A COMPARISON OF GRADE 1O MATHEMATICS CLASSROOM-BASED TEST ITEMS AND THE END –OF-YEAR NATIONAL EXAMINATIONS, USING STEIN'S FRAMEWORK OF COGNITIVE DEMANDS: A NAMIBIAN CASE STUDY

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ABSTRACT

This study researched the nature of tasks used in Grade 10 mathematics tests and end-of-year national examinations. The study was carried out in three, purposively selected, Grade 10 schools in the Ohangwena region in Northern Namibia.

For the purpose of this study, a mixed method approach was employed to analyse a combination of both quantitative and qualitative data. A sample of three tests per mathematics teacher from the three participating schools and national examinations question papers for the past three consecutive years (2011-2013) were analysed using Stein, Smith, Henningsen, & Silver's (2000) framework of cognitive demand. The study was divided into two phases. Phase 1 was the analysis of teacher test items and national examination items in terms of their cognitive demand. Phase 2 involved semi-structured interviews with three selected teachers to probe their views and find out their basis for selecting test items.

The findings of this study revealed that there was no substantial difference in the distribution of the levels of cognitive demand in both tests and national examinations items. The study, however, showed that mainly tasks requiring only procedures without connections dominated the tests and the examinations. The number of higher level tasks in both tests and examinations analysed was low. There was no single task coded at level 4 in any of the teachers' tests. Only 2% of tasks could be classified at level 4 in the examination items. The study also revealed that since tests and examinations assess the same learning objectives from the syllabus, most of the test items set by teachers were extracted from the national examinations question papers.

The paper recommends that more tasks at a higher level category need to be included in assessment tasks to promote critical thinking amongst learners.

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DEDICATIONS

I dedicate this work to my late parents; my father, Andreas Vilho Ihonya, and my mother, Justina Johannes Nambahu. It is through your hard work and good upbringing that I am who I am today.

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LIST OF ABBREVIATIONS USED

CA	Continuous Assessment
DNEA	Directorate of national examinations and assessment
JSC	Junior Secondary Certificate
LCE	Learner Centered Education
MEC	Ministry of Education and Culture
MBESC	Ministry of Basic Education, Sport, and Culture
MoE	Ministry of Education
NIED	National Institute for Educational Development

CHAPTER ONE

INTRODUCTION OF THE STUDY

1.1 INTRODUCTION

This chapter introduces the research study, a comparison of Grade 10 mathematics test items and the end-of-year national examinations, using Stein, Smith, Henningsen, & Silver's (2000) framework of cognitive demand. The chapter begins by presenting the background information of the study. It continues by presenting the problem statement, theoretical and conceptual considerations, significance of the study, research goals, and the research process of the study. The chapter concludes by providing an overview of the study, highlighting the contents of all five chapters.

1.2 BACKGROUND INFORMATION

After political independence and stability in Namibia in 1990, the education system went through several reform processes whereby a new curriculum was introduced. This curriculum aimed to develop a literate and knowledge-based society, where knowledge is constantly being acquired and renewed, and emphasising innovation to improve the quality of life of all Namibian citizens (Namibia. Ministry of Education [MoE], 2010). For the realization of the reformed curriculum goal a new approach to teaching, learning and assessment was adopted.

In terms of assessment, the reformed curriculum calls for teachers to move "away from a narrow notion of examination to a broader notion ..." (Namibia. Ministry of Education and Culture [MEC], 1993, p.124). This change involves a move aligned with Moore's (1998) assertion that assessment should be transformed from being a testing and examinations' hurdle to an assessment model where all candidates are given an opportunity to demonstrate what they know, understand and can do. Thus, emphasis was placed on synergizing continuous assessment (formative assessment) and examinations (summative assessments).

Both Continuous Assessment (CA) and the end-of-year examination are combined to determine the end-of-year promotional grade for learners in the Upper Primary (Grades 5-7) and Junior Secondary (Grades 8-10) phases. CA in Mathematics for the Junior Secondary Phase (8-10),

contributes 35% of the final grade while the national end-of-year examination contributes 65% of the final grade (Namibia. Ministry of Basic Education, Sport and Culture [MBSEC], 1999, p. 11). CA is mainly done throughout the year and requires teachers to plan and prepare tasks carefully for the CA marks. In my experience, many teachers are pressured to ensure that the CA marks align with the national examination marks. However, this is not always the case.

In Marongwe's (2012) research in the Oshikoto region, it is evident that CA and examination marks (2008-2010) are weakly aligned. The results indicated that there was, in fact, no school with average examination marks equal to average CA marks in the three consecutive years 2008, 2009 and 2010. One reason presented in this study to justify the differences is that teachers often set easy and poor quality tasks which do not help learners develop the basic competencies that are asked at the end-of-year examination.

This notion inspired me to build on Marongwe's (2012) study to critically examine the nature and cognitive-demand level of questions used in test and examination items in Namibian schools. I selected Stein et al.'s (2000) assessment framework of cognitive demand for my analysis of test and examination items since it is mathematics specific rather than using other frameworks, such as the Bloom taxonomy which is more generalist in nature.

1.3 PROBLEM STATEMENT

Poor academic achievement has been witnessed in Mathematics at all levels in Namibian secondary schools, particularly in external examinations such as the Grade 10 JSC examination as shown in Figure 1.1 below.

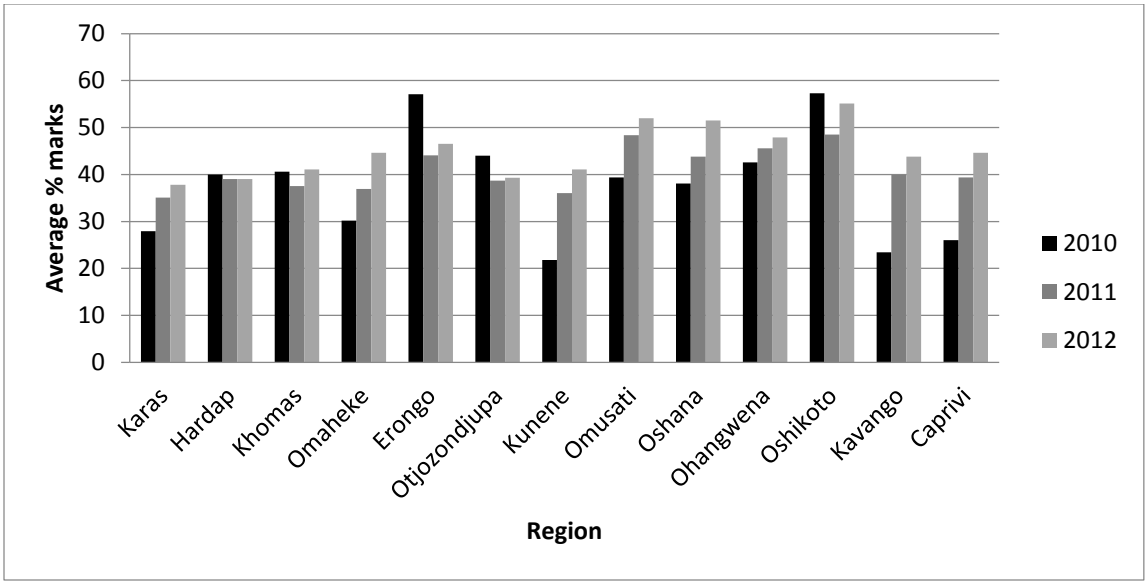


Figure 1.1: Regional performance in average JSC Grade 10 Mathematics marks over the period 2010 to 2012.

[Source: Adapted from DNEA, 2010, 2011, & 2012].

It is clearly evident from Figure 1.1 that among 13 regions, only four regions scored an average mark of 50% and above between 2010 and 2012. These are the Erongo, Omusati, Oshana and Oshikoto regions. The Ohangwena region where this study was conducted had an average score ranging between 40% - 48%.

At this point, it is worth looking at the Grade 10 mathematics performance of individual schools in mid-year-tests and national examinations in the Ohangwena region, specifically in the Eenhana circuit where this study was located, to illustrate the discrepancy of marks in many of the schools. Since the assessment policy in Namibia suggests that all learning objectives assessed by the national end-of-the-year examination should already be assessed by individual schools in the middle of the year (Namibia. Ministry of Basic Education, Sport and Culture [MBESC], 1999, p. 11) the weak alignment of results of the two assessments can be interpreted as surprising. See Figure 1.2 below. There are 18 Junior Secondary Schools in the Eenhana circuit.

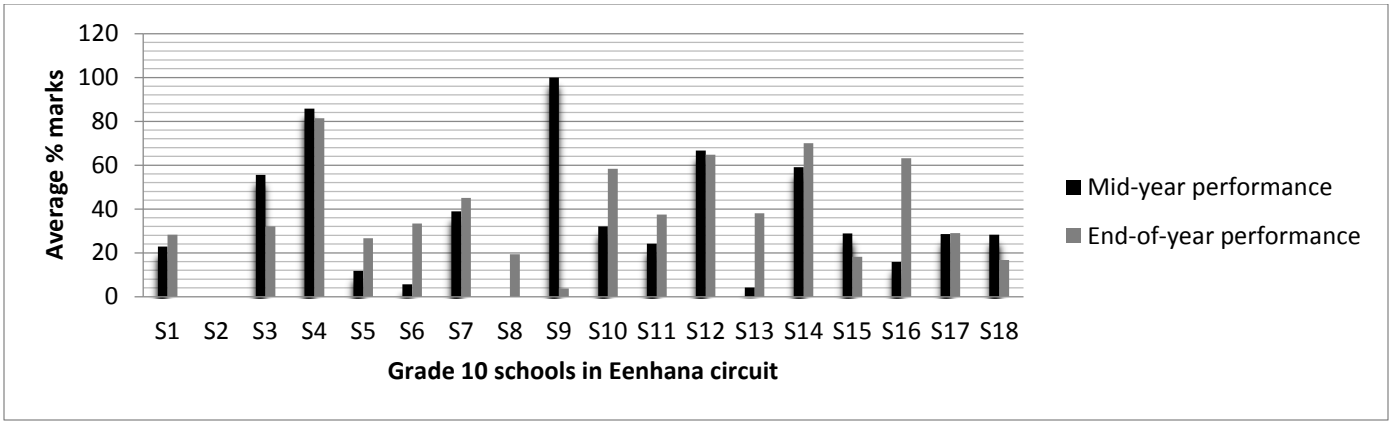


Figure 1.2: Eenhana circuit performance in JSC Grade 10 mathematics mid-year and end-of-year average marks in 2012

[Source: Adapted from Ministry of Education (MoE), 2012a].

There is a clear discrepancy between mid-year-test marks and end-of-year examination marks as shown in Figure 1.2 above. This could be due to inconsistencies in the nature of the assessment items. Even though the mathematics syllabus for grade 8-10 clearly states that teachers should set tests (including mid-year-tests) consisting of both short and structured questions (as in the national examination), the two assessment processes are not aligned. Many learners perform relatively well in the mid-year-test but fail to attain good marks at the end of the year, while others perform poorly in the mid-year-test but score good marks at the end of the year (See Figure 1.2). It has also been reported in the mathematics examiners reports (Namibia. Ministry of Education [MoE], 2011, 2012b) that many learners underperform in the national examinations, particularly in the structured question paper.

The reports state that many learners fail to justify their answers by just writing down the final answer without showing their calculations and workings. Therefore, it is against this background that this study was conducted to compare the levels of cognitive demand required by Grade 10 mathematics test items and the end-of-year national examinations.

1.4 CONCEPTUAL CONSIDERATIONS

This study used Stein et al.'s (2000) framework of cognitive demands as a conceptual and analytical framework to analyse mathematics teachers' test and examination items. Cognitive demand is defined as "the kind and level of thinking required of students in order to successfully engage with and solve a task" (Stein et al., 2000, p.1). Stein et al. (2000) developed a framework that essentially consists of two categories of cognitive demands. Category 1 categorizes tasks into lower-level demand tasks, requiring mainly memorization and procedures-without connections skills. Category 2 categorizes tasks into higher-level demand tasks, mainly requiring procedures-with-connections and doing-mathematics skills. Each level of cognitive demand consists of characteristics (identification features) of tasks that help in identifying the levels of cognitive demand (see Table 1.1). These identification features served as my judgment template during the analysis of the test and examination tasks in this study.

Table 1.1: The features of mathematical tasks at each of the four levels of cognitive demand

Level of cognitive demands		**Descriptors**
Lower level	• Memorization	- Involves reproducing memorized items. - Cannot be solved using procedures because a procedure does not exist or because time frame is too short to complete a task by using the procedure. - Have no connections to the concepts or meaning that underlie the facts, rules, formulas or definition being reproduced.
	• Procedures without connections	- Are algorithmic. Require limited cognitive demand for successful completion. - Have no connection to the concepts or meaning that underlies the procedure being used. - Focusing on producing correct answers and requires no explanations.
Higher level	• Procedures with connections	- Uses procedures with an understanding of mathematical concepts and ideas. - Makes connections among various representations.
	• Doing mathematics	- Requires complex and non-algorithmic thinking. - Explore and understand concepts. - Analyse tasks and access relevant background knowledge.

Adapted from Stein et al. (2000)

Stein et al. (2000) and Thompson (2011) clearly distinguished between lower-level and higher-level tasks. They assert that lower-level tasks are solved by applying a well-known algorithm and often require no justification, explanation or proof. They often only require a single answer. Higher-level tasks, however, involve more open-ended tasks that are solved by applying more nuanced algorithms whilst working in unfamiliar contexts or situations. They also require problem solving skills such as justification or explanations with multiple solutions.

However, learner-centred education in Namibia (National Institute for Education Development [NIED], 2003) advocates that assessment in this context "must take stock of the breadth and depth of what the learner has learnt" (p.31). Open-ended questions should form the standard for learners to demonstrate their understanding. Researchers, such as Stein et al. (2000), Yeo (2004), Berger, Bowie, & Nyaumwe (2010) and Breen, & O'shea, (2010) support this notion. They state that for learners to develop mathematical thinking they should be given a variety of mathematical tasks. Questions designed must cover a range of lower to higher order thinking skills. They further state that one type of mathematical task cannot foster all types of thinking. Thus, assessment should involve a variety of mathematical tasks.

Moore (1998) advocated that for assessment to bring about desired outcomes, teachers need to have a deep understanding of the kinds of questions they ask. Supporting the same point of view, Yeo (2004) argues that designing mathematical tasks is a demanding and challenging activity. In my experience, teachers often simply modify questions from past exam question papers, textbooks and other resources by just changing the numbers and the context. These questions sometimes are poorly designed. As a result, set questions tend to be unrealistic and poorly designed as well. Thus, teachers and examiners need to attain skills in designing and assessing appropriate mathematics questions based on reliable criteria (Yeo, 2004).

1.5 SIGNIFICANCE OF THE STUDY

Being a mathematics teacher (subject head) and regional examination setter in the Ohangwena region I found it very useful and informative to carry out a research looking at the cognitive demands of tasks. The outcomes of this study will be shared with mathematics teachers and examination setters in Namibia. Thus, this study could potentially provide useful insight on setting mathematical tasks and examinations.

1.6 RESEARCH GOALS AND QUESTIONS

The purpose of this study was to compare the nature of questions used in Grade 10 mathematics test items and national examinations as per Stein et al.'s (2000) framework of cognitive demand in the Eenhana district in the Ohangwena region of Northern Namibia. For the realization of this goal, the study was guided by the following research questions:

1. How do Grade 10 Mathematics test items compare with the end-of-year examinations items in terms of Stein et al.'s (2000) framework of cognitive demands?

2. What are selected teachers' views on the relationship between test items and national examination items?

3. On what basis do the participating teachers select items for classroom tests?

1.7 RESEARCH PROCESS

This study was framed within the interpretive paradigm and adopted a case study methodology. The study employed a 'mixed method' approach. A mixed method approach is defined as a combination of both quantitative and qualitative research techniques, methods, approaches and concepts into a single study (Creswell, 2009; Johnson and Onwuegbuzie, 2004; Cohen, Manion, & Morrison, 2011).

A purposeful sampling technique was used to select three Junior Secondary Schools in Eenhana Circuit in the Ohanwena region. Participating schools were selected according to their performance

in the JSC examinations of 2013. Thus, the best, average and weakest schools were selected in this research study.

The research study was divided into two phases. The first phase involved an analysis of quantitative data of teachers' test items of 2013 and items of the 2011-2013 Grade 10 National examinations question papers. The second phase involved the analysis of one-on-one semi-structured interviews with the participants.

1.8 OVERVIEW OF THE STUDY

This dissertation has five chapters. It is structured as follows:

Chapter one: Introduction

This chapter presents the background of the study problem, the aims of the study, and objectives of the study, research questions, the problem statement and significance of the study.

Chapter two: Literature Review

This chapter provides a comprehensive summary of the literature sources that were used. The chapter begins by defining the term mathematical tasks. It proceeds by looking at the following themes: nature of mathematical tasks, tasks selection and opportunity to learn, assessment in Namibia after independence, mathematics assessment at junior secondary phase, relationship between continuous assessment and examinations. It also discusses Stein et al.'s (2000) framework of cognitive demand, the basis for the analysis of the data in Chapter four. The chapter concludes by discussing the theory underpinning the research study.

Chapter three: Research Methodology

This chapter summarises the research methodology used for this study. The research design, strategies, sampling method, data analysis, validity and reliability, limitations of the study and ethical considerations are discussed.

Chapter four: Results and Discussion of Findings

This chapter presents and discusses the findings of the research study. The chapter is divided into two sections. Section A involves the presentation and discussions of quantitative data obtained from the analysis of teachers' test and national examination items. Section B presents and discusses qualitative data obtained from one-on-one structured interviews with the teachers. The chapter concludes with the synthesis of both quantitative and qualitative data.

Chapter five: Conclusion and Recommendations

The chapter presents a summary of the study's findings with specific reference to the research questions. The chapter provides some recommendations from the study's findings and concludes with some reflections of the research journey.

1.9 CONCLUSION

This chapter introduced the study by providing some background information of the study, the research goals, the research questions, a brief discussion on the theoretical framework and the process of the study. The next chapter presents a discussion on the literature review for the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The cognitive demands of mathematical tasks play a crucial role in the teaching and learning of Mathematics as these tasks determine the nature and level of thinking required of students in order to solve the task successfully (Stein et al., 2000). Numerous research studies such as Henningsen, & Stein, 1997; Thompson, 2011; Jones, & Tarr, 2007; Berger, Bowie, & Nyaumwe, 2010; Ozgeldi, & Esen, 2010; Aysel, O'shea, & Breen, 2011 have been conducted on the design, selection and use of tasks using different frameworks that look at the cognitive demands of tasks that have been used. Among these frameworks, I selected Stein et al.'s (2000) framework of cognitive demand for my analysis of selected test and examination items. Before I present my analysis, a clear conceptualization of Stein's framework is needed.

This chapter reviews the literature and explores other research that informs this study. According to De Vos, & Strydom (2005) a literature review is an examination of scholarly information and research based information on a specific topic. A literature review presents what is already known about a particular subject or topic. This review of the literature begins by defining the term mathematical tasks. It proceeds by looking at the nature of mathematical tasks, Stein et al.'s (2000) framework of cognitive demand, tasks' selection and opportunities to learn. The chapter continues by looking at assessment in Namibia after independence, mathematics assessment at Junior Secondary phase, and the relationship/ link between Continuous Assessment (CA) and national examinations in Namibia. The chapter concludes by presenting the theory underpinning the research study.

2.2 DEFINITION OF MATHEMATICAL TASKS

A mathematical task has been defined as a set of problems or a single complex problem that focuses learners' attention on a particular mathematical idea (Stein, Grover, & Henningsen, 1996). Powell (2009) defines a mathematical task as "an exercise to an individual learner if, due to the individual's experience, the learner knows what sequence of mathematical actions should be applied to achieve the task" (p.136). Margolinas (2013) defines mathematical tasks as a wider range of 'things to do' ranging from "repetitive exercises, constructing objects, exemplifying definitions, solving single-stage and multi-stage problems, deciding between two possibilities, or carrying out an experiment or investigation" (p.11). From these definitions, one can conclude that a mathematical task entails anything that learners are asked to do for the purpose of learning Mathematics. In this study, the term 'mathematical task' is used to refer to mathematical assessment items that are delivered in more formal settings, such as tests and examinations.

2.3 NATURE OF MATHEMATICAL TASKS

Mathematical tasks are selected and set by teachers and given to learners to engage them in learning. Although the selection and setting of these tasks is greatly influenced by the learning goals, the nature and the kind of mathematical tasks selected and implemented by the teachers influence the way learners think and can limit or broaden their views of Mathematics (Henningsen, & Stein, 1997).

Park (2011) argues that mathematical tasks with different cognitive demands are likely to engage learners in different kinds of learning. Stein et al. (2009) define cognitive demand as "the kind and level of thinking required of students in order to successfully engage with and solve the task" (p.1). They argued that the kind and level of thinking in which learners engage determines what they will learn by creating different opportunities for learning. Park (2011) defines cognitive demand as the amount of intellectual activity required to perform a task. He argued that cognitive demand is important in determining the level of thinking taking place in students' minds. Thus, the nature and the kind of mathematical tasks, involving different types of cognitive demands, contribute greatly to learners' learning.

Stein et al. (1996) stated that the nature of mathematical tasks often changes from how they appear in the curricula, how they are set-up by the teachers to how they are implemented by the teachers and learners. Figure 2.1 below shows the phases that mathematical tasks pass through.

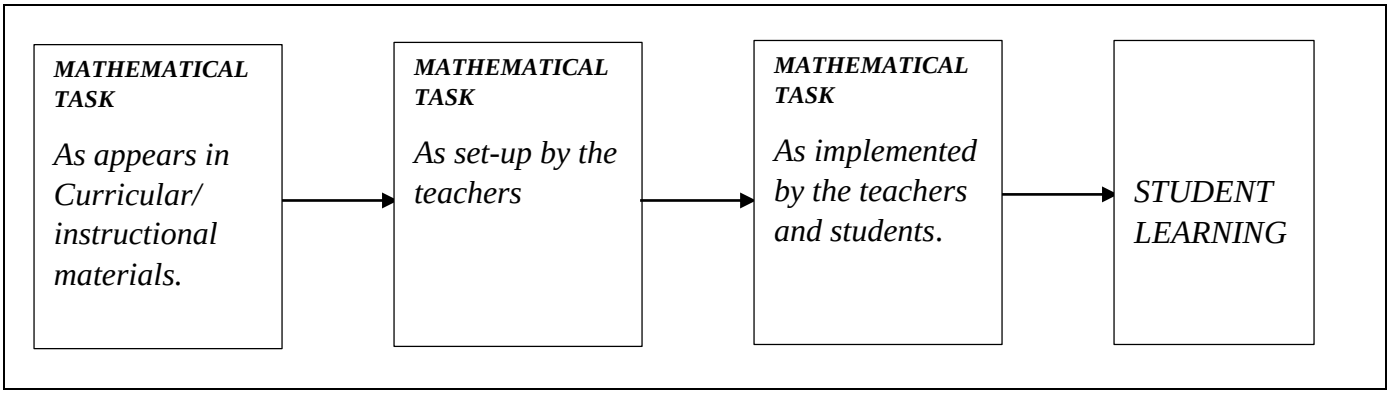


Figure 2.1: Progression of Mathematical tasks (adapted from Stein, Grover, & Henningsen, 1996)

The arrows in Figure 2.1 show that the features of curricular/ instructional tasks have different characteristics depending on their intentions. For example, tasks set by teachers are not necessarily similar to the tasks that are ultimately tackled by the students (Stein et al., 1996). Henningsen, & Stein (1997) suggested that cognitive demands of tasks do not remain the same as tasks progress through users. For example, tasks could originally be set up requiring high-level cognitive activities by students, but during the implementation it could decline to low-level cognitive activity (if, for example, hints are provided). Stein, & Henningsen (1997) point out some factors that influence the change in cognitive demand of tasks between phases such as classroom norms, tasks conditions, and teachers' and students' dispositions.

In their study Henningsen, & Stein (1997) found that tasks that were originally designed to demand a high cognitive level were often reduced to procedural tasks requiring low cognitive levels thinking during their implementation process. They state that often teachers remove challenging aspects of the tasks by making their instructions too explicit or providing too many hints and pointers to solve the task. Henningsen, & Stein (1997) also made the observation that an overemphasis on the correct answer as opposed to the process of arriving at this answer can reduce a task to a low cognitive demand task.

2.4. STEIN ET AL.'S (2000) FRAMEWORK OF COGNITIVE DEMAND

This study uses Stein et al.'s (2000) framework as its conceptual and analytical tool to determine the cognitive levels of mathematical tasks of selected teacher tests and national examinations. It has been used extensively globally and has gained international reputation (Henningsen, & Stein, 1997; Thompson, 2011; Jones, & Tarr, 2007; Berger, Bowie, & Nyaumwe, 2010; Ozgeldi, & Esen, 2010; Aysel, O'shea, & Breen, 2011).

Stein et al. (2000) point out that the cognitive demand of tasks determines what students will learn and the extent of their engagement with the tasks. Stein et al. (2000) identify four levels of cognitive demand as shown in Table 2.1 below.

Table 2.1: Characteristics of Stein et al.'s (2000) framework at each of the four levels of cognitive demand.

Lower-level Demands	**Higher-level Demands**
Memorisation Tasks • Involves reproducing previously learned facts, rules, formulae or definitions to memory. • Cannot be solved using procedures because a procedure does not exist or because the time frame in which the task is being completed is too short to use procedures. • Are not ambiguous, such tasks involve exact reproduction of previously seen material and what is to be produced is clearly and directly stated. • Have no connection to the concepts or meanings that underlie the facts, rules, formulae, or definitions being learned or reproduced.	**Procedures with connections Tasks** • Focus students' attention on the use of procedures for the purpose of developing deeper levels of understanding of mathematical concepts and ideas. • Suggest pathways to follow (explicit or implicit) that are broad general procedures that have close connections to underlying conceptual ideas as opposed to narrow algorithms that are opaque with respect to underlying concepts. • Usually they are represented in multiple ways (e.g. visual diagrams, manipulative, symbols, problem situations). Making connections among multiple representations helps to develop meaning. • Require some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Students need to engage the conceptual ideas that underlie the procedures in order to successfully complete the task and develop understanding.
Procedures without connections Tasks • Are algorithmic. Use of procedure is either specifically called for or its use is evident based on prior instruction, experience, or placement of the task. • Require limited cognitive demand for successful completion. There is little ambiguity about what needs to be done and how to do it. • Have no connection to the concepts or meaning that underlie the procedure being used. • Are focused on producing correct answers rather than developing mathematical understanding. • Require no explanations, or no explanations that focus solely on describing the procedure that was used.	**Doing mathematics Tasks** • Require complex thinking (i.e., there is not a predictable, well-rehearsed approach or pathway explicitly suggested by the task, task instruction, or a worked out examples). • Require students to explore and understand the nature of mathematical concepts, processes, or relationships. • Demand self-monitoring or self-regulation of one's own cognitive processes. • Require students to access relevant knowledge and explanation and make appropriate use of them in working through the task. • Require students to analyse the task and actively examine task constraints that may limit possible solution strategies and solutions. • Require considerable cognitive effort and may involve some level of anxiety for students due to the unpredictable nature of the solution process required.

Source: Adapted from Stein et al.'s (2000).

Stein et al. (2000) place the levels of cognitive demands into four categories namely; memorization, procedures without connections, procedures with connections and doing mathematics. They classified the first two as lower- level (memorization and procedures without connections) tasks, and the last two as higher-level (procedures with connections and doing mathematics) tasks. Each level of cognitive demand has its own characteristics/ identification features (see Table 2.1). These identification features served as my judgment template for the analysis of the test and examination tasks in this study.

Smith, & Stein (1998) made a clear distinction between lower-level and higher-level tasks. They assert that lower-level tasks involve tasks that are solved by applying a well-known algorithm which often requires no justification, explanation or proof. They often only require one answer. The two subcategories of low cognitive demand tasks are identified as: memorization and procedures without connections tasks.

According to Smith, & Stein (1998) memorization tasks ask students to perform a memorized procedure in a routine manner that leads to one level of thinking. An example of this task could be: what is the rule for multiplying fractions?

Expected student response: You multiply the numerator times the numerator and the denominator times the denominator.

This task requires students to simply retrieve a learnt rule for multiplying fractions from memory. Procedures without connections tasks ask students to perform a learned procedure. An example of this task could be: Find the following products: $\frac{2}{3} \times \frac{3}{4}$ and $\frac{5}{6} \times \frac{7}{8}$

Expected student response:

$\frac{2}{3} \times \frac{3}{4} = \frac{2\times3}{3\times4} = \frac{6}{12}$

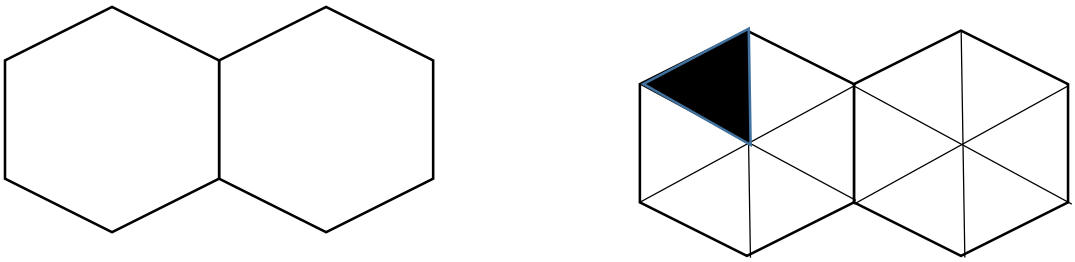
$\frac{5}{6} \times \frac{7}{8} = \frac{5\times7}{6\times8} = \frac{35}{48}$

This task requires students to follow a learnt procedure in a routine manner to arrive at the correct answer.

However, higher-level tasks involve more open-ended tasks that are solved by applying more nuanced algorithms whilst working in unfamiliar contexts or situations. They also require problem solving skills such as justification or explanations with multiple solutions (Stein et al., 2000). The two subcategories of high cognitive demand are procedures with connections and doing mathematics.

Procedures with connection tasks focus students' attention on the use of procedures with the purpose of developing deeper understanding of mathematical concepts and ideas (Smith, & Stein, 1998). An example of this task could be: Find $\frac{1}{6}$ of $\frac{1}{2}$ by using hexagonal blocks. Draw your answers and explain your solution.

Expected student response:



First you take half of the whole, which would be one hexagon. Then you take one-sixth of that half. This requires the division of the hexagon into six pieces, which would be six triangles. We only need one-sixth, so that would be one triangle. Then we need to figure out what part of the two hexagons one triangle is. It is 1 out of 12. So $\frac{1}{6}$ of $\frac{1}{2}$ is $\frac{1}{12}$.

This task requires the representation and justification of the solution diagrammatically. By doing this the learners are making connections and meanings.

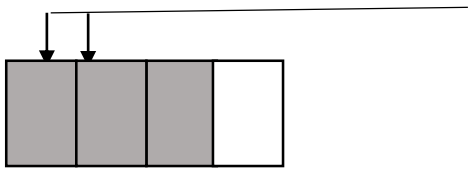
For doing mathematics, Smith, & Stein (1998) advocate that students use non-algorithmic methods to solve the problem. An example could be: Create a real world situation that has $\frac{2}{3} \times \frac{3}{4}$ as its solution.

One possible student response:

For lunch Mom gave me three-quarters of a pizza that we ordered. I could only finish two-thirds of what she gave me. How much of the whole pizza did I eat?

I drew a rectangle to show the whole pizza. Then I cut it into fourths and shaded three of them to show the part Mom gave me. I only ate two-thirds of what she gave me. This would be only two of the shaded sections.

Mom gave me what I shaded



Pizza

This is what I ate for lunch. So $\frac{2}{3}$ of $\frac{3}{4}$ is the same thing as half of the pizza.

This level of task requires students to analyse and use their analysing and thinking skills to find solutions. Students would not be able to rely on a simple algorithm to solve this task.

Although, there are identification features in each category of cognitive demands, determining the level of cognitive demand of a task is not always straight forward. Stein et al., (2000) indicate that to categorise tasks appropriately it is important to move beyond the surface feature of the tasks and consider the level of thinking required by the specific task. They pointed out that, ideally, factors such as students' age, grade level, prior knowledge and experiences should all be considered when deciding the level of challenge provided by a task.

2.5 TASKS SELECTION AND OPPORTUNITY TO LEARN

Tasks are central to students' learning. They shape learners' opportunities to learn and their view of the subject matter (Kilpatrick, Swafford, & Swindler, 2001). Mathematical tasks provide learners with different opportunities for learning. Stein et al. (2000) noted that mathematical tasks that engage students in complex forms of thinking lead to different sets of opportunities for student thinking while tasks focusing on memorization and routines, use of rules and procedures lead to only one type of opportunity for students. Often, tasks assigned to students in classrooms make only minimal demands on their thinking. Those are the tasks that depend heavily on memorization or use of procedures without connections to other concepts (Kilpatrick et al., 2001).

Research by Byrnes and Wasik (1991) reveals that the use of procedures without understanding does not necessarily lead to increased conceptual understanding. Although students spend time learning correct procedures, they do not necessarily understand the principles that justify these procedures. Because of the abstract nature of Mathematics some mathematical concepts are difficult to understand and too much attention is sometimes paid to the procedural nature of Mathematics.

Monk (1994) claims that students learn best when they are presented with challenging academic work that focuses on sense making and problem solving as well as skill building. Researchers (Yeo, 2004; Breen, & O'shea, 2010) state that selecting and designing valid and reliable mathematical tasks is a challenging activity. In their analysis of several US state examinations, Resnick, Rothman, Slattery, & Vranek, (2003) noted that "it is easier to test simple knowledge and skills, leaving complex concepts, extending reasoning, and other higher-level cognitive demands underrepresented on the test" (p. 6). They found that in state examinations that assess higher-order thinking, teachers were found using tasks similar to those on the state examinations. Thus, large scale assessments play an important role in what teachers teach and what they assess (Lane, 2004).

Many authors (Schoenfeld, 1992; Berger et al., 2010; Breen, & O'shea, 2010) agree that mathematical thinking should be encouraged in learners by exposing them to a range of mathematical tasks. Schoenfeld (1992) advocates that no single task type could foster all thinking types. Rather, a set of tasks should be designed and used to enhance mathematical thinking. Manson and Johnston-Wilder (2004) cited in Berger et al. (2010) supported this point by

advocating that learners should be given a variety of tasks to develop mathematical thinking. Yeo (2004) points out that questions and tasks should be designed to cover a range of lower to higher-order skills. This means that teachers should not set higher order thinking questions only as they tend to discourage students but they should assign a wider range of tasks that would enable learners to develop mathematical thinking skills (Yeo, 2004).

Berger et al. (2010) and Stein et al. (2000) assert that when designing mathematical tasks, teachers should not only focus on engaging students in cognitively demanding tasks but they should also consider things such as students' learning goals, students' age, grade level and students' experiences. However, designing mathematical tasks is a demanding and challenging activity. Teachers and examiners need to attain skills in designing and assessing mathematics questions based on reliable criteria to ensure that questions are well designed, reliable and fair to the target group and are of an appropriate cognitive level (Yeo, 2004).

2.6 ASSESSMENT IN NAMIBIA AFTER INDEPENDENCE

Since political independence and stability in Namibia in 1990, the new government embarked on promoting equal education for all its citizens. Actions toward education reforms were taken immediately after independence and new goals for education were identified as presented in '*Towards education for all'*, Ministry of Education and Culture [MEC] (1993), as access, equity, quality and democracy. For the realization of these new major goals a new approach to teaching, learning and assessment was adopted. This approach involves a shift from a teacher-centered approach that depends on rote learning and repetition of content, to a learner-centered (LCE) approach that advocates for the development of innovation and creativity among students (Namibia. Ministry of Education [MoE], 2010).

In terms of assessment, the reformed curriculum calls for assessment to "move away from a narrow notion of examination to a broader and more inclusive concern with assessment and evaluation" (MEC, 1993, p.124). This change involved a move from norm-referenced assessment to criterion-based assessment at all levels (MEC, 1993). Criterion-based assessment expects learners to demonstrate their thinking and communication skills according to given sets of criteria. To meet these demands, two modes of assessment dominate the reformed curriculum, namely: Continuous

Assessment (CA) and examinations. CA allows teachers to continuously assess and monitor the progress of individual learners and their level of achievement, thus providing a comprehensive picture of what each learner has learnt (Namibia. Ministry of Basic Education, Sport, and Culture [MBESC], 1999). Different authors and researchers such as Gipps (1994), Nitko (1995), Le Grange, & Reddy (1998) supported the use of CA in education. They state that CA offers opportunities to assess a range of activities that cannot be assessed in a single examination, it enables teachers to use a wide variety of assessment methods and allows teachers to concentrate on tasks that require higher cognitive levels of thinking rather than on tasks that only require basic skills and rote learning.

According to MoE (2010), CA serves the purpose of both formative and summative assessment. Formative assessment is done throughout the school year, primarily to improve learning and teaching on a continuous basis. However, summative assessment is done at the end of the school year (MoE, 2010) to provide a retrospective picture of teaching and learning. Black (1998) clearly distinguished between formative and summative assessment. He asserts that 'formative assessment' is used to help teachers and other students identify learners' progression problems. Formative assessment occurs often and requires continuous guidance from teachers for students to attain their learning goals. Summative assessment is aimed at reviewing and making an overall judgment to give strategic advice about the next level in learning. It involves marks and grades that do not necessarily tell what a student should do for improvement purposes.

2.7 MATHEMATICS ASSESSMENT AT JUNIOR SECONDARY PHASE

Regarding the reforms of assessment in Namibia, assessment at the junior secondary phase (Grade 8-10) was revised to focus on assessment that promotes learning with understanding. The junior secondary Certificate (JSC) examination was introduced in 1991 at the end of the junior grade (Grade 10) (MEC, 1993).

As outlined in the *Mathematics syllabus grade 8-10,* (Namibia. Ministry of Education [MoE], 2010), assessment comprises both informal and formal continuous assessment of learners' mastery of all the competencies specified in the syllabus. At the end of each year learners write a formal examination appropriate for their grade. The Grade 8 and 9s write internal end-of-year

examinations while learners in Grade 10 write a national external examination. In the junior Grades these examinations are made up of more than one paper. In Grade 8, learners take two papers, Paper 1 and 2; while in Grades 9 and 10, learners take Paper 1, 2 and 3, the latter being additional mathematics. Paper 1 consists of short-answer questions that test basic knowledge and technical skills. Paper 2 consists of structured questions that assess analysing, abstraction, and synthesizing skills. The description of each paper is presented in Table 2.2 below.

Table 2.2: Description of Grade 8, 9 and 10 examination papers in Mathematics

Grades	**Written examination grade 8-10**	**Duration**	**Marks**
8, 9 and 10	This will consist of two papers consisting of:		
	Paper 1: short questions and include calculations using mental strategies or paper and pencil algorithms	1 hour	65
	Paper 2: structured questions and problems	2 hours	85
9 and 10	This will consist of three papers consisting of:		
	Paper 1: same paper as the mathematics above	1 hour	45
	Paper 2: same paper as the mathematics above	2 hours	85
	Paper 3: short and structured questions on additional mathematics.	1 hour 30 minutes	65

(Source: MoE, 2010, p. 28).

To determine the final grade in all the Grades (8, 9 & 10), the CA and end-of-year examination are combined in the ratio of 7:13 respectively. This means that the CA mark contributes 35% and end - of- year examination mark contributes 65% of the final grade (MoE, 2010). The calculation of the final grade for Grade 10 is calculated by the Directorate of National Examinations and Assessment (DNEA), as shown in Table 2.3 below.

Table 2.3: Promotion marks for Grade 10

Term mark	**Term 1**	**Term 2**	**Total**
	200	200	400
CA mark	$(400 \div 40) \times 7$		70
End-of-year examination	130 marks		130
Promotion mark	(Average term marks + End-of-year examination) ÷2 $200 \div 2$		100

(**Source**: MoE, 2010, p.29).

2.8. RELATIONSHIP BETWEEN CONTINUOUS ASSESSMENT AND EXAMINATIONS IN NAMIBIA

As stipulated in the document '*Towards improving continuous assessment in schools'* Namibia. Ministry of Basic Education, Sport, and Culture [MBESC] (1999), CA and the final annual examination complement each other. MBESC (1999) advocates that learners' average CA marks should align with their end-of-year examination marks if CA has been done properly.

Samson, & Marongwe (2013) found, however, that CA marks seem to be a poor predictor of end-of-year examination marks. They observed negative correlation between CA and examination marks (Samson, & Marongwe, 2013). In fact there was not a single school in Oshikoto District with average examination marks equal to average CA marks in three consecutive years as shown below in Table 2.4.

Table 2.4: Summary of 2008-2010 comparison of Mathematics CA and examination marks

	CA > examination	**CA≈ examination**	**CA < examination**
2008	4	17	41
2009	4	24	34
2010	15	20	27

(**Source**: Samson, & Marongwe, 2013, p. 200).

All three consecutive years were dominated by average CA marks which were less than the examination marks (see Table 2.4).

Weak alignment of CA and examination marks was also observed in most of the other regions in Namibia. The statistics for the Eenhana Circuit schools in the Ohangwena region (the location of this study) indicated a clear discrepancy between mid-year-test marks and end-of-year examination marks as shown in Figure 2.2 below. Many learners perform relatively well in mid-year-tests but fail to attain good marks at the end of the year, while others perform poorly in mid-year-tests but score good marks at the end of the year (See Figure 2.2).

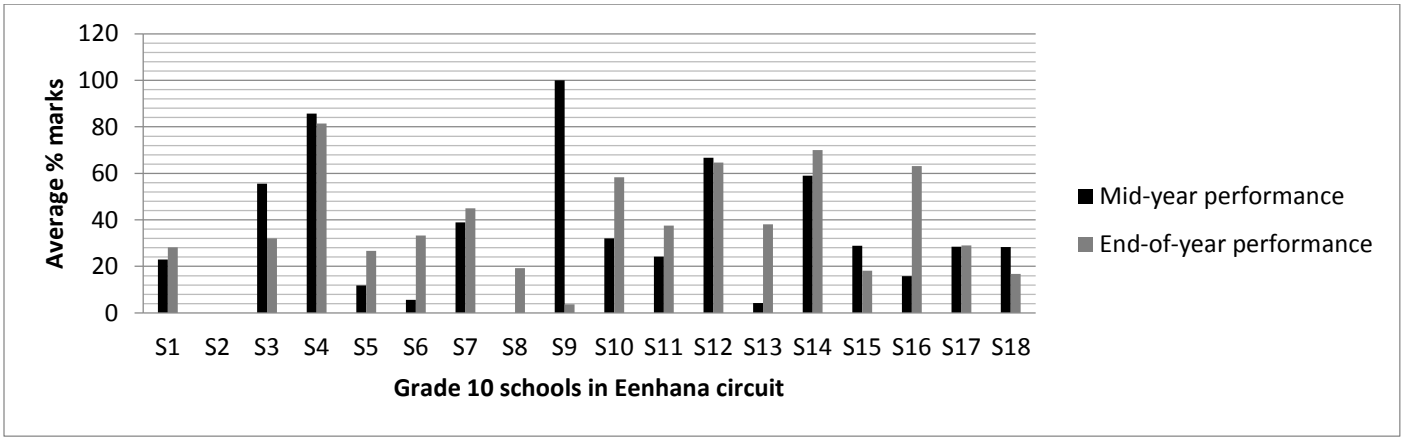


Figure 2.2: Eenhana circuit performance in JSC Grade 10 mathematics mid-year and end-of-year average marks in 2012.
[**Source**: Adapted from Ministry of Education (MoE), 2012a].

It has also been reported in the examiners reports (Namibia. Ministry of Education [MoE], 2011, 2012b) that many learners underperform in the national examinations, particularly in the structured question paper. The reports state that many learners fail to justify their answers and just write down the final answer without showing their calculations and workings.

2.9 THEORETICAL CONSIDERATION

After political independence in Namibia, a new educational policy was formulated. Learner Centered Education (LCE) was chosen as a basis for the reform (Ministry of Basic Education, Sport, and Culture [MBESC], 1991). An LCE approach places the students at the centre of the teaching and learning process. It is underpinned by social constructivism which advocates that the learner is the constructor of knowledge within a social milieu.

Since this study is looking at classroom tests and examinations items (assessment items) in a newly reformed curriculum (LCE), the study is underpinned by social constructivism. According to Major (2012), constructivism is a learning theory that describes learning as an active process of knowledge construction. Constructivists believe that knowledge is not deposited in learners' minds but learners actively construct knowledge individually or socially from their prior knowledge (Pon, 2001). The theory goes further by stating that knowledge is acquired through active interaction between the learner and the content to be learnt instead of imitation and repetition of what was taught (Hausfather, 2001). Thus, for learners to construct their own knowledge actively, constructivists suggest that teachers should provide learners with the opportunity to interact with the content.

Constructivism theory is relevant in this study as the study focuses on the levels of cognitive demand of tasks. From the constructivists' perspective, learners are expected to construct their own meaningful knowledge and think at high cognitive levels. According to the LCA education in Namibia (National Institute for Education Development [NIED], 2003), assessment in the LCE context "must take stock of the breadth and depth of what the learner has learnt" (p.31). Open-ended questions should form the standard for learners to demonstrate their understanding. Researchers such as Stein et al. (2000), Yeo (2004), Berger et al. (2010) and Breen, & O'shea (2010) supported this notion. They state that for learners to develop mathematical thinking they should be given a variety of mathematical tasks.

Social constructivism aligns well with the common goals of Stein et al.'s (2000) framework of cognitive demand - the conceptual and analytical framework used in this study. They both emphasize the importance of learners constructing their own knowledge to develop mathematical thinking by engaging in tasks that are of an appropriately high level of cognitive demand.

2.10 CONCLUSION

It is evident from the literature reviewed in this chapter that the types of tasks presented to the learners influence the kind and level of thinking required of learners. The literature points out the importance of matching learning goals with tasks designed to determine learners' understanding.

This study, therefore, embarked on analysing the cognitive demand levels of tasks that selected Grade 10 mathematics teachers present to their learners in tests and in the national examinations. The next chapter presents the methods used in this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter provides a description of the methods and procedures used to collect and analyse the data of this study.

The chapter begins by presenting the goals of the study and proceeds by discussing the research orientation, research design, sampling procedures, data collection methods and analysis of the data. The chapter concludes by presenting a brief outline of the ethical considerations, validity and limitations of the study.

3.2 RESEARCH GOALS

The main goal of this study was to compare the nature of questions used in Grade 10 Mathematics test items and National examinations items in Namibia. To achieve this goal the research attempted to respond to the following questions:

1. How do Grade 10 Mathematics test items compare with the end-of-year examinations items in terms of Stein et al.'s (2000) framework of cognitive demands?

2. What are the selected Mathematics teachers' views on the relationship between test items and national examination items?

3. On what basis do the participating teachers select items for classroom tests?

3.3 RESEARCH ORIENTATION

This study was located within the interpretive paradigm. According to Hassard (2009) the interpretive researcher seeks to deconstruct the phenomenological process through which shared realities are created, sustained and changed. Cohen et al. (2011) added that the aim of scientific investigation for the interpretive researcher is to "understand how this glossing of reality goes on at one time and in one place and compare it with what goes on in different time and place" (p.18).

This aligned well with the aims of this study and enabled me to analyse and compare the nature of questions used in selected Grade 10 classroom test items for 2013 in three different participating schools and the items used in the National examinations for 2011-2013. It also allowed me to interact closely with the participants, gain insight and obtain a clearer picture about their rationale for selecting test items.

3.4 RESEARCH DESIGN

This study employed a 'mixed method' approach. A mixed method approach is defined as a combination of both quantitative and qualitative research techniques, methods, approaches and concepts into a single study (Creswell, 2009; Johnson and Onwuegbuzie, 2004; Cohen et al., 2011). This approach enabled me to combine both quantitative and qualitative data. Qualitative data and quantitative data are differentiated by the data and tools they use. Qualitative data mostly uses document analysis, observations, interviews and focus group conversations as data gathering techniques. However, quantitative data usually involves the use of numerical data to test relationships between variables. It often uses existing or pilot-tests, self-developed instruments such as surveys, tests, scales and checklists to collect data.

The study was divided into two phases. The first phase focused on the collection and analysing of quantitative data of classroom test items of participants set in 2013 and items of the 2011-2013 Grade 10 National examinations question papers. The second phase involved one-on-one semi-structured interviews with the participants

3.5 METHODOLOGY

This study adopted a case study methodology. The case study was useful for my purposes as it enabled me to analyse, in depth, the 'why' and 'how' questions in this study.

Maree (2007) defines a case study as a 'systematic inquiry' into an event or a set of related events which aims to describe and explain the phenomenon of interest. Apart from Maree's (2007) definition, Cohen et al. (2011) define a case study as a single instance of a bounded system such

as a class, a school or a community and it involves looking at a phenomenon in its real-life context. The case study methodology, therefore, allowed me to look at the nature of test and examination items used in a real life context. Since this study adopted a 'mixed method' approach I found a case study appropriate. The 'case' in this study was the 2011-2013 Grade 10 national examinations question papers and the 2013 test items used by three participating teachers from three purposively selected schools and their views and perceptions of these assessment tools.

Maree (2007) advocates that in a case study the unit of analysis is a critical factor. Therefore, the unit of analysis in this study was firstly the levels of cognitive demand of the questions used in classroom test items and national examinations, and secondly the views of the selected teachers on the relationship between test items and national examinations items, and their reasons for selecting their test items.

3.6 DATA COLLECTION TECHNIQUES

To address the research goals of this study and answer the research questions, data for this study was collected in two phases.

Phase 1. Document analysis

In this phase of the study quantitative data was collected through documents analysis. Two sources of documents were used namely; classroom tests and national examinations question papers. These documents were analysed to shed light on and answer the first research question of this study. This analysis was then used to construct the interview schedule (see Appendix C) used to collect data in the second phase of this study.

Phase 2. Semi-structured interview

In this phase of the study qualitative data was collected using one-on-one semi-structured interviews. Maree (2007) defines an interview as "a two-way conversation in which the interviewer asks the participants questions to collect data and learn about the ideas, beliefs, views, opinions and behaviours of the participants" (p.87). De Vos, & Strydom (2005) stress that interviewing is an important mode of data collection in a qualitative approach. Thus, one-on-one

semi-structured interviews were used in this study to probe each participating teacher's views about the relationship between test items and national examinations as well as to find out their (participating teachers) basis for selecting test items.

Since semi-structured interview require the participants to answer a set of pre-determined questions (De Vos, & Strydom, 2005), I developed an interview schedule for this study (see Appendix C). The interview schedule consisted of 14 questions that focused specifically on the setting of mathematics classroom tests and end-of-term examinations. All the interviews were conducted in the afternoons. Participants were encouraged to ask for clarification if the questions were not clear.

This interview schedule was useful as it enabled me to ask a series of open-ended questions, probe for more clarification and deeper insights (De Vos, & Strydom, 2005; Maree, 2007). I was thus able to obtain a clear picture about the teachers' rationale for selecting test items. All interviews conducted in this study were recorded and transcribed later.

3.7 RESEARCH SITE AND SAMPLING

3.7.1 Research site

This study was conducted in three, purposively selected, Junior Secondary Schools (JSC) in the Eenhana Circuit of the Ohangwena region in northern Namibia.

3.7.2 Sampling procedures

In this study purposive sampling was used to select the three JSC participating schools in the Eenhana Circuit. According to Cohen et al. (2011) in purposive sampling the researcher hand-picks the cases to be included in the sample on the basis of his/ her judgment of their typicality. This sampling technique enabled me to come up with a sample that satisfied the needs of this study (Cohen et al., 2011).

Participating schools were selected using the Grade 10 statistics for the national examinations in Mathematics for 2013. The best performing, an average performing, and the weakest performing schools in Mathematics were selected. This sample of schools provided for a good cross section

of performance in this circuit, although the primary rationale was to find out how teachers set their classroom tests that prepare learners for the- end-of-year examinations.

In terms of participating teachers, my initial intention was to select Grade 10 mathematics teachers with several years of teaching experience in the participating schools. As it happened, however, in all three schools selected for this study there was only one grade 10 mathematics teacher per school. These teachers were then asked to volunteer and took part in this study.

3.8 SUMMARY OF THE DESIGN AND TOOLS

Table 3.1 below summarizes the design and tools employed in this study.

Table 3.1: Summary of the research design

Phases	**Tools**	**Purpose**	**Data**
Phase 1 1. Document analysis Classroom tests and National examination question papers	Stein et al. 's (2000) framework, Excel as well as descriptive statistics.	To determine the level and nature of tasks (questions) used in mathematics tests and examinations. Aimed at answering the first question in this study.	Quantitative data
Phase 2 2. Interviews	Semi-structured interviews	To obtain teachers' views and rationale for selecting test items. Aimed at answering the second and third questions of this study.	Qualitative data

3.9 DATA ANALYSIS

In this study the analysis of data was aligned with the two phases above. Maree (2007) briefly defines data analysis as the conversion of raw data into useful information. Therefore, data was analysed in each phase as follows:

Phase 1. Analysis of data obtained from documents (quantitative data)

The data analysis in this phase focused on comparing the nature of questions used in Grade 10 mathematics test items set in 2013 and the 2011-2013 National examinations items. Stein et al.'s

(2000) framework of cognitive demand was used as an analytical framework to categorise all the classroom test items and the National examination questions according to the four levels of cognitive demand (see Table 2.1, p.25).

Stein et al.'s (2000) framework of cognitive demand was used to classify each test and examination items accordingly. The identification features/ indicators for each cognitive demand level served as my judgment template when I analysed the test and examination item in this study. I used the following coding scale to categorize each item under scrutiny.

Coding scale:

1 For memorization task;

2 For procedural task without connections;

3 For procedural task with connections;

4 For doing Mathematics task.

The data generated from the analysis of the classroom tests items and the National examinations items analysed was summarized as in Table 3.2 and 3.3 below. Full details of these tables are presented in Appendix A and B respectively.

Table 3.2: Summary table for Classroom tests

Grade 10 Mathematics Classroom based test items: Test number			
Question number	**Question**	**Stein et al.'s coding**	**Comments**

Table 3. 3: Summary table for National examinations items (both Paper 1 & 2)

Grade 10 Mathematics National Examination			
Question number	**Question**	**Stein et al.'s coding**	**Comments**

The quantitative data was analysed using descriptive statistics. Microsoft Excel was used to draw graphs, tables and bar charts to show the results. This also enabled me to compare classroom tests and national examination items, thus, answering the first research question in this study.

Phase 2. Analysis of data obtained from semi-structured interviews (qualitative data)

Data obtained from one-on-one semi-structured interviews was transcribed for analysis. Responses to each question were transcribed and discussed.

3.10 VALIDITY

In this study validity was ensured in a number of different ways. Maree (2007) briefly defines validity as the degree to which the researcher has measured what he/ she intended to measure. Ayodele (2012) defines validity in a broad sense as "the extent to which meaningful and appropriated inferences or decisions are made on the basis of scores derived from the instrument used in a research" (p.391).

Therefore, the mixed method approach and a combination of different research tools (documents analysis, Stein et al.'s (2000) framework and semi-structured interviews) employed in this study enhanced the validity by the means of triangulation. However, in order for me to gain experience in using the framework and get the best results, I conducted a pilot test on a handful of test items together with my supervisor. The pilot study revealed good results. Again, a pilot test with a Grade 10 mathematics teacher from my school to maximise the validity of the semi-structured interview questions in terms of its suitability, utility, and clarity was conducted. The pilot test revealed that

some of terms and words used were not clear and some were difficult to understand. Thus, those terms were changed in the final interview schedule.

3.11 ETHICAL CONSIDERATIONS

In this study permission to conduct this study in the selected schools of Eenhana Circuit was obtained from the Regional Director of education, the Inspector of Eenhana circuit, the school principals and the teachers participating in this study (see Appendix A for informed consent).

Participating teachers were informed about the purpose of the study and their right to withdraw from the study at any time without penalty. The principles of privacy, confidentiality, and anonymity was maintained throughout the study. All participants' information and responses, shared during the study, were kept confidential. The results were presented anonymously to protect the participants' identities. Therefore, no participating school and teachers' names appear in this study.

3.12 LIMITATIONS AND CHALLENGES

Accessing classroom test items from teachers was a challenge in this study as teachers were not able to find all the test papers used in 2013. Only the test items that were obtained were thus analysed for this study. Also, accessing the research sites was another challenge in this study. Schools used in this study were far apart, although they are in the same circuit. After several efforts I managed to reach all the participating schools to gather the appropriate data for this study.

3.13 CONCLUSION

This chapter presented and discussed the research orientation, research design, methodology, research tools, sampling method and analysis of the data used in this study. The next chapter presents and discusses the findings from this study.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents, analyses and discusses the findings of this study. The chapter is divided into two sections. Section A involves the presentation and analysis of data obtained from tests and examinations. This section is sub-divided into two parts. Part 1 presents the findings obtained from the Grade 10 mathematics test items set in 2013 by the teachers of the three participated schools. Part 2 presents the findings obtained from the 2011 to 2013 Grade 10 Mathematics National examinations question papers. Data obtained in section A is analysed according to Stein et al.'s (2000) framework of cognitive demands to determine the nature of these items in terms of their cognitive demand levels.

Section B presents and discusses the qualitative data obtained from the one-on-one semi-structured interviews.

Before presenting the findings of this study, a short profile of the research participants is provided.

4.2 PROFILES OF THE RESEARCH PARTCIPANTS

This research was conducted in three schools in the Eenhana Circuit that offer Grade 10. The best performing, an average performing, and the weakest performing schools in Mathematics in 2013 were selected. Three Grade 10 mathematics teachers, one from each school mentioned above, participated in this study.

4.2.1 Teacher A

Teacher A is a male teacher from the best performing school in Mathematics. He teaches Mathematics for Grades 8, 9 and 10. He has been teaching Grade 10 for seven years.

4.2.2 Teacher B

Teacher B is a female teacher from an average performing school in Mathematics. She teaches Mathematics for Grades 7, 9 and 10. She has been teaching Mathematics for five years.

4.2.3 Teacher C

Teacher C is a male teacher from the weakest performing school in Mathematics. He teaches Mathematics for Grade 9 and 10. He has been teaching Grade 10 for 14 years.

4.3 SECTION A: TEST AND NATIONAL EXAMINATION ITEMS

This section is divided into two parts. Each part presents a summary of the findings in table format. In the table, teachers' test and national examination items are being reproduced, analysed and coded as per Stein et al.'s (2000) framework. Due to the limited scope of this thesis, only the detailed analysis for teacher A's, test items and the 2011 national examination question papers are reproduced in this chapter. For the test items of teacher B and teacher C as well as for the 2012 and 2013 national examination papers, I only include summaries. The full analysis of the latter can be found in Appendix A and B respectively.

4.3.1 PART 1: TEST ITEMS

4.3.1.1Teacher A

Teacher A **Mathematics Test 1** **Grade 10**

1. Determine whether the following are rational or irrational.
   (a) $\frac{2\sqrt{4}}{\sqrt{2}}$

Coding: 1

Justification of my grading and comments

This task requires learners to use previously learnt definitions of rational and irrational numbers in order to produce the correct answer. I thus placed this task in the memorization category of low cognitive demand.

(b) $\sqrt{5} \times \sqrt{5}$

Coding: 1

Justification of my grading and comments

This task requires learners to use previously learnt definitions of rational and irrational numbers in order to produce the correct answer. I thus placed this task in the memorization category of low cognitive demand.

2. (a) Write 160 as the product of its prime factor

Coding: 2

Justification of my grading and comments

This task requires learners to know what a prime factor is and how to express a number as a product of its prime factor. Example, prime factors of 28 should be a number that goes into 28 without leaving a remainder and that number must be having two factors only (1 and the number itself). This is a definition that helps learners to express the number as a product of its prime factors correctly, thus it places this task under level 1. Learners also need to follow the steps of expressing numbers as a product of their prime factors. I thus placed this task in the procedure without connections category of low cognitive demand.

(b) Find the highest common factor of 35 and 42

Coding: 2

Justification of my grading and comments

This task requires learners to know what the highest common factor of two or more numbers is and how to obtain it. Example, to get the highest common factor of 24 and 28, one can either list all the factors of 24 and 28 and choose the highest factor that is common in both numbers or express numbers 24 and 28 as a product of its prime factors and multiply all the common prime factors in both numbers. By doing so learners are using the definition at the same time they are following the procedures in order to produce the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.

3. An alloy is made by mixing copper and zinc in the ratio 5:2. If 10 kg of zinc is used, how much copper is in the alloy?

Coding: 2

Justification of my grading and comments

In this task learners are required to use the usual procedures of finding the required number using the given ratio. Learners just need to use the unitary method and apply the cross multiplication method. Learners usually use these procedures mindlessly and focus mainly on producing the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.

4. Express the ratio 6: 9 as a fraction in its lowest terms.

Coding: 2

Justification of my grading and comments

This task requires learners to follow the procedure of ratio as a fraction in simplest form/ procedure of division (e.g. $\frac{6}{9} = \frac{2}{3}$). The task does not aim at developing mathematical understanding but focusses on producing the correct answer only. I thus placed this task in the procedure without connections category of low cognitive demand.

5. In a class the ratio of boys to girls is 4: 5. If there are 20 girls, how many boys are there?

Coding: 2

Justification of my grading and comments

In this task learners are required to use the usual procedure of finding the required number using the ratio. Learners just need to use the unitary method and apply the cross multiplication method. Learners usually use these procedures mindlessly and focus mainly on producing the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.

6. The value of a car costing N$980 000 decreases in the ratio 4: 5. Calculate the new price

Coding: 2

Justification of my grading and comments

This task requires learners to use the usual procedure of decreasing quantity in a given ratio, i.e. to decrease make the ratio a fraction with the small number on top ($\frac{4}{5} \times 980\,000 = 784\,000$). Learners usually use these procedures without knowing why the procedure is being used so long as it produces the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.

Synopsis

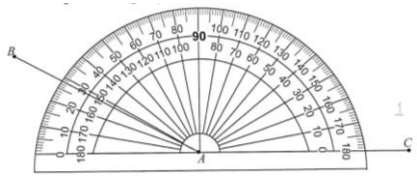
Table 4.1: Distribution of Stein et al.'s (2000) coding for tasks in Mathematics test 1 for teacher A

Stein et al.'s coding	**Frequency**
1	2
2	6
3	0
4	0

It is evident from Table 4.1 that all of the tasks in this test were low level tasks that required learners to memorize or use algorithms of the skills taught. Seventy five percent of the tasks indicated above were procedural tasks that required step-by-step routines while 25% required recall and memorization of mathematical terms, facts and rules. None of the tasks in this test required learners to make connections between various concepts, explore and understand the nature of mathematical concepts (level 3 & 4). This implies that the test did not aim to develop learners thinking and reasoning skills. It only sought to test mathematical skills as no level 3 and 4 tasks were found. Shannon (1999) suggests that mathematics tasks in tests are designed according to the skills they are testing. The skills that were assessed in the above test are thus knowledge of facts, routines or algorithms.

Teacher A **Mathematics Test 2** **Grade 10**

1. Measure angle BAC, using the protractor shown below.



Coding: 1

Justification of my grading and Comments

This task involves the exact reproduction of previously seen material and learnt facts about measuring angles. What is to be produced is clearly and directly stated in this question 'i.e. measure angle BAC. The protractor is already placed to measure the angle. One only needs to read from the protractor and determine the required angle. I thus placed this task in the memorization category of low cognitive demand.

2. **MARIETJIE**

In the word above:

(a). Which letters have no line of symmetry?

Coding: 1

Justification of my grading and Comments

This task requires learners to recall a previous learnt meaning of 'line of symmetry' and 'order of rotational symmetry'. Learners can use the definition to identify the letters without a line of symmetry and letters with order of rotational symmetry. The task requires limited cognitive demand and focuses on reproduction of what was done previously in the classroom. I thus placed this task in the memorization category of low cognitive demand.

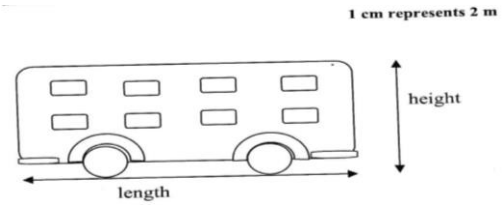
b). Which letter has rotational symmetry of order 2?

Coding: 1

Justification of my grading and Comments

This task requires learners to recall previous learnt meaning of 'line of symmetry' and 'order of rotational symmetry'. Learners can use the definition to identify the letters without a line of symmetry and letters with order of rotational symmetry. The task requires limited cognitive demand and focus on reproduction of what was done previously in the classroom. I thus placed this task in the memorization category of low cognitive demand.

3. The figure shows the model of a bus (drawn to scale) used by Bush Tours to transport tourists.



(a). Measure the height of the scale drawing in **cm**

Coding: 1

Justification of my grading and Comments

This task involves the reproduction of previously learned facts and rules. What is to be measured is clearly shown and stated in the question (height). It does not require any connection to the concept (e.g. height) as learners are only required to use the ruler correctly and take accurate measurement. I thus placed this task in the memorization category of low cognitive demand.

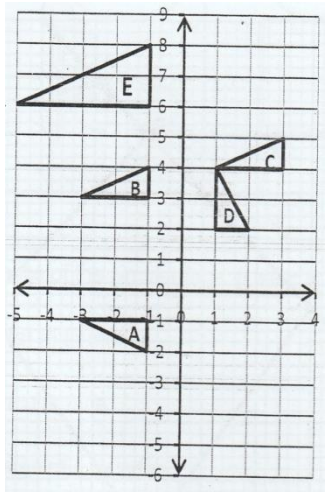
(b) Find the length of the bus in **meters**

Coding: 2

Justification of my grading and Comments

This task involves the reproduction of previously learned facts and standard algorithms of conversion to convert **cm** into **m**. What is to be produced is clearly shown and stated in this question (measure the length and use the scale given). Learners are just expected to use the ruler correctly and make accurate measurement. Learners are expected to convert **cm** to **m** using the conversion that **1m=100cm**. I considered this as a procedure without connection task of low cognitive demand.

4. Describe fully the single transformation that maps:



(a) Triangle A onto B

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners first need to recall the four types of transformation learnt and identify the one that fits A onto B. Learners need to engage with the conceptual ideas of reflection, translation, enlargement and rotation in order to describe fully the transformation that maps A onto B. For example, the single transformation in this task is reflection (along the line $y = 1$. So, learners need to know the descriptor of reflection in order for them to complete the task successfully. I thus placed this task in the procedures with connections category of low cognitive demand.

(b) Triangle D onto C

Coding: 3

Justification of my grading and Comments

This task also requires some degree of cognitive effort. Learners first need to recall the four types of transformations learnt and identify the one that fits D onto C. Learners need to engage with the conceptual ideas of reflection, translation, enlargement and rotation in order to describe fully the transformation that maps D onto C. For example, the single transformation in this task is rotation. So learners need to know the descriptor of reflection in order for them to complete the task successfully. I thus placed this task in the procedures with connections category of low cognitive demand.

(c) Triangle E is the enlargement of triangle B.

(i) Write down the scale factor that maps triangle B onto E

Coding: 1

Justification of my grading and Comments

This task requires learners to use the learnt formula of finding the scale factor of enlargement (e.g. scale factor=$\frac{image}{object}$) or use the standard algorithms of dividing the length of corresponding sides of the image divided by the object. This task does not ask learners to give an explanation but focus on producing the correct answer. I classified this as memorization task of low cognitive demand.

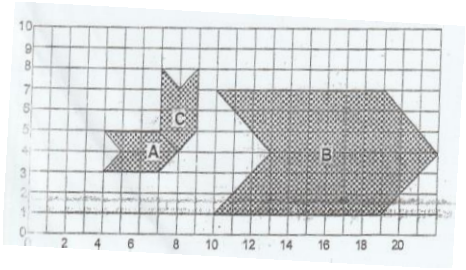
(ii) Give the centre of enlargement that maps triangle B onto E

Coding: 2

Justification of my grading and Comments

This task requires learners to follow learnt steps of finding the centre of enlargement (e.g. connect all corresponding points, were all the corresponding points intersect is where the centre of enlargement is) and recall memorized facts of writing down the coordinates (e.g. coordinates are written in the form $(x; y)$). This task does not require any explanation but focuses on reproducing what is learnt previously to get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

5. The grid below shows two simple transformations



(a) Describe fully the single transformation that maps figure A onto figure B

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners need to first recall the four types of transformation learnt and identify the one that fits A onto B. Learners need to engage with the conceptual ideas of reflection, translation, enlargement and rotation in order to describe fully the transformation that maps A onto B. For example, the single transformation in this task is enlargement. So learners need to know the descriptor of enlargement in order for them to complete the task successfully. I thus placed this task in the procedures with connections category of low cognitive demand.

(b) Figure C is a rotation of A. Write down the Centre, angle and direction of this rotation.

Coding: 1

Justification of my grading and Comments

This task is simplified since the type of transformation is already given. To get the correct answer learners need to recall previously learnt facts of finding the angle of rotation and determining the direction (moving up is anticlockwise while moving down is clockwise). Learners can either measure the angle or use the tracing paper to determine the angle. I thus placed this task in the memorization category of low cognitive demand.

Synopsis

Table 4.2: The distribution of Stein et al.'s coding for tasks in Mathematics test 2 for teacher A

Stein's coding	**Frequency**
1	6
2	2
3	3
4	0

Table 4.2 shows that 73% of the tasks administered in this test were low level tasks. Fifty five percent of these low tasks were mainly memorization that required fairly simple mathematics. Twenty seven percent of the tasks were high level tasks consisting mainly of procedures with connections task. None of the tasks demanded complex thinking (doing mathematics level). Although this test did not seek to assess learners' problem solving skills (level 4), it enabled learners to demonstrate their understanding of the procedures or algorithms used (level 3).

Teacher A **Mathematics Test 3** **Grade 10**

1. C A R M I N I A

A letter is chosen at random from the word above. What is the probability that it is an A? Write your answer as a fraction in simplest form.

Coding: 1

Justification of my grading and Comments

In this task learners are required to perform standard algorithm of working out the probability of the successful event/ outcome or use the formula of working out the probability of a successful event = $\frac{Number\ of\ successful\ outcomes}{Total\ number\ of\ outcomes}$. Since the formula is already in the fraction form, learners can just use the calculator to simplify the fraction. I thus placed this task in the memorization category of low cognitive demand.

2. The table below shows the rubbish Ndeapo collected during the school cleaning campaign.

Type of rubbish	Bottles	Plastics	Paper	Tins
Number of items	5	11	8	6

Find:

(a) The mean of the items.

Coding: 2

Justification of my grading and Comments

This task requires learners to recall a memorized formula of the mean and use standard algorithms to find the sum of items and work out the mean, i.e. $mean = \frac{sum\ of\ items}{Number\ of\ items}$. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) The mode.

Coding: 1

Justification of my grading and Comments

This task requires learners to recall a memorized definition of the mode and use the definition to get the answer. The task cannot be solved using procedures because a procedure does not exist. I thus placed this task in the memorization category of low cognitive demand.

3. Simplify: *5(a + 2b) -4b*

Coding: 2

Justification of my grading and Comments

In this task learners are required to use the 'distributive law' to open the brackets and use the algorithms procedure of collecting like terms to simplify the expression (e.g. *5(a + 2b) - 4b* $= 5a + 10b - 4b = 5a + 6b$). I thus placed this task in the procedures without connection category of low cognitive demand.

4. Factorize: $12m^3n^2 + 16m^2n$

Coding: 3

Justification of my grading and Comments

Although this task requires learners to follow the procedure of writing expressions in factorization form, they cannot be followed mindlessly. Learners need to have knowledge of factors of coefficients and variables in order to factorize completely i.e. learners need to know the highest common factors of 12 and 16 as well as m^3n^2 and m^2n. I thus placed this task in the procedures with connections category of high cognitive demand.

5. Calculate $3x^2 - 4x + 2$ if x =5

Coding: 2

Justification of my grading and Comments

This task requires learners to substitute the letter with the value given and follow the procedures of multiplication, addition and subtraction (BODMAS) to get the answer. The task does not requires mathematical understanding. Learners can just follow the procedures taught in the classroom to get the answer. I thus placed this task in the procedures without connections category of low cognitive demand.

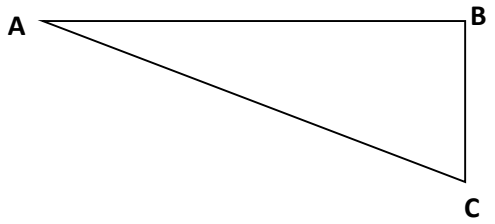
6. Solve the equation $\frac{y}{3} = \frac{8}{2}$

Coding: 2

Justification of my grading and Comments

This task requires learners to use learnt procedures of solving linear equations in fractional form. Learners can follow the procedure of cross multiplication and division to get the value of y. This task does not requires mathematical understanding. I thus placed this task in the procedures without connections category of low cognitive demand.

7. The diagram shows a right-angled triangle.



(a) Find the length of BC when AB = 12cm , AC = 15cm and angle ABC=90 $^{\circ}$

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners need to think of the possible solution strategies in order to find the length of AB (e.g. Pythagoras theorem). Afterwards they can then follow the procedures. I thus placed this task in the procedures with the connections category of high cognitive demand.

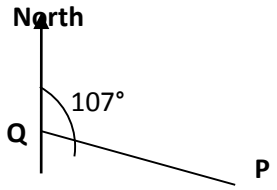
(b) Calculate the angle ACB

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners need to engage with the three trigonometric ratios (sine, cosine and tangent) and identify the ratio to use in order to get the size of angle ACB. Since this task requires learners to recognize and identify the ratio that gives angle ACB. I thus placed this task in the procedures with connections category of high cognitive demand.

8. Calculate the bearing of Q from P

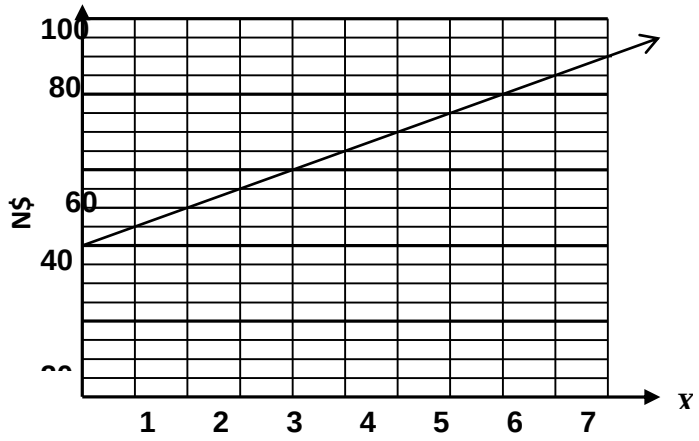


Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Although general procedures of finding the bearing may be followed, they cannot be followed mindlessly. Learners need to know the properties of angles (e.g. co-interior angles) and how to use 107° to get the bearing of Q from P. The task does not only requires following the procedure but also making connections among various concepts. I thus placed this task in the procedures with connections category of high cognitive demand.

9. Sophia does baby-sitting for pocket money. The graph below shows her rates.



(a) Find the y-intercept, (Sophia's basic fee) on the graph.

Coding: 1

Justification of my grading and Comments

This task requires learners to recall the previous learnt meaning of y-intercept in order to produce the correct answer. There is no procedure involved. Once learners know what the y-intercept is then they can obviously come up with the correct answer, i.e. y-intercept is where the graph cuts the y-axis. Then the y-intercept of this graph is N$ 40. I thus placed this task in the memorization category of low cognitive demand.

(b) Use the graph to find the amount she charges for 7 hours.

(c)

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners need to first engage with the graph and interpret the graphs in order to get the amount charged for 7 hours. I thus placed this task in the procedures with connection category of high cognitive demand.

(d) Calculate her rate per hour using the gradient of the graph.

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners first need to engage with the concepts of rate and gradient in order to follow the procedure of division. I thus placed this task in the procedures with connections category of high cognitive demand.

Synopsis

Table 4.3: The distribution of Stein et al.'s coding for tasks in Mathematics test 3 for teacher A

Stein et al.'s coding	Frequency
1	3
2	4
3	6
4	0

It is evident from Table 4.3 that nearly half of the tasks (46%) were high level tasks, mainly procedures with connections. Most of these tasks were presented in such a way that learners needed to think of the method to use in order to tackle the problem. Some utilized multiple representations (graphs and symbols). Thirty one percent of the tasks were of the procedures without connections type that required learners to use algorithms. Only 23% of the tasks used in this test were knowledge questions that only required memorization. None of the tasks in this test were at an advanced level (i.e. doing mathematics level of cognitive demand).

Summary of teacher A tests items

Table 4.4: Summary of Stein et al.'s coding in all the Mathematics tests for teacher A

Stein et al.'s coding	Frequency
1	11
2	11
3	10
4	0

The analysis of teacher A's test items in terms of Stein et al.'s framework of cognitive demand reveals that tasks were almost equally distributed among the first three levels of cognitive demand. Percentage of memorization and procedures without connections tasks appeared to be equal (34%). Although no tasks of the 'doing mathematics' level of cognitive demand were included in any of the three tests that were analysed, learners were at least exposed to different learning opportunities. This is because all three categories were tested. Supporting this view, Schoenfeld (1992) claimed

that one type of task could not foster all types of thinking but when a set of tasks of different levels are designed, it enhance mathematical thinking. Thus, teachers should design a wide range of mathematical tasks that would enable them to develop mathematical skills (Breen et al., 2010).

4.3.1.2 Synopsis for mathematics tests for teacher B

This part presents the summaries of teacher B test items. The full analysis of teacher B tests (test 1, 2 and 3) are found in Appendix A.

Table 4.5: The distribution of Stein et al.'s coding for tasks in Mathematics test 1 for teacher B

Stein et al.'s coding	Frequency
1	1
2	18
3	0
4	0

As shown in Table 4.5, all the tasks included in this test were low level tasks. Ninety five percent of these tasks were procedures without connections type. These tasks were algorithmic in nature and required learners to perform previously learnt procedures in a routine manner. Only 5% of the tasks were of memorization type. There was no single task that required a high level of cognitive demand. This implies that this test was entirely procedural and could be solved by recalling ideas or well-practiced routines. Hence this test aimed at only assessing procedural mathematical skills (Shannon, 1999).

Table 4.6: The distribution of Stein et al.'s coding for tasks in Mathematics test 2 for teacher B

Stein et al.'s coding	Frequency
1	2
2	11
3	4
4	0

The levels of cognitive demand in these tasks were coded in the first three categories as shown in Table 4.6. The majority of the tasks (64.7%) were procedures without connections while 11.8% of the tasks were of the memorization type. Procedures without connections tasks were used extensively to possibly only assess procedural skills. This aligned with Kilpatrick et al. (2001) who suggest that procedures without understanding need extensive practice in order to be remembered and used correctly.

The percentage of high level tasks, mainly procedures with connections was reasonably high, namely 23.5% as compared to the memorization type (11.8%). This enabled learners to demonstrate their understanding of mathematical concepts. When students understand concepts, they are less likely to forget critical steps involved (Kilpatrick et al., 2001).

Table 4.7: The distribution of Stein et al.'s coding for tasks in Mathematics test 3 for teacher B

Stein et al.'s coding	Frequency
1	5
2	17
3	0
4	0

It is evident from Table 4.7 that test 3 for teacher B was only made up of low level tasks. Seventy seven percent of these tasks were of procedures without connections and only 23% of these tasks were of the memorization type. These tasks make minimal demands on learners' thinking as they

rely primarily on procedural skills. The findings are not well aligned with a call for curriculum reform in mathematics (NCTM, 2000). These curriculum reforms call on teachers to generate ways of eliciting high level mathematical ideas from their students. One way to elicit these ideas is through setting challenging activities.

Summary of teacher B tests items

Table 4.8: Summary of Stein et al.'s coding in all the Mathematics tests for teacher B

Stein et al.'s coding	Frequency
1	8
2	46
3	4
4	0

About 93% of the tasks in teacher B's tests required low levels of cognitive demand. Only 7% of the tasks required a high level of cognitive demand mainly procedures with connections. There was no evidence of a single level 4 test item.

4.3.1.3 Synopsis for mathematics tests for teacher C

This part presents the summaries of teacher C test items. The full analysis of teacher C tests (test 1, 2 and 3) are found in Appendix A.

Table 4.9: The distribution of Stein et al.'s coding for tasks in Mathematics test 1 for teacher C

Stein et al.'s coding	Frequency
1	2
2	8
3	2
4	0

Table 4.9 shows that this test only assessed the first three levels of cognitive demand. The majority of the tasks (66.7%) consisted mainly of procedures without connections items. There were an equal number of tasks that fell into the memorization and procedures with connections categories (16.7%).

Table 4.10: The distribution of Stein e al.'s coding for tasks in Mathematics test 2 for teacher C

Stein et al.'s coding	Frequency
1	1
2	10
3	0
4	0

As it is evident in Table 4.10 all the tasks in this test were entirely of low level cognitive demand. Ninety one percent of the tasks were procedural and algorithmic in nature. Only 9% of the low level tasks required learners to reproduce facts, rules and formulae without any explanations.

Table 4.11: The distribution of Stein et al.'s coding for tasks in Mathematics test 3 for teacher C

Stein et al.'s coding	Frequency
1	15
2	19
3	3
4	0

As shown in Table 4.11, tasks in this test were distributed in the first three levels of cognitive demand. No task could be categorized in the fourth level. The majority of the tasks (51%) were algorithmic and procedural in nature while 41% tested factual knowledge. Although 8% of the tasks were coded as procedure without connections (level 3), tasks that elicit high-order thinking from the learners were absent.

Table 4.12: Summary of Stein et al.'s coding in all the Mathematics tests for teacher C

Stein et al.'s coding	Frequency
1	18
2	37
3	5
4	0

Table 4.12 shows that all tasks given by teacher C tested only the first three levels of cognitive demand. No items could be categorized in level 4. Significantly, the entire teacher C test items were procedural in nature. This means that teacher C only tested procedural knowledge. Kilpatrick et al. (2001) makes the observation that procedures that are used several times become automatic and results in the production of correct answers. It begs the question; however, if learners are sufficiently exposed to tasks that promote thinking at a higher cognitive level.

Teacher C's tests suggest that learners had limited opportunity to engage in mathematically rich tasks in their lessons. Only 8% of the entire teacher C test items included procedures with connections while no single task could be categorized in the mathematics category of high cognitive demand. I agree with Resnick et al. (2003) who assert that simple knowledge and skills are easier to test than complex concepts of other higher-level cognitive demands. However, it is

important that learners are adequately exposed to tasks that require high cognitive skills. These skills then need to be appropriately assessed.

4.3.2 PART 2: NATIONAL EXAMINATIONS ITEMS

This part presents the analysis of the end-of-year national examinations items for the 2011, 2012 and 2013 according to Stein et al.'s framework of cognitive demand. Examination questions are not being reproduced, only question numbers are included. The entire questions are found in Appendix B.

JSC Mathematics National examination 2011 , Paper 1 Grade 10		
Question number	**Stein et al.'s coding**	**Justifications of my grading and comments**
1.	2	This question requires learners to recall previously learned facts about working out directed numbers. Since the level of water in this question was higher, learners just need to simply follow the procedure and add the given numbers or do it straight from the number line given. There is no in-depth thinking involved in this question. To get the answer learners just need to know the basic mathematics of adding directed numbers. I thus placed this task in the procedures without connections category of low cognitive demand.
2. **(a)**	2	This question requires learners to recall previously learned rules of writing numbers in standard form and follow the rule in order to produce the correct answer. There is no in-depth thinking involved. What is to be written in standard form is clearly and directly stated. Thus, learners are just expected to reproduce exactly what they did in the classroom about writing such a number (i.e. 0.007889) in standard form. I thus placed this task in the procedures without connections category of low cognitive demand task.
(b)	1	This question requires learners to recall previously learned rules of rounding numbers to decimal places. There is no in-depth thinking involved apart from following the rule. What is to be written correct to 2 decimal places is clearly and directly stated. I thus placed this task in the memorization category of low cognitive demand task.
3. **(a)**	2	This question requires learners to know what a prime factor is and how to express a number as a product of its prime factors. For example, prime factors of 28 should be a number that goes into 28 without leaving a remainder and that number must have two factors only (1 and the number itself). This is a definition that will help learners to express the number as a product of its prime factors correctly. Learners also need to follow the steps of expressing numbers as products of their prime factors. Following the steps to produce the correct answer places this task under level 2. I thus placed this task in the procedures without connections category of low cognitive demand.

(b)	2	This question requires learners to know what the highest common factor of two or more numbers is and how to obtain it. In this task learners are required to use the definition at the same time following the procedures in order to produce the correct answer. I thus placed this task in the procedures without connection category of low cognitive demand.

4.	2	In this task learners are required to use the usual procedure of finding required number using the ratio. For example, learners just need to add the ratios together and express the ratio of mathematics marks as fraction of the total ratios and multiply it with 120 which is the total mark of three tests ($\frac{3}{12} \times 120 = 30$). Learners usually follow the procedures exactly and focus on producing the correct answer. I thus placed this task in the procedures without connection category of low cognitive demand.
5.	3	This question requires learners to engage with the pictures given and relate the pictures to the previous one as they go along. Learners need to make connections between the numbers of squares used in each picture in order to determine the number of squares that will be in picture 4. Learners can also make connection among multiple representations (picture given and symbolic) to help them develop meaning and determine the number of squares that will be in picture 4. Since this task allows learners to connect what they are doing to the previous picture and allow learners to compare the pictures. I thus placed this task in the procedures with connections category of high cognitive demand.
6.	2	In this question the theorem to be used is clearly stated. Learners are just expected to recall and use the Pythagoras theorem for the purpose of producing a correct answer. This question does not require learners to connect what they are doing to the meaning of the triangle given. Example, to find the length of side x, learners can just do it as follow $x^2 = z^2 - y^2$, $x^2 = 169 - 144$,then, $x^2 = 25$, $x = 5$cm. By doing so learners are just following the Pythagoras theorem steps to get the answer. I thus placed this task in the procedures without connections category of low cognitive demand.
7.	1	This task involves exact reproduction of previously seen material and learnt facts about measuring angles. What is to be produced is clearly and directly stated in this question, i.e. measure angle BAC. The protractor to measure the angle stated is already placed on the angle to be measured, one only needs to read from the protractor and determine the angle stated. I thus placed this task in the memorization category of low cognitive demand.
8.	2	This task requires memorization of the formula for calculating the volume of the cuboid and the use of standard algorithms to get the height of the tank. Example, learners can either write down the formula for the volume of the cuboid, substitute and rearrange to get the height ($v = lbh, 30\,000 = 30 \times 20 \times h, \frac{30\,000}{600} = h, h = 50\ cm$) or learners can rearrange the formula from the beginning and work out the height ($h = \frac{v}{lb}$, $h = \frac{30\,000}{20 \times 30}$, $h = 50\ cm$). I thus placed this task in the procedures without connections category of low cognitive demand.

9.(a)	1	This task requires learners to use the memorized BODMAS rule using standard algorithms of addition and multiplication of algebraic terms in order to get the correct answer. Example, according to the BODMAS rule one should multiply first before adding. i.e.$9a \times 3c + 4ac = 27ac + 4ac = 31ac$. The task does not ask for any explanation as to how learners get the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires learners to use the memorized 'law of indices' to answer the question correctly. Learners are required to recall the product (×) and quotient (÷) laws of indices to simplify the given expression, i.e. $\frac{x^9 \times x^5}{x^3} = x^{(9+5)-3} = x^{11}$. I thus placed this task in the memorization category of low cognitive demand.
10.	1	This task requires learners to reproduce previously seen inequalities for the number line from memory. What is to be produced is clearly stated and shown on the number line. Learners are just expected to recall the type of inequality produced by an open circle on one side and the closed circle on the other side, i.e. open circle implies that the number is not included use < or > inequalities sign and closed or shaded circle implies that the number is included, use $\leq or \geq$ inequalities sign. Once learners are capable of recalling that they can obviously produce correct answers. I thus placed this task in the memorization category of low cognitive demand.
11.(a)	1	In this task learners are required to perform standard algorithms of working out the probability of successful events /outcomes or use the formula of working out probability of successful event = $\frac{Number\ of\ successful\ outcomes}{Total\ number\ of\ outcomes}$. Learners are also expected to write the answer in a correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Probability of yellow =$\frac{4}{15}$. This task requires no explanations. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	In this task learners are required to perform standard algorithms of working out the probability of successful events /outcomes or use the formula of working out probability of successful event = $\frac{Number\ of\ successful\ outcomes}{Total\ number\ of\ outcomes}$. Learners are also expected to write the answer in a correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Probability of picking green=$\frac{6}{15}$.= $\frac{2}{5}$ .This task requires no explanations. I thus placed this task in the memorization category of low cognitive demand.
12. (a)	1	This task requires learners to recall memorized facts of writing down the coordinates and reading from the Cartesian plane. For example, coordinates are written in the form $(x; y)$. The coordinates of A will be (-2; 0). Since the task only asks learners to write down the coordinates, I thus placed it in the memorization category of low cognitive demand.

(b)	1	This task requires learners to recall previous learnt meaning of y-intercept in order to produce the correct answer. There is no procedure involved and the task does not require any thinking. Once learners know what y-intercept is they can obviously come up with the correct answer, i.e. y-intercept is where the graph cuts the y-axis. Then the y-intercept of line AL is 1. I thus placed this task in the memorization category of low cognitive demand.
(c)	2	To find the gradient of line *AL*, learners are expected to know the procedure of division. In this task, learners are expected to divide the change in y by the change in x in order to get the gradient. Learners can also get the answer by using the formula $\frac{y_2-y_1}{x_2-x_1}$ and follow the steps to get the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.
13.	3	Although this task requires learners to follow the procedure of writing expressions in factorization form, it cannot be followed thoughtlessly. Learners need to have knowledge of factors of coefficient and variable in order to factorize completely, i.e. learners need to know the highest factors of 56 and 21 as well as a^3 and a^2. I thus placed this task in the procedures with connections category of high cognitive demand.
14.	2	This task requires learners to use the usual procedure of finding percentage decrease, i.e. N\$119.99-N\$95.99=$\frac{24}{119.99} \times 100 = 20\%$. They usually use these procedures without knowing why the procedure is being used so long as it produces the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.
15. (a)	1	This task requires memorization of the formula for calculating simple interest and the use of standard algorithms to work out the total interest received after three years. The task does not require anything beyond the formula. Once learners know the formula they can get the interest correctly. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires memorization of the formula for calculating the total amount of money received given simple interest, i.e. Total amount= Principal amount + interest received. The task does not require anything beyond the formula. Once learners know the formula they can get the interest correctly. I thus placed this task in the memorization category of low cognitive demand.
16. (a)	1	This task requires learners to recall memorized definition of the mode and use the definition to get the answer. The task cannot be solved using procedures because a procedure does not exist. I thus considered this as memorization task of low cognitive demand.
(b)	2	This task requires learners to recall memorized formula of the median and use standard algorithms to find the median, i.e. arrange numbers in ascending or descending order and identify the number in the middle. I thus placed this in the procedures without connections category of low cognitive demand.

(c)	2	This task requires learners to recall memorized formula of the mean and use standard algorithms to find the sum of items and work out the mean, i.e. $mean = \frac{sum\ of\ items}{Number\ of\ items}$. I thus placed this task in the procedures without connections category of low cognitive demand.
17.	3	This task requires some degree of cognitive effort. Although general procedures of finding the bearing may be followed, they cannot be followed thoughtlessly. Learners need to know the properties of angles at a point and how to use 110° to get the bearing of B from A. E.g. the bearing of B from A is obtained by using $360 - 110 = 250^\circ$. Since the task does not only requires following the procedure but also making connections among various concepts. I thus placed this question in the procedures with connections category of high cognitive demand.
18.(a)	1	This task requires learners to recall previously learnt meaning of 'line of symmetry' and use the definition to identify the line of symmetry in the shape shown in Figure A (see Appendix B). The task does not require any thinking but only exact reproduction of what was done previously in the classroom. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires learners to recall previous learnt meaning of 'order of symmetry' and use the definition to identify the order of rotational symmetry in the shape shown in figure B. The task does not require any thinking but exact reproduction of what was done previously in the classroom. I thus placed this task in the memorization category of low cognitive demand.
19.	2	This task requires learners to follow the procedure of unitary method to determine the number of kilometres John will run in three days. E.g. $1\frac{1}{2}km = 1\ day$ then $x\ km = 3\ days$, to find x one can use cross multiplication method. Once learners follow these procedures they can get the correct answer, although they do not know why the procedure is being used. I thus placed this question in the procedure without connections category of low cognitive demand.

Synopsis

Table 4.13: The distribution of Stein et al.'s coding for tasks in the Mathematics examination paper 1 for 2011

Stein et al.'s coding	Frequency
1	14
2	12
3	3
4	0

From the frequency Table 4.13 above it is clear that most tasks (90%) in Paper 1 for 2011 were low level tasks that required memorization and procedural skills only. Only 10% of the tasks in this paper were high level tasks that required data analysis skills, pattern recognition and problem solving. Overall, the distribution of the tasks in this paper resonates quite well with what the paper should test according to the educational policies. According to the Grade 10 Mathematics syllabus (Namibia, Ministry of Education [MoE], 2010) assessment objectives state that paper 1 aims at testing basic knowledge and technical skills. These basic knowledge and technical skills can be referred to as low level of cognitive demand in Stein et al.'s level of cognitive demand

JSC Mathematics National examination 2011 , Paper 2 Grade 10		
Question number	**Stein et al.'s coding**	**Justifications of my grading and comments**
1.(a)	2	This task requires learners to recall memorized equivalent forms between kilograms and grams and carry out conversions of kilograms to grams using standard conversion algorithms in the absence of additional context or meaning(e.g. 1kg=1000g, 0.78kg =x, then x= 1000 × 0.78=780 grams). One needs to use the unitary method and perform the procedure of multiplication in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task requires learners to recall memorized equivalent forms between millilitres and litres as well as carry out conversions of millilitres and litres using standard conversion algorithms in the absence of additional context or meaning (e.g. 1litre=1000ml, 38 200 ml =$x$litres, then x= $\frac{38\,200}{1000} = 38.2$ litres). One needs to use the unitary method and perform the procedure of division to get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
2. **(a)**	1	This task requires learners to recall previously learnt facts about number line (e.g. numbers on the left side of a number line are less than numbers on the right side) in order to perform correct ordering. I thus placed this task in the memorization category of low cognitive demand.
(b)	2	This task requires learners to use the calculator to work out 2^4 and 4^2. After knowing the values of the two numbers learners will be able to insert the correct symbol. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	This task requires learners to use the calculator to work out the values of the numbers given. After knowing the values of the two numbers learners will be able to insert the correct symbol. I thus placed this task in the procedures without connections category of low cognitive demand.
(d)	2	This task requires learners to recall previously learnt indices rule about numbers to the power of zero ($7^0 = 1$) or use the calculator to find the value of 7^0 . Once learners use the law of indices and find out that $7^0 = 1$ they will be able to insert the correct symbols and produce the correct answer. There is no in-depth thinking involved. I thus placed this task in the procedures without connections category of low cognitive demand.

3. **(a)(i)**	2	In this task learners will use the learnt procedure of finding required numbers using the procedure of multiplication (multiplying the fraction with the amount given). For example, learners just need to add the ratios together and express the ratio of mathematics marks as fraction of the total ratios and multiply it with 120 which is the total mark of three tests ($\frac{3}{12} \times 120 = 30$). Learners usually use these procedures thoughtlessly just focussing on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(ii)	2	In this task learners are required to use the usual procedure of finding required numbers using the ratio. Learners would just need to know and follow the procedures of addition, division and multiplication (e.g. $5+4+3=12$ then $\frac{4}{12} \times 12\ 600 = 4200$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)(i)	2	In this task learners are required to use the usual procedure of using fraction and total cost to find the required number. Learners would just need to know and follow the procedures of division (converting percentage to fractions) and multiplication (e.g. $\frac{35}{100} \times 21\ 000 = 7350$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(ii)	2	This task requires learners to follow the procedure of writing numbers as fraction in simplest form/ procedure of division (e.g. $\frac{6500}{21\ 000} = \frac{13}{42}$). The task does not require connection to the concept being used and does not aim at developing mathematical understanding rather than producing correct answer only. I classified this task as procedures without connection of low cognitive demand.
(iii)	2	This task requires learners to use the usual procedure of subtraction to get the remaining amount. (e.g. 21 000- (i) + (ii) that is now 21 000-7350+6500= 6650). There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I considered this task as procedures without connection of low cognitive demand.
4	2	This question requires learners to use the formula of perimeter of a rectangle (e.g. p=2l+2b) and follow the standard algorithm of substituting the length and breadth with the given terms, multiplication and collection of like terms. The task does not require connection to the concept being used and does not aim at developing mathematical understanding rather than producing correct answer only. I considered this as procedures without connections tasks of low cognitive demand.

5.(a)	2	In this task learners are required to use the usual procedure of using fractions and total costs to find the required number. Learners would just need to know and follow the procedures of division (converting percentage to fractions) and multiplication (e.g. $\frac{15}{100} \times 8900 = 1335$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I considered this task as procedures without connections of low cognitive demand.
(b)	2	This task requires learners to use the usual learnt procedure of getting total amount given deposit and the monthly instalments (e.g. 15% + (24×400.75) = 1335+ 9618=10953). There is no in-depth thinking involved as the deposit has been calculated in the previous part of this question part (a) and the number of months is clearly stated. Learners need only to follow the steps to produce correct answers. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	This task again builds on the previous one (question 5 (b). It only requires learners to follow the procedure of subtraction (hire purchase price-cash price= 10953-8900=2053) in order to produce the correct answer. There is no in-depth thinking involved as the hire purchase price has been calculated in the previous part of this question part (b) and the cash price is already given in **option 1.** I thus placed this task in the procedures without connections category of low cognitive demand.
6.(a)	2	In this task learners are required to use the 'distributive law' to open the brackets and use the algorithms procedure of collecting like terms to simplify the expression (i.e.$3y(7x^2 - y) = 21x^2y - 3y^2$). However, in this question there are no like terms after multiplying out the brackets. Once you multiply out the brackets that becomes the final answer already. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	In this task learners are expected to substitute the letters y and x with the numbers given and carry out the addition. The question does not require in- depth thinking. Once learners substitute and perform addition correctly they can obviously get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
7. (a)	2	This task requires learners to follow the procedure of unitary method to determine the number of kilometres that will be covered in one day (e.g. $440km = 4\ days$ then $x\ km = 1\ day$, to find x one can cross multiply and follow the procedure of division ($\frac{440}{4} = 110$). Once learners follow these procedures they can get the correct answer, although they do not know why such procedures are being used. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task requires learners to follow the procedure of unitary method to determine the number of kilometres that will be covered in six days. Learners are expected to follow the procedure of multiplication ($6\times 110 = 660$) or division ($\frac{440\times 6}{4} = 660$) to get the correct answer. Once

		learners follow these procedures they can get the correct answer, although they do not know why the procedure is being used. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	This task requires learners to follow the procedure of unitary method to determine the number of days required to cover 1210 kilometres. Learners are expected to follow the procedure of multiplication ($1210\times 4 = 4840$) and division ($\frac{4840}{440} = 11$). Once learners follow these procedures they can get the correct answer, although they do not know why the procedure is being used. I thus placed this task in the procedures without connections category of low cognitive demand.
8. (a)	3	This question requires learners to make connections between diagrams and mathematical symbols in order to formulate correct equation. Learners can follow the procedure of addition in each of the scale by connecting the concept to make the two sides of the scale equal. I classified this as a procedures with connections task of high cognitive demand.
(b)	2	This question builds on the previous question (8(a)). In this part learners are expected to follow the procedure of solving linear equations in one unknown. Learners are expected to follow the procedure of multiplication, collection of like terms and division to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
9. (a)	2	This task requires learners to use the usual procedure of multiplication and division in order to produce the correct answer. They usually use these procedures without any explanation so long as it produces the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	In this task learners are required to use the usual procedure of using fractions and total cost to find the VAT. Learners would just need to know and follow the procedures of division (converting percentage to fractions) and multiplication (e.g. $\frac{15}{100}\times 6296.05 = 944.41$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	This task requires learners to use the usual procedure of addition (e.g. 6296.05 + 944.41=7240.46). What is to be added together is clearly stated in the question and shown in the table. Learners would just need to follow the stated statement in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
10. (a)	1	This task requires learners to recall memorized formulae of calculating the probability of successful event (e.g. P (of successful event) $=\frac{number\ of\ successful\ outcomes}{total\ number\ of\ outcomes} = \frac{3}{20}$). Learners are expected to write the answer in correct format as learnt previously, i.e. probability is written

		as a fraction in its simplest form or decimal number. Once the learners use the formula correctly they can obviously produce the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(b)	2	In this task learners are required to use the formula and perform standard algorithms of working out the probability of successful event/ outcome (e.g. probability of successful event = $\frac{Number\ of\ successful\ outcomes}{Total\ number\ of\ outcomes}$). To produce the correct answer learners are required to know what a hexagon is in order to come up with the probability of taking out a hexagon. Learners are expected to write the answer in a correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Probability of taking a hexagon=$\frac{6}{15}$.=$\frac{2}{5}$. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	In this task learners are required to use the formula and perform standard algorithms of working out the probability of an event that cannot occur (e.g. probability of not = 1- probability of getting an event). To produce the correct answer learners are required to know the number circle in a box. Learners are expected to write the answer in a correct format as stated in the question, i.e. write your answer as a decimal number. I thus placed this task in the procedures without connections category of low cognitive demand.
11. (a)	1	This task requires memorization of the formula for calculating the volume of the cuboid (e.g. length × breadth × height). To get the correct answer learners are expected to use the formula correctly. I considered this as a memorization task of low cognitive demand.
(b)	1	In this question learners are required to identify the shape that forms up the base area of the cylindrical candle and use the learnt formula to calculate the area of the shape (circle). I classified this as a memorization task of low cognitive demand.
(c)	4	This task requires complex thinking. Learners need to analyse and examine the task in order for them to recognize that the volume of the wax in the cuboid shape is the same as volume of wax in the cylindrical shape. The task requires appropriate use of relevant knowledge (correct volume to calculate the height) in working through the task. I thus placed this task in the doing Mathematics category of low cognitive demand.
12. (a)	3	This task requires some degree of cognitive effort. Learners need first to recall the four types of transformation learnt and identify the one that fits A onto C. Learners need to engage with the conceptual ideas of reflection, translation, enlargement and rotation in order to fully describe the transformation that maps A onto C. For example, the single transformation in this task is reflection. So learners need to know the descriptor of reflection (along the y-axis) in order for them to complete the task successfully. I thus placed this task in the procedures with connections category of high cognitive demand.

(b)(i)	2	This task requires learners to follow learnt steps of finding the centre of enlargement (e.g. connect all corresponding points, where all corresponding points are intersecting is where the centre of enlargement is) and recall memorized facts of writing down the coordinates (e.g. coordinates are written in the form $(x; y)$). This task does not require any explanation but focuses on reproducing what is learnt previously to get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(ii)	1	This task requires learners to use the learnt formula of finding the scale factor of enlargement (e.g. scale factor= $\frac{image}{object}$) or use the standard algorithms of dividing the length of corresponding sides of the image divided by the object. The task does not ask learners to give explanations but focuses on producing correct answers. I thus placed this task in the memorization category of low cognitive demand.
(c)	1	This task is simplified since the type of transformation is already given. To get the correct answer learners need to recall previously learnt facts of finding the angle of rotation and determining the direction (moving up is anticlockwise while moving down is clockwise). Learners can either measure the angle or use the tracing paper to determine the angle. I thus placed this task in the memorization category of low cognitive demand.
13. (a)	3	This task requires some degree of cognitive effort. Learners need to engage with the conceptual ideas of a 'million' (know how to write a million in number format) in order for them to complete the task successfully. I thus placed this task in the procedures with connections category of high cognitive demand.
(b)	2	This task requires learners to recall previously learnt facts about working out the angle in the pie chart. Learners need to formulate a linear equation in one unknown and follow the procedure of collecting like terms and subtractions to get the answer (e.g. $x + 120 + 54 = 360; x = 360 - 174 = 186$). There is no in-depth thinking involved in this task. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	In this task learners are required to use the usual procedure of using fraction and total cost to find the required number. Learners would just need to know and follow the procedures of division (converting degrees to fractions) and multiplication (e.g. $\frac{120}{360} \times 840\,000\,000 = 280\,000\,000$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps of working out angles in the pie chart to produce correct answers. I thus placed this task in the procedures without connections category of low cognitive demand.

(d)(i)	2	This task requires learners to follow the procedure of writing numbers as fraction in simplest form/ procedure of division (e.g. $\frac{54}{360} = \frac{3}{20}$). The task does not require connection to the concept being used as the total is already given and does not aim at developing mathematical understanding rather than producing correct answer only. I thus placed this task in the procedures without connections category of low cognitive demand.
(ii)	1	This task requires learners to recall memorized equivalent forms of fractional quantities (e.g. $\frac{3}{20} = 0.15$) or convert fractions to decimal using standard conversion algorithms. I considered this as a memorization task of low cognitive demand.
(e)	2	This task requires learners to use the usual procedure of working out percentage increase in order to get the total amount spent (e.g.$\frac{5}{100} \times 840\,000\,000 = 42\,000\,000; 4\,200\,000 + 840\,000\,000 = 882\,000\,000$ *or* $\frac{105}{100} \times 840\,000\,000 = 882\,000\,000$). Learners use this procedure without understanding the rationale behind the procedure. All learners can get the correct answers if they follow the procedure correctly. I thus placed this task in the procedures without connections category of low cognitive demand.
14.	2	This task requires learners to recall previously learnt trigonometric ratios (e.g. sine, cosine and tangent) and when to use each ratios (e.g. recall SOH, CAH, and TOA). After knowing which ratio to use, learners are expected to follow the procedure of division and multiplication (e.g. use CAH; $\cos 18 = \frac{ED}{50}, ED = \cos 18 \times 50 = 47.5528 = 47.55$). Learners are also expected to recall how to write numbers correct to 2 decimal places. The task does not require mathematical understanding of the concepts being used, rather focusing on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
15. (a)	1	This task requires learners to recall memorized formula of calculating the sum of interior angle of a regular polygon (sum=180(n-2)). The number of sides of the polygon is clearly stated. Learners only need to use the formula to produce the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires learners to recall previously learnt facts about finding the size of one interior angle of a regular polygon (size = $\frac{sum}{number\ of\ side}$) given the sum (as calculated in part (b)). Again, in this part learners only need to use the formula to produce the correct answer. I thus placed this task in the memorization category of low cognitive demand.

16(a)	3	This task requires some degree of cognitive effort. Learners need first to engage with the distance-time graph and interpret the graph in order to get the speed. Learners need to make connections between the graph and problem situation (e.g. the speed measurement and to get speed is the slope of the graph = $\frac{Distance}{time}$). I thus placed this task in the procedures with connections category of high cognitive demand.
(b)	3	This task requires some degree of cognitive effort. Learners first need to engage with the distance-time graph and interpret the graph in order to get the distance. Learners need to make connections between the graph and problem situation (e.g. how far refers to the distance at 08:15). I thus placed this task in the procedures with connections category of high cognitive demand.
(c)	3	This task requires some degree of cognitive effort. Learners first need to engage with the distance-time graph and interpret the graph in order to get the average speed. Learners need to make connections between the graph and problem situation (e.g. total distance and total time). Learners also need to recognize that the time given in the graph is in minutes and they need to give their answer in m/s. So they should be able to convert minutes into seconds using standard algorithms of converting minutes to seconds. I thus placed this task in the procedures with connections category of high cognitive demand.
17.(a)	1	This task requires learners to recall previously learnt facts about angle properties (e.g. alternate angle (z)). Learners only need to use this property in order to produce the correct answer (m=32°). I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires learners to recall previously learnt facts about angle properties (e.g. corresponding angle (F)). Learners only need to use this property in order to produce the correct answer (n=103°). I thus placed this task in the memorization category of low cognitive demand.
(c)	2	This task requires learners to use the property of angle at a straight line to work out q ($q = 180 - 32 - n = 180 - 32 - 103 = 45$). Learners need to follow the steps learnt to work out q. I thus placed this task in the procedures without connections category of low cognitive demand.

Synopsis

Table 4.14: The distribution of Stein et al.'s coding for tasks in Mathematics examination paper 2 for 2011

Stein et al.'s coding	Frequency
1	13
2	32
3	6
4	1

From the frequency Table 4.14 above it is clear that most of the tasks (87%) in Paper 2 for 2011 were low level tasks that required only procedural skills. Thirteen percent of the tasks in this paper were presented in the forms of pictures, diagrams and graphs allowing learners to visualize and develop mental pictures of the whole tasks. The presentation of these tasks made them fit into the higher level task categories but most of them were reduced to low level by the instructions preceding them. For example, in task 12 (b) learners were already given the type of transformation that map A onto B and for task 14 (see Paper 2, 2011, Appendix B) learners were already told what a hexagon is instead of them to figure it out. This point on alteration of levels of cognitive demand is observed by Jackson, Garrison, Wilson, Gibbons, & Shahan (2003) who state that the cognitive demand of a high-level task can be lowered if a solution path is suggested before students begin to solve a problem.

Only 13% of the tasks fit the higher-level category of cognitive demand. These findings were contrary to what Paper 2 should be testing. Assessment objectives for paper 2 as presented in the syllabus (Namibia, Ministry of Education [MoE], 2010) are analysing, abstracting and synthesising skills (high-level cognitive demand skills in Stein et al.'s framework). This implies that, on the basis of my analysis, the quality of this paper is questionable since the paper did not assess most of the assessment skills as stipulated in the mathematics syllabus.

Summary of Mathematics examination papers for 2011

Table 4.15: The distribution of Stein et al.'s coding for both Mathematics papers 1 and 2 for 2011

Stein et al.'s coding	Frequency
1	27
2	44
3	9
4	1

It is evident from Table 4.15 that the 2011 external Mathematics examination was dominated by the tasks that required procedural skills (54.3%). Thirty three point three percent were memorization tasks, 11.1% were procedures without connection tasks and only 1.3% of these tasks were doing mathematics tasks. This suggests that the 2011 examinations primarily focused on lower-level demands. Although the ability to engage learners in high cognitively demanding activities has been a major concern (Kilpatrick et al., 2001; NCTM, 2000), the distribution of low level tasks in this examination is worrisome. The levels of cognitive demand required by the above examination in its entirety are contrary to what mathematics in the reformed curriculum entails. The reformed curriculum promotes students to become mathematically proficient (NCTM, 2000). For this to occur, learners need to spend sustained time doing mathematics at Stein et al.'s levels 3 and 4 categories.

It is thus important that an appropriate balance in terms of cognitive demand of tasks for examinations of the type analysed above is needed. Schoenfeld (1993) emphasises the point of balanced assessment. He claims that one task cannot foster all types of thinking, but when a set of tasks is designed it should cover as many cognitive levels as possible. The findings in this examination showed an imbalance between low and high level tasks. It can thus be argued that, according to my analysis, the examination for 2011 as a whole did not satisfactorily assess and promote critical thinking amongst learners.

Summaries for 2012 national examination items

Table 4.16: The distribution of Stein et al.'s coding for tasks in Mathematics examination paper 1 for 2012

Stein et al.'s coding	Frequency
1	12
2	14
3	3
4	0

As shown in Table 4.16, this examination, unfortunately, focused too heavily on low level of cognitive demand. The majority of the tasks (48.3%) were mainly of procedures without connections, while 41.4% of the tasks were of memorization type. Given that Paper 1 should consist of short answer questions to assess the testing of basic knowledge and technical skills according to policy (Namibia, Ministry of Education [MoE], 2010), the heavy dominance of low level cognitive demand tasks is of concern.

Table 4.17: The distribution of Stein et al.'s coding for tasks in Mathematics examination paper 2 for 2012

Stein et al.'s coding	Frequency
1	13
2	28
3	6
4	1

All of Stein et al.'s levels of cognitive demand were assessed in this examination paper as shown in Table 4.17. The majority of the tasks (85%) were low level tasks, while only 15% of the tasks required high levels of cognitive demand. The findings are in contrast to what the paper should assess. According to the mathematics syllabus, Paper 2 should consist of 60% structured questions

that assess learners' analysing, abstraction, and synthesising– skills that require a high cognitive level. As evident from my analysis, tasks in this paper made minimal demands on learners' thinking.

The paper was dominated by procedures without connections tasks. These tasks only test algorithmic and procedural skills. It can thus be argued that the paper does not serve it is purpose. Resnik et al. (2003), in support of this finding, state that the emphasis on trivial facts rather than mathematics concepts or process could hinder the fostering of higher order thinking in students.

Summary of Mathematics examination papers for 2012

Table 4.18: The distribution of Stein et al.'s coding for both Mathematics papers 1 and 2 for 2012

Stein et al.'s coding	Frequency
1	25
2	42
3	9
4	1

In summary, Table 4.18 shows that majority of the tasks (87%) for Paper 1 and 2 in 2012 were low level tasks consisting of procedures without connections. Only 13% of the tasks were categorized as high level. The findings are in strong contrast to what the papers were supposed to assess. According to policy (Namibia, Ministry of Education [MoE], 2010) short questions should contribute 40% of the tasks while 60% should be the structured questions of high cognitive demand. The papers analysed above fell well short of this requirement. Knowing that performance in Grade 10 national examination often determines the future trajectory of study for many learners, the extent to which low level tasks dominated this examination is worrisome. Learners will have limited understanding of Mathematics and this may indeed limit their access to advanced schooling and other opportunities (Kilpatrick et al., 2001). It is thus important that awareness should be created amongst setters of the mathematics examination to set examinations that aligned with the cognitive levels set out by the policy.

Table 4.19: The distribution of Stein et al.'s coding for tasks in Mathematics examination paper 1 for 2013

Stein et al.'s coding	Frequency
1	14
2	15
3	3
4	0

Tasks in this paper were distributed around the first three categories of cognitive demand (see Table 4.19). The number of tasks that required memorization and procedures without connections category of low cognitive demand were almost equal (44% and 47% respectively). Only 9% of the tasks required high level thinking. This paper focused primarily on low level categories. Although many researchers (Stein et al., 2000; Yeo, 2004; Berger et al., 2010; Breen, & O'shea, 2010) point out that assessments tasks should include a wider range of tasks (lower to higher order skills) to enable learners to develop mathematical thinking skills, the paper underrepresents the high level tasks. According to the syllabus (MoE, 2010), Paper 1 should include calculation using mental strategies or paper and pencil algorithms. From this perspective, the findings resonate quite well with the syllabus.

Table 4.20: The distribution of Stein et al.'s coding for tasks in Mathematics examination paper 2 for 2013

Stein et al.'s coding	Frequency
1	11
2	26
3	13
4	0

As shown in Table 4.20, 52% of these tasks required procedural skill while 22% were memorization tasks. Once again this paper was heavily dominated by tasks that required only low levels of cognitive demands. The paper, therefore, does not meet its objective.

Summary of Mathematics examination papers for 2013

Table 4.21: The distribution of Stein et al.'s coding for both Mathematics papers 1 and 2 for 2013

Stein et al.'s coding	Frequency
1	25
2	41
3	16
4	0

The entire examinations for 2013 were dominated by low level tasks. Fifty percent of the tasks were mainly procedures without connections, while 30% of the tasks required memorization. Only 20% of tasks required procedures with connection tasks. There was no single task coded at level 4. It can thus be argued that again, as a whole, the papers for 2013 were not pegged at an appropriate cognitive level. This is concerning as there is a danger that the overall message of the national examination perpetuates a practice of engaging mainly with low level tasks in the classroom.

4.4 OVERALL COMPARISON OF ALL ANALYZED TEACHERS' TESTS AND NATIONAL EXAMINATION ITEMS

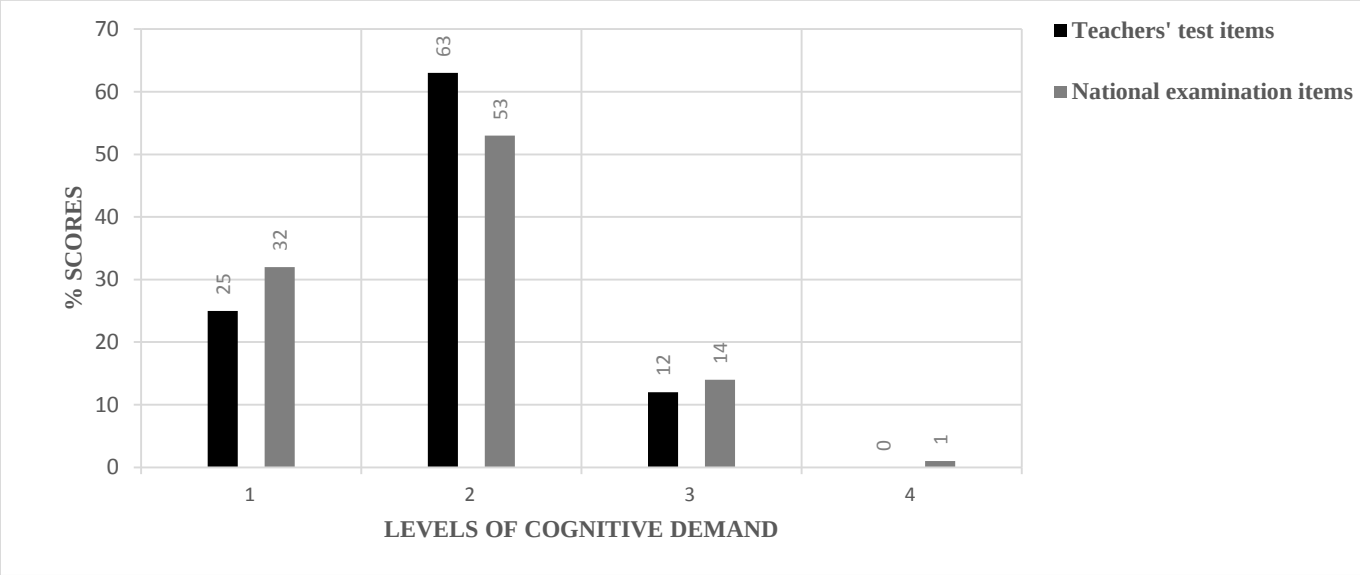


Figure 4.1: Overall distribution of Stein et al.'s coding in teachers' tests (teacher A, B & C) and national examination papers (2011, 2012 & 2013)

There were no substantial differences in the distribution of Stein et al.'s levels of cognitive demand between the teachers' test items and the national examination items (see Figure 4.1). The majority of the tasks (88% of teachers test items and 85% of the examination items) required predominantly low levels of cognitive demands. These were mainly procedures without connections. The Namibian syllabus for Grade 10 (MoE, 2010) however requires that only 40% of the tasks should be assessing knowledge and technical skills which are of low levels in terms of Stein et al.'s levels of cognitive demand. It is clear from the above analysis that the tests and examinations in this study fell well short of this requirement. Although, as Kilpatrick et al. (2001) write it is important to develop and assess procedural skills, this cannot be done at the expense of developing high order cognitive skills.

As shown in Figure 4.1, high level categories of cognitive demand are underrepresented in both teachers' tests and national examination items. Only 12% of teachers' tasks and 15% of national examinations tasks were found in this category, mostly procedures with connections tasks. Notably there was not a single task (0%) in the teachers' tests coded at level 4, tasks that required problem solving and application skills. In the examination only 1% of the tasks were coded in this category. The literature reviewed in this study assert that large-scale assessments (such as national examinations) play an important role in what teachers teach and what they assess (Lane, 2004). Stecher, Barron, Chun, & Ross (2000) claim that in state examinations that assess higher-order thinking, teachers were found using tasks similar to those on the state examinations. The converse of this claim was found to be true in this study. There were very few high level tasks in examination items and there were woefully few tasks that assess higher-order thinking in teacher tests.

In all levels of cognitive demand except for level 2 (procedures without connections), the number of teachers' test items were below the number of examination items. The literature in this study, regarding the findings, claim that CA tasks (e.g. teacher test) offer opportunities to assess a range of activities that cannot be assessed in a single examination. Gipps (1994); Nitko (1995); Le Grange, & Reddy (1998), state that CA allows teachers to concentrate on higher cognitive levels rather than tasks that require basic skills and rote learning. However, this did not happen in this study. Teachers' test items were consistently below the levels of the examination tasks. Teachers extract tasks from textbooks and past examinations that mostly require low levels of cognitive demand and thus perpetuate a cycle of low level mathematical engagement.

4.5. SECTION B: TEACHERS' INTERVIEWS

Following the test items and examinations analysis, one-on-one semi-structured interviews were carried out to explore teachers' rationale behind selecting the tasks they used for the setting of test items. The responses of the teachers were recorded and transcribed. The responses of the individual teachers to each question were compared and analysed to identify similarities and differences. The codes A, B, C were used to distinguish the three teachers (e.g. Teacher A). The actual words of the respondents had been used as supporting evidence. A synopsis of teachers' responses was presented at the end of each question. The findings are discussed according to the research questions they intended to respond to.

4.5.1 DESCRIPTION OF THE RESPONSES

Question 1: Continuous Assessment (CA) forms part of assessment in Grade 10. Activities such as topic tasks, topic tests and end- of –term test are part of CA. How do you select question items for these tests? What do you base your decision on when you select the questions items?

Responses

Teacher A: This teacher responded that he selected question items based on the topics covered. He further stated that, "*I normally base my decision on the learning objectives and basic competencies in the syllabus."*

Teacher B: This teacher responded that "*I use the syllabus and scheme of work to select test items specifically looking at the basic competencies."* She continued by stating that "*I based my decision on the type of assessment tasks I would like to engage my learners in and level of questions that I want to include in the test."*

Teacher C: This teacher indicated that he selected question items based on the topics covered guided by the scheme of work and the syllabus. He stated that "*I normally base my decision on the basic competencies in the syllabus."*

Synopsis

It is evident from all three teachers' responses that they selected question items based on the topics covered guided by the learning objectives and basic competencies in the syllabus. Only one teacher indicated that the type of assessment tasks and level of questions played a major role when selecting learners' test items. This coincides with Stein et al. (2000) who claimed that when teachers are giving tasks, they should give tasks that match their learning goals.

Question 2: Where do you source the questions that make up these test items?

Responses

Teacher A: Responded that "*I personally set questions from the previous covered topics, past test and examination papers, past project/ practical activities and Mathematics textbooks."*

Teacher B: This teacher responded that her sources varied depending on the topic being assessed and the type of engagement she would like her learners to be involved in. She added that "*I often use past question papers for my learners to be familiar with the questions asked at the end of year. I also use textbooks, teachers' manual, and internet and sometimes construct the questions personally."*

Teacher C: Answered the question as follows: "*I use different sources such as past question papers, textbooks and teachers' manual*." He clarified that "*I normally use past question papers when setting end- of-topic test and end of term tests. I like using textbook when setting classroom tasks (topic tasks)."*

Synopsis

All three teachers indicated that they set tests/ activities from past test and examination papers as well as from mathematics textbooks. Only one teacher indicated that she sometimes use the internet and construct the tasks herself.

Question 3: In your experience, does the nature/ design of the CA questions influence the performance of the learners in their end-of-year examinations?

Teacher A: This teacher agreed that the design of the CA questions influences learners' performance at the end of the year examinations. He states that "*To my knowledge learners get used to the type of questions that we give in tests and activities. If we keep on giving easy and short questions only while in the end-of-year examinations there are some other questions, then learners will not be able to answer those other questions that they were not trained to answer."*

Teacher B: Responded that "*I design most of my CA questions from the past end of year question papers. This helps my learners to be familiar with most of the questions asked at the end of the year examinations. My learners use to perform well at the end of the year. Thus, I believe that the nature of CA questions influences the performance of learners in their end-of-year examinations."*

Teacher C: Responded that the design of the CA questions influences the performance of learners in their end-of-year examinations. He stated that learners tends to be familiar with the questions asked in the middle of the year and this made it easier for them to tackle most of the questions at the end of the year. He further stated that "*if I keep on giving my learners questions that are not up to standard, either below or above their level, the performance of my learners will be affected at the end of the year since my learners will be just expecting the type of questions similar to what we have been doing in the course of the year."*

Synopsis

In response to this question, all three teachers believed that learners tend to be familiar with the questions asked in the mid-year tests and activities. They stressed that questions that are too easy or questions that are below or above learners' level disadvantage the learners at the end of the year. They added that learners expected the end - of-year examinations to have similar types of questions to the ones they have been trained to answer in the middle of the year.

Question 4: According to the Grade 10 Mathematics syllabus, learners should be prepared to answer both short and structured questions at the end-of –year external examination. How does this requirement influence your choice of tasks/ activities for the CA process? Please provide examples.

Teacher A: This teacher replied that "*this requirement prompt me to set/ give tasks or activities that are 50: 50 in terms of short and structured questions."*

Teacher B: This teacher stated that "*I mix up different types of questions (both short and structured) in tasks/ activities in order to acquaint my learners to both structured and short questions."* She added that "*instead of asking learners knowledge questions only, I give them questions that ask them to compare and recognize patterns, etc."*

Teacher C: Responded that '*this requirement enabled me to consider all types of questions when I am setting my tests and activities. However, I normally set short questions for topic tasks and include only few structured questions. I do this simply because of work load and limited time available for me to mark learners work. When it comes to the end of the term test, I include both short and structured questions in the ratio of 2:3 as stipulated in the syllabus."*

Synopsis

All three teachers responded that they selected tasks that consisted of both short and structured questions. One teacher indicated that he only included both structured and short questions in end-of-term tests otherwise the topic tasks and topic tests were entirely short questions. The reason he gave to justify his action was that *'too much work load'* and *'limited time'* available for him to mark learners' work.

Question 5: In your opinion, is there any effect on learners' performance at the end-of-year examinations if the teacher designs tasks/ activities for CA consisting of short or structured questions only?

Responses

Teacher A: Responded "*Yes, it really affect learners' performance if a teacher keeps on giving learners short questions only. At the end of the year learners will find it difficult to answer structured questions as they have not been prepared to do so. Therefore, tasks/ activities for CA must consist of both short and structured questions."*

Teacher B: This teacher agreed that there was a great effect on learners' performance if teachers designed activities consisting of one type of question only. She stated that "*if learners are used to short questions only they will find it difficult when answering structured questions. But if learners are trained to answer structured questions they develop conceptual understanding, reasoning and problem solving skills that will enable them to answer short questions within limited time."*

Teacher C: This teacher responded that "*if the teacher designs one type of activity for example short questions only learners will find it difficult to answer the other type (structured questions). When it comes to the end of the year, learners may find it difficult to answer structured questions resulting in poor performance."*

Synopsis

All three teachers were of the opinion that tasks/ activities consisting of short questions only were not likely to prepare learners to tackle structured questions. One teacher pointed out that structured questions enhanced the development of conceptual understanding, reasoning and problem solving skills. This literally helped learners to answer short questions.

Question 6: In your opinion, generally, how do the CA marks compare with the end-of-year external examination marks? Please elaborate.

Teacher A: This teacher believed that if a learner had high CA marks she/ he might perform better at the end of the year examination. He stated that *"It is not possible for a learner to have CA marks of 68 and get 20 marks at the end-of-the year examinations and vice versa*."

Teacher B: This teacher responded that *"CA and end-of-year external examination marks are directly proportional. Learners who perform better in CA tasks do perform better in end-of-year examinations and vice versa."*

Teacher C: This teacher responded that "*often CA marks use to be high but when it comes to the end of the year examinations the marks are so low. For example, learners use to obtain A and B symbols in mid-year tests and examinations but score D and E symbols at the end of the year external examinations."*

Synopsis

In response to this question, two of the teachers were of the opinion that CA and end-of-year examination marks were directly proportional. They stated that learners who performed better in CA tasks/ activities, performed better in the end-of-year examinations and vice versa. One teacher had a different opinion. He felt that CA and end-of-examination marks were not comparable as in most cases CA marks for schools tend to be high while the end-of-year examination marks were low.

Question 7: Why do you think, in some instances, there is such a big difference in the CA and the end-of-year examination marks?

Teacher A: This teacher responded "*There is such big difference in the CA and the end-of-year marks resulting from many instances such as: some tasks/ activities for CA are group work, open book activities (homework) and some are research in which learners depend on other sources while examination is just an individual tasks.*" He added that "*when learners are given group work some benefit from others and obtain high marks that will of course elevate individual learners' CA marks. Some teachers do not test learners but give fabricated marks.*"

Teacher B: This teacher responded "*In some instance such big differences is caused by the amount of content assessed for CA marks."* She elaborated that "*Topic tasks and topic tests given for CA marks only assess specific topics that make it easier for learners to answer questions correctly, unlike the examinations that assess all the topics covered at the same time. Again, the structure or the format of CA activities also contribute to such big differences. This is to say some activities for CA are just made up of short questions that are easy and straight forward but when it comes to the end of year examination, it consists of both type of questions. There are some other factors that are contributing to such big differences such as social factors affecting individual learners' commitment and effort."*

Teacher C: This teacher responded that "*Such big difference might be caused by the tests that I give to my learners. I normaly design tests according the basic competencies in the syllabus but I try to simplify them so that they fit the ability of my learners*."

Synopsis

In response to this question, teachers believed that such big differences were caused by many issues. Some were caused by the teachers themselves while others were beyond the teachers' control. From the teachers' side the following were identified:

- Some teachers tend to simplify CA tasks to fit the ability of the their learners;
- Some teachers tend to set short questions only for topic tasks and topic tests;
- Some teachers gave fabricated marks for CA;

- Some teachers did not fully supervise CA tasks.

Factors beyond the teachers' level included the notion that some CA tasks such as investigations and projects were open book tasks that left room for learners to copy. These tasks also allowed learners to engage with others and they were likely to copy from one another or get the tasks done by somebody else on their behalf. Some issues identified were social factors affecting individual learners such as commitment and effort.

Question 8: What, in your opinion is the relationship between CA and the end-of-year examination?

Teacher A: Responded *"The higher the CA marks a learner has, the higher his/ her end-of-year examination marks and vice versa."*

Teacher B: *"They all aim to assess the same basic competencies and they should both contain short and structured questions."*

Teacher C: *"Objectives being tested are the same but marks yielded are different. Sometimes higher CA marks are higher than examination marks and sometimes examination marks are high than CA marks."*

Synopsis of the responses

In response to this question, all three teachers' stated that CA and end-of-year examination were related to each other in terms of the same objectives found in the subject syllabus.

Question 9: Do you think that the CA mark that a learner achieves should be a predictor for his/ her end-of-year examination mark? Please elaborate.

Responses

Teacher A: This teacher responded that the CA mark should not be a predictor for the end-of-year examination mark. *"If a learner obtains high CA marks and failed to prepare/ study for examination there is a possibility for that learner to fail regardless of the high CA marks and vice versa."*

Teacher B: This teacher responded that CA marks should be a predictor of end-of-year examination mark *"Only when CA activities/ tasks are fairly and accurately conducted with appropriate and quality tasks."*

Teacher B: This teacher replied that "*most of the learners do well in topic tests and topic tasks but perform poorly at the end-of-the year."*

Synopsis of the response

All three teachers agreed that CA marks should not be a predictor of learners' end-of-year marks. One teacher felt that the preparedness of the learners towards end-of-year examinations determined their performance regardless of their CA marks. The other teacher stated that CA marks would be a predictor if CA tasks/ activities were fairly and accurately administered with quality tasks which was not the case in most of the schools.

Question 10: What in your view, is the purpose of the CA process?

Teacher A: This teacher responded that *"The purpose of the CA process is to monitor learners' progress, to evaluate the successfulness of the lesson and to assess whether the learning objectives have been achieved."*

Teacher B: This teacher responded that "*The purpose of CA process is to assess one's performance and use the results to reflect on one's weakness."*

Teacher C: This teacher responded that the purpose of CA process *"Is to tell the teacher whether learners understand the topic and achieved the learning objectives or the teacher needs to improve on his/ her teaching style."*

Synopsis of the responses

It is evident from the responses of all three teachers that the purpose of the CA process was to assess, evaluate and monitor learners' performance and attainment of the learning objectives. One teacher indicated that the CA process enabled teachers to reflect on their teaching for the purpose of improvement.

Question 11: Why do you think there is such a big discrepancy between the CA marks and the external end-of-year marks? Do you think this discrepancy is a good thing? Why?

Teacher A: Responded that "*Maybe because external examination is being controlled seriously than CA tasks/ activities. This may bring fear among learners and start thinking that the external examination is a difficult thing. The discrepancy is not a good thing at all."*

Teacher B: This teacher responded that "*This could be because of the nature of the questions set by teachers for example teachers may set questions which are too easy for the learners, amount of content assessed, quality of task and social factors affecting learners. I think it is a good thing because CA activities and external end-of-year examinations are not conducted in the same manner."*

Teacher C: This teacher responded that *"It could be due to the way questions for CA tasks/ activities are being set/ designed by the teachers. Some teachers set very easy tests/ activities that require learners to memorize what they have been taught'. This discrepancy is not a good thing because both CA tests and external examination should assess the same objectives in the syllabus. So marks obtained from the two are supposed not to differ much."*

Synopsis of the responses

In response to this question, two of the teachers felt that one cause might be the nature of questions designed for CA tasks/ activities. They stated that teachers sometimes set too easy questions that were not stimulating learners to work hard. One teacher felt that external end-of-year examinations are being supervised and controlled too much to the extent that it brings fear amongst learners. As a result, learners tend not to answer the questions well, compared to how it would be if the examinations were conducted in the same manner as other mathematics tests/ tasks. Again, two of the teachers felt that the discrepancy was not good at all. One teacher agreed that it was not a good thing because the two are conducted totally differently, so one should expect the differences.

Question 12: Do you like the current CA and external end-of-year examination structure? Please elaborate.

Teacher A: Responded, *"Yes, I like the current CA and external end-of-year examination structure. Both consist of short and structured questions and they all assess learners' mastery of the topics taught."*

Teacher B: Responded, *"I like the way CA and external examination are contributing towards the final marks. External examination carry more marks than the CA which is fair as CA marks can be unreliable."*

Teacher C: This teacher stated, "*CA helps learners to score marks at the end of the year in case one get sick and happen not to prepare him/ herself very well for the final examinations. At least the CA marks will elevate the final marks. Unlike the case where there is no CA marks that learners only get what they score in the examination."*

Synopsis of the responses

Although all three teachers agreed that they like the structure mentioned in this question, it was evident from the explanation of individual teachers that they liked the structure for different reasons. One teacher claimed that he liked the fact that both consist of short and structured questions, enhancing the development of necessary skills. The other teacher claimed that he liked

the way CA and external examinations are contributing towards the final marks. The third teacher stated that CA might be used to award final marks in case some learners are absent.

Question 13: If you could, would you change anything on the CA/end-of-year assessment structure?

Teacher A: Responded, *"No, I would not change anything because they are fine the way they are."*

Teacher B: Responded, "*No, I think the structure is just fine like that."*

Teacher C: Responded, *"I would change the format of questions in both CA activities and external examinations. Instead of learners answering all questions, I would give them options to choose between questions as it is the case in other subjects, e.g. Geography."*

Synopsis of the responses

Two teachers indicated that they are satisfied with the CA and end-of-year structure. One teacher felt that it was not fair for learners to be answering all questions in the question paper for CA tasks/ activities and end-of-year examinations. However, options should be given to learners to choose questions that they would prefer to answer.

Question 14: Are there any other additional points or comments that you would like to make with regard to the relationship between CA and the external end-of-year examination?

Teacher A: Responded, *"No comments."*

Teacher B: Responded, *"Teachers believe that CA tasks need to be supervised seriously in the same way the external examination is supervised to prevent learners to copy from summary/ textbooks as well as from other learners."*

Teacher C: *'It requires teachers' commitment and efforts to administer CA tasks. Once they are properly administered then they will be compared with the external end-of-year examination.'*

Synopsis of the responses

In response to this question, two teachers highlighted that CA tasks must be controlled and supervised as seriously as the external end-of –year examinations. They continued saying that teachers must commit themselves and make sure that CA tasks are properly administered.

4.5.2 DISCUSSION

This part of the analysis discusses the main findings in relation to the research questions two and three of this study.

What are selected teachers' views on the relationship between test items and national examination items?

When selected teachers were asked to talk about how they view the relationship between test items and external examinations, two teachers responded that there was a strong correlation between the test items and examinations items. One of the teachers indicated that there was a weak correlation between the two. In response to this question, two of the teachers had the opinion that CA and end-for-year examination marks are in direct proportion. They stated that learners who performed better in CA tasks/ activities, performed better in the end-of-year examinations and vice versa. One teacher had a different opinion. He felt that CA and end-of-examination marks cannot be compared as in most cases CA marks for schools tend to be high while the end-of-year examination marks are low. In response to this question, all three teachers believed that learners tend to be familiar with the questions asked in the mid-year tests and activities. They stressed that questions that were too easy or questions that were below or above learners' standard put learners at a disadvantage at the end of the year. They added that learners expected the end- of-year examinations to have the type of questions similar to ones they had been trained to answer in the middle of the year.

The findings also revealed that the nature of the questions designed influence learners' performance at the end of the year. Both short and structured questions were the types of questions that teachers were expected to design and include in learners' tasks/ activities. The study revealed that there were inconsistencies in the way teachers designed tasks for tests/ activities. Some teachers indicated that they designed tasks consisting of short questions only and some claimed that they designed tasks consisting of both short and structured questions. The responses indicated that tasks that were entirely short questions were less likely to assist learners in answering structured questions. Supporting this, Stein et al. (1996) advocate that low-level tasks virtually never result in high-level engagement. It could be construed from this finding that learners were deprived the opportunity to engage in high level tasks. In the same vein, learners' conceptual understanding and problem solving skills were not promoted. As a result, learners were at risk of

forgetting learned facts and procedures. This might be a contributing factor to low performance in national examinations.

Familiarity was one of the main reasons given by participating teachers to justify why teachers should design both short and structured questions. This finding supported by Berger et al. (2010) findings. In their study, they found out that the level of thinking required by a task depends on learners' familiarity. Learners who are not familiar with the task cannot successfully achieve the cognitive demand level of that specific task.

On what basis do the participating teachers select items for classroom tests?

In response to this research question, the findings revealed that selected teachers designed tasks for tests and examinations according to the basic requirements of and competencies in the syllabus. Learning objectives were the basis from where teachers sourced, developed and/ or designed questions. Questions designed by the participating teachers directed learners towards the achievement of learning objectives and indeed towards the basic competencies stipulated in the syllabus. In a nutshell, knowing the learning goals assisted participating teachers in setting appropriate tasks for their learners. This finding aligned with Stein et al. (2000) who assert that it is vital to be clear about one's goals for student learning. Once learning goals for students have been clearly articulated, tasks can be selected or created to match these goals.

Regarding the issue of sourcing tasks, this study revealed that past test and examination papers, past external end-of-year examination papers and textbooks were the main teachers' source when setting/ designing mathematics tasks. Other sources such as internet and teachers' manual were also identified by some of the teachers in this study. Interestingly, only one teacher appeared to design and construct new mathematics tasks. This resonates well with Yeo (2004) who claimed that designing mathematical tasks that are new and original is a demanding and challenging activity.

4.5.3 SYNTHESIS OF ENTIRE TASKS ANALYZED AND TEACHERS' INTERVIEWS

Items analysed in this study indicated that most of the teachers' tests were constructed from the external examination papers. This was confirmed by the three teachers interviewed in this study. Teachers extracted questions as they were, without changing anything. Questions that were poorly constructed in the external examinations perpetuated in teachers' tests. This resonates with Yeo (2004) who asserts that teachers often tend to simply modify questions from past question papers, textbooks and other resources by just changing the number and perhaps the context. As a result, set questions tend to perpetuate low cognitive demand levels and are poorly designed.

4.6 CONCLUSION

This chapter presented the analysis and discussions of the quantitative data, obtained from Grade 10 teachers test and national examination items, and qualitative data obtained through one-on-one structured interviews with the participants. The findings of this study indicated that there were no substantial differences in the distribution of Stein et al.'s levels of cognitive demand between the teachers' test items and the national examination items. Both the teachers' test and national examination items were predominantly made up of low level cognitive demand tasks. Teachers' test items were mostly constructed from past examination papers, textbook, and past national examinations. Consequently, poorly constructed examination items also appeared in teachers' tests. It can thus be argued that this practice perpetuates a practice of engaging mainly with mathematical tasks that demand a low level of cognitive engagement. The next chapter concludes this study.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter serves to conclude the study and suggest recommendations for possible future research. The chapter reviews the objectives of the study and presents a summary of the findings. The chapter concludes by presenting the limitations of the study and a brief personal reflection.

5.2 THE OBJECTIVES OF THE STUDY

The purpose of this study was to research the nature of questions used in Grade 10 mathematics test items and national examinations items in the Eenhana district in the Ohangwena region of Northern Namibia using Stein et al.'s framework of cognitive demand. For the realization of this goal, the study was guided by the following research questions:

1. How do Grade 10 Mathematics test items compare with the end-of-year examinations in terms of Stein et al.'s (2000) framework of cognitive demands?

2. What are selected teachers' views on the relationship between test items and national examination items?

3. On what basis do the participating teachers select items for classroom tests?

5.3 SUMMARY OF THE FINDINGS

A summary of the findings of this study are presented and discussed according to the research questions.

How do Grade 10 Mathematics test items compare with the end-of-year examinations in terms of Stein et al.'s framework of cognitive demands?

In response to this question the following were found:

- There were no substantial differences in the distribution of levels of cognitive demand between the teachers' test items and the national examinations items. Only a difference of 3% existed between the two. This indicated that tests and examinations items analysed in this study were reasonably well aligned in terms of Stein et al.'s framework of cognitive demands that they made of the learners.
- The majority of the tasks in both teachers' tests (88%) and national examinations items (85%) however, required predominantly low level cognitive demands. They fitted into Stein et al.'s procedures without connections category. This indicated that tasks were mostly procedural and routine in nature.
- High level tasks were underrepresented in both teachers' tests (12%) and national examinations items (15%). There was not a single task in the teachers' tests coded at Stein et al.'s level 4 category of high cognitive demand with only 1% of national examination items found in this category.

What are selected teachers' views on the relationship between test items and national examination items?

In response to this question the findings revealed that teachers perceived tests and national examinations items as being closely related and aligned. The study showed that both test and examinations assessed the same contents and basic competencies found in the mathematics syllabus. The teachers did not feel that the test and examination items should assess different skills. So there was a valid reason for the tests and examinations to be aligned. Two of the teachers suggested that the test items and examinations items were supposed to be directly proportional.

However, one teacher indicated that the relationship between the test and examination items should not necessarily align and can, therefore, not be compared. The teachers felt that, often, teachers' tests contained too easy and short questions compared to the national examinations. They stated this was one of the reasons why learners perform poorly in national examinations.

On what basis do the participating teachers select items for classroom tests?

All three teachers responded that test and examination items were developed based on the basic competencies and requirements of the syllabus. Being familiar with the learning goals enabled teachers to design appropriate tasks for the learners. The study revealed that teachers sourced mathematical tasks mainly from past question papers and past national examinations. Other sources indicated were teacher manuals and the internet. Interestingly, only one teacher indicated that she constructed some of the tasks herself. It was evident from my analysis of the teachers' test items and examinations items that most of the teachers' tasks were extracted from the national examination question papers. The analysis revealed that most of the teachers' test items were extracted from the national examinations without any modification.

5.4 LIMITATIONS

The study was very small in scale. The research findings are thus not necessarily generalizable. The number of test items analysed in this study was not as I initially intended as most teachers were unable to find the test items they used in 2013. Therefore, the results of this study pertained to my participants only.

5.5 LESSON LEARNT

In retrospect the interview data was not as rich as I hoped. It was thus not easy to find answers to the last two research questions in this study. As my analysis progressed I realized that most of my interview questions were not relevant and did not relate to my main research questions. If I were to conduct this study again, I would analyse teachers' test items first and only construct interview schedules later to follow up on the results obtained from the analysis. I would also interview setters

for the national examinations to find out their rationale behind designing/ setting examination tasks.

5.6 RECOMMENDATIONS

From the findings of this study it is recommended that:

- Teachers' and examination setters should include more tasks that require higher levels of cognitive demand. They should include tasks that not only assess procedural skills but also doing mathematical skills.
- Continuous Assessment (CA) tasks/ activities should reflect what learners would expect to find in the end-of-year examination.
- When adapting questions from past examination papers and national examination papers, teachers should be more creative and innovative to avoid poorly designed questions, thus perpetuating a cycle of low cognitive demand tasks.
- This study was only conducted in three schools in one Circuit. Similar studies should be conducted in other regions with a larger sample for better representation.

5.7 REFLECTIONS

This study was of great significance to me. It afforded me an opportunity to reflect critically as a teacher and a regional examination setter on how we select tasks for tests and examinations. It enabled me to understand the purpose of using assessment frameworks to categorize questions according to their levels of cognitive demand when setting test and examination tasks. During the entire process of researching and writing I was able to grow as an academic writer and indeed as a novice researcher.

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APPENDICES

Appendix A: Classroom based test items

Test items for teacher B

Teacher B **Mathematics Test 1** **Grade 10**

1. Express
   (a) 0.78 kg in grams. [1]

Coding: 2
Justification of my grading and Comments
This task requires learners to recall memorized equivalent forms between kilograms and grams and carry out conversions of kilograms to grams using standard conversion algorithms in the absence of additional context or meaning (e.g. 1kg=1000g, 0.78kg =x, then x= 1000 × 0.78=780 grams). One needs to use the unitary method and perform the procedure of multiplication in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) 38 200 ml in litres. [1]

Coding: 2
Justification of my grading and Comments
This task requires learners to recall memorized equivalent forms between millilitres and litres as well as carry out conversions of millilitres and litres using standard conversion algorithms in the absence of additional context or meaning (e.g. 1litres=1000ml, 38 200 ml =$x$litres, then x=$\frac{38\,200}{1000}$ = 38.2 litres). One needs to use the unitary method and perform the procedure of division to get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

2. Write down one of the symbols <; > or = that will make the statement true:

(a) -3 ….. -4 [1]

Coding: 1

Justification of my grading and Comments

This task requires learners to recall previously learnt facts about number line (e.g. numbers on the left side of a number line are less than number of the right side) in order to perform correct ordering. I thus placed this task in the memorization category of low cognitive demand.

(b) 2^4 …… 4^2 [1]

Coding: 2
Justification of my grading and Comments
This task requires learners to use the calculator to work out 2^4 and 4^2. After knowing the values of the two numbers, learners will be able to insert the correct symbol. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) $\sqrt[3]{27}$ …… $16 - \sqrt[3]{27}$ [1]

Coding: 2
Justification of my grading and Comments
This task requires learners to use the calculator to work out the values of the numbers given. After knowing the values of the two numbers learners will be able to insert the correct symbol. I thus placed this task in the procedures without connections category of low cognitive demand.

(d) 7^0 …….. 7 [1]

Coding: 2
Justification of my grading and Comments
This requires learners to recall previously learnt indices rule about numbers to the power of zero ($7^0 = 1$) or use the calculator to find the value of 7^0. Once learners use the law of indices and find out that $7^0 = 1$ they will be able to insert the correct symbols and produce the correct answer. There is no in-depth thinking involved. I thus placed this task in the procedures without connections category of low cognitive demand.

3. Selma, Wilma, and Bertha need N$ 21 000 to start a salon business.

(a) (i) They borrowed $\frac{2}{5}$ of this amount. How much did they borrow? [2]

Coding: 2
Justification of my grading and Comments

In this task learners will use the usual procedure of finding required numbers using the procedure of multiplication. (multiplying the fraction with the amount given e.g.) For example, learners just need to add the ratios together and express the ratio of mathematics marks as fraction of the total ratios and multiply it with 120 which is the total mark of three tests ($\frac{3}{12} \times 120 = 30$). Learners usually use these procedures mindlessly they just focus on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(ii) They contributed N$ 12 600 amongst themselves in the ratio of Selma: Wilma: Bertha = 5:4:3. Calculate the amount Wilma contributed. [2]

Coding: 2
Justification of my grading and Comments
In this task learners are required to use the usual procedure of finding required number using the ratio. Learners would just need to know and follow the procedures of addition, division and multiplication (e.g. $5+4+3=12$ then $\frac{4}{12} \times 12\ 600 = 4200$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) (i) The salon equipment costs 35% of the N$ 21 000. Calculate the cost of the equipment. [2]

Coding: 2
Justification of my grading and Comments
In this task learners are required to use the usual procedure of using fraction and total cost to find the required number. Learners would just need to know and follow the procedures of division (converting percentage to fractions) and multiplication (e.g. $\frac{35}{100} \times 21\ 000 = 7350$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(ii) They needed to buy the hair products. The hair product cost N$ 6 500. Write this as a fraction of N$ 21 000. Give your answer in its lowest terms. [2]

Coding: 2
Justification of my grading and Comments

This task requires learners to follow the procedure of writing numbers as fractions in simplest form/ procedure of division (e.g. $\frac{6500}{21\,000} = \frac{13}{42}$). The task does not require connection to the concept being used and does not aim at developing mathematical understanding rather than producing correct answer only. I classified this task as procedures without connection of low cognitive demand.

(iii) How much remains of the N$ 21 000 now? [1]

Coding: 2
Justification of my grading and Comments
This task requires learners to use the usual procedure of subtraction to get the remaining amount. (e.g. 21 000- (i) + (ii) that is now 21 000- 7350+6500= 6650). There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I considered this task as procedures without connection of low cognitive demand.

4. Find the value of $\frac{3}{5} - \frac{3}{7}$ [2]

Coding: 2
Justification of my grading and Comments
This task requires learners to use the usual procedure of subtraction of fractions to get the value of the fractions given. Learners can also use the calculator to work out the values of the fractions given. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I considered this task as procedures without connection of low cognitive demand.

5. A shop owner advertises the sale of a computer with two payment options as shown below.

Option 1: Pay cash price of N$8 900.

Option 2: Pay a deposit of 15% of the cash price followed by 24 monthly instalments of N$400.75 each (hire purchase).

Peter chooses **Option 2** to buy the computer.

(a) Calculate the deposit peter has to pay. [2]

Coding: 2
Justification of my grading and Comments

In this task learners are required to use the usual procedure of using fraction and total cost to find the required number. Learners would just need to know and follow the procedures of division (converting percentage to fractions) and multiplication (e.g. $\frac{15}{100} \times 8900 = 1335$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I considered this task as procedures without connections of low cognitive demand.

(b) Calculate the total amount that Peter will have to pay for the computer. [2]

Coding: 2
Justification of my grading and Comments
This task requires learners to use the usual learnt procedure of getting total amount given deposit and the monthly instalments (e.g. 15% + (24×400.75) = 1335+ 9618=10953). There is no in-depth thinking involved as the deposit has been calculated in the previous part of this question part (a) and the number of months is clearly stated. Learners need only to follow the steps to produce correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) Calculate the difference between the cash price and hire purchase price. [1]

Coding: 2
Justification of my grading and Comments
This task again build on the previous one (question 5 (b). It only requires learners to follow the procedure of subtraction (hire purchase price-cash price= 10953-8900=2053) in order to produce the correct answer. There is no in-depth thinking involved as the hire purchase price has been calculated in the previous part of this question part (b) and the cash price is already given in **option 1.** I thus placed this task in the procedures without connections category of low cognitive demand.

6. The wrapper of a 250 g pack of butter is marked off into 5 equal parts. Anna uses 2 parts for frying and 3 parts for baking. Find the amount of butter in grams used for frying. [1]

Coding: 2
Justification of my grading and Comments
In this task learners are required to use the usual procedure of using fraction and total cost to find the required number. Learners would just need to know and follow the procedures of division (converting percentage to fractions) and multiplication (e.g. $\frac{15}{100} \times 8900 = 1335$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answer only. I considered this task as procedures without connections of low cognitive demand.

7. A ship sails at a steady speed and covers a distance of 440 kilometres in 4 days.

(a) How many kilometres will it cover in one day? [1]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedure of unitary method to determine the number of kilometres that will be covered in one day (e.g. $440km = 4\ days$ then $x\ km = 1\ day$, to find x one can cross multiply and follow the procedure of division ($\frac{440}{4} = 110$). Once learners follow these procedures they can get the correct answer, although they do not know why the procedure is being used. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) How many kilometres will it cover in 6 days? [1]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedure of unitary method to determine the number of kilometres that will be covered in six days. Learners are expected to follow the procedure of multiplication ($6\times 110 = 660$) or division ($\frac{440\times 6}{4} = 660$) to get the correct answer. Once learners follow these procedures they can get the correct answer, although they do not know why the procedure is being used. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) How long will it take to cover 1210 kilometres [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedure of unitary method to determine the number of days required to cover 1210 kilometres. Learners are expected to follow the procedure of multiplication ($1210\times 4 = 4840$) and division ($\frac{4840}{440} = 11$). Once learners follow these procedures they can get the correct answer, although they do not know why the procedure is being used. I thus placed this task in the procedures without connections category of low cognitive demand.

Teacher B **Mathematics Test 2** **Grade 10**

1. On a very cold day at Keetmanshoop, the temperature dropped from 11℃ to -2℃. By how many degrees Celsius did the temperature change? [1]

Coding: 2

Justification of my grading and Comments

This question requires learners to recall previously learned facts about working with directed numbers. Since the temperature dropped and the new temperature is given, learners just need to simply follow the procedure of subtraction. There is no in- depth thinking involved in this question. To get the answer learners just need to know the basic math's of subtracting directed numbers. I thus placed this task in the procedures without connections category of low cognitive demand.

2. Work out:
$\frac{496+296}{396-196}$ [1]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedures of addition, subtraction and division. There is no in-depth thinking involved in this task as the task requires learners only to work out. I thus placed this task in the procedures without connections category of low cognitive demand.

3. The diameter of the sun is 1300 000km. Write the diameter of the sun in standard form. [2]

Coding: 2

Justification of my grading and Comments

This question requires learners to recall previously learned rules of writing numbers in standard form and follow the rule in order to produce the correct answer. There is no in-depth thinking involved. What is to be written in standard form is clearly and directly stated. Thus, learners are just expected to reproduce exactly what they did in the classroom about writing numbers in standard form. I thus placed this task in the procedures without connections category of low cognitive demand task.

4. Find the next two terms of the following sequence: [2]

2 6 12 20 ……., …….

Coding: 3

Justification of my grading and Comments

This task requires learners to recognize patterns in order to determine the next terms in the sequence. Learners need to think about the relationship between the terms in the sequence and think about the procedure they need to use in order to find the next terms in the sequence. The task is testing learners' data analysis skills. I thus placed this task in the procedures with connections category of high cognitive demand task.

5. Harold's salary increased from N$ 2 050 to N$ 2 214.

(a) Find the amount by which his salary increased. [1]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedures of subtraction (N$2214- N$2050= N$164). The task does not require any explanation but focuses merely on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand task.

(b) Calculate the percentage increase. [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to use the usual procedure of finding percentage increase, i.e. $\frac{164}{2050} \times 100 = 8\%$. They usually use these procedures without knowing why the procedure is being used so long as it produces the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.

6. Penny receives N$ 1 400 for scoring 5 goals. How many goals must she score to receive N$3 920? [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedure of unitary method to determine the number of goals scored to receive 3920 (N$ 1400= 5 goals, N$ 3920= x goals then). Once they follow the procedure of multiplication and division correctly, they can obviously produce correct answers. I thus placed this task in the procedure without connections category of low cognitive demand.

7. Etuna invests N$ 300 at 8% simple interest for 4 years.

   (a) Calculate the total interest received after 4 years. [2]

Coding: 1

Justification of my grading and Comments

This task requires memorization of the formula for calculating simple interest and the use of standard algorithms to work out the total interest received after 4 years. The task does not require anything beyond the formula. Once learners know the formula they can get the interest correctly. I thus placed this task in the memorization category of low cognitive demand.

   (b) What is the total amount that he will have after 4 years? [1]

Coding: 1

Justification of my grading and Comments

This task requires memorization of the formula for calculating the total amount of money received given simple interest, i.e. Total amount= Principal amount + interest received. The task does not require anything beyond the formula. Once learners know the formula they can get the total amount correctly. I thus placed this task in the memorization category of low cognitive demand.

8. Mr Shaanika's total annual income is N$ 84 000. He pays 14% of his total income plus N$ 5 000 in taxes.

   (a) Calculate the amount of tax he has to pay. [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedures of division, multiplication and addition ($\frac{14}{100} \times N\$\ 84\ 000 = N\$\ 11760 + N\$\ 5000 = N\$\ 16\ 760$) in order to get the correct answer. There is no in-depth thinking involved in this task. I thus placed this task in the procedure without connections category of low cognitive demand.

(b) Find his salary per month after tax has been deducted. [1]

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners need to have an understanding of the term 'annual' in order to find the salary per month. To arrive at the solution, learners are required to follow the procedure of subtraction and division (N$ 84 000- N$ 16 760 = N$ 67 240/ 12= N$ 5603. 33) correctly. I thus placed this task in the procedure with connections category of high cognitive demand.

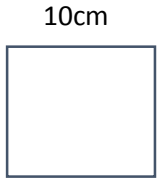
9. The original price of a haircutter is N$119.99. It is reduced to N$95.99. Calculate the percentage decrease in price. [3]

Coding: 2

Justification of my grading and Comments

This task requires learners to use the usual procedure of working out percentage decrease by following the procedures of subtraction, division and multiplication (e.g. N$119.99 – N$ 95.99= N$ 24 then, $\frac{24}{119.99} \times 100 = 20.0\%$). All learners can get correct answer if they follow the procedures correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

10. The diagram shows a square and the lengths of two sides.



(a) Use the information to write an equation to solve for x. [1]

Coding: 3

Justification of my grading and Comments
This task requires learners to have an understanding of the term 'equation' and know the relationship between the sides of a square in order to construct the equation correctly. I thus placed this task in the procedures with connections category of high cognitive demand.

(b) Find the value of x [1]

Coding: 2

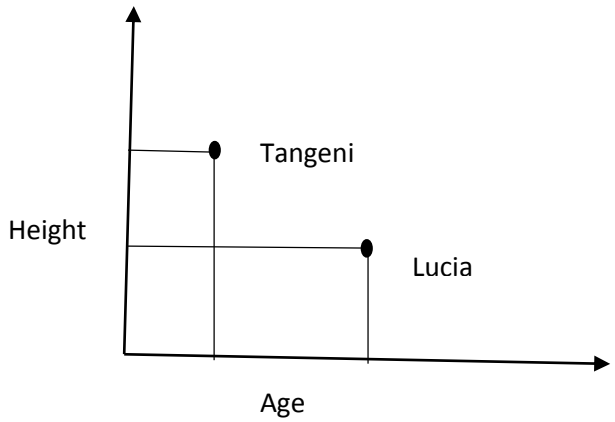
Justification of my grading and Comments
This task requires learners to follow the procedure of solving linear equation in one unknown (collecting like terms and dividing) in order to get the correct answer. There is no in-depth thinking involved. All learners can get correct answers if they follow the procedures correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

11. Find the value of $5x^3$ if $x = -2$. [2]

Coding: 2

Justification of my grading and Comments
In this task learners are expected to substitute letter x with the number given and work out. The question does not require in- depth thinking. Once learners substitute and work out correctly they can obviously get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

12. The diagram shows the relationship between the ages and the heights of two learners. Use the diagram to answer the following questions.



(a) Explain why Tangeni's point is above Lucia's point on the graph. [1]

Coding: 3

Justification of my grading and Comments
This task requires some degree of cognitive effort, as no algorithm or procedure has been previously given that addresses the situation in this form. Learners are expected to think critically in order for them to be able to interpret the diagram shown. I thus placed this task in the procedures with connections category of high cognitive demand.

(b) Who of Tangeni and Lucia is the eldest? [1]

Coding: 3

Justification of my grading and Comments
This task requires some degree of cognitive effort, as no algorithm or procedure has been previously given that addresses the situation in this form. Learners are expected to think critically in order for them to be able to interpret the diagram shown. I thus placed this task in the procedures with connections category of high cognitive demand.

Teacher B **Mathematics Test 3** **Grade 10**

1. 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70

From the list of numbers above, write down

(a) A square number [1]

(b) A prime factor of 305 [1]

(c) A multiple of 7 [1]

(d) Two prime numbers [2]

Coding: 1

Justification of my grading and Comments

These tasks ((a), (b), (c) and (d)) require learners to recall previously learnt definitions of the terms used in each task in order to produce correct answers. The tasks cannot be solved using a procedure because a procedure does not exist. Once learners know the meaning of each term they can obviously get the correct answer. I thus placed these tasks in the memorization category of low cognitive demand.

(e) The difference between 33 and -35 [1]

Coding: 2

Justification of my grading and Comments

This task require learners to follow the procedure of subtraction (33- -35). The task requires no explanation but focus on producing correct answer only. I thus placed this task in the procedures without connections category of low cognitive demand.

2. Building work will take one man 160 hours to complete.
   (a) How long will it take 4 men? [2]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive demand. It requires learners to follow the procedure of unitary method and carry out division ($\frac{1man \times 160\ hours}{4\ men}$= 40 hours) in order to get the correct answer. The task does not require any explanation. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Each man is paid N$ 3.50 per hour. How much will each of the four men get? [2]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive demand. It requires learners to follow the procedure of unitary method and carry out multiplication and division correctly ($\frac{40\ hours \times N\$3.50}{4\ men}$= N$ 35) in order to get the correct answer. The task does not require any explanation but focus on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

3.

(a) Simplify

(i) $6x(2-3y)$ [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of 'distributive law' in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure. I thus placed this task in the procedures without connections category of low cognitive demand.

(ii) $6a^2 \times 5a$ [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of multiplication of algebraic terms in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure. I thus placed this task in the procedures without connections category of low cognitive demand.

(iii) $3x-5y+7x+6y$ [2]

Coding: 2

Justification of my grading and Comments
This task is algorithmic. It requires learners to follow the procedure of addition and subtraction of like terms in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Solve the equation $6y - 5 = 13$ [2]

Coding: 2

Justification of my grading and Comments
This task is algorithmic. It requires learners to follow the procedure of solving linear equations in one unknown (procedure of addition and division) in order to produce the correct answer ($6y = 13 + 5, 6y = 18, y = 3$). There is no in-depth thinking involved. Once learners follow the procedures correctly they can obviously produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

4.

(a) Mr Uirab buys nine DVD players for N$ 425.00 each. Calculate the total cost for nine DVD players. [2]

Coding: 2

Justification of my grading and Comments
This task requires limited cognitive demand. It requires learners to follow the procedure of multiplication (9×425=3825) or addition which is evident based on the placement of tasks. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Mr Uirab sells the DVD players in his shop for N$ 595.00 each. Calculate the percentage profit he makes on each one. [2]

Coding: 2

Justification of my grading and Comments
This task is algorithmic. It requires learners to follow the procedure of subtraction and express one quantity as a percentage of another (595 – 425= 170, $\frac{170}{425} \times 100 = 40\%$). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) A television set in Mr Uirab's shop costs N$ 442.00. Mr John buys a television set and a DVD player from Mr Uirab's shop. He is given a discount of 15% on the total price. Calculate how much Mr John pays. [3]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedures of addition, subtraction and multiplication (N$442 + N$425= N$867, 100 -15 = 85, $\frac{85}{100} \times N\$\ 867 = N\$\ 736.95$) based on the placement of the task. This task focuses on producing correct answers rather than developing mathematical understanding. I thus placed this task in the procedures without connections category of low cognitive demand.

5. Mandy was given this recipe for rock cakes by her grandmother. These quantities make 6 rock cakes.

   Rock Cake
   240 g flour
   150 g sugar
   150 g margarine
   210 g dried fruit
   2 large eggs

(a) How much sugar does Mandy need to make 8 rock cakes? [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of unitary method ($\frac{150\times8}{6} = 200g$) in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Mandy has only 100g of margarine but has plenty of all the other ingredients. How many rock cakes can she make? [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. The use of produce is evident from the prior instruction in the task. Learners can follow the procedure of unitary method to produce correct answer ($\frac{100\times6}{150} = 4\ rocks$). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

6. In 2010, 80% of 1800 000 Namibians owned cellphones.
   (a) Calculate the number of Namibians who owned cellphones in 2010. [1]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of expressing percentage as a fraction and multiply by the quantity given ($\frac{80}{100} \times 1800\ 000 = 1440\ 000$ Namibians). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

   (b) Give the fraction of Namibians who did not own a cellphone in 2010. Give your answer in simplest form. [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of subtraction and express one quantity as a percentage of another (595 – 425= 170, $\frac{170}{425} \times 100 = 40\%$). The task requires no explanation but focus merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

   (c) Mr Simaata signed a contract with a local cellphone company to buy a cellphone. He pays a once-off connection fee of N$ 218.00 as well as a monthly fee of N$ 179.00 for two years. Calculate the total amount he pays for the cellphone for two years. [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. The use of procedure is evident based on the prior instruction in the task. The task requires learners to follow the procedure of multiplication and addition (218 + (179× 24 months) = 4514) in order to get the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

   (d) Ms Samuel bought the same cellphone as Mr Simaata, at a cash price of N$ 2500. She buys N$ 50.00 prepaid airtime for her monthly usage.
   (i) Calculate the total amount Ms Samuel would have spent on the cellphone and its usage for two years. [2]

Coding 2

Justification of my grading and Comments

This task requires limited cognitive demand. It requires learners to follow the procedure of multiplication and addition (2500 + (50× 24 months) = 3700) in order to get the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

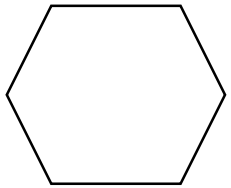
(ii) Work out how much money Mr Simaata would have saved if he had bought the cellphone through Ms Samuel's method. [1]

Coding 2

Justification of my grading and Comments

This task is algorithmic. The use of procedure is evident based on the prior instruction in the task. The task requires learners to follow the procedure of multiplication and addition (218 + (179× 24 months) = 4514) in order to get the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

7. The diagram shows a regular hexagon.



(a) How many lines of symmetry are there in a hexagon? [1]

Coding 1

Justification of my grading and Comments

This task requires limited cognitive demand. It requires learners to recall and use the previously learnt definition of 'line of symmetry' to identify the number of line of symmetry a hexagon is having. Learners can also recall learnt facts about the number of line of symmetry in a hexagon (the number of sides = number of line of symmetry). Once learners know the meaning of each term they can obviously get the correct answer. I thus placed these tasks in the memorization category of low cognitive demand.

(b) Calculate the sum of the interior angles in a regular hexagon. [1]

Coding 1

Justification of my grading and Comments

This task requires learners to use the memorized formula of finding the sum of interior angles ($180(n-2)$) in order to produce the correct answer. The task does not require any in-depth thinking but focuses merely on producing the correct answer. I thus placed these tasks in the memorization category of low cognitive demand.

(c) Calculate the value of one interior angle in a regular hexagon. [1]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of division ($\frac{720}{6} = 120^\circ$). The task requires no explanation but focus merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(d) Calculate the value of one exterior angle in a regular hexagon. [1]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow either the procedure of division ($\frac{360}{6} = 60^\circ$) or multiplication (180-120=60°). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

Test items for teacher C

Teacher C **Mathematics Test 1** **Grade 10**

1.1. Calculate and write your answer in standard form

(a) $\sqrt[3]{\frac{3}{13}}$ [2]

(b) 3420×510 [2]

Coding: 2

Justification of my grading and Comments

These tasks ((a) and (b)) require limited cognitive demand. Learners are expected to work out correctly in each task (they can use the calculator) in order to write the answer in standard form. To arrive at the solution, learners are required to recall and follow previously learnt rules of writing numbers in standard form. There is no in-depth thinking involved but focuses solely on following the rules learnt. I thus placed these tasks in the procedures without connections category of low cognitive demand.

1.2. Write your answer correct to **3 significant figures**

(a) $\frac{60}{3+14}$ [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners first to follow the procedure of addition and division ($\frac{60}{17} = 3.53$). Learners are then expected to recall previously learnt rules of rounding numbers to significant figures. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) 0.6134 [1]

Coding 1

Justification of my grading and Comments
This task requires learners to recall previously learnt rules of rounding numbers to significant figures. There is no in-depth thinking. What is to be written correct to 3 significant figures is clearly and directly stated. There is no working involved. I thus placed these tasks in the memorization category of low cognitive demand.

2. The table below shows the temperature of five European cities on a winter night.

City	**Temperature**
London	1℃
Oslo	-12℃
Rome	2℃
Frankfurt	-3℃
Paris	-5℃

(a) Write down the lowest temperature [1]

Coding 1
Justification of my grading and Comments
This task requires knowledge of a number line. Learners are expected to recall learnt facts about directed numbers in order to determine the lowest temperature. There is no in-depth thinking involved. I thus placed these tasks in the memorization category of low cognitive demand.

(b) Find the difference between Rome and Paris [2]

Coding 2
Justification of my grading and Comments
This task requires limited cognitive demand. It requires learners to follow the procedure of subtraction (2 – (-3) =5) in order to get the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) What temperature is halfway between 1℃ and -3℃ [2]

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort, as no algorithm or procedure has been previously given that addresses the situation in this form. Learners are expected to think critically and engage with the term 'halfway' in order to follow the procedures of addition and division ($\frac{1+(-3)}{2} = -1$). I thus placed this task in the procedures with connections category of high cognitive demand.

3. A manufacturer sells weed killer in two sizes. The bargain pair contains 550g and costs N$ 8.50. The value pair contains 0.8kg and costs N$ 12.50.
   (a) In the bargain pack, how many grams of weed killer do you get for N$ 1? [1]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of unitary method ($\frac{N\$1\times 550g}{N\$8.50} = N\$\ 64.71$) in order to produce the correct answer. The task requires no explanation but focus merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

   (b) In the value pack, how many grams of weed killer do you get for N$ 1? [1]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It first requires learners to recall memorized equivalent forms between kilograms and grams using standard conversion algorithms. Then, the task requires learners to follow the procedure of unitary method in order to arrive at the final answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

   (c) Which of these two packs is the better value for money? [1]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive demand. It requires learners to compare the answers obtained in part (b) and (c) in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

4. Tickets for church concert cost N$ 14.50 each and a programme costs 45 cents each.
The table below shows the number of tickets programmes sold.

Day	**Tickets**	**Programmes**
Friday	186	125
Saturday	204	115
Sunday	222	105

(a) Find the total number of people who attended the show [2]

Coding: 2

Justification of my grading and Comments
This task is algorithmic, and there is little ambiguity on how to complete the task successfully. Learners are expected to add the number of tickets sold in all three days in order to produce correct answers. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Calculate the total income from the concert. [3]

Coding: 3

Justification of my grading and Comments
This task requires some degree of cognitive effort. It requires learners to think about the procedure they have to use in order to get the total income. Learners can then follow the procedures of multiplication and addition). I thus placed this task in the procedures with connections category of high cognitive demand.

Teacher C **Mathematics Test 2** **Grade 10**

1. Simplify the following:

(a) 12: 18:24 [2]

Coding: 2

Justification of my grading and Comments
This task requires limited cognitive demand. It requires learners to recall and follow the procedure of finding highest common factors of the numbers given in order to simplify the ratio. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) $\frac{3}{7}: \frac{1}{7}$ [2]

Coding: 1

Justification of my grading and Comments
This task requires learners to recall previously learnt facts about simplifying ratios in fraction form. Since the denominators are the same in this task, learners would just simply cancel the denominator out. The task does not require any in-depth thinking but focuses merely on producing the correct answer. I thus placed these tasks in the memorization category of low cognitive demand.

2. 120 000 new cars were registered in 2013.

(a) $\frac{1}{4}$ of the cars were Saloon cars. Find the number of Saloon cars [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to use the usual procedure of finding required numbers given fractions. Learners need to follow the procedure of multiplication. (Multiplying the fraction with the amount given, e.g. $\frac{1}{4} \times 120\,000 = 30\,000$). Learners usually use these procedures mindlessly they just focus on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) 30% of the cars were mini-buses. Calculate the number of mini-buses. [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the usual procedure of finding a percentage of a quantity using percentage. Learners are expected to follow the procedure of division and multiplication ($\frac{30}{100} \times 120\ 000 = 36\ 000$). Learners usually use these procedures mindlessly they just focus on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) The rest of the cars are Lorries. What fraction of the cars were Lorries? [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedure of subtraction ($120\ 000 - 36\ 000 = 84\ 000$) and writing numbers as fractions ($\frac{84\ 000}{120\ 000} = \frac{7}{10}$). Learners just need to follow the instructions accordingly in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

3. The table shows the electricity meter readings for a household in Eenhana for January 2014.

Meter readings (in kilowatt hours)

Previous	**Current**	**Consumption**
94962	95433	_____

(a) Find the number of units of electricity that were used in January 2014. [1]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive demand. It requires learners to follow the procedure of subtraction ($95433 - 94962 = 471$). Learners are expected to follow the instructions accordingly in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Electricity in Eenhana costs N$1.55 per unit. Calculate the amount charged for the electricity consumption for January 2014. [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of unitary method ($471 \times 1.55 = N\$\ 730.05$) in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

4. Mr Toivo works for Security Services limited. Next is his salary pay slip for the month of December 2013.

Security Services Limited

Date:	31 December 2013
Name:	A. J. Toivo
Salary Number:	16579
Basic salary (Gross):	N$6200.00
Deductions:	
Income Tax	N$ 690.60
Medical Aid	N$ 320.00
Pension Fund	_____
Total	_____
Net salary	_____

(a) Calculate Mr Toivo's annual salary. [1]

Coding: 2

Justification of my grading and Comments
This task is algorithmic. It requires learners to recall the definition of the term 'annual' and follow the procedure of multiplication (N$ $6200 \times 12 = N\$\ 74\ 400$). The task requires no explanation. All learners taught this topic can follow the procedure and get the answer correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) His pension contribution amounts to 7% of his basic (gross) salary. Calculate the amount he contributes to his pension. [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the usual procedure of finding a percentage of a quantity using percentage. Learners are expected to follow the procedure of division and multiplication ($\frac{7}{100} \times 6200 = N\$\,434$). Learners usually use these procedures mindlessly they just focus on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) Find the total value of his deductions [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of addition evident from the word 'total' used in the task ($N\$\,690 + N\$\,320 + N\$\,434 = N\$\,1444$) in order to produce the correct answer. The task requires no explanation but focus merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(d) Find his net salary [2]

Coding: 2

Justification of my grading and Comments

This task is algorithmic. It requires learners to recall the definition/ meaning of the term 'net salary' and follow the procedure of subtraction correctly (N$ 6200 – N$ 1444= $N\$\,4756$). The task requires no explanation. All learners taught this topic can follow the procedure and get the answer correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

Teacher C **Mathematics Test 3** **Grade 10**

1.1. From the list of numbers , write down

$3\frac{1}{2}$, $\sqrt{-2}$, 3, $\sqrt[3]{-30}$, 8

(a) Prime number [1]

(b) Cube number [1]

(c) Non-real number [1]

(d) Rational number [1]

(e) Irrational number [1]

Coding: 1

Justification of my grading and Comments

These tasks ((a), (b), (c), (d) and (e)) require learners to recall previously learnt definition of the terms used in each task in order to produce correct answers. The tasks cannot be solved using a procedure because a procedure does not exist. Once learners know the meaning of each term they can obviously get the answer correctly. I thus placed these tasks in the memorization category of low cognitive demand.

1.2. Calculate, where, needed, round off your answer to 2 decimal places.

(a) π [1]

(b) $\sqrt[3]{12}$ [1]

(c) $\frac{\sqrt[3]{125}}{5}$ [1]

Coding: 2

Justification of my grading and Comments

These tasks are algorithmic. It requires learners first to work out the given numbers (mainly just by using the calculator). Learners are then expected to recall previously learnt rules of rounding numbers to 2 decimal places The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed these tasks in the procedures without connections category of low cognitive demand.

1.3. Write down the following numbers in standard form.

(a) 0.00022 [2]

(b) 321000 [2]

Coding: 2

Justification of my grading and Comments

These tasks ((a) and (b)) require learners to recall and follow previously learnt rules of writing numbers in standard form. There is no in-depth thinking involved. What is to be written in standard form is clearly and directly stated. I thus placed these tasks in the procedures without connections category of low cognitive demand.

2. Simplify the following;

(a) $3^2 \times 3^0$ [1]

(b) $(a^2)^2$ [1]

(c) $4^x \times 3^x$ [1]

(d) $3a \times 2a$ [1]

Coding: 1

Justification of my grading and Comments

These tasks ((a), (b), (c) and (d)) require learners to recall previously learnt 'law of indices' and multiplication of algebraic terms. The tasks require no explanation but focus merely on using the laws correctly in order to produce correct answers. I thus placed this task in the memorization category of low cognitive demand.

3.1. In a group of 300 school children $\frac{1}{3}$ are lower primary learners, $\frac{1}{2}$ are upper primary learners and the rest are junior secondary learners.

How many learners are in the

(a) Lower primary phase [2]

(b) Upper primary phase [2]

Coding: 2

Justification of my grading and Comments

These tasks require learners to use the usual procedure of finding required number given fraction. Learners need to follow the procedure of multiplication. (Multiplying the fractions with the amount given, e.g. $\frac{1}{3} \times 300 = 100$ and $\frac{1}{2} \times 300 = 150$). There is no in-depth thinking involved but the tasks focus on following the procedures correctly in order to produce the correct answer. I thus placed these tasks in the procedures without connections category of low cognitive demand.

(c) Junior secondary phase [2]

Coding: 2

Justification of my grading and Comments

This task requires learners to follow the procedure of subtraction ($3000 - (a) - (b) = 300 - 100 - 150 = 50$). The use of the procedure is evident in this task from prior instruction in the task (the rest are junior secondary). Learners just need to follow the instructions and work out accordingly in order to produce the correct answer. There is no in-depth thinking involved. I thus placed this task in the procedures without connections category of low cognitive demand.

3.2. Kandiwapa is seven years old and Natangwe is nine years old, have to share 4800ml of milk in the ratio of their ages.

How many millilitres of milk will:

(a) Natangwe get? [2]

Coding: 2

Justification of my grading and Comments

In this task learners are required to use the usual procedure of finding required number using the ratio. Learners would just need to know and follow the procedures of addition, division and multiplication (e.g. $7+9 = 16$, then $\frac{7}{16} \times 4800 = 2100$) in order to produce the correct answer. There is no in-depth thinking

involved but the task focus on following the steps to produce correct answer only. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Kandiwapa get? [2]

Coding: 2

Justification of my grading and Comments

In this task learners are required to use the usual procedure of finding required number using the ratio. Learners would just need to know and follow the procedures of addition, division and multiplication (e.g. $7+9=16$, then $\frac{9}{16}\times 4800=2700$) in order to produce the correct answer. There is no in-depth thinking involved but the task focuses on following the steps to produce correct answer only. I thus placed this task in the procedures without connections category of low cognitive demand.

3.3. The 50kg Mahangu meal can feed 8 people for 30 days.

(a) For how long will the same bag last for 3 people? [2]

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners need to analyse the task critically (identify whether it is a direct or indirect proportional task) in order to choose the correct method and follow procedures of multiplication and division correctly, i.e. $8\times 30=240\div 3=80\ days$. I thus placed this task in the procedures with connections category of high cognitive demand.

(b) How many people will feed on the same bag for 40 days? [2]

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. Learners need to analyse the task critically (identify whether it is a direct or indirect proportional task) in order to choose the correct method and follow procedures of multiplication and division correctly, i.e.$8 \times 30 = 240 \div 40 = 6\ people$. I thus placed this task in the procedures with connections category of high cognitive demand.

4.1. This table shows a municipal bill for Mrs Shikongo.

EENHANA TOWN COUNCIL

Mrs Shikongo

Account No. 242425

Po box 12 Eenhana Account period: 12/06/2011-12/07/2011

12/07/2011

Water meter reading			**Description**	**Amount in N$**
Previous	Current	Units used/kl	Water basic/kl	39.84
(a)	3789	24	Water consumption	193.20
			Sewerage	(c)
			Refuse removal	19.00
			Sub-total	**278.04**
			VAT	41.71
			Total amount due	**319.75**

(a) Calculate the previous water meter reading. [1]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive effort and there is a little ambiguity on how to complete the task. The task requires learners to follow the procedure of subtraction in order to produce correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Work out the cost of water per unit in N$/kl [1]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive effort. The task requires learners to follow the procedure of unitary method to get the cost of water per unit. The task requires no explanation but appears to focus on producing the correct answer than fostering mathematical understanding. I thus placed this task in the procedures without connections category of low cognitive demand.

(c) How much did Mrs Shikongo pay for sewerage [1]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive effort. The task requires learners to follow the procedure of subtraction in order to produce correct answer. The procedure is evident based on the placement of the task (the cost of all other items is given and the total cost). So to find the remaining one it's obvious that one need to subtract). I thus placed this task in the procedures without connections category of low cognitive demand.

(d) Express the value of VAT as a percentage of the sub-total [1]

Coding: 2

Justification of my grading and Comments

This task requires limited cognitive effort. The task requires learners to follow the procedure of expressing one quantity as a percentage of another. There is no in-depth thinking involved. I thus placed this task in the procedures without connections category of low cognitive demand.

4.2. Mr Nakale borrowed N$ 55 000 from the bank. He has to pay back this money to the bank three years' time at the rate of 22% simple interest.

(a) How much is the interest that he has to pay? [2]

Coding: 1

Justification of my grading and Comments

This task requires memorization of the formula for calculating simple interest. The task does not require anything beyond the formula. Learners solving this task may know little about simple interest beyond the formula. I thus placed this task in the memorization category of low cognitive demand.

(b) Calculate the total amount of money he has to pay back after three years. [2]

Coding: 1

Justification of my grading and Comments

This task requires memorization of the formula for calculating total amount given simple interest. The task does not require anything beyond the formula. Once learners know the formula and use it correctly, they can obviously produce the correct answer. I thus placed this task in the memorization category of low cognitive demand.

4.3. David works for Furnmart furniture. He has a basic monthly salary of N$ 1500 and 21% commission of all goods the he sells. During March 2013, he sold furniture worth N$ 60 000.

(a) Calculate the value of commission he received. [2]

Coding: 2
Justification of my grading and Comments
This task is algorithmic. It requires learners to follow the procedure of using percentage of a quantity ($\frac{21}{100} \times 60\,000 = 12\,600$). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

(b) Calculate his total income for March 2013. [1]

Coding: 2
Justification of my grading and Comments

This task is algorithmic. It requires learners to follow the procedure of addition which is evident based on the keyword used in the task (total). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer ($N\$\ 1600 + N\$\ 12600 = N\$\ 14\ 100$). I thus placed this task in the procedures without connections category of low cognitive demand.

4.4. Given that €1=N$ 11.70

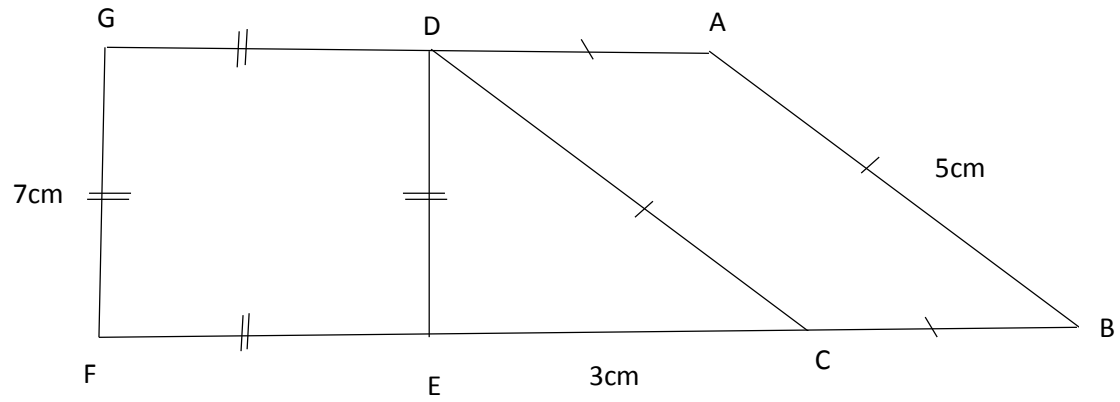
(a). Convert € 1500 to N$ and round off your answer to 2 decimal places. [2]

Coding: 2
Justification of my grading and Comments
This task is algorithmic. It requires learners first to follow the procedure of standard conversion then write the answer correct to 2 decimal places. There is no in-depth thinking involved. All learners can get the correct answer if they use the procedure correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

(b). Convert N$ 510 to Euro (€). [2]

Coding: 2
Justification of my grading and Comments
This task is algorithmic. It requires learners first to follow the procedure of standard conversion then write the answer correct to 2 decimal places. There is no in-depth thinking involved. All learners can get the correct answer if they follow the procedures correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

5.1. Study the following figure before answering the following questions.
5.2.



(a). What are the geometrical names of the following figures:

(i) ABCD [1]

(ii)DEFG [1]

(iii) CDE [1]

(iv)DCFG [1]

Coding: 1

Justification of my grading and Comments

These tasks ((i), (ii), (iii) and (iv)) require learners to recall previously learnt properties of geometrical shapes in order to determine the name. The task involves exact reproduction of seen materials. Since all learners have seen the shapes in the classroom. I thus placed these tasks in the memorization category of low cognitive demand.

(b). Find the perimeter of figure:

(i) ABFG [2]

(ii)CDE [2]

Coding: 1

Justification of my grading and Comments

These tasks ((i) and (ii)) require learners to recall previously learnt properties of geometrical shapes in order to determine the name. The tasks involve exact reproduction of seen materials. Since all learners have seen the shapes in the classroom, there is in-depth thinking involved. I thus placed these tasks in the memorization category of low cognitive demand.

(c). Find the area of figure:

(i) ABCD [3]

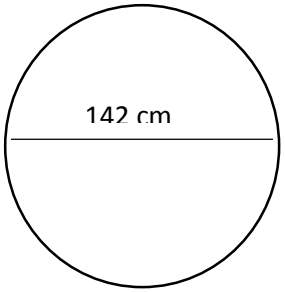
(ii) DEFG [3]

Coding: 1

Justification of my grading and Comments

These tasks ((i) and (ii)) require memorization of the formula for calculating the area of the figures given (Rhombus and a square). The task does not require anything beyond the formula. Learners solving this task may know little about the area of a rhombus and square beyond the formula. I thus placed these tasks in the memorization category of low cognitive demand.

5.2. Mr Shafuda has a dining room table with a diameter of 142 cm.



(a) Calculate the area of the table and round off your answer correct to 2 decimal places (take$\pi = 3.142$). [2]

Coding: 1

Justification of my grading and Comments

This task requires memorization of the formula for calculating the area of the circle. The task does not require anything beyond the formula. Learners solving this task may know little about the area of a circle beyond the formula. I thus placed this task in the memorization category of low cognitive demand.

(b) Find the circumference of the table [2]

Coding: 1

Justification of my grading and Comments

This task requires memorization of the formula for calculating the circumference of the circle. The task does not require anything beyond the formula. Learners solving this task may know little about the circumference beyond the formula. I thus placed this task in the memorization category of low cognitive demand.

(c) If each quest needs 46cm of space, how many quests can seat at the table? [2]

Coding: 3

Justification of my grading and Comments

This task requires some degree of cognitive effort. It requires learners to think of the procedure they can use to find the number of guests that can seat at the table. Learners who understand the relationship between circumference of a table and table space may get the correct answer. I thus placed this task in the procedures with connections category of high cognitive demand.

APPENDIX B: JUNIOR SECONDARY CERTIFICATE (JSC) NATIONAL EXAMINATION ITEMS

(a) JSC Mathematics question papers for 2011, 2012, &2013 respectively

(i) 2011 question papers

Marks 45 Additional Materials: Answer Book Non-programmable scientific calculator	JUNIOR SECONDARY CERTIFICATE EXAMINATION Subject code: 1200/1 **Mathematics** Paper 1 (Short Answer Questions) Monday, 10 October 2011 08:00 – 09:00

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Write your answers on the separate answer book provided.
- Write your Candidate Name and Number on the cover page of your answer book.
- Write in dark blue or black pen.
- Do not use correction fluid.

- Answer all questions. All working must be shown clearly.

- The number of marks is given in brackets [ ] at the end of each question or part question.
- Non-programmable scientific calculators should be used.
- If an answer is not exact, it should be rounded off to one decimal place.

This document consists of 6 printed pages.

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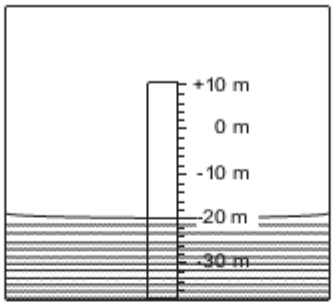
MINISTRY OF EDUCATION

1 On the 1st November the level of water in a lake was −20 metres. A month later, the water level was 3 metres higher.



Write down the new level of water. [1]

2 Write 0.007889

(a) in standard form, [2]

(b) correct to 2 decimal places. [1]

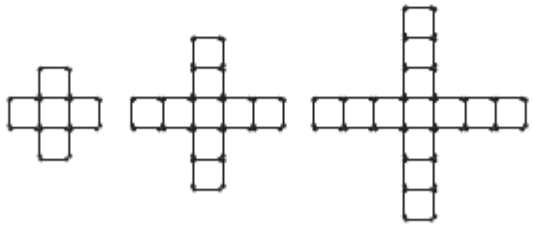
3 (a) Write 28 as a product of its prime factors. [1]

(b) Find the highest common factor of 24 and 28. [1]

4 Arison wrote 3 tests, Mathematics, English and Physical Science. His marks in the tests were in the ratio Mathematics: English: Physical Science = 3:4:5. His total mark for the three tests was 120.

Calculate his mark in the mathematics test. [2]

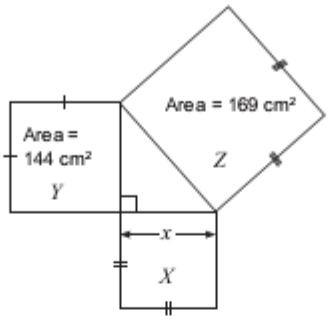
5 Thandi builds patterns that consist of squares as shown below:



Picture 1 Picture 2 Picture 3

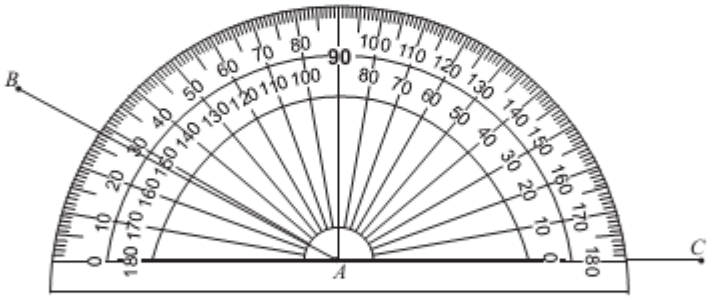
How many squares will picture 4 have? [2]

6 The centre of diagram is a right angled triangle. Square Z has an area of 169 cm² and square Y has an area of 144 cm².



Use the theorem of Pythagoras to calculate the length of side x of square X. [2]

7 Measure angle BAC, using the protractor shown below. [1]



8 A rectangular prism tank has a volume of 30 000 cm³. The base of the tank measures 30 cm by 20 cm.

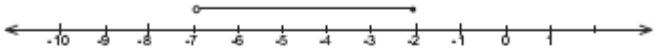
Calculate the height (h) of the tank. [2]

9 Simplify

(a) $9a \times 3c + 4ac$ [2]

(b) $\frac{x^9 \times x^5}{x^3}$ [2]

10 Write an inequality for the number line below. [2]



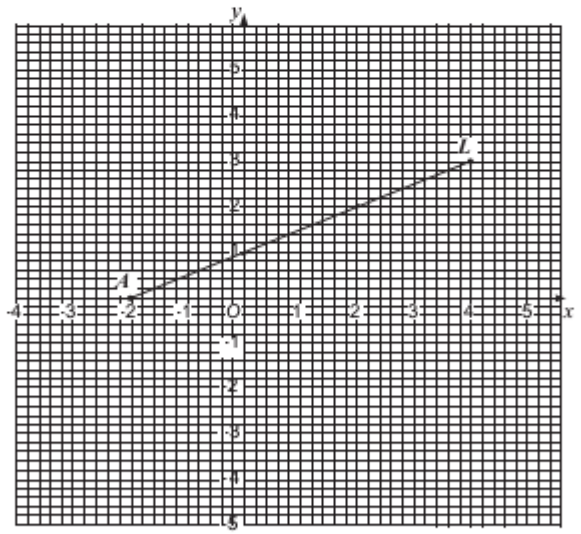
11 A box of 15 pencils contains 5 red, 4 yellow and 6 blue pencils. One pencil is chosen at random from the box.

Find the probability that the pencil picked is

(a) yellow, [1]

(b) green. [1]

12



(a) Write down the coordinates of point A. [1]

(b) Write down the y-intercept of line AL. [1]

(c) Calculate the gradient of line AL. [2]

13 Factorise completely

$56a^3 - 21a^2$ [2]

14 The original price of a haircutter is N$119.99. It is reduced to N$95.99.
Calculate the percentage decrease in price. [3]

15 Sharon invests N$500 at 10% p.a. simple interest for 3 years.

(a) Calculate the total interest received after 3 years. [2]

(b) What is the total amount that she will have after 3 years. [1]

16 The list show the daily maximum temperature recorded for a period of one week.

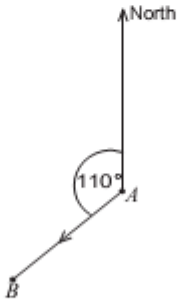
9°C, 14°C, 8°C, 9°C, 10°C, 11°C, 9°C.

(a) Write down the modal temperature. [1]

(b) Find the median temperature. [1]

(c) Calculate the mean temperature. [2]

17



Calculate the bearing of B from A. [2]

18 The diagram shows two shapes, A and B.

(a) State the number of lines of symmetry of shape A. [1]

(b) Write down the order of rotational symmetry of shape B. [1]

19 John runs $1\frac{1}{2}$ km each day.

How far will he run in 3 days? [2]

Marks 85	JUNIOR SECONDARY CERTIFICATE EXAMINATION
	Subject code: 1200/2 **Mathematics**
Additional Materials: Answer Book Non-programmable scientific calculator	Paper 2 (Structured Questions)
	Monday, 10 October 2011 09:45 – 11:45

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Write your answers on the separate answer book provided.
- Write your Candidate Name and Number on the cover page of your answer book.
- Write in dark blue or black pen.
- Do not use correction fluid.

- **Answer all questions. All working must be shown clearly.**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- Non-programmable scientific calculators should be used.
- If an answer is not exact, it should be rounded off to one decimal place.

This document consists of 9 printed pages.

Republic of Namibia

MINISTRY OF EDUCATION

1 Express

(a) 0.78 kg in grams. [1]

(b) 38 200 ml in litres. [1]

2 Write down one of the symbols <; > or = that will make each statement true:

(a) -3 .... -4

(b) 2^4 .... 4^2

(c) $\sqrt[3]{27}$ .... $16 - \sqrt[3]{27}$

(d) 7^0 .... 7 [4]

3 Selma, Wilma and Bertha need N$21 000 to start a salon business.

(a) (i) They borrowed $\frac{2}{5}$ of this amount. How much did they borrow? [2]

(ii) They contributed N$12 600 amongst themselves in the ratio of Selma: Wilma: Bertha = 5:4:3.

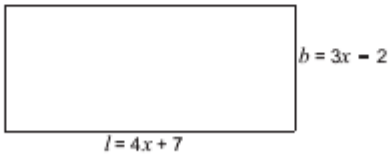
Calculate the amount Wilma contributed. [2]

(b) (i) The salon equipment costs 35% of the N$21 000.
Calculate the cost of the equipment. [2]

(ii) They needed to buy the hair products. The hair products cost N$6 500.
Write this as a fraction of N$21 000. Give your answer in its lowest terms. [2]

(iii) How much remains of the N$21 000 now? [1]

4 The diagram shows a rectangle with the length (l) = $4x + 7$ and the breadth (b) = $3x - 2$.



Calculate its perimeter in terms of x. [2]

5 A shop owner advertises the sale of a computer with two payment options as shown below.

Option 1: Pay a cash price of N$8 900.

Option 2: Pay a deposit of 15% of the cash price followed by 24 monthly installments of N$400.75 each (hire purchase).

Peter chooses **Option 2** to buy the computer.

(a) Calculate the deposit Peter has to pay. [2]

(b) Calculate the total amount that Peter will have to pay for the computer. [2]

(c) Calculate the difference between the cash price and hire purchase price. [1]

6 (a) Simplify $3y(7x^2 - y)$. [2]

(b) Given that $x = -3$; $y = 4$ find the value of $y + x$. [2]

7 A ship sails at a steady speed and covers a distance of 440 kilometres in 4 days.

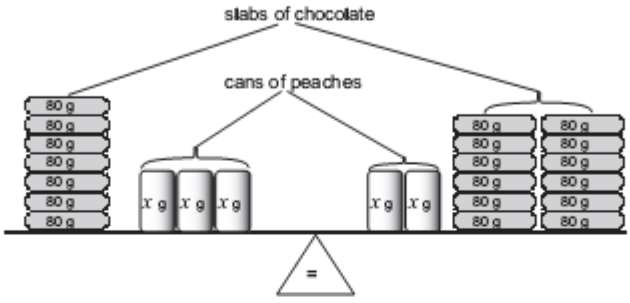
(a) How many kilometres will it cover in one day? [1]

(b) How many kilometres will it cover in 6 days? [1]

(c) How long will it take to cover 1 210 kilometres? [2]

8 The diagram shows a simple scale. The cans of peaches and slabs of chocolate are place such that the scale balances.

Each can of peaches has a mass of x g.
Each slab of chocolate has a mass of 80 g.



(a) Use the diagram above to write an equation in terms of x . [1]

(b) Solve your equation in part (a) to calculate x, the mass of each can of peaches. [2]

9 The invoice below was completed halfway by Mr Cooper, the plumber.

Prompt Plumbing Services			**30 September 2011**
parts or services	**quantity**	**price per unit (N$)**	**total (N$)**
washer for taps	5	3.35	...**(i)**...
pressure valves	...(ii)...	246.80	740.40
new cobra taps	7	...(iii)...	668.85
copper pipe	9 m	74.45 per meter	...**(iv)**...
labour	12 hours	...**(v)**... per hour	4 200.00
Total amount due			6 296.05
15% VAT			...**(b)**...
TOTAL + VAT			...**(c)**...

(a) Calculate each value from **(i)** to **(v)**. [5]

(b) Calculate 15% VAT on the total. [2]

(c) Find the total price after VAT has been added. [1]

10 Three year old Liina, was given a box of 20 differently shaped wooden blocks to play with. The diagram below shows the amount of different geometric shapes in Liina's box.

If Liina takes one block out of the box.

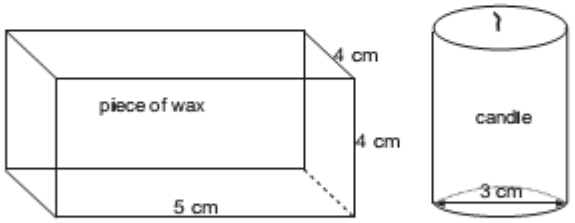
(a) What is the probability that she takes a square? [1]

(b) What is the probability that she takes a hexagon? Give your answer as a fraction in its simplest form. [2]

(c) What is the probability that she does not take a circle? Write your answer as a decimal number. [2]

11 Victoria has a piece of wax in the form of a cuboid measuring 5 cm by 4 cm by 4 cm and wants to make a cylindrical candle. She melts the wax and moulds into the cylindrical candle as shown in the diagram.

NOT TO SCALE

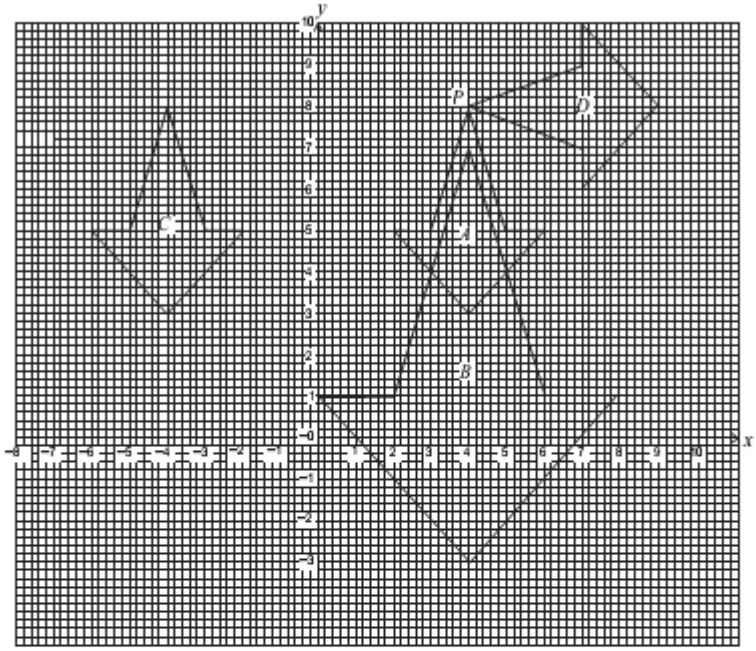


(a) Calculate the volume of the piece of wax in cm^3. [2]

(b) Calculate the base area of the cylindrical candle ($\pi = \frac{22}{7}$). [2]

(c) Calculate the height of the candle to the nearest cm. [2]

12 The shapes of A, B, C and D are drawn on the grid below.



(a) Describe fully the transformation that maps A onto C. [2]

(b) Shape B is an enlargement of shape A.

(i) Give the coordinates for the centre of enlargement. [2]

(ii) Find the scale factor of the enlargement. [1]

(c) Shape D is a rotation of shape A about P. Give the angle and the direction of the rotation. [2]

13 In 2009, one of the small countries had 840 million to spend. The pie chart shows how it was spent.

(a) Write 840 million in standard form. [1]

(b) Calculate angle x, which represents other services. [2]

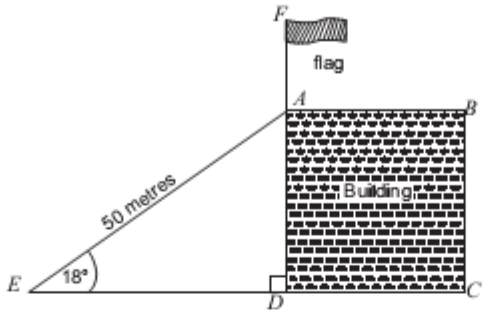
(c) How much money was spent on education? [2]

(d) (i) What fraction of the total was spent on defence, give your answer in its simplest form. [2]

(ii) Write your answer of part (d)(i) as a decimal fraction. [1]

(e) In 2010, the total amount spent was increased by 5%. What was the total amount spent in 2010? [2]

14 $ABCD$ represents a building with a vertical flagpole, AF, on the roof. The points E, D and C are on the level ground, EA = 50 metres.



NOT TO SCALE

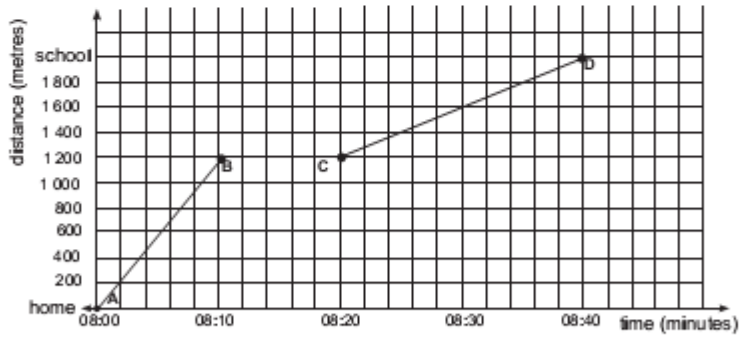
Calculate the length of ED, giving your answer to 2 decimal places. [3]

15 A hexagon is a six-sided regular polygon.

(a) Calculate the sum of interior angles of a regular hexagon. [2]

(b) What is the size of one interior angle in a regular hexagon? [1]

16 The distance-time graph below represents Rowan's journey from home to school.

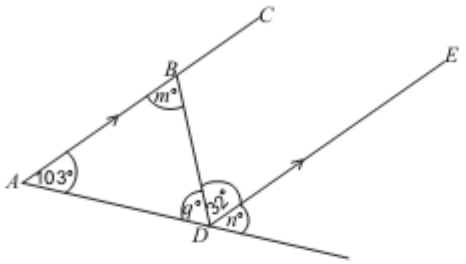


(a) How fast in m/min was Rowan travelling during the first 10 minutes? [2]

(b) How far was Rowan from home at 08:15? [1]

(c) What was the average speed of the journey from home to school in m/s. [3]

17



NOT TO SCALE

ABC is parallel to line DE. Angle $BAD = 103°$ and angle $BDE = 32°$.

(a) Find angle m. [1]

(b) Find angle n. [1]

(c) Calculate angle q. [2]

(ii) 2012 question papers

Candidate Number	Candidate Name

JUNIOR SECONDARY CERTIFICATE

MATHEMATICS **1200/1**

PAPER 1 (Short Questions) 1 hour

Marks 45 **2012**

Additional Materials: Non-programmable scientific calculator

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Candidates answer on the Question Paper in the spaces provided.
- Write your Centre Number, Candidate Number and Name in the spaces at the top of this page.
- Answer all the questions. All working must be shown clearly.
- Write in dark blue or black pen.
- You may use a non-programmable calculator.
- Do not use correction fluid.
- Do not write in the margin *For Examiner's Use*.

- If an answer is not exact, it should be rounded to one decimal place and for money give your answer to two decimal place.
- The number of marks available is shown in brackets [ ] after each question or part question.

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Marker	
Checker	

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MINISTRY OF EDUCATION

[Turn over

For Examiner's Use

1 Calculate $4 + 3 \times 2$

Answer ..... [1]

2 The temperature was 3°C. It decreases with 7°C.

What is the temperature now?

Answer ..... [1]

3 Write 0.000927 in standard form.

Answer ..... [2]

4 A farmer has 20 hectares of land.

Express this area in m². (1 ha = 10 000 m²)

Answer ..... [2]

5 Write down the inequalities represented in the number line.

Answer ..... [2]

6 Write down the following as fractions in their simplest forms.

(a) 0.56

Answer (a) ..... [1]

(b) 28%

Answer (b) ..... [1]

7 Frankie runs 100 metres in 25 seconds.

Calculate his average speed in metres per second.

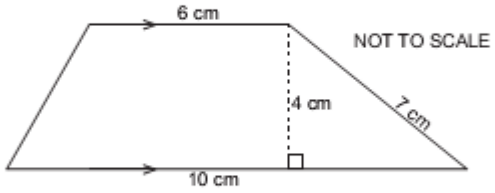
Answer ..... m/s [2]

For Examiner's Use

8 Find the value of $3x^2 - 2x + 1$ when $x = 3$.

Answer ..... [2]

9 Calculate the area of the trapezium below.



Answer ..... cm² [2]

10 There are 27 Mathematics books and 189 English books in a store.

Calculate the percentage of the Mathematics books in the store.

Answer ..... [2]

11 (a) Factorise completely $3x - 9xy$.

Answer ..... [2]

(b) Solve the following equation $3y - 7 = y + 4$.

Answer ..... [2]

12 Seven boys are asked to mention their favourite colour.

Their replies are: green, red, yellow, red, blue, red, blue.

What is the mode colour?

Mode ..... [1]

For Examiner Use

13 Berta borrows N$1 200.00 from her bank at 23% simple interest per year.

Calculate the total amount that she has to pay back after one year.

Answer ..... [2]

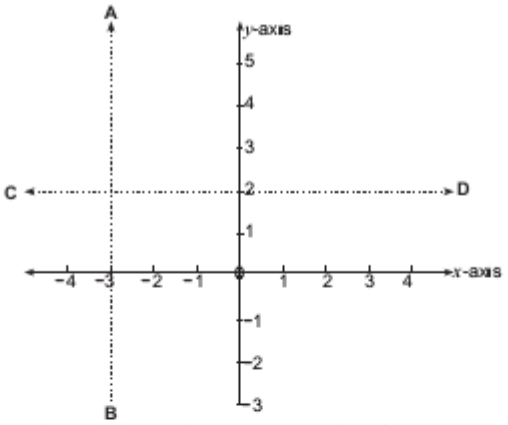
14 Mr Chan has three daughters, Ann, Lien and Tao, aged 7, 8 and 10 years respectively.

He shares N$100 between them in the same ratio as their ages.

How much does Lien receive?

Answer ..... [2]

15



(a) Using the diagram above write down the equation of

(i) AB,

Answer ..... [1]

(ii) CD.

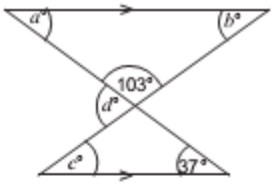
Answer ..... [1]

(b) Write down the coordinates of the point of intersection of line AB and CD.

Answer (..... ; .....) [2]

16

For Examiner's Use



NOT TO SCALE

In the figure above, determine the size of angle

(a) a

Answer **(a)** .....° [1]

(b) b

Answer **(b)** .....° [1]

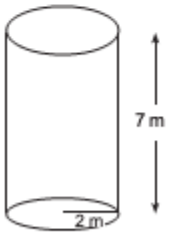
(c) c

Answer **(c)** .....° [1]

(d) d

Aswer **(d)** .....° [1]

17



NOT TO SCALE

The figure shows a petrol drum with the radius of 2 m and a height of 7 m. Calculate the volume of the drum. Give your answer in m³. (Use $\pi = \frac{22}{7}$)

Answer ..... m³ [2]

For Examiner's Use

18 Loide writes the word Okakarara on the cards.

O	K	A	K	A	R	A	R	A

One card is randomly selected, what is the probability that the card has letter:

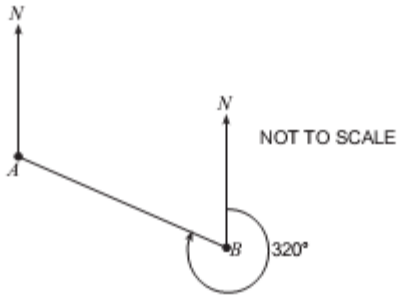
(a) A

Answer ..... [1]

(b) K

Answer ..... [1]

19

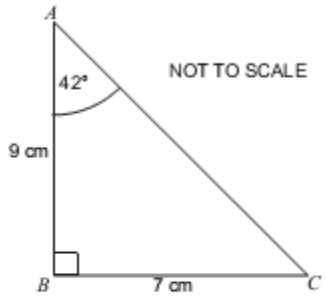


Calculate the bearing of B from A.

Answer ..... [2]

For Examiner Use

20 Triangle ABC is a right-angled triangle.



(a) Calculate the length of AC.

Answer ..... [2]

(b) Calculate angle ACB.

Answer ..... [2]

Candidate Number	Candidate Name

JUNIOR SECONDARY CERTIFICATE

MATHEMATICS **1200/2**

PAPER 2 (Structured Questions) 2 hours

Marks 85 **2012**

Additional Materials: Non-programmable scientific calculator

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Candidates answer on the Question Paper in the spaces provided.
- Write your Centre Number, Candidate Number and Name in the spaces at the top of this page.
- Answer all the questions. All working must be shown clearly.
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- Do not write in the margin *For Examiner's Use*.

- If an answer is not exact, it should be rounded to one decimal place and for money give your answer to two decimal place.
- The number of marks available is shown in brackets [ ] after each question or part question.

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Marker	
Checker	

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[Turn over

For Examiner's Use

1 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70

From the list of numbers above, write down

(a) a square number

Answer (a) ..... [1]

(b) a prime factor of 305

Answer (b) ..... [1]

(c) a multiple of 7

Answer (c) ..... [1]

(d) two prime numbers

Answer (d).....and ..... [2]

(e) the difference between 33 and –35

Answer (e) ..... [1]

2 Building work will take one man 160 hours to complete.

(a) How long will it take 4 men?

Answer (a) ..... [2]

(b) Each man is paid N$3.50 per hour.

How much will each of the four men get?

Answer (b) ..... [2]

For Examiner's Use

3 (a) Simplify

(i) $6x\,(2 - 3y)$.

Answer (a)(i) ..... [2]

(ii) $6a^2 \times 5a$

Answer (a)(ii) ..... [2]

(iii) $3x - 5y + 7x + 6y$.

Answer (a)(iii) ..... [2]

(b) Solve the equation $6y - 5 = 13$.

Answer (b) ..... [2]

4 (a) Mr Uirab buys nine DVD players for N$425.00 each.

Calculate the total cost for nine DVD players.

Answer (a) N$..... [2]

(b) Mr Uirab sells the DVD players in his shop for N$595.00 each.

Calculate the percentage profit he makes on each one.

Answer (b) ..... % [3]

For Examiner's Use

(c) A television set in Mr Uirab's shop costs N$442.00. Mr John buys a television set and a DVD player from Mr Uirab's shop. He is given a discount of 15% on the total price.

Calculate how much Mr John pays.

Answer (c) N$..... [3]

5 Mandy was given this recipe for rock cakes by her grandmother.
These quantities make 6 rock cakes.

Rock Cake

240 g flour
150 g sugar
150 g margarine
210 g dried fruit
2 large eggs

(a) How much sugar does Mandy need to make 8 rock cakes.

Answer (a) ..... g [2]

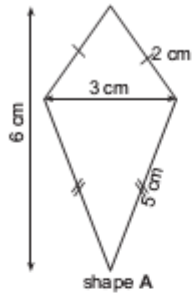
(b) Mandy has only 100 g of margarine but has plenty of all the other ingredients.

How many rock cakes can she make?

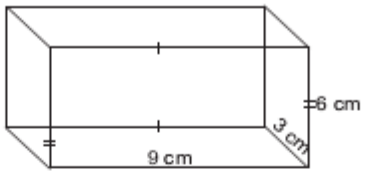
Answer (b) ..... [2]

6 The diagram shows three shapes **A**, **B** and **C**.

For Examiner's Use

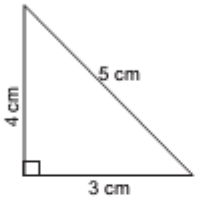


shape **A**



shape **B**

NOT TO SCALE



shape **C**

(a) State the mathematical names of shapes **A**, **B** and **C**.

A .....

B .....

C ..... [3]

(b) Calculate the area of shape **A**.

Area of **A**..... [2]

(c) Calculate the volume of shape **B**.

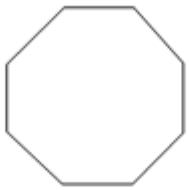
Area of **B**..... [2]

(d) Calculate the perimeter of shape **C**.

Area of **C**..... [2]

7 The diagram shows a regular octagon.

For Examiner's Use



(a) How many lines of symmetry are there in an octagon?

Answer (a) ..... [1]

(b) Calculate the sum of the interior angles in a regular octagon.

Answer (b) ..... [2]

(c) Calculate the value of one interior angle in a regular octagon.

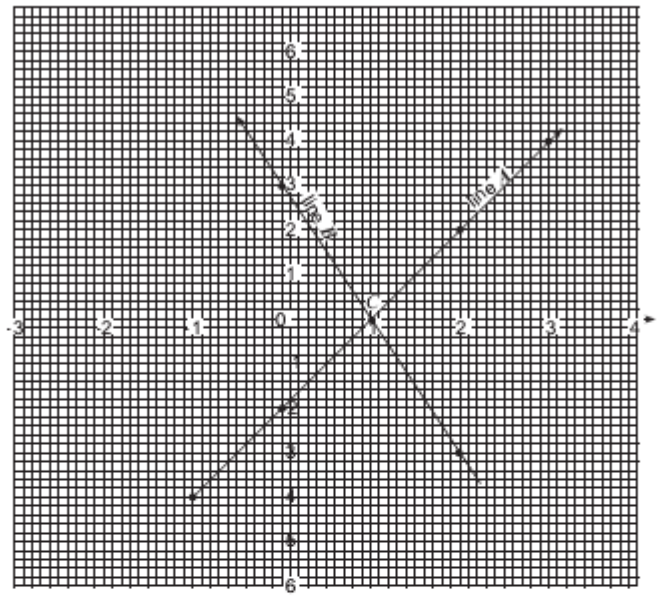
Answer (c) ..... [1]

(d) Calculate the value of one exterior angle in a regular octagon.

Answer (d) ..... [2]

For Examiner's Use

9 On the grid below lines A and B intersect at point C.



(a) Write down the coordinate of point C.

Answer (a) (.....; .....) [2]

(b) Write down the y-intercept of line B.

Answer (b) ..... [1]

(c) Calculate the gradient of line B.

Answer (c) ..... [2]

(d) Write down the equation of line B.

..... [2]

For Examiner's Use

10 Twenty Grade 10 learners wrote a Mathematics test with a maximum total marks of 20. Their test marks are as follows:

12; 7; 11; 19; 16; 7; 13; 14; 13; 10; 11; 7; 18; 8; 9; 15; 17; 17; 20; 10.

(a) Find the range of the learners' marks.

Answer **(a)** ..... [1]

(b) Find the median. Show your working.

Answer **(b)** ..... [2]

(c) Calculate the mean mark.

Answer **(c)** ..... [2]

(d) State the mode.

Answer **(d)** ..... [1]

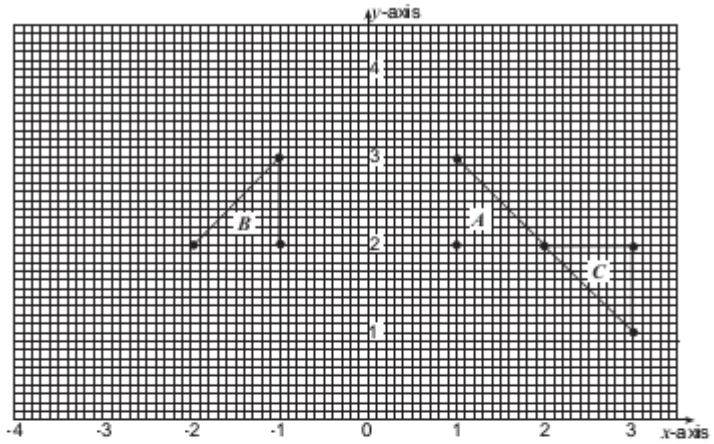
(e) Loide was absent and took the test the next day. When her mark was included, the mean mark of the 21 learners was 13.

Calculate Loide's mark in the test.

Answer **(e)** ..... [3]

11 Triangle A is transformed onto triangle B and triangle C.

For Examiner's Use



(a) Describe fully the transformation which maps A onto B.

.....

[2]

(b) Triangle A is rotated onto triangle C.

Give the coordinate of the centre of rotation and the angle of the rotation.

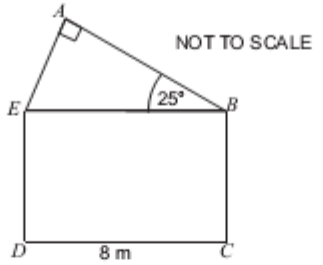
Coordinate (..... ; .....)

Angle..... °

[3]

For Examiner's Use

12 Diagram $ABCDE$ shows a model of a house. Angle EAB is 90°. Side AB makes an angle of 25° with side BE. The house is 8 m wide.



(a) Write down the length of EB.

Length of EB =.....m [1]

(b) Write down the value of angle AEB.

Angle AEB =.....° [1]

(c) Calculate the length of AE, correct to 2 decimal places.

Length of AE ..... m [2]

13 In 2010, 80% of 1 800 000 Namibians owned cellphones.

(a) Calculate the number of Namibians who owned cellphones in 2010.

Answer (a) ..... [1]

(b) Give the fraction of Namibians who did not own a cellphone in 2010. Give your answer in simplest form.

Answer (b) ..... [2]

For Examiner's Use

(c) Mr Simaata signed a contract with a local cellphone company to buy a cellphone. He pays a once-off connection fee of N$218.00 as well as a monthly fee of N$179.00 for two years.

Calculate the total amount he pays for the cellphone for two years.

Answer (c) N$..... [2]

(d) Ms Samuel bought the same cellphone as Mr Simaata, at a cash price of N$2 500. She buys N$50.00 prepaid airtime for her monthly usage.

(i) Calculate the total amount Ms Samuel would have spent on the cellphone and its usage for two years.

Answer (d)(i) N$..... [2]

(ii) Work out how much money Mr Simaata would have saved if he had bought the cellphone through Ms Samuel's method.

Answer (d)(ii) N$..... [1]

iii) 2013 question papers

Candidate Number	Candidate Name

JUNIOR SECONDARY CERTIFICATE

MATHEMATICS **1200/1**

PAPER 1 (Short Questions) 1 hour

Marks 45 **2013**

Additional Materials: Non-programmable scientific calculator

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Candidates answer on the Question Paper in the spaces provided.
- Write your Centre Number, Candidate Number and Name in the spaces at the top of this page.
- Answer **all** the questions. **All working must be shown clearly.**
- Write in dark blue or black pen.
- You may use a non-programmable calculator.
- Do not use correction fluid.
- Do not write in the margin *For Examiner's Use.*

- If an answer is not exact, it should be rounded to **one** decimal place and for money give your answer to **two** decimal places.
- The number of marks available is shown in brackets [ ] after each question or part question.

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Checker	

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Republic of Namibia

MINISTRY OF EDUCATION

[Turn over

For Examiner's Use

1 Write the following number as a decimal fraction, correct to 3 decimal places

(a) $\frac{1}{11}$,

Answer **(a)** ..... [1]

(b) 2.1×10^{-2}.

Answer **(b)** ..... [1]

2 Workout $2.1 \times 10^{-2} - 2.1 \times 10^{-3}$, giving your answer in standard form.

Answer..... [2]

3 Matches are used to make squares below.

Complete the table

number of squares	1	2	3	
number of matches	4	7		16

[2]

4 Find the Highest Common Factor (HCF) of 15 and 30.

Answer..... [1]

5 On a Monday morning, a farmer realises that, $\frac{3}{5}$ of his goats slept in the kraal.

Calculate the percentage of the farmer's goats that slept outside the kraal.

Answer..... % [2]

6 Fill in the missing number in the following statement.

$$\frac{99}{132} = \frac{33}{\ldots\ldots}$$

[1]

For Examiner's Use

11 Mr Witbooi exchanged N$2 400 to US dollars. The exchange rate was, $1.00 = N$10.24

Determine the amount of money he got in US dollars

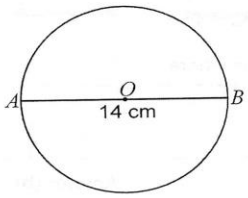
Answer $..... [2]

12 A farmer has 20 hectares of land?

Express 20 hectares in square metres (m^2).

Answer..... m^2 [1]

13 The diagram shows a circle of centre O, with line AB = 4 cm.



(a) State the special name for line AB.

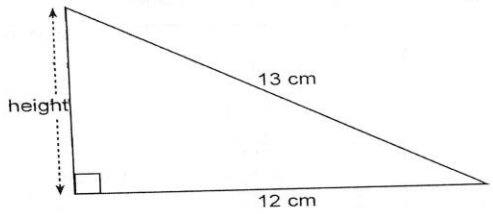
Answer **(a)**..... [1]

(b) Calculate the circumference of the circle. ($\pi = \frac{22}{7}$)

Answer **(b)** ..... [2]

For Examiner's Use

14 The diagram shows a right angled triangle. The area of the triangle is 30 cm^2.



Calculate its height.

Answer..... [2]

15 The list of different types of angles is given.

List: reflex, right, acute and obtuse

Use the list to name the angle with the following values.

(a) 120°

Answer **(a)** ..... [1]

(b) 200°

Answer **(b)** ..... [1]

16

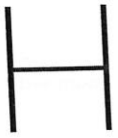


diagram 1

diagram 2

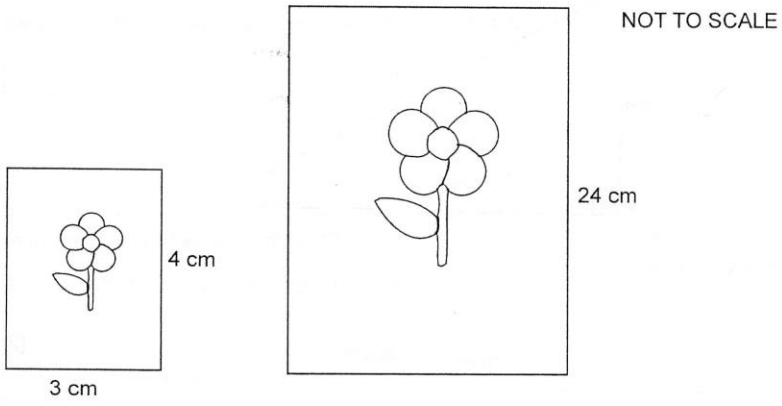
(a) What is the order of rotational symmetry does diagram 1 has?

Answer **(a)** ..... [1]

(b) Draw the line of symmetry on diagram 2. [1]

For Examiner's Use

17 A photograph measuring 4 cm long and 3 cm wide is enlarged. The length of the enlarged photograph is 24 cm as shown in the diagram.



(a) What is the width of the enlarged photograph?

Answer **(a)** .....cm [1]

(b) Write down the scale factor of enlargement.

Answer **(b)** ..... [1]

18 **(a)** Simplify

(i) $t^2 \times t^6$

Answer **(a)(i)** ..... [1]

(ii) $4(3x + 2)$

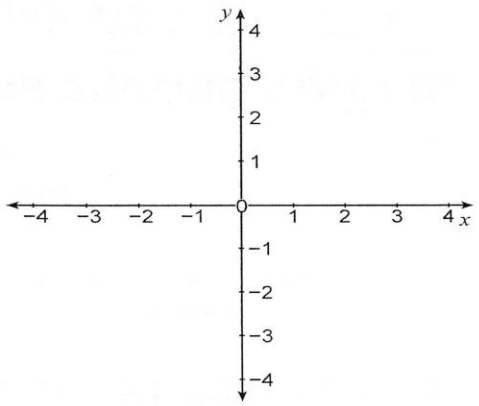
Answer **(a)(ii)** ..... [1]

(b) Solve the equation $3(2x - 1) = 3$

Answer **(b)** ..... [2]

19

For Examiner's Use



On the grid above,

(a) Draw the line of $y = -3$, [1]

(b) Plot the point (2, 0) and label it A. [1]

20 The ages of the people in a group are as follows;

63 32 34 64 32 27 35

(a) Calculate the mean.

Answer **(a)** ..... [2]

(b) Determine the mode.

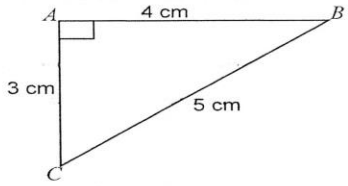
Answer **(b)** ..... [1]

(c) Find the median.

Answer **(c)** ..... [1]

For Examiner's Use

21 The diagram shows a right angled triangle.



NOT TO SCALE

Determine the value for

(a) sin $A\hat{B}C$,

Answer **(a)** ..... [1]

(b) tan $A\hat{C}B$.

Answer **(b)** ..... [1]

Candidate Number	Candidate Name

JUNIOR SECONDARY CERTIFICATE

MATHEMATICS **1200/2**

PAPER 2 (Structured Questions) 2 hours

Marks 85 **2013**

Additional Materials: Non-programmable scientific calculator

INSTRUCTIONS AND INFORMATION TO CANDIDATES

- Candidates answer on the Question Paper in the spaces provided.
- Write your Centre Number, Candidate Number and Name in the spaces at the top of this page.
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- Do not write in the margin *For Examiner's Use*.

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Marker	
Checker	

This document consists of **13** printed pages.

Republic of Namibia

MINISTRY OF EDUCATION

For Examiner's Use

1 Put one of the symbols <, > or = in each part to make these two statements correct.

(a) 5^3 ..... 3^5 [1]

(b) $-3 - (-5)$ ..... $-3 + (-5)$ [1]

(c) $9\,(17 - 8)$ ..... $9 \times 17 - 9 \times 8$ [1]

(d) $\frac{3}{4}$ ..... 0.6 [1]

2 Fill in the spaces in the grid by answering the questions below. Write one digit only in each unshaded space.
Question **(a) (v)** (Across) has been done for you.

(i)		**(ii)**	
		(iii)	
	(iv)		
	(v) 1	5	

(a) Across **(from left to right)**

(i) Convert 0.254 kilograms to grams. [1]

(ii) Work out $10.5 \times 7 + 17.5$. [1]

(iii) A multiple of 9 between 90 and 100. [1]

(v) A factor of 30 and 75

(b) Down **(from top to bottom)**

(i) A cube root of 15 625. [1]

(ii) A square number between 40 and 50. [1]

(iv) The lowest common multiple of 3 and 7. [1]

For Examiner's Use

3 **(a) (i)** Work out

$3 \div 3 =$ .....

$(5+7) \div 3 =$ .....

$(7+9+11) \div 3 =$ .....

$(9+11+13+15) \div 3 =$ ..... [2]

(ii) What is the special name give to the answers in **(a)(i)**?

Answer **(a)(ii)** ..... [1]

(b) Find x if $x^2 = 1^2 + 4^2 + 8^2$

Answer **(b)** ..... [2]

---

4 The people of country **G** were asked to vote for Red Party or Blue Party or Green Party in an election.

The votes were shared between the Red, Blue and Green parties in the ratio 5 : 8 : 7 respectively.

(a) What fraction of the votes did the Red party receive? Give your answer in its simplest form.

Answer **(a)** ..... [2]

(b) The total number of votes was 12 600 000.
How many votes did the Green party receive?

Answer **(b)** ..... [2]

For Examiner's Use

5 A survey on the causes of heart diseases was conducted on a group of 16 500 Africans. The table shows the results

causes	fraction of people
high blood pressure	$\frac{1}{5}$
high cholesterol level	$\frac{7}{10}$
regular smoker	$\frac{1}{4}$
no physical exercises	$\frac{1}{5}$

(a) Write 16 500 in standard form.

Answer **(a)** ..... [2]

(b) Calculate the percentage of the group that has high blood pressure.

Answer **(b)** ..... [2]

(c) How many people in the group have high cholesterol level?

Answer **(c)** ..... [2]

(d) Write the number of people who take no physical exercises to the number of people who are regular smokers.

Give your answer in its simplest form.

Answer **(d)** ..... : ..... [2]

6 4 metres of a dress material costs N$124.40.

How much does 1 metre cost?

Answer N$ ..... [2]

For Examiner's Use

7 Mr Prezzo invests N$4 800 at simple interest of 15% per annum for 3 years.

(a) Calculate the interest he will earn for 3 years.

Answer **(a)** N$..... [2]

(b) Work out the total amount Mr Prezzo will have at the end of 3 years.

Answer **(b)** ..... [1]

8 Shop **A** sells rice at N$2.56 per 500 grams. The same rice is sold by shop **B** at N$12.20 per 2.5 kilograms.

(a) Work out the price per kilogram for

(i) shop **A**,

Answer **(a)(i)** N$ ..... [2]

(ii) shop **B**.

Answer **(a)(ii)** N$ ..... [1]

(b) Which shop **A** or **B** sells the rice at a cheaper price?

Answer **(b)** ..... [1]

For Examiner's Use

9 The table shows Mr Kaulinge's electricity bill.

City of Windhoek				
Mr Kaulinge P O Box 4850 Windhoek			Account No: 1041052 Statement Date: 2012/04/21 Due Date: 2012/05/15	
METER READING			DESCRIPTION	Amount
previous reading	current reading	units (kWh)	electricity consumption	N$578.00
31 445	31 665	**(a)**	basic electricity charges	**(b)**
			total amount due	N$601.45

Calculate, writing you answers in the table,

(a) the number of units of electricity that Mr Kaulinge used. [1]

(b) the basic charges for electricity per month.

Answer **(b)** ..... [2]

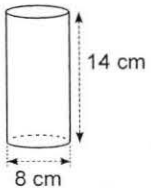
(c) Mr Kaulinge did not pay his account in time. The City of Windhoek charged him 12% interest on the total amount due.

Calculate the total amount Mr Kaulinge paid after the interest was added.

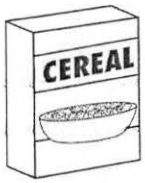
Answer **(c)** ..... [2]

For Examiner's Use

10 The diagram shows four familiar objects, all shaped differently.



glass cup



cereal box


football


a dice

(a) Which of the above objects is

(i) a cuboid

Answer **(a)(i)** ..... [1]

(ii) a sphere

Answer **(a)(ii)** ..... [1]

(b) Calculate the volume of the glass cup. [$\pi = \frac{22}{7}$]

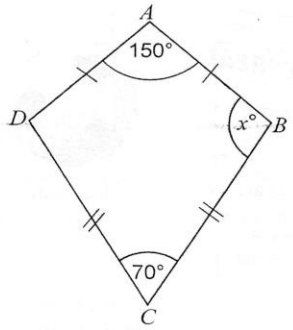
Answer **(b)** ..... [3]

(c) Convert your answer in part **(b)** to litres.

Answer **(c)** ..... [1]

For Examiner's Use

11 In the diagram above $AB = DA$ and $BC = CD$.



(a) What is the name of quadrilateral $ABCD$?

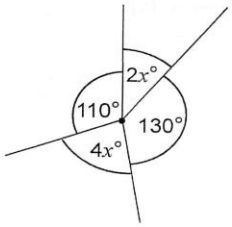
Answer **(a)**..... [1]

(b) Calculate the value of angle x.

Answer **(b)** x = ... ° [2]

12 **(a)** Calculate the value of x in the diagram.

NOT TO SCALE

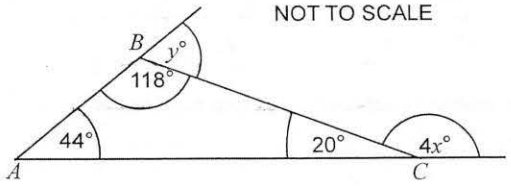


Answer (a) x =..... ° [2]

For Examiner's Use

(b) The diagram shows triangle ABC. Line AB extends at point B and line AC extends at point C.

NOT TO SCALE



Calculate

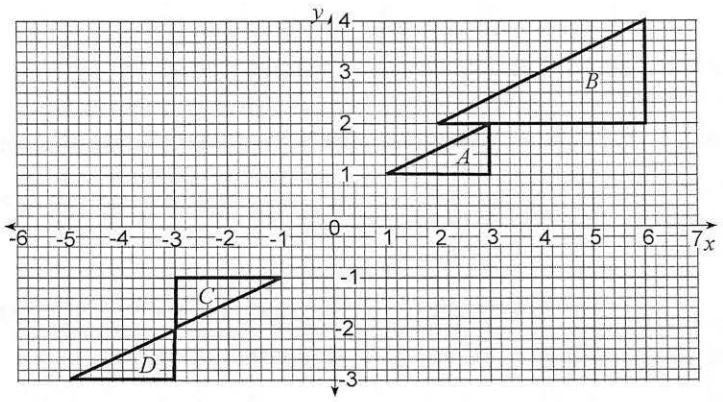
(i) the value of x,

Answer **(b)(i)** x = ... ° [2]

(ii) the value of y.

Answer **(b)(ii)** y = ... ° [1]

13 The grid shows triangles A, B, C and D.



(a) B is an enlargement of A. Give the centre of enlargement and the scale factor.

Centre of enlargement = (.... , ...) [1]

Scale factor = ... [1]

(b) Describe fully a single transformation which maps triangle C onto to triangle D.

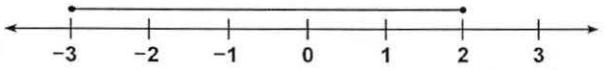
.....

..... [2]

(c) Reflect triangle A in the y - axis and label it E. [2]

For Examiner Use

14 A set of numbers is represented on a number line.



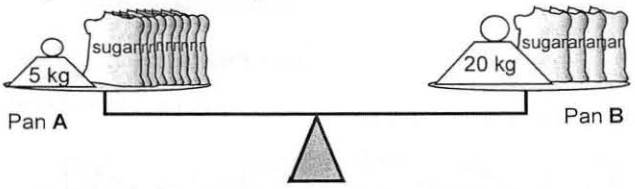
(a) Write down the inequality represented on the number line.

Answer **(a)**..... [2]

(b) What is the smallest integer in the set represented by the number line.

Answer **(b)** ..... [1]

15 The diagram show packets of sugar in the pan of a weighing balance. Each packet of sugar has a mass of x kg.



In pan **A**, there are 9 packets of sugar and a metal load of mass 5 kg.
An expression for the total mass in pan **A** is $9x + 5$.

In pan **B**, there are 4 packets of sugar and a metal load of mass 20 kg.

(a) Write down in terms of x an expression for the total mass of pan **B**.

Answer **(a)** ..... [1]

(b) The total mass of pan **A** is equal to the total mass of pan **B**.
Write down an equation in terms of x to represent this information.

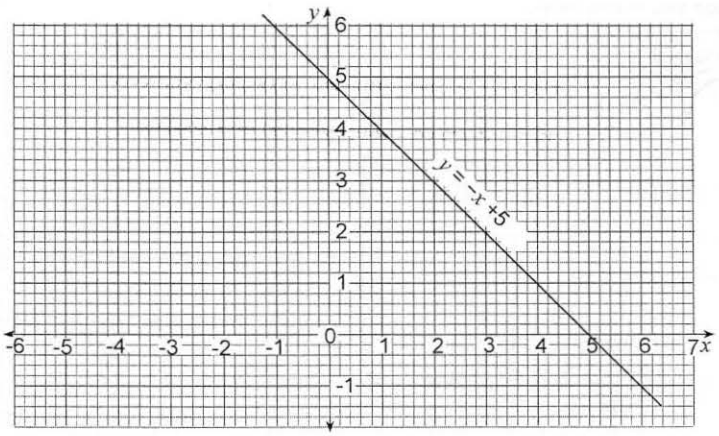
Answer **(b)**..... = ... [1]

(c) Use your equation in part **(b)** to calculate the mass x kg, of one packet of sugar.

Answer (c) x =..... [3]

For Examiner's Use

16. The diagram shows the graph of $y = -x + 5$.



(a) Complete the table of values for the equation $y = x + 1$.

x	−2	0	2	**(ii)**
y	**(i)**	1	3	5

[2]

(b) Draw the graph of $y = x + 1$ on the grid above. [2]

(c) Write down the coordinates of the point where the two graphs intersect.

Answer **(c)** (..... , ...) [2]

17 The diagram shows nine cards, each with a different number.

One card is chosen at random. Find the probability that the number on the card is

(a) a 5,

Answer **(a)** ..... [1]

(b) a square number,

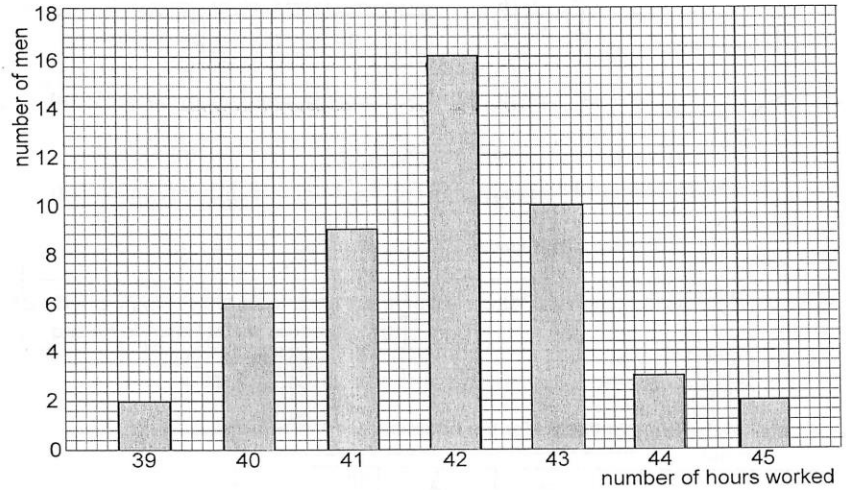
Answer **(b)** ..... [1]

(c) an odd number.

Answer **(c)** ..... [1]

For Examiner's Use

18 The bar chart shows the number of hours worked by a group of men at construction site in one week.



(a) How many men in the group worked for 40 hours?

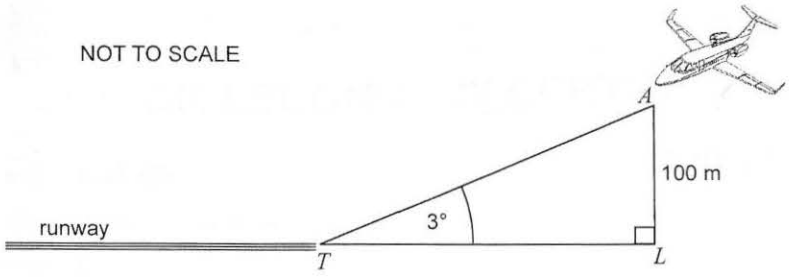
Answer **(a)** ..... [1]

(b) What is the total number of the men in the group at the construction site?

Answer **(b)** ..... [2]

For Examiner's Use

19 An aircraft approaching a runway, descends on a flight path at an angle of 3° with the ground.



(a) Write down the size of angle TAL.

Answer **(a)** ..... ° [1]

(b) Calculate the length of LT, correct to the nearest metre.

Answer **(b)** ..... m [3]

(b) National examination analyzed items for 2012 and 2013 respectively

JSC Mathematics National examination 2012 , Paper 1 Grade 10		
Question number	**Stein's coding**	**Justifications of my grading and comments**
1.	1	This question requires learners to recall previously learned BODMAS rule. There is no in-depth thinking involved apart from following the rule. I thus placed this task in the memorization category of low cognitive demand task.
2.	2	This question requires learners to recall previously learned facts about working out directed numbers. Since the temperature in this question decreases, learners just need to simply follow the procedure of subtraction. There is no in- depth thinking involved in this question. I thus placed this task in the procedures without connections category of low cognitive demand.
3.	2	This question requires learners to recall previously learned rules of writing numbers in standard form and follow the rule in order to produce the correct answer. There is no in-depth thinking involved. What is to be written in standard form is clearly and directly stated. Thus, learners are just expected to reproduce exactly what they did in the classroom about writing such a number (i.e. 0.000927) in standard form. I thus placed this task in the procedures without connections category of low cognitive demand task.
4.	2	This task requires learners to use standard conversion algorithms to convert hectares in m^2. The number of m^2 in 1 hectare are already given, learners are just expected to use the unitary method and perform the procedure of multiplication in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
5.	1	This task requires learners to reproduce previously seen inequalities for the number line from memory. What is to be produced is clearly stated and shown on the number line. Learners are just expected to recall the type of inequality produced the closed circle, i.e. closed or shaded circle implies that the number is included, use $\leq or \geq$ inequalities sign. Once learners are capable of recalling, they can obviously produce correct answers. I thus placed this task in the memorization category of low cognitive demand.

6. (a)	1	This task requires learners to recall memorized equivalent forms of fractional quantities (e.g.$0.56 = \frac{14}{25}$) or convert decimal to fraction using standard conversion algorithms. I considered this as a memorization task of low cognitive demand.
(b)	1	This task requires learners to recall memorized equivalent forms of fractional quantities (e.g.$28\% = \frac{7}{25}$) or convert percentage to fraction using standard conversion algorithms. I considered this as a memorization task of low cognitive demand.
7.	1	This task requires memorization of the formula for calculating average speed. The task does not require anything beyond the formula. Once learners know the formula they can get the answer correctly. I thus placed this task in the memorization category of low cognitive demand.
8.	2	In this task learners are expected to substitute letter x with the number given and work out. The question does not require in- depth thinking. Once learners substitute and work out correctly they can obviously get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
9.	1	This task requires memorization of the formula for calculating the area of the trapezium. Once learners use the formula correctly they can obviously get the correct answer. I thus placed this task in the memorization category of low cognitive demand.
10.	2	This task requires learners to use the usual procedure of addition, division, and multiplication in order to produce the correct answer. They usually use these procedures mindlessly so long as it produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
11. (a)	3	Although this task requires learners to follow the procedure of writing expressions in factorization form, they cannot be followed mindlessly. Learners need to have knowledge of factors of coefficient and variable in order to factorize completely, i.e. learners need to know the highest factors of 3 and 9 as well as xy and x. I thus placed this task in the procedures with connections category of high cognitive demand.
(b)	2	This task requires learners to follow the procedure of solving linear equations in one unknown. Learners are expected to follow the procedure of collecting like terms, subtraction, addition, and division in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
12.	1	This task requires learners to recall memorized definition of the mode and use the definition to get the answer. The task cannot be solved using procedures because a procedure does not exist. I thus considered this as memorization task of low cognitive demand.

13.	2	This task requires memorization of the formula for calculating simple interest and the use of standard algorithms to work out the total amount of money she has to pay back after one year, i.e. Total amount= Principal amount + interest received. The task does not require anything beyond the formula. Once learners know the formula they can get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
14.	2	In this task learners are required to use the usual procedure of finding required numbers using the ratio. Learners would just need to know and follow the procedures of addition, division and multiplication (e.g. $7+8+10=25$ then $\frac{8}{25}\times 100=32$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answer only. I thus placed this task in the procedures without connections category of low cognitive demand.
15. (a)	2	This task requires learners to recall the procedures of writing down equations of all straight line more specially the vertical line (i.e.$x=-3$). There is no in-depth thinking involved. I thus placed this task in the procedure without connections category of low cognitive demand.
(b)	2	This task requires learners to recall the procedures of writing down equations of all straight line more specially the horizontal line (i.e.$y=2$). There is no in-depth thinking involved. I thus placed this task in the procedure without connections category of low cognitive demand.
(c)	3	This task requires some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Learners need to know what the point of intersection is. To write down the coordinates, learners need to recall memorized facts of writing down the coordinates and reading from the Cartesian plane. For example, coordinates are written in the form $(x;y)$. The coordinates of point of intersection is (-3; 2). I thus placed this task in the procedures with connections category of high cognitive demand.
16. (a)	1	This task requires learners to recall previously learnt facts about angle properties (e.g. alternate angle (z)). Learners only need to use this property in order to produce the correct answer ($a=37^\circ$). I thus placed this task in the memorization category of low cognitive demand.
(b)	2	This task requires learners to use the angle property of a triangle to work out b ($b=180-103-a=180-103-37=40$). Learners just need to follow the steps learnt. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	1	Once the size of angle b is known in part (b) of this question, learners are required to recall previously learnt facts about angle properties (e.g. alternate angle (z)). Learners need to use this property in order to produce the correct answer ($c=40^\circ$). There is no in-depth thinking involved. I thus placed this task in the memorization category of low cognitive demand.
(d)	2	This task requires learners to use the property of angle at a straight line to work out d ($d=180-103=77$). Learners need to carry out the procedure of subtraction correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

17.	1	This task requires memorization of the formula for calculating the volume of the cylinder. Once learners use the formula correctly they can obviously get the correct answer. I thus placed this task in the memorization category of low cognitive demand.
18. (a)	1	In this task learners are required to perform standard algorithms of working out the probability of successful events /outcomes or use the formula of working out probability of successful event = $\frac{Number\ of\ successful\ outcomes}{Total\ number\ of\ outcomes}$. Learners are also expected to write the answer in a correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Probability of A=$\frac{4}{9}$. This task requires no explanations. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	In this task learners are required to perform standard algorithms of working out the probability of successful events /outcomes or use the formula of working out probability of successful event = $\frac{Number\ of\ successful\ outcomes}{Total\ number\ of\ outcomes}$. Learners are also expected to write the answer in a correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Probability of K=$\frac{2}{9}$. This task requires no explanations. I thus placed this task in the memorization category of low cognitive demand.
19.	3	This task requires some degree of cognitive effort. Although general procedures of finding the bearing may be followed, they cannot be followed mindlessly. Learners need to know the properties of angles at a point and co-interior angle. For example, to get the bearing of B from A, $360 - 320 = 40^\circ, then\ 180 - 40 = 140$. Since the task does not only require following the procedure but requires making connections among various concepts. I thus placed this in the procedures with connections category of high cognitive demand.
20. (a)	1	This task requires learners to recall previously learnt Pythagoras theorem (e.g.$AC^2 = 9^2 + 7^2 = 130, then\ AC = \sqrt{130}$ = 11.40. Or use trigonometric ratios (e.g. sine, cosine and tangent) and when to use each ratios (e.g. recall SOH, CAH, and TOA). After knowing which ratio to use, learners are expected to follow the procedure of division and multiplication. The task does not require mathematical understanding of the concepts being used, rather focusing on producing the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(b)	2	This task requires learners to use the property of angle in a triangle to work out angle ACB. ($ACB = 180 - 90 - 42 = 48$). Learners just need to carry out the procedure of subtraction correctly. I thus placed this task in the procedures without connections category of low cognitive demand.

JSC Mathematics National examination 2012 , Paper 2 Grade 10		
Question number	**Stein's coding**	**Justifications of my grading and comments**
1.(a), (b), (c) and (d)	1	These tasks ((a), (b), (c) and (d)) require learners to recall previously learnt definition of the terms used in each task in order to produce correct answers. The tasks cannot be solved using a procedure because a procedure does not exist. Once learners know the meaning of each term they can obviously get the correct answer. I thus placed these tasks in the memorization category of low cognitive demand.
(e)	2	This task require learners to follow the procedure of subtraction (33- -35). The task requires no explanation but focus on producing correct answer only. I thus placed this task in the procedures without connections category of low cognitive demand.
2. (a)	2	This task requires limited cognitive demand. It requires learners to follow the procedure of unitary method and carry out division ($\frac{1man \times 160\ hours}{4\ men}$= 40 hours) in order to get the correct answer. The task does not require any explanation. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task requires limited cognitive demand. It requires learners to follow the procedure of unitary method and carry out multiplication and division correctly ($\frac{40\ hours \times N\$3.50}{4\ men}$= N$ 35) in order to get the correct answer. The task does not require any explanation but focus on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
3. (a) (i)	2	This task is algorithmic. It requires learners to follow the procedure of 'distributive law' in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure. I thus placed this task in the procedures without connections category of low cognitive demand.
(ii)	2	This task is algorithmic. It requires learners to follow the procedure of multiplication of algebraic terms in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure. I thus placed this task in the procedures without connections category of low cognitive demand.
(iii)	2	This task is algorithmic. It requires learners to follow the procedure of addition and subtraction of like terms in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure. I thus placed this task in the procedures without connections category of low cognitive demand.

(b)	2	This task is algorithmic. It requires learners to follow the procedure of solving linear equations in one unknown (procedure of addition and division) in order to produce the correct answer ($6y = 13 + 5, 6y = 18, y = 3$). There is no in-depth thinking involved. Once learners follow the procedures correctly they can obviously produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
4. (a)	2	This task requires limited cognitive demand. It requires learners to follow the procedure of multiplication (9×425=3825) or addition which is evident based on the placement of tasks. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task is algorithmic. It requires learners to follow the procedure of subtraction and express one quantity as a percentage of another (595 – 425= 170, $\frac{170}{425} \times 100 = 40\%$). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	This task is algorithmic. It requires learners to follow the procedures of addition, subtraction and multiplication (N$442 + N$425= N$867, 100 -15 = 85, $\frac{85}{100} \times N\$\ 867 = N\$\ 736.95$) based on the placement of the task. This task focuses on producing correct answers rather than developing mathematical understanding. I thus placed this task in the procedures without connections category of low cognitive demand.
5. (a)	2	This task is algorithmic. It requires learners to follow the procedure of unitary method ($\frac{150 \times 8}{6} = 200g$) in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task is algorithmic. The use of produce is evident from the prior instruction in the task. Learners can follow the procedure of unitary method to produce correct answer ($\frac{100 \times 6}{150} = 4\ rocks$). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

6.(a)	1	This task requires learners to recall previously learnt properties of geometrical shapes in order to determine the name of each shape. The task involves exact reproduction of seen materials. Since all learners have seen the shapes in the classroom, they can easily recognise the name of each shape. I thus placed these tasks in the memorization category of low cognitive demand.
(b)	1	This task requires memorization of the formula for calculating the area of a kite. Once learners recall and use the formula correctly they can obviously get the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(c)	1	This task requires memorization of the formula for calculating the volume of the cuboid. Once learners recall and use the formula correctly they can obviously get the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(d)	2	This question requires learners to use the formula of perimeter of a triangle (e.g. p= S_1+S_2 + S_3) and follow the procedure of addition in order to produce the correct answer. I considered this as procedures without connections tasks of low cognitive demand.
7. (a)	1	This task requires limited cognitive demand. It requires learners to recall and use the previously learnt definition of 'line of symmetry' to identify the number of line of symmetry a hexagon is having. Learners can also recall learnt facts about the number of line of symmetry in a hexagon (the number of sides = number of line of symmetry). Once learners recall the definition they can obviously get the correct answer. I thus placed these tasks in the memorization category of low cognitive demand.
(b)	1	This task requires learners to use the memorized formula of finding the sum of interior angles ($180(n-2)$) in order to produce the correct answer. The task does not require any in-depth thinking but focuses merely on producing the correct answer. I thus placed these tasks in the memorization category of low cognitive demand.
(c)	2	This task is algorithmic. It requires learners to follow the procedure of division ($\frac{720}{6} = 120^\circ$). The task requires no explanation but focus merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(d)	2	This task is algorithmic. It requires learners to follow either the procedure of division ($\frac{360}{6} = 60^\circ$) or multiplication (180-120=60°). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
8. (a)	1	This task requires learners to recall previously learnt facts about angle properties (e.g. vertically opposite angles (x)). Learners only need to use this property in order to produce the correct answer ($a = 70^\circ$). I thus placed this task in the memorization category of low cognitive demand.

(b)	2	This task requires learners to use the angle property of an isosceles triangle to work out b ($b = 180 - 70 - 70 = 40$). Learners just need to follow the steps learnt correctly. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	1	This task requires learners to recall previously learnt facts about angle properties (e.g. corresponding angle (F)). Learners only need to use this property in order to produce the correct answer (c=70°). I thus placed this task in the memorization category of low cognitive demand.
(d)	2	This task requires learners to use the property of angle at a straight line to work out d ($d = 180 - 70 = 110$). Learners need to carry out the procedure of subtraction correctly or use the property of co-interior angle. I thus placed this task in the procedures without connections category of low cognitive demand.
9. (a)	2	This task requires learners to recall memorized facts of writing down the coordinates and reading from the Cartesian plane. For example, coordinates are written in the form $(x; y)$. The coordinates of C will be (1; 0). Since the task only asks learners to write down the coordinates. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	1	This task requires learners to recall the previous learnt meaning of y-intercept in order to produce the correct answer. There is no procedure involved. Once learners know what the y-intercept is then they can obviously come up with the correct answer, i.e. y-intercept is where the graph cuts the y-axis. Then the y-intercept of line B is three. I thus placed this task in the memorization category of low cognitive demand.
(c)	2	To find the gradient of line B, learners are expected to know the procedure of division. In this task, learners are expected to divide the change in y by the change in x in order to get the gradient. Learners can also get the answer by using the formula $\frac{y_2-y_1}{x_2-x_1}$ and follow the steps to get the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.
(d)	2	This task requires learners to recall the equation of all straight line (i.e.$y = mx + c$) and substitute m and c respectively. There is no in-depth thinking involved. I thus placed this task in the procedure without connections category of low cognitive demand.
10. (a)	1	This task requires learners to recall memorized definition of the range and use the definition to get the answer. The task cannot be solved using procedures because a procedure does not exist. I thus considered this as memorization task of low cognitive demand.
(b)	2	This task requires learners to recall memorized formula of the median and use standard algorithms to find the median, i.e. arrange numbers in ascending or descending orders and identify the number in the middle. I thus placed this in the procedures without connections category of low cognitive demand.

(c)	2	This task requires learners to recall memorized formula of the mean and use standard algorithms to find the sum of items and work out the mean, i.e. $mean = \frac{sum\ of\ items}{Number\ of\ items}$. I thus placed this task in the procedures without connections category of low cognitive demand.
(d)	1	This task requires learners to recall memorized definition of the mode and use the definition to get the answer. The task cannot be solved using procedures because a procedure does not exist. I thus considered this as memorization task of low cognitive demand.
(e)	4	This task requires some degree of complex thinking. Learners need to analyse and examine the task in order to get the correct answer. The task requires working backward given the mean, and total marks ($\frac{total\ of\ 20\ learners + x}{21} = 13$) , solve for x to get Loide's mark. I thus placed this task in the doing Mathematics category of low cognitive demand.
11. (a)	3	This task requires some degree of cognitive effort. Learners' first need to recall the four types of transformation learnt and identify the one that fits A onto B. Learners need to engage with the conceptual ideas of reflection, translation, enlargement and rotation in order to fully describe the transformation that maps A onto B. For example, the single transformation in this task is reflection. So learners need to know the descriptor of reflection (along the y-axis) in order for them to complete the task successfully. I thus placed this task in the procedures with connections category of high cognitive demand.
(b)	2	This task is simplified since the type of transformation is already given. To get the correct answer learners need to recall previously learnt facts of finding the angle of rotation and determining the direction (moving up is anticlockwise while moving down is clockwise). Learners can either measure the angle or use the tracing paper to determine the angle. Learners are also expected to follow learnt steps of finding the centre of rotation and recall memorized facts of writing down the coordinates (e.g. coordinates are written in the form $(x; y)$). This task does not require any explanation but focuses on reproducing what is learnt previously to get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
12. (a)	1	This task requires learners to recall previously learnt facts about the properties of a rectangle (e.g. parallel sides are equal). Learners only need to use this property in order to produce the correct answer ($EB = 8m$). I thus placed this task in the memorization category of low cognitive demand.
(b)	2	This task requires learners to use the property of angle in a triangle to work out angle AEB. ($AEB = 180 - 90 - 25 = 65$). Learners just need to carry out the procedure of subtraction correctly. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	This task requires learners to recall previously learnt trigonometric ratios (e.g. sine, cosine and tangent) and when to use each ratios (e.g. recall SOH, CAH, and TOA). After knowing which ratio to use, learners are expected to follow the procedure of division and multiplication (e.g. use SOH; $\sin 25 = \frac{AE}{8m}, AE = sin\ 25 \times 8m = 3.3809 = 3.38$). Learners are also expected to recall how to write numbers correct to 2 decimal

		places. The task does not require mathematical understanding of the concepts being used, rather focusing on producing the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
13. (a)	2	This task is algorithmic. It requires learners to follow the procedure of expressing percentage as a fraction and multiply by the quantity given ($\frac{80}{100} \times 1800\ 000 = 1440\ 000$ Namibians). The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task is algorithmic. It requires learners to follow the procedure of subtraction and express one quantity as a percentage of another (595 – 425= 170, $\frac{170}{425} \times 100 = 40\%$). The task requires no explanation but focus merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	2	This task is algorithmic. The use of procedure is evident based on the prior instruction in the task. The task requires learners to follow the procedure of multiplication and addition (218 + (179× 24 months) = 4514) in order to get the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(d)(i)	2	This task requires limited cognitive demand. It requires learners to follow the procedure of multiplication and addition (2500 + (50× 24 months) = 3700) in order to get the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(ii)	2	This task is algorithmic. The use of procedure is evident based on the prior instruction in the task. The task requires learners to follow the procedure of multiplication and addition (218 + (179× 24 months) = 4514) in order to get the correct answer. The task requires no explanation but focuses merely on following the procedure in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

JSC Mathematics National examination 2013 , Paper 1 Grade 10		
Question number	**Stein's coding**	**Justifications of my grading and comments**
1.(a)	1	This task requires learners to recall memorized equivalent forms of fractional quantities (e.g. $\frac{1}{11} = 0.090909 = 0.091$) or convert decimal to fraction using standard conversion algorithms. Learners need to know how to write numbers correct to 3 decimal places as learnt. There is no in-depth thinking involved. I considered this as a memorization task of low cognitive demand.
(b)	1	This task requires learners to use the calculator and evaluate the numbers given. Learners need to know how to write numbers correct to 3 decimal places as learnt. There is no in-depth thinking involved. I considered this as a memorization task of low cognitive demand.
2.	2	This question requires learners to use the BODMAS rule and workout the given numbers. The question requires learners to recall previously learned rules of writing numbers in standard form and follow the rule in order to produce the correct answer. There is no in-depth thinking involved. I thus placed this task in the procedures without connections category of low cognitive demand task.
3.	3	This question requires learners to engage with the pictures given and relate the pictures to the previous one as they go along. Learners need to make connections between the numbers of squares and number of matches used in each picture. Learners can also make connection among multiple representations (picture given and symbolic) to help them develop meaning and determine the number of matches and squares asked in the task. Since this task allows learners to connect what they are doing to the previous picture and allow learners to compare the pictures. I thus placed this task in the procedures with connections category of high cognitive demand.
4.	2	This task requires learners to know what the highest common factor of two or more numbers is and how to obtain it. Example, to get the highest common factor of 15 and 30, one can either list all the factors of 15 and 30 and choose the highest factor that is common in both numbers or express numbers 15 and 30 as a product of its prime factors and multiply all the common prime factors in both numbers. By doing so learners are using the definition at the same time they are following the procedures in order to produce the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.
5.	2	In this task learners are required to use the usual procedure of converting fraction into percentage and carry out subtraction correctly to get the required number of goats. There is no in-depth thinking involved but focus on following the steps to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

6.	2	This task requires learners to use the usual procedure of cross multiplication and division in order to produce the correct answer. They usually use these procedures without any explanation so long as it produces the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
7.	2	In this task learners are required to use the usual procedure of multiplying percentage with the total given to get the required number. There is no in-depth thinking involved but focus on following procedures to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
8. (a)	2	This tsk requires learners to follow the usual method of writing ratio and follow the procedure of division to simplify the ratio. There is no in-depth thinking involved but focus on following procedures to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task requires learners to use the unitary method and follow the procedures of multiplication and division to determine the number of lemonade cans sold. Once learners follow these procedures they can obviously get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
9.	1	This task requires memorization of the formula for calculating average speed. The task does not require anything beyond the formula. Once learners know the formula they can get the answer correctly. I thus placed this task in the memorization category of low cognitive demand.
10.	2	This task requires learners to use the usual procedure of finding percentage profit, i.e. $N\$75 - N\$50 = \frac{25}{75} \times 100 = 33.3\%$. They usually use these procedures without knowing why the procedure is being used so long as it produces the correct answer. I thus placed this task in the procedure without connections category of low cognitive demand.
11.	2	This task requires learners to use the unitary method using the exchange rate given and follow the procedures of cross multiplication and division to determine the amount of money in US dollars. Once learners follow these procedures they can obviously get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
12.	2	This task requires learners to recall memorized equivalent forms between hectares and square metres and carry out conversions using standard conversion algorithms in the absence of additional context or meaning (e.g.$1ha = 10\,000\,m^2$). One needs to use the unitary method and perform the procedure of multiplication in order to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

13. (a)	1	This tasks requires learners to recall previous learnt properties of a circle in order to determine the name of line AB. There is no in-depth thinking involved. Once learners know the properties they can obviously get the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires memorization of the formula for calculating the circumference of the circle. The task does not require anything beyond the formula. Once learners know the formula they can get the answer correctly. I thus placed this task in the memorization category of low cognitive demand.
14.	2	This task requires learners to recall previously learnt Pythagoras theorem (e.g.$height^2 = 13^2 - 12^2 = 25, then\ height = \sqrt{25}$ = 5). The task does not require mathematical understanding of the concepts being used, rather focusing on using the theorem to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
15. (a) and (b)	1	These tasks require learners to recall previous learnt definition of different types of angles. There is no in-depth thinking involved. Once learners know the definitions they can obviously get the correct answers. I thus placed these tasks in the memorization category of low cognitive demand.
16. (a)	1	This task requires learners to recall previous learnt meaning of 'order of symmetry' and use the definition to identify the order of rotational symmetry in diagram 1. The task does not require any thinking but exact reproduction of what was done previously in the classroom. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires learners to recall previously learnt meaning of 'line of symmetry' and use the definition to identify where the line of symmetry in the diagram 2 will be and draw the line correctly. The task does not require in-depth thinking but focus on exact reproduction of what was done previously in the classroom. I thus placed this task in the memorization category of low cognitive demand.
17. (a)	3	This task requires some degree of cognitive effort. Learners need to engage with the conceptual ideas of enlargement and make connection between the heights given and the width in order for them to complete the task successfully ($4 = 24, then\ 3 = x, \frac{3\times24}{4} = x, x = 18$). I thus placed this task in the procedures with connections category of high cognitive demand.
(b)	1	This task requires learners to use the learnt formula of finding the scale factor of enlargement (e.g. scale factor = $\frac{image}{object}$) or use the standard algorithms of dividing the length of corresponding sides of the image divided by the object. The task does not ask learners to give explanations but focuses on producing correct answer. I thus placed this task in the memorization category of low cognitive demand.
18. (a)(i)	1	This task (a)(i) requires learners to recall previously learnt 'law of indices' and multiplication of algebraic terms. The task require no explanation but focus merely on using the laws correctly in order to produce correct answers. I thus placed this task in the memorization category of low cognitive demand

(ii)	2	This task is algorithmic. It requires learners to follow the procedure of 'distributive law' in order to produce the correct answer. The task requires no explanation but focuses merely on following the procedure. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	This task is algorithmic. It requires learners to follow the procedure of solving linear equations in one unknown (procedure of multiplication, addition and division) in order to produce the correct answer. There is no in-depth thinking involved. Once learners follow the procedures correctly they can obviously produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
19. (a)	2	This task requires learners to recall memorized facts of drawing straight line (i.e. horizontal cutting $y - axis$ at 3). There is no in-depth thinking involved. Once learners recall and follow the procedures correctly they can obviously produce the correct answer. I thus placed this task in the procedures without connections category of high cognitive demand.
(b)	3	This task requires some degree of cognitive effort. Learners need to recall how to plot coordinates and know the Cartesian plane for them to plot the point correctly. Since the task requires learners to connect coordinates and the Cartesian plane, I thus placed this task in the procedures with connections category of low cognitive demand.
20. (a)	2	This task requires learners to recall memorized formula of the mean and use standard algorithms to find the sum of items and work out the mean, i.e. $mean = \frac{sum\ of\ items}{Number\ of\ items}$. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	1	This task requires learners to recall memorized definition of the mode and use the definition to get the answer. The task cannot be solved using procedures because a procedure does not exist. I thus considered this as memorization task of low cognitive demand.
(d)	2	This task requires learners to recall memorized formula of the median and use standard algorithms to find the median, i.e. arrange numbers in ascending or descending orders and identify the number in the middle. I thus placed this in the procedures without connections category of low cognitive demand.
21. (a)	1	This task requires learners to recall previously learnt trigonometric ratios (e.g. sine, cosine and tangent) and when to use each ratios (e.g. recall SOH, CAH, and TOA). After knowing when to use each ratio (i.e. $ABC = \frac{3}{5}$), learners are expected are just expected to write down the value without working out follow the procedure of division. The task does not require mathematical understanding of the concepts being used, rather focusing on producing the correct answer. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires learners to recall previously learnt trigonometric ratios (e.g. sine, cosine and tangent) and when to use each ratios (e.g. recall SOH, CAH, and TOA). After knowing when to use each ratio (i.e. $ACB = \frac{3}{4}$), learners are expected are just expected to write down the value without working out follow the procedure of division. The task does not require mathematical understanding of the concepts being used, rather focusing on producing the correct answer. I thus placed this task in the memorization category of low cognitive demand.

JSC Mathematics National examination 2013 , Paper 2 Grade 10		
Question number	**Stein's coding**	**Justifications of my grading and comments**
1.(a), (b), (c), and (d)	2	These tasks require learners to use the calculator to work out the values of the numbers given. After knowing the values of the two numbers given in each sub-question, learners will be able to insert the correct symbol. I thus placed these tasks in the procedures without connections category of low cognitive demand.
2. (a) and (b)	3	These tasks require some degree of cognitive effort. Although there are some general procedures to be followed, the presentation of the answers cannot be done mindlessly (i.e. write one digit only in each unshaded space). Learners need to think and engage with the grid given in order to produce correct answers. I thus placed these tasks in the procedures with connections category of high cognitive demand.
3.(a) (i)	2	This task requires learners to use the BODMAS rule and workout the given numbers. There is no in-depth thinking involved. Once learners follow the rule and work out correctly they can obviously get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand task.
(ii)	1	This task requires learners to recall memorized definition of different types of numbers. The task cannot be solved using procedures because a procedure does not exist. Once learners recognize the type of numbers produced in (a)(i) they can obviously get the correct answer. I thus considered this as memorization task of low cognitive demand.
(b)	2	In this task learners are required to use the usual procedure of finding the value of the unknown given square numbers. There is no in-depth thinking involved but focus on following the steps to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
4.(a)	2	In this task learners are required to use the usual procedure of expressing ratios as fractions. Learners would just need to know and follow the procedures of addition, and division (e.g. $5+8+7=20$ then $\frac{5}{20}=\frac{1}{4}$) in order to produce the correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	2	In this task learners are required to use the usual procedure of finding required numbers using the ratio. Learners would just need to know and follow the procedures of addition, division and multiplication (e.g. $5+8+7=20$ then $\frac{7}{20}\times 12\ 600\ 000=4\ 410\ 000$) in order to produce the

		correct answer. There is no in-depth thinking involved but focus on following the steps to produce correct answers only. I thus placed this task in the procedures without connections category of low cognitive demand.
5. (a)	2	This question requires learners to recall previously learned rules of writing numbers in standard form and follow the rule in order to produce the correct answer. There is no in-depth thinking involved. What is to be written in standard form is clearly and directly stated. Thus, learners are just expected to reproduce exactly what they did in the classroom about writing such a number (i.e. 16 500) in standard form. I thus placed this task in the procedures without connections category of low cognitive demand task.
(b)	2	This task requires learners to follow the procedure of finding percentage from fractions given. Learners are expected to follow the procedures of multiplication with 100. The task does not aim at developing mathematical understanding rather than producing correct answer only. I classified this task as procedures without connection of low cognitive demand.
(c)	2	This task requires learners to follow the procedure of finding required number using the fraction and the total numbers. Learners are expected to follow the procedures of multiplication (i.e. $\frac{7}{10} \times 16\,500 = 11550$). The task does not aim at developing mathematical understanding rather than producing correct answer only. I classified this task as procedures without connection of low cognitive demand.
(d)	2	This task requires learners to follow the procedure of expressing numbers as fraction of the other. Learners are expected to first follow the procedures of multiplication to get the number of people who take no exercise and the number of people who are regular smokers and secondly to follow the procedure of division to get the fraction. The task does not aim at developing mathematical understanding rather than producing correct answer only. I classified this task as procedures without connection of low cognitive demand.
6.	2	This task requires learners to follow the procedure of unitary method to determine the cost of one metre. Learners are expected to follow the procedure of multiplication and division ($\frac{1\times124.40}{4} = 31.1$) to get the correct answer. Once learners follow these procedures they can get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
7. (a)	1	This task requires memorization of the formula for calculating simple interest and the use of standard algorithms to work out the total interest received after three years. The task does not require anything beyond the formula. Once learners know the formula they can get the interest correctly. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires memorization of the formula for calculating the total amount of money received given simple interest, i.e. Total amount= Principal amount + interest received. The task does not require anything beyond the formula. Once learners know the formula they can get the interest correctly. I thus placed this task in the memorization category of low cognitive demand.
8. (a)(i)	2	This task requires learners to follow the procedure of conversion and use standard algorithms to convert grams into kilograms ($1kg = 1000g$). Learners are expected to follow the procedures of division in order to get the correct answer. The task does not aim at developing mathematical understanding rather than producing correct answer only. I thus classified this task as procedures without connection category of low cognitive demand.

(ii)	2	This task requires learners to use the unitary method and follow the procedure of division in order to get the correct answer. The task does not aim at developing mathematical understanding rather than producing correct answer only. I thus classified this task as procedures without connection of low cognitive demand.
(b)	3	This task requires learners to make comparison to determine the shop with cheaper price. The task requires some cognitive effort in order to produce the correct answer. Learners need to convert grams into kilograms correctly and work out the price per kilogram in order to compare the price of two shops. I classified this task as procedure with connections category of high cognitive demand.
9. (a)	2	This task requires limited cognitive effort and there is a little ambiguity on how to complete the task. The task requires learners to follow the procedure of subtraction in order to produce correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	3	This task requires learners to follow the procedure of subtraction. Learners cannot just follow this procedure mindlessly they need to think of how to get the basic charges. I thus placed these tasks in the procedures with connections category of high cognitive demand.
(c)	3	This task depends on (b). Learners need first to get (a) correctly and work 12% of (a). Learners can follow the procedures of division, multiplication and addition to get the correct answer. Since the task allows learners to make connection between total amount and percentage, I thus placed these tasks in the procedures with connections category of high cognitive demand.
10. (a)(i), (ii)	1	These tasks require learners to recall previously learnt properties of geometrical shapes in order to determine the name of the shapes given. The tasks involve exact reproduction of seen materials. Since all learners have seen such shapes in the classroom, they can easily recognise the name of each shape. I thus placed these tasks in the memorization category of low cognitive demand.
(b)	1	This task requires memorization of the formula for calculating the volume of the cylinder. The task does not require anything beyond the formula. Once learners know the formula they can get the interest correctly. I thus placed this task in the memorization category of low cognitive demand.
(c)	2	In this task learners are required to follow the usual procedure of conversion and use the standard algorithm to convert cubic centimetres into litres. There is no in-depth thinking involved but focus on following the steps to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
11. (a)	1	This task requires learners to recall previously learnt properties of geometrical shapes in order to determine the name of the shape given. The task involves exact reproduction of seen materials. Since all learners have seen such shape in the classroom, they can easily recognise the name of the shape. I thus placed these tasks in the memorization category of low cognitive demand.
(b)	2	This task requires learners to recall previously learnt properties of a kite and follow the procedures of subtraction, and division. There is no in-depth thinking involved but focus on following the steps to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.

12. (a)	2	In this task learners are required to follow the usual procedure of working out angle at a point. Learners are expected to follow the procedures of addition, subtraction and division. There is no in-depth thinking involved but focus on following the steps to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)(i), (ii)	2	These tasks require learners to use the property of angle at a straight line to work out the value of $x\ and\ y$ ($x = \frac{180-20}{4} = 40\ and\ y = 180 - 118 = 62$). Learners need to carry out the procedure of subtraction and division correctly to get correct answers. I thus placed these tasks in the procedures without connections category of low cognitive demand.
13. (a)	2	This task requires learners to follow learnt steps of finding the centre of enlargement (e.g. connect all corresponding points, where all corresponding points are intersecting is where the centre of enlargement is) and recall memorized facts of writing down the coordinates (e.g. coordinates are written in the form $(x; y)$). Learners are also expected to use the learnt formula of finding the scale factor of enlargement (e.g. scale factor= $\frac{image}{object}$) or use the standard algorithms of dividing the length of corresponding sides of the image divided by the object. This task does not require any explanation but focuses on reproducing what is learnt previously to get the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	3	This task requires some degree of cognitive effort. Learners' first need to recall the four types of transformation learnt and identify the one that fits C onto D. Learners need to engage with the conceptual ideas of reflection, translation, enlargement and rotation in order to fully describe the transformation that maps C onto D. For example, the single transformation in this task is rotation. So learners need to know the descriptor of rotation in order for them to complete the task successfully. I thus placed this task in the procedures with connections category of high cognitive demand.
(c)	3	This task requires some degree of cognitive effort. Learners' first need to recall how to reflect an object along the given line in order for them to complete the task successfully. Learners need to engage with the Cartesian plane and the object given I thus placed this task in the procedures with connections category of high cognitive demand.
14. (a)	1	This task requires learners to reproduce previously seen inequalities for the number line from memory. What is to be produced is clearly stated and shown on the number line. Learners are just expected to recall the type of inequality produced by the closed circle, i.e. closed or shaded circle implies that the number is included, use $\leq or\ \geq$ inequalities sign. Once the learners are capable of recalling, they can obviously produce correct answers. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task build on the previous one (a). It requires learners to recall the definition of the word integer. Once learners know the definition and write down the inequality represented in (a) they can obviously produce the correct answer. I thus placed this task in the memorization category of low cognitive demand.
15. (a)	1	This task requires learners to recall what an expression is and how to write down an expression. There is no in-depth thinking involved. What is to be expressed is evident from the word 'total' (add). I thus placed this task in the memorization category of low cognitive demand.

(b)	2	This question builds on the previous question (15(a)). In this part learners are expected to follow the procedure of constructing linear equations from the word statement given. Learners are expected to write down correct expressions of pan A and pan B and equate them. There is no in-depth thinking involved. I thus placed this task in the procedures without connections category of low cognitive demand.
(c)	3	This task requires some degree of cognitive effort. Learners' first need to answer part (b) of this task correctly in order to get the correct value of x. Learners need then to follow the procedures of collecting like terms and division. I thus placed this task in the procedures with connections category of high cognitive demand.
16. (a)	2	This task requires learners to substitute the unknowns with the number given and carry out the procedures of addition and subtraction correctly. There is no in-depth thinking involved but focuses on following the procedures to produce the correct answer. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	3	This task requires some degree of cognitive effort. Learners need to recall how to plot coordinates and know the Cartesian plane for them to plot the point correctly. Learners are also expected to join the point with a ruler to produce a straight line. I thus placed this task in the procedures with connections category of high cognitive demand.
(c)	3	This task requires some degree of cognitive effort. Although general procedures may be followed, they cannot be followed mindlessly. Learners need to know what the point of intersection is. To write down the coordinates, learners need to recall memorized facts of writing down the coordinates and reading from the Cartesian plane. For example, coordinates are written in the form $(x; y)$. I thus placed this task in the procedures with connections category of high cognitive demand.
17. (a)	1	This task requires learners to recall memorized formulae of calculating the probability of successful event (e.g. P (of successful event) $=\frac{number\ of\ successful\ outcomes}{total\ number\ of\ outcomes} = \frac{1}{9}$). Learners are expected to write the answer in correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Once the learners use the formula correctly they can obviously produce the correct answers. I thus placed this task in the memorization category of low cognitive demand.
(b)	1	This task requires learners to recall memorized definition of the term square number and use the definition to calculate the probability of successful event (e.g. P (of successful event) $=\frac{number\ of\ successful\ outcomes}{total\ number\ of\ outcomes} = \frac{3}{9} = \frac{1}{3}$). Learners are expected to write the answer in correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Once the learners use the formula correctly they can obviously produce the correct answers. I thus placed this task in the memorization category of low cognitive demand.
(c)	1	This task requires learners to recall memorized definition of the term odd number and use the definition to calculate the probability of successful event (e.g. P (of successful event) $=\frac{number\ of\ successful\ outcomes}{total\ number\ of\ outcomes} = \frac{4}{9}$). Learners are expected to write the answer in correct format as learnt previously, i.e. probability is written as a fraction in its simplest form or decimal number. Once the learners use the formula correctly they can obviously produce the correct answers. I thus placed this task in the memorization category of low cognitive demand.

18. (a)	2	This task requires learners to read from the bar chart. Learners are expected to follow the procedures of reading from the graph in order to produce the correct answer. There is no in-depth thinking involved. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	3	This task requires some degree of cognitive effort. Learners' first need to read from each bar to determine the number of men at each bar. Then learners need to add all the number together to determine the total number of men in the group. I thus placed this task in the procedures with connections category of high cognitive demand.
19. (a)	2	This task requires learners to use the property of angle in a triangle to work out angle TAL. ($TAL = 180 - 90 - 3 = 87$). Learners just need to carry out the procedure of subtraction correctly. I thus placed this task in the procedures without connections category of low cognitive demand.
(b)	3	This task requires some degree of cognitive effort. Learners need to recall previously learnt trigonometric ratios (e.g. sine, cosine and tangent) and when to use each ratios (e.g. recall SOH, CAH, and TOA). After knowing which ratio to use, learners are expected to follow the procedure of division and multiplication (e.g. use TOA; $\tan 3 = \frac{100}{LT}$, $LT = \frac{100}{\tan 3} = 1908.11 = 1908 metres$. Learners are also expected to recall how to write numbers correct to the nearest metres. The task requires mathematical understanding of the concepts being used in order to produce the correct answer. I thus placed this task in the procedures with connections category of high cognitive demand.

Appendix C: Interview schedule for teachers

Introduction: The researcher outlines the purpose of the interview and assures the participants of the confidentiality of the data generated from the interviews.

1. Continuous Assessment (CA) forms part of assessment in Grade 10. Activities such as topic tasks, topic tests and end- of –term test are part of CA. How do you select question items for these tests? What do you base your decision on when you select the questions items?

2. Where do you source the questions that make up these test items?

3. In your experience, does the nature/ design of the CA questions influence the performance of the learners in their end-of-year examinations?

4. According to the grade 10 Mathematics syllabus, learners should be prepared to answer both short and structured questions at the end-of –year external examination. How does this requirement influence your choice of tasks/ activities for the CA process? Please provide examples.

5. In your opinion, is there any effect on learners' performance at the end-of-year examinations if the teacher designs tasks/ activities for CA consisting of short or structured questions only?

6. In your opinion, generally, how do the CA marks compare with the end-of-year external examination marks? Please elaborate.

7. Why do you think, in some instances, there is such a big difference in the CA and the end-of-year examination marks?

8. What is the relationship between CA and the end-of-year examination?

9. Do you think that the CA mark that a learner achieves should be a predictor for his/ her end-of-year examination mark? Please elaborate.

10. What, in your view, is the purpose of the CA process?

11. Why do you think there is such a big discrepancy between the CA marks and the external end-of-year marks? Do you think this discrepancy is a good thing? Why?

12. Do you like the current CA and external end-of-year examination structure? Please elaborate.

13. If you could, would you change anything on the structure?

14. Are there any other additional points or comments that you would like to make regarding the relationship between CA and the external end-of-year examination.

TEMPLATE

Template A: Permission to carry out research in the Ohangwena region: Director consent.

Consent Form

I [redacted] in my capacity as the Director of Education, Ohangwena region, Namibia hereby give written consent for **Saima N Ihonya** in her capacity as a Masters' student at Rhodes University, to conduct research at the above mentioned schools in Eenhana Circuit, Ohangwena region. Both parties understand that this consent can be revoked without explanation at any time.

Signed: [redacted]

Date: 03/02/14

Ohangwena Regional Council
03 FEB 2014
REPUBLIC OF NAMIBIA

Template B: Permission to carry out research in Eenhana Circuit, Ohangwena region.

Consent Form

I [redacted] in my capacity as inspector of education Eenhana Circuit, Ohangwena region, Namibia hereby give written consent for Saima N Ihonya in her capacity as a masters student at Rhodes University, to conduct research at the above mentioned schools. Both parties understand that this consent can be revoked without explanation at any time.

Signed: [redacted]

Date: 07/02/2014

OHANGWENA REGIONAL COUNCIL
Directorate of Education
Eenhana Circuit
07 -02- 2014
P/Bag 88005
Eenhana
REPUBLIC OF NAMIBIA

Template C: Permission to carry out research in School A, Ohangwena region

(a) Principal Consent.

Consent Form

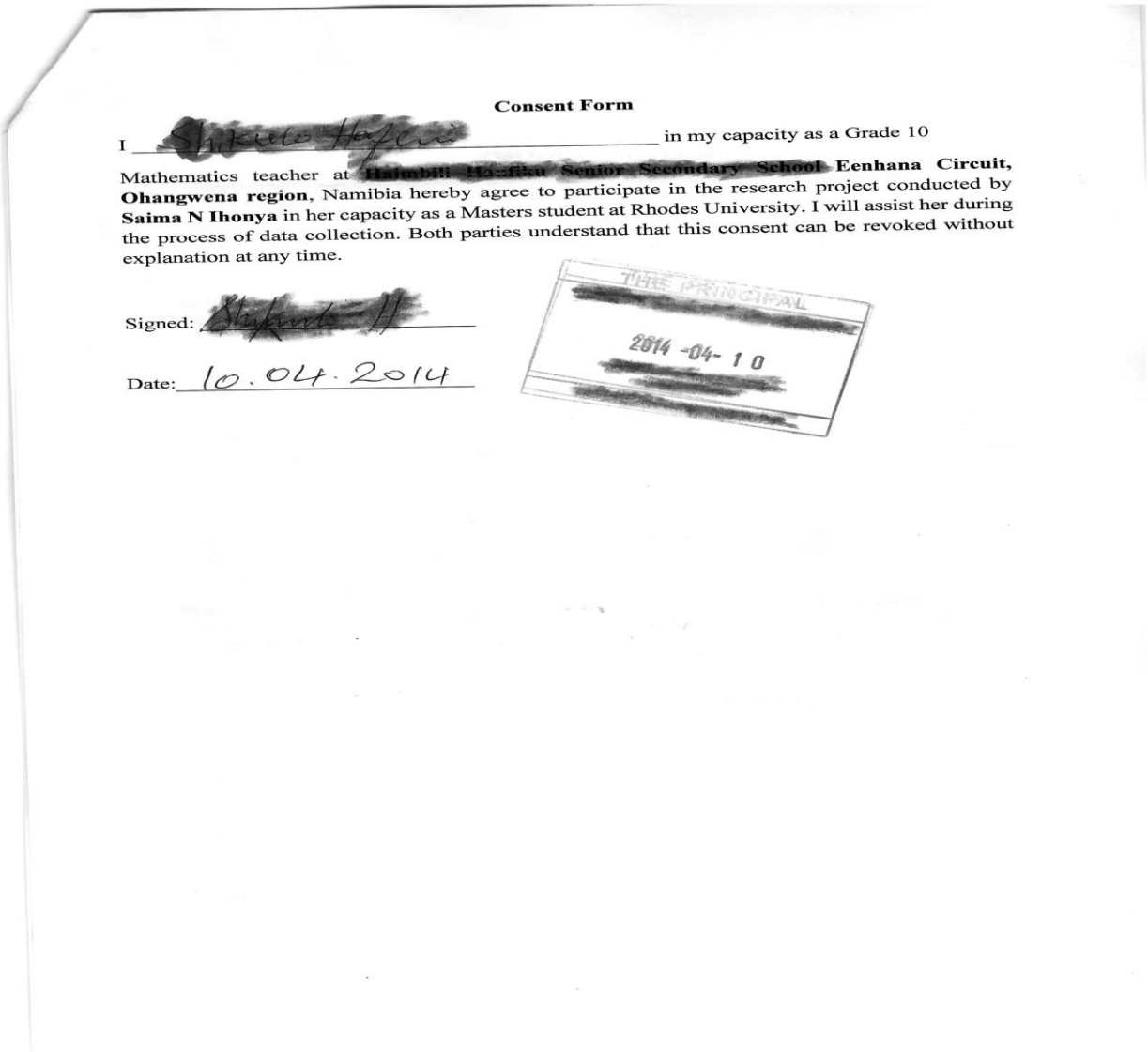
I [redacted] in my capacity as Principal of [redacted] Eenhana Circuit, Ohangwena region, Namibia hereby give written consent for **Saima N Ihonya** in her capacity as a Masters' student at Rhodes University, to conduct research at my school. Both parties understand that this consent can be revoked without explanation at any time.

Signed: [redacted]

Date: 05/04/14

THE PRINCIPAL
[redacted] Sec. School
2014 -04- 05
[redacted]
Tel / Fax: [redacted]

(b) Teacher's Consent



Consent Form

I [redacted] in my capacity as a Grade 10 Mathematics teacher at **[redacted] Eenhana Circuit, Ohangwena region**, Namibia hereby agree to participate in the research project conducted by **Saima N Ihonya** in her capacity as a Masters student at Rhodes University. I will assist her during the process of data collection. Both parties understand that this consent can be revoked without explanation at any time.

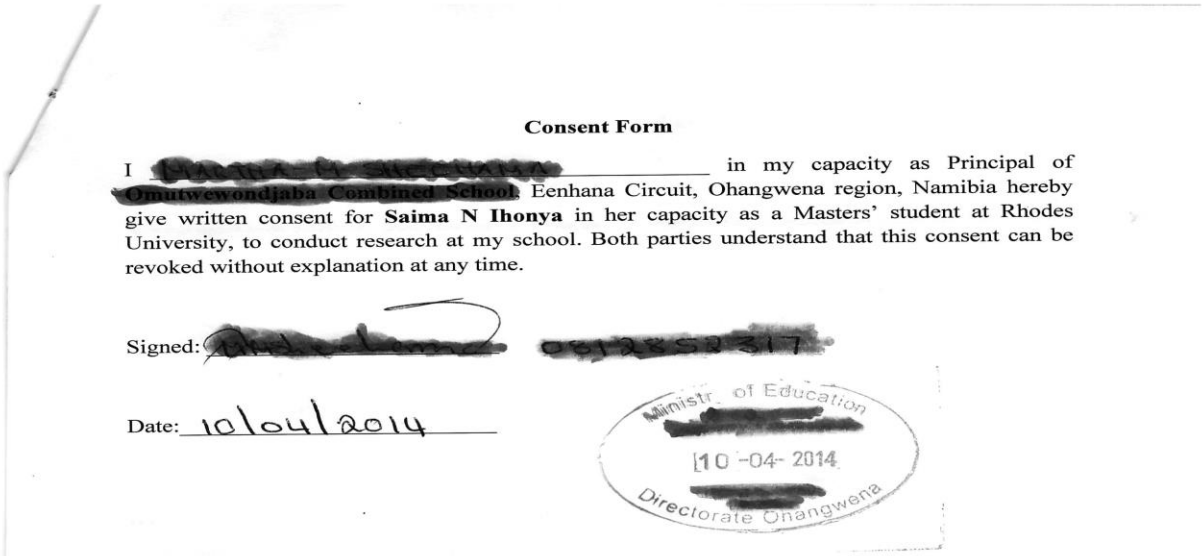
Signed: [redacted]

Date: 10.04.2014

THE PRINCIPAL
[redacted]
2014 -04- 10
[redacted]

Template D: Permission to carry out research in School B, Ohangwena region

(a) Principal's Consent.



Consent Form

I [redacted] in my capacity as Principal of Omutwewondjaba Combined School, Eenhana Circuit, Ohangwena region, Namibia hereby give written consent for **Saima N Ihonya** in her capacity as a Masters' student at Rhodes University, to conduct research at my school. Both parties understand that this consent can be revoked without explanation at any time.

Signed: [redacted]

Date: 10/04/2014

Ministr. of Education [redacted] 10 -04- 2014 [redacted] Directorate Ohangwena

(b)Teacher's Consent

Consent Form

I [redacted] in my capacity as a Grade 10 Mathematics teacher at **Omutwewondjaba Combined School Eenhana Circuit, Ohangwena region**, Namibia hereby agree to participate in the research project conducted by **Saima N Ihonya** in her capacity as a Masters student at Rhodes University. I will assist her during the process of data collection. Both parties understand that this consent can be revoked without explanation at any time.

Signed: [redacted]

Date: April 10, 2014

Ministr. of Education [redacted] 10 -04- 2014 [redacted] Directorate Ohangwena

Template E: Permission to carry out research in School C, Ohangwena region

(a) Principal's Consent

Consent Form

I [redacted] in my capacity as Principal of **Egambo Combined School**, Eenhana Circuit, Ohangwena region, Namibia hereby give written consent for **Saima N Ihonya** in her capacity as a Masters' student at Rhodes University, to conduct research at my school. Both parties understand that this consent can be revoked without explanation at any time.

Signed: [redacted]

Date: 10/04/2014

[redacted]

(b) Teacher's Consent

Consent Form

I [redacted] in my capacity as a Grade 10 Mathematics teacher at [redacted] **Ohangwena region**, Namibia hereby agree to participate in the research project conducted by **Saima N Ihonya** in her capacity as a Masters student at Rhodes University. I will assist her during the process of data collection. Both parties understand that this consent can be revoked without explanation at any time.

Signed: [redacted]

Date: 10.04.2014