbal answers was 89,5%, which parallels the lowest percentage allocated to verbal, ie 10,5%. Yet the average percentages for these two types of questions respectively were 66,4% and 33,6%. The range, therefore, as regards allocation of marks to verbal vs non-verbal questions, is very wide. The same range can be seen by examining the second table. Both tables similarly show a wide range in History examinations. If one turns one's attention to the allocation of marks to descriptive answers, one sees that the range in Science is from 35,0% of the total marks for the paper to 3,5% (a range of 31,5%), while in History the range was 26%. The second table, similarly, shows that, although 70% of the Science papers allocated between 10 and 19% of their marks to descriptive questions, as many as 20% allocated more than this. In History, there was also a fairly wide spread. From this one can deduce that different papers (maybe different schools) are making very different linguistic demands upon their pupils as far as examinations in Science and History are concerned.

(b) On the other hand, there are certain clear tendencies within the respective subjects that can be discerned. These present a definite contrast between the two subjects:

(i) Whereas all the Science papers (except one, which happened to have no multiple-choice questions) allocated more marks to non-verbal than verbal questions (on average, in the ratio of 2:1), History papers display the exact opposite tendency, the only difference being that the ratio of verbal to non-verbal is far greater.

(ii) For the verbal questions, there is also a contrast. In Science, there is a more-or-less equal distribution between one-word answers and descriptive answers, whereas in History descriptive answers far outweigh one-word answers.

From the point of view of Science examinations, the key point which emerges is the small proportion of marks allocated to questions that require descriptive answers - ie truly verbal answers. On average, these types of questions account for only 17.9% of the whole paper. The lack of emphasis on descriptive answers is even further borne out by an examination of the questions that fall into this category. It becomes clear that many of these questions require little more than one-word answers or strings of phrases; which means that, in fact, a very small percentage of the questions demand any kind of ability to express concepts in connected discourse. The following question, for example, appears in one of the papers:

A photographic light meter is used in your classroom.

- (a) What happens to the pointer of the meter ? (1)
- (b) Where does the energy come from ? (2)
- (c) Why does the pointer show a large deflection when held outside in the sun ? (2)
- (d) The meter is held first in red light and then in violet light. The pointer shows a larger deflection in violet light. Assume that the two light sources have the same intensity. What do you deduce from this observation ? (3)

Although the marks indicate that only brief answers are required, one would nevertheless see these questions as falling into the descriptive category as they require some kind of explanation. If one examines the memorandum, however, one realises that all that the Science teacher really wants is a word or phrase or brief semi-sentence which indicates that the pupil understands the basic concepts involved. The answers given in the memorandum are as follows:

- (a) moves
- (b) light
- (c) greater power (or intensity) (accept energy)
- (d) violet transfers more energy for second

If one examines some of the scripts, one notices that pupils tend on the whole to write more fully than the memorandum seems to require. This is partly the case because the memorandum is written for the use of teachers; it is meant to be a quick guide for marking; furthermore, it can be cryptic without running the risk of becoming vague or ambiguous because of the teachers' knowledge which is brought to bear upon the memorandum. Yet even when a copy of the memorandum is issued to pupils after the examination, it would appear that teachers do not express answers in any more

fluent style.

The point which emerges from this is that Science teachers are not really testing ability to express scientific concepts so much as comprehension of certain concepts. The aim is to test knowledge of facts, processes, etc.

An examination of 25 scripts of pupils who answered this particular paper substantiates the above observation. Answers which are brief and lacking in full sentences can earn as much as answers which use complete sentences and explain much more (ie rely much less on presuppositions). Take, for example, the following two sets of answers to the above question. The marks assigned to each were the same - 2 marks for (a) and (b) combined and 2 for (c):

- A. (a) When it pointed near sunlight the pointer of meter rises.
 (b) From sun, or electrical energy from light bulb.
 (c) When outside sun's rays sunshine stronger than inside then large deflection.
 (d)
- B. (a) If the light is on, the pointer on the meter will move, giving you a reading.
 (b) The energy is obtained from the light which in turn produces a weak electric current which in turn is converted into mechanical energy which moves the needle. The light falls on a photo-electric cell.
 (c) Because there is more light and it is more brighter and therefore more light falls on the meter and since there is more brightness there will be more energy.

The following two also earned the same marks as above:

- C. (a) deflects
 (b) from the light.
 (c) The intensity of light increased.
 (d) That violet light bends more than red light.
- D. (a) The pointer moves.
 (b) The light in the classroom.
 (c) The sun has greater light energy outside than inside therefore the pointer is deflected more.
 (d) The violet light has a shorter wave-length.
 The violet light travels faster.
 The violet light is refracted more.

These deductions are further reinforced by examining the marks allocated descriptive questions. It has been argued that all that pupils are required to do is to write their answers in point-form to indicate that they know

and understand what they have been taught. What is also significant is that they are seldom called upon to write answers of this type of any length. 'Descriptive' answers are, in effect, brief notes and no more. This can be seen by noting the marks allocated to descriptive answers. Only one question in the 20 Science papers required an answer worth 10 marks; one required an answer worth 7; and one an answer worth 6. The rest of the descriptive questions were worth less than 6 marks, with the majority (approximately 80%) in the range of 2 - 3 marks.

There were a number of questions which counted for more than 6 marks; however, with the exception of those cited above, these all contained clear sub-divisions which made in them effect a collection of short questions worth 2 - 3 marks. The following, for example, is typical of these types of questions:

You have set up an apparatus to show how a current may be induced using a changing magnet flux.

- (i) Sketch a diagram of the apparatus.
- (ii) Say what happens in each of the following cases when the switch is (1) closed (2) stays closed (3) switched off.
- (iii) Name three ways in which the strength of the induced current may be increased.

The descriptive parts of this question were worth 9 marks, divided into two parts, (ii) and (iii). This makes for short, separate answers. Furthermore, (ii) is sub-divided into three clear parts, with the result that the pupil is given a clear structure for his answer. The situation would have been different if the question had been worded as follows:

Say what happens when the switch is in different positions.

In questions such as these, the pupil is given a clear outline for what could have been set as a paragraph or a mini-essay question. Sometimes there are no stated sub-divisions, yet the question clearly requires a certain number of points each of which separately counts 2 - 3 marks and each of which is, in effect, a separate short question. This can be seen in (iii) above. Other examples of this tendency are as follows:

- (1) Name four methods of preparing salts.
- (2) Name three properties of the image produced ...
- (3) Name four changes which occur when heat is transferred.
- (4) Compare the camera and the eye by mentioning five factors that they have in common.

Even the last of these, which counted 10 marks, simply demanded an answer which could be done in tabular form containing key words or phrases.

It can be seen, then, that descriptive questions generally demand very little in the way of connected discourse in Science. Where this is ostensibly called for, the question is worded in such a way as to indicate very clearly the items or points to be covered. In some of the questions, the answers consist of set answers composed of a combination of terms selected from sets of options.

The general conclusion which can be drawn from all this is that pupils are not required, on the whole, in Science to write pieces of connected discourse. Therefore, the writing skills required of pupils are not those typically associated with discourse, eg cohesion, unity, logicality, etc. The assumption of shared knowledge between writer and reader is also a typical feature.

In History, the position is very different. The majority of marks in a paper are allocated to descriptive - especially essay-type - questions. Furthermore, marks are included in the mark-scheme for what is called 'insight'. The memoranda to the questions in Addendum A indicate that this includes such qualities as coherence, logical development, etc.

2 1/2 HOURS
260 MARKS

STD 8 HISTORY H.G.

NOVEMBER 1982

NOTE TO CANDIDATES:

This paper comprises two sections. Section A contains the Essay Questions. You are required to answer three. You must answer at least one essay question from the South African essay questions (ie nos 1 to 3) and at least one from the European essay section (ie nos 4 to 6). You must answer any one additional essay question ie from either section. You should write about 1 1/2 to 2 foolscap pages on each essay and you should not take more than 35 minutes over each essay. Please number your answers exactly as the questions are numbered. Read all the questions in both sections carefully. Good luck!

SECTION A : ESSAYS

QUESTION ONE

The "Great" Trek enjoys pride of place as the central event in South African history. Suggest in what important respects it differed from the haphazard expansionist trekboer movements which had taken place since the early days of the Dutch settlement at the Cape.

(30 = Insight + 30 = Content = 60)

QUESTION TWO

The M'Fecane was essentially a process of social, political and military change within African society which took place with explosive rapidity during the rule of Shaka. Discuss this statement in an essay in which you expand on the ideas stated above.

(30 = Content + 30 = Insight = 60)

QUESTION THREE

In 1843 and 1848 the attempts of the Trekkers to establish independent republics in Natal and Transorange were blocked by the British annexations of these two territories. Discuss the causes which led to both annexations.

(30 = Content + 30 = Insight = 60)

P.T.O.

QUESTION FOUR

Describe carefully the role played by foreign countries in the struggle for Italian Unification during the period 1854 to 1870.

(30 = Content + Insight = 30 = 60)

QUESTION FIVE

"Bismarck, far from planning the war with France, was surprised when war between that country and Prussia became a reality. Many observers felt that if there was any planning it was to be found in the French Foreign Office." Do you agree with this assessment of the responsibility for the outbreak of the Franco-Prussian war?

(30 = Content + Insight = 30 = 60)

QUESTION SIX

If the expansion of empires into Africa from the 1870s onwards involved several European governments in "unwelcome and costly commitments", why was the partition of Africa nevertheless undertaken with such vigour?

(30 = Content + Insight = 30 = 60)

3 X 60 = 180

SECTION B : NON-ESSAYSQUESTION ONE

1. Which historical figure is most closely connected with each of the following?

(E.g. Hitler's Gestapo = Heinrich Himmler)

- (i) Reforms introduced at the Cape during the Batavian period of rule.
- (ii) The arrival of the 1820 Settlers at Algoa Bay.
- (iii) Scottish clergy's contribution to the Dutch Reformed Church in the Cape.
- (iv) The struggle for a free press at the Cape in the early 19th century.
- (v) The great anti-slavery movement in Britain in 19th century.

(5)

2. Read the following brief extract and answer the questions which follow.

11 February 1823

" My Lord

The subscribing colonists in South Africa who emigrated to the Eastern districts in the year 1819 are compelled to lay before your Lordship a statement of the real circumstances and grievous difficulties which have led to our present sorry plight...."

- (i) Who were the subscribing colonists referred to? (1)
 - (ii) Who was the Governor of the Cape at the time? (1)
 - (iii) In what ways had the emigrant suffered in the political sense by coming to the Cape? (3)
 - (iv) Describe some of the material problems suffered by the Settlers. (3)
- (8)

3. Simply write down the number of the question and the letter A, B, C or D of the item which does not fit in with the statement underlined.

(i) The Circuit Court of 1811 visited

- A Graaff Reinet
- B Uitenhage
- C George
- D Cape Town

(ii) The Circuit found that

- A Many of the accusations levelled against the farmers were untrue
- B Not a single charge of murder could be proved
- C the honesty of the complainants was often not verified
- D Only three thousand cases of assault were proved

(iii) The reaction of the slave owners to the Circuit Court's findings

- A was one of increased mistrust of the missionaries
- B was that they were annoyed at the time wasted by the court's deliberations
- C was one of understanding the real service the Court's findings had done them
- D drove a further wedge between the Colonial authorities and the frontiersmen

change - pr

(iv) The importance of the Slagtersnek affair was that it

- A Showed that the farmers were contemptuous of British law
- B Proved the frontiersmen were courageous fighters
- C Showed the desire for a republic on the part of some farmers
- D Showed a lack of agreement amongst Eastern Province farmers

(v) Somerset's new technique for controlling stock thefts included

- A invoking the so-called spoor law system
- B replacement by village chiefs of stolen cattle by a similar number
- C increasing the number of forts along the frontier
- D shooting the stock thieves if caught red-handed

(vi) To maintain peace on the frontier after 1819 Somerset

- A moved the boundary from the Fish to the Keiskamma
- B the annexation of the area between the Kei and the Keiskamma rivers
- C the construction of more forts to carry out this policy
- D the declaration of a neutral belt between the Fish and Keiskamma rivers

(vii) Information about the Southern Bantu is obtained from

- A school text books
- B archaeological excavations
- C tribal traditions
- D the oral tradition

(7)

4. Write an explanatory sentence on each of any five of the following items, to make the meaning clear in its historical context.

- (i) Treaty of Amiens; (ii) Anglicisation; (iii) Lord Glenelg; (iv) Battle of Blood River; (v) Sobhuza; (vi) Thomas Moodie; (vii) Vagrancy;

(viii) Gaika.

(5 X 2 = 10)

5. Read the following extract carefully and answer the questions which are set below:

16 January 1852

"The Assistant Commissioners guarantee in the fullest manner, on the part of the British Government, to the emigrant farmers beyond the Vaal River,

the right to manage their own affairs and to govern themselves according to their own laws, without any interference on the part of the British Government.

- (1) Name the three people who signed the Sand River Convention. (3)
- (ii) Why was the British Government so ready at this stage to grant independence to the Transvaal? (2)
- (iii) What requirement did the Convention lay down about the practice of slavery? (2)
- (iv) What was the reaction of the Transvaal to the Convention when it was made public? (3) (10)

TOTAL = 40

QUESTION TWO

1. Simply write down the number of the question and the letter T or F (True or False), whichever you feel is applicable.
 - (i) Gioberti urged that the Pope become the champion and liberator of Italy.
 - (ii) Venice became for a time the Republic of St Mark.
 - (iii) The abdication of Charles Albert of Piedmont was welcomed by many liberals.
 - (iv) The journal 'Il Risorgimento' was founded in 1847 by Mazzini.
 - (v) The conservative influence of the church in Piedmont was greatly reduced by the Siccardi laws.
 - (vi) The British naval force near Sicily attacked and defeated a French force trying to interfere with Garibaldi's crossing to the Italian mainland. (6)
2. Read the following question and write down just the number and the letter A, B, C or D of the item which FITS IN BEST with the underlined statement.
 - (i) Bismarck's early political ambitions included
 - A a desire that Prussia should become Austria's equal in Germany
 - B a desire to maintain north and south German identity.
 - C a desire to encourage liberal political thinking in Prussia
 - D a desire to contract a mutual defence alliance with Italy
 - (ii) Bismarck was said to have been a master of the art of
 - A Realpolitik
 - B Weltpolitik
 - C Oostpolitik
 - D Wespolitik

(iii) The Treaty of London of 1852 stipulated

- A Schleswig could be incorporated in Denmark at any date
- B the heir to the Danish throne was Prince Leopold
- C the heir to the duchies was Prince Christian
- D the Danish king Frederick VII could have no more children

(3)

Write down the letter of the item which DOES NOT FIT IN with the underlined sentence.

(iv) Bismarck was determined to obtain the duchies of Schleswig-Holstein because

- A of their important geographic and strategic position
- B they gave Prussia a chance to obtain more territory
- C they could provide a cause of war with Austria
- D they could provide a cause of war with France

(v) Bismarck was easily able to isolate Austria on account of

- A Russia's friendship with Prussia over the Polish refugees
- B Napoleon's desire to obtain territorial concessions from Prussia
- C Italy's desire for unity with France
- D Britain's preoccupation with internal franchise reform.

(2)

3. Write a paragraph of 10 to 12 lines on the Treaty of Prague and other results of the Austro-Prussian War. (10)

4. Which historical figure is most closely linked to each of any six of the items following below.

- (i) The introduction of European civilization to Egypt in the 19th century.
- (ii) The purchase of a controlling share in the Suez Canal Co. for Britain.
- (iii) The summoning of the Berlin Conference on colonial affairs.
- (iv) The acquisition of a concession at Angra Pequena.
- (v) The exploration of Uganda.
- (vi) The formation of the British South Africa Company.
- (vii) The defeat of the Sudanese forces at Omdurman.

(5)

5. Write a brief note, between 8 and 10 lines, on the significance of the Fashoda Incident OR the consequences of the French occupation of Algeria & Tunis.

(5)

7.

6. In what significant respects did the British and French colonial policies differ in regard to the African and Asian peoples under their rule? (9)

TOTAL = 40 X 2 = 80

TOTAL FOR PAPER = 260

STD 8
TIME: 3 hrs

HISTORY
STANDARD GRADE

AUGUST 1981
MARKS: 240

- REMEMBER TO: a. Draw a margin down the right side of each page and
b. LEAVE FOUR LINES OPEN before you begin to answer.

SECTION A - GENERAL HISTORY

QUESTION 1 - COMPULSORY

A. Write down the name in A and next to it the fact in B which fits in with it.

A

B

- | | |
|--------------------------|--|
| 1. Louis XVI | i. became the French national anthem |
| 2. General Lafayette | ii. was the new government which was formed after the 'tennis-court oath' |
| 3. Necker | iii. was the state prison where political prisoners were kept |
| 4. Mirabeau | iv. is the French national holiday |
| 5. The Marseillaise | v. was a nobleman who supported the Third Estate |
| 6. Pichegru | vi. was king of France at the time of the French Revolution |
| 7. The National Assembly | vii. was commander-in-chief of the British fleet in 1805 |
| 8. The Bastille | viii. invaded The Netherlands in 1794 |
| 9. 14 July | ix. was The Minister of Finances in France in 1789 |
| 10. Nelson | x. was commander-in-chief of the French troops in America at the time of the American Revolution. (20) |

B. Write short notes on 5 of the following:

1. The Treaty of Campo Formio, 1797.
2. The Battle of the Nile, 1798.
3. The Coup'd etat of Brumaire, 1799.
4. The Legion of Honour.
5. The Peace of Tilsit, 1807.
6. The Old Holy Roman Empire, 800 A.D.
7. Waterloo
8. The First Decree of Berlin, 1806. (10)

C. Answer the following:

1. Who wrote: "Man is born free, but is everywhere in chains"?
2. Who dissolved the States General in 1614? (Louis XVI/Charles X/Marie de Medici/Metternich)?
3. Name the wife of the French King who dies under the guillotine.
4. Name Napoleon's first military campaign in 1796 - 1797.
5. By what action did Napoleon become the absolute ruler of France? (10) /40

ANSWER TWO OF THE FOLLOWING:

QUESTION 2.

"When Napoleon came into control in France, he introduced many reforms"
In the light of this statement, explain what Napoleon did for France. (40)

QUESTION 3.

The philosophers contributed in a large measure towards the outbreak of the revolution. Explain the part played by Rousseau, Voltaire and Montesquieu in awakening the people to the poor conditions in which they had to exist. (40)

QUESTION 4.

Napoleon appeared like a shooting star, but disappeared as quickly. Describe Napoleon's fall, and why it happened. (40)

(40 + 80 = 120)

Std 8 History SG

SECTION B - SOUTH AFRICAN HISTORY

QUESTION 1 - COMPULSORY QUESTION

A. Answer the following:

1. The Peace of Amiens was signed in _____.
2. Who was the governor of the Cape during the rule of the Batavian Republic?
3. Name the first newspaper established by the 1820 settlers.
4. Who was the acting-governor at the Cape who supervised the arrival of the 1820 settlers?
5. Ordinance 50 was passed in (i) _____, and referred to the (ii) _____ (Bantu/Griquas/Hottentots). (10)

B. Write short notes on 5 of the following:

1. The First Occupation of the Cape, 1795.
2. Benjamin Moodie
3. Thomas Pringle
4. The Black Circuit Court
5. Genadendal
6. Bethelsdorp
7. "Researches in South Africa"
8. Ordinance 50, 1828. (10)

C. Fill in the missing word (or words):

The name (1) _____ is also a collective name for many Bantu tribes.

The Bantu divided up into various tribal groups - The (2) _____ in Swaziland, The (3) _____ in Northern Natal and the (4) _____ in the Transkei.

One of Chaka's most capable leaders, (5) _____ fled with a section of Zulus under his command. His tribe became known as the (6) _____. They settled in the Western Transvaal. They were chased out of this area by the (7) _____ and settled north of the (8) _____ river.

Dr J. Philip was head of the (9) _____ missionary society.

Britain occupied the Cape for the first time in (10) _____ (20)

ANSWER TWO OF THE FOLLOWING:

QUESTION 2.

Discuss the slaves in the Cape under the following aspects: their origin, work, the laws passed in regard to the slaves, their emancipation and the results of their emancipation. (40)

QUESTION 3.

Describe the faults of the schemes to bring the Settlers to the Cape and grievances of the 1820 Settlers. (40)

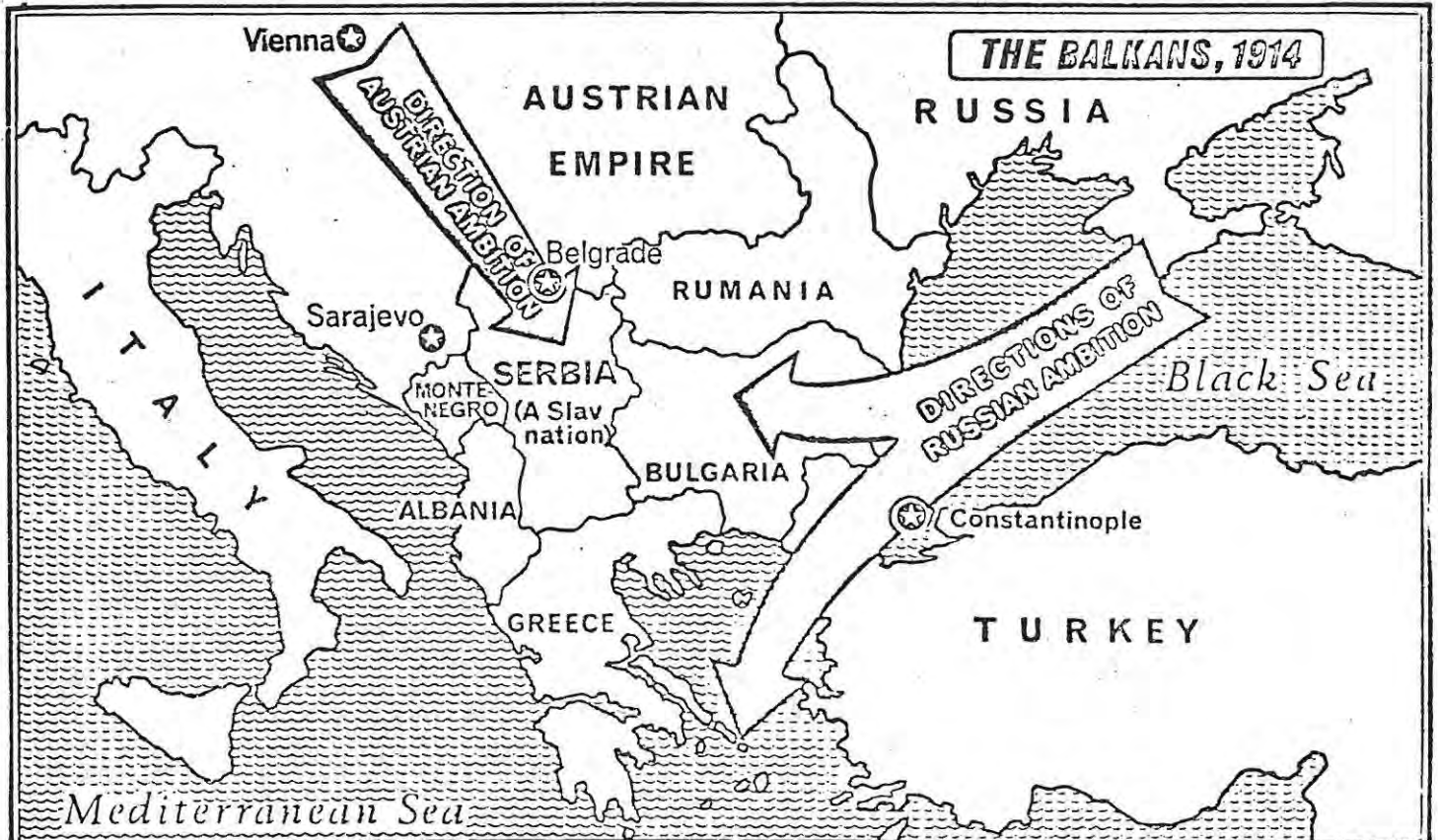
QUESTION 4.

Discuss the work of the missionaries amongst the various tribes with special emphasis on the Xhosa and the Zulus. (40)

(40 + 80 = 120)

Question 4.

STUDY THE MAP BELOW AND THEN ANSWER THE QUESTIONS WHICH FOLLOW.



- (a) ATTEMPT AN EXPLANATION OF WHAT THE MAP IS DEPICTING IN THE TWO ARROWS: "DIRECTION OF AUSTRIAN AMBITION" AND "DIRECTIONS OF RUSSIAN AMBITION." (2 X 10 = 20).
- (b) EXPLAIN THE IMPORTANCE OF SERBIA IN THE BUILD-UP OF TENSION IN THE BALKANS BEFORE 1914. (10)
- (c) EXPLAIN HOW THE ASSASSINATION AT SARAJEVO IN 1914 SPARKED OFF A WORLD WAR. (20).

Question 3(a)

DESCRIBE THE CONTRIBUTIONS OF THE FOLLOWING TO THE UNIFICATION OF ITALY.

- (1) GARIBOLDI (10)
- (2) NAPOLEON III (20)
- (3) CAVOUR (20)

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Question 3(b).

WITH THE AID OF THE MAPS, EXPLAIN HOW THE NORTH GERMAN CONFEDERATION CAME INTO BEING IN GERMANY IN 1866.



Attempt THREE questions. Number your questions correctly. Marks will be deducted for slovenly language and presentation. Answer the question set and refer directly to the diagrams when instructed to do so. Allocate about 40 minutes to each question.

Question 1.

This contemporary cartoon depicts the condition of the French Third Estate in 1789.

Explain the significance of the cartoon by stating:

- (a) Who the three estates represent. (5)
- (b) How the cartoonist sees the condition of the Third Estate. (5)
- (c) What conditions in France led the cartoonist to represent the Third Estate in this way. (20)
- (d) How these conditions contributed to the outbreak of the French Revolution. (20)



Question 2.

Read the following extract carefully and then answer the question which follows:

"St. Helena, May 1816: They may change and chop and suppress, but after all they will find it pretty difficult to make me disappear altogether. A French historian cannot very easily avoid dealing with the Empire, and ... he will have to give me back something of my own. I sealed the gulf of anarchy and I unravelled chaos. I purified the revolution, raised the people, and strengthened the monarchy. I stimulated every ambition and rewarded every merit for my maxim was the career open to talent without distinction of birth or fortune ... I have framed and carried into effect a code of laws that will bear my name to the most distant posterity. I have fought fifty pitched battles and pushed back the bounds of glory! All that amounts to something!"

How accurate and reliable is Napoleon's assessment of his own achievements? Give reasons for your answer.

[50]

InSTRUCTIONS: Please draw narrow margins down the right hand sides of your answer pages and number your work correctly.
Section A consists of General History. Answer Question 1 and two of the four essays in this section.
Section B consists of South African History. Answer Question 2 and two of the four essays in this section.

Question 1

SECTION A - GENERAL HISTORY

a) Explain the meaning of 3 of the following terms

- i) lettre de cachet
- ii) lit de justice
- iii) corvée
- iv) gabelle

(6)

b) Study the following list which shows how some revolutionaries voted on the question of Louis XVI's punishment in January 1793 and then answer the questions below:

Robespierre M	-	Death
Danton	-	Death
Marat	-	Death within 24 hours
Desmoulins	-	Death
David	-	Death
Carnot	-	Death
Paine	-	Banishment

- i) Name the "parliament" which voted on this question. (1)
- ii) To which political party did most of these voters belong? (1)
- iii) What does Marat's decision tell us about him? (1)
- iv) How was David employed during Napoleon's reign? (1)
- v) Write a sentence describing the rôle of 5 of the voters during the revolution. (5)

(9)

c) Read the document and then answer the following questions:

NAPOLÉON'S PROCLAMATION TO THE SPANISH 1808

"Spaniards, you have been misled by traitors. I have abolished everything that was opposed to your prosperity and grandeur. A liberal constitution offers you a moderate constitutional monarchy in place of absolutism. If all my endeavors are in vain, if you do not respond to my confidence, I shall have no alternative but to treat you as conquered provinces. In that case I shall set the crown of Spain on my head and I shall know how to make evildoers respect it."

- i) Who are the traitors referred to by Napoleon. (2)
- ii) What does Napoleon mean by: "I have abolished everything that was opposed to your prosperity and grandeur"? (3)
- iii) Define the term "a constitutional monarchy" (2)
- iv) Is it true that the new constitution introduced a moderate constitutional monarchy in place of absolutism. Explain your answer. (2)
- v) Was Napoleon able to persuade the Spaniards to respect French rule? (2)

(11)

d) State the four basic principles agreed on by the representatives at the Congress of Vienna. (4)

e) Which of the following items does not fit in with heading. Write down the number and the relevant letter only.

i) Congress of Aix la Chapelle

- A. The army of occupation was withdrawn from France
- B. Britain suggested that she should be given the right to search suspected slave ships
- C. Russia suggested that an international fleet should be stationed
- D. Austria was given permission to intervene in the Italian revolts.

ii) Members of the Holy Alliance

- A. Britain
- B. Russia
- C. Austria
- D. Prussia

iii) Delegates at the Congress of Vienna

- A. Alexander I
- B. Louis XVIII
- C. Castlereagh
- D. Metternich

iv) The Frankfurt Parliament 1848

- A. The majority of delegates came from Austria
- B. The delegates decided on a national flag
- C. Universal male suffrage would be adopted
- D. The crown was offered to Frederick William IV

(4)

f) Study the cartoon labelled Figure 1 which is attached to the back of the paper

- i) Who is using the hat as a boat?
- ii) Whose hat is it?
- iii) Explain the symbolism of the hat and the eagle in the cartoon.

(1)
(1)

(4)
/6/
/40/

Question 2

Describe the provisions of the constitution drafted by the National Assembly which came into operation in 1791 and the laws passed with regard to the Church and show to what extent they satisfied the principles laid down in the Declaration of the Rights of Man.

/60/

Question 3

"Although Napoleon's campaigns between 1805 and 1807 resulted in some of his greatest victories the peace settlements contained the seeds of his destruction."

Give an account of the campaigns against Austria, Prussia and Russia and the terms of the treaties (1805 - 1807) and evaluate the accuracy of the statement.

/60/

Question 4

Give an account of the liberal and national revolts which took place in Europe between 1815 and 1829 and describe the steps taken by the governments to suppress these revolts and explain why they failed in most European countries but succeeded in Greece.

/60/

Question 5

Describe the Bourbon regime in France 1815 - 1830 and explain why their rule ended in 1830.

/60/

SECTION B - SOUTH AFRICAN HISTORY

Question 6

- a) The following questions must be answered on the map. Remember to pin the map to your answer pages.
- i) Label the rivers 1, 2, 3 (3)
 - ii) Annotate the map to clearly describe Somerset's frontier policy (6)
 - iii) Label the Province of Queen Adelaide (1)
- /10/
- b) Write a paragraph on one of the following:
- i) Describe the terms of Somerset's Slave Proclamation of 1823.
 - ii) Describe the Bantu policy introduced by the trekkers in Natal in 1840. (8)
- c) i) Define the term "the Mfecane" (2)
- ii) What effect did Shaka's campaigns have on the Eastern Frontier? (2)
 - iii) Name three Nguni tribes which caused chaos in the interior during this period. (3)
 - iv) Where did Moshesh establish his headquarters? (1)
- /8/
- d) Read the following extracts from a letter written to Dingaan by Retief and answer the questions below:

Port Natal, 18 November 1837

To Dingaan, King of the Zulus,

I heartily thank the king for his kind and favourable answer to my request and I hope he will remember his word and promise till I return. You may rest satisfied that I will do the same.

Moselekatzi, (Mzilikazi) I have no doubt has fled, for he cannot but think and feel that I shall punish his very bad conduct. Already I am much grieved that I have been compelled to kill so many of his people who only executed his cruel and wicked commands. What has now happened to Moselkatzi makes me believe that the Almighty and All-knowing God will not permit him much longer to live.

With regard to the thieves who stole your cattle, what they said viz. that they were Boers was a cunning device to make you think that I was the thief in order that they might themselves escape punishment. Knowing my innocence, I feel that you have imposed a severe task, which I must perform in order to show that I am not guilty."

- i) What request had Retief made to Dingaan and what was the "favourable answer"? (2)
 - ii) Explain Retief's reference to Mzilikazi's "bad conduct" (2)
 - iii) Retief claims that he responsible for killing many of Mzilikazi's people. Is this an accurate claim? Explain your answer. (3)
 - iv) Who was the leader of the thieves who stole Dingaan's cattle? (1)
 - v) Was Retief successful in completing the severe task? (1)
 - vi) What would Dingaan have felt on receiving this letter? Support your suggestions with good reasons. (5)
- /14/
/40/

Question 7

Explain how the Batavian rulers at the Cape (1803-1806) introduced French Revolutionary principles, by describing the political, administrative and economic reforms established by Janssens and De Mist. /60/

Question 8

Give an account of the Hottentot legislation passed by Caledon, Cradock, Somerset and Bourke (1809-1828) and describe and explain the colonists' reactions to these laws.

/60/

Question 9

Describe the economic and political consequences of the 1820 settlement scheme and Somerset's policy of Anglicization.

/60/

Question 10

Explain why Britain annexed the Orange River Sovereignty in 1848 and describe the events which led to the signing of the Bloemfontein Convention and the provisions of the Convention.

/60/

Name. _____



Figure I.

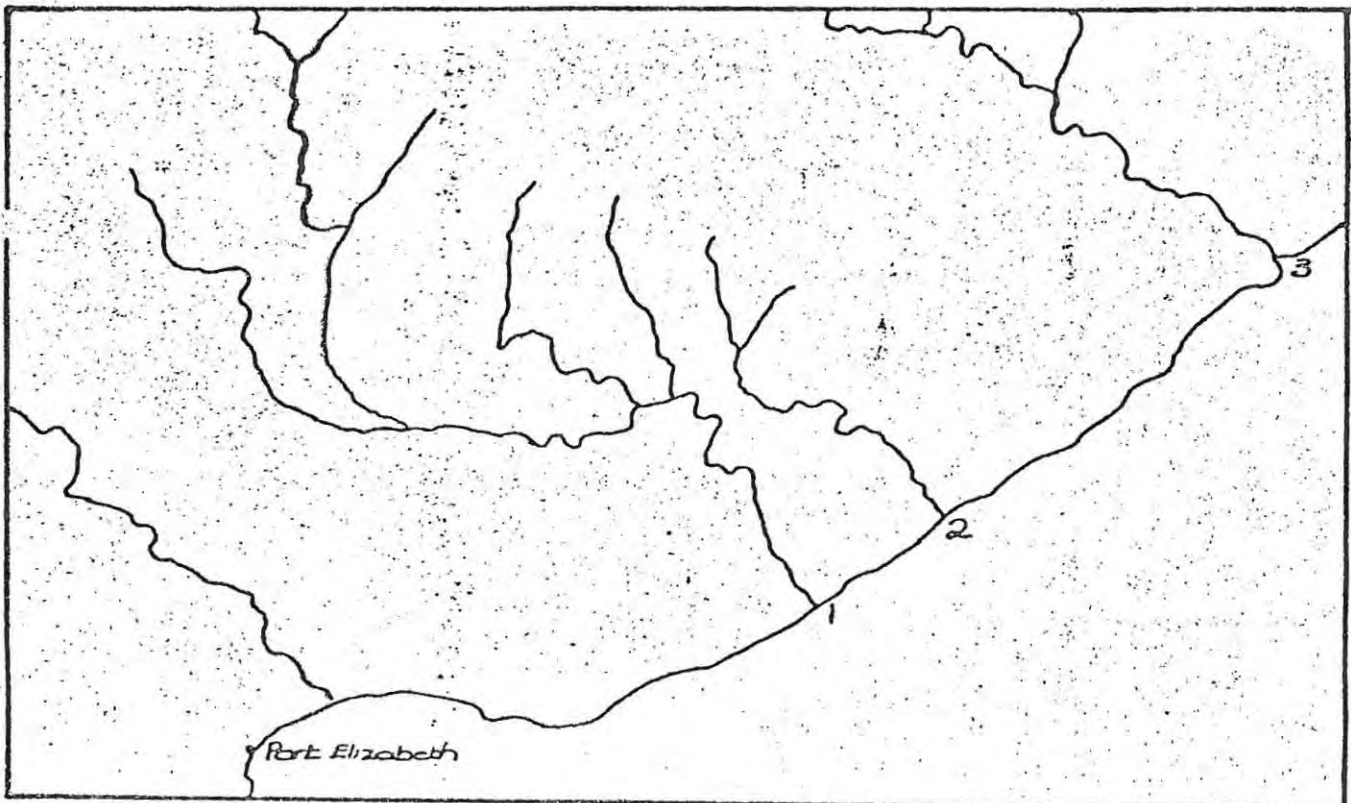


Figure II Question 6a.

Standard 8 History

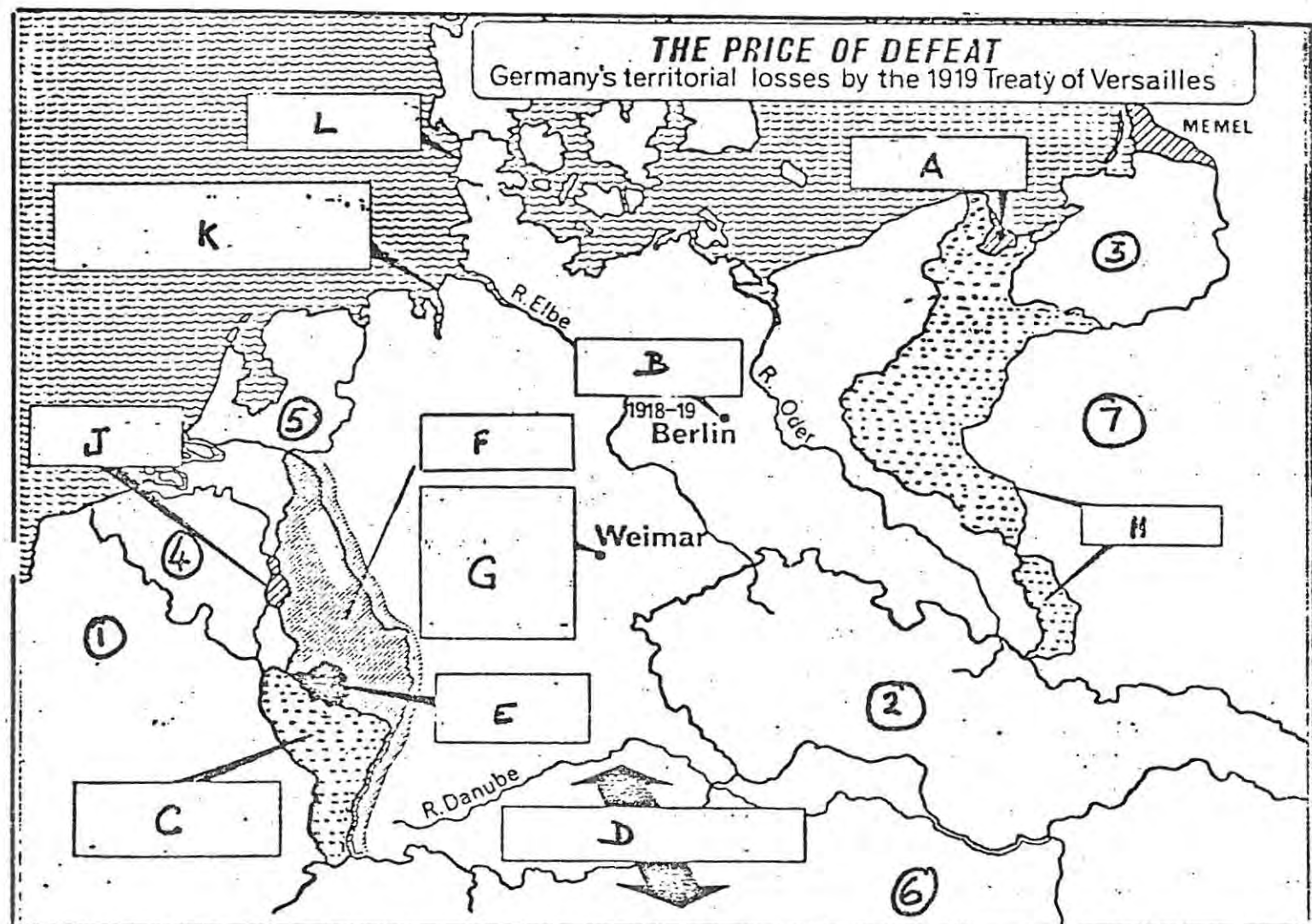
November 1981

2 Hours.

Attempt 3 Questions. Section A is Compulsory. Then attempt two from Section B.

Put your name on Page 2 and hand in the question paper with your essay answers.

Question 1(a)



On the original map information was provided in the "windows" or "blocks" explaining the Versailles Settlement (1919) in Europe. Below is some of the information which came out of some of the "blocks". Indicate, by placing the appropriate letter next to the piece of information, which piece of information came out of which block. Note that there are more blocks than there are pieces of information to make guessing more difficult. Put the letters in the column on the right.

(1)	"Territory lost to France"	
(2)	"Danzig (free city)"	
(3)	"Demilitarized zone"	
(4)	"Saar Coalfields placed under French rule for five years"	
(5)	"Germany was forbidden to unite with Austria"	

Identify the following countries by placing the appropriate numbers next to them in the column on the right.

a. Poland	
b. Czechoslovakia	
c. Belgium	
d. Prussia	
e. Austria.	

Question 1(b) COMPULSORY FOR BOTH SETS.

What was Germany's attitude to the Treaty of Versailles, and was it justified? [40]

Structure your essay around the following points.

1. The attitudes of France, Britain and America towards Germany.
2. German territorial losses in Europe and overseas.
3. Safeguards against German aggression.
4. Reparations - their purposes etc.
5. War guilt.
6. Nation States and German nationalism.
7. Any other important points you want to make.

NOTE THAT YOUR ANSWER MUST BE IN PROPER ESSAY FORM.

Section B.

BOTH SETS: ATTEMPT TWO QUESTIONS FROM THIS SECTION.

Question 2.

Explain how Hitler regained the Saarland, the Rhineland, Austria and the Sudetenland for Germany, showing how he used different methods in each case to do so. [50]

Question 3.

Describe the most important factors leading to the failure of the Weimar Republic in 1933, showing clearly why you think they are important. [50]

Question 5.

Describe the League of Nation's attempts to enforce Collective Security from 1920 to 1936 and explain why it failed. [50]

OR

Describe the structure and organs of the League of Nations, bringing out clearly the Organization's strengths and weaknesses. [50]

Question 6.

Explain why Germany signed the Armistice in 1918, and show why she felt that she had been fooled into signing it. Comment on whether or not the Germans were justified in thinking this way. [50]

STD 8 : HISTORY

STANDARD GRADE

Time: 3 hours

Examiner: B.G. Phillips

Marks : 200

INSTRUCTIONS FOR CANDIDATES:

1. Section A deals with European History.
Section B deals with South African History.
2. Questions 1 and 6 are non-essay-type questions and are compulsory (20 marks each).
3. Questions 2 to 5 and 7 to 10 are essay questions worth 40 marks each. You must answer 2 essays from each section (i.e. 2 from Section A and 2 from Section B). A total of 4 essays must be answered.
4. The length of your essays should be approximately 2 pages each (spend about 35 minutes on each essay).
5. Number your answers clearly and accurately.
6. Marks may be deducted for slovenly and untidy work.

SECTION A : EUROPEAN HISTORY(Question 1 : Compulsory - Answer all questions)QUESTION 1

(Choose the correct alternative in each of the following questions or statements).

1. Who wrote "The Spirit of the Laws"? (1)
(a) Montesquieu
(b) Rousseau
(c) Diderot
(d) Wilbur Smith
(e) Voltaire
2. Which of the following was the salt tax paid by the peasants? (1)
(a) corvée
(b) taille
(c) guillotine
(d) lettre de cachet
(e) gabelle
3. Who was the "Sun King"? (1)
(a) Louis Napoleon
(b) Louis 14
(c) Louis Philippe
(d) Louis 15
(e) Louis 16

On what date did the Paris mob storm the Bastille?

(1)

- (a) 25 December 1791
- (b) 14 July 1789
- (c) 14 January 1789
- (d) 4 July 1820
- (e) 4 June 1781

Which of the following colours was a part of the new flag (Tricolour) introduced during the French Revolution?

(1)

- (a) Brown
- (b) Purple
- (c) Red
- (d) Black
- (e) Green

What important event occurred on 21 January 1793?

(1)

- (a) Outbreak of the French Revolution
- (b) Storming of the Bastille
- (c) Drawing up of a new Republican Constitution
- (d) Execution of Marie Antoinette
- (e) Execution of Louis 16

Which political party did Napoleon join at the outbreak of the French Revolution?

(1)

- (a) United Party
- (b) Jacobins
- (c) Feuillants
- (d) Nationalists
- (e) Socialists

The Austrian Campaign ended successfully, for Napoleon, in 1797 with the signing of the

(1)

- (a) Peace of Versailles
- (b) Peace of Amiens
- (c) Non-alliance Pact
- (d) Treaty of Campo Formio
- (e) Treaty of Pressburg

What happened at Baylen?

(1)

- (a) French army of 20 000 was forced to surrender
- (b) "Spanish Ulcer" took place
- (c) Wellington defeated Villeneuve
- (d) France sunk 10 British ships
- (e) Nelson tactically defeated Villeneuve

When did the Battle of Waterloo take place?

(1)

- (a) 18 October 1813
- (b) 31 March 1814
- (c) 4 July 1820
- (d) 18 June 1815
- (e) 7 May 1813

11. The Congress of Vienna gave Prussia the important seaport of (1)
- (a) London
 - (b) Antwerp
 - (c) Berlin
 - (d) Danzig
 - (e) Rotterdam
12. Which of the following took place in November 1815? (1)
- (a) Holy Alliance
 - (b) Congress of Aix - la- Chapelle
 - (c) Quadruple Alliance
 - (d) Battle of Waterloo
 - (e) Congress of Laibach
13. The concept whereby people became aware of the bonds of language, custom and tradition is known as (1)
- (a) Communism
 - (b) Marxism
 - (c) Liberalism
 - (d) Nationalism
 - (e) Socialism
14. When the Duke of Artois ascended the French throne he was known as ... (1)
- (a) The "Sun King"
 - (b) Charles X
 - (c) Louis Napoleon
 - (d) Louis 18
 - (e) King George V
15. What is Karl Marx's most renowned and important work? (1)
- (a) The Social Contract
 - (b) Encyclopaedia
 - (c) Das Kapital
 - (d) The Communist Manifesto
 - (e) Workers unite
16. Who established the National Workshops in Paris? (1)
- (a) Louis Blanc
 - (b) Friedrich Engels
 - (c) Louis Napoleon
 - (d) Karl Marx
 - (e) Louis 16
17. On 1 December 1851 Louis Napoleon took over the government of France by a (1)
- (a) freely contested campaign
 - (b) well planned coup d'etat
 - (c) fair election
 - (d) democratic constitution
 - (e) instantaneous dictatorship.

18. Which of the following characters does NOT have anything in common with the others? (1)
- (a) Louis 14
 - (b) Mazzini
 - (c) Metternich
 - (d) Napoleon
 - (e) Monroe
19. Which of the following was NOT present at the Congress of Vienna? (1)
- (a) Talleyrand
 - (b) Metternich
 - (c) Tzar Alexander
 - (d) Castlereagh
 - (e) William Pitt
20. Tzar Alexander 1 concluded the Treaty of Tilsit, with Napoleon, after his defeat at Friedland in (1)
- (a) 1789
 - (b) 1820
 - (c) 1807
 - (d) 1802
 - (e) 1791

TOTAL : 20

ANSWER 2 OF THE FOLLOWING ESSAYS.

QUESTION 2

Explain why a revolt broke out in France in February 1848 and how the "Second French Republic" was formed. (40)

QUESTION 3

Account for the fall of Napoleon from power, pointing out the most important reasons for this downfall. (40)

QUESTION 4

What were the aims of the 1814 - 1815 Congress of Vienna; what territorial adjustments were made; and what were the major errors made by the people at the Congress? (40)

QUESTION 5

Discuss the major causes of the French Revolution. (40)

2 X 40

TOTAL : 80

EUROPEAN HISTORY : 100

SECTION B : SOUTH AFRICAN HISTORY

(Question 6 : Compulsory - answer all questions)

QUESTION 6.1

To answer the following questions refer to the Map of Southern Africa.

1. Name the mission station founded by the Moravian missionaries in 1792. (1)
 2. Name the area where the Griquias established themselves under Adam Kok. (1)
 3. Name the river where the contact between the frontiersmen and Xhosa tribesmen caused serious problems. (1)
 4. On what date did the Chapman arrive in the bay marked 4. (1)
 5. To commemorate their victory against the Matabele at Mosega the Trekkers founded between the Vet and Vaal Rivers. (1)
 6. Name the town from which Andries Pretorius started his trek. (1)
 7. Name the port where the American ship, *Levant*, arrived in August 1841 to trade with the Trekkers. (1)
 8. Trace on the map the migratory paths of the following tribes:
(i) Matabele
(ii) Herero
(Label each one very carefully) (2)
 9. Indicate, on the map, the route taken by Retief's Trekker group. (1)
- (10)

QUESTION 6.2

Match up the following dates with the events listed in the right-hand column.

- | | | |
|-----------------------|--|-----|
| (i) May 1842 | (a) Defeat of Matabele at Mosega | |
| (ii) 9 December 1838 | (b) Trigardt reaches Lourenco Marques | |
| (iii) 6 February 1838 | (c) Smith arrived in Port Natal with his troops from Pondoland | |
| (iv) January 1837 | (d) Oath of the Covenant | |
| (v) April 1838 | (e) Death of Retief | (5) |

QUESTION 6.3

Complete the following sentences:

1. The Bantu peoples belong to the race. (1)
 2. The Bantu, being primarily a people, were forced to migrate southwards in search of new grazing. (1)
 3. The Tonga and Swazi tribes are part of the group of people. (1)
 4. Chaka's mother's name was (1)
 5. Chaka learnt Dingiswayo's disciplined fighting methods while living with the tribe. (1)
- (5)

TOTAL: 20

6./

ANSWER 2 OF THE FOLLOWING ESSAYS

QUESTION 7

The 1820 Settlers : Discuss the reasons for their coming, the Organization of the Scheme and how the immigrants were Selected.

(40)

QUESTION 8

Discuss the influence that the various population groups at the Cape in 1806 exerted on each other (i.e. Whites, Hottentots, Slaves, Bantu and Griquas)

(40)

QUESTION 9

What was the Mfecane and how did it affect the tribal situation in South Africa?

(40)

QUESTION 10

Discuss the major causes of the Great Trek.

(-)

2 X 40

TOTAL : 80

SOUTH AFRICAN HISTORY : 100

SECTION A : EUROPEAN HISTORYAnswer ALL the questionsQUESTION IAnswer the following questions in one word:

1. Who was the author of The Spirit of the Laws?
2. Who was the author of The Social Contract?
3. Name the body that was set up to govern France in 1795.
4. What was the name of Napoleon's agreement with the Pope?
5. Where was the Battle of the Nations fought in 1813?
6. What power ruled Poland in terms of the Treaty of Vienna?
7. What European power governed the greater part of South America in the early nineteenth century?
8. Who was elected Pope in the year 1846?
9. Who was elected President of the French Republic in 1848?
10. Who was the dauphin?

/10/

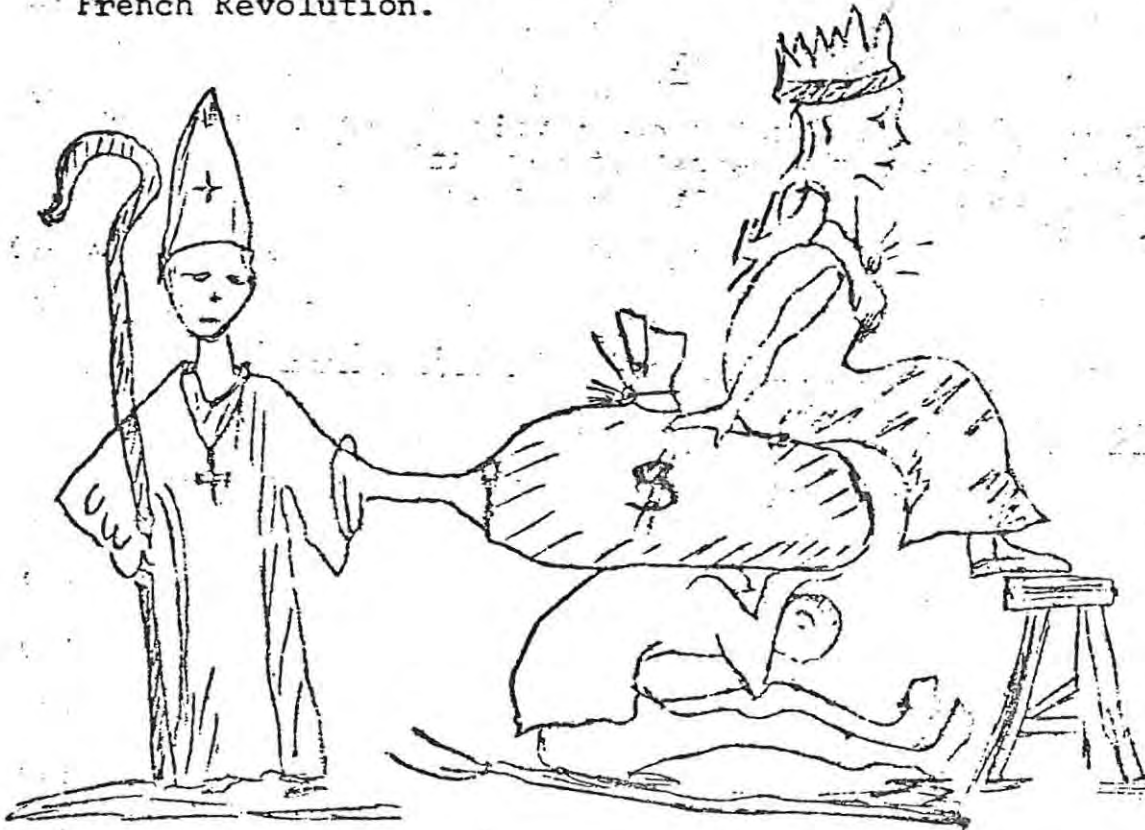
Choose the most accurate answer to complete the following.
(Write down only number and letter.)

11. In France the States-General was:
 - (a) the provincial administration system.
 - (b) a body representing the privileged classes.
 - (c) the parliament.
 - (d) the head of the army.
12. The 'Sun-King' was:
 - (a) Louis XIV.
 - (b) Henry VIII.
 - (c) Louis XV.
 - (d) Louis Philippe.
13. The Paris mob marched to Versailles because:
 - (a) they wanted to pay homage to the royal family.
 - (b) they wanted to remove the royal family to Paris.
 - (c) they had been summoned by the king.
 - (d) they wanted to hand over a list of grievances.

/14. In 1792

14. In 1792 the new French Republic was governed by:
- (a) the National Guard.
 - (b) the monarchy.
 - (c) the Directory.
 - (d) the National Convention.
15. In 1802 Napoleon wanted peace with Britain because:
- (a) he wanted to rebuild his navy.
 - (b) he wanted to concentrate on defeating Austria.
 - (c) he had given up all hope of defeating Britain.
 - (d) he wanted to reorganise France.
16. A coup d'etat means:
- (a) overthrowing the government by force.
 - (b) being arrested without a warrant.
 - (c) compiling a list of grievances.
 - (d) a new system of voting.
17. Napoleon's 1st Italian Campaign ended with the signing of:
- (a) the Treaty of Tilsit.
 - (b) the Treaty of Luneville.
 - (c) the Treaty of Campo Formio.
 - (d) the Treaty of Pressburg.
18. Nationalism means:
- (a) a movement towards a unity of language, custom and tradition.
 - (b) a gathering of different nations.
 - (c) a movement towards gaining freedom.
 - (d) a system of conquering nations to become more powerful.
19. Metternich was unpopular in the German States because he:
- (a) was not German by birth.
 - (b) encouraged student demonstrations.
 - (c) spread anti-government propaganda.
 - (d) tried to suppress liberal movements.
20. The Second French Republic was proclaimed in:
- (a) 1839
 - (b) 1848
 - (c) 1851
 - (d) 1852
21. From what document does the following quotation come?
- "The aim of all political association is the preservation of the natural and prescriptive rights of man. These are liberty, property, security and resistance to oppression."
- Who said the following:
22. ... that other countries should not interfere with

23. that the "Spanish Ulcer" led to his downfall.
24. that only the noble savage is virtuous.
25. Of whom was it said "he is an honest man and wishes really to do good, but he has neither genius nor education to show the way towards that which he desires." /5/
26. Referring to the cartoon below deduce five causes of the French Revolution.



QUESTION II

Answer either (a) or (b)

EITHER

- (a) Napoleon was at the height of his power in 1807 when he made the Treaty of Tilsit.

Show how Napoleon's application of the Continental System, and the rise of nationalism in the German States and Italy contributed to his downfall in 1814.

(35 + 10 + 5 = 50)

OR

- (b) Metternich was an extreme reactionary.

Show how the application of his policies at the Congress of Vienna and subsequent Congresses led to the breakdown of Congress Rule in 1829.

(35 + 10 + 5 = 50)

QUESTION III

Answer either (a) or (b).

EITHER

- (a) Discuss the reasons for the growth of discontent among the French people with Louis Philippe's government in the period 1830 - 1848.

(35 + 10 + 5 = 50)

OR

- (b) In which Italian States did revolts occur in the year 1848? Explain the causes of revolution in each case and also the reasons for the failure of these various revolts.

(35 + 10 + 5 = 50)

SECTION B : SOUTH AFRICAN HISTORY

QUESTION IV

Who or what were the following? Explain as briefly as possible.

1. Researches in South Africa. (2)
2. Matabele (2)
3. Mfekane (2)
4. Neutral Territory (2)
5. Dingiswayo (2)

/10/

Give as briefly as possible the main reason for the following,

6. The movement of the trekboers into the interior in the 18th century. (2)
7. The coming of the 1820 Settlers. (2)
8. The change in the language laws. (2)
9. The southward migration of the Bantu people, (2)
10. The rise of Chaka to supremacy. (2)

/10/

Choose the answer which DOES NOT fit the phrase (write down only number and letter).

11. The 1st British Occupation of the Cape included the following years:

- (a) 1795
- (b) 1801
- (c) 1794

12. Slaves were imported to the Cape from:

- (a) Mozambique
- (b) Malaya
- (c) Malta
- (d) Madagascar

13. Moravian mission stations were established at:

- (a) Pacaltsdorp
- (b) Genadendal
- (c) Enon
- (d) Mamre

14. From 1809 - 1819 these governors proclaimed laws regarding the Hottentots.

- (a) D'Urabn
- (b) Somerset
- (c) Caledon
- (d) Cradock

15. The Nguni people include these tribes:

- (a) Pondo
- (b) Tonga
- (c) Swazi
- (d) Sotho

/5/

16. Fill in the missing words:

"The hinterland of the Colony comprised the vast area between the16.... Mountains and the Fish River, the official eastern boundary. This area was divided into the districts of ..17..., ...18...,19... and .20....."

/5/

17. "All Hottentots in the different districts of this colony shall have a fixed place of abode and they shall not be allowed to change their place of abode from one district to another without a pass from the landdrost of the district."
1st November 1809.

- (a) Who issued this law? (1)
- (b) Name three other provisions contained in the same law. (3)
- (c) Name the ordinance which changed these provisions in 1828. (1)

/5/

18. "We complain of the unjustifiable odium which has been cast upon us by interested and dishonest persons, under the cloak of religion, whose testimony is believed in England to the exclusion of all evidence in our favour."

2nd February 1837.

- (a) From what document is the above extract taken? (1)

/(b) Who are

- (b) Who are the "interested and dishonest persons"? (1)
- (c) On whose behalf was the document written? (1)
- (d) Why does the writer feel that they have been unjustly treated? (2)
- /5/

QUESTION V

Answer either (a) or (b)

EITHER

- (a) The 1820 Settlers had considerable difficulty adjusting, both socially and economically to their new environment. Discuss these problems.

How far had their grievances been settled by the end of Somerset's governorship in 1828?

(35 + 10 + 5 = 50)

OR

- (b) Explain the steps (starting in 1807) leading up to the emancipation of the slaves in 1834, and the part played by philanthropists in their liberation.

Discuss the effect of emancipation on slave owners.

(35 + 10 + 5 = 50)

QUESTION VI

Answer either (a) or (b)

EITHER

- (a) Explain the frontier policies adopted by the Governors Cradock, Somerset and D'Urban, and explain why each of them failed.

(35 + 10 + 5 = 50)

OR

- (b) Anti-British feeling at the Cape had been increasing and resulted in the Great Trek in 1837.

In the light of this statement discuss the causes of the Great Trek.

(35 + 10 + 5 = 50)

SECTION A (SOUTH AFRICAN HISTORY)

Question 1 (non-essay) is compulsory. TWO essays must be chosen from essay questions 2, 3 and 4.

QUESTION 1 (COMPULSORY)

(a) Fill in the missing words. Write down the number and the missing word(s):

In 1802 by the Treaty of -(1)-, the Cape was returned to the Batavian Republic. The new Commissioner of the Cape was -(2)-, while the Governor was -(3)-. In Central government legislative and executive powers were held by the governor and -(4)- officials. In local government, the new districts of -(5)- and -(6)- were formed. At the head of each district was a -(7)- and six -(8)-. A mission station was also set up at -(9)- by Dr Van der Kemp and -(10)-. (10)

(b) Write down the letter A, B, C, D which does NOT fit in with the heading in capital letters:

(1) THE 1809 PROCLAMATION

- A: The tribal system was abolished
- B: The hottentot had to have a pass.
- C: A hottentot child had to be apprenticed to the farmer for eight years.
- D: Introduced by Caledon.

(ii) THE TREATY STATE SYSTEM

- A: The chief must keep law and order in his own territory.
- B: The chief will be under the control of the colonial authorities.
- C: The chief will be paid in return for his duties.
- D: The chief will receive arms and ammunition.

(iii) D'URBAN'S FRONTIER POLICY

- A: Province of Queen Adelaide was returned to the Bantu
- B: Treaty made with Waterboer.
- C: Area between the Kei and Keiskamma was annexed.
- D: The boundary was the Keiskamma.

(iv) ORDINANCE 50

- A: It increased the labour shortage
- B: 1828
- C: Contracts between master and servant were cancelled.
- D: Tobacco could not be used as wages.

(v) POLICY OF ANGLICISATION

- A: English was the only medium of instruction in state schools
- B: English became the sole official language
- C: Scottish Presbyterian ministers were sent to the Cape
- D: English coinage was replaced by Dutch coinage. (5)

(c) Study the map attached and answer the questions below:

(i) Identify the Trek parties taking the following routes:

- (a) xx; (b) - - ; (c) ... (3)

(ii) Name the town (10) where most of the Trekkers met. (1)

(iii) Name the mountain range (5). (1)

(iv) Give the number of the river which forms the northern boundary of the Cape. (1)

- (v) Name the rivers (2) and (3).
 (vi) Which tribe lived at (8) and who was their leader?

(2)
 (2)
 (10)/40/

(d) See attached.

QUESTION 2

EITHER:

- (a) Why was there unrest along the Eastern Frontier? Describe the steps taken by Caledon, Cradock and Somerset to solve the problem.

/40/

OR

- (b) Explain the steps taken by Britain between 1807 and 1831 to improve the conditions of the slaves. Also show how the liberation of the slaves was finally accomplished.

/40/

QUESTION 3

Discuss the 1820 Settlers with regard to:

- (i) their reasons for immigrating and the conditions under which they arrived and settled themselves;
 (ii) their grievances and clashes with Somerset.

/40/

QUESTION 4

Explain carefully why Britain annexed Natal in 1843.

/40/

SECTION B (EUROPEAN HISTORY)

QUESTION 1

- (a) Give one word or phrase for the following:

- (i) the nobles who fled from France during the Revolution.
 (ii) the overthrow of a government by military force
 (iii) the French admiral who was pursued by Nelson and forced to retire to Cadiz for repairs
 (iv) the agreement made by Napoleon with the Pope
 (v) the Treaty by which the Greeks received their independence in 1829.

(5)

- (b) Write down the item which will make the statement true. Write down the number and the answer.

- (i) In the coup d'etat of Brumaire, Napoleon was helped by (Lafayette/Abbé Sieyès/Carnot).
 (ii) Napoleon was defeated at (Baylen/Dresden/Lodi).
 (iii) Mirabeau led the (National Guard/National Assembly/National Convention).
 (iv) The Congress of (Aix-la Chapelle/Laibach/Verona) dealt with the question of revolts in the Spanish colonies.
 (v) The (Holy Alliance/Grand Alliance/Quadruple Alliance) consisted of Britain, Austria, Prussia and Russia.

(5)

- (c) The following are events which occurred during the French Revolution. Place them in the correct chronological order:

Bread March; Meeting of the States General; Storming of the Bastille; Reign of Terror; Execution of the King.

(5)

d)/

(d) Write down only the letter A,B,C,D which does NOT fit in with the heading in capital letters:

(i) NAPOLEON'S EGYPTIAN CAMPAIGN

- A: The French landed at Aboukir Bay
- B: The Battle of the Pyramids was fought
- C: The Rosetta Stone was discovered
- D: The campaign was a success.

(ii) BATTLES FOUGHT BY NAPOLEON

- A: Waterloo
- B: Leipzig
- C: Amiens
- D: Lutzen

(iii) NAPOLEON'S INTERNAL REFORMS

- A: A Bank of France was established
- B: Freedom of the press and speech
- C: The Roman Catholic Church became the State Church
- D: Education was to be controlled by the State.

(iv) CONGRESS AT TROPPAU

- A: Revolts in Spain, Italy and Greece
- B: Protocol of Troppau signed by Austria, Britain, Russia
- C: 1820
- D: Powers declared they had the right to suppress revolution.

(v) NAPOLEON'S ITALIAN CAMPAIGN

- A: The Cisalpine Republic was formed
- B: Peace was signed at Campo-Formio
- C: The Republic of Venice received its independence
- D: The Pope had to give up art treasures

(5)

(e) Write down only the letter A,B,C etc. of the Column II next to the corresponding number 1,2,3, of Column I.

- | <u>A</u> | <u>B</u> |
|----------------------|---|
| (1) Louis XVIII | A: Commander of the British troops in Spain |
| (2) William Pitt | B: The French representative at the Congress of Vienna |
| (3) Wellington | C: Elected President of France in 1848. |
| (4) Metternich | D: King of Spain in 1808 |
| (5) Robespierre | E: Responsible for the formation of the First Coalition |
| (6) Talleyrand | F: Was executed for wanting to end the Reign of Terror |
| (7) Louis Napoleon | G: The French King from 1815 - 1824. |
| (8) Danton | H: Carried out a policy of suppressing liberalism and nationalism |
| (9) Joseph Bonaparte | I. A leading member of the Jacobin Club. |

(10)

(f) What is meant by FIVE of the following:

- | | |
|--------------------------------|-------------------------------|
| (i) Confederation of the Rhine | (vi) divine right of kings |
| (ii) Monroe Doctrine | (vii) constitutional monarchy |
| (iii) Scorched earth policy | (viii) lettre de cachet |
| (iv) Code Napoleon | |
| (v) nationalism | |

QUESTION 2

"Like that of other continental countries, French Society was characterized by rigid class distinction." The people of France were divided into three "estates" - the clergy, nobles and Third estate".

Within these groups were a number of people who were unprivileged. Discuss the grievances of the unprivileged people.

/40/

QUESTION 3

Write an essay on Napoleon's Continental System, saying when and why it was introduced, how it was put into operation, the British reaction to it and the effect it had on Britain, France and on Napoleon in particular.

/40/

QUESTION 4

- (a) What were the aims of the Congress of Vienna?
- (b) Discuss the principles on which the settlement was based.
- (c) How did the Congress deal with the problems presented by France, Germany and Italy?

NOTE: the above must take the form of an essay.

/40/

QUESTION 5

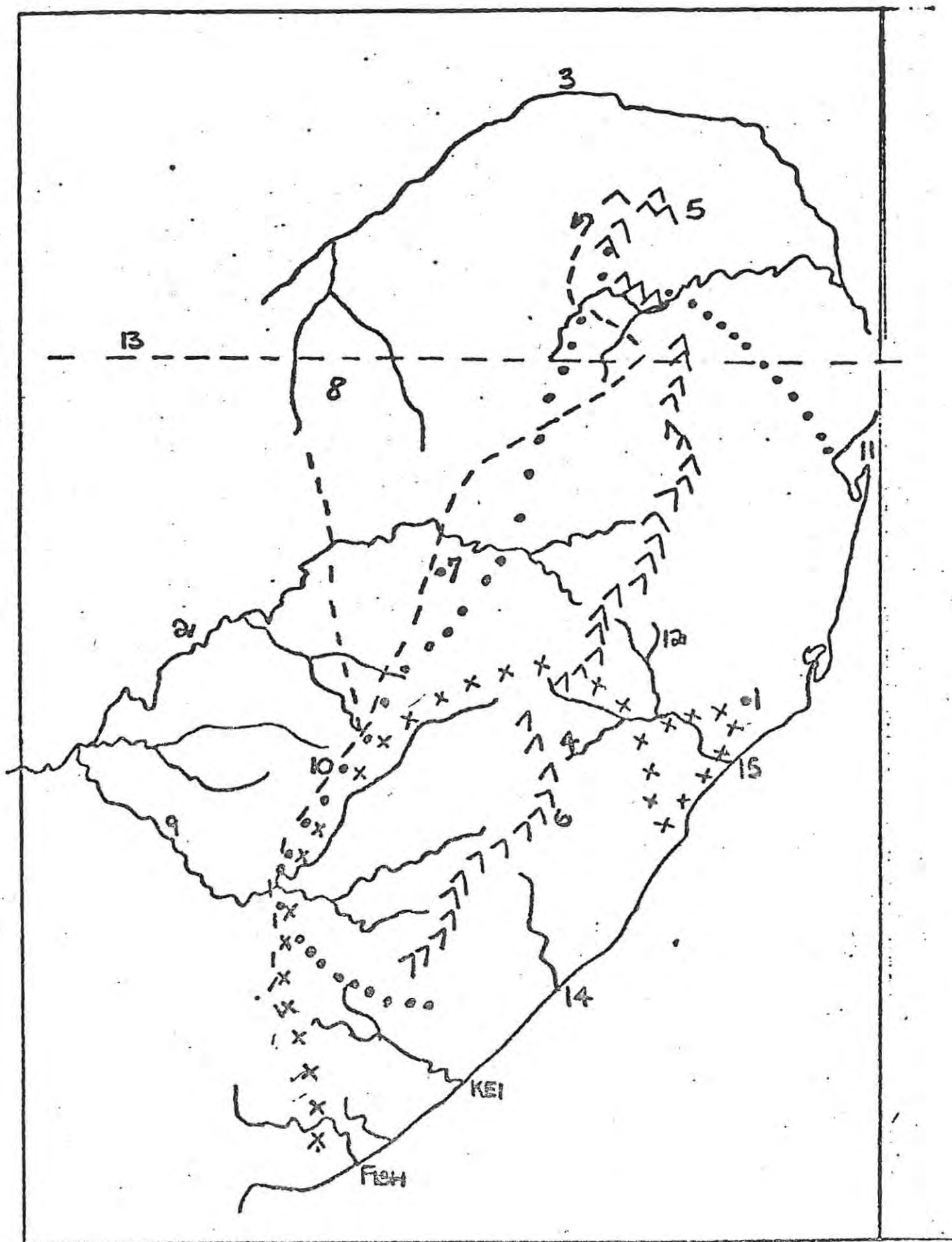
Write an essay showing how increasing dissatisfaction with Louis Philippe's foreign and domestic policies led to revolution in France in 1848.

/40/

QUESTION 1(d)

Answer the following direct questions:

- (1) In what year and by what treaty did Britain take control of the Cape for the last time? (2)
 - (2) What event in Europe played a great part in influencing reforms during the Batavian rule of the Cape? (1)
 - (3) In 1795 the British defeated the Dutch at two battles. Name them. (2)
 - (4) Who was the leading missionary from the London Missionary Society? (1)
 - (5) Who were the editors of "the South African Commercial Advertiser"? (2)
 - (6) By what treaty and in what year was the Transvaal's independence recognised by Britain? (2)
 - (7) What town did Potgieter found near Delagoa Bay? (1)
 - (8) Who was the chief of the Basuto tribe? (1)
 - (9) Who was Oberholster? (1)
 - (10) What is the Day of the Covenant? (1)
 - (11) Who was the governor of the Cape in 1824? (1)
- (15)



HISTORY HIGHER GRADE TEST

1 HOUR

100 MARKS

PEANUTS

featuring
"Good ol'
Charlie Brown"
by SCHULZ



INSTRUCTIONS TO CANDIDATES

- 1 Answer ONE of the Essay Questions from Section A.
- 2 Answer ALL questions from Section B (Non-Essay Questions) in the order as set out in the Question Paper.
- 3 All questions must be answered on your answer sheets and questions must be numbered CLEARLY and CORRECTLY.
- 4 DO NOT WRITE IN THE MARGIN.
- 5 TIMING GUIDE: SECTION A - 35 minutes
SECTION B - 25 minutes
- 6 PLEASE FILE THIS QUESTION PAPER FOR LATER REFERENCE.

SECTION A

Answer CNE of the following 60 MARK ESSAY QUESTIONS:

QUESTION 1:

"Ordinance 50 was the culmination of a long series of proclamations, often contradictory, regulating the status of free persons of colour. With Ordinance 50, Philanthropic influence achieved its first major success."

Trace the development of legislation affecting 'free persons of colour' (Khoikhoi ONLY) from 1809 to 1828 (inclusive), showing clearly the attitudes during this period of Governors, Missionaries and Colonists.

(60 - CONTENT = 25; INSIGHT = 35)

O R

QUESTION 2:

- (a) Explain what you understand by the term "Mfecane" and discuss the contribution made by Dingiswayo and Chaka to this movement.

(30 - CONTENT = 15; INSIGHT = 15)

A N D

- (b) "The annexation of Natal was a humanitarian gesture and a strategic move".

In discussing this statement describe how and why it was that Britain came to annex the territory.

(30 - CONTENT = 15; INSIGHT = 15)

SOME LIGHT RELIEF:

On his first trip to London, van der Merwe could not cope with the mad rush of traffic. Trying to cross Oxford Street, he would put out a foot when another car would come hurtling towards him, forcing him to leap back onto the pavement.

After battling for about 20 minutes, a "Bobby" walked up to him and said: "There's a zebra crossing half a block away."

"So what?" asked Van. "That zebra has as much chance of getting across the road as I have!!"

..... / SECTION B:



SECTION B:

Answer ALL Questions in this SECTION:

QUESTION 1:

BRIEFLY comment on the following documentary extract: that is, place the extract into its historical setting by providing an explanation of what it contains. (Bear in mind that such explanation may, at times, require you to comment on the events leading up to those mentioned in the extract and to show an understanding of the consequences of such events).

"February 12 ... It seems that 50 or 60 Dutch farmers with Retief had arrived at the Royal Kraal, and Dingaan received them favourably. They presented the very peace offering he had requested, and which Dingaan had said would convince him they were not his enemies. Matters went on favourably. He gave them, it is said, a tract of country to dwell in ... and just as they were going to bid him adieu, they were surrounded, seized and hurried to the place of execution. They were killed and the King immediately collected his impi and sent them upon the others (Trekks), who were quietly waiting the return of Retief ... "

(JOURNAL OF THE REV G CHAMPION)

(10)

QUESTION 2:

Read the following extract carefully and answer the questions as set:

"The Circuit Court, freshly created in 1811, announced a new era by making itself accessible to the Khoikhoi as well as the European population. Of the cases promptly brought against European masters many were malicious and false. Certain missionaries undoubtedly overreached themselves in trying to strike a blow for their proteges. But other accusations were proven. The sentences which the Court pronounced against white masters shook the Colony. It was the achievement of Dr John Philip and the philanthropic movement to carry it significantly farther."

- Who was responsible in England for making Cradock introduce the Circuit Courts? (1)
- Who were the judges responsible for conducting affairs? (2)
- Give one notable event which arose as a result of the Black Circuit. (1)
- Explain: "philanthropic movement". (2)
- Name a missionary who "overreached" himself in this matter. (1)
- What important legislation was introduced before the Circuit Courts were introduced and by whom was it introduced? (2)
- What dramatic legislation was to follow the Black Circuit some 17 years later? (1)

(10)

QUESTION 3:

Muller, in an essay on the Great Trek, has suggested that, when a Black Historian from South Africa comes to analyse this period, he will no doubt offer an interpretation additional to the positions taken by English Historians on the one hand and by Afrikaner Historians on the other.

In a SHORT SENTENCE for EACH of the following figures, identify his role as it would be interpreted by (i) an English Historian; (ii) an Afrikaans Historian and (iii) a Black Historian writing about the period we have studied. (NOTE: THERE MUST THEREFORE BE 9 SHORT SENTENCES IN ALL)

(A) RETIEF; (B) MOSHESH; (C) DINGAAN. (3 x 3 = 9)

..... / QUESTION 4:

QUESTION 4:

In 1820 four young boys - Dini Diemont, Seatamix Broad, Lood Linder and Wessell Lood - applied to join Chaka's army. Describe how their veteran campaigner, Happiness van der Easthuizen, would have prepared them for their first battle.

(5)

QUESTION 5:

In a short paragraph give the terms of D'Urban's "amended" Frontier Policy.

(6)

/40/

GRAND TOTAL: 100

FOR THOSE WHO FINISH EARLY!!

"Is that 999?" van der Merwe asked urgently on the telephone.

"You have the wrong number. This is 998."

"Well, would you go next door and tell them to send an ambulance? There's been an accident."



SECTION ASOUTH AFRICAN HISTORYQUESTION 1 (COMPULSORY)

- (a) Write down the name from Column A and next to it the letter (e.g. a, b) of the corresponding item from Column B.

<u>A</u>	<u>B</u>	
General Craig	(a)	Ordered the implementation of the "Treaty State System".
Cradock	(b)	He campaigned for the rights of the Hottentots.
Van der Kemp	(c)	Allowed a Hottentot settlement along the Kat River.
J. Phillip	(d)	Successful at Muizenburg and Wynburg Hill.
Janssens	(e)	Introduced the 1812 Apprenticeship Act for Hottentots.
Glenelg	(f)	Supervised the mission station at Bethelsdorp.
Cole	(g)	His troops surrendered to the British by the Treaty of Papendorp 1806.

(7)

- (b) Write one or two explanatory sentences on each of the following:

- (i) Circuit Courts
- (ii) representative government
- (iii) the "rule of law"

(3)

- (c) Write down the number and next to it the letter (e.g. a, b) of the item which does NOT fit in with the heading in capital letters:

(1) 1809 PROCLAMATION REGARDING THE HOTTENTOTS

- (a) Pass laws introduced
- (b) Access to law courts guaranteed
- (c) The Hottentots were no longer British subjects
- (d) Introduced to end vagrancy and to meet the demand for labour.

(2) REASONS FOR 1820 SETTLERS' CLASH WITH SOMERSET

- (a) Not allowed to hold public meetings
- (b) Had difficulty in marketing their produce because of the competition of the government farms at Somerset West.
- (c) Forbidden to farm with stock.
- (d) Their farms were too small.

(3) SOMERSET'S POLICY OF ANGLICIZATION

- (a) English was the only medium of instruction in state schools.
- (b) English became the sole official language.
- (c) Scottish Presbyterian ministers were sent to the Cape.
- (d) English coinage was replaced by Dutch coinage.

(4) D'URBAN'S FRONTIER POLICY

- (a) Sixth Frontier War
- (b) Moved the colonial boundary to the Keiskamma River.
- (c) The Province of Queen Adelaide was between the Keiskamma River and the Kei River
- (d) The Xhosa between the Keiskamma River and the Kei River were to live in reserves.

(4)

d) Answer the following questions:

- (i) What name is given to the land between the Fish River and the Sundays River? (1)
- (ii) Give TWO reasons for the immigration of the 1820 British Settlers. (2)
- (iii) Where was the 1820 Scottish group settled? (1)
- (iv) Name TWO men involved in the struggle for freedom of the press at the Cape. (2)

e) Study the attached map and then answer the questions below:

- (1) Identify the trekker parties taking the following routes:
 - (a) xx
 - (b) - -
 - (c) ...
- (ii) Name the tribe and their chief resident at (1) at the time of the Great Trek. (2)
- (iii) Give the number of the river which formed the northern boundary of the Cape. (1)
- (iv) Name the rivers (2), (3) and (4). (3)
- (v) Identify the mountain ranges (5) and (6). (2)
- (vi) Name the battle fought at (7) in October 1836. (1)
- (vii) Which tribe lived at (8) and who was their leader? (2)
- (viii) Name the town (10) where most of the trekkers met. (1)
- (ix) State the NUMBERS of those rivers which formed the boundary of the land promised to Retief by the chief at (1). (2)
- (x) Identify the bay (11). (1)
- (xi) Which battle occurred along the river (12)? (1)
- (xii) Comment on the significance of the line (13). (1)

(20)/40/

ESSAYS: Answer TWO essays.

QUESTION 2

- (a) During the period of Batavian Rule (1803 - 1806) the church as well as central and local government were reformed. Describe these reforms showing how they were influenced by French revolutionary ideas. (30)
- (b) "By 1836 the Cape governor's legislative and judicial powers had been reduced considerably." Discuss these constitutional changes for the period 1806 - 1836. (30)/60/

QUESTION 3

EITHER

To what extent was British policy at the Cape responsible for the Great Trek?
(NOTE: Avoid vague answers. Back up your argument with facts.)

/60/

OR

Account for the friction between the Bantu and the farmers on the eastern frontier. THEN describe and critically assess the attempts of Cradock, Somerset and Bourke to solve this problem.

/60/

QUESTION 4/

QUESTION 4

EITHER

Explain why Britain annexed Natal in 1843 and the Orange River Sovereignty in 1848 and yet recognized the independence of the trekkers north of the Vaal.

/60/

OR

(a) Explain why Britain annexed the Orange River Sovereignty in 1848.

(b) Why then did she grant this territory its independence six years later?

/60/

SECTION B

EUROPEAN HISTORY

QUESTION 1 (compulsory)

(a) Identify the following characters:

- (i) Leader of the National Assembly from 1789 to 1791.
- (ii) A Jacobin leader who was murdered in his bath.
- (iii) Advocated the separation of the legislative, the executive and the judiciary.
- (iv) Responsible for the "September Massacres".
- (v) Organized a number of coalitions aimed at destroying France.
- (vi) "Madame Deficit"
- (vii) Leader of the National Guard.
- (viii) Threatened to destroy Paris if the royal family were harmed.
- (ix) His death ended the Reign of Terror.
- (x) Became the King of Belgium in 1831.

(10)

(b) Who or what do you associate with each of the following:

- (i) a "loud-sounding nothing"
- (ii) "Those who blame me have never drunk of fortune's intoxicating cup."
- (iii) "Man is born free, but is everywhere in chains."

(3)

(c) Explain the following terms:

- (i) emigrés
- (ii) parlements
- (iii) absolutism
- (iv) liberalism
- (v) reactionary policy

(1)

(2)

(1)

(2)

(1)

(7)

(d) Write down the number and next to it the letter (e.g. a, b) of the item which does NOT fit in with the heading in capital letters:

(i) CONSTITUTION OF 1791

- (a) Despotic rule was replaced by parliamentary rule.
- (b) France was divided into departments, districts, cantons and communes.
- (c) The king could dissolve parliament.
- (d) The king's ministers had no say in the making of the laws.

(ii) NAPOLEON'S INTERNAL POLICY

- (a) The Roman Catholic Church was the only church.
- (b) There was press censorship.
- (c) The Legion of Honour was established.
- (d) All citizens were taxed according to their means.

(iii)/

(iii) QUADRUPELLE ALLIANCE

- (a) Britain, Russia, Austria, Prussia.
- (b) The Concert of Europe
- (c) 1814
- (d) To meet to deal with threats to the peace of Europe.

(iv) CHARLES X

- (a) Adopted a reactionary policy.
- (b) Issued the Ordinances of St Cloud.
- (c) He appointed an Ultra-Royalist Prime Minister even though the liberals had a majority in parliament.
- (d) He was succeeded by Louis XVIII.

(v) AIX-LA CHAPPELLE

- (a) Canning opposed the policy of interfering in the internal affairs of other states.
- (b) Britain, France, Russia, Prussia and Austria were represented.
- (c) Russia proposed an international fleet be stationed in the Mediterranean.
- (d) Britain's proposal to suppress slave trade by searching ships at sea was rejected.

(5)

(e) Write down the letter and the missing word(s):

- (a) The Treaty of _____ recognized the independence of Greece in 1829 and _____ of Bavaria became the new ruler.
- (b) _____ was known as the "Organizer of Victory".
- (c) Members of the _____ pledged to conduct their affairs with one another in a Christian manner.
- (d) The Declaration of _____ in 1791 stated that it was the duty of all the kings of Europe to go to the aid of the French monarchy.
- (e) In 1798 the British under _____ destroyed the French fleet anchored in _____ in Egypt.
- (f) In 1805 the French fleet under _____ was destroyed by the British at the Battle of Trafalgar.

(8)

(f) Complete the following paragraph. Write down the number and the missing word(s):

In 1796 Napoleon entered Italy. He encountered the Austrians at -(i)- and then entered (ii). The Austrians took refuge in the fortress of -(iii)-, but finally surrendered and peace was made by the Treaty of -(iv)-. By this treaty France gained the -(v)- and -(vi)-. The -(vii)- Republic which included Lombardy, Modena and part of the Papal States was formed in northern Italy.

(7)/40/

ESSAY: Answer TWO essays.

QUESTION 2

Imagine you are an English reporter based in Paris. It is the 15 July 1789 and the French Revolution has just broken out. Write a report giving a detailed explanation for this violent event in history.

/60/

QUESTION 3

Denis Richards claims that, amongst other factors, it was Napoleon's insatiable desire to conquer Britain which brought about his (Napoleon's) downfall.

(a)/

a) Describe the plan introduced in 1806 whereby Napoleon hoped to bring about the downfall of Britain. Give the reasoning behind the introduction of such a scheme and say why Napoleon was in a position to embark on such a scheme.

(20)

b) What justification is there for claiming that Napoleon's attempts to enforce this system led directly to his downfall?

(40)/60/

QUESTION 4

Read the paragraph and then answer the questions which follow:-

The European Coalition, having finally disposed of Napoleon at Waterloo, was now free to resume its conference at Vienna. The problem which confronted the Allies was twofold: first, how to reward the victors and punish the vanquished without setting all at each other's throats; and secondly, how to prevent a recurrence of the great catastrophe that had convulsed Europe for over 20 years. These weighty tasks, however, did not prevent the congress from being one of the most sparkling social events in European history, where brilliantly uniformed kings, emperors and ambassadors gave attention to the lighter pursuits of dancing, etc. in the intervals between the more serious business ... The bills for hospitality were enormous and cost the Emperor fortune ... From the political point of view the outstanding personalities of the Congress were Metternich, Castlereagh ... and Talleyrand."

(Richards: "Early Modern Europe", page 64)

a) Whose (person) idea was the formation of coalition against France? (1)

b) When was the battle of Waterloo fought? (1)

c) Which two major powers opposed Napoleon at Waterloo? (2)

d) Who commanded the two armies mentioned in (b) & (c)? (2)

e) "The European Coalition ... was now free to resume its conference ..." Which event had interrupted this meeting? (5)

f) How were Russia, Prussia, Austria and Britain rewarded for their stand against Napoleon? (7)

g) Give TWO examples of how France, as the vanquished power, was punished. (2)

h) Explain what "great catastrophe" had convulsed Europe for more than 20 years. (2)

i) Which Emperor was out of pocket as a result of the lavish entertainment? (Name the country.) (1)

j) Which countries did the following men represent at the Congress:

- (i) Metternich
- (ii) Castlereagh
- (iii) Talleyrand

(3)

k) Name the FOUR barrier states used to keep France in check. (4)

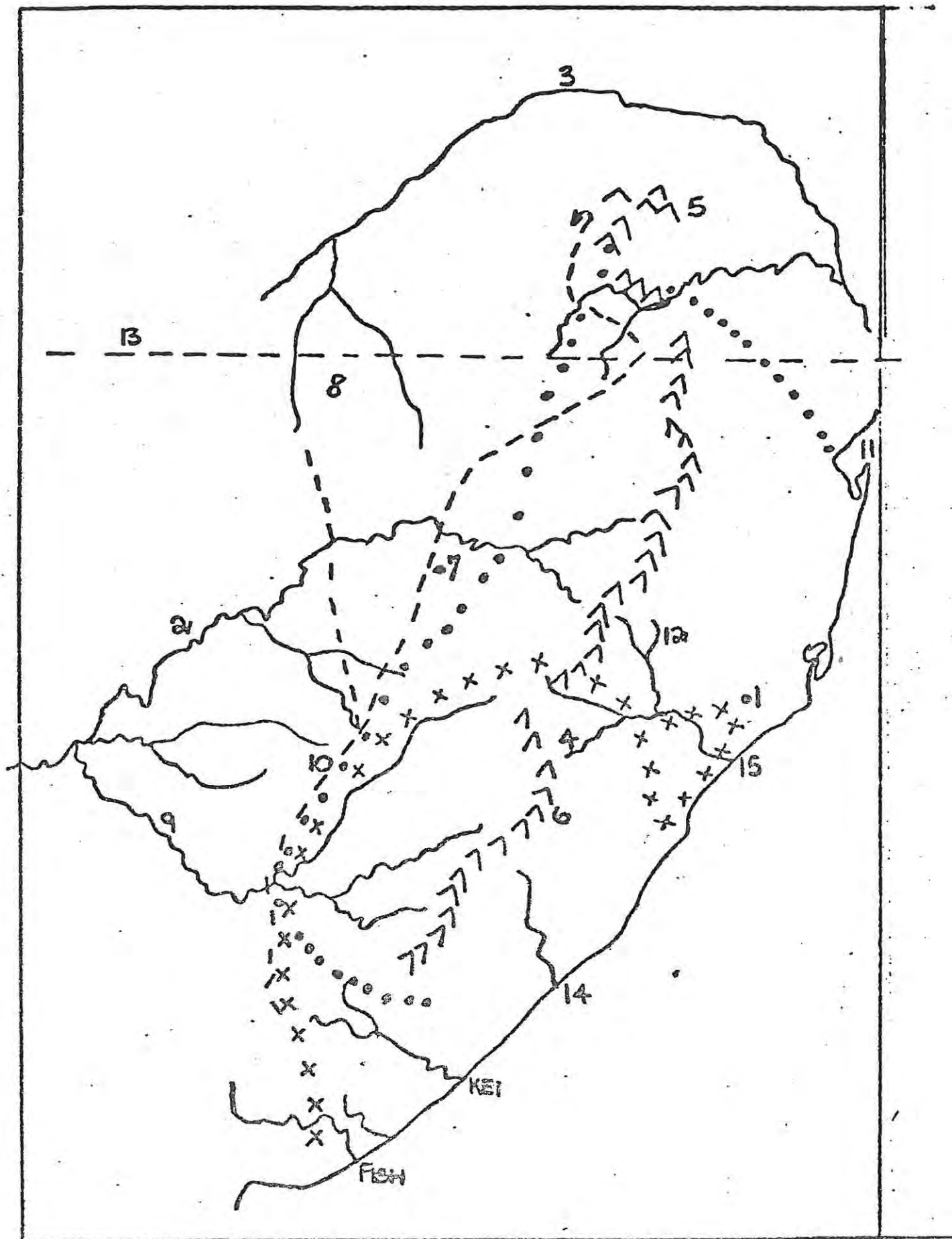
l) Explain fully, with EXAMPLES, why many COUNTRIES WERE DISSATISFIED with the decisions taken by the Congress of Vienna and say how they TRIED TO REVERSE THESE DECISIONS BETWEEN 1815 and 1830. Were their efforts successful?

(30)/60/

QUESTION 5

Account for the fall of the French king, Louis Phillippe in 1848 and Louis Napoleon's subsequent rise to the position of Emperor.

/60/



INSTRUCTIONS: Answer Question 1 in Section A and Question 5 in Section B, i.e. non-essay questions, and ONE essay question from the section on which you did an assignment and TWO essay questions from the other section. Adequate and accurate factual knowledge is essential; equally important is the ability to use relevant information in answering the questions. Special credit will be given to pupils who show an understanding of the subject. Pay attention to the correct use of language. Sub-sections of non-essay questions should be answered in the correct sequence. Number questions clearly, do not write in the margins and rule a line after each question.

SECTION A : GENERAL HISTORY

Question 1:

- (a) Study the "Awakening of the Third Estate", Appendix A, and answer the following question:-

Explain why the two figures on the left had every reason to fear the awakening of the Third Estate in 1789.

OR

Read the following extract and then answer the questions which follow:-

"It was, on the whole, a reasonable and statesmanlike arrangement, of which the chief defect was that it underestimated the dynamism of nationalism. Territories such as Norway, Finland, and Belgium were used as pawns in the calculations of the treaty makers, regardless of the wishes of their inhabitants. Considerations of strategy, power, and dynastic convenience took priority over national or economic interests. It was a settlement framed by monarchs and aristocratic diplomats of the old order, and it was infused with the spirit of the eighteenth century. As such, it could have only limited applicability and longevity in the faster-moving world of the nineteenth century. ... the makers of the settlement ... were bound not only by agreements previously reached among themselves, but still more by the need to reach some compromise between the conflicting political interests of the major participants. "

(D. Thomson, Europe Since Napoleon, p. 95.)

- (i) Give the name and date of this settlement. (2)
- (ii) Explain what happened to Norway, Finland and Belgium. (3)
- (iii) Give an example of an arrangement made for reasons of: (2)
 - A. 'strategy' and B. 'dynastic convenience'.
- (iv) In what way was the settlement 'infused with the spirit of the eighteenth century' ? (2)
- (v) Name one monarch and one aristocratic diplomat responsible for framing the settlement. (2)
- (vi) Why would the settlement have only limited applicability and longevity ? (2)
- (vii) Name the 'major participants'. (2)

15/

- (b) Write a paragraph on the Concert of Europe and the Spanish American Colonies.

OR

Write a paragraph on the Holy and Quadruple Alliances.

10/

- (c) The following questions refer to the map, Europe 1815-1850, Appendix B:-

- (i) Give the names of the places with the following numbers, and one fact of importance about each, relating to this period:

A. 32 ; B. 33 ; C. 28 ; D. 3.

(4)

- (ii) Who was the king of the territory number 15 in 1848 ? Give the number and name of another country or state of considerable size, which he ruled as well. (2)
- (iii) Give the number and name of the last Italian state to surrender after the collapse of the 1848 revolts. (1)
- (iv) Explain what happened in state number 21 in 1830. (2)

OR

The three "pillars of Austria", Count Jellacic, Count Radetsky and Prince Windischgrätz, as seen by a French satirist.



Explain why and in what circumstances these three men were regarded as the "pillars of Austria". 19/

- (d) Write down only the number of the question and the letter, A, B, C or D, of the item which does not fit in with the heading in capital letters.
- (i) THE PHYSIOCRATS
- A. They were concerned with the economic life of the people in France.
 - B. Turgot was a follower of this group.
 - C. Their motto was "Liberty, Equality, Fraternity".
 - D. They advocated the idea of free trade in France.
- (ii) ATTEMPTS TO MEET THE FINANCIAL CRISIS IN FRANCE BEFORE 1789
- A. Turgot tried to do away with corruption in the various state departments.
 - B. Necker attempted rigid economy, even cutting down the expenses of the Royal household.
 - C. Calonne proposed calling the Council of Notables to raise more money.
 - D. Assignats were issued with the former Church property as security.
- (iii) COUNTRIES WHICH EVENTUALLY HELPED THE GREEKS GAIN INDEPENDENCE
- A. Austria
 - B. France
 - C. Russia
 - D. Britain

(iv) IDEAS EMBODIED IN SOCIALISM

- A. A better sharing of the wealth created in industry.
- B. The encouragement of individual enterprise.
- C. All industry should be placed under state ownership.
- D. Workers should participate in the running and control of the factories.

(v) REASONS FOR THE ULTIMATE FAILURE OF CONGRESSIONAL RULE

- A. Metternich wanted to use Congress to suppress all revolts.
- B. Britain only wanted to maintain the arrangements made at the Congress of Vienna.
- C. The irreconcilable attitudes of the members of the Congress were borne out by the Greek Revolt.
- D. France joined the Congress at Aix-la-Chapelle.

(vi) RESULTS OF THE FALL OF METTERNICH

- A. The Poles rose in rebellion against Russia.
- B. In Vienna a liberal constitution was drawn up.
- C. Hungary practically became an independent state.
- D. The Czechs strove to form a Pan-Slav state.

/6/

Total: 40 marksQuestion 2:

"... the Revolution developed from a movement for peaceful reform to an orgy of blood-letting."

Trace this development in the French Revolution and explain why it followed this pattern.

/80/

Question 3:

"... Napoleon has left a lasting imprint on history, for both good and evil, and this will never wholly be erased by time."

Discuss, in broad outline, what Napoleon did to warrant this comment.

/80/

Question 4:

Account for Louis Philippe's ascension to the throne of France in 1830 and his subsequent relinquishment thereof in 1848.

/80/

SECTION B : SOUTH AFRICAN HISTORYQuestion 5:

- (a) Describe the reforms introduced in the administration of the Cape under Batavian rule.

OR

Describe the reforms made in the judiciary of the Cape by the Charter of Justice, 1827.

/10/

- (b) The following questions refer to the map, Appendix C:-

- (i) Give the numbers and names respectively for three tribes which belong to the Nguni group of the Bantu. (3)
- (ii) Give the name and number of one tribe of the North Sotho which retained its culture almost intact. (1)
- (iii) Give the number and name of one tribe of the South Sotho which was a source of concern in the early history of the Orange Free State. (1)
- (iv) Give the names of the tribes situated at 1 and 4 respectively. (2)
- (v) Give the name of the tribe settled at 19 and a prominent chief of the tribe. (2)
- (vi) Give the name of one of the tribes constituting the West Sotho. (1)

OR

PTO

OR

The Heerengracht (Adderley Street), reproduced from a rare print by an unknown artist.



Give an approximate date for this print and explain why you have chosen the date. Then describe the scene depicted here in accordance with what you know about this period. Also point out any recognisable landmarks.

/10/

- (c) Refer to Appendices D and E. The four sketches relate to the coming of the British Settlers in 1820 and their difficulties and adventures. Study the pictures carefully, then select TWO of them (indicate which) and for each one you have chosen

- (i) State briefly what information can be gained FROM THE PICTURE about the Settlers and their adventures;
- (ii) then state shortly other facts which you know about the coming of the Settlers which would support or contradict the information given pictorially.

/16/

- (d) For each item in column I select the correct answer from column II. Write down only the number and letter.

I. (i) JJ Burger

(ii) AH Potgieter

(iii) A Pretorius

(iv) WF Joubert

II. A. was appointed Commandant-General at Marico.

B. did not want the Transvaal Church to be joined to the Cape Synod as the latter had not been sympathetic to the Trek.

C. left the OFS to join the trekkers at Andries Ohrigstad.

D. was opposed to the Sand River Convention as he feared it might lead to British intervention and obligations.

E. founded the settlement at Lydenburg.

F. was appointed Commandant-General at Lydenburg.

G. became the first President of the ZAR.

/4/

Total: 40 marks

PTO

Question 6:

Discuss Britain's policy towards the Slaves and Hottentots at the Cape between 1806 and 1834, mentioning factors influencing it and explaining why it led to friction with the White inhabitants.

/80/

Question 7:

Discuss critically, with regard to motivation and effectiveness, the frontier policy pursued by the different British governors at the Cape during the period 1806 to 1836.

/80/

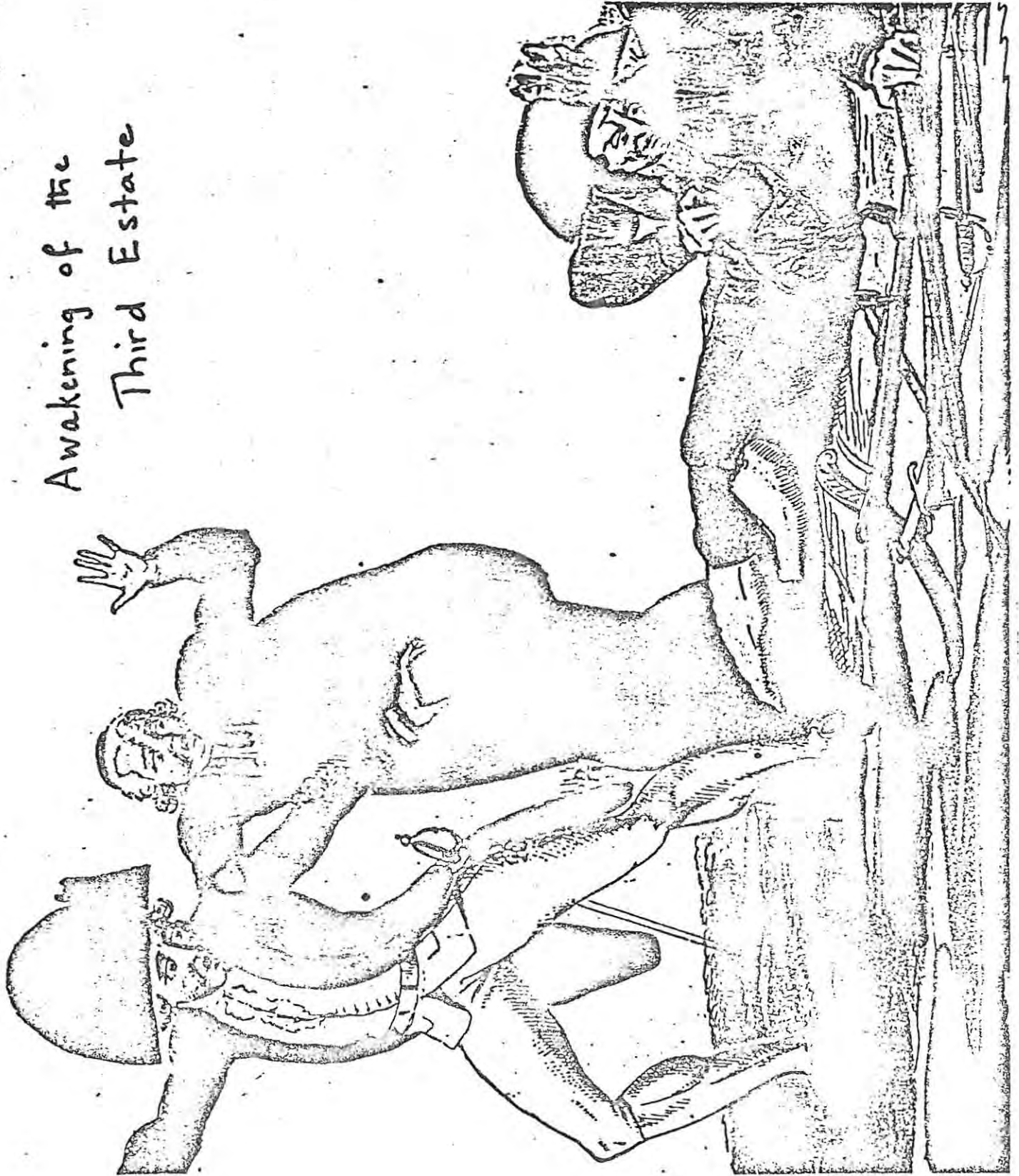
Question 8:

The course of the Great Trek was affected by three main factors: the qualities of the Trek leaders and of the Trekker community; the environment into which they migrated and the reaction of the British Government and its local representatives.

Discuss, in broad outline, with reference to the period 1836 - 1854.

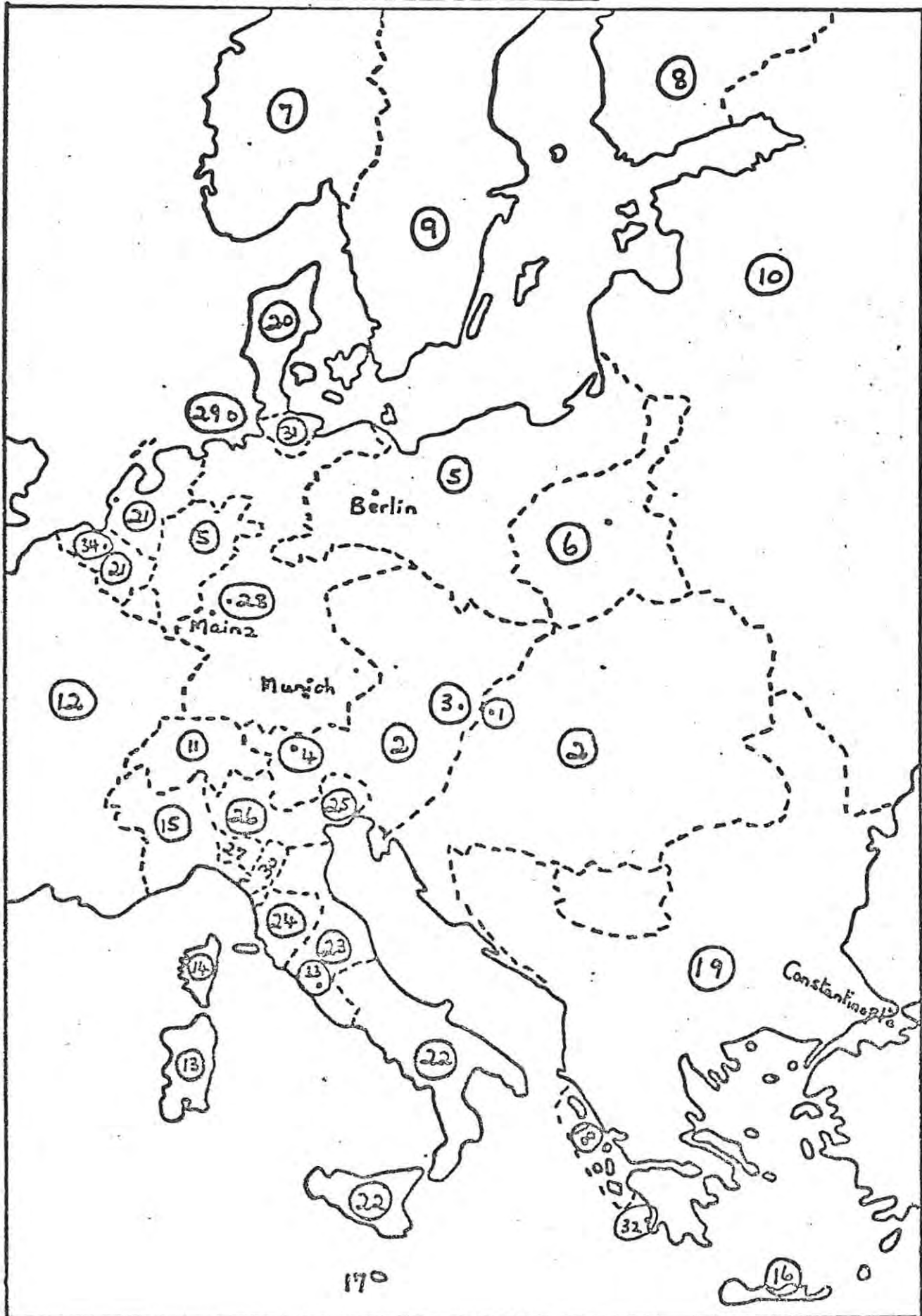
/80/

Awakening of the
Third Estate

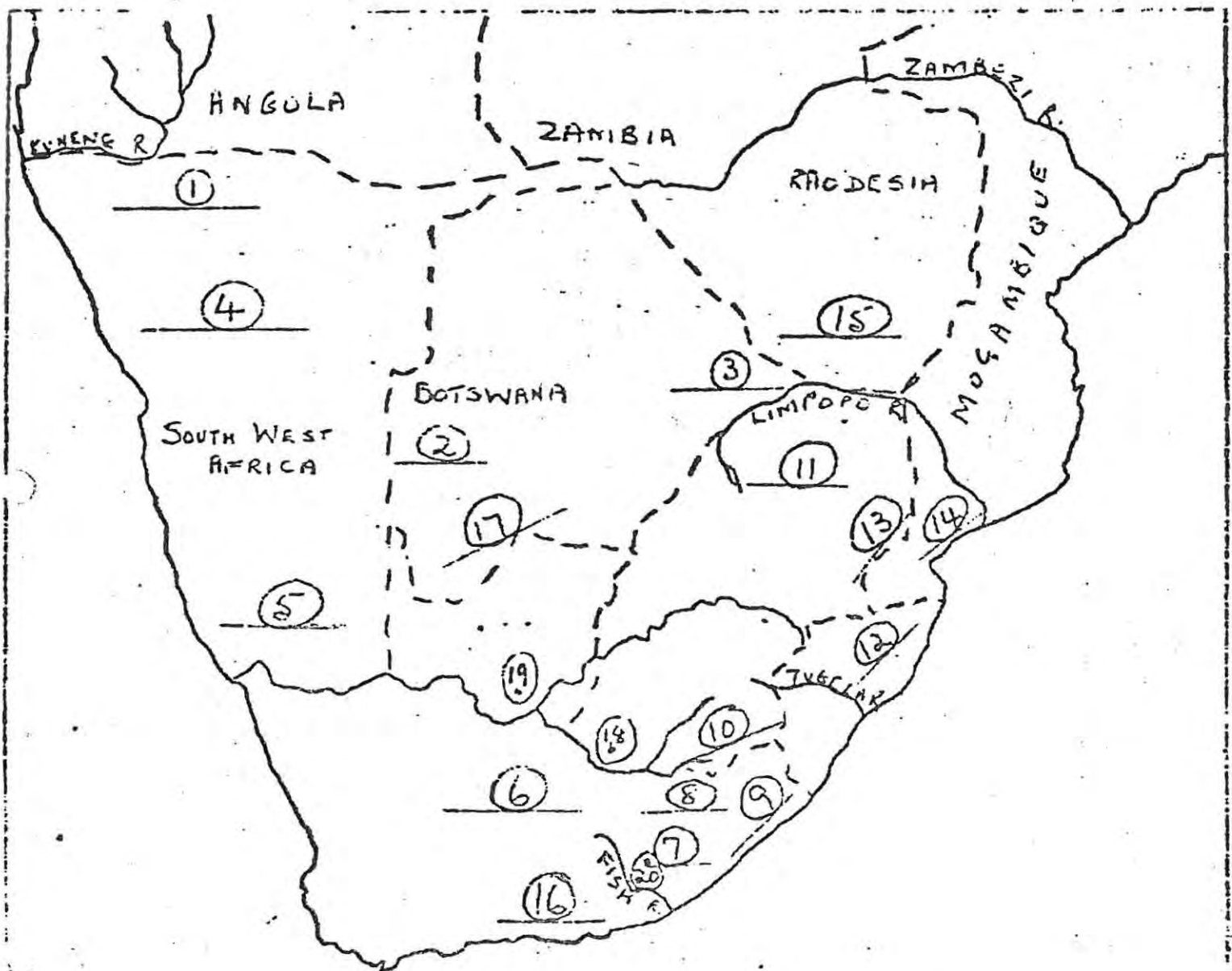


Appendix A

EUROPE 1815 - 1850



Appendix B



Appendix C



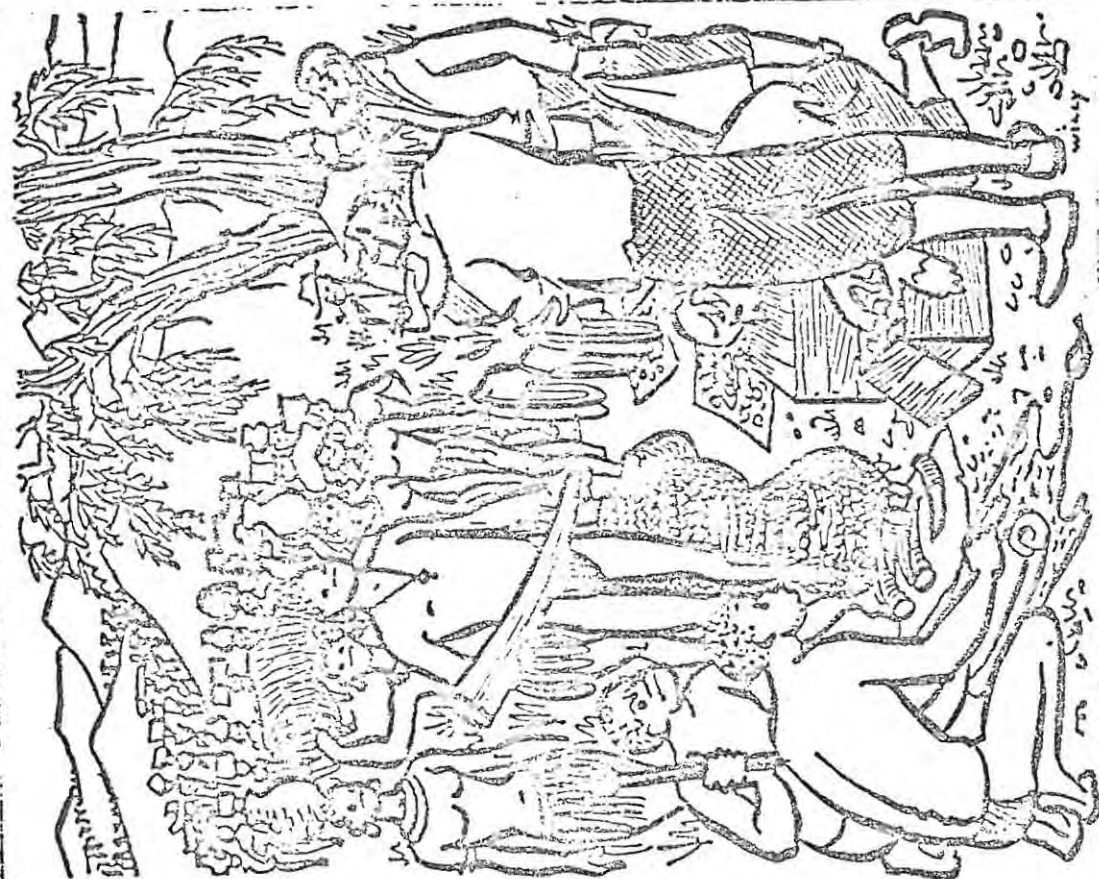
Picture I



Picture II



Picture IV



Picture III

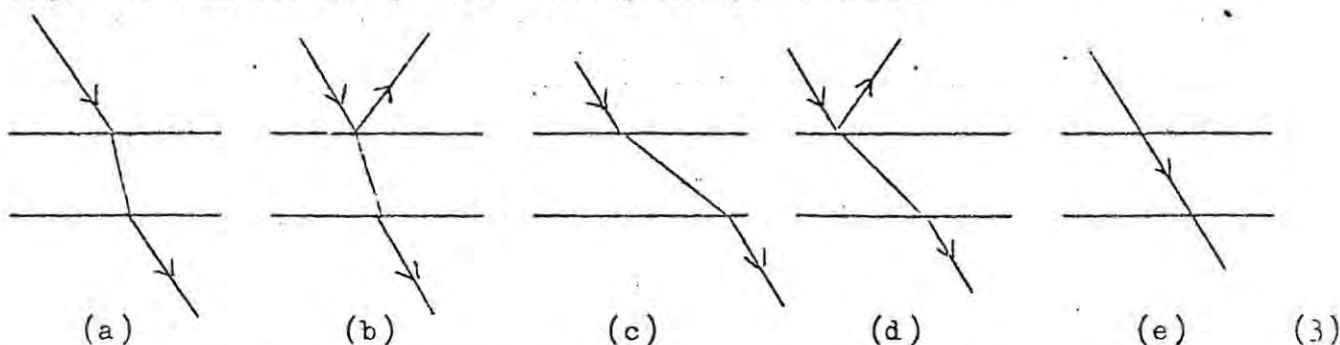
Higher Grade and Standard Grade answer all questions.

SECTION A

Write only the letter(s) which will make each of the following statements true:

1. The image in a plane mirror is
 (a) larger than the object,
 (b) further from the mirror than the object,
 (c) upside down,
 (d) laterally inverted,
 (e) upright and diminished. (3)

2. The following diagram is the best representation of the path of a ray of light falling obliquely on a rectangular glass slab:



3. Violet light is more refracted by a prism than red light. This indicates that
 (a) white light is a mixture of colours,
 (b) red light has a higher frequency than violet light,
 (c) red light has a lower frequency than violet light,
 (d) red light has a shorter wave length than violet light,
 (e) total internal reflection occurs in the prism. (3)

4. An object, 20 mm high, stands 40 mm from a convex lens. An image, 30 mm high is formed. The distance in mm, of the image from the lens is:
 (a) 20 (b) 2 (c) 70 (d) 60 (e) 26,7 (3)

5. Notes J and K have the same amplitude but frequencies of 500 and 700 Hz respectively. J and K are
 (a) equally loud and of the same pitch,
 (b) of equal pitch but not equally loud,
 (c) equally loud but not of the same pitch,
 (d) of equal pitch,
 (e) not equally loud and not of the same pitch. (3)

6. A dog rushes at a speed of 2 m/s to attack its own reflection in a shop window. At what speed do the dog and its image approach each other?
 (a) 0 m/s (b) 2 m/s (c) 4 m/s (d) 6 m/s
 (e) none of these because the image is stationary (3)

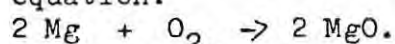
7. An object, 18 mm high, stands vertically in front of a vertical mirror at a distance of 42 mm from the mirror. The size of the image is:
 (a) 18 mm (b) 42 mm (c) 60 mm (d) 24 mm (e) not determinable (3)

8. A beam of green light crosses a beam of red light without any change. This phenomenon is analogous with
 (a) the crossing of two streams of particles,
 (b) the crossing of two water waves,
 (c) the particle nature of light,
 (d) the wave and the particle nature of light,
 (e) the chemical reaction during photosynthesis. (2)

9. Any image in a pin-hole camera is always:
 (a) inverted (b) upright (c) diminished
 (d) upright and diminished (e) larger than the object (3)
10. The acoustics of a hall can be improved by heavy curtains at the front and back of the hall because
 (a) the angle of reflection = the angle of incidence,
 (b) multiple reflections improve acoustics,
 (c) soft material prevents most of the sound reflections,
 (d) curtains are conducive to more reflection of sound,
 (e) heavy curtains do not absorb any sound energy. (3)
11. If A is the mass number of an isotope and Z is the atomic number, the number of protons in the nucleus will be:
 (a) A (b) A + Z (c) A - Z (d) Z - A (e) Z (3)
12. The number of orbitals in the 2p sublevel is:
 (a) 1 (b) 2 (c) 3 (d) 4 (e) 6 (3)
13. The number of valency electrons in an atom of chlorine (atomic number = 17) is:
 (a) 2 (b) 5 (c) 6 (d) 7 (e) 3 (3)
14. Covalent bonding between chlorine atoms can only take place when
 (a) two orbitals with different energy values overlap,
 (b) the two atoms are of equal size,
 (c) the electrons in the half-filled orbitals have opposite spins,
 (d) the two atoms have each obtained an extra electron,
 (e) the two atoms have no half-filled orbitals. (3)
15. When nitrogen atoms bind to form a molecule, the electron pairs are formed between electrons from the following orbitals:
 (a) 1s (b) 2s (c) 2p (d) 3s (e) 3p (3)
16. When a chlorine atom forms an ion, the latter will have the same number of electrons as:
 (a) Ar (b) O^{2-} (c) S (d) Ca (e) Na^{+} (3)
17. Which of the following represents a mole?
 (a) 16 g of sulphur, (b) 16 g of oxygen gas, (c) 19 g of potassium,
 (d) 1 g of hydrogen gas, (e) 6.02×10^{23} sodium atoms. (3)
18. Which set of coefficients will balance the following equation:
 $Al + H_2O \rightarrow Al_2O_3 + H_2$?
 (a) 2 : 1 : 3 : 3 (b) 2 : 3 : 1 : 3 (c) 3 : 2 : 1 : 3
 (d) 2 : 3 : 3 : 1 (e) 3 : 1 : 2 : 3 (3)
19. 46 g of sodium reacts with an excess of sulphur. The mass, in grams, of sodium sulphide formed is:
 (a) 39 (b) 46 (c) 78 (d) 156 (e) 32 (3)
20. Which one of the following formulae is wrong?
 (a) XCl_3 (b) X_2S_3 (c) X_2O_3 (d) $X(NO_3)_2$ (e) XBr_3 (3)
21. The electron dot structure of the nitrogen molecule can be represented by:
 (a) :N: :N: (b) :N:::N: (c) N::N (d) :N:N: (e) :N:::N: (3)
22. Which of the following represents a mole?
 (a) 14 g of nitrogen gas (b) 16 g of oxygen gas
 (c) 20 g of sodium (d) 6.02×10^{23} atoms of potassium
 (e) 6 g of carbon (3)
23. The reactivity of metals decreases from left to right in period 3. Which one of the following elements is, therefore, the strongest reducing agent?
 (a) sulphur (b) magnesium (c) sodium
 (d) phosphorus (e) aluminium (3)

24.

Magnesium burns in oxygen to form magnesium oxide according to the equation:



What mass of magnesium oxide, in grams, will be formed if 2,4 g of magnesium is burnt?

- (a) 4,8 (b) 6,6 (c) 2,0 (d) 4,0 (e) 6,4

(3)

(72)

SECTION B

Each item in the first column matches an item or description in the second column. Write down the number of the first column and next to it only the letter of the most suitable matching description:

- | | |
|-------------------------|---|
| 1. Atomic mass unit | (a) potassium chloride |
| 2. Salt crystal lattice | (b) probable spaces in which electrons may be found |
| 3. Hydronium ions | (c) good oxidising agent |
| 4. Normal valency | (d) one twelfth of the mass of an atom of C-12 |
| 5. Filled s-orbitals | (e) Alkali earth metals |
| 6. Avagadro's number | (f) number of atoms in 32 g of O_2 |
| 7. Mole | (g) unpaired electrons in the highest energy level. |
| 8. Orbital | (h) responsible for acidic property |
| 9. Lithium | (i) exothermic reaction takes place |
| | (j) good reducing agent |
| | (k) number of atoms in 12 g of C-12. |

(9)

SECTION C

- (1) If no light reaches our eyes ^{from} an object, then what colour does the object appear to be? (2)
- (2) A mirror is rotated through an angle of 30° . Through what angle will the reflected ray be rotated? (2)
- (3) Why does a black object appear black in all colours of light? (2)
- (4) What colour is obtained when the following colours of light are mixed?
 - (i) Red and green
 - (ii) Blue and yellow
 (4)
- (5) Give the names of four famous scientists other than those associated with models of an atom. (4)
- (6) Calculate the approximate mass of an α particle, if the mass of a proton = $1,6 \times 10^{-27}$ kg. (3)
- (7) Which of the atoms A, B, C, D and E, are according to the under-mentioned data, isotopes of the same element?

$$\begin{matrix} y & x & z & w & y \\ A & B & C & D & E \\ x & y & x & x & z \end{matrix}$$
 (3)
- (8) Why does Helium exist as single atoms rather than a diatomic molecule? (2)
- (9) Why do most copper solutions have a blue colour? (2)
- (10) Give the name of two indicators other than litmus. (2)
- (11) Give the chemical name for the following
 - (i) lime water
 - (ii) washing soda
 - (iii) bicarb.
 (3)

SECTION D

Question 1

- (a) Explain (i) Why the moon is visible, even though it does not emit light of its own. (8)
(ii) Why the shadow of the moon, caused by the light rays of the sun is not visible in space.
(iii) What happens when this shadow of the moon falls on the earth. What is this phenomenon called? (8)
- (b) (i) State the laws of reflection of light.
(ii) Draw a ray diagram to illustrate that the image of an object appears as far behind a mirror as the object is in front of the mirror.
(iii) What is meant by the statement that the image is virtual? (15)
- (c) An object, size 12 mm is examined through a magnifying glass. The object is 15 mm from the lens and $f = 20$ mm.
(i) Construct a ray diagram to show how the image is formed.
(ii) What is the nature of the the image?
(iii) Determine the magnification. (12)
- (d) As water waves pass into shallow water, the wavelength decreases, explain why. (5)
- (e) What is the difference between noise and a musical note? Sketch wave forms to illustrate your answer. (5)
- (f) Assume the speed of sound to be 330 m/s. Calculate the frequency of a sound, the wavelength of which is 1,5 m. (5)

/50/

Question 2

- (a) Draw diagrams to illustrate how the models of a fluorine atom differ according to (i) The Thompson (ii) Bohr (iii) Orbital model. (11)
- (b) An element has an electron distribution $1s^2, 2s^2, 2p^6, 3s^1$
(i) In which group, and
(ii) in which period in the periodic table does it occur?
(iii) Is the element likely to be a metal or a non metal? (6)
- (c) The element sulphur can be written ${}^{32}_{16}\text{S}$.
(i) What is the atomic number of this element?
(ii) How many electrons are in one atom of this element? Use the the arrow-block notation, $\uparrow\downarrow$ to represent the electronic structure of an atom of this element.
(iii) How many valency electrons does this element possess? What is the normal valency of sulphur? (10)
- (d) Show by means of the arrow-block notation, or otherwise, how two atoms of oxygen combine to form an O_2 molecule. Indicate in your diagram, or state clearly, which orbitals are involved in the bonding. (6)
- (e) The pH values of a number of solutions have been determined with indicator paper and are as follows:
Solution: A B C D E F G
pH: 3 4 9 6 8 5 7
(1) Which is the strongest alkaline solution?
(2) Which is the strongest acidic solution?
(3) Which solution is approximately neutral?
(4) What will happen to the pH of solution D when sodium hydroxide is added?
(5) How would you decrease the pH of solution C?
(6) Which of these solutions will have the highest number of hydronium ions per cm^3 ? (12)
- (f) (i) Calculate formula mass for $(\text{NH}_4)_2\text{SO}_4$
(ii) What is this substance called? (5)

/50/

Question 3

- (a) Consider these metals: lead, potassium, copper, mercury, sodium.
(1) Which is the most reactive in oxygen?
(2) Which of these react with cold water?
(3) When HgO is heated, Hg and O_2 are formed; when PbO_2 is heated, PbO and O_2 are formed. Which of Hg and Pb would you say is then the most reactive? (6)
- (b) Chlorine water is added to a solution of potassium bromide. Explain what happens and why? (4)
- (c) Describe the method you would use and substances involved if you wished to prepare a dry sample of potassium chloride. (10)
- (d) Write balanced chemical equations for the following where reactions occur, if no reactions occurs explain why.
(i) Sodium is added to water.
(ii) Nitrogen and hydrogen are used to prepare ammonia.
(iii) An iron nail is dipped into a solution of silver (I) nitrate.
(iv) Bromine is added to a solution of potassium chloride.
(v) Hydrochloric acid is added to calcium carbonate.
(vi) Sodium hydroxide is titrated against dilute sulphuric acid until an end point is reached. (23)
- (e) Calculate the mass of Mg required to make 20g of magnesium oxide. (4)
- (f) Write the two half reactions for the reaction which takes place when a strip of magnesium is put in a solution of copper sulphate. Name also
(i) The oxidation half reaction
(ii) The better reducing agent. (8)
- (g) (i) Describe what you would observe if a deflagrating spoon containing sulphur is ^{heated and then} put into a gas jar containing oxygen.
(ii) Write a balanced equation for the reaction.
(iii) If the gas jar is then shaken up with some water, write a balanced equation of what takes place. (10)
(iv) Name the substance which is formed.

[65

Total [27

1. Answer Section A in pencil on the multiple choice sheet provided.
2. Answer Sections B and C on the Examination paper provided.

SECTION A.

1. When rays parallel to the principal axis of a lens are refracted by the lens, the rays pass through:
 - (a) the centres of curvature
 - (b) the optical centre
 - (c) the focal length
 - (d) the principal focus
2. A convex lens can form:
 - (a) only enlarged real images
 - (b) only diminished real images
 - (c) only virtual enlarged images
 - (d) all kinds except virtual, diminished images
3. The image in the eye is:
 - (a) real and inverted
 - (b) virtual and erect
 - (c) real and enlarged
 - (d) virtual and enlarged
4. An electric current in a copper wire is a flow of:
 - (a) negative charge only
 - (b) positive charge only
 - (c) both positive and negative charge
 - (d) either positive or negative charge
5. A galvanometer:
 - (a) measures current strength
 - (b) measures potential difference
 - (c) indicates that some current is flowing
 - (d) measures resistance
6. A volt is a measure of :
 - (a) number of coulombs per second
 - (b) number of joules per coulomb
 - (c) number of coulombs per joule
 - (d) number of amperes per second
7. A 30 ohm and 90 ohm resistor are connected in series to a battery. If the current strength in the circuit is 4A the potential difference in volts will be:
 - (a) 24V
 - (b) 480V
 - (c) 12V
 - (d) 36V

SUPPLY THE MISSING WORDS ONLY:

16. The movements of electrons cannot be predicted with certainty according to _____
17. The wave-model of the atom calls the electron spaces _____ having different shapes known as _____.
18. Pauli allocated a maximum of _____ and the outer electrons in the highest main energy level are called _____.
19. The following element with an electron structure of $1s^2, 2s^2, 2p^6, 3s^1$ is _____ and occurs in Group _____ of the Periodic Table.
20. The valency electrons of the alkali metals (Group 1) is _____ and that of the halogens is _____
21. The second main energy level of an atom can accommodate _____ electrons with _____ sublevels in this main energy level.
22. Covalent bonds are formed when there is a _____ of electrons between atoms so that they acquire the structure of the _____ in order that their half-filled orbitals may _____

/15/

SECTION B.

1. An object 20 cm high is placed vertically 45mm f on a convex lens with a focal length of 30mm.
- (i) Sketch the light rays and show how the image is formed
 - (ii) Determine the magnification
 - (iii) Name the properties of the image formed
- (20)
2. You have set-up an apparatus to show how a current may be induced using a changing magnet flux.
- (i) Sketch a diagram of the apparatus
 - (ii) Say what happens in each of the following cases when the switch is (1) closed (2) stays closed (3) switched off
 - (iii) Name three ways in which the strength of the induced current may be increased.
 - (iv) If the primary solenoid connected to a 6V battery has 100 turnings and the other secondary solenoid has 360 turnings, calculate the emf (voltage) that can be produced.
 - (v) If you were using a.c. current from the mains in (iv) above, what name would you give to such an apparatus?
- (20)
3. (i) Sketch a horse-shoe electromagnet which is connected to a battery. Show the direction(s) of the electron current and the magnetic polarity at the ends of the electromagnet.

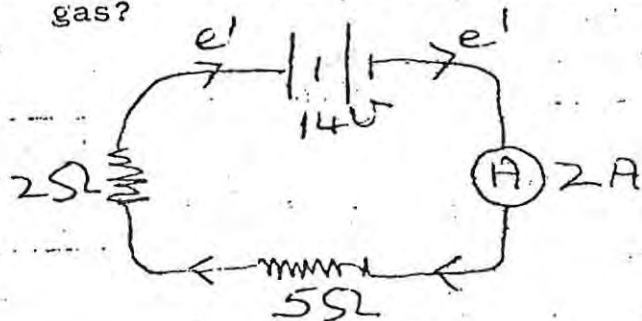
(ii)/.....

- (ii) What is meant by a "soft iron" magnetic material?
- (iii) In what kind of application are soft magnetic materials required?
- (iv) Calculate the energy transferred (work done) when a 6V battery delivers 0.5 ampere current for 10 minutes.

(20)

4. (i) State one reason for each of the following :
- (aa) Why is tungsten used in filament lamps and
 - (bb) Why is the lamp filled with nitrogen or argon gas?

(ii)

Calculate:

- (aa) Total resistance (R) in circuit
 - (bb) Prove that Ohms Law $R = \frac{V}{I}$ applies here
 - (cc) Use the readings given in the circuit diagram to find the heat produced in the 5 Ohm resistor in 2 minutes
- (iii) (aa) What causes an "induced" current?
(bb) State Lenz's Law

(20)

5. (i) Show by means of a simple graph with a suitable curve how the strength of the induced current in an a.c. dynamo varies over a period (cycle) of 360°.
- (ii) Indicate the position of the dynamo coil at 0°, 90°, 180°, 270° and 360°.
- (iii) (aa) What rule may be applied here?
(bb) State this rule.
- (iv) Use one sentence to describe what is understood by the concept "orbital".
- (v) How many s-orbitals are there in any main energy level? (20)

6. (a) State the Principle of : (i) Heisenberg
(ii) Pauli

- (b) You are given the symbol ${}_{13}^{27}\text{Al}$ (Al)
- (i) Write down the name of this element
 - (ii) Give the atomic number of ${}_{13}^{27}\text{Al}$
 - (iii) By using the arrow-in-a-circle (aufbau) notation draw a diagram to show the grouping of the electrons in an atom of this element.

(iv)/.....

Page 5.

- (iv) How many valency electrons are there?
- (v) Hence deduce the Group Number of this element.
- (vi) Write sp notation for the ion of this element. (20)

7. (a) State briefly how each of the following contribute to the modern concept of an atom :

- (i) Faraday
- (ii) Thomson
- (iii) Rutherford
- (iv) Bohr

(b) Sketch and label the apparatus used by Rutherford.

- (c) (i) Why did Rutherford use alpha particles?
- (ii) Write the chemical formula for an alpha particle
- (iii) How many e^- are there in this particle?

(d) An element is written ${}^A_Z X$

What does (i) A represent?

(ii) Z represent?

(20)

SECTION C.

1. (a) Define (i) covalent bond
(ii) polar covalent bond
(iii) ionic bond

(b) Show the bonding in :

- (i) ${}_{17}\text{Cl}$ molecule
- (ii) HCl(g) molecule
- (iii) KCl molecule

(c) Sketch neatly the bonding in a molecule of ammonia gas. (20)

2. (a) (i) Calculate the mass of 0.3 moles of AgNO_3
(ii) How many moles are there in 34g ammonia gas

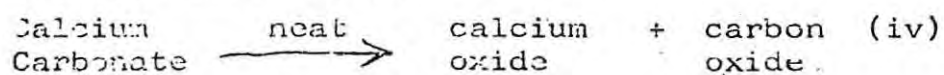
(b) Hydrogen + nitrogen = ammonia

- (i) Write and balance this equation
- (ii) How many moles of ammonia will be formed if 4.5 moles of hydrogen combine with nitrogen
- (iii) Calculate the mass of ammonia formed in (ii) above
- (iv) Calculate the number of molecules of ammonia formed in (iii) above
- (v) If one mole of ammonia gas occupies 22.4dm^3 , calculate the volume of ammonia formed in (iii) above.

(c)/.....

Page 6.

- (c) (i) What mass of slaked lime, (calcium oxide), can be obtained by heating or roasting 500g of limestone (calcium carbonate).



- (ii) How many moles of carbon (iv) oxide will be liberated in this reaction?
- (iii) How many molecules of calcium oxide will be formed? (30)

TOTAL 250

STD 8
2 HOURS

PHYSICAL SCIENCE - HIGHER GRADE

AUGUST EXAM
200 MARKS

Answer all questions.

Draw a 20 mm margin on the right hand side of every page.

Section A is to be done on the squared paper provided.

Draw a line after each number in sections B and C and write the number of the next question clearly in the centre of the page.

ST. 8
2 UUR

NATUUR- EN SKEIKUNDE - HOËR GRAAD

AUGUSTUS EKSAMEN
200 PUNTE

Beantwoord alle vrae.

Trek 'n kantlyn van 20 mm op die regterkant van elke bladsy.

Afdeling A moet op die blokkies wat verskaf is gedoen word.

Trek 'n lyn na elke nommer in afdelings B en C en skryf die nommer van die volgende vraag duidelik in die middel van die bladsy.

SECTION A

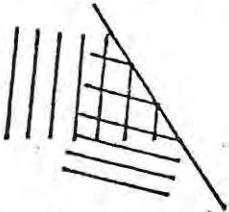
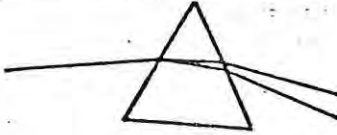
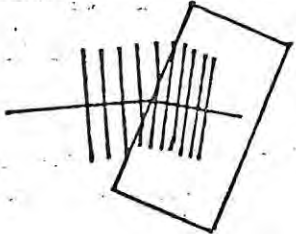
- 1 The fact that the pointer of a photographic light meter moves when the meter is exposed to sunlight indicates that
 - (a) sunlight is a force
 - (b) energy is transferred from the light meter to the sun
 - (c) the light meter has a battery
 - (d) energy is transferred from the light source to the meter
 - (e) the pointer is light-sensitive
- 2 When a ray of light falls obliquely on the surface of separation between two different media
 - (a) all the light is refracted and transmitted
 - (b) all the light is reflected and no light is transmitted
 - (c) the ray is refracted towards the normal
 - (d) the ray is refracted away from the normal
 - (e) the light is partially reflected and partially transmitted at the surface of separation
- 3 The magnification (M) of a convex lens is 3. The distance of the object is 20 mm. The distance of the image, in mm, is
 - (a) 17
 - (b) 6,66
 - (c) 60
 - (d) 23
 - (e) 20,3
- 4 Both the microscope and the telescope have the disadvantage that the final image is seen
 - (a) upright and diminished
 - (b) inverted and diminished
 - (c) upright and enlarged
 - (d) inverted
 - (e) enlarged
- 5 The acoustics of a hall can be improved by heavy curtains at the front and back of the hall because
 - (a) the angle of reflection = the angle of incidence
 - (b) multiple reflections improve acoustics
 - (c) soft material prevents most of the sound reflections
 - (d) curtains are conducive to more reflection of sound
 - (e) heavy curtains do not absorb any sound energy
- 6 When equal quantities of energy are transferred to equal masses of different substances, the substances will always undergo
 - (a) the same rise in temperature
 - (b) no rise in temperature
 - (c) different rises in temperature
 - (d) a phase change
 - (e) no phase changes
- 7 The specific latent heat of evaporation of water is much higher than the specific latent heat of fusion of ice because
 - (a) the temperature of steam is always 100°C
 - (b) the temperature of ice is always 0°C
 - (c) the average kinetic energy of the ice particles is much higher than that of the steam particles.
 - (d) more energy is needed to separate the particles when a change to the gas phase takes place
 - (e) the molecules in the solid phase are much further apart than in the gas phase
- 8 When the volume of a gas is kept constant a transfer of energy to the gas will lead to
 - (a) a rise in temperature and a rise in the pressure of the gas
 - (b) only a rise in temperature
 - (c) expansion
 - (d) only a rise in pressure
 - (e) a rise in temperature accompanied by a decrease in the gas pressure

- 9 When molten candle wax falls on your hand it hurts more when the wax solidifies because
- solid candle wax has a higher temperature than molten wax
 - molten candle wax has a higher temperature than solidified wax
 - molten wax gives out a lot of energy when it solidifies
 - candle wax has a low latent heat of fusion
 - your hand is an unreliable temperature meter
- 10 Which of the following represents the electron grouping of an atom of phosphorous (atomic number 15) in its ground state ?
- $1s^2 2s^2 2p^6 3s^2 3p^3$
 - $1s^2 2s^2 2p^6 3s^1 3p^4$
 - $1s^2 2s^2 2p^5 3s^2 3p^4$
 - $1s^2 2s^2 2p^4 3s^2 3p^5$
 - $1s^2 2s^2 2p^3 3s^2 3p^6$
- 11 Which of the following Lewis-structures is wrong ?
- $\text{:}\ddot{\text{O}}\text{:}\ddot{\text{O}}\text{:}$
 - $\text{H}:\ddot{\text{Cl}}:$
 - $\text{:}\ddot{\text{N}}\text{:}\ddot{\text{N}}\text{:}$
 - $\begin{array}{c} \text{H} \\ | \\ \text{:}\ddot{\text{N}}\text{:}\text{H} \\ | \\ \text{H} \end{array}$
 - $\text{:}\ddot{\text{Cl}}\text{:}\ddot{\text{Cl}}\text{:}$
- 12 If the electrons of atoms only occur in the first main energy level then these atoms belong to elements in
- group 1
 - group II
 - period 2
 - group VII
 - period 1
- 13 When nitrogen atoms bind to form a molecule, the electron pairs are formed between electrons from the following orbitals
- 1s
 - 2s
 - 2p
 - 3s
 - 3p
- 14 If A is the mass number of an isotope and Z is the atomic number, the number of protons in the nucleus will be
- A
 - A + Z
 - A - Z
 - Z - A
 - Z
- 15 Ionic compounds consist of
- molecules
 - atoms
 - atoms which are not neutral
 - metal atoms
 - atoms which have lost 2 electrons

(45)

(The following are to be done on your foolscap answer sheet)

- 16 Complete each of the following by writing down only the missing word(s):
- Early in the twentieth century scientists discovered that radio-active elements emitted small particles, called _____ and _____.
 - One twelfth of the mass of an atom of carbon-12 is called a(an) _____.
 - A molecule of oxygen has _____ unpaired electrons.
 - In the compound CO the valency of C is _____.
- 17 Each item in the first column matches an item or description in the second column. Write down the number of the first column and next to it only the letter of the most suitable matching description.
- | | |
|----------------------|---|
| (1) Atomic mass unit | (a) probable spaces in which electrons can be found |
| (2) Hydronium ions | (b) one twelfth of the mass of an atom of C-12 |
| (3) Mole | (c) number of atoms in 32 g of O_2 |
| (4) Orbital | (d) responsible for acidic property |
| (5) Lithium | (e) number of atoms in 1 g of hydrogen gas |
| | (f) group 1 |
| | (g) alkali earth metals |

- a) Draw a diagram to show how the image of an object is formed by a concave lens. What is the nature of the image? (7)
- b) An object, 20 mm high is 200 mm away from a convex lens ($f = 100$ mm). If the image is required to be 80 mm high, how far from the object should the screen be placed? (6)
- c) Explain why a red object appears black in green light. (3)
- d) Name the property of light which is illustrated by each of the following:
- (1)  (2)  (3)  (5)
- e) Draw ray diagrams to illustrate what is meant by
- (1) apparent depth of an object under water
- (2) total internal reflection in a rectangular glass block.
- Show the critical angle of incidence in your diagram. (6)
- f) What is the frequency of a sound wave with $\lambda = 3$ m? (3)
- (Speed of sound may be taken as 300 m.s^{-1})

- a) Draw two separate diagrams to show the difference in wave form of the following vibrations:
- (1) a vibration with an amplitude of 10 mm and a frequency of 6 Hz
- (2) a vibration with an amplitude of 20 mm and a frequency of 5 Hz (6)
- b) If the vibrations in (1) and (2) should cause audible sounds, how would the notes differ from each other? (3)
- c) What causes the difference between middle-C on a piano and the same note on a violin? (1)
- d) What is the frequency of a sound wave with $\lambda = 3$ m? (3)
- (The speed of sound may be taken as 300 m.s^{-1})

- a) What is the difference between solid H_2O , liquid H_2O and gaseous H_2O in terms of its molecules? (3)
- b) What is the difference between 'heat' and 'internal energy'? (4)
- c) Name four changes which can occur when heat is transferred. (4)
- d) How much heat is required, in Joules, to change the temperature of 200 g of pure water from 20°C to 80°C ? (6)
- (The specific heat capacity of water is $4.2 \text{ kJ/kg}^\circ\text{C}$)
- e) A pile of lead shot with a mass of 1200 g and at a temperature of 85°C is placed in a calorimeter with a heat capacity of $84 \text{ J}^\circ\text{C}$ which contains 100 g water at 20°C . The temperature rises to 35°C . Calculate
- (1) the heat capacity of the pile of lead shot
- (2) the specific heat capacity of lead. (9)
- f) Draw a rough labelled sketch of the cooling curve of water from 110°C to -10°C (at normal pressure). (4)

- a) Give the main reason why Dalton's model of the atom proved unsatisfactory. (2)
- b) What important conclusions did Rutherford come to as a result of his famous experiment? (4)
- c) Give the meaning of the numbers in ${}^{18}_9\text{F}$. (5)
- d) (1) Draw a Lewis Structure for the water molecule. (3)
(2) What type of bonding exists between the atoms in this molecule?
- e) Write down the symbols for the following ions: (4)
(1) carbonate ion (2) ammonium ion
- f) $\text{K} + \text{chlorine} \longrightarrow \text{KCl}$ (Atomic masses: $\text{K} = 39, \text{Cl} = 35,5$)
(1) Balance the equation.
(2) Calculate the mass of potassium necessary to form 3,02 g of potassium chloride. (6)
- g) Write in symbols and balance the following equations: (5)
(1) magnesium + water $\longrightarrow$ magnesium oxide + hydrogen
(2) nitrogen + hydrogen $\longrightarrow$ ammonia

h)

A											B
C	D					E	F	G	H	I	J
K	L					M	N	O	P	Q	R
S	T					U	V	W	X	Y	Z

- (1) According to what property are the elements arranged in the periodic table?
- (2) Which letter represent alkali metals? Write down the number of valency electrons in an element of this group.
- (3) Which letters represent elements in Group VII? Name the two elements represented by the letters Q and Y.
- (4) How many unpaired valency electrons are possessed by the elements in Group V? What type of bonding do you expect when these elements react with other elements?
- (5) Write down the letters which represent the first four elements in period 2 and next to them the grouping of electrons for each. (Use the s-, p- notation)
- (6) What type of bond will be formed when elements C and Q react?
- (7) What three letters represent metals which will react violently with water? Which gas is liberated during this reaction? (20)

- a) Draw a ring and arrow diagram for Li, Na and K. (7)
(1) Why do these have similar chemical properties?
(2) What happens when salts of these metals are dissolved in water?
(3) What is the valency of each in chemical reactions?

b) Sodium reacts with Iodine to form Sodium Iodide:



(1) What kind of bond exists between the atoms ?

(2) Write down the ions in the sodium iodide crystal.

(3) Which atom has been oxidised? Give the reason for your answer.

(6)

c) You are given four metals, A, B, C and D. B and D react with cold water. C does not react with water or steam. A reacts with steam but with dilute acid is more reactive than C. D in dilute acid reacts more vigorously than B. Write these down in order of reactivity.

(3)

d) Write down the ions that are formed when the following salts dissolve in water:

(1) KOH

(2) CaCl_2

(3) KMnO_4

(5)

HIGHER AND STANDARD GRADE.SECTION A.

From the answers given to each of the questions below, choose the one that you think best answers the question. Mark the block on the answer sheet provided that corresponds to your choice of answer.

1. When a ray of light passing through a more dense optical medium toward a less dense optical medium strikes the interface at the critical angle.
 - (a) it is refracted at 90° to the surface;
 - (b) it is reflected at 90° to the surface;
 - (c) it is refracted at 90° to the normal;
 - (d) it is totally internally reflected;
 - (e) it is not refracted.
2. An image is produced on the screen of a pinhole camera because:
 - (a) it is a real image;
 - (b) light travels in straight lines;
 - (c) no lens is used;
 - (d) the object is real;
 - (e) light is a form of energy.
3. The following statements compare the eye and the camera.
 - (i) both have a convex lens;
 - (ii) the camera produces an inverted image and the eye an erect image;
 - (iii) The diaphragm controls light entry in the camera and the iris does the same in the eye.
 - (a) (i) and (ii) are true;
 - (b) (ii) and (iii) are true;
 - (c) only (i) is true;
 - (d) (i) and (iii) are true
 - (e) only (ii) is true.
4. To produce a virtual enlarged image using a convex lens place the object:
 - (a) between principal focus and the lens;
 - (b) between F and 2F;
 - (c) at the optical centre;
 - (d) beyond 2F;
 - (e) at 2F.
5. Which of the following is not a rule for reflection from a plane surface.
 - (a) all rays lie in the same plane;
 - (b) normals are drawn at 90° to the rays;
 - (c) the angle of reflection equals the angle of incidence;
 - (d) the angle of deviation is between the surface and the ray;
 - (e) all rays pass through the point of incidence.
6. The image produced by the eyepiece in both the telescope and microscope in relation to the object is:
 - (a) erect and real;
 - (b) inverted and virtual;
 - (c) inverted and real;
 - (d) erect and virtual;
 - (e) diminished and virtual.

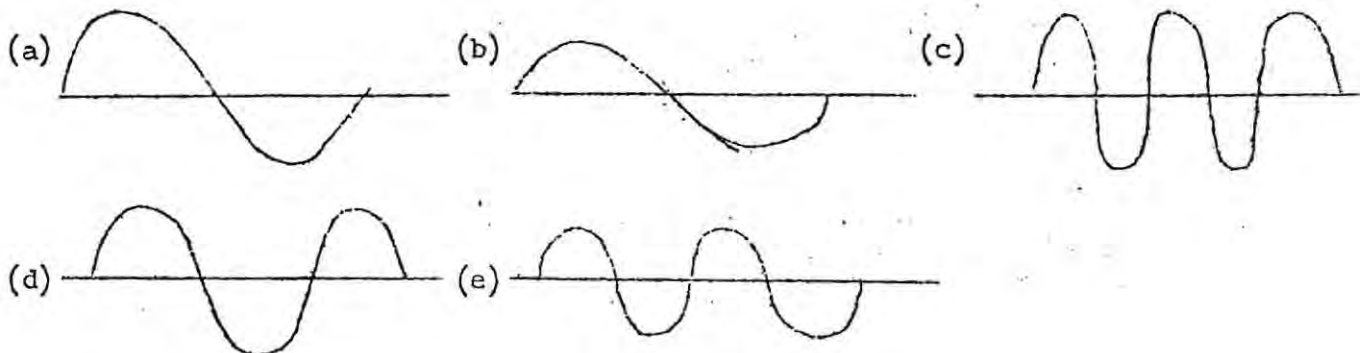
7. The mirage is an example of:

- (a) total internal refraction within a medium;
- (b) rectilinear propagation of light;
- (c) refraction within a medium;
- (d) refractive index between two media;
- (e) total internal reflection within a medium.

8. The colour in the spectrum that is bent most when white light is passed through a triangular prism is:

- (a) indigo; (b) red; (c) green; (d) blue; (e) violet.

9. The sound with the highest pitch is represented by:



10. The quality of a musical note is determined by the:

- (a) amplitude; (b) frequency; (c) velocity;
- (d) harmonics; (e) pitch.

11. The wavelength of a sound is:

- (a) the same in all media - only its velocity changes;
- (b) longest in dense media;
- (c) shortest in dense media;
- (d) longest in a vacuum;
- (e) shortest in a vacuum.

12. Which of the following statements is NOT true of sound waves.

- (a) sound waves are longitudinal waves;
- (b) sound waves can be reflected;
- (c) sound waves are transverse waves;
- (d) when sound waves enter another medium they are refracted;
- (e) sound waves transfer energy.

13. The unit we use to measure potential difference is:

- (a) $J.C^{-1}$; (b) $J.A^{-1}$; (c) $J.C.$; (d) $C.s^{-1}$; (e) A^{-1} .

14. The resistance of a conductor does NOT depend upon:

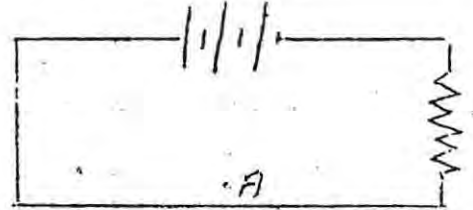
- (a) the kind of metal from which it is made;
- (b) the length of the conductor;
- (c) the charge flowing in the conductor per second
- (d) the temperature of the conductor;
- (e) the thickness of the conductor.

15. The emf of a cell is:

- (a) the number of volts given to 1 coulomb of charge;
- (b) the maximum energy for each amp flowing;
- (c) the maximum voltage for each amp flowing;
- (d) the maximum energy given to 1 coulomb of charge;
- (e) the number of volts lost in the circuit.

16. The direction of the magnetic field at point A near a current carrying conductor is:

- (a) to the left;
- (b) out of the page toward you;
- (c) into the page away from you;
- (d) to the right;
- (e) from top to bottom of page below the conductor.

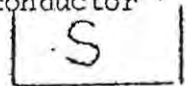


17. The strength of an electromagnet will be increased by:

- (a) increasing the retentivity of the core;
- (b) Using thinner wire in the coil;
- (c) using more turns of conductor;
- (d) decreasing the susceptibility of the core;
- (e) using nichrome for the conductor.

18. The direction of thrust exerted by the magnetic field on the conductor shown will be:

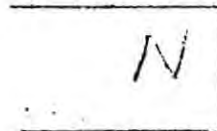
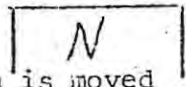
- (a) to the right;
- (b) to the left;
- (c) toward the North pole;
- (d) toward the South pole;
- (e) directly out of the page toward you.



e^-

19. The direction of the electron current when the conductor shown is moved in the magnetic field will be:

- (a) to the right;
- (b) to the left;
- (c) toward the North pole;
- (d) toward the South pole;
- (e) directly out of the page toward you.



↑ Thrust

20. Lenz's Law states that the direction of the induced current is:

- (a) from North to South in the magnetic flux;
- (b) in the same direction as the motion of the conductor;
- (c) is such as to oppose the motion of the conductor;
- (d) along the magnetic flux lines;
- (e) predicted using the right hand rule.

21. The relative atomic mass of a neutron is:

- (a) 1; (b) 2; (c) 0; (d) 3; (e) 4.

22. The number of neutrons in the atom ${}^{19}_{9}\text{F}$ is:

- (a) 8; (b) 10; (c) 28; (d) $19\frac{1}{2}$; (e) 38.

23. The electron dot structure of water may be represented as:

- (a) H : O : H (b) H : $\underset{\cdot\cdot}{\underset{\cdot\cdot}{\text{O}}} : \text{H}$ (c) H : $\overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{O}}} :: \text{H}$
- (d) H : H : O (e) H : O : H.

24. Which of the following elements will exist as a diatomic molecule:

- (a) Na; (b) Ho; (c) C; (d) L; (e) H.

25. The carbon atom has valency electrons:

- (a) 0; (b) 1; (c) 2; (d) 3; (e) 4.

26. The correct formula of the Carbonate ion is:

- (a) CO_3^- ; (b) CO_3^{2-} ; (c) CO_2^{2-} ; (d) CO^{3-} ; (e) CO_3^+ .

27. The mole is defined as:

- (a) the mass of matter having as many elementary particles as 0,012 kg of $^{12}_6\text{C}$.
 (b) the weight of matter having as many elementary particles as 0,012 kg of $^{12}_6\text{C}$.
 (c) the mass of matter having as many electrons as 0,012 kg of $^{12}_6\text{C}$.
 (d) the mass of matter having as many elementary particles as 0,12 kg of $^{12}_6\text{C}$.
 (e) the mass of matter having as many elementary particles as 0,012 kg of $^{12}_7\text{C}$.

28. Rutherford's model of the atom proposed that:

- (a) the atom was indivisible;
 (b) electrons orbited the nucleus like planets;
 (c) positive and negative charges were mixed up together;
 (d) there is a positive nucleus surrounded by electrons;
 (e) electrons are found in orbitals.

29. When two oxygen atoms bond together:

- (a) a covalent bond is formed by sharing electrons;
 (b) a polar covalent bond forms due to unequal sharing of electrons;
 (c) the s orbitals have only 1 electron in each;
 (d) two covalent bonds are formed by the sharing of two pairs of electrons;
 (e) two pairs of electrons are lost by each atom.

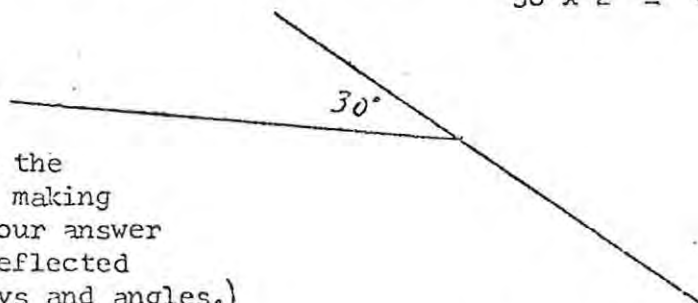
30. An isotope of an element is defined as follows:

- (a) atoms with the same atomic number but different mass numbers;
 (b) atoms with the same mass number but different atomic numbers;
 (c) atoms with more protons in the nucleus than usual;
 (d) atoms with more electrons around the nucleus;
 (e) atoms with Avogadro's number of protons in the nucleus.

$$30 \times 2 = 60.$$

SECTION B.

1. (a) A ray of light strikes a plane mirror as shown in the sketch. Copy the sketch, making it large and clear, into your answer and show the path of the reflected ray. (Label clearly all rays and angles.)



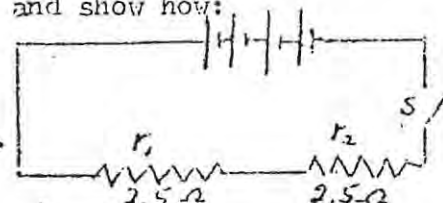
- (b) Write down six characteristics of the image produced by a plane mirror.

2. (a) A ray of light enters a rectangular glass block at an angle of 60° to the surface. Make a neat large clearly labelled drawing to show the path of the ray of light through the block.

On the sketch show clearly:

- (i) the angle of refraction;
 (ii) the angle of deviation;
 ... the size of the angle of emergence.

- (b) (i) Make a neat clear drawing to show how a concave lens forms an image. (6)
 (ii) On the sketch label the following:
 (1) The principal focus;
 (2) The optical centre;
 (3) Principal axis. (3)
 (iii) Write down in words the characteristics of the image. (4)
3. The element Nitrogen can be represented by the following symbol ${}^{14}_7\text{N}$.
 (a) What do the numbers 7 and 14 tell you about the atom? (6)
 (b) Using the arrow in a box (orbital) notation make a diagram of the arrangement of the electrons in the nitrogen atom. (5)
 (c) (i) Make a neat diagram of the two different types of orbital found in the nitrogen atom. (3)
 (ii) State how many electrons may be accommodated in each type of orbital. (2)
4. (a) Write correct chemical formulas for each of the following compounds:
 (i) Potassium oxide;
 (ii) Iron (II) Sulphate;
 (b) Calculate the mass of one mole of:
 Magnesium Hydroxide $\text{Mg}(\text{OH})_2$ given the Atomic masses $\text{Mg} = 24$; $\text{O} = 16$; $\text{H} = 1$ (5)
 (c) Calcium chloride (CaCl_2) reacts with Silver Nitrate (AgNO_3) to give Silver Chloride (AgCl) and Calcium Nitrate $\text{Ca}(\text{NO}_3)_2$.
 (i) Write out and balance the reaction above using chemical formulae. (4)
 (ii) What do we mean when we say that Calcium Chloride contains an ionic bond. (4)
 (iii) Use your equation to find the number of moles of Silver Chloride that will be formed from 170 g of Silver Nitrate.
 ($\text{Ag} = 108$; $\text{N} = 14$; $\text{O} = 16$) (8)
5. In the circuit illustrated each cell has an emf of 1.5 volts and is connected to two resistors r_1 and r_2 each having a resistance of 2.5Ω . A voltmeter connected across r_2 is found to read 2.5 volts.
 (a) Copy the diagram into your answer (making it large) and show how:
 (i) an ammeter is connected;
 (ii) the volt meter is connected.
 (b) Calculate the reading on the ammeter if s is closed.
 (c) Define in words the coulomb.
 (d) Calculate the internal resistance of each cell when s is closed.
6. (a) State Faraday's Law.
 (b) A North pole of a magnet is pushed into a coil of conductor connected to a centre zero galvanometer.
 (i) what will you observe? Give a good reason.
 (ii) What is observed if the magnet remains stationary within the coil?
 (iii) List three ways to increase the strength of the current.



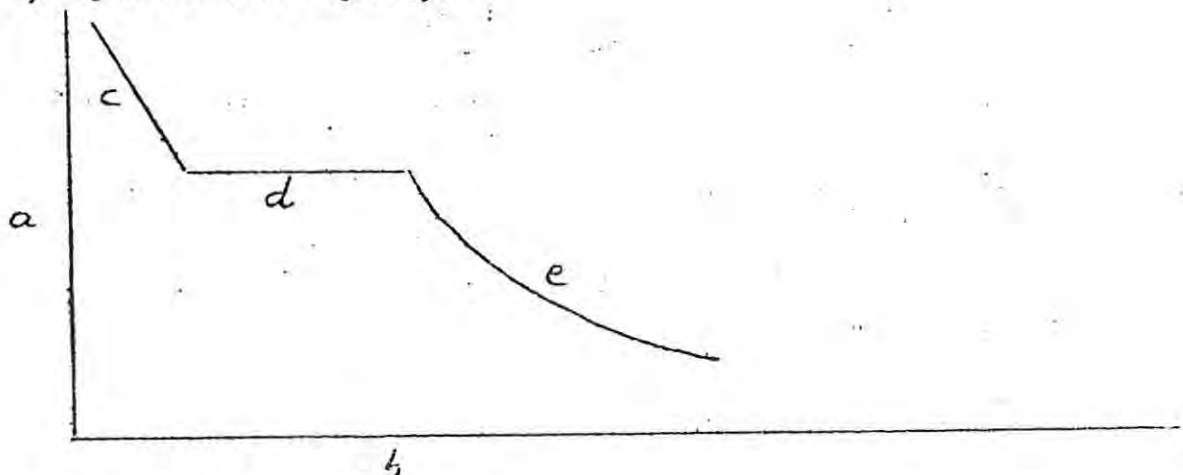
7. (a) Make a neat drawing of a step down transformer.
- (b) Explain briefly why it is necessary to use alternating current in the transformer.

FROM QUESTION NUMBER 8 ONWARDS, ANSWER EITHER THE QUESTIONS ON HEAT OR THE QUESTIONS ON METALS AND NON-METALS:

8. (a) Define each of the following terms:

- (i) Temperature of a body.
- (ii) Heat
- (iii) Specific heat capacity.

(b)



Write down labels for each of the letters on the graph above.

- (c) Briefly mention the energy changes that take place when water at 20°C is frozen into ice at 0°C .
9. A piece of copper with a mass of 0,6 kg cools from 100°C to 30°C giving out 16800 J of heat. Calculate its specific heat capacity.
10. (a) What sort of energy change takes place when a liquid evaporates.
- (b) List four factors that will control the evaporation of a liquid at room temperature. With each state how a change in the Factor will increase the rate of evaporation.

OR

8. Some magnesium ribbon is added to a solution of copper (II) sulphate and after some time, the reaction ceases and the blue colour of the solution disappears, leaving a clear solution.
- (a) Which of the two metals (magnesium or copper) is more reactive?
- (b) Write down SEPARATELY:
 - (1) the equation showing what happens to each magnesium atom.
 - (2) the equation showing what happens to each copper (II) ion.
- (c) (1) what is meant by the term OXIDATION?
- (2) Identify the oxidising agent in this reaction.

/13/

9. Small amounts of Sulphur and Sodium are burnt separately in gas jars of pure oxygen.

(a) For each, give the colour of the flame and the name of the product formed. (12)

(b) A little water is added to each jar, the covered jar shaken and some universal indicator solution is added to each jar.

(1) What would you expect the pH value to be in each jar.
(Give an approximate value) (4)

(2) Complete: Solution of the oxides of metals are -----
Solution of the oxides of non-metals are -----

/8/ (4)

20

PHYSICAL SCIENCE STANDARD GRADE STD 8.

AUG 81.

TIME 1 1/2 HOURS

EXAMINER L. F. MEIRING

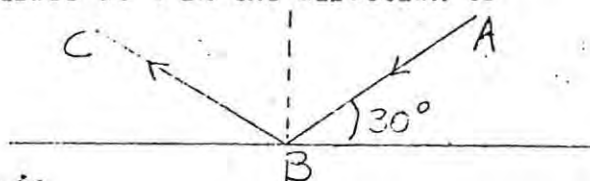
SECTION A. MULTIPLE CHOICE.

Answer the following on the multiple answer

sheet provided.

- Shadows cast by the sun have slightly fuzzy edges because.
 - the sun is an external light source ie. it is not a point source.
 - sunlight is refracted as it enters the earth's atmosphere.
 - sunlight is scattered off dust as it enters the atmosphere.
 - the sun is very bright.
- An image which is virtual,
 - must be upside down
 - is always smaller than the object
 - cannot be cast onto a screen
 - is always slightly larger than the object.

- The figure shows the path of a ray of light which travels from an object A and is reflected in a mirror at B in the direction BC



The angle of reflection is.

- 0°
 - 30°
 - 60°
 - 90°
- Red light passes through a dispersing prism firstly, and a green filter secondly, and finally falls on a white screen. The screen appears:
 - white
 - red
 - green
 - black.
 - A short sighted person would be able to see a distant object more clearly by using a-
 - diverging lens
 - plane mirror
 - triangular prism
 - converging lens
 - How many electrons are needed to fill up an s orbital?
 - 8
 - 0
 - 2
 - 1.
 - Which is the most fundamental description of a covalent bond?
 - the attraction between nuclei
 - the sharing of an electron pair
 - the attraction of the nucleus for an electron
 - the transfer of electrons from one atom to another.
 - Which of the following is NOT bonded ionically (electrovalently)?
 - CaCl_2
 - KI
 - NaCl
 - H_2 .
 - Which of the following elements reacts most vigorously with water?
 - Lithium
 - potassium
 - sodium
 - magnesium.

10. When a Substance passes directly ^{from} a solid to a gaseous phase, it is said to,
a) boil b) sublime c) evaporate d) diffuse.
11. A substance reacted with Hydrochloric Acid giving off a gas which turned calcium hydroxide milky. The substance was?
a) an oxide b) a hydroxide c) a sulphate d) a carbonate.
12. When ions are discharged at the anode the process is one of.
a) reduction b) titration c) oxidation d) neutralisation.
13. When an aqueous solution of copper chloride is electrolysed, the reaction at the cathode can be expressed by.
a) $\text{Cu}^{+} + \text{e}^{-} \longrightarrow \text{Cu}$
b) $\text{Cu}^{+} - \text{e}^{-} \longrightarrow \text{Cu}^{++}$
c) $\text{Cl}^{-} + \text{e}^{-} \longrightarrow \text{Cl}^{2-}$
d) $2\text{Cl}^{-} - 2\text{e}^{-} \longrightarrow \text{Cl}_2$
14. Pure lead bromide is heated to its melting point and electrolysed with carbon electrodes. Which of the following processes will take place at the cathode?
a) the formation of metal globules
b) evolution of red-brown vapour
c) evolution of hydrogen
d) evolution of oxygen
15. The precipitate formed on adding aqueous silver nitrate to a solution of silver chloride is :
a) soluble in nitric acid
b) insoluble in nitric acid
c) a dirty brown colour
d) soluble in sulphuric acid
16. A piece of zinc and a piece of silver are placed in a solution of copper sulphate. After a while:
a) Copper will be deposited on the zinc and the silver
b) Copper will be deposited on the zinc
c) Copper will be deposited on the silver
d) Copper and silver will be deposited on the zinc.
(see Q 4 b for reactivities)
17. A solution which is strongly alkaline probably has a pH of
a) 1 b) 4 c) 12 d) 7

$$16 \times 3 = 48 + 2 = 50$$

SECTION B

Answer this on the foolscap.

Question 1.

- a. Name the two Laws of Reflection (4)
- b. Give three characteristics of a real image. (3)
- c. Give four properties of the image in a plane mirror. (4)

- ld. Draw a ray diagram to show the path of a ray of light through a rectangular glass prism. Label: (i) incident ray (ii) refracted ray (iii) emergent ray (iv) angle of incidence (v) angle of refraction (vi) normal. (9)

/20/

Question 2.

- a. Show by means of a diagram how a beam of white light can be refracted into coloured light. Name the colours in correct order on the diagram. (6)
- b. Common salt sprinkled into a flame gives a pure yellow colour (light). How will a yellow tie with blue stripes appear in this light. Explain. (4)
- c. The focal length of a convex lens is given as 21 mm. An object of height 8 mm is placed at a distance of 32 mm from the optical centre of the lens and on the principal axis.
- Draw a neat, labeled, accurate ray diagram of the above. (3)
 - Determine the size of the image. (2)
 - Determine the position of the image. (2)
 - What is the magnification of the lens. (3)

/20/

Question 3.

- a. Complete the following. Write only the correct word next to the number.
- The mass of an atom is concentrated in the.....
 - If an atom loses an electron it becomes.....charged.
 - A neutral atom, when it gains an electron, is called..... (3)
- b. What is the valency of an element? (2)
- c. Write down the valency of the following: (3)
- K
 - Cu(II)
 - C
- d. Write the formula for the following: (3)
- Sodium Iodide
 - Calcium Chloride
 - Aluminum Oxide
- e. Balance the following equations. (3)
- $\text{KClO}_3 \longrightarrow \text{KCl} + \text{O}_2$
 - $\text{Na} + \text{Cl}_2 \longrightarrow \text{NaCl}$ (2)
- f. Calculate the mass of one mole of the following: (4)
- NaHCO_3
 - Bi_2S_3

/20/

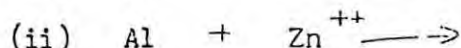
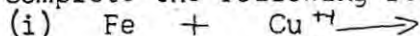
Question 4.

- a. Using Lewis structures show how sodium reacts with oxygen to form Sodium Oxide. Clearly show the transfer of electrons. (4)

Q 4 b. Given the following reactivity series for metals. Order most reactive to least

K, Na, Li, Mg, Ca, Al, Zn, Fe, Pb, Cu, Hg, Ag.

Complete the following reactions:



c. Give the colours of (i) iodine (6)
(ii) chlorine in Carbon Tetrachloride. (2)

d. You are given 5 substances and their corresponding pH values.

A
3

B
7

C
9

D
12

E
1

- (i) Which substance is neutral?
(ii) Which one is the strongest acid?
(iii) Which one is the strongest base?
(iv) What is the colour of phenolphthalein in A? (4)

e. Name four methods of preparing a salt. (4)

/20/

Question 5.

a. Define (i) oxidation, (4)
(ii) oxidising agent.

b. Draw and fully label a galvanic cell that has Zinc and Copper electrodes. (8)
Indicate the direction of electron flow.

c. Which of the following will conduct an electric current.
(i) Sea water
(ii) Sugar solution
(iii) Dilute Sulphuric acid
(iv) Copper Sulphate crystals (4)

d. Give a description of the test that you would use to test for a sulphate. (4)

/20/

50 + 100 = 150

PHYSICAL SCIENCE

STANDARD EIGHT

HIGHER GRADE

81:08:17

TIME: 2 HOURS

SET BY: F. EASTON

INSTRUCTIONS:

Answer Section A on the multiple choice answer sheet. In some cases there is more than one correct answer, select the answer which is most correct for the circumstances given.

SECTION A:

1. Shadows cast by the sun have slightly fuzzy edges because:
 - a) the sun is an extended light source i.e. is not a point source
 - b) sunlight is refracted as it enters the earth's atmosphere
 - c) sunlight is scattered off dust in the atmosphere
 - d) the sun is very bright
 - e) light does not always travel in straight lines
2. Red light passes through a prism first then a green filter. The light then falls on a white screen. The screen appears:
 - a) white b) red c) green d) black e) yellow
3. The image formed by a magnifying glass under operating conditions is always
 - a) upright and diminished
 - b) inverted and enlarged
 - c) upright and enlarged
 - d) inverted and diminished
 - e) a real image
4. When a ray of light falls obliquely on the surface of separation between two different media
 - a) all of the light is refracted and no light is transmitted
 - b) the ray is refracted towards the normal
 - c) all the light is reflected and no light is transmitted
 - d) the ray is refracted away from the normal
 - e) the light is partially reflected and partially transmitted at the surface of separation
5. Different isotopes of the same element have different:
 - a) numbers of protons
 - b) numbers of neutrons
 - c) numbers of electrons
 - d) chemical properties
 - e) bonding properties

6. When atoms form cations they:
- gain electrons
 - gain protons
 - lose electrons
 - lose protons
 - undergo covalent bonding
7. Which one of the following atoms would lose an electron most readily
- $1s^2$
 - $1s^2 2s^2 2p^6 3s^1$
 - $1s^2 2s^1$
 - $1s^1$
 - $1s^2 2s^2 2p^1$
8. In which of these compounds is the noble gas electron structure not attained by the atoms that make up the compound
- H_2O
 - NH_3
 - HCl
 - BH_3
 - H_2S
9. The formation of the aluminium ion is best represented by:
- $Al \longrightarrow Al^- + e$
 - $Al + e \longrightarrow Al^-$
 - $Al \longrightarrow Al^{3+} + 3e$
 - $Al \longrightarrow Al^{2+} + 1e$
 - $Al + 3e \longrightarrow Al^{3+}$
10. Which of the following metals will not displace lead from lead II nitrate solution?
- magnesium
 - calcium
 - copper
 - aluminium
 - iron
11. When iodine crystals are heated in our ^{AIR}
- it burns
 - forms a brown vapour
 - sublimes
 - forms a brown liquid
 - remains unchanged
12. Which of the following reactions are NOT displacement reactions
- $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$
 - $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$
 - $CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$
 - $H_2 + Br_2 \longrightarrow 2HBr$
- 3 & 4
 - 1, 3 & 4
 - 4
 - 3
 - 1
13. If a metal M has a valency of 3, which of the following formulae are correct
- M_3O_2
 - $M_3(OH)$
 - $M_2(NO_3)_3$
 - $M_3(CO_3)_2$
 - $M_2(SO_4)_3$
14. The mass of hydrogen in 102g of ammonia is:
- 6g
 - 12g
 - 18g
 - 28g
 - 34g

15. The oxide of a certain element is soluble in water giving a solution having a pH greater than 7. The element could be:
a) zinc b) sulphur c) xenon d) sodium e) gold
16. When sulphur trioxide dissolves in water a great deal of heat is liberated. Which one of the following statements is NOT true
a) a chemical reaction takes place between sulphur trioxide and water
b) sulphuric acid is formed
c) an exothermic reaction takes place
d) the solution will react with sodium hydroxide
e) the pH of the solution is greater than 7
17. The net ionic equation for the reaction between aqueous solutions of potassium hydroxide and sulphuric acid is given by:
a) $2K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4$
b) $KOH(s) \rightarrow K^+(aq) + OH^-(aq)$
c) $2H^+(aq) + SO_4^{2-}(aq) \rightarrow H_2SO_4(aq)$
d) $H^+(aq) + OH^-(aq) \rightarrow H_2O$
e) $2H^+(aq) + O^{2-}(aq) \rightarrow H_2O$
18. Which of the following statements about the reaction:
 $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$ is NOT true
a) the zinc metal neutralizes the acid
b) the spectator ions are $H^+(aq)$ and $Zn^{2+}(aq)$
c) this shows that zinc is higher in the reactivity series than hydrogen
d) if excess metal is used then all the acid will be used up
e) no precipitate is formed
19. When an electric current is passed through a saturated solution of copper II bromide, the following substance will be reduced
a) Cu b) Br^- c) CuBr₂ d) Cu^{2+} e) H₂O
20. When solutions of sodium carbonate and calcium chloride react, the spectator ions are
a) Na^+ and Cl^- b) Na^+ , Cl^- and Ca^{2+}
c) Cl^- and CO_3^{2-} d) Na^+ and Ca^{2+} e) Na^+ , Cl^- , Ca^{2+} and CO_3^{2-}
21. Which of the following types of reactions will not lead to salt formation
a) acid + base b) metal + acid c) metal + water
d) acid + carbonate e) alkali + acid

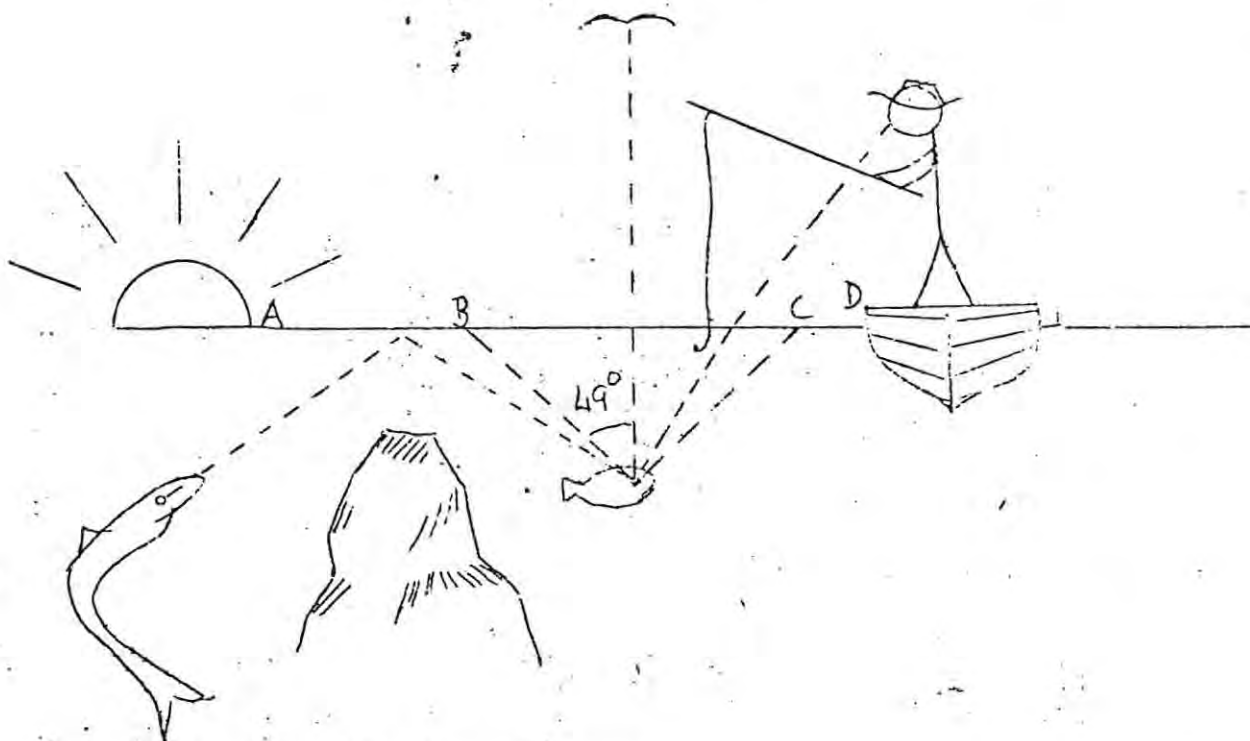
22. When the pH values of solutions of the oxides in Period 3 are compared, it will be noted that the
- acidity increases from left to right
 - alkalinity increases from left to right
 - pH values increase from left to right
 - pH values increase in metals and decrease in non-metals
 - pH values show no regular pattern of increase or decrease (4)
on moving from left to right
23. Carbonic acid may be considered to be a fairly weak acid as compared to hydrochloric acid. The following explanation holds
- Carbonic acid ^{has} twice as many hydrogen atoms per molecule than hydrochloric acid
 - Carbonic acid is, compared to hydrochloric acid, relatively insoluble in water
 - Carbonic acid does not undergo dissociation to the same degree as hydrochloric acid
 - Carbonic acid undergoes ionization to a lesser extent than hydrochloric acid
 - Carbonic acid has a greater formula mass than hydrochloric acid (4)
24. The percentage of copper in copper II sulphate is approximately:
- a) 64 b) 20 c) 10 d) 80 e) 40
 $(3 \times 4) + (2 \times 3) = 75$ (4)

SECTION B

- Construct a ray diagram which will enable you to determine the position of the final image formed by a converging lens of focal length f when the object distance is u .
 $f = 200\text{mm}$ $u = 500\text{mm}$
 - Describe the nature of the image (8)
- Explain each of the following phenomena:
 - When you stand outside in the sun and look at your shadow, the outline of your ankles is very much sharper than that of your head.
 - Older window panes are easily distinguished from new because any object viewed through old pane appears distorted
 - When blue and yellow light shine together on an actor, white garments appear white. Yet when blue and yellow paint are mixed green paint is obtained. (6)
- The diagram below shows a fisherman in a boat, a fish, a bird, a rock, and a shark at sunset. The critical angle between air and water = 49°

Diagram on next page

5/....



- a) Where will the fish see:
- the bottom of the boat
 - the angler
 - the shark
 - the bird
 - the setting sun

(10)

4. You are given the symbols ${}^{14}_{7}\text{X}$ and ${}^{12}_{7}\text{Y}$

- Name the element concerned
- What is the atomic number of X?
- Write out the spd notation for X?
- How many valence electrons exist in one atom of X?
- In which energy levels and orbital/s do these electrons normally exist?
- In what way do X and Y differ?
- What do we call atoms that differ in this way?
- The atomic mass for X and Y is given on a periodic table as 14.01. Which is the more abundant atom, X or Y?
- Is it possible to find a mass of 15 or possibly 16 for this element? Explain
- If this element were to undergo bonding
 - How many bonds would it be likely to make?
 - What type of bonding would you expect?

(24)

5. pH values are given for substances A to F. Using these values only answer the questions given below:

A : 7 B : 10 C : 2 D : 4 E : 15 F : 8

- Which is the most alkaline substance?
- What pH value would you predict for a mixture of A and C?
- What products would definitely be obtained if B and C were combined?
- Which one of the above could be the pH value for tomato juice?
- Where is the misprint? Explain why it is incorrect.
- Which could be the pH value for the solution formed when calcium oxide is dissolved in solution A?

(14)

6. A piece of copper wire is placed in a solution of silver I nitrate. After a period of time the solution appears light blue and the copper is coated with greyish fur.

- a) Write an equation for the reaction which has occurred (Assume the Copper II ion is formed)
- b) What causes the solution to turn blueish?
- c) What is the greyish fur?
- d) What type of reaction could this be called?
- e) Which substance undergoes oxidation?
- f) Which substance acts as a reducing agent? (15)

7. a) $\text{Ag NO}_3 (\text{aq}) + \text{Ca Cl}_2 (\text{aq}) \longrightarrow$ _____

- i) Complete and balance the equation above
- ii) Name the precipitate formed
- iii) Which ions will be present in solution after reaction?
- iv) If 4 moles of Ag NO_3 react, how many moles of CaCl_2 will be required?

b) _____ $\longrightarrow$ $\text{Ba SO}_4 \downarrow + \text{Na Cl (aq)}$

- i) Complete and balance equation above
- ii) If 2.3 g of precipitate was produced how much barium salt was required as a reactant? (16)

8. From each of the following groups choose one compound that shows a physical or chemical property not possessed by the other two compounds and state the reason for your choice

- a) Na Cl ; Mg Cl_2 ; Ag Cl
- b) Mercuric II oxide; Iron III oxide ; Magnesium oxide
- c) $(\text{NH}_4)_2\text{CO}_3$; K_2CO_3 ; Ca CO_3 (9)

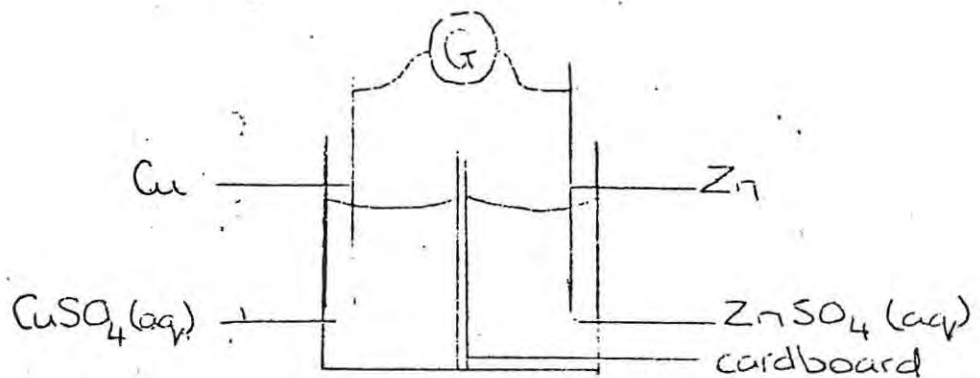
9. When rain drops fall through air, the water combines with the carbon dioxide in the air to form an acid. This acid, when falling on limestone deposits, reacts forming a solid. Write out two fully balanced equations for the reactions which occur. (8)

10. Chlorine water is added to a solution of a colourless potassium salt and a brownish-yellow solution is produced. When carbon IV sulphide is added the brownish-yellow colour turns lighter but the CS_2 is coloured violet.

- a) Identify the potassium salt
- b) Write a balanced equation for the reaction of the potassium salt with chlorine water (5)

11. The diagram on page 7. represents an electrochemical cell

- 7 -



- In which direction do the electrons move?
- Write an equation for the reaction that occurs at the anode.
- What is the function of the cardboard? (10)

TOTAL: 125

ALL questions are compulsory

SECTION A.

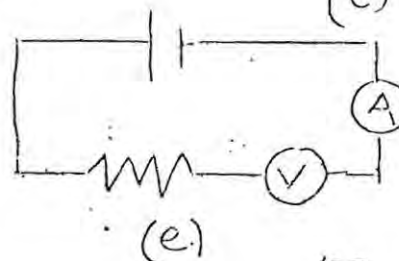
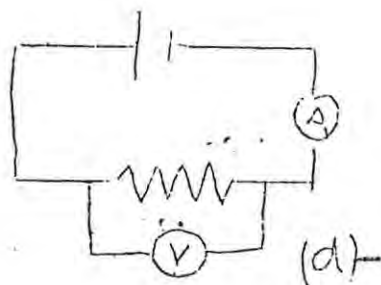
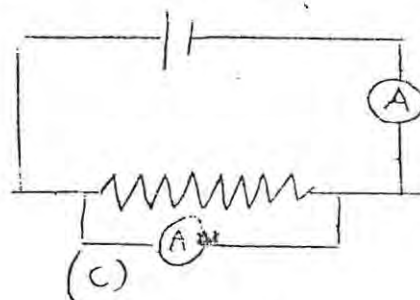
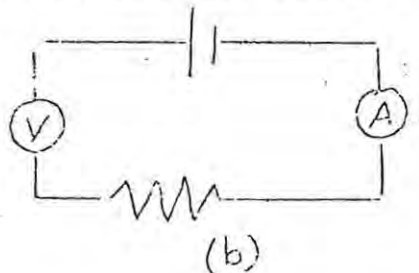
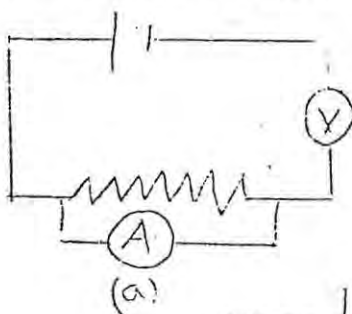
Multiple choice.

Fill in the answer sheet provided to indicate the answer to each question.

1. The image we see on a cinema screen is:
 - a) upright and enlarged and therefore virtual
 - b) virtual because it is upright
 - c) real because it is cast on a screen
 - d) real because the image distance is smaller than the object distance
 - e) none of these is correct.
2. Refraction is at a minimum when:
 - a) the angle of incidence is 0°
 - b) the angle of incidence is 10°
 - c) angle of incidence is equal to the critical angle.
 - d) there is a large difference in the optical densities of the media through which the light passes
 - e) there is a very small difference in the optical densities of the media through which the light passes
3. A convex lens can form:
 - a) only enlarged real images
 - b) only diminished real images
 - c) only vertical enlarged images
 - d) all kinds except virtual diminished images
 - e) all kinds of images except virtual enlarged images.
4. Which of the following do the good camera (not instamatic) and the eye not have in common?
 - a) convex lens
 - b) fixed image distance
 - c) light sensitive area
 - d) inverted diminished image
 - e) apart from mechanical aspects, all others are similar.
5. In a solid the particles have:
 - a) no kinetic energy because they are stationary
 - b) strong forces of repulsion and weak forces of attraction acting between them.
 - c) an average position where the attracting and repelling forces are balanced for a moment
 - d) weak repulsive and weak attractive forces acting between them
 - e) only potential energy because they attract each other.
6. A thermometer measures:
 - a) only kinetic energy
 - b) kinetic and potential energy
 - c) only potential energy.
 - d) an average of potential and kinetic energy
 - e) neither kinetic or potential energy.

7. A gas can be compressed easily because:
- the forces of attraction are strong and particles are fairly close together.
 - the forces of repulsion are weak and particles are far apart
 - forces of repulsion are weak and particles are close together
 - forces of attraction are strong and particles are far apart
 - none of these.
8. The correct S.I. unit for the specific latent heat of a phase change is
- $\text{kg} \cdot \text{J}^{-1}$
 - $\text{J} \cdot \text{K}^{-1}$
 - $\text{J} \cdot \text{kg}^{-1}$
 - $\text{J} \cdot \text{kg}^{-1} \text{K}^{-1}$
 - $\text{kg}^{-1} \text{K}^{-1}$
9. Pure water must boil at a temperature:
- of $98^{\circ} - 100^{\circ}\text{C}$
 - which depends on the altitude above sea level
 - which depends on the pressure immediately above the water
 - which depends on the pressure of its saturated vapour.
 - none of the above.
10. Latent heat is given out:
- only when a liquid boils
 - only when a liquid solidifies
 - only when a solid melts
 - only when a vapour condenses to liquid
 - when a vapour condenses as well as when a liquid solidifies
11. One metre of wire has a resistance of 10 ohms. The wire is folded double and the ends twisted together. The half-metre of double wire will now have resistance:
- 10 ohms
 - 20 ohms
 - 30 ohms
 - 2.5 ohms
 - 5 ohms

12. Which circuit can be used to find the resistance of the resistor?



13. The formula for potassium sulphate is

- a) KS
- b) K_2S
- c) KSO_3
- d) K_2SO_3
- e) K_2SO_4

14. The formula for magnesium iodide is

- a) $MgIO_3$
- b) MgI
- c) Mg_2I
- d) MgI_2
- e) MgI_3

15. The formula for aluminium phosphate is

- a) Al_2P_3
- b) Al_2PO_3
- c) Al_2PO_2
- d) $AlPO_4$
- e) $Al(PO)_2$

16. A glass prism separates white light into the colours of the spectrum because:

- a) light is reflected by a prism
- b) light of different frequencies (colours) moves with different velocities through the prism
- c) rays of different frequencies (colours) are superposed in the prism
- d) the frequency of the light is changed by the prism
- e) no colours are produced by a prism.

17. The mass of an atom depends on:

- a) the number of electrons
- b) the number of protons
- c) the number of neutrons
- d) the number of nucleons
- e) the number of electrons and protons.

18. The electronic configuration $1s^2 2s^2 2p^6 3s^2$ designates an atom of atomic number:

- a) 2
- b) 8
- c) 18
- d) 12
- e) -6

19. For a chlorine atom to become a chloride ion the atom must:

- a) absorb a proton
- b) gain an electron
- c) lose a neutron
- d) lose an electron
- e) lose a proton

20. Which of the following has a charge of +2?

- a) a proton
- b) a neutron
- c) an electron
- d) an alpha particle
- e) hydrogen.

60 Marks.

SECTION B.

Give all Formulae used in the following questions.

Question 1. Light

- (a) A ray of light strikes a plane mirror at an angle of incidence of 20° . What is the angle between the reflected ray and the mirror? (2)
- (b) You are 20m away from a plane mirror which is directly in front of you
- i) How far will your image be from you?
 - ii) A picture hangs on a wall 2m behind you. How far are you from the image of the picture?
 - iii) Are these images real or virtual? (6)
- (c) Draw a diagram of a triangular glass block with a ray of light travelling through it and label on it
- i) an incident ray
 - ii) an angle of refraction
 - iii) an angle of deviation
 - iv) an emergent ray
 - v) an angle of incidence
 - vi) a normal (8)
- (d) With the aid of a labelled sketch explain fully what is meant by the term "critical angle." (8)
- (e) A spherical air bubble is trapped in a slab of glass. It will then act as a lens. Will it be a converging or diverging lens? Explain briefly. Draw a diagram to help you. (6)
- (f) Use a sketch to help you explain why and where a person must aim a spear gun if he sits on a bank and he hopes to hit a fish he sees in the water. (5)
- (35)

Question 2. Heat.

- (a) What is heat? (3)
- (b) What is temperature? (3)
- (c) A block of ice at -10°C is placed in an open beaker. This is placed over a bunsen burner flame at sea level. After 15 minutes all the ice has turned to liquid and this in turn has turned to gas. Draw a (rough) graph of the temperature of the ice/liquid/gas versus time taken for the changes to take place. Divide the graph into 5 distinct regions. State what happens in each region. Explain the shape of the graph. (10)
- (d) How much ice at 0°C can just be melted by 10g steam at 100°C ?
Take specific latent heat of ice : 340 kJ/kg
specific latent heat of steam: $2,3 \times 10^6 \text{ J/kg}$
specific heat capacity of water : $4,2 \text{ kJ/kg.K}$. (12)
- (e) Explain how a pressure cooker works - how does it make the food cook more quickly? (7)
- (35)

Question 3. Electricity.

- (a) What is an electric current? (2)
- (b) A current of 3 amperes flows for 100 minutes through a light bulb connected across a 12 V battery.
How much heat is produced? (6)
- (c) Calculate the resistance of the light bulb in question (b) above. (3)
- (d) Four resistors of resistance 2 ohms, 3 ohms, 4 ohms and 5 ohms, respectively, are connected in parallel. Calculate the effective resistance of these resistors. (4)
- (e) What is the origin of any magnetic field? (3)
- (f) Explain how an electric current flowing through a resistor (which is connected to the terminals of a battery) will cause the resistor to rise in temperature. (7)
- (25)

Question 4. Chemistry.

- (a) (i) What does the atomic number of an element tell you about the element? (2)
- (ii) What is the symbol used for the "atomic number"? (2)
- (b) (i) What does the mass number of an element tell you about the element? (2)
- (ii) What is the symbol used for the "mass number"? (2)
- (c) What are isotopes of an element? (4)
- (d) Calculate the mass of 12 moles of Carbon atoms. (4)
- (e) How many valence electrons do silicon atoms have? (2)
- (f) Draw an Aufbau diagram and fill in the electrons of a phosphorus atom. (5)
- (g) Which part of an atom:
(i) remains unchanged
(ii) undergoes a change during a chemical reaction? (2)
- (h) What kind of bond is formed between 2 atoms which share electrons? (2)
- (i) Give the formulae for water, hydrochloric acid, State whether the bonds are ionic or covalent. (4)
- (j) (i) How many bonds are there in a molecule of ammonia? (2)
- (ii) Give the formula for ammonia. (2)
- (k) Write the balanced equation for the reaction:
Calcium reacts with water to form calcium hydroxide and hydrogen. (5)
- (l) $2 \text{ Na} + \text{Cl}_2 \rightarrow 2 \text{ NaCl}$
- What mass of Na Cl would be formed if 25g of Cl_2 reacts with Na? (5)
- (45)

$$\begin{array}{r} \text{Total: } 200 \\ \times \quad 1.5 \\ \hline 300 + 100 = 400. \end{array}$$

PHYSICAL SCIENCE: STANDARD AND HIGHER GRADE

MAXIMUM MARKS: HIGHER GRADE 200
STANDARD GRADE 150

TIME: HG 10h00 to 13h00
SG 10h30 to 13h00

SECTION A: MULTIPLE CHOICE

1. Elements are arranged in the periodic table in order of
A. mass number. B. number of neutrons. C. atomic volume.
D. atomic number. E. relative atomic mass.
2. The following is electrically negative:
A. an anion. B. a proton. C. a neutron. D. a cation.
E. an atomic nucleus.
3. The first energy level in an atom of sodium contains
A. three electrons. B. three orbitals. C. two electrons.
D. two orbitals. E. two protons.
4. OH^- represents the
A. hydromium ion. B. oxonium ion. C. ammonium ion.
D. hydrogen ion. E. hydroxyl ion.
5. When sodium combines with chlorine
A. an electron is transferred from chlorine to sodium.
B. an electron is transferred from sodium to chlorine.
C. two electrons are transferred from chlorine to sodium.
D. two electrons are transferred from sodium to chlorine.
E. no electron transfer takes place.
6. When two chlorine atoms combine to form a chlorine molecule, electrons are shared between the two atoms in such a way that each atom appears to have the electron structure of
A. sulphur. B. fluorine. C. bromine. D. argon. E. neon.
7. The formula SO_4^{2-} stands for
A. a molecule. B. a cation. C. a polyatomic ion.
D. sodium sulphate. E. sulphur dioxide.
8. MgSO_4 is the chemical formula of
A. manganese sulphide. B. manganese sulphate. C. magnesium sulphate.
D. magnesium sulphite. E. magnesium sulphide.
9. Calcium carbonate occurs in nature as
A. slaked lime. B. marble. C. baking soda. D. washing soda.
E. blue vitriol.
10. The molar formula mass of water is
A. 18. B. 17. C. 10. D. 9. E. 3.
11. A strongly alkaline solution might have a pH value of
A. 1 B. 4 C. 12 D. 7 E. 0
12. When potassium metal is placed in water, a flame appears, coloured
A. yellow. B. green. C. orange. D. white. E. lilac.
13. The order of increasing reactivity for the halogens is
A. F; Cl; Br; I. B. Br; Cl; F; I. C. I; F; Cl; Br.
D. I; Br; Cl; F. E. I; Cl; Br; F.
14. An element forms an oxide which dissolves in water to form a strong acid. The element is probably
A. in Group 8. B. in Group 1.
C. in Group 2. D. on the right of a Period. E. on the left of a Period.

15. The equation $\text{HCl} + \text{NaOH} = \text{NaCl} + \text{H}_2\text{O}$ is an example of
 A. oxidation. B. reduction. C. neutralisation.
 D. crystallisation. E. electrolysis.
16. When magnesium carbonate is added to dilute sulphuric acid the gas given off is
 A. carbon monoxide. B. carbon dioxide. C. oxygen.
 D. hydrogen. E. hydrogen sulphide.
17. The anode of an electrolytic cell is the electrode
 A. which is negatively charged. B. which attracts cations.
 C. at which reduction occurs. D. at which oxidation occurs.
 E. which is connected to the negative terminal of the battery.
18. During electrolysis
 A. anions migrate towards the negative electrode.
 B. cations migrate towards the positive electrode.
 C. electrons move from the positive terminal of the battery to the positive electrode.
 D. the ions move in opposite directions.
 E. electrons move through the electrolyte.
19. An insoluble precipitate is formed by mixing solutions of
 A. silver nitrate and sodium nitrate.
 B. Barium chloride and calcium nitrate.
 C. sodium carbonate and potassium chloride.
 D. sodium chloride and potassium bromide.
 E. sodium chloride and silver nitrate.
20. A hot object A is placed in contact with another object B. The average kinetic energy of the particles of A will increase if
 A. B has greater mass than A.
 B. B has greater heat capacity than A.
 C. A has a smaller specific heat capacity than B.
 D. B has a higher temperature than A.
 E. A is made of a different substance from B.
21. Heat of transformation (latent heat) is given out
 A. Only when a liquid boils. B. only when a liquid solidifies.
 C. only when a solid melts. D. only when a vapour condenses.
 E. when a vapour condenses and also when a liquid solidifies.
22. The correct SI unit for measuring specific heat capacity is
 A. kg/J B. JK^{-1} C. J.K.kg^{-1} D. Jkg^{-1} E. $\text{J.kg}^{-1}.\text{K}^{-1}$
23. The quantity of energy absorbed by m kilograms of a substance with specific heat capacity s when its temperature is raised by T degrees Celsius is given by the formula
 A. $\frac{ms}{T}$ B. msT C. $\frac{m}{sT}$ D. $\frac{s}{mT}$ E. $\frac{sT}{m}$
24. Joule found the specific heat capacity of water by heating a known mass of water in a calorimeter, using
 A. an electric heater coil. B. a lens focussing the sun's rays.
 C. a paddle wheel operated by a falling weight.
 D. a paddle wheel operated by an electric motor.
 E. a Bunsen burner.
25. When snow falls, the air temperature often rises, because
 A. latent heat of fusion (liquefaction) is given out.
 B. the specific heat capacity of ice is greater than of water.
 C. a warm front passes over whenever snow falls.
 D. the specific heat capacity of water is greater than of ice.
 E. latent heat of condensation is given out.

SECTION B: ANSWER IN EXAMINATION BOOKS.

N.B.: HIGHER GRADE CANDIDATES ANSWER ALL THE QUESTIONS.
STANDARD GRADE CANDIDATES ANSWER ONLY QUESTIONS ONE, TWO AND THREE.

- 1.(a) The periodic table gives sodium as $^{11}_{23}\text{Na}$. Use the information provided by the table to describe:
- (i) the nature and number of the particles in the nucleus of the sodium atom;
 - (ii) the number of electrons in the sodium atom;
 - (iii) the arrangement of the electrons;
 - (iv) the chemical properties of sodium, with regard to valency, oxidising/reducing properties, and ability to form covalent and/or ionic compounds. (11)
- (b)(i) From the periodic table deduce the bond numbers (valencies) of the following elements: potassium; chlorine; aluminium; phosphorus; lithium; oxygen; carbon; calcium; sulphur; nitrogen.
- (ii) Give the chemical formulae of: calcium oxide; sodium sulphide; magnesium iodide; potassium carbonate. (14)
/25/
- 2.(a) Write equations for the following reactions:
- (i) lithium reacts with water;
 - (ii) a piece of zinc is placed in a solution of copper sulphate.
 - (iii) bromine water is added to a solution of potassium iodide.
- (b) After the reaction in "2.(a)(iii)" above has taken place, explain how you could test the solution for the presence of free iodine. (11)
- (c)(i) Write the equation for the reaction between zinc and dilute hydrochloric acid, used to prepare hydrogen.
- (ii) Draw a sketch of the apparatus which could be used to prepare and collect hydrogen over water. The main features should be indicated by labels.
- (iii) State whether any advantage, and, if so, what advantage, might be gained by the use of heat in the above reaction.
- (iv) Use the above chemical equation to calculate what mass of hydrogen could be obtained by dissolving 25g of zinc in an excess of hydrochloric acid. (14)
/25/
- 3.(a)(i) Draw a sketch of a simple electrolytic cell for the electrolysis of sodium chloride solution, together with the electric circuit connected to the cell. Label the important features.
- (ii) Explain clearly (A) what happens when the current is switched on; (B) what gases are given off at the electrodes; (C) what reactions have taken place (give equations). (11)
- (b)(i) Mention three physical changes which can be produced by a rise in the temperature of an object,
- (ii) Compare the solid form and the gaseous form of a substance under the following headings:
- (A) Force between molecules;
 - (B) Motion of molecules.
 - (C) Size and shape of a given mass of the substance.
 - (D) Compressibility.
- (c) The table shows the results of an experiment to determine how the volume of a fixed mass of gas is affected by change of pressure. Complete the table:
- | PRESSURE (kPa) | 350 | 200 | 150 | 125 |
|----------------|-----|-----|-----|-----|
| VOLUME (ml) | 12 | | | |
- (14)
/25/

QUESTIONS 4 AND 5 ARE TO BE ATTEMPTED BY HIGHER GRADE CANDIDATES ONLY.

4. (a) A solution containing 4,77g of sodium carbonate is added to a solution containing 5,55g of calcium chloride. A white precipitate is formed.
- (i) What substance is precipitated?
- (ii) Calculate the mass of precipitate formed. (10)
- (b) (i) Calculate the mass of sodium hydroxide granules which must be dissolved in 500 millilitres of solution in order to obtain a concentration of 0,05M (0,05 mole/dm³).
- (ii) In a titration, 35 millilitres of the above standard solution were just neutralised by 15 millilitres of dilute hydrochloric acid. Calculate the concentration (in molar units) of the hydrochloric acid.
- (iii) Calculate the mass of pure HCl which would be contained in one litre of the acid solution used in the above titration. (15)
- /25/
5. (a) Pieces of hot copper of mass 100g and temperature 81°C are dropped into 200g of water at 15°C. The final temperature of the mixture is 18°C. Given that the specific heat capacity of water is 4 200 J/kg/K, calculate the specific heat capacity of copper. (8)
- (b) 200g of glycerine in a well-insulated container of negligible heat capacity is heated by a coil of wire connected to a 200 volt electricity supply. If a current of 5 amperes flows for 15 seconds, and at the end of this time the temperature of the glycerine is found to have risen from 15°C to 45°C, calculate the specific thermal capacity of glycerine. (8)
- (c) In an experiment with a constant volume gas thermometer, the outer jacket of the gas burette is filled with melting ice; the pressure of the enclosed column of gas is calculated to be 100kPa. When the outer jacket has been filled with steam and the mercury level brought back to its original reading for the gas volume, the new pressure of the enclosed gas is calculated to be 137kPa. Use this information to calculate
- (i) the rise in pressure per degree Celsius;
- (ii) the rise in pressure per degree Celsius, expressed as a fraction of the pressure at 0°C;
- (iii) supposing that the gas continues at low temperatures to behave subject to the same law as for the temperature range observed in the experiment, at what temperature, in degrees Celsius, the pressure of the gas would drop to zero.
- (iv) Give a brief explanation, in terms of the kinetic theory, how the drop to zero pressure at the above-mentioned temperature could be explained. (9)

<u>TOTAL MARKS:</u>	<u>HIGHER GRADE:</u>	200
	<u>STANDARD GRADE:</u>	150

STANDARD 10

MAY 1980

PHYSICAL SCIENCE

HIGHER AND STANDARD GRADE

Higher Grade candidates answer ALL the questions.
Standard Grade candidates answer Questions 1 to 36 in Part I, and Questions 1 to 4 in Part II.

PART I

Ring in pencil the letter indicating what you consider to be the best or most correct answer to each question.

1. A man travels 50km due west, then 40km due south and finally 20km due east. The magnitude of his displacement, in km, is
A. 110 B. 30 C. 60 D. 50 E. 90
2. A free-falling object, starting from rest, attains a velocity of 98m/s. Ignore resistance of the air. The distance travelled is
A. 1960m B. 980m C. 50m D. 490m E. 98m
3. The formula for calculating the weight of an object is
A. $M = mv$ B. $F = mg$ C. $s = \frac{1}{2}at^2$ D. $W = \frac{1}{2}mv^2$ E. $E = mc^2$
4. The coulomb is the unit of
A. charge. B. power. C. current strength. D. potential difference.
E. electromotive force.
5. An object with an initial velocity of 20m/s is accelerated at 5m/s² over a distance of 50m. At the end of this distance it attains a velocity, in m/s, of
A. 25 B. 500 C. 30 D. 125 E. 270
6. In order to give an uncharged object a positive charge
A. neutrons must be added. B. protons must be removed.
C. electrons must be added. D. electrons must be removed.
E. neutrons must be removed.
7. A stone is raised vertically and acquires a potential energy of 100J. The stone is then dropped, and after it has fallen 0.5m its potential energy has decreased to 40J. The kinetic energy of the stone at this point is (in joules)
A. 60 B. 50 C. 140 D. 2.5 E. 80
8. A gamma ray is a beam of
A. electrons. B. protons. C. photons. D. helium nuclei.
E. neutrons.
9. In a vacuum, electromagnetic waves such as radio waves, ultra-violet rays and X-rays have all the same
A. wavelength. B. amplitude. C. speed. D. frequency.
E. phase.
10. The colour of light consisting of photons with the lowest energy content is
A. violet. B. red. C. green. D. blue. E. yellow.
11. The fluoride ion has the electron configuration
A. $1s^2 2s^2$ B. $1s^2 2s^2 2p^5$ C. $1s^2 2s^2 2p^6$ D. $1s^2 2s^2 2p^4$
E. $1s^2 2s^7$
12. Water molecules are attracted to each other by forces that are called
A. ionic B. covalent. C. metallic. D. hydrogen bonds. E. van der Waals

13. Polarisation of light indicates that light
 A. causes the photo-electric effect. B. is a longitudinal wave motion
 C. can be diffracted. D. is a transverse wave motion.
 E. has particle properties.
14. The relationship representing the ideal gas law can be expressed
 A. $pV = k$ B. $\frac{V}{T} = k$ C. $pT = k$ D. $\frac{pV}{T} = k$ E. $\frac{p}{T} = k$
15. A town in the Karoo experiences an annual range of temperature, in $^{\circ}\text{C}$, of 45 degrees. The minimum temperature, in kelvin, could reasonably have been
 A. 263 B. 225 C. -15 D. 293 E. 7
16. A transformer has 150 turns on the secondary coil, and 6 000 turns on the primary coil. The potential difference which must be supplied across the 6 000 turns in order to activate a 6V bell connected across the secondary coil so that it rings properly is
 A. 40V direct current. B. 6V direct current.
 C. 6V alternating current. D. 240V direct current.
 E. 240V alternating current.
17. An object having a mass of 3kg is supported on a horizontal frictionless surface. A force of 30N acts on the object for 2 seconds in a horizontal direction. The displacement of the object during this time is
 A. 20m B. 180m C. 40m D. 10m E. 30m
18. An object having a mass of 20kg is supported on a horizontal frictionless surface and is connected to a hanging object of mass 5kg by means of a light string passing over a frictionless pulley. The acceleration of the object of mass 20kg, in m/s^2 , is
 A. 9,8 B. 2,5 C. 1,96 D. 5,0 E. 2,45
19. The heating element of an electric kettle has a resistance of 60 ohm, and it is connected to a direct current source of 240V. The rate of transformation of energy, in watts, is
 A. 960 B. 9 600 C. 1 440 D. 4 E. 0,0036
20. In a thermionic diode, electrons will travel from the cathode to the anode only if
 A. the cathode is heated directly. B. the cathode is heated indirectly.
 C. the cathode is sufficiently heated, directly or indirectly, and an electric field, directed from the anode to the cathode, is applied.
 D. the cathode is heated, directly or indirectly, and an electric field, directed from the cathode to the anode, is applied.
 E. the cathode is heated indirectly, and an electric field, directed from the cathode to the anode, is applied.

NOTE: Next to each of the numbers from 21 to 30 inclusive, write the letter according to your selection of the item from list B which is best associated with the number from list A.

LIST A

21. unit of current
 22. capacity of a body for doing work by reason of its position
 23. momentum
 24. unit of power
 25. quantum of electromagnetic radiation
 26. metallic bond.
 27. Lewis structure
 28. ionisation
 29. ionic crystal
 30. surface tension

LIST B

- A. photon
 B. ampere
 C. watt
 D. mv
 E. potential energy
 F. $\text{H}:\text{Br}$
 G. $\text{NaCl} \longrightarrow \text{Na}^+ + \text{Cl}^-$
 H. van der Waals forces
 I. delocalised electrons
 J. forces of cohesion
 K. coulomb
 L. kinetic energy

NOTE: The calculations and answers for the remaining questions in Part I are to be done on your answer book.

31. A car travelling at a speed of 20m/s in a straight line is decelerated uniformly over a distance of 168m , thus reducing its speed to 8m/s . Calculate the acceleration of the car.
32. A stone of mass $0,5\text{kg}$ is released from a bridge spanning a river, and hits the water after 4 seconds. Ignore the resistance of the air, and calculate the kinetic energy of the moving stone at the moment it hits the water.
33. An electric circuit consists of a 6V battery and two resistances, of 5 ohms and 7 ohms respectively, connected in series. Calculate the magnitude of electric charge which passes a fixed point in the circuit in the course of 4 seconds.
34. Calculate the mass of 6 moles of water.
35. 50ml of a gas at a pressure of 59kPa and at 22°C are kept at constant volume while the temperature is increased to 57°C . Calculate the new pressure.
36. Calculate the frequency of a radio wave having a wavelength of 5m .

N.B.: Allocation of marks: question 1 to 20: 3 each: 60
question 21 to 30: 1 each: 10
question 31 to 36: 5 each: 30
100

QUESTIONS 37 to 40 ARE TO BE ATTEMPTED BY HIGHER GRADE CANDIDATES ONLY.

37. An object having a mass of 6kg is projected vertically upwards with an initial kinetic energy of $2\,700\text{J}$. Ignore air-friction and calculate the maximum height attained if the gravitational acceleration is 10m/s^2 .
38. A small sphere with a mass of $5 \times 10^{-8}\text{kg}$ is placed in an electric field with a horizontal direction and a field strength of 20V/m . Calculate the acceleration of the sphere in the direction of the electric field if the sphere has a charge of $2,5 \times 10^{-9}\text{C}$, and can move freely.
39. When an atom changes from an excited state to the ground state it radiates a photon with an energy content of $3,3 \times 10^{-19}\text{J}$. Calculate the wavelength of this electromagnetic radiation.
40. Calculate the mass of sulphur in 5mol pure sulphuric acid.

Questions 37 to 40: 5 each: 20
120

PART II

Standard Grade candidates must answer Question 1 to 4.
Higher Grade candidates must answer all the Questions.

1. (VECTORS: GRAVITY: MOMENTUM)

(a) An object undergoes the following displacements:

- 6km in the direction 60° (60° E of N);
8km in the direction 150° (i.e. 60° S of E).

Determine by accurate drawing and measurement, using the scale 10mm equivalent to 1km, the magnitude and direction of the resultant displacement. (16)

(b) A trolley of mass 3kg travels at a velocity of 8m/s due north. A second trolley, of mass 4kg, following the first trolley along the same path, travels at a velocity of 9m/s due north. It overtakes the first trolley and collides with it. After the collision, the first trolley is travelling with a velocity of 9m/s due north.

- (i) Calculate the momentum of each trolley before the collision;
- (ii) Calculate the total momentum after the collision;
- (iii) Calculate the velocity of the second trolley after the collision;
- (iv) Name and state in words the physical principle you have used. (20)

(c)(i) State in words Newton's Law of Universal Gravitation.
(ii) Calculate the gravitational force between two metal spheres of uniform density, if their masses are 30kg and 50kg respectively and the distance between their centres is 5m.
(iii) State precisely how the force between the spheres will be affected if the distance between their centres is reduced to 2.5m. (14)

(50/)

2. (COMPONENTS: EQUATIONS OF MOTION: WORK: CURRENT ELECTRICITY)

(a) A force of 8N acts in the direction 310° (i.e. 50° W of N). Determine by accurate drawing, using the scale 10mm equivalent to 1N, the components of the force in the directions due north and due west. (14)

(b) In the equations $F = ma$ and $v = u + at$, six different physical quantities appear. Explain the meaning of each symbol in the two equations, and state which are vectors and which are scalar quantities. (12)

(c) An object having a mass of 10kg is lifted vertically to a height of 10m above the ground. Calculate:-

- (i) the quantity of work done;
- (ii) the potential energy of the object in its highest position;
- (iii) the sum of its potential energy and its kinetic energy after it has fallen 5m;
- (iv) the velocity of the object when it strikes the ground. (12)

(d) An electric circuit consists of a battery providing an EMF of 6V, and two 4-ohm resistors connected in parallel; an ammeter is connected directly to one of the resistors (i.e., in series with it, but in parallel with the other resistor). Calculate:-

- (i) the combined resistance of the two parallel resistors;
- (ii) the reading of the ammeter;
- (iii) the quantity of energy converted in one of the two resistors, if the current registered by the ammeter is kept constant for two minutes. (12) (50/)

3. (WAVES: ELECTRIC FIELDS: ATOMIC STRUCTURE)

- (a) Complete the following sentences by writing down the missing words. You need not write out the whole sentence if your answers are clearly numbered.
- (i) A displacement vector has both..... and
 - (ii) If air friction is ignored, all objects fall towards the earth with the same.....
 - (iii) Between unlike charges there exists a force of.....
 - (iv) The emission of electrons from a metal as a result of heating is called.....
 - (v) Resistors can be used as potential dividers if they are connected in..... instead of in.....
 - (vi) For the transmission of alternating current over long distances a..... is used at the power station.
 - (vii) A man walks 6km north and then 6km south. His..... is zero
 - (viii) The equation $F = ma$ is a mathematical formulation of Newton's Law of Motion.
 - (ix) An electric current will flow in a conductor only if a..... exists between the ends of the conductor.
 - (x) The bending of waves around the edge of an obstacle is due to the phenomenon called..... (20)
- (b) The frequency of an ultra-violet wave is 7.5×10^{14} Hz. Calculate:-
- (i) the wave-length;
 - (ii) the energy of a photon of this radiation. (10)
- (c) Two beams of electrons are projected in a direction from top to bottom of your page. Beam (i) encounters a uniform electrostatic field directed from left to right across your page; beam (ii) encounters a uniform magnetic field perpendicular to the paper, directed downwards into the page. Draw 2 sketches to show the paths followed by beam (i) and beam (ii) respectively. (6)
- (d) Potassium is the element with atomic number 19.
- (i) Write down its electron configuration, using the s,p-notation.
 - (ii) State what you can discover about the number and type of particles in the nucleus, from the information given.
 - (iii) Write down the formula of the potassium ion, and state what its electron configuration is, using the same notation as in (i)
 - (iv) What relationships would you expect to find between the chemical properties of potassium and those of sodium? Give reasons for your answers. (14)

/50/

4. (BONDING: SOLIDS: ORGANIC CHEMISTRY)

- (a) Hydrogen chloride is a typical example of a covalent molecule.
- (i) Draw the Lewis structure of the molecule.
 - (ii) Name the orbitals from each atom that are involved in the bonding and state what happens between these orbitals when bonding occurs.
 - (iii) Draw the molecule, showing the resultant shape of the orbitals.
 - (iv) What is a covalent bond?
 - (v) What is a dipole?
 - (vi) State, with reasons, whether an HCl molecule is a dipole or not. (26)
- (b) (i) What is a crystal?
- (ii) Describe the structure of the diamond lattice, stating clearly what change the carbon atoms have undergone to form the lattice. (12)
- (c) The saturated hydrocarbons form the simplest homologous series.
- (i) What does saturated mean?
 - (ii) What is a homologous series?
 - (iii) Write down the general formula of this series.
 - (iv) Draw the structural formula of butane. (12) /50/

- (a) Three long parallel conductors are aligned in a north-south direction, and lie in the same horizontal plane. Conductor P lies 20mm to the west of conductor Q, and conductor R lies 40mm to the east of Q. The conductors carry currents as follows:

P: 3A conventional current flowing north;

Q: 4A conventional current flowing north;

R: 5A conventional current flowing south.

Calculate the magnitude and direction of the force exerted, per metre length, on Q. (19)

- (b) A particular isotope of aluminium has the structure $^{27}_{13}\text{Al}$.

(i) How many protons, neutrons and electrons are there in an atom of this isotope?

(ii) State the symbol for each quantum number, what information is given by each, and the value of each for the last electron added to this atom of aluminium. (21)

- (c) Methane is a typical example of a covalent molecule with a shape which is best explained in terms of hybridisation.

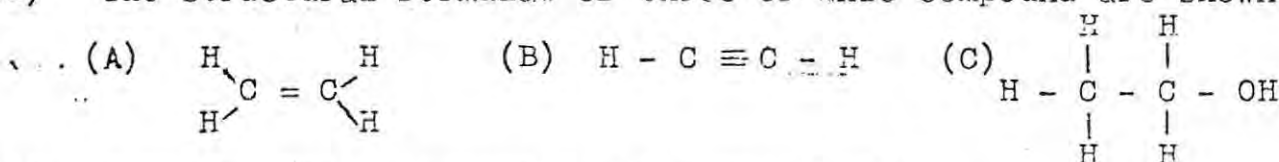
(i) Why does the molecule exist rather than the separate atoms?

(ii) What would be the shape of the molecule without using the concept of hybridisation?

(iii) What is the shape, and what are the bond angles of the molecule?

(iv) How is this shape explained in terms of hybridisation? (18)

- (d) The structural formulae of three organic compound are shown:-



(i) Name the three compounds, in correct order.

(ii) What are unsaturated compounds? State which of the above are unsaturated.

(iii) What structural difference exists between the carbon atoms in (A) and those in (B)?

(iv) What is isomerism?

(v) Discuss the existence of isomers of the compound represented by structural formula (C). (22)

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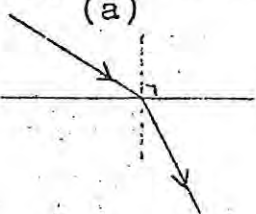
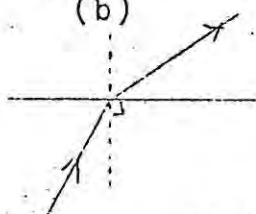
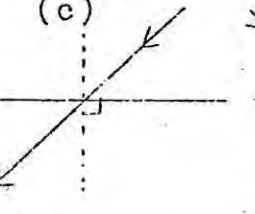
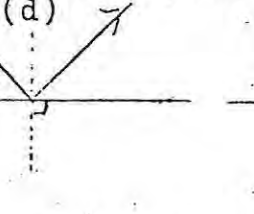
Totals for Part II: SG 200
HG 280

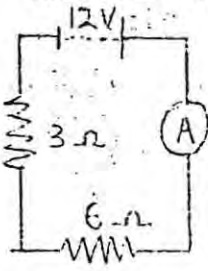
Totals for whole paper: SG 300
HG 400

Answer all questions from all sections.

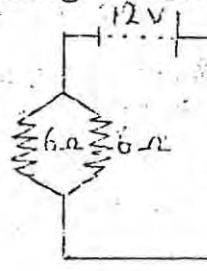
SECTION A

Answer the following 29 questions on the MULTIPLE CHOICE ANSWER SHEET by making a cross in the block containing the letter representing the correct answer. Only one of the five choices is correct. Use a PENCIL.

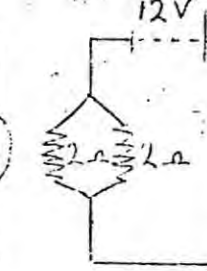
1. The line joining a point on the object with the corresponding point on the image forms the following angle with the mirror:
 (a) 180° (b) 90° (c) 45° (d) 0° (e) none of these. (2)
2. The apparent depth of the plug in a bath of water is a result of
 (a) total internal reflection,
 (b) only refraction,
 (c) refraction and reflection,
 (d) the fact that water is optically less dense than air,
 (e) expansion and contraction. (3)
3. Which one of the following diagrams represents the path of a ray of light from one medium to a second medium of greater optical density?
 (a)  (b)  (c)  (d)  (e)  (3)
4. A prism refracts red light less than violet light. This demonstrates that
 (a) white light is a mixture of only red and violet light,
 (b) red light has a lower frequency than violet light,
 (c) red light has a higher frequency than violet light,
 (d) red light has a shorter wave length than violet light,
 (e) red light travels faster than violet light. (3)
5. Nearsightedness can be remedied by
 (a) making the eye lens fatter,
 (b) wearing spectacles with suitable convex lenses,
 (c) wearing spectacles with suitable concave lenses,
 (d) shifting the retina further from the eye lense,
 (e) closing one eye. (3)
6. An object 30mm from a convex lens is 15mm high. An image 20mm high is formed. The distance in mm, of the image from the lens is:
 (a) 15 (b) 2 (c) 50 (d) 60 (e) 40 (4)
7. Musical notes A and B have frequencies 400 and 600 Hz respectively. If they have the same amplitudes then A and B are
 (a) of equal pitch but not equally loud,
 (b) of equal pitch and equally loud,
 (c) not of the same pitch but loudness in the ratio 2:3,
 (d) equally loud and not of the same pitch,
 (e) of equal pitch. (3)
8. To raise the temperature of 5000g of water by 20°C the following quantity of work, in joules, must be done:
 (a) $4,2 \times 10^2$ (b) $4,2 \times 10^3$ (c) $4,2 \times 10^4$ (d) $4,2 \times 10^5$
 (e) $4,2 \times 10^6$

9. When a quantity of gas is compressed by the piston of a hand pump
 (a) the kinetic energy of the gas decreases,
 (b) the internal energy of the gas increases,
 (c) the temperature of the gas decreases,
 (d) the only work done is against friction,
 (e) no work is done. (1)
10. As soon as a substance begins to change its phase any additional energy transferred to the substance is used to
 (a) increase the kinetic energy of the particles,
 (b) increase the potential energy and distance between the particles,
 (c) increase the temperature of the substance,
 (d) decrease the temperature of the substance,
 (e) reverse the change. (3)
11. 15kJ of energy is just enough to melt 50g of ice. Hence the specific latent heat of fusion of ice is:
 (a) 3,33kJ/g (b) 333J/kg (c) 300J/kg (d) 300kJ/kg
 (e) 0,3kJ/g (3)
12. If the resistance of the ammeter, battery and circuit wiring is 3ohms, which one of the following circuits will result in an ammeter reading of 3A ?
- 

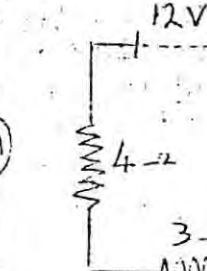
(a)



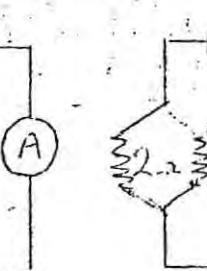
(b)

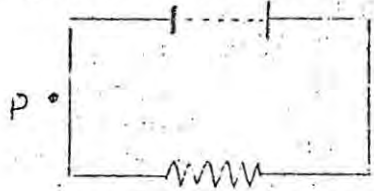


(c)



(d)



(e)
13. A current of 3A is equal to the following rate of flow of charge:
 (a) 3A.s (b) 3C.s (c) 20C/s (d) 3A/s (e) 3C/s (3)
14. The relationship V/I for a certain metallic conductor is 4. When this conductor is connected to a 6V-battery, the current in it is:
 (a) 24A (b) 2A (c) 2,4A (d) 10A (e) 1,5A (3)
15. The direction of the magnetic field at the point P as shown in the sketch is:
 (a) parallel to the conductor,
 (b) from left to right,
 (c) from right to left,
 (d) perpendicular out of the paper,
 (e) perpendicular into the paper. (3)
- 
16. To supply a 6V bell from a 220V source, a transformer must be used which has a winding ratio (primary:secondary) of:
 (a) 6:1 (b) 110:3 (c) 3:110 (d) 1:220 (e) 220:1 (3)
17. The number of electrons in the isotope ${}^7_3\text{Li}$ is:
 (a) 3 (b) 10 (c) 4 (d) 7 (e) 5 (3)
18. Which one of the following representations of atoms in their ground state is wrong?
 (a) Sodium: $1s^2 2s^2 2p^6 3s^1$
 (b) Oxygen: $1s^2 2s^2 2p^4$
 (c) Hydrogen: $1s^1$
 (d) Nitrogen: $1s^2 2s^1 2p^4$
 (e) Magnesium: $1s^2 2s^2 2p^6 3s^2$ (3)
19. Neutral atoms of ${}^{23}_{11}\text{Na}$ and ${}^{24}_{11}\text{Na}$ differ with respect to the,
 (a) number of neutrons and number of protons,
 (b) atomic number and the relative atomic mass,
 (c) number of neutrons and relative atomic mass,
 (d) number of protons only,
 (e) number of electrons only. (3)

20. The number of valency electrons in an atom of sulphur (atomic number is 16) is:
 (a) 2 (b) 4 (c) 6 (d) 1 (e) 0 (3)
21. Which of the following represents a mole?
 (a) 1g of hydrogen gas
 (b) 32g of oxygen gas
 (c) 17g of chlorine
 (d) 16g of oxygen gas
 (e) 6g of carbon (3)
22. If the reactivity of metals decreases from left to right in the Periodic Table, which one of the following is the strongest reducing agent?
 (a) sulphur (b) phosphorus (c) aluminium (d) magnesium
 (e) sodium (3)
23. The reactivity series of some of the metals is: Mg, Ca, Al, Zn, Fe, Pb. Deduce which one of the following metals does not displace iron from its salt solution:
 (a) zinc (b) lead (c) magnesium (d) aluminium (e) calcium (3)
24. Sulphur burns in oxygen to form sulphur dioxide according to the equation:

$$S + O_2 \rightarrow SO_2$$

 What mass of sulphur dioxide, in grams, will be formed if 3.2g of sulphur is burnt?
 (a) 4.8 (b) 2.4 (c) 4.0 (d) 3.2 (e) 6.4 (3)
25. Which of the following metals is the most reactive with cold water?
 (a) Copper (b) iron (c) aluminium (d) potassium (e) zinc (3)
26. Which of the following elements is the strongest reducing agent?
 (a) mercury (b) copper (c) chlorine (d) aluminium
 (e) lithium (3)
27. In the investigation of the displacement of one metal from a solution of its compound by another metal, the following observations were made:
 Lead metal displaces copper from a solution of copper sulphate.
 Zinc metal displaces lead from a solution of lead nitrate.
 Hence, the order of decreasing reducing ability of these metals is:
 (a) Zn, Cu, Pb (b) Zn, Pb, Cu (c) Cu, Zn, Pb (d) Cu, Pb, Zn
 (e) Pb, Zn, Cu (4)
28. Which one of the following statements is true with regard to the substances calcium oxide, lithium hydroxide, carbonic acid, potassium bromide:
 (a) When two of these substances is heated, oxygen is released.
 (b) Three of these substances contain hydrogen atoms.
 (c) All four substances contain oxygen atoms.
 (d) Two of these substances contain potassium atoms.
 (e) Two of these substances, dissolved in water, cause universal indicator to turn blue. (4)
29. In a redox reaction
 (a) the reducing agent is reduced,
 (b) the oxidising agent is oxidised,
 (c) the oxidising agent loses electrons,
 (d) the reducing agent gains electrons,
 (e) the oxidising agent is reduced. (2)

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SECTION B

Each item in the first column matches an item or description in the second column. Write down the numbers of the items of the first column 1 to 10 underneath each other and next to each only the letter of the most suitable matching description.

- | | |
|-------------------------|---|
| 1. Filled s-orbitals | (a) potassium chloride |
| 2. Orbital | (b) probable spaces in which electrons may be found |
| 3. Atomic mass unit | (c) good oxidising agent |
| 4. Normal valency | (d) one twelfth of the mass of an atom of carbon-12 |
| 5. Mole | (e) alkali earth metals |
| 6. Lithium | (f) number of atoms in 32g of O_2 |
| 7. Salt crystal lattice | (g) unpaired electrons in the highest energy level |
| 8. Alkali | (h) positively charged ion |
| 9. Anion | (i) responsible for acidic property |
| 10. Hydronium ions | (j) soluble base |
| | (k) good reducing agent |
| | (l) number of atoms in 12g of carbon-12 |

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SECTION C

1. (a) Draw a ray diagram to show how two lenses are combined to form a microscope. Show the positions of the object, the images and the focal points. Label the lenses according to their names. (1)

- (b) Give the meaning of

- (1) heat,
- (2) latent heat of vaporisation of water at $100^\circ C$,
- (3) internal energy. (1)

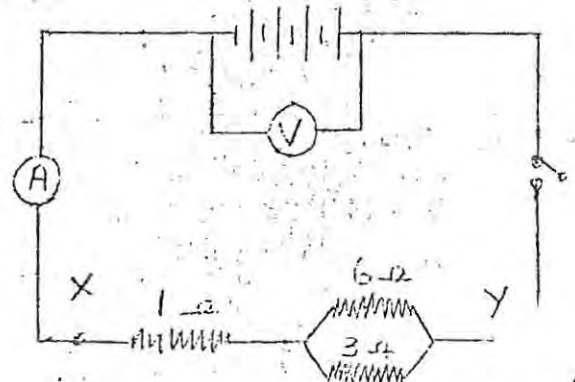
- (c) In the circuit the four 2V-cells each have a resistance of 0.25 ohms. Ignore the resistance of V, A and the wiring.

- (1) What are the readings on V and A when the switch is open?
- (2) Calculate the total resistance of the circuit. (1)

- (3) What is the reading on A when the switch is closed?

- (4) With the switch closed, a voltmeter is connected across points X and Y. What is the reading on this voltmeter?

- (5) What is the reading on V? What is the reading on A? What quantity of energy is transferred to the conductors in the closed circuit in one second? (1)



- (d) (1) Write down the meaning of each of the symbols in the formula as well as the units in which they are measured:

$$AQ = m.c.\theta$$

- (2) A quantity of lead of mass 1400g and at a temperature of $120^\circ C$ is added to 130g of water at $18^\circ C$. The temperature of the mixture rises to $35^\circ C$. Calculate the specific heat capacity of the lead. (1)

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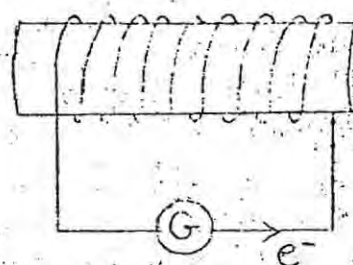
2. (a) A single beam of red light is directed obliquely onto the side of an equilateral prism.

- (1) Draw a sketch to show the path of the beam through the prism.

.... cont. 2(a) (2)

2. (a) continued.

- (2) Indicate in your sketch: the angle of refraction (r) at the first surface of separation; the angle of incidence (i) at the second surface of separation; the angle of deviation (D).
- (3) Under what circumstances will the angle of deviation be a minimum?
- (4) How would the angle of deviation differ if blue light was used instead of red light? Give a reason for your answer. (1)
- (b) Explain briefly the method we used to measure the speed of sound in air. Mention the precautions which need to be taken and discuss possible sources of error. (9)
- (c) A piece of hot metal of mass 30g and Specific Heat Capacity $840 \text{ J.kg}^{-1}.\text{K}^{-1}$ is dropped into a cavity in a large block of ice. 7.5g of the ice melts and the mixture of metal and water in the cavity eventually remain at 0°C . Calculate the initial temperature of the hot metal. (1)
- (d) A strong bar magnet is pushed into a coil as shown in the diagram.
 - (1) What should you observe at G? Why does this happen?
 - (2) Name three ways of increasing the effect in (1).
 - (3) The direction of the current is shown in the diagram. What effect does this have on the approaching magnet?
 - (4) What other means, without using a permanent magnet, would produce the same effect observed in (1)?
 - (5) Name two common bits of apparatus which operate on this principle?



3. (a) The element phosphorus can be written $^{31}_{15}\text{P}$.
 - (1) What is the atomic number of this element?
 - (2) How many electrons are in one atom of this element? Use the arrow-block notation $\uparrow$ to represent the electronic structure of an atom of this element.
 - (3) How many valency electrons does this element possess? What is the normal valency of phosphorus? (1)
- (b) By means of the arrow-block notation, show how two atoms of hydrogen and one atom of oxygen combine to form a H_2O molecule. Mention the type of bonding and show, on your sketch, which orbitals are involved in the bonding. (8)
- (c) The compounds carbon(IV) oxide and carbon(II) oxide are examples of the occurrence of multiple valencies.
 - (1) Write balanced equations to show how these compounds are formed from their elements.
 - (2) What type of oxide is carbon(IV)oxide?
 - (3) Name the product formed when carbon(IV)oxide is dissolved in water? Write the balanced equation for the reaction. What effect does this solution have on universal indicator?
 - (4) Calculate the mass of carbon necessary to produce 11g of carbon(IV)oxide when it is burnt in an excess of oxygen. (1)
- (d) The following seven solutions have pH values as shown:

Solution:	A	B	C	D	E	F	G
pH:	5	3	4	7	6	9	8

 - (1) Which is the strongest alkaline solution?
 - (2) Which is the strongest acidic solution?
 - (3) Which solution is approximately neutral?
 - (4) What will happen to the pH of solution G if sodium hydroxide is added?
 - (5) What substance, when added to solution F, will decrease the pH value of F?
 - (6) Which of these solutions will have the greatest number of hydronium ions per cm^3 ?

4. (a) Oxygen gas may be prepared by heating potassium chlorate(KClO_3).
- (1) What catalyst was used in the preparation?
 - (2) Balance the equation: $\text{KClO}_3 \longrightarrow \text{KCl} + \text{O}_2$
 - (3) If 2 moles of the potassium chlorate were used up in the reaction, how many moles of oxygen were formed?
 - (4) How many molecules of oxygen does your answer in (3) represent?
 - (5) If 6.1g of potassium chlorate was used in the reaction, calculate the mass of oxygen produced.
 - (6) What volume of oxygen is produced in (5) if the density of oxygen is 0.001 g/cm^3 ? (18)
- (b) The salt, sodium sulphate, can be prepared in the laboratory by using a carbonate and an acid.
- (1) What carbonate and acid would you use?
 - (2) What other products (apart from the salt) are formed in the reaction?
 - (3) Write a balanced equation for the reaction.
 - (4) Explain briefly how to prepare dry crystals of the salt.
 - (5) Give three ways, other than using a carbonate and an acid, of preparing salts in the laboratory. Write a balanced equation of a reaction for one of the ways you mentioned. (22)
- (c) Chlorine water is added to a solution of a colourless halogenide of potassium. When chloroform is added and the mixture is shaken thoroughly, the chloroform layer that settles at the bottom of the test tube has a red colour.
- (1) Identify the halogenide.
 - (2) Write down a balanced equation for the reaction of the halogenide with chlorine water.
 - (3) Which substance is oxidised in the reaction?
 - (4) Name two other substances that could have been used instead of chloroform. (10)

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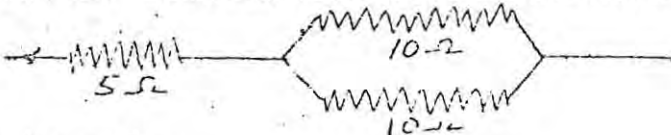
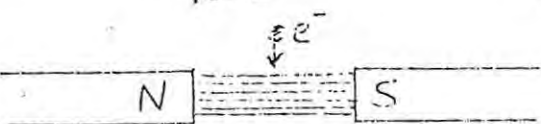
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Answer all questions from all sections.

SECTION A

Answer the following 25 questions on the MULTIPLE CHOICE ANSWER SHEET by making a cross in the block containing the letter representing the correct answer. Only one of the five choices in each question is correct. Use a PENCIL.

1. The image in a mirror is not
 - (a) laterally inverted, (b) behind the mirror, (c) upright,
 - (d) larger than the object in front of the mirror,
 - (e) of the same size as the object.
2. A green object looks green because the surface of the object absorbs the following colours of white light:
 - (a) only green (b) all the colours of white light
 - (c) red and yellow (d) all colours except green
 - (e) yellow and blue
3. A ray of light passing through the optical centre of a lens is
 - (a) refracted parallel to the principal axis,
 - (b) refracted through the focal point of the lens,
 - (c) refracted obliquely away from the principal axis,
 - (d) not refracted,
 - (e) called a virtual image.
4. It is not true that
 - (a) sound waves can be refracted,
 - (b) sound waves can be reflected,
 - (c) sound waves transfer energy,
 - (d) sound waves need a material medium for propagation,
 - (e) sound waves are transverse waves.
5. According to the kinetic-particle model of matter the
 - (a) distance between gas particles is generally less than the distance between the particles of a solid,
 - (b) distance between gas particles is greater than the distance between the particles in a solid at the same temperature,
 - (c) distance between the particles in a liquid is always greater than the distance between gas particles,
 - (d) volume of a gas particle is always greater than that of a particle in a solid,
 - (e) vibrations of the particles in a solid are less energetic at a high temperature than at a low temperature.
6. Heat is always transferred to the surroundings in the following change of phase:
 - (a) evaporation (b) condensation (c) sublimation
 - (d) boiling (e) fusion
7. The current in a metallic conductor is 3A when the potential difference across its ends is 6V. The resistance of this conductor is
 - (a) 18 ohms (b) 3 ohms (c) 2A (d) 2 ohms (e) 0,5 ohms
8. The total resistance, in ohms, of the combination of resistances as shown in the diagram is:
 - (a) 15 (b) 10 (c) 5,2
 - (d) 25 (e) 20
9. An electron moves down the page towards a magnetic field as shown in the sketch. The subsequent path of the electron as it passes through the field is:
 - (a) into the page (b) out of the page (c) towards N
 - (d) towards S (e) unaltered.

10. Which factor does not affect the strength of the induced current when a magnet is moved into a solenoid?
(a) the speed at which the magnet is pushed into the solenoid,
(b) the number of windings on the solenoid,
(c) the strength of the magnet,
(d) the speed at which the magnet is withdrawn from the solenoid,
(e) the type of pole which is moved into the solenoid. (3)
11. The magnitude of the positive charge on the nucleus of an atom is determined by the number of :
(a) protons (b) protons and neutrons (c) electrons and protons
(d) neutrons (e) electrons and neutrons (3)
12. The order in which the elements are arranged in the Periodic Table is according to their
(a) mass numbers (b) atomic numbers (c) atomic masses
(d) atomic volume (e) number of nucleons (3)
13. The group of elements that easily form positive ions is called
(a) metals (b) non-metals (c) inactive gases (d) gases
(e) group VII (3)
14. Atomic masses are measured relative to the mass of
(a) one atom of oxygen (b) one atom of hydrogen
(c) one 16th of an oxygen atom (d) one 12th of any atom of carbon
(e) one 12th of a carbon-12 atom (3)
15. Three moles of H_2O contain the following number of moles of hydrogen atoms:
(a) 1 (b) 2 (c) 3 (d) 5 (e) 6 (3)
16. When a potassium atom forms an ion
(a) no electron transfer takes place
(b) reduction takes place
(c) one electron is given off
(d) one electron is taken up
(e) no redox reaction takes place (3)
17. Which of the following metals is the most reactive with oxygen?
(a) copper (b) zinc (c) potassium (d) aluminium (e) mercury (3)
18. A chemical substance that most easily releases oxygen when heated is:
(a) magnesium oxide (b) mercury oxide (c) zinc oxide
(d) calcium oxide (e) copper(II) oxide (3)
19. When dissolved in water which one of the following will turn litmus paper blue?
(a) sodium oxide (b) phosphorus(V) oxide (c) carbon(IV) oxide
(d) sulphur(VI) oxide (e) sulphur(IV) oxide (3)
20. Which one of the following makes the statement false? An acid is a compound which
(a) reacts with some metals to form a salt and hydrogen
(b) contains hydrogen
(c) turns blue litmus red
(d) forms hydroxyl ions in solution
(e) reacts with an alkali to form a salt and water (3)
21. No image will be formed on a screen when an object is placed in the following position with respect to a convex lens:
(a) further than $2F$ (b) between F and the optical centre
(c) between F and $2F$ (d) on $2F$ (e) on F (3)
22. The equation giving the relationship between the frequency, wave length and speed of sound is
(a) $f = v \cdot \lambda$ (b) $\lambda = f \cdot v$ (c) $v = f / \lambda$ (d) $v = f$ (e) $v = f \cdot \lambda$ (3)
23. The quantity of energy needed to increase the temperature of 2 kg of water by $50^\circ C$ is:
(a) $4,2 \times 10^4 J$ (b) $4,2 \times 10^5 Nm$ (c) $4,2 \times 10^5 J$
(d) 100 N (e) 100 J (3)

.....cont.

24. Isotopes of the same element differ with regard to the number of
 (a) energy levels (b) beta particles (c) electrons
 (d) neutrons (e) protons (3)
25. An ionic bond is formed as a result of
 (a) sharing of electron pairs,
 (b) covalent bonding between atoms,
 (c) sharing of electrons,
 (d) electrostatic attraction between ions,
 (e) compounds consisting of molecules. (3)
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SECTION B

1. Write down the numbers of the items in the first column underneath each other and next to each write only the letter of the item in the second column which matches or describes the first

- | | |
|--|----------------------------|
| 1. Current strength | (a) phosphorus(V) oxide |
| 2. Heat transfer | (b) halogen |
| 3. Prism | (c) spectrum |
| 4. Current-carrying wire in a magnetic field | (d) positively charged ion |
| 5. Changing magnetic field | (e) solvent for iodine |
| 6. Nucleons | (f) good reducing agent |
| 7. Diatomic molecule | (g) motor-effect |
| 8. Iodine | (h) halogenide |
| 9. Insoluble base | (i) ohm |
| 10. Potassium | (j) oxygen |
| 11. Yellow flame | (k) test for a chloride |
| 12. Anion | (l) ampere |
| 13. Acidic oxide | (m) nucleus of atoms |
| 14. Potassium chloride | (n) copper(II) oxide |
| 15. Chloroform (or carbon(IV) sulphide) | (o) work |
| | (p) sodium burns |
| | (q) oxidation takes place |
| | (r) induction |

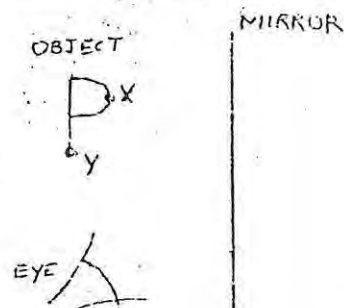
2. Complete the following by writing down only the missing word(s):

- Heat transfer to a solid may lead to a change inor..... or
- A change in temperature of a substance is always accompanied by a change inenergy, while a change in phase is accompanied by a change in theenergy of the particles.
- A proton and a neutron have equal but differ in
- 1 u is the mass of one neutron while $\frac{1}{1840}$ u is the mass of one e.....
- If the oxide of a metal dissolves in water it colours litmus.....

SECTION C

1. (a) An object the shape of a capital letter P is used to investigate the position, size and nature of the image formed by reflection in a plane mirror.

- Write down the two laws of reflection.
- Copy the given sketch. Draw the image of P behind the mirror and show how the eye sees the image by drawing rays reflected from the points X and Y on the image to the eye (two rays from each point).
- What is the nature of the image?



1. continued.

- (b) Draw a ray diagram to show how two lenses are combined to form a microscope. Show the positions of the object, the images and the focal points. Label the lenses according to their names. (10)
- (c) (1) Assuming the speed of sound to be 330 m/s, calculate the length of one wave of a sound note which has a frequency of 200 Hz. (8)
- (2) Using two tuning forks of the same frequency, how would you demonstrate that energy is transferred by sound? (8)
- (d) A solid substance is heated. (4)
- (1) Name two changes (other than volume and colour) which may occur.
- (2) State in each of the two changes you gave in (1), the type of energy changes that take place. (4)
- (e) A circuit consists of three 2V cells in series, a switch, an ammeter and two parallel-connected resistors of 2 ohms each. (18)
- (1) Draw a diagram of the circuit and show the direction of the electron current.
- (2) Show in your diagram how the necessary meter will be connected for measuring the potential difference across the resistors.
- (3) Calculate the combined resistance of the two resistors.
- (4) Disregarding the resistance of the cells and the wiring, calculate the reading on the ammeter.
- (5) Calculate the reading on the meter referred to in (2).
- (6) What is the strength of the current through each of the two resistors?
- (7) How much energy is transferred if 1 C of charge flows through the circuit? (18)

2. (a) Hydrogen is the first element in the periodic table and has a relative atomic mass of 1. /50/
- (1) What is the atomic number of hydrogen?
- (2) Which particles in the hydrogen atom are responsible for its (i) mass (ii) volume?
- (3) What type of bond is formed between two hydrogen atoms? State how this type of bond is formed.
- (4) Granulated zinc is used to prepare hydrogen. What other substance is used? Write a balanced equation for the reaction.
- (5) How many moles of zinc are required to produce three moles of hydrogen? (15)
- (b) A small piece of sodium is placed on water.
- (1) What do you observe?
- (2) What gas is given off?
- (3) How did you test for this gas?
- (4) Write a balanced equation for the reaction of sodium with water.
- (5) Name two other metals that will react with cold water. (11)
- (c) A strip of zinc metal is placed in a solution of copper(II) sulphate in a test tube.
- (1) What will you observe?
- (2) Write a balanced equation of the reaction.
- (3) Which substance is reduced? Give a reason for your answer. (10)
- (d) Chlorine has a normal valency of -1.
- (1) How many unpaired electrons does chlorine have in its valency energy level?
- (2) Chlorine water is added to a solution of potassium iodide. Name a substance which should now be added to the above and shaken well to test for the presence of displaced iodine.
- (3) Write a balanced equation for the reaction of potassium iodide and chlorine.
- (4) Which of the elements, iodine or chlorine, gains an electron in the reaction? (14)

June 1981

Std. 8

PHYSICAL SCIENCE

HIGHER GRADE

Time: 2 hours

Marks: 200

Answer ALL questions in Section A using the answer sheet provided. Simply cross out the letter on the answer sheet which corresponds to the correct answer. There is only one correct answer to each question.

Answer All questions in Section B on the sheets of paper provided. Ensure that you number your answers exactly as they are numbered in the question paper, that your name appears on each sheet, and that you hand in the sheets in the correct order, with Section A answer sheet on top. Remember to show all your working in the calculations. Make use of the Periodic Table given you when you need atomic numbers and atomic masses.

SECTION A

1. Which of the following pairs of elements includes one metal and one non-metal?
(a) barium and sodium
(b) lithium and fluorine
(c) copper and potassium
(d) sulphur and bromine
(e) lithium and calcium (3)
2. The Periodic Table arranges the elements in order of
(a) increasing atomic mass
(b) increasing molecular mass
(c) reactivity
(d) increasing number of protons
(e) increasing acidity (3)
3. Which of the following substances is an element?
(a) bromine gas
(b) water
(c) carbon
(d) salt
(e) oxygen gas (3)

4. Which one of the following ions does not carry a charge of 2+?
(a) calcium ion
(b) sodium ion
(c) copper (II) ion
(d) zinc ion
(e) magnesium ion (3)
5. The number of orbitals in the 2p sublevel is
(a) 1 (b) 2 (c) 3 (d) 6 (e) 8 (3)
6. Covalent bonds are formed by
(a) the sharing of electron pairs
(b) the transfer of 1 electron from one atom to another
(c) the electrostatic attraction between ions
(d) the sharing of one electron between 2 atoms
(e) the formation of ions (3)
7. The number of electrons in the isotope ${}^3_1\text{H}$ is
(a) 0 (b) 1 (c) 2 (d) 3 (e) 4 (3)
8. Salts cannot be prepared by having an acid react with
(a) a metal
(b) an alkali
(c) water
(d) a metal oxide
(e) a carbonate (3)
9. Which one of the following equations is the correctly balanced equation to represent the reaction between hydrogen and oxygen?
(a) $\text{H}_2 + \text{O} \longrightarrow \text{H}_2\text{O}$
(b) $\text{H}_2 + \text{O}_2 \longrightarrow \text{H}_2\text{O}_2$
(c) $\text{H}_2 + \text{O}_2 \longrightarrow \text{H}_2\text{O}$
(d) $2\text{H}_2 + \text{O}_2 \longrightarrow 2\text{H}_2\text{O}$
(e) $\text{H} + \text{O} \longrightarrow \text{OH}$ (3)

10. How many electrons are there in the calcium ion?
(a) 2 (b) 16 (c) 18 (d) 20 (e) 22 (2)
11. Sodium has atomic number 11, mass number 23.
Which one of the following sets of particles does one atom of sodium contain?
(a) 11 protons; 12 electrons; 12 neutrons
(b) 11 protons; 11 electrons; 23 neutrons
(c) 11 protons; 11 electrons; 12 neutrons
(d) 12 protons; 12 electrons; 11 neutrons
(e) 12 protons; 11 electrons; 12 neutrons (3)
12. Which one of the following metals will react only very slowly with cold water but will burn brightly in steam?
(a) sodium (b) potassium (c) calcium (d) magnesium (e) iron (2)
13. Sulphuric acid is regarded as a strong acid because it
(a) reacts with zinc to release hydrogen gas
(b) neutralises all alkalis
(c) contains a high percentage of hydrogen per mole
(d) forms a large number of H_3O^+ ions in solution
(e) reacts with carbonates in aqueous solution to release carbon (VI) oxide (3)
14. Which one of the following equations represents the reaction between sodium and water core
(a) $2\text{Na} + \text{H}_2\text{O} \rightarrow \text{Na}_2\text{O} + \text{H}_2$
(b) $2\text{Na} + 2\text{H}_2\text{O} \rightarrow \text{Na}_2\text{O}_2 + 2\text{H}_2$
(c) $\text{Na} + \text{H}_2\text{O} \rightarrow \text{NaO} + \text{H}_2$
(d) $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaH} + \text{H}_2\text{O}_2$
(e) $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$ (3)

15. When the pH values of solutions of the oxides of period 3 are compared, it will be noted that:
- (a) acidity increases from right to left
 - (b) alkalinity increases from left to right
 - (c) acidity increases from left to right
 - (d) alkalinity decreases from right to left
 - (e) there is no change in the pH values (3)
- 16-19 (a) 53g (b) 36g (c) 20g (d) 18g (e) 4g
- From the above list of masses (a) to (e), select that mass which corresponds to the mass of
16. 0,1 mol NaOH (3)
17. 0,5 mol Na_2CO_3 (3)
18. 1,0 mol H_2O (3)
19. 0,2 mol CaCO_3 (3)
- 20-23 (a) inert gas (b) halogen (c) alkali metal
(d) group IV element (e) transition element
- From the list (a) to (e) above, select the type of element which has the electronic structure:
20. 2. 8. 1 (2)
21. 2. 8. 8 (2)
22. 2. 8. 16. 2 (2)
23. 2. 8. 7 (2)
24. Which one of the following formulae contains a total of six oxygen atoms?
- (a) $4\text{Al}_2\text{O}_3$ (b) $2\text{Ca}(\text{OH})_2$ (c) $2\text{H}_2\text{SO}_4$ (d) 2HNO_3 (e) 3NaOH (3)
25. When 12g of magnesium are completely burnt in oxygen the mass of the product formed is;
- (a) 20g (b) 24g (c) 30g (d) 36g (e) 40g (4)

SECTION B

Question 1

(20 marks)

(a) Copy and complete the following table.

Element	Z	A	n^0	e^-
Cu		63		29
		1		
Cl^-	17	35		
Ca^{2+}		40		18

(10)

- (b) Write down
- (i) the Lewis dot formula
 - (ii) the Bohr model
 - (iii) the spd-notation (energy diagram with blocks for orbitals)

for each of the following ; Na, F^- .

(10)

Question 2

(15 marks)

		A (columns) (15 marks)						
		E						
B (rows)				F	D		J	
		C					G	H
	i							

Please use the symbols above and not the real names of elements.

- i) Label A and B.
- ii) Which two elements will react in similar ways?
- iii) Which element(s) will not react?
- iv) How many valence electrons are found in C, J, D?
- v) What is the valency of C, J, D?
- vi) Name any two elements (use the letters given above) which are metals.
- vii) Give the formula of the compound which consists of the elements D and C.

(15)

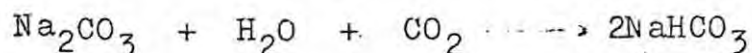
Question 3

(20 marks)

(a) Explain how and why fluorine forms a diatomic molecule. (3)

(b) Calculate the percentage of oxygen in $\text{CuSO}_4 \cdot 6\text{H}_2\text{O}$. (4)

(c) Consider the following balanced equation:



i) How many moles of CO_2 are used to form 2 moles of NaHCO_3 ?

ii) How many moles of H_2O are required to form 0,5 moles of NaHCO_3 ?

iii) How many moles of NaHCO_3 can be obtained from 7,5 moles of Na_2CO_3 ? (5)

(d) Calculate the mass of 6 moles of N_2 . (3)

(e) An element, atomic number 17, occurs in nature as two isotopes, X and Y, with mass numbers 35 and 37 respectively. If the relative atomic mass of the element is 35,5, state which is the more abundant isotope. Give the ratio in which the isotopes occur. (5)

Question 4

(15 marks)

(a) Write formulae for the following:

i) aluminium oxide

ii) potassium chlorate

iii) table salt

iv) sodium hydrogen carbonate (7)

(b) What is the molecular mass of potassium sulphate? (5)

(c) Define the 'mole'. (3)

Question 5

(20 marks)

Write balanced equations for the following reactions:

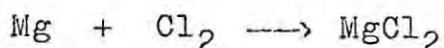
- i) magnesium + oxygen gas -----
- ii) sodium hydroxide + sulphuric acid -----
- iii) magnesium + steam -----
- iv) zinc + copper sulphate -----
- v) copper + magnesium sulphate -----
- vi) sodium + iodine -----
- vii) chlorine + potassium bromide -----

(20)

Question 6

(20 marks)

- a What is 'oxidation' and 'reduction'? Explain these terms with reference to the reaction



(6)

- b You wish to prepare lithium sulphate crystals by the process of neutralisation.

- i) Which acid and which alkali would you use?
- ii) Give a balanced equation for the reaction.

(5)

- c i) Draw a Lewis dot structure to show how bonding occurs in water.

- ii) What type of bond is this?

(9)

Question 7
(20 marks)

Sulphur and potassium each react with oxygen. The products are then dissolved in water. Compare the reactions with respect to:

- i) colour of flame
- ii) violence of reaction
- iii) acidity or alkalinity of product when dissolved in water
- iv) name of product(s) formed
- v) name of solution when dissolved in water

(15)

How do we test for the presence of the gas liberated when:

- i) zinc reacts with hydrochloric acid
- ii) a carbonate is treated with an acid
- iii) red mercury (II) oxide is heated

(5)

TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

SLEUTEL / KEY

Relazione alleanza

Symbol

Abstract

Relative atomic mass

Symbol

Atomic number

I												0					
I 1	II											4 He 2					
7 Li 3	9 Be 4											20 Ne 10					
23 Na 11	24,3 Mg 12											40 Ar 18					
39 K 19	40 Ca 20	45 Sc 21	48 Ti 22	51 V 23	52 Cr 24	55 Mn 25	56 Fe 26	59 Co 27	59 Ni 28	63,5 Cu 29	65,4 Zn 30	70 Ga 31	72,6 Ge 32	75 As 33	79 Se 34	80 Br 35	84 Kr 36
85,5 Rb 37	87,6 Sr 38	89 Y 39	91 Zr 40	93 Nb 41	96 Mo 42	99 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54
133 Cs 55	137 Ba 56	139 La 57	173 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	193 Pt 78	197 Au 79	200 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	210 Po 84	210 At 85	222 Rn 86
223 Fr 87	226 Ra 88	227 Ac 89															
140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	151 Eu 63	157 Gd 64	159 Tb 65	163 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71				
232 Th 90	231 Pa 91	238 U 92	237 Np 93	242 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	249 Cf 98	254 Es 99	253 Fm 100	256 Md 101	254 No 102	257 Lw 103				

STD 8

PHYSICAL SCIENCE

MAY 1981

Time: 2 Hours

Higher Grade.

Marks 200

SECTION A.

(Answer ALL question) 4 marks each.

1 - 14 are multiple choice. Write down the number of the question and next to it the letter which you think corresponds to the most correct answer.

1. Balance the equation $N_2 + H_2 \rightarrow NH_3$. How many moles of NH_3 will be formed if 1,5 moles of hydrogen reacts with nitrogen?

a. 3 b. 1,5 c. $2/3$ d. 2 e. 1

2. Which set of coefficients will balance the following equation -



a. 2=1=3=3 b. 2 = 3=1 = 3 c. 3=2=1=3
d. 2=3=3=1- e. 3=1=2=3

3. When hydrogen and nitrogen combine to form ammonia (NH_3)

a. two electrons from the hydrogen atom are shared
b. five electrons from the nitrogen atom are shared
c. electrons are transferred from the hydrogen atoms.
d. electrons are transferred from the nitrogen atom
e. three electrons from the nitrogen atom are shared.

4. If the electrons of certain atoms only occur in the first main energy level, then these atoms belong to elements in -

a. group 1 b. group 11. c. period 2.
d. group VII e. period 1.

5. The number of electrons in the isotope 3_1H is -

a. 0 b. 1 c. 2 d. 3 e. 4.

6. The number of nucleons in the ion ${}^{27}_{13}Al^{3+}$ is

a. 10
b. 13
c. 14
d. 27
e. 40

7. The following ratios involve the masses of protons, neutrons and electrons. Which ratio is true?
- a. $\frac{\text{electron}}{\text{neutron}} = 1$
 - b. $\frac{\text{electron}}{\text{proton}} = 1$
 - c. $\frac{\text{electron}}{\text{proton}} = \frac{1}{1840}$
 - d. $\frac{\text{proton}}{\text{neutron}} = \frac{1}{1840}$
 - e. $\frac{\text{proton}}{\text{neutron}} = 1840$
8. Which of the following does not represent a mole?
- a. 18g of water
 - b. 32g of oxygen gas
 - c. 24g of magnesium
 - d. 150g of CaCO_3
 - e. 71g of chlorine gas.
9. The number of orbitals in the 2p sublevel is
- a.1 b.2 c.3 d.4 e.0
10. When nitrogen atoms bond to form a molecule, the electron pairs are formed between electrons from the following orbitals -
- a. 1s b. 2s c. 2p d. 3s e. 3p

11. The valency of carbon in CO_2 is -
a. +2 b. -2 c. +4 d. -4 e. +6.
12. $1s^2 2s^2 2p^6 3s^1$ is the electronic configuration of:
a. potassium. b. boron c. beryllium d. sodium
e. lithium.
13. Which formula below is incorrect?
a. sodium carbonate - $\text{Na}_2 \text{CO}_3$
b. copper (I) oxides - CuO
c. potassium nitrate - KNO_3
d. iron (III) chloride - FeCl_3
e. ammonium sulphate - $(\text{NH}_4)_2 \text{SO}_4$
14. Magnesium burns in oxygen forming an oxide which is then dissolved in water. The pH of the resulting solution will be approximately:
a. 10 b. 7 c. 5 d. 3 e. 0.

14x4 = 56

Higher Grade.SECTION E.

Copy out and complete the following table:

15a

Symbol for atom or ion	No. of protons	No. of neutrons	No. of electrons.
${}^1_1\text{H}$			
${}^2_1\text{H}$			
${}^{35}_{17}\text{Cl}$			
${}^?_{?}\text{Li}$		4	
	8	8	8
${}^{64}_{29}\text{Cu}^{2+}$			

(19)

b. What are isotopes?

Give an example of isotopes, basing your answer on the table in the previous section. Give reasons for your choice. (6)

Higher Grade.

16. A very small piece of lithium is placed in a trough of water.
- State clearly what you would observe
 - In what respects would the observation differ if potassium were used instead of lithium?
 - Write a balanced equation for the reaction in (a).
 - Mention two other metals (besides lithium, and potassium) which will react with cold water. (12)
17. A molecule of magnesium nitride has the formula Mg_3N_2
- What is the mass of 1 mole of magnesium nitride?
 - How many formula units are there in 1 mole of magnesium nitride?
 - How many nitrogen atoms are there in 1 mole of magnesium nitride ?
 - How many moles of magnesium nitride are there in 400g of the solid (3,1,3,3.)
18. Using the s - p notation, write down the electronic-configurations of the following elements.
- carbon
 - Potassium
 - Magnesium (9)
19. Balance the equation and find the mass of oxygen evolved if 5.0 grams of potassium chlorate are decomposed by heat.
- i.e. $KClO_3 \longrightarrow Cl + O_2$ (9)
20. The element sulphur can be represented by $^{32}_{16}S$
- What is the atomic number of the element?
 - How many electrons are in one atom of this element?
 - Use the arrow-in-circle notation $\uparrow$ to represent the electronic structure of this element. Label.
 - How many valence electrons does this element possess?
 - What is the normal valency of sulphur? (9)

Higher Grade

21. Write down the formula for the following:
- Sodium bicarbonate
 - Carbon disulphide
 - Hydrogensulphide
 - Aluminium carbonate
 - Calcium phosphate. (10)
22. a Sulphur and potassium each react with oxygen. The products are then dissolved in water. Compare the reactions with respect to -
- colour of flame
 - violence of reaction
 - Acidity or alkalinity of product when dissolved in water
 - name of product formed in reaction with oxygen
 - name of solution when dissolved in water.
- b. Give balanced equation for the reactions of -
- sulphur with oxygen
 - the product in (i) with water.
 - potassium with oxygen
 - the product formed in (iii) with water (18)
23. Use the simple electron-dot diagrams to show how
- atoms of magnesium combine with atoms of fluorine
 - atoms of oxygen and hydrogen combine with each other. (10)

24. Define covalent and ionic bonds.
Give an example of a covalent compound and ionic compound (4)

25.

B →	E	A					
			F	D		J	
		C				G	H
	I						

Shortened Periodic Table

- Label A and B (2)
- Which two elements will react in similar ways? (1)
- Which element/s will not react? (1)
- How many valency electrons are found in C, J, D? (3)
- What is the valency of C, J, D? (3)

/10/

Higher Grade.

- 26.. Give balanced chemical equations for each of the following reactions which occur under laboratory conditions. (NB the following abbreviations are used in this question - (s) = solid (l) = liquid; (g) gas; (aq) = in water solution.)

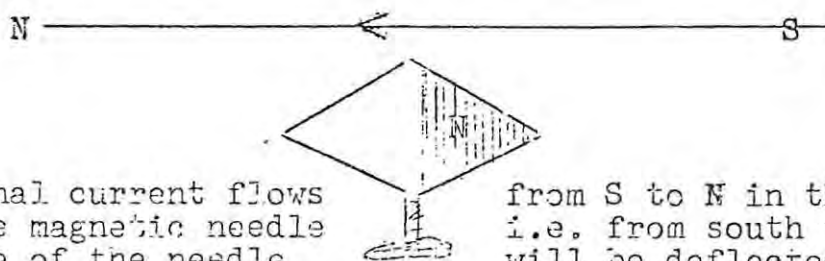
- a. sodium (s) + oxygen (g) $\longrightarrow$
- b. magnesium (s) + iodine (g) $\longrightarrow$
- c. zinc (s) + copper sulphate (aq) $\longrightarrow$
- d. chlorine (g) + sodium iodide (aq) $\longrightarrow$ (12)

- 27 Show clearly and briefly explain how two atoms of oxygen combine to form an O_2 molecule. State which orbitals are involved in the bonding. (6)

Section A
(Compulsory)

Write down only the letter of the answer which, in your opinion, is the correct answer.

1. An incident light ray forms an angle of 40° with the surface of a plane mirror. The angle of reflection is
(a) 40° (b) 50° (c) 90° (d) 60°
2. There will be no refraction when an incident light ray from air strikes the plane surface of a glass block at an angle of
(a) 40° (b) 45° (c) 90° (d) 60°
3. No image will be formed on a screen when an object is placed on the principal axis in the following position with respect to a convex lens
(a) between F and 2F (b) between F and the lens
(c) on 2F (d) farther than 2F



Conventional current flows above the magnetic needle. The N pole of the needle

from S to N in the conductor i.e. from south to north. will be deflected towards

- (a) the east (b) west (c) upwards (d) the north.
4. The unit of electrical potential difference is
(a) V.s^{-1} (b) C.s. (c) Nm.C^{-1} (d) J.C.
 5. An ionic bond usually forms between atoms of
(a) chlorine (b) potassium and bromine (c) sulphur (d) neon and argon
 6. The following pair represent isotopes of the same element
- | | | | |
|---------|---------|---------|---------|
| p
A | q
B | r
C | s
D |
| x
1. | y
2. | x
3. | z
4. |
- (a) 1 and 2 (b) 2 and 4 (c) 1 and 3 (d) 3 and 4
7. With a magnification of 10, the distance of an object from a lens is
(a) 5 (b) 2.5 (c) 20 (d) 500 millimetres, if the distance of the image from the lens is 50 mm.

9. Copper metal reacts with a solution of Hg^+ ions.



- (a) the copper atom is the oxidising agent
(b) the mercury ion is the reducing agent
(c) the mercury ion is the oxidising agent
(d) the reaction is not redox.
10. An insoluble substance is formed if a solution of NaCl is added to a solution of
(a) MgSO_4 (b) $\text{Cu}(\text{NO}_3)_2$ (c) K_2CO_3 (d) AgNO_3
11. Evaporation of a liquid causes cooling because
(a) the slower moving molecules are left behind
(b) the molecules are losing potential energy
(c) evaporation is a cooling process
(d) the faster moving molecules are left behind.
12. An electric lamp requires 0,5 A to burn properly. How many coulombs of charge have passed through the lamp after burning for 5 minutes?
(a) 150 (b) 2,5 (c) 5,5 (d) 10.
13. The rate at which 1 C of charge moves through a circuit is a measure of
(a) potential difference
(b) electrical power
(c) current strength
(d) resistance
14. A white object appears white in daylight because
(a) it transmits white light
(b) it reflects all the colours of the spectrum
(c) it absorbs all the colours of the spectrum
(d) it is opaque
15. To increase the temperature of a piece of copper of mass 200 g, by 5°C , the amount of energy required is ($c = 400 \text{ J.kg}^{-1}.\text{K}^{-1}$)
(a) 2000 J (b) 400 J (c) 200 J (d) 100 J
16. When molten wax is being cooled from 75°C to 45°C , the temperature remains constant at 52°C for a time. The reason for this is
(a) the burner was removed
(b) latent heat of solidification is being given out
(c) the molecules of wax have lost all their kinetic energy
(d) the wax is cooling down
17. A metre of wire has a resistance of 10 ohms. It is folded double and the ends twisted together. The resistance of the wire now, in ohms, is
(a) 20 (b) 40 (c) 5 (d) 2,5.

18. Refraction of light is due to a change in
- the angle of incidence
 - frequency of the light
 - the amplitude of the waves
 - the speed of light
19. The elements on the periodic table are arranged in (i) horizontal periods and (ii) vertical groups respectively, because of their
- atomic number and mass number
 - atomic number and similarity in properties
 - mass number and similarity in properties
 - atomic mass and mass number.
20. A change in the temperature of a substance is an indication of a change in the following property of the particles of the substance
- potential energy
 - kinetic energy
 - chemical energy
 - phase.
- (20 x 3 = 60)

Write down the numbers of the words in the left-hand column and next to them the letters from the right hand column so that related concepts are matched.

- | | |
|-----------------------------|---------------------------|
| 21. nucleons | (a) protons |
| 22. current strength | (b) reduction takes place |
| 23. anode | (c) sodium oxide |
| 24. basic oxide | (d) coulomb |
| 25. potassium | (e) nucleus of atom |
| 26. changing magnetic field | (f) ampere |
| 27. diatomic molecule | (g) oxidation takes place |
| 28. phenolphthalein | (h) motor effect |
| 29. strong alkali | (j) indicator |
| 30. iodine | (k) halogen |
| | (l) alkali metal |
| | (m) oxygen |
| | (n) NaOH. |
- (10 x 2 = 20)

TOTAL 80

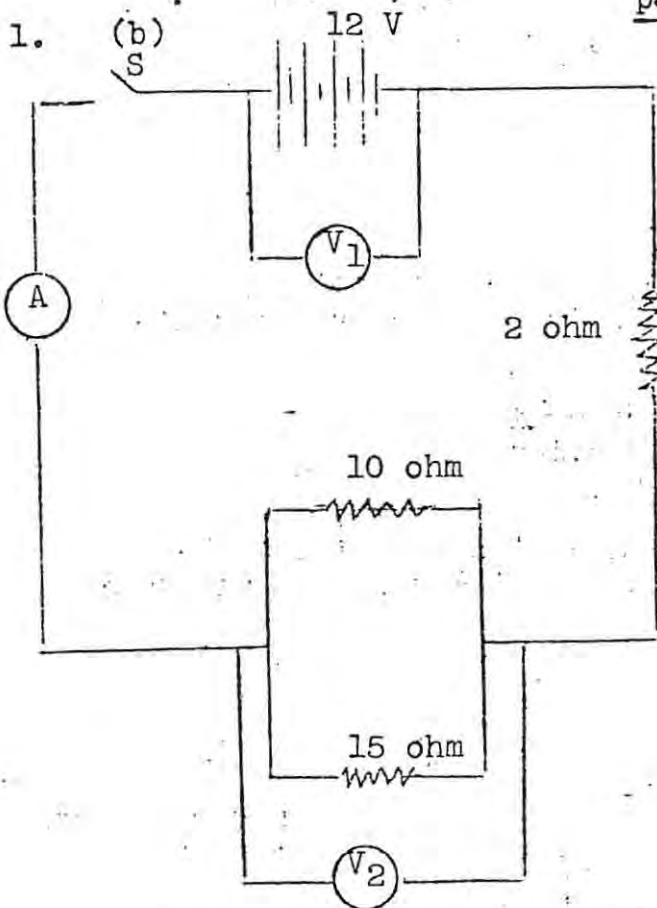
SECTION B

Answer any FOUR questions

1. (a) An experiment to illustrate Ohm's Law gave the following results:

p.d. (volts)	2	3	4	5	6
Current (A)	0,5	0,75	1	1,25	1,5

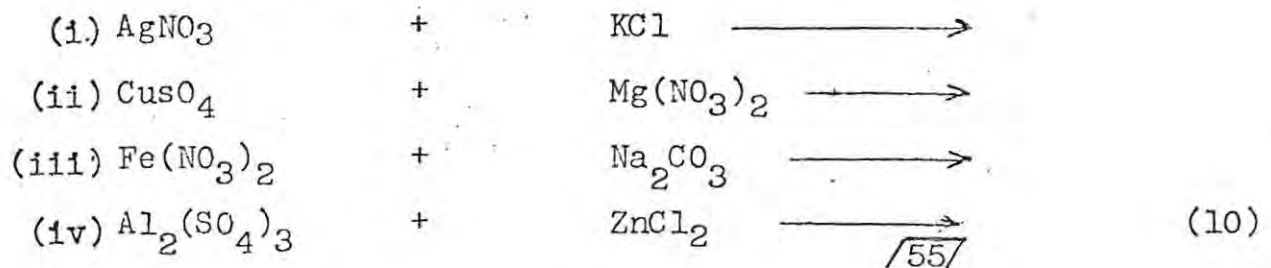
- Represent these results on a graph, with current strength on the horizontal axis.
 - What does the graph indicate about the V/I relationship?
 - What current does a potential difference of 3,6 V produce?
 - What is the resistance of the conductor?
- (15)



- (i) Calculate the resistance of the parallel resistors.
- (ii) What is the total resistance?
- (iii) What are the readings on the meters A, V_1 and V_2 while the switch S is open?
- (iv) What are the readings on these meters when the switch S is closed?
- (v) Calculate the current strength in the 15 ohm resistor.
- (vi) How much energy is transferred when a charge of 2 C flows through the circuit?

(30)

(c) Complete and balance the following equations; indicate any insoluble precipitates:



55

2. State the laws of reflection

(8)

- (b) Give neat, ray diagrams to illustrate
- (i) that water is deeper than it appears to be
 - (ii) the passage of a ray of light striking a 60° glass prism at an angle; label the following: incident ray; refracted ray, emergent ray, angle of deviation.

(15)

- (c) An object, 30 mm high is placed on the principal axis of a concave lens, of focal length 40 mm, at a point 20 mm from the optical centre of the lens.
An exactly similar object is placed on the principal axis of a convex lens, of focal length 40 mm, at a point 20 mm from the optical centre of the lens.

- (i) Draw accurate ray diagrams of each set-up
- (ii) Measure and compare the heights of the images of the objects.
- (iii) Mention THREE similarities and ONE dissimilarity between the two images.

(24)

- (d) A sound wave has a wavelength of 200 mm. The speed of sound in air is 330 m.s^{-1} . Calculate the frequency of the sound. (8)

55

3. (a) An aluminium atom is represented as

27
Al.
13

- (i) How many protons are there?
- (ii) How many neutrons in the atom?
- (iii) How many electrons encircle the atomic nucleus?
- (iv) What is the mass number of aluminium?
- (v) What is its atomic number?
- (vi) Give the electronic configuration of aluminium (s-p notation)
- (vii) Write down the symbol for the aluminium ion.
- (viii) Write down the chemical formula for aluminium chloride.
- (ix) What type of bonding occurs in (viii)?
- (x) Aluminium appears in period ____ and group ____ of the Periodic Table. (20)

(b) Write chemical formulae for

- (i) iron(III) oxide
- (ii) copper(I) chloride
- (iii) ammonium sulphate
- (iv) calcium nitrate
- (v) mercury(II) carbonate. (10)

(c) Make a neat diagram of an electrolytic cell, using copper electrodes in a copper(II) chloride solution in the cell. Name the anode and the cathode on the sketch.

- (i) State where
 - (aa) oxidation takes place
 - (bb) reduction takes place.
- (ii) Do electrons actually pass through the copper chloride solution; if not, how is the circuit completed?
- (iii) What will happen to the blue colour of the copper chloride solution if the reaction goes on for a long time? Explain your answer.
- (iv) What energy changes have taken place? (25)

55

4. (a) Explain what you would observe if air is blown through some ether, contained in a small glass beaker, standing in a few drops of water on a glass slab.

- (i) What phase changes have taken place in the
 - (aa) ether
 - (bb) water?
- (ii) Would your observation have been the same, if the two liquids had been in reverse positions? Explain your answer. (11)

(b) What is a coulomb?

- (i) 12 J of work are done in moving a charge of 2 C between two points in a circuit. What is the potential difference between these points?
- (ii) What quantity of charge is transferred between points A and B if a potential difference does 12 J of work in moving the charge? The potential difference is 4 V. (10)

(c) Write down chemical formulae for the compounds and then balance the equations:

- (i) Potassium iodide + lead nitrate $\longrightarrow$
- (ii) Carbon(IV) oxide + sodium hydroxide $\longrightarrow$
- (iii) Iron(II) chloride + silver nitrate $\longrightarrow$

(15)

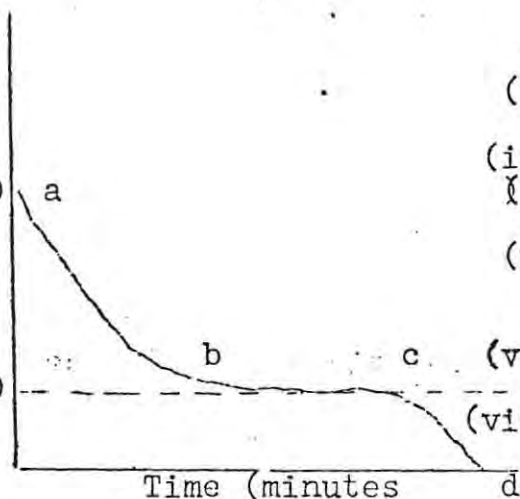
- (d) Give a simple ray diagram to show how a tree, standing on the bank of a river, is reflected in the water. (10)
- (e) An electrical device with a resistance of 55 ohms allows 4 A to flow through it.
- (i) What is the potential difference between its ends?
- (ii) If 15 C of charge pass through the device, how much energy has been supplied? (9)

/55/

5. (a)

Temp.

°C



- (i) Which liquid is represented?
- (ii) What is the freezing point of the liquid?
- (iii) What does section a-b represent?
- (iv) What does section b-c represent?
- (v) What does section c-d represent?
- (vi) Which sections can be associated with the kinetic energy of the molecules?
- (vii) At what stage is latent heat given out?
- (viii) How does the volume of the substance change?

(20)

- (b) A coin lies on the bottom of a porcelain basin; a person lowers his head until the coin just cannot be seen. The head is held in this position while someone else pours water into the basin. The coin becomes visible. Give a ray diagram to explain this phenomenon. (10)
- (c) Zinc powder is added to a solution of copper(II) sulphate in a beaker.
- (i) What gives the copper sulphate solution its blue colour?
- (ii) What do you observe in the beaker?
- (iii) Give two half-equations for the reaction
- (iv) Which substance is reduced?
- (v) Which substance is the oxidising agent? (18)
- (d) Name FOUR factors which influence evaporation. When does a liquid boil? (7)

/55/

$$4 \times 55 = 220 + 80 = 300$$

PHYSICAL SCIENCE
(HIGHER GRADE)

2½ hours.

Section A
(Compulsory)

Choose the correct answer. (4 marks each)

- Elements are arranged in the Periodic Table according to their
 - atomic mass
 - number of neutrons
 - mass number
 - atomic number
 - number of nucleons.
- How many moles of carbon dioxide would react completely with 4 moles of magnesium?
 - 4
 - 3
 - 2
 - 1
 - 0.5.
- A reducing agent is a chemical substance which
 - gives up electrons
 - takes up electrons
 - gives up protons
 - takes up protons
 - reduces the number of electrons in an atom
- The reaction at the anode in a zinc/copper electrochemical cell is
 - $\text{Zn} + \text{Cu}^{+2} \longrightarrow \text{Zn}^{+2} + \text{Cu}$
 - $\text{Cu} + 2\text{e}^- \longrightarrow \text{Cu}^{+2}$
 - $\text{Zn} \longrightarrow \text{Zn}^{+2} + 2\text{e}^-$
 - $\text{Zn}^{+2} + 2\text{e}^- \longrightarrow \text{Zn}$
 - $\text{Cu} \longrightarrow \text{Cu}^{+2} + 2\text{e}^-$
- The number of neutrons in isotope of chlorine $^{35}_{17}\text{Cl}$ is
 - 18
 - 17
 - 35
 - 52
 - 21
- One of the following salts is soluble in water
 - MgCO_3
 - BaSO_4
 - $(\text{NH}_4)_2\text{CO}_3$
 - AgCl
 - CuCO_3
- Electrical energy is converted into chemical energy by
 - a dynamo
 - an electrochemical cell.
 - an electrolytic cell
 - an electric motor
 - torch cell.

8. A volt may be expressed as

- (a) $C.J^{-1}$ (b) $J.s^{-1}$ (c) $J.C^{-1}$ (d) $C.s^{-1}$ (e) $J.s$

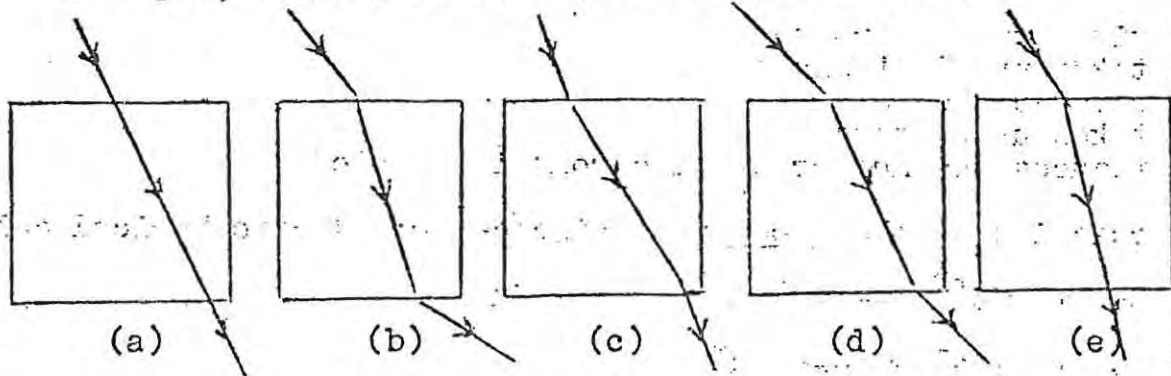
9. 25 grams of copper, in cooling from $80^{\circ}C$ to $40^{\circ}C$ gave out 400 joules of heat; the specific heat capacity of copper is

- (a) $800 J.kg^{-1}K^{-1}$ (b) $400 J.kg^{-1}K^{-1}$
 (c) $200 J.kg^{-1}K^{-1}$ (d) $300 J.kg^{-1}K^{-1}$
 (e) $4,2 \times 10^3 J.kg^{-1}K^{-1}$

10. A red coat looks red because

- (a) it absorbs red and reflects the other colours
 (b) it reflects red and absorbs the other colours
 (c) it reflects all the colours
 (d) it absorbs all the colours
 (e) red is a primary colour

11. The following diagram is the best representation of the path of a ray of light, falling at an angle on a glass block



12. 16,8 kJ of heat are required just to melt 50 g of ice at $0^{\circ}C$ to water at $0^{\circ}C$; the specific latent heat of ice is, in $kJ.kg^{-1}$,

- (a) $3,36 \times 10^2$ (b) $4,2 \times 10^3$ (c) $1,82 \times 10^2$ (d) 5,4 (e) $16,8 \times 10^3$

13. A cylinder of soft iron inside a current-carrying solenoid becomes strongly magnetised because

- (a) the magnetic field converts the iron atoms into magnets
 (b) the magnetic field swings the atomic magnets into line
 (c) the iron makes the magnetic field of the current stronger
 (d) the magnetic field of the iron increases the magnetic field of the current
 (e) iron is a good conductor of electricity.

14. A convex lens can form only

- (a) only enlarged, real images
 (b) only diminished and real images
 (c) only virtual, enlarged images
 (d) all kinds except virtual, diminished images
 (e) all kinds except virtual, enlarged images

15. Refraction is due to a change in

- (a) direction of light (b) speed of light
 (c) position of the object (d) angle of incidence
 (e) angle of reflection.

Show your working in any calculations which follow.

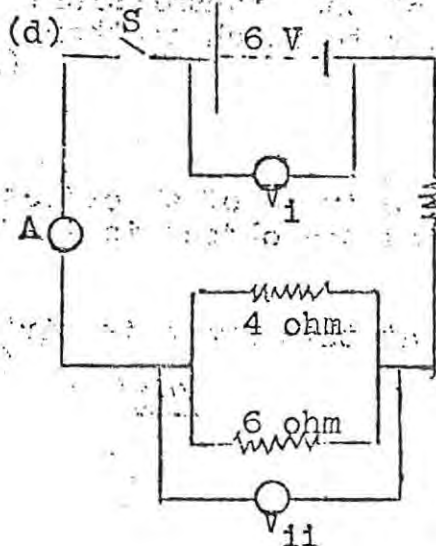
16. Write down the equation for the reaction between Na_2CO_3 and AgNO_3 . Calculate the mass of the precipitate formed when 10.6 g of Na_2CO_3 are added to an excess of AgNO_3 solution.
(Na = 23; C = 12; O = 16; Ag = 108; N = 14) (8)
17. A tuning fork is marked 512 Hz. The speed of sound is given as 330 m.s⁻¹. Calculate the wavelength of the sound produced by the tuning fork. (5)
18. Write chemical formulae for the following compounds:
(a) ammonium sulphate (b) copper(II) chloride
(c) iron(III) oxide (d) aluminium hydroxide
(e) barium iodide (f) calcium sulphate. (6)
19. A current of 3 A flows for 10 minutes through a resistor, connected to a 6 V battery. Calculate the amount of heat developed in the resistor. (7)
20. Name the colours of the visible (continuous) spectrum in their correct order. (7)
21. Draw a rough graph to show what a cooling curve looks like when there is a phase change during the cooling.
Name the axes correctly and indicate where the phase change took place. (7)

100

SECTION B

Answer any FOUR questions.

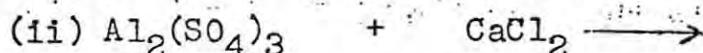
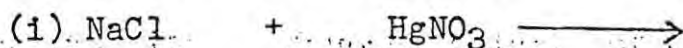
1. (a) Give a neat, clear diagram of an electrochemical cell and indicate the direction of the electron current. (10)
- (b) Label the following parts of the cell and state their composition:
(i) the anode (ii) the cathode (iii) the salt bridge
(iv) the anode electrolyte (v) the cathode electrolyte. (10)
- (c) Write down the half-cell reaction
(i) at the anode
(ii) at the cathode and state where oxidation and reduction have taken place. (8)



- (i) What are the readings on A, V_1 and V_2 with switch S open?
- (ii) What is the total resistance?
- (iii) What are the readings on A, V_1 and V_2 with switch S closed?
- (iv) What is the current in the 4 ohm resistor?
- (v) How much heat is developed in the 6 ohm resistor in 2 minutes?
- (vi) How many coulombs of charge pass through the ammeter in 1 minute? (22)

50

2. (a) Give clear diagrams of an a.c. dynamo, showing how the current is made to alternate. Label FIVE parts of the dynamo. (15)
- (b) A transformer is made to step 240 V down to 6 V a.c. The primary coil has 480 turns. With the aid of a diagram of the transformer, calculate the number of turns on the secondary coil. (12)
- (c) Calculate the percentage of nitrogen in a sample of ammonium nitrate. (N = 14; H = 1; O = 16) (6)
- (d) Complete and balance the following equations and show clearly all precipitates formed:



(15)

- (e) What is an isotope?

(2)

50

3. (a) (i) A concave lens always produces an image having the same general properties. Name FOUR of these properties.
- (ii) Give a diagram of the image of an object formed by a concave lens, which will illustrate the properties named in (i). (12)
- (b) An object, 30 mm high, is placed 50 mm away from a convex lens, of focal length 15 mm. The object stands on the principal axis. Draw a ray diagram accurately, showing the formation of the image.
- (i) measure the size of the image
- (ii) measure the distance of the image from the optical centre
- (iii) calculate the magnification, by two separate calculations.
- (iv) what is the nature of the image? (15)
- (c) Radio waves travel at a speed of $3 \times 10^8 \text{ m.s}^{-1}$. If you are listening to a programme on the radio on a frequency of $1.5 \times 10^3 \text{ Hz}$, what is the wavelength of the transmission? How long would it take for the signals to reach another station 3 000 km away? (10)
- (d) (i) State the laws of reflection.
- (ii) Draw a ray diagram to show that the image of an object appears as far behind the mirror as the object is in front of the mirror.
- (iii) What is meant by the statement that this image is virtual? (13)

50

4. (a) Distinguish clearly between the terms, and give the units in which each is measured:
- (i) heat capacity of a substance
 - (ii) specific heat capacity of a substance
 - (iii) specific latent heat of a substance (12)
- (b) Some lead shot is placed in an insulated container. The temperature of the lead is 15°C .
 50 g of water at 37°C is poured onto the lead shot and the mixture is stirred with the thermometer.
 The final temperature of the mixture is found to be 35°C .
 Calculate the heat capacity of the lead.
 (c for water is given as $4,2 \times 10^3 \text{ J.kg}^{-1}.\text{K}^{-1}$) (10)
- (c) State three methods by which salts may be prepared and give a balanced chemical equation to illustrate each method. (18)
- (d) Make use of the substances, chlorine gas (Cl_2) and sodium bromide (NaBr) to explain the difference between a covalent bond and an ionic (electrovalent) bond. Make use of the Lewis structure. (6)
- (e) Use the Stock notation and allocate names for the following compounds:
- (i) FeI_3 (ii) $\text{Co}(\text{NO}_3)_2$ (iii) HgSO_4 (iv) CuO (4)

50

5. (a) A lump of copper, of mass 180 g, at a temperature of 100°C are placed on a block of ice. It is found that 22,5 g of ice were melted to water at 0°C .
 Calculate the specific latent heat of ice.
 (Given: c for copper is $400 \text{ J.kg}^{-1}.\text{K}^{-1}$) (12)
- (b) Draw an energy-level diagram for an atom of the element chlorine. Indicate the valence electrons and the valency of chlorine. (8)
- (c) (i) Explain why we refer to the atomic number of an element but the mass number of an atom of that element.
 (ii) Using the information in (i), explain why the relative atomic masses of elements are not whole numbers. (10)
- (d) A mixture of calcium carbonate and pure sand has a total mass of 50 g. After treatment with excess nitric acid, it was found that 65,6 grams of calcium nitrate had been formed.
 Calculate the percentage of calcium carbonate in the mixture. (15)
- (e) How many atoms are there in 2,5 moles of copper? (5)

50

$$(300 \times \frac{4}{3} = 400)$$

ANSWER ALL THE QUESTIONS.

- 1.(i) Write 657000 in the power of ten notation. (1)
 - (ii) Should two quantities be plotted on a graph and the graph yields a straight line passing through the origin, what can be said of the two quantities. (2)
 - (iii) By means of a ray diagram indicate why a picture taken with a pin hole camera is inverted. (2)
 - (iv) Name 3 characteristics of a real image. (3)
 - (v) Describe the steps, using pin optics, that you would perform to prove that the image in a plane mirror is as far behind the mirror as the object is in front of the mirror. (10)
 - (vi) Without performing an experiment how do we know that light can travel through a vacuum while sound cannot travel through a vacuum, (2)
 - (vii) If the sun is 1.5×10^{11} m from us and the speed of light is 3×10^8 m/s how long does it take light to travel from the sun to the earth. (5)
- 2.(i) Define refraction. (3)
 - (ii) Draw a ray diagram of the virtual image you would see if you were to look through a glass block at an oblique angle to an object on the other side of the glass block. Show the position of the object and the actual path of light. (5)
 - (iii) Sketch a convex lens and indicate
 - a. the principle axis
 - b. the optical centre
 - c. the principle focus
 - d. the focal length. (8)
 - (iv) If an object is placed in the following positions, state the nature, size and position of the image. (9)
 - a. beyond 2F of a convex lens.
 - b. at 2F of a convex lens
 - c. at 2F of a concave lens.
- 3.(i) Compare the camera and the eye by mentioning five factors that they have in common. (10)
 - (ii) Indicate the characteristics of a sound wave produced by a tuning fork and also represent this graphically showing the wavelength of the sound wave. (10)
 - (iii) Density affects the speed of sound. The lower the density the faster will be the speed of sound. Why is the speed of sound in a metal approximately 15 times faster than in air. (3)
 - (iv) What can be said regarding the angles of incidence and reflection for sound waves. (2)
- 4.(i) Taking the speed of sound in air to be 330 m/s, calculate the wavelength in air of a note of frequency 1100Hz. (4)
 - (ii) The echo of a sound signal generated near the bottom of a ship's hull is received at the ship 0.8 seconds after the signal was transmitted. Calculate the depth of the sea bed below the ship. (speed of sound in water = 1500 m/s) (5)
 - (iii) If you clap your hands at the bottom of a flight of stairs, what is the high pitched ringing sound that you hear? (2)
 - (iv) A string or column of air does not only vibrate in wholes but also in smaller segments. Discuss and show by means of a graph how, by vibrating in smaller segments it affects the quality of a musical note. (10)
 - (v)
 - a. What is the minimum size of a room in which an echo can be produced? (2)
 - b. Why is this the minimum size? (2)
- 5.(i) Define heat. (3)
 - (ii) Name the energies which particles within a substance may possess, that make up the internal energy of that substance. (6)

- 5(iii) Sketch the shape of the graph you would expect if ice at -10°C were heated to steam at 130°C . Mention the energy changes that would be taking place at each the stages, and also state the phase the substance would be in. (Temperature on vertical axis against time on the horizontal axis)
- 6.(i) Define heat capacity and give the units for heat capacity.
 (ii) Define specific heat capacity and give the units for specific heat capacity.
 (iii) Define the latent heat of fusion of ice and give the units for latent heat of fusion of ice.
 (iv) In an experiment to determine the specific latent heat of fusion of ice, the following readings were obtained:
 heat capacity of calorimeter = 20 J/K
 mass of hot water = 62g - at temperature 30°C
 mass of ice added = 15g - at temperature 0°C
 final temperature = 10°C
 Calculate the latent heat of fusion of ice. (Take the specific heat capacity of water to be 4200 J/K kg)
- 7.(i) Define potential difference between two points in a circuit.
 (ii) Three cells are connected in series to form a battery. The cells are connected to an ammeter (which reads 2A), a switch and two resistors r_1 and r_2 . A voltmeter across r_2 reads 2V . The potential difference across the terminals of the battery reads 6V . Consider the resistance of the ammeter, switch and connecting wires to be negligible.
 a. draw the circuit diagram
 b. what total charge will pass through the circuit in $\frac{1}{2}$ minute.
 c. calculate the resistance of r_1
 d. calculate the resistance of r_2
 e. calculate the amount of energy transferred to r_2 in 5 minutes.
 (iii) a. Sketch the shapes of the graph you would expect if the V and I for 2 different metal resistors were investigated.
 b. What conclusion could you draw from the graph concerning the relationships for V and I .
- 8.(i) What causes the heating effect when an electric current passes through a resistor?
 (ii) Discuss the properties of the metal core of a good electro magnet.
 (iii) How could you increase the strength of the electro magnet.
 (iv) Sketch and label the electric bell and very briefly explain how it works. (Clearly indicate the windings and show the polarities of the poles of the electro magnet)

TOTAL

Answer ALL the questions.

Marks will be deducted for untidy or slovenly work and diagrams should be neat. You may give a diagram wherever you think it will help you.

SECTION A.

THE QUESTION PAPER FOR THIS SECTION MUST BE HANDED IN WITH THE ANSWER SHEET, SO DO NOT WRITE ON IT. BOTH QUESTION AND ANSWER PAGES FOR THIS SECTION OF THE EXAM WILL BE TAKEN IN HALF AN HOUR BEFORE THE EXAM ENDS.

This section is to be answered on the special answer sheet provided and it should be detached from the question pages. Choose the answer you think is correct and then cross out the letter corresponding to that answer. e.g. The number of cm in a metre is

a)1000 b)500 c)100 d)50 e)10

a b ~~c~~ d e

There is only One correct answer to each question so only one letter may be crossed out. You can go over it in pencil first and later in ink when you are certain but it must be easy to see.

There are 2 marks for each correct answer in this section. Total = 52.

1. Which of the following is true during a change of phase?

- a)There is no change in the energy of the substance.
- b)The volume remains constant.
- c)There is no change of temperature.
- d)The shape can change but the volume remains constant.
- e)A new chemical substance is formed.

2. A force

- a)can alter the speed of a body or its direction of motion.
- b)is another name for pressure.
- c)must make a body move.
- d)must be transmitted through a material substance.
- e)can be measured in kilogrammes.

3. The force of friction acting on a body that is on a flat table

- a)only acts when the body is stationary.
- b)only acts when the body is moving.
- c)is always smaller than any other force acting on the body.
- d)is greatest just before the body starts moving.
- e)depends on the area of the body in contact with the table.

4. A boy of weight 300 N takes 5 s to run upstairs to a floor which is 4 m higher. The work he does, measured in joules is,

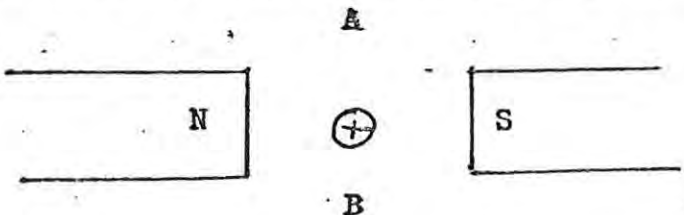
a)6000 b)1500 c)1200 d)600 e)240

5. For the boy in question 4, his average power in watts is,

a)6000 b)1500 c)1200 d)600 e)240

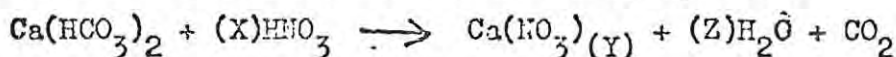
6. A metre rule has a weight of 10 N. It is pivoted at the 20 cm mark. Which of the following will keep it in equilibrium?

- a)a force of 15 N acting down at the 0 mark.
- b)a force of 5 N acting up at the 100 mark.
- c)a force of 10 N acting down at the 0 mark.
- d)a force of 20 N acting up at the 100 mark.
- e)a force of 50 N acting down at the 0 mark.

7. A piece of metal is at 20°C . It has a mass of 10 kg and a specific heat capacity of $400 \text{ J.kg}^{-1}.\text{C}^{-1}$. What will be its new temperature if it receives 20 000 J?
 a) 5°C . b) 25°C . c) 40°C . d) 100°C . e) 400°C .
8. Which of the following will produce a real diminished image? An object is placed
 a) anywhere in front of a plane mirror.
 b) more than twice the focal length from a converging lens.
 c) anywhere in front of a diverging lens.
 d) within the focal length of a converging lens.
 e) between the focal length and twice the focal length from a converging lens.
9. Which of the following properties of a sound wave affects the quality of the musical note heard?
 a) amplitude.
 b) shape of the wave.
 c) frequency of the wave.
 d) speed of travel of the wave.
 e) intensity of the wave.
10. One end of a bar magnet has an N stamped on it. This means that the magnetic pole at that end of the magnet
 a) is attracted to the north magnetic pole.
 b) is the same type of pole as the north magnetic pole.
 c) attracts other poles marked N.
 d) has a positive charge.
 e) has a current flowing from it to the south pole when a wire is connected between them.
11. N and S are two magnetic poles. Between them is a wire carrying a current into the paper as shown. The magnetic force on this wire is in a direction
 a) towards N.
 b) towards S.
 c) up, towards A.
 d) down, towards B.
 out of the paper.
- 
12. A real image is one which:
 a) is always the same size as the object.
 b) is always larger than the object.
 c) is always smaller than the object.
 d) is always produced when a converging lens is used.
 e) can be formed on a screen.
13. An electric bulb is marked 36W, 12 V. This means
 a) its resistance is 3 ohms.
 b) its resistance is $1/3$ ohm
 c) the current it needs is 3 amperes.
 d) the current it needs is $1/3$ amperes.
 e) its resistance is 432 ohms.

14. Which of the following involves a chemical change?
a) Switching on an electric light.
b) Boiling water.
c) Melting ice.
d) Running a car engine.
e) Sawing a piece of wood.
15. The property of an acid that causes it to be called an acid is that
a) it has a nasty taste.
b) it has a pH of less than 7.
c) it is the soluble hydroxide of a non-metal.
d) it contains oxygen.
e) it contains hydrogen.
16. A base is
a) an alkali.
b) something with a pH of less than 7.
c) something with a pH of more than 7.
d) something that reacts with an acid to produce only a salt and water.
e) a soluble hydroxide.
17. The property of an alkali that causes it to be called an alkali is that it is
a) a soluble metal hydroxide.
b) something with a pH of less than 7.
c) an oxide or hydroxide of a metal.
d) the oxide of a non-metal.
e) something with a sour taste.
18. The following are burnt in oxygen and the product is then shaken up with water containing universal indicator. Which one will give an acid reaction?
a) sodium. b) lead. c) hydrogen d) magnesium. e) phosphorus.
19. In which of the following cases will a reaction take place?
a) Silver is added to copper sulphate solution.
b) magnesium is added to zinc chloride solution.
c) Copper is added to sodium chloride solution.
d) Copper is added to hydrochloric acid.
e) tin is added to iron sulphate solution.

Questions 20 to 22 refer to the following equation.



20. The value of X is
a) 1 b) 2 c) 3 d) 4 e) 6
21. The value of Y is
a) 1 b) 2 c) 3 d) 4 e) 6
22. What is the relative formula mass of the first substance?
a) 101 b) 149 c) 69 d) 162 e) 202

23. The first person to put forward a theory about an atom having some sort of structure was
- a) Thompson.
 - b) Bohr.
 - c) Democritus.
 - d) Rutherford.
 - e) Dalton.
24. The mole is the quantity of substance identified by
- a) the number of atoms in 1 g of hydrogen 1.
 - b) the number of atoms in 1 g of carbon 12.
 - c) the number of atoms in 12 g of carbon 12.
 - d) the number of atoms in 1 g of any element.
 - e) the number of atoms in 12 g of any element.
25. Which of the following sets of formulae is correct?
- | | | |
|--------------|-----------|-----------|
| a) HCl | MgCl | NaCl |
| b) K_2SO_4 | K_2NO_3 | K_2CO_3 |
| c) NaOH | KOH | CaOH |
| d) $CuCO_3$ | $ZnCO_3$ | $AgCO_3$ |
| e) MgO | CaO | CuO |
26. Which of the following must be true for an atom?
- a) The number of electrons in it is equal to the number of neutrons.
 - b) The number of neutrons in it is equal to the number of protons.
 - c) The number of protons in it is equal to the number of electrons.
 - d) The protons and electrons are found in the nucleus.
 - e) The atomic number tells you the number of particles in the nucleus.

You may use this information for both sections of the paper.

H = 1. N = 14. O = 16. C = 12. Ca = 40.

Section B. (83 marks for this section)

1. Base your answers to this question on a resistor R, through which a current is flowing as shown. The ends of the resistor are A and B. A voltmeter connected between A and B reads 12 volts.



- What do you mean by the expression "The potential difference between A and B is 12 volts."?
- An ammeter in the wire at A reads 2 amperes. What do you mean by the expression "The current through R is 2 amperes"?
- What do you mean by the expression "The resistance of R is 6 ohms"?

(15)

2. When a cell was connected across a 20 ohm resistor, a current of 0.3 A flowed through it.

- What was the potential difference (voltage) between the terminals of the cell?
- What current will the cell produce if a 30 ohm resistor is connected across it so that it is in parallel with the 20 ohm one?

(10)

3. Two cells are connected in series and send a current through two resistors in parallel. Give a circuit diagram for this and also show on it where you would connect ammeters to measure the current in each resistor and a voltmeter to measure the potential difference across them.

(6)

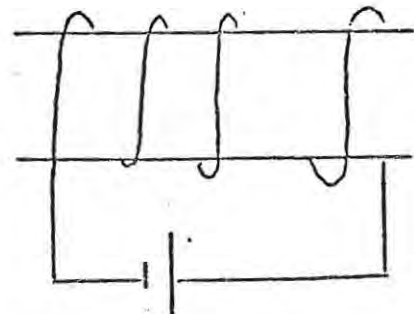
4. Copy either diagram (a) or diagram (b) into your answer book and then draw in the magnetic field. Indicate the polarity of the solenoid and the direction of the field lines.

(6)

a.



b.



5. An object 2 cm. high was placed 4 cm from a converging lens of focal length 3 cm. By construction find the position and size of the image to the nearest mm.

(6)

6. You are asked to prepare pure samples of the following salts, starting in each case with sulphuric acid as one of your reagents. For each one give the equation for a suitable reaction and then state the most important fact about the quantities you would use. (i.e. if you would use excess of either of the reagents, exact quantities or that this was not important.)

- a) Copper sulphate.
- b) Barium sulphate.
- c) Sodium sulphate.

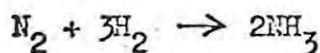
(18)

7. Give balanced equations for the reactions that take place when the following substances are mixed. Any that are soluble in water are in solution.

- a) Silver nitrate + magnesium Chloride.
- b) Sulphuric acid + sodium carbonate.
- c) Potassium hydroxide + hydrochloric acid.
- d) Iron (iii) oxide + nitric acid.

(12)

8. Given the equation



Calculate:

- a) The number of moles of nitrogen ^{gas} that are needed to react with 0,5 moles of hydrogen.
- b) The number of grams of nitrogen that are needed to react with 0,5 g of hydrogen.

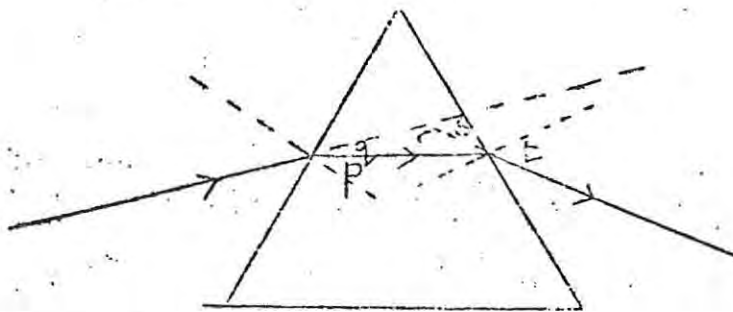
(10)

Time: Higher Grade: 2 hours
Standard Grade: $1\frac{1}{2}$ hours

SECTION AStandard and Higher Grades

Answer this section on the printed sheet provided. For each question a number of answers is given. Choose only that answer which in your opinion is the correct or best answer and shade in the appropriate block with a pencil.

1. A very small light source causes a shadow of a suspended table tennis ball. When the light source approaches the ball, the shadow will
 - (a) become larger
 - (b) not be affected
 - (c) become smaller
 - (d) become larger or smaller
 - (e) disappear.
2. The main reason why a pinhole camera works is the fact that light
 - (a) is refracted as it passes through a lens
 - (b) travels in straight lines
 - (c) is reflected when it strikes any object
 - (d) diffracts round objects
 - (e) travels at very high speeds.
3. A dog rushes at a speed of 2 m/s to attack its own reflection in a shop window. At what speed do the dog and its image approach each other?
 - (a) 0 m/s
 - (b) 2 m/s
 - (c) 4 m/s
 - (d) 6 m/s
 - (e) none of these because the image is stationary.
4. In the diagram below, the angle of deviation is
 - (a) p
 - (b) q
 - (c) r
 - (d) s
 - (e) t.

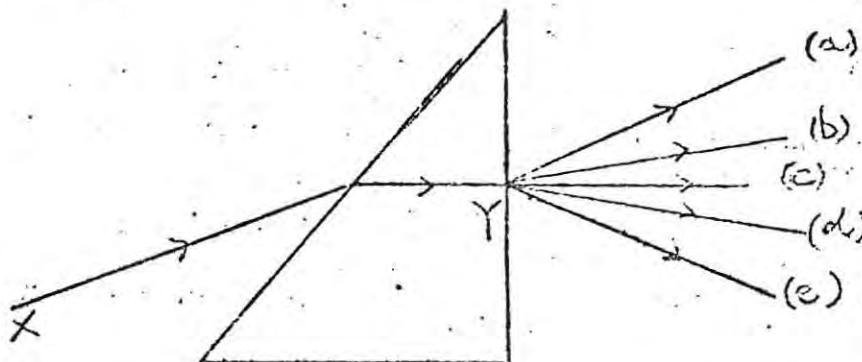


5. A man observes a fish in a pond. The fish appears to be

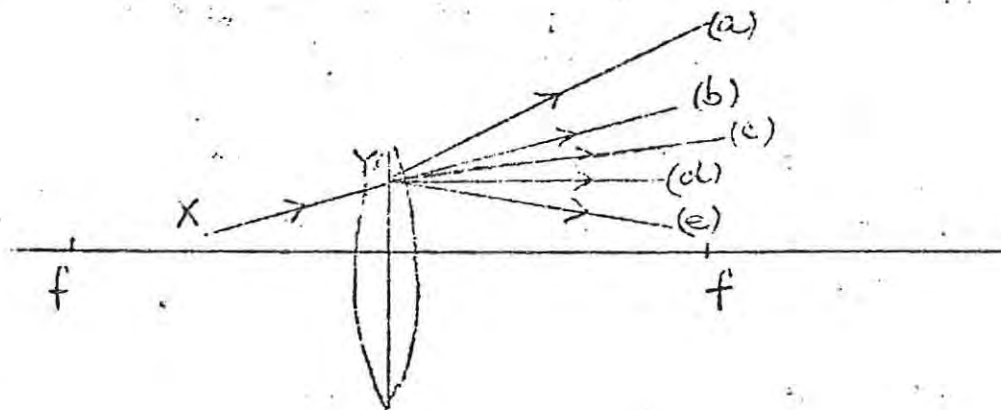
- (a) deeper in the water than it really is because a ray of light drawn from the fish will refract towards the normal.
- (b) deeper in the water than it really is because a ray of light drawn from the fish will refract away from the normal.
- (c) nearer the surface than it really is because a ray of light drawn from the fish will refract towards the normal.
- (d) nearer the surface than it really is because a ray of light drawn from the fish will refract away from the normal.
- (e) at its true depth, unless the man is looking directly down on the fish.

In questions 6 and 7 a diagram is drawn in which XY is the given ray. Choose the ray from those drawn to complete the diagram correctly.

6.



7.



8. An object is placed at the principal focus of a concave lens. The image formed is at a distance from the lens of

- (a) half a focal length on the same side as the object.
- (b) half a focal length on the opposite side to the object.
- (c) one focal length on the opposite side to the object.
- (d) two focal lengths on the opposite side to the object.
- (e) None of these answers are possible since there is no image.

9. A simple magnifying glass is formed with
- (a) a concave lens with the object at a distance from the lens of more than two focal lengths.
 - (b) a concave lens with the object at a distance from the lens of between one and two focal lengths.
 - (c) a convex lens with the object at a distance from the lens of more than two focal lengths.
 - (d) a convex lens with the object at a distance from the lens of between one and two focal lengths.
 - (e) a convex lens with the object between the lens and the principal focus.

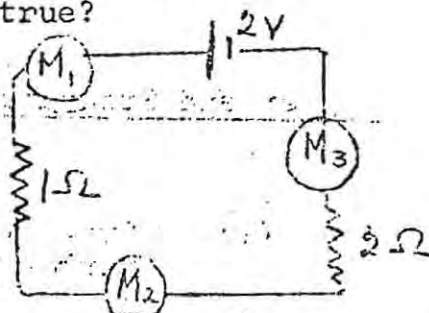
10. The dispersion of white light by a prism can be explained
- (a) in terms of the fact that a prism is made of a very special type of glass.
 - (b) because white light is a mixture of two colours.
 - (c) because the different colours of white light are not refracted to the same extent.
 - (d) in terms of reflection.
 - (e) in terms of absorption of colour.

11. Towards sunset one might see a rainbow

- (a) in the east
- (b) in the west
- (c) in the north
- (d) in the south
- (e) anywhere in the sky.

12. In the circuit shown below, M_1 , M_2 and M_3 are ammeters. Of the following statements, which is true?

- (a) M_1 reads more than either M_2 or M_3 .
- (b) M_1 and M_2 read the same.
- (c) M_1 and M_2 read more than M_3 .
- (d) M_3 reads more than M_2 .
- (e) M_3 reads more than M_1 .

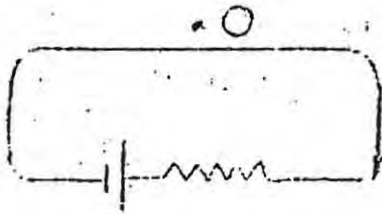


13. When 4 J of work per 2 C is done between two points in a circuit, the potential difference between the points is

- (a) 6 V
- (b) 2 V
- (c) 2 J
- (d) 8 J
- (e) 8 V

14. Ohm's law tells us that

- (a) the ratio of the current flowing through a metallic conductor to the potential difference across its ends is called the resistance.
- (b) at constant temperature, the ratio of current flowing through any conductor to the potential difference across its ends is constant.
- (c) the resistance of any conductor is constant.
- (d) at constant temperature a metallic conductor will have constant resistance.

15. The filament of a lamp bulb becomes white hot although the connecting leads to it are cold. Which statement explains this best?
- (a) the filament carries a higher current than the leads.
 - (b) the filament has a higher resistance than the leads.
 - (c) the filament is wound into a coil.
 - (d) the filament is of shorter length than the leads.
 - (e) the filament is in a vacuum and the leads are not.
16. The direction of the magnetic field at point O near a current-carrying conductor as shown in the diagram is
- (a) to the right
 - (b) upwards out of the page
 - (c) to the left
 - (d) downwards into the page
 - (e) perpendicular to the wire.
- 
17. A good electromagnet has
- (a) a copper core with many turns of insulated wire round it.
 - (b) a steel core with few turns of insulated wire round it.
 - (c) a soft iron core with many turns of insulated wire round it.
 - (d) a steel core with many turns of insulated wire round it.
 - (e) a copper core with few turns of insulated wire round it.

/50/

SECTION B

Higher and Standard Grades

QUESTION I

- (a) (i) State where the image of an object in a plane mirror lies.
- (ii) You are provided with a plane mirror and some pins. Carefully describe, with the aid of a sketch, how you would determine experimentally in the laboratory where this position of the image in (i) will be. (16)
- (b) (i) State what you understand by refraction of light and very briefly explain why it occurs.
- (ii) A light ray strikes a rectangular slab of glass at an angle of incidence of 60° , part of the ray being reflected and part refracted. The reflected and refracted rays make an angle of 90° with each other. Draw a neat labelled diagram to show the path of this light ray. Show the different angles with their sizes in the sketch. (15)

/(c) (i) Make an

- (c) (i) Make an accurate, labelled diagram to show how a telescope produces a visible image of a distant star.
- (ii) What type of image is the image seen by an observer through a telescope? Give one reason for your answer. (13)
- (d) (i) A 30 mm high object is enlarged to 90 mm by a convex lens. What is the magnification?
- (ii) If the distance between the object and the optical centre of the lens is 120 mm, what is the distance of the image from the optical centre? (6)

QUESTION II

- (a) How do you account for the colour of:
- (i) a yellow pencil
- (ii) black shoes
- (iii) green grass when viewed through a red glass plate? (12)
- (b) (i) Explain how the eye adjusts when viewing near and distant objects.
- (ii) What then is the cause of short-sightedness and long-sightedness?
- (iii) How can these defects be corrected? (9)
- (c) An electric circuit consists of 4 cells in series, conducting wire, a switch and a piece of resistance wire XY.
- (i) Draw a simple sketch to show how an ammeter and a voltmeter should be connected in a circuit in order to determine respectively the current flowing and the potential difference between X and Y.
- (ii) Why should, firstly the ammeter and secondly the voltmeter, be connected in its own special way in the circuit?
- (iii) Mention four factors upon which the resistance of XY depends.
- (iv) When the current was switched on, the ammeter and voltmeter readings were 0,7 and 2,8 respectively. What is the resistance of XY? (17)
- (d) State the rule (and give a labelled sketch to illustrate your answer) which enables you to determine
- (i) the direction of the magnetic field lines round a straight conductor carrying an electric current.
- (ii) the polarity of a horseshoe electromagnet. (12)

SECTION C

Higher Grade ONLY

QUESTION III

- (a) A boy is 1,5 m tall and his eyes are 100 mm below the top of his head. Draw an accurate scale drawing to find the shortest length of mirror needed for him to see a full length image of himself in it. What will be the height of its base above floor level? (10)
- (b) Explain, with the aid of a sketch, the formation of a mirage. (16)
- (c) You are given enough switches, four 1,5 V cells and two 3 V lamps.
- (i) Use all the cells and lamps and draw circuit diagrams to show how
1. both lamps can be switched on simultaneously
 2. one lamp can be switched on at a time.
- (ii) If each lamp has a resistance of one ohm and each cell a resistance of 0,5 ohms, calculate the current strength in the circuit when all the components (except the switches) are connected in series.
- (iii) Hence find how much charge flows through the circuit in two minutes when connected as in (ii). (13)
- (d) Explain as fully as you can why an electric current flowing through a wire causes that wire to become hot. (5)
- (e) State three arguments in favour of Weber's theory of magnetism. (6)

PHYSICAL SCIENCE (STANDARD GRADE)

DATE 19 May 1980 STD 8

May 1980

NAME Arvind Kumar

CLASS SECTION 7F

TEACHER: Mr/Mrs/Miss Singh

$$\frac{18}{48} + \frac{32}{102} = \frac{50}{150}$$

Answer all the questions from both sections.
Do Section A on the question paper and section B on folio paper.
Use the tables where necessary.
Neat and systematic work will be to your advantage.

SECTION A

Answer all the questions from this section by encircling the letter in front of the answer of your choice on the question paper.

1. A very small light source causes a shadow of a suspended table tennis ball. When the light source approaches the ball, the shadow will
 - (a) become larger
 - (b) not be affected
 - (c) become smaller
 - (d) remain the same

(3)
2. During an eclipse of the sun as seen from the earth
 - (a) the moon is between the earth and the sun
 - (b) the sun is between the earth and the moon
 - (c) the earth is between the moon and the sun
 - (d) the sun is behind the earth.

(3)
3. You stand in front of a mirror and lift your left hand. Your image lifts its right hand. We say that the image is
 - (a) vertically inverted
 - (b) laterally inverted
 - (c) diagonally displaced
 - (d) right handed

(3)
4. A ray of light strikes a mirror at an angle of 30° with the normal at the point of incidence. The angle of reflection is
 - (a) 90°
 - (b) 60°
 - (c) 30° ✓
 - (d) 15°

(3)
5. The phenomenon of apparent depths can be explained in terms of:
 - (a) reflection at the surface
 - (b) dams of different depths
 - (c) illusions of sight
 - (d) light refraction

(3)
6. When a ray of light from air enters the surface of separation between air and water obliquely, the ray is
 - (a) refracted towards the normal
 - (b) refracted along the surface of the water
 - (c) refracted away from the normal
 - (d) refracted along the normal

(3)

7. In pure red light a blue dress will have the following colour:
 a) red
 b) blue-red
 c) blue
 d) black (3)
8. A leaf looks green because the substance of the leaf absorbs the following colours of white light
 a) all colours except green
 b) only green
 c) all the colours of white light
 d) colours with short wave lengths. (3)
9. Spectacles with concave lenses are necessary to correct the following defect in vision
 a) long-sightedness
 b) short-sightedness
 c) loss of accommodation
 d) astigmatism (3)
10. The iris of the human eye can be compared with the following part of a camera:
 a) shutter
 b) lens
 c) lens opening
 d) diaphragm (3)
11. Sound will not be propagated through the following
 a) vacuum
 b) a metal spoon
 c) a metal wire
 d) water (3)
12. We say sound waves are longitudinal because
 a) they always travel away from the source
 b) the direction of propagation is perpendicular to the direction of motion of the particles
 c) the particles which constitute the wave have the same direction of motion as the wave
 d) they transfer energy (3)
13. Avogadro's number (6×10^{23}) represents the number of
 a) atoms of sulphur in 12 g of sulphur
 b) molecules of oxygen in 12 g of oxygen
 c) atoms of carbon in 12 g of the carbon-12 isotope
 d) molecules of hydrogen in 12 g of hydrogen (3)
14. Ionic compounds consist of
 a) molecules
 b) atoms which have positive and negative charges
 c) atoms which have lost more than 2 electrons
 d) atoms (3)
15. Which statement is untrue? The symbol Na represents the following:
 a) the name of the element sodium
 b) one atom of sodium
 c) one mole of sodium atoms
 d) one molecule of sodium (3)
16. The catalyst used during the decomposition of potassium chlorate for the preparation of oxygen is
 a) KMnO_4 b) MnO_2 c) MnSO_4 d) $\text{Mn}(\text{OCl})_2$ (3)

SECTION B

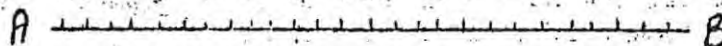
Do all the questions from this section on folio paper and staple it to the back of the question paper. Do all the drawings on your folio paper.

1. a) Light rays which come together in a point are called rays. (2)
 - b) What name is given to a region of partial shadow? (2)
 - c) What is meant by rectilinear propagation of light? (2)
 - d) Draw a ray diagram which illustrates the formation of an image in a pinhole camera. (6)
- ((12))

2. a) Compare real and virtual images by mentioning at least two points of difference. (4)

- b) Complete the adjacent sketch by drawing the ray diagram to show how and where the image of the candle will be seen in a plane mirror AB.

(Hint: Draw the paths of two rays from C.)



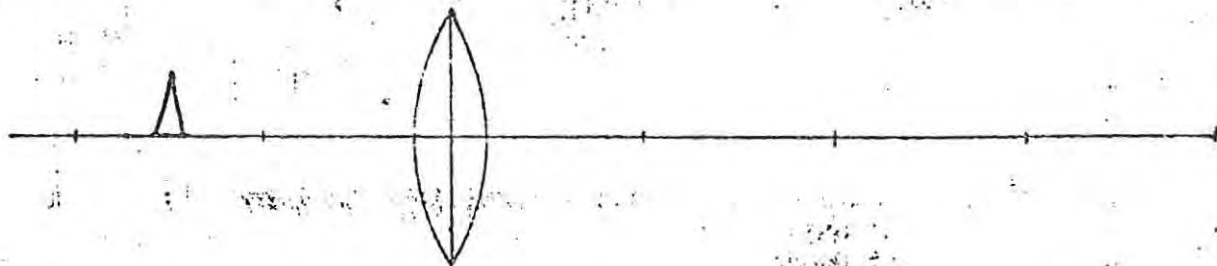
(5)

((10))

3. a) Make a neat labelled sketch to show the nature of the passage of a ray of light through a 60° glass prism. Indicate amongst others the angle of deviation clearly. (9)
- b) True or false?: Paraffin floats on water and is therefore less dense than water, but it is optically more dense than water. (2)
- c) Name the three primary colours of light. (6)
- d) Which colour of light is refracted the most and how does its wavelength compare with the other colours of the spectrum? (4)

((21))

4. a)



Complete the ray diagram of the sketch above to show where and how the image is produced. Only two rays are necessary. Label your sketch, especially the 1F and 2F points.

(7)

4. b) Mention three facts in connection with the image produced in 4(a). (6)
((13))
5. a) When sound of the same frequency and intensity is emitted from two sources, we find that there are positions where the sound is louder and others where it is softer than that of a single source. What are these two phenomena called? (4)
- b) Calculate the speed of sound in air of a note of frequency 1 100 Hz and a wavelength of 0,3 m. (6)
((10))
6. a) Write down the following ions and compound ions with their correct positive or negative valencies:
- i) CO_3
 - ii) HCO_3
 - iii) SO_4
 - iv) Ca
 - v) NH_4
 - vi) Al
- (6)
- b) Write down the chemical names of the following compounds:
- i) Cu(II)SO_4
 - ii) NaCl
 - iii) Cr(III)Cl_3
- (6)
- c) Write the correct chemical formula for the following
- i) Sodium hydrogen carbonate
 - ii) Magnesium oxide
 - iii) iron(III)chloride
- (6)
((18))
7. a) Calculate the mass of 1 mole of each of the following compounds:
- i) K_2O
 - ii) HNO_3
 - iii) NaOH
- (6)
- b) Balance the following equations:
- i) $\text{KClO}_3 \longrightarrow \text{KCl} + \text{O}_2$
 - ii) $\text{Cl}_2 + \text{NaBr} \longrightarrow \text{NaCl} + \text{Br}_2$
- (6)

120
120
—
40
80
80
80

7. c) Arrange the following metals in decending order of reactivity with pure oxygen:

Zn, K, Cu, Li

{2}

- d) Complete:

If the pH values of oxide solutions are alkaline they are called

(2)

- e) How can the pH value of a solution be determined?

(2)

((18))

TOTAL = 102 + 48

May 1980

PHYSICAL SCIENCE (HIGHER GRADE)

STD 8

Time: 2 hours
Marks: 200

SECTION A: (Multiple Choice) (60 marks)

Answer the 20 multiple choice questions by colouring in the appropriate block on the answer paper provided. Pin your answer sheet on top of your written paper.

1. The following is a property of a wave motion:
 - (a) it always causes a rise in temperature
 - (b) it transfers energy
 - (c) it always causes a stationary object to move
 - (d) it only takes place in water
 - (e) it always occurs as light
2. During an eclipse of the sun a penumbra is also formed because
 - (a) the earth is between the sun and the moon
 - (b) the sun is between the earth and the moon
 - (c) the moon shines at night
 - (d) the sun is a large source of light
 - (e) the earth is very large
3. A dog rushes at a speed of 2 m/s to attack its own reflection in a shop window. At what speed do the dog and its image approach each other?
 - (a) 0 m/s
 - (b) 2 m/s
 - (c) 4 m/s
 - (d) 6 m/s
 - (e) none of these because the image is stationary
4. When a ray of light passes from one medium to the other without changing its direction
 - (a) one medium is optically denser than the other
 - (b) the angle of incidence is a right angle
 - (c) one medium is air and the other is water
 - (d) the direction of the ray is from water into air
 - (e) the direction of the ray is from glass into air
5. Straight water waves in a ripple tank approach a glass sheet under the water parallel to the edge of the sheet. The direction of the waves crossing the sheet
 - (a) remains unchanged
 - (b) is refracted towards the normal
 - (c) is refracted away from the normal
 - (d) shows that light as well as water consists of particles
 - (e) shows that water waves have a high frequency
6. An object is between F and 2F with respect to a convex lens. The image formed is:
 - (a) diminished
 - (b) only diminished and upright
 - (c) enlarged and inverted
 - (d) enlarged and upright
 - (e) diminished and inverted

7. The following transparent glass object is not a lens:
 - (a) one refracting surface is curved and the other is flat
 - (b) both refracting surfaces are curved
 - (c) both refracting surfaces are flat
 - (d) a concave spectacle glass
 - (e) a convex spectacle glass

8. A boy is farsighted. He
 - (a) can see nearby objects clearly
 - (b) cannot see far-away objects clearly
 - (c) should wear spectacles with concave lenses
 - (d) can see far away objects enlarged
 - (e) should wear spectacles with convex lenses

9. Which of the following statements are false?
 - (a) A convex lens can form real and virtual images of objects.
 - (b) A concave lens can only form virtual images.
 - (c) Images formed by concave lenses are always diminished and upright
 - (d) Images formed by diverging (concave) lenses are always diminished and inverted.
 - (e) A convex lens can only form inverted real images.

10. The retina of the human eye can be compared with the following part of a camera:
 - (a) shutter
 - (b) lens
 - (c) diaphragm
 - (d) film
 - (e) lens opening

11. The relationship between the frequency, wave length and speed of sound is given by the equation:
 - (a) $v = f$
 - (b) $f = v\lambda$
 - (c) $\lambda = fv$
 - (d) $v = f/\lambda$
 - (e) $v = f\lambda$

$\lambda = \text{wavelength.}$

12. The incident ray and the emergent ray do not have the same direction when a ray of red light passes through a prism. The angle between the emergent ray and the incident ray is called
 - (a) the angle of incidence
 - (b) the angle of deviation
 - (c) the angle of reflection
 - (d) a right angle
 - (e) the angle of refraction

13. The fact that sound cannot be propagated through a vacuum indicates that
 - (a) a material is necessary for the propagation of sound
 - (b) air is absolutely necessary for the propagation of sound
 - (c) sound is only conducted by gases and solids
 - (d) light is not propagated through a vacuum
 - (e) sound waves are always longitudinal

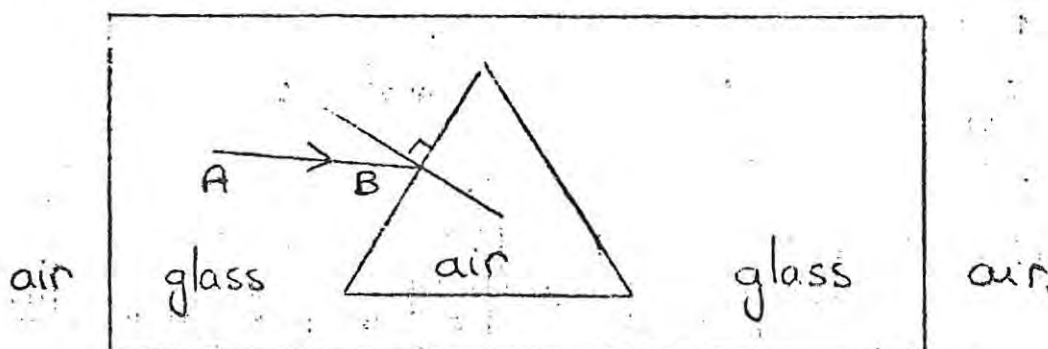
14. The acoustics of a hall can be improved by heavy curtains at the front and back of the hall because
 - (a) the angle of reflection = the angle of incidence
 - (b) multiple reflections improve acoustics
 - (c) soft material prevents most of the sound reflections
 - (d) curtains are conducive to more reflection of sound
 - (e) heavy curtains do not absorb any sound energy
15. Two notes of the same pitch played on different musical instruments always differ in
 - (a) speed
 - (b) wave length
 - (c) frequency
 - (d) quality of tone
 - (e) amplitude
16. Which one of the following formulae is wrong?
 - (a) $AlCl_3$
 - (b) Al_2S_3
 - (c) Al_2O_3
 - (d) $Al(NO_3)_2$
 - (e) $AlBr_3$
17. The number of moles of oxygen atoms in one mole of H_2SO_4 is
 - (a) 8
 - (b) 4
 - (c) 3
 - (d) 2
 - (e) 1
18. A metal which does not react with water or steam is
 - (a) zinc
 - (b) calcium
 - (c) iron
 - (d) copper
 - (e) aluminium
19. A chemical substance which easily releases oxygen when it is heated is
 - (a) zinc oxide
 - (b) mercury oxide
 - (c) calcium oxide
 - (d) copper(II) oxide
 - (e) magnesium oxide
20. Which of the following represents a mole?
 - (a) 16 g of sulphur
 - (b) 16 g of oxygen gas
 - (c) 19 g of potassium
 - (d) 1 g of hydrogen gas
 - (e) 6.02×10^{23} sodium atoms

SECTION B

- 4 -

ANSWER ALL QUESTIONS.

1. A photographic light meter is used in your classroom.
 - (a) What happens to the pointer of the meter? (1)
 - (b) Where does the energy come from? (2)
 - (c) Why does the pointer show a large deflection when held outside in the sun? (2)
 - (d) The meter is held first in red light and then in violet light. The pointer shows a larger deflection in violet light. Assume that the two light sources have the same intensity. What do you deduce from this observation? (3)
(8)
2. List five properties of the image formed by a plane mirror. ((10))
3. a) Draw a straight line PQ = 65 mm. PQ represents a plane mirror. Also draw an arrow AB = 15 mm with A at a distance of 35 mm from the mirror. AB is not parallel to PQ. Now draw two light rays from A and B respectively reaching the eye after reflection from PQ. Show how an image of AB is formed. (6)
- b) Measure the length of the image of AB. (2)
(8)
4. In the accompanying sketch, a large triangle has been cut out of a glass block. The triangle is thus air. Copy the drawing, and trace the path of a ray of light commencing from A to B.



5. a) Name the colours of the spectrum, in order, starting with red. (4)
- b) What are complementary colours? (2)
- c) Give an example of complementary colours. (2)
(8)
6. Supply neat labelled ray diagrams to show how
 - a) a pirhana would 'see' a man standing on the bank of the Amazon. (6)
 - b) a convex lens can be used as a magnifying glass. (6)
(12)

- Cover 5 -
7. An object 20 mm high stands vertically on the principal axis of a lens of focal length 24 mm. If the object is 36 mm from the optical centre, by means of an accurate ray diagram
- measure the distance of the image from the lens
 - measure the size of the image
 - calculate the magnification of the lens
 - state the nature of the image.
- ((17))
8. The critical angle for water is 48° .
- Name two conditions with which the incident ray must comply before total internal reflection will take place.
 - Draw three separate diagrams to show the path of a ray of light from an object under water when the angle of incidence is
 - smaller than 48°
 - larger than 48°
 - equal to 48°
- ((11))
9. The search for oil in the Karoo continues! Echo sounding equipment is in use to determine the depth of rock layers. A blast is detonated in the soil and it takes 6 seconds before the echo from bed rock is recorded.
- If sound travels at $1\,850\text{ m.s}^{-1}$, through the earth's crust, how deep is the bed rock layer? Give your answer in kilometers.
- ((5))
10. Sound is propagated through air as a longitudinal wave. How do particles move in such a wave?
- ((3))
11. Sketch a graphical representation of each of the following. (N.B. the sketches should be below one another and at least 3 wave lengths of each wave should be shown.)
- a musical note
 - a pure note with the same frequency and amplitude as (i)
 - a pure note with twice the frequency as (ii), but having the same amplitude.
- ((6))
12. a) Briefly explain the validity of the statement: "Sound plus sound can equal silence."
- (4)
- b) How does the speed of sound in a gas vary as the temperature of the gas increases?
- (2)
((6))
13. a) What is the valency of Cu in CuO ? (2)
- b) Name the compound CO using the Stock notation. (2)
- c) Name the compound $\text{Fe}(\text{NO}_3)_2$ using the Stock notation. (2)
- d) Write the formula of
- potassium hydrogen carbonate (2)
 - calcium sulphite (3)
- e) Balance the equations:
- $\text{P}_4 + \text{O}_2 \longrightarrow \text{P}_2\text{O}_5$ (3)
 - $\text{P}_2\text{O}_5 + \text{H}_2\text{O} \longrightarrow \text{H}_3\text{PO}_4$ (3)

13. f) Calculate the mass of one mole of $\text{Ba}_3(\text{PO}_4)_2$

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(4)

g) What does it mean to say that you have one mole of H_2O ?

(2)
((23))

14. Calculate the mass of iodine which yields 40,8 g of aluminium iodide.
The balanced equation for the reaction is



15. A small piece of sodium is placed in water in a trough.

- i) State what you observe. (3)
 - ii) What additional observations would you make if potassium were used in place of sodium? (2)
 - iii) What conclusions can be drawn about the reactivity of potassium compared with that of sodium? (1)
 - iv) Within what pH range do you expect to find the solution remaining after the above metals have reacted with water? (2)
 - v) What is the name of the solution called which is formed when sodium reacts with water? (2)
- ((10))

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A P P E N D I X I

S P E L L I N G T E S T

SPELLING TEST : DICTATION

1. diameter	The circle is two centimetres in diameter.
2. tyrannical	He was a tyrannical king.
3. transformer	I used a transformer to change the voltage.
4. effervesce	Eno's salts can effervesce (bubble) very much at times.
5. catalyst	Something which helps a reaction to occur is called a catalyst.
6. combustible	Wood is combustible (ie it can burn).
7. independent	South Africa is an independent country.
8. metre	The ruler is one metre long.
9. conductor	Copper is a good conductor of electricity.
10. fluorescent	I switched on the fluorescent light.
11. magnifying	I used a magnifying glass to read the small print.
12. prosecutor	The prosecutor read out a charge of theft against the man.
13. receiver	The receiver of the parcel bomb was not very pleased.
14. hereditary	The monarchy in Britain is hereditary (ie the position of king or queen is inherited).
15. thermometer	I used a thermometer to take her temperature.
16. vacuum	I used the vacuum cleaner on the carpet.
17. toleration	You should show more toleration towards those with whom you do not agree.
18. massacre	Everyone condemned the massacre of the innocent children.
19. visible	The bird was hardly visible.
20. banish	They decided to banish the king.
21. allies	Britain and America are allies.
22. vaporise	If it is cold the mist will vaporise on the window.
23. indicator	The car's indicator is broken.
24. millimetre	The plant has grown only one millimetre.
25. transmitter	I bought a new radio transmitter.
26. responsible	I was not responsible for breaking the window.
27. nuclear	There was a nuclear explosion yesterday.
28. susceptible	He is very susceptible to colds.
29. government	The government has changed its mind.
30. magnetise (ze)	I tried to magnetise the piece of steel.
31. cylinder	I poured the acid into a gas cylinder.
32. vapour	There was vapour on the window pane.
33. circular	The garden was circular in shape.
34. ballot	The matter was decided by secret ballot (vote).
35. rebellion	They staged a rebellion against the unpopular government.
36. parliament	The act was not passed by parliament.
37. voltmeter	The voltmeter registered sixty volts.

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|-------------------|--|
| 38. emergent | This is the emergent ray. |
| 39. expel | They decided not to expel the naughty child. |
| 40. non-magnetic | Glass is non-magnetic. |
| 41. resistance | The captured thief put up no resistance. |
| 42. molecule | A molecule of water contains two parts hydrogen and one part oxygen. |
| 43. separation | The young couple could not bear the separation. |
| 44. sovereign | Parliament holds the sovereign power in a democracy. |
| 45. Great Britain | That is the touring team from Great Britain. |
| 46. Graaff-Reinet | He comes from Graaff-Reinet. |
| 47. principle | Honesty is an important principle in life. |
| 48. Campbell | Mrs Campbell comes from Glasgow. |
| 49. relative | She is not a relative of mine at all. |
| 50. Karoo | They have gone to live in the Karoo. |