THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

EXAMINERS' REPORT ON THE PERFORMANCE OF CANDIDATES CSEE, 2014

041 BASIC MATHEMATICS
(For School Candidates)

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TABLE OF CONTENTS

FOREWORD

The Examiners' Report on the Performance of the Candidates in Basic Mathematics subject, in the Certificate of Secondary Education Examination (CSEE) 2014, was prepared in order to provide feedback to students, teachers, policy makers and the public in general about the performance of the candidates in this examination.

The Certificate of Secondary Education Examination marks the end of four years of secondary education. It is a summative evaluation which among other things shows the effectiveness of education system in general and education delivery system in particular. Essentially, candidates' responses to the examination questions is a strong indicator of what the education system was able or unable to offer to students in their four years of ordinary level secondary education.

The analysis presented in this report is intended to contribute towards understanding of some of the reasons behind the poor performance in Basic Mathematics subject. The factors which have contributed to the general poor performance in this examination include: candidates lack of knowledge and skills on the examined topics, candidates inability to use concepts/formulas/laws correctly, failure of candidates to identify the demand of the questions, lack of skills to interpret word problems mathematically or diagrammatically and failure of candidates to draw graphs correctly.

The report was written therefore to provide feedback to students, teachers, policy makers and other educational stakeholders for appropriate measures to be taken to improve the performance in this subject.

The National Examinations Council of Tanzania will highly appreciate comments and suggestions from teachers, students and the public in general that can highlight any area for improvement for future Examiners Reports.

Finally, the Council would like to thank all the Examination Officers, Subject Teachers and all others who were involved in the preparation of this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report is based on the analysis of the candidates' performance in 041 Basic Mathematics examination for the Certificate of Secondary Education Examination (CSEE 2014). The analysis highlights the strengths and weaknesses that were observed when the candidates were answering the questions in order to provide a general overview of the candidates' performance.

The 041 Basic Mathematics examination paper consisted of two (2) sections namely, A and B with a total of 16 questions. The paper was set in accordance with the 2008 Examination Format which was derived from the 2005 Revised Syllabus. Section A contained 10 questions, each carrying 6 marks while section B contained 6 questions each carrying 10 marks. All questions in section A were compulsory whereas in section B the candidates were required to answer any 4 questions.

A total of 240,160 candidates sat for the 041 Basic Mathematics examination, out of which 47,001 (19.58%) candidates passed. As compared to the CSEE 2013 examination results, the performance has increased by 1.8 percent.

An analysis of the individual questions is herein presented. It comprises a brief account of the requirements of the questions and the performance of candidates. The factors that accounted for good and poor performance in each question have been indicated and illustrated using samples of candidates' responses.

2.0 ANALYSIS OF INDIVIDUAL QUESTIONS

This section presents the analysis of the candidates' performance in each question. The performance of candidates in each question was categorized as good, average, or weak if the percentage of candidates who scored 30 percent or more of the marks allocated for the question lies in the intervals 50 – 100, 30 – 49, 0 – 29 respectively.

2.1 Question 1: Numbers and Units

The question was;

1(a) Kisiki and Jembe are riding on a circular path. Kisiki completes a round in 24 minutes whereas Jembe completes a round in 36 minutes. If they both started at the same place and time and go in the same direction, after how many minutes will they meet again at the starting point?

1(b) An empty bottle weighs 115 grams. If 45 tablets each weighing $\frac{3}{5}$ gram are put in the bottle, what is the total weight?

This question was attempted by 98.1 percent of the candidates, out of which 81.3 percent scored from 0 to 1.5 out of 6 marks with 75.3 percent of them scoring a 0 mark. Only 18.7 percent of the candidates who attempted this question managed to score from 2 to 6 marks, indicating that this question was poorly performed.

In part 1(a), the majority of the candidates were unable to apply the concept of Lowest Common Multiples (LCM) in finding how long it would take for Kisiki and Jembe to meet again at the starting point. The candidates were supposed to use either the listing method or the factorization method to find the LCM of 24 and 36. Contrary to this, the candidates were performing operations such as addition, subtraction and multiplication of the numbers that were given in the question, indicating that the candidates lacked knowledge and skills to solve word problems requiring application of the concept of LCM. Although part 1(b) was straightforward, the majority of the candidates were unable to find the total weight required. The candidates were expected to add the weight of the empty bottle and the weight of the 45 tablets i.e. $(115\text{ gm} + \frac{3}{5} \times 45\text{ gm})$ to obtain 142 gm. Extract 1.1 is a sample answer from one of the candidates showing how the candidates failed to answer this question.

Extract 1.1

1.

a) soln·

24minutes + 36 ninutes = 60 minus

But

Riski used 24 minus

and

Jembe use 36 minus

36+24=60·

∴ They use 60 minutes to meet

b) soln·

data

empty bottle = 115g,

then·

Empt bottle 115g = 0 when empty·

$\frac{115}{1} + \frac{3}{5} = \frac{575+3}{5} = \frac{578}{5}$

= 115·6

∴ The total weigh is 115·6g·

In Extract 1.1, the candidate added 24 and 36 instead of finding the LCM of these numbers. The candidate also added the weight of the empty bottle and weight of one tablet instead of the weight of the 45 tablets.

However, there were a few candidates (2.1%) who managed to apply the knowledge of LCM and added the weight of the bottle and the tablets correctly. Extract 1.2 is a sample answer from one of the candidates who scored full marks in question 1.

Extract 1.2

1. a) Time to meet again = Lowest common factor of Kwiki's and Jembe's time;

2	36	24
2	18	12
2	9	6
3	9	3
3	3	1
	1	1

$\therefore$ L.C.M = $2 \times 2 \times 2 \times 3 \times 3$

$= 8 \times 9 = 72$

$\therefore$ After 72 minutes they will meet again.

b) Weight of bottle = 115 grams

1 tablet = $3/5$ gram

45 = x

$\frac{3}{\cancel{5}_1} \times \cancel{45}^{9} = 1 \times x$

$27 = x$

$\therefore$ Total weight = Weight of bottle + weight of all tablets

= (115 + 27) grams = 142

$\therefore$ Total weight is 142 grams.

In Extract 1.2 the candidate managed to identify the required tasks in parts 1(a) and (b) and eventually provided a clear and detailed solution.

2.2 Question 2: Exponents and Radicals

In part 2(a)(i), the candidates were supposed to express $\left(\sqrt{3}+5\right)^2$ in the form $a + b\sqrt{3}$, where a and b are integers. In part 2(a) (ii), they were required express $\frac{\left(\sqrt{3}+5\right)^2}{\left(7\sqrt{3}+2\right)}$ in the form $p + q\sqrt{3}$ where p and q are rational numbers. In part 2(b), the candidates were required to solve for x if $\left(\frac{1}{81}\right)^{-6x} \times 81 = \sqrt{9}$.

This question was attempted by majority of the candidates (98.1%). Out of these candidates, 85.5 percent scored below 2 out of 6 marks with 77 percent of them scoring a 0 mark. The factors that contributed to candidates scoring low marks in part 2(a) include: inability to expand the expression given in part 2(a)(i) indicating that the candidates had inadequate knowledge on the operations involving radicals. In part 2(a)(ii), the candidates lacked the skills to rationalize the denominator of the given expression and to simplify radicals to their lowest terms. It was noted that several candidates failed to obtain the final answer in part 2(a)(ii) because they did not follow the instructions given. The candidates in this category went through all the steps that were necessary in answering this part and ended up with the answer $\frac{154+176\sqrt{3}}{143}$ that was not in the required form of $p+q\sqrt{3}$. These candidates were supposed to express $\frac{154+176\sqrt{3}}{143}$ as $\frac{154}{143}+\frac{176\sqrt{3}}{143}$ and thereafter to simplify it to obtain $\frac{14}{13}+\frac{16\sqrt{3}}{13}$.

In part 2(b), the majority of the candidates performed poorly because they were unable to express the terms of the right hand side and the left hand side of the given equation using a common base to obtain either $9^{12x}\times 9^2=(9)^{\frac{1}{2}}$ or $3^{24x}\times 3^4=3^1$ or $(81)^{6x}\times 81^1=(81)^{1/4}$ and thereafter to equate the exponents of both sides of the equation in order to find the required value of x. Extract 2.1 is a sample answer, illustrating how the candidates failed to answer this question as required.

Extract 2.1

2 a) i) $(\sqrt{3}+5)^2$

$= (\sqrt{3}+5)\times(\sqrt{3}+5)$

$= \sqrt{9}+\cancel{\sqrt{15}+\sqrt{15}}+25$

$= \sqrt{9}+25$

$= \sqrt{3}+\sqrt{25}$

$= \sqrt{3}+\sqrt{5}$

$= 5+5=\sqrt{3}$

ii)

$$\frac{(\sqrt{3}+5)^2}{(7\sqrt{3}+2)}$$

$$= \frac{(\sqrt{3}+5)^2}{(\sqrt{21}+2)} \times \frac{(\sqrt{21}+2)}{(\sqrt{21}+2)}$$

$$= \cancel{\sqrt{63} - \sqrt{6} + \sqrt{105} +}$$

$$= \sqrt{63} + \sqrt{6} + \sqrt{105} + 10$$

2 b)

$$\left(\frac{1}{81}\right)^{-6x} \times 81 = \sqrt{9}$$

$$= \frac{-6x}{81} \times 81 = \sqrt{9}$$

$$\cancel{81} \times \frac{-6x}{\cancel{81}} \times 81 = \sqrt{9} \times 81$$

$$= -6x \times 6561 = \sqrt{9} \times 81$$

$$= -6x \times \sqrt{9} = 81 \times 6561$$

$$= -6x \times \sqrt{9} =$$

In Extract 2.1, the candidate was unable to expand the brackets in part 2(a)(i), used the rationalizing factor $(\sqrt{21}+2)$ instead of $(2-7\sqrt{3})$ in part 2(a)(ii) and could not apply the laws of exponents in answering part 2(b).

Very few candidates (0.1%) managed to simplify the given radical expressions and applied correctly the laws of exponents in order to find the value of *x*. A sample answer from one of the candidates is shown in Extract 2.2.

Extract 2.2

02 a) i) $(\sqrt{3}+5)^2$

$(\sqrt{3}+5)(\sqrt{3}+5)$

$\sqrt{3}(\sqrt{3}+5) + 5(\sqrt{3}+5)$

$3 + 5\sqrt{3} + 5\sqrt{3} + 25$

$28 + 10\sqrt{3}$

$\therefore = 28 + 10\sqrt{3}$

ii) $\dfrac{(\sqrt{3}+5)^2}{(7\sqrt{3}+2)}$

From (i) above

$(\sqrt{3}+5)^2 = 28+10\sqrt{3}$

$\dfrac{28+10\sqrt{3}}{2+7\sqrt{3}}$

We rationalise the denominator

$\dfrac{(28+\sqrt{300})}{(2+\sqrt{147})} \times \dfrac{2-\sqrt{147}}{2-\sqrt{147}}$

$= \dfrac{56 - 28\sqrt{147} + 2\sqrt{300} - 210}{4 - 2\sqrt{147} + 2\sqrt{147} - 147}$

$= \dfrac{-154 - 28\sqrt{147} + 2\sqrt{300}}{-143}$

$= \dfrac{^-154 - 28 \times 7\sqrt{3} + 2 \times 10\sqrt{3}}{^-143}$

$= \dfrac{^-154 - 196\sqrt{3} + 20\sqrt{3}}{^-143}$

$= \dfrac{^-154 - 176\sqrt{3}}{^-143}$

$= \dfrac{+(154+176\sqrt{3})}{^-143}$

$= \dfrac{154}{143} + \dfrac{176\sqrt{3}}{143}$

$= \dfrac{14}{13} + \dfrac{16}{13}\sqrt{3}$

$= {}^{14}/_{13} + {}^{16}/_{13}\sqrt{3}$

2 b) $\left(\frac{1}{81}\right)^{-6x} \times 81 = \sqrt{9}$

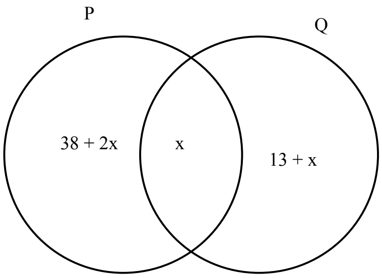
$$(81^{-1})^{-6x} \times 81 = 9^{1/2}$$
$$81^{6x} \times 81 = 3$$
$$(3^4)^{6x} \times 3^4 = 3$$
$$3^{24x} \times 3^4 = 3$$
$$3^{24x+4} = 3^1$$
$$24x + 4 = 1$$
$$24x = 1 - 4$$
$$\frac{24x}{24} = \frac{-3}{24}$$
$$x = -\frac{1}{8}$$

$\therefore x = -\frac{1}{8}$

Extract 2.2 shows that the candidate had good understanding on how to simplify radicals and apply the laws of exponents in doing computations.

2.3 Question 3: Sets and Algebra

In part 3(a), the candidates were given the Venn diagram below, which showed the number of elements in sets P and Q. They were required to find the value of x in part 3(a)(i) and $n(P \cap Q)'$ in part 3(a)(ii) given that $n(P \cup Q) = 95$.



In part 3(b), they were given that the age of Timothy is $\frac{1}{8}$ the age of his father and the sum of their ages is 54 years and were required to find the age of the father.

This question was attempted by 98.1 percent of the candidates, of which 35.2 percent scored from 2 to 6 marks and among them 2.8 percent scored all the 6 marks. Therefore, the performance in this question was satisfactory. As illustrated in Extract 3.1, the candidates who answered well this question managed to recall and apply correctly the formula to find the number of elements in the union of two sets and had the right skills to formulate the required equations from the word problem and solve them.

Extract 3.1

3. a) i) from $n(P \cup Q) = n(P) + n(Q) - n(P \cap Q)$

$n(P \cup Q) = 38 + 3x + 13 + 2x - x$

$95 = 51 + 4x$

$4x = 95 - 51$

$4x = 44$

$x = \frac{44}{4}$

$x = 11$

$\therefore$ The value of x is 11.

ii) from $n(P \cap Q)' = n(P' \cap Q) + n(P \cap Q')$

$= 38 + 22 + 13 + 11$

$= 60 + 24$

$= 84$

$\therefore n(P \cap Q)' = 84.$

b) let the age of Timothy be x and age of his father be y.

$x = \frac{1}{8}y$

$x + y = 54$

but $x = \frac{1}{8}y$

$\frac{1}{8}y + y = 54$

$\frac{y}{8} + y = 54$

$y + 8y = 432$

$9y = 432$

$y = \frac{432}{9}$

3 b) $y = \frac{432}{9}$

$y = 48$

$\therefore$ The father's age is 48.

In Extract 3.1, the candidate was able to use the appropriate formulas in answering part 3(a) and also managed to translate the word problem in part 3(b) into the required algebraic equation and then solved it correctly.

However, 64.8 percent of the candidates who attempted this question scored below 2 out 6 marks with 57.9 percent of them scoring a 0 mark. The candidates who scored low marks in this question had insufficient knowledge and skills on the topic of Algebra and Sets. In part 3(a), the candidates were unable to recall and apply correctly the formulas $n(P \cup Q) = n(P) + n(Q) - n(P \cap Q)$ and $n(P \cap Q)' + n(P \cap Q) = n(P \cup Q)$ that were essential in finding the required answers in parts 3(a)(i) and (ii) respectively. In part 3(b), the majority of the candidates performed poorly because they were unable to represent the given information mathematically as $\frac{1}{8}x + x = 54$ and thereafter solve this equation in order to get x, which was the father's age. Extract 3.2 is a sample answer from the scripts of the candidates showing how they failed to answer this question.

Extract 3.2

3a	Soln
	$3x + 2x + x + 13 + x$
	$3x + 13 = 2x + (x + x)$
	$3x + 13 = 2^x + 2^x$
	$51 = 4^2$
	$51 + 8$
	51
	$+8$
	$59 = x = 59$ Answer
3a	$3x + 13 + 2x + x + x$
	$\frac{51}{6}$
	$\frac{51}{6}$ $\;6\overline{)81}$ 48 10 6 00 $\quad n(P \cap Q) = 81$

b

$\frac{5y}{1} - \frac{1}{8}$ ——— 8

$\frac{53}{8}$ $\quad 8\overline{)53}$ 51, 43, 8, 8, --

Age of his father is 57 yrs

In Extract 3.2, the candidate was unable to apply the set formulas in answering part 3(a) and could not translate the given word problem in part 3(b) into the required equation.

2.4 Question 4: Coordinate Geometry and Vectors

The question had two parts, 4(a) and (b). In part 4(a), the candidates were required to find the equation of the line passing through the point $(6, 4)$ and perpendicular to the line whose equation is $12x + 6y = 9$. In part 4(b), the candidates were given the vectors $\underline{a} = 2\underline{i} + 3\underline{j}$, $\underline{b} = 19\underline{i} - 15\underline{j}$, $\underline{c} = 5\underline{i} - 7\underline{j}$ and were required to find the value of *x* such that $x\underline{a} + y\underline{c} = \underline{b}$.

The analysis of the candidates' responses shows that most of the candidates (85.2%) scored from 0 to 1.5 out of 6 marks, with 70.3 percent of them scoring a 0 mark. This question was therefore poorly done. In part 4(a), majority of the candidates were unable to obtain the equation of the line because they failed to apply the condition for perpendicularity of lines i.e. $m_1 m_2 = -1$ in order to find the slope of the required line and its equation. In part 4(b), the candidates were unable to substitute the vectors $\underline{a}$, $\underline{b}$ and $\underline{c}$ into the equation $x\underline{a} + y\underline{c} = \underline{b}$ and then equate the coefficients for $\underline{i}$ and $\underline{j}$ on both sides of the equation to obtain the equations $2x + 5y = 19$ and $3x - 7y = -15$ for which they were to solve simultaneous to get the required value of *x*. Extract 4.1 is a sample answer showing how the candidates lacked knowledge on the topic of Coordinate Geometry and Vectors.

Extract 4.1

4 Solution

equation $= 12x + 6y = 9$

x-intercept $y = 0$

$12x + 6(0) = 9$

$12x + 0 = 9$

$\frac{12x}{12} = \frac{9}{12}$

$\cancel{x = \frac{9}{12}}$ $\therefore x = \frac{9}{12}$

4 y-intercept $x = 0$

$12(0) + 6y = 9$

$0 + 6y = 9$

$6y = 0 + 9$

$\frac{6y}{6} = \frac{9}{6}$

$y = 1.66 \approx 2$

$y = 2.$

$\therefore x = \frac{9}{12}$ and $y = 2$

$Y - Y_1 = m \cdot x - x_1$

$y - 4 = -x - 6$

Gradient $= \frac{x_2 - x_1}{y_2 - y_1} = \frac{0 - 6}{0 - 4} = \frac{\cancel{6}^3}{\cancel{4}^2} = \frac{3}{2}$

gradient $= \frac{3}{2}$

$y - y_1 = m - x - x_1$

$y - 4 = \frac{3}{2} - x - 6$

$y - 4 = \frac{3x - 6}{2}$

$y - \frac{3x}{2} = 4 - 6$

$y = \frac{3x}{2} = 2$

4a equation of line which $12x + 6y = 9$ passing way $y = \frac{3x}{2} + 2$

4b value of x such that $xa + yc = b$

solution

$a = 2i + 3j$
$b = 19i + 15j$
$C = 5i - 7j$

$x(2i + 3j) + y(5i - 7j) = 19i + 15j$

$(2i + 5i) + (3j - 7j) = 19i + 15j$
$(3i + 4j) = (19i + 15j)$

$x = (3i + 19i + 4j - 15j)$

$(22i + 11j)$

$\therefore x = 22i + 11j$

In Extract 4.1, the candidate computed the *x* and *y* intercepts which were not needed. He/she wrote the formula for slope as $\frac{\Delta x}{\Delta y}$ instead of $\frac{\Delta y}{\Delta x}$ and the formula for finding the equation of a line as $y - y_1 = m - x - x_1$ instead of $y - y_1 = m(x - x_1)$. The candidate also failed to equate the coefficients of $\underline{i}$ and $\underline{j}$ on both sides of the given vector equation, indicating a poor mastery of the concepts of Coordinate Geometry and Vectors.

Notwithstanding the poor performance in this question, there were a few candidates (2%) who managed to apply correctly the required concepts and finally scored full marks. Extract 4.2 shows the solution from one of these candidates.

Extract 4.2

4 a) $12x + 6y = 9$

$\frac{12x}{^-6} - \frac{9}{^-6} = \frac{^-6y}{^-6}$

$^-2x + \frac{3}{2} = y$

gradient $= ^-2$

for $\perp$ lines $M_1 M_2 = ^-1$

$M_1 = ^-2.$

$M_2 = ^-1/_{-2}$

$M_2 = 1/_2$

$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$ $A' = (6,4), A(x,y)$

$\frac{1}{2} = \frac{y-4}{x-6}$

$2y - 4(2) = x - 6$

$2y - 8 = x - 6$

$2y = x - 6 + 8$

$\frac{2y}{2} = \frac{x}{2} + \frac{2}{2}$

$y = x/_2 + 1$

$\therefore$ The equation is $y = x/_2 + 1.$

b) $x\underline{a} + y\underline{c} = \underline{b}$

$x\begin{pmatrix}2\\3\end{pmatrix} + y\begin{pmatrix}5\\-7\end{pmatrix} = \begin{pmatrix}19\\-15\end{pmatrix}$

$\begin{pmatrix}2x\\3x\end{pmatrix} + \begin{pmatrix}5y\\-7y\end{pmatrix} = \begin{pmatrix}19\\^-15\end{pmatrix}$

$2x + 5y = 19$ --- i

$3x + -7y = ^-15$ --- ii

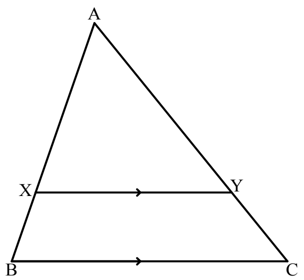
$\frac{2x}{2} = \frac{19 - 5y}{2}$ $x = \frac{19 - 5y}{2}$

4.	$3x - 7y = -15$
	$3\left(\frac{19-5y}{2}\right) - 7y = -15$
	$\cancel{2} \times \frac{57-15y}{\cancel{2}} - (7y)^{\times 2} = -15 \times 2$
	$57 - 15y - 14y = -30$
	$-29y = -30 - 57$
	$\frac{-29y}{-29} = \frac{-87}{-29}$
	$y = 3$
	$x = \frac{19-5y}{2}$ but $y = 3$
	$x = \frac{19-5(3)}{2} = \frac{19-15}{2} = \frac{4}{2} = 2$
	$\therefore x = 2$

In Extract 4.2, the candidate managed to find the equation of the line passing through the given point and perpendicular to the line given, changed the given vector equation into simultaneous equations and solved them correctly.

2.5 Question 5: Similarity, Area and Perimeter

In part 5(a), the candidates were required to calculate the area of triangle AXY given that XY = 2 cm, BC = 3 cm and area of XYCB = 10 cm^2.



In part 5(b), they were required to determine the length of one side of a regular quadrilateral inscribed in a circle of radius 10 cm.

Although question 5 was clear and well-constructed, it was the most poorly performed question, with the majority of the candidates (97%) scoring from 0 to 1.5 out of 6 marks. Many candidates failed to recall and apply the formula stating the relationship between the ratio of areas and the ratio of lengths of corresponding sides of two similar triangles in part 5(a) i.e.

$\dfrac{\text{Area of } \Delta \text{ ABC}}{\text{Area of } \Delta \text{ AXY}} = \left(\dfrac{\text{BC}}{\text{XY}}\right)^2$ to obtain $\dfrac{\text{Area of } \Delta \text{ AXY} + 10}{\text{Area of } \Delta \text{ AXY}} = \dfrac{9}{4}$ and finally to find the required area from this equation. However, some candidates managed to apply the formula but did not manage to obtain the final correct answer because of poor arithmetic skills.

In part 5(b), the candidates were unable to apply the formula $s = 2r\sin\dfrac{180°}{n}$ to obtain the required length. For instance, several candidates were unable to write the formula correctly while some candidates substituted incorrect values of r and n in the formula. Extract 5.1 illustrates this case.

Extract 5.1

5. (a) ~~Area of x~~ A

$\dfrac{\text{Area of AXY}}{\text{Area of XYCB}} = \dfrac{XY}{BC}$

$\dfrac{\text{area AXY}}{10} = \dfrac{2}{3}$

$2 \times 20 = 3 \text{ area of AXY}$

$\dfrac{40}{3} = \dfrac{3 \text{ area of AXY}}{3}$

$\therefore \text{area of AXY} = 13.3\text{cm}^2$

(b). $S = 2\pi r$

$= 2 \times \dfrac{22}{7} 3.14 \times 10$

$= 2 \times 31.4$

$= 62.8 \text{ cm}.$

∴ The length of one side of requiar quadrateral is 62.8cm

In Extract 5.1, the candidate applied the concepts of similarity in part 5(a) wrongly to obtain $\dfrac{\text{Area AXY}}{10} = \dfrac{2}{3}$ instead of $\dfrac{A_1 + 10}{A_1} = \dfrac{9}{4}$ and in part 5(b) the candidate used the formula $s = 2\pi r$ instead of $s = 2r\sin\dfrac{180°}{n}$.

Apart from the weaknesses shown by most candidates, there were a few candidates (0.4%) who managed to use correct formulas, carried out the calculations step by step and finally got the correct solutions, see Extract 5.2.

The examiners were impressed by the way several candidates answered part 5(b) using different approaches such as the sine rule, cosine rule, Pythagoras theorem and the definition of trigonometrical ratios and managed to obtain the final answer successfully. A sample answer from one of the candidates who applied the Pythagoras theorem is shown in Extract 5.3.

Extract 5.2

5 a) Soln.

$$\frac{A_1}{A_2} = \left(\frac{l_1}{l_2}\right)^2$$

$$\frac{A_1}{A_1 + 10} = \left(\frac{2}{3}\right)^2$$

$$\frac{A_1}{A_1 + 10} = \frac{4}{9}$$

$$4(A_1 + 10) = 9A_1$$

$$4A_1 + 40 = 9A_1$$

5) a) $4A_1 + 40 = 9A_1$

$$40 = 9A_1 - 4A_1$$

$$\frac{40}{5} = \frac{5A_1}{5}$$

$$A_1 = 8$$

$\therefore$ The area of $\Delta AXY = 8cm^2$

5 b) Soln.

$$L = 2r \sin \frac{180}{n}$$

$$L = 2 \times 10 \sin \frac{180}{4}$$

$$L = 20 \times \sin 45$$

$$L = \cancel{20}^{10} \times \frac{\sqrt{2}}{\cancel{2}}$$

$$L = 10\sqrt{2} \text{ cm}$$

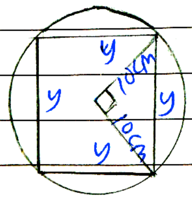
$\therefore$ The Length is $10\sqrt{2}$ cm.

In Extract 5.2, the candidate applied correctly the formulas, indicating a good understanding on the tested concepts of similarity and areas.

Extract 5.3

(b) SOLUTION

From the figure below



$y^2 = (10\text{ cm})^2 + (10\text{ cm})^2 = 200\text{cm}^2$

$y^2 = 200\text{ cm}^2$

$\therefore y = \sqrt{200}\text{ cm}$

$y = 10\sqrt{2}\text{ cm}$

Therefore, the length of one side $= 10\sqrt{2}\text{ cm}$

In Extract 5.3, the candidate represented the given information in part 5(b) in a well labeled diagram and applied correctly the Pythagoras theorem to obtain the length of one side of the regular quadrilateral as required.

2.6 Question 6: Rates and Variations

In part 6(a), the candidates were given that Juma sells one litre of milk at sh. 600 and were required to find how many litres of milk he will sell to get sh. 208,800.

In part 6(b), the candidates were given that the compression l of a spring is directly proportional to the thrust, T Newtons exerted on it and that a thrust of 2 Newtons produces a compression of 0.4 cm. They were required to find:

(i) The compression when the thrust is 5 Newtons,

(ii) The thrust when the compression is 0.7 cm.

This question was attempted by 98.1 percent of the candidates. Out of these, 49.8 percent scored from 2 to 6 marks and among them 12.5 percent scored all the 6 marks, indicating that this question was averagely performed. The candidates who scored high marks managed to apply the concepts of direct variation correctly and performed correct calculations to obtain the required answer; see Extract 6.1.

Extract 6.1

6 a. Given

One litre of milk costs sh 600

Required to find the litres which will be sold by June to acquire 208, 800/=

hence,

$1 \text{ litre} = sh\ 600$

$x = 208800 sh$

$$x = \frac{208800 sh \times 1 \text{ litre}}{sh\ 600}$$

$$x = \frac{2088 sh \times 1 \text{ litre}}{6 sh}$$

$x = 348 \times 1$ litre

$x = 348$ litres

∴ In order to get sh 208800 June will have to sell the total of 348 litres

b.

Given

L is directly proportional to the thrust (T) on introducing the constant K

$L \propto K$

$L = TK$

but

when $L = 0.4cm$

$T = 2N$

Required to find K

from

$L = TK$

$$\frac{0.4}{2} = \frac{2K}{2}$$

$K = 0.2$

Now required to find

1. The compression when the thrust is 5 newtons.

from

$L = TK$, where $K = 0.2$

$T = 5$ newtons

$L = 5 \times 0.2$

$L = 1$ cm

6b	∴ The compression is 1 cm
	ii. The thrust when the compression is 0.7 cm
	from
	$L = TK$, where $K = 0.2$
	$L = 0.7$
	$0.7 = T(0.2)$
	$\frac{0.7}{0.2} = \frac{0.2T}{0.2}$
	$T = \frac{0.7 \times 10}{0.2 \times 10}$
	$T = \frac{7}{2}$
	$T = 3.5N$
	∴ The thrust is 3.5 Newtons

Extract 6.1 shows a sample response from one of the candidates who demonstrated good understanding of the concepts of direct variation and applied them correctly in answering the question.

About 50 percent of the candidates who attempted this question scored low marks, from 0 to 1.5 out of 6 marks and among them 37.5 percent scored zero. These candidates were unable to apply the concepts of rates and variations to answer the question. In part 6(a), the candidates could not recognize that the number of litres of milk that would be sold was to be obtained by just dividing 208,800 by 600, indicating a serious lack of skills to solve word problems. In part 6(b), the candidates were unable to apply the concepts of direct proportion to formulate the variation equation $T = kl$ that was useful in answering the question. Extract 6.2 illustrates this case.

Extract 6.2

6	a, 1 liter = 600
	1 liter = 1000cm²
	6 = ?
	600 + 208,800
	= 214800 liter

b	$L \alpha T$
	$= L = KT$
	$K = LT$
	where $T_1 =$ $T_2 =$ $L_1 = 2$
c	$K = L \times T$
	$K = 2 \times 5$
	$K = 10$
	∴ The comprehession when 5 network = 10
	$10 = T_2 L_2$
	$\frac{10}{0.7} = \frac{0.7 \times L_2}{0.7}$
	$L_2 = \frac{10 \times 10}{0.7 \times 10}$
	$L_2 = \frac{100}{7}$
	$L_2 = 14.2$

In Extract 6.2, the candidate added the numbers that were given in part 6(a) i.e. 208,800 and 600 instead of dividing 208,800 by 600 in order to get the number of litres that were sold. In part 6(b), the candidate was able to formulate the direct variation equation $l = kt$ but expressed $k = lt$ instead $k = \frac{l}{t}$ and ultimately ended with incorrect final solution.

2.7 Question 7: Ratio, Profit and Loss

In part 7(a), the candidates were given that Kieku has to share 80 books with his younger sisters Upendo and Okuli. The candidates were then required to find the number of books each gets if Kieku decided that for every 2 books that Okuli gets Upendo gets 3 and he gets 5 books.

In part 7(b), they were given that Nyaumwa invested a certain amount of money for 5 years in a bank which offers interest rate of 6 percent after every six months. The candidates were required to determine the amount of money Nyaumwa invested initially if his total savings were sh. 9,600,000.

The question was attempted by 98.1 percent of the candidates, out of which 67.4 percent scored a 0 mark and only 24.3 percent scored from 2 to 6 out of the allocated 6 marks. Therefore, the majority of the candidates failed to provide the required solution.

The analysis of the candidates' responses shows that the poor performance in part 7(a) was due to candidates' inability to apply the knowledge of ratios to find the number of books each person would get. They were unable to realize that the books were to be shared in the ratio $2:3:5$; that is Kieku would get $\frac{5}{10} \times 80 = 40$ books, Upendo gets $\frac{3}{10} \times 80 = 24$ books and Okuli gets $\frac{2}{10} \times 80 = 16$ books.

In part 7(b), the candidates were unable to apply the simple interest formula; $I = \frac{PRT}{100}$ to determine the amount of money invested. Some candidates were unable to recognize that the figure sh. 9600000 which was given in the question was the amount (A) obtained by adding the principle (P) and the interest (I) i.e. $9,600,000 = P + 0.6P$ and therefore they were supposed to find the value of P from this equation. It was noted that other candidates were using the compound interest formula $A_n = P\left(1 + \frac{RT}{100}\right)^n$ instead of the simple interest formula, see Extract 7.1.

Extract 7.1

7a. $n(A) + n(B) - n(A \cup B) = n(A \cap B)$

$3 + 5 - 80 = n(A \cap B)$

$8 - 80 = n(A \cap B)$

The number of books each gets is 23.

7 b) Data given

Rate = R 6%

Time = T, 5

Principal = 9600 000/=

Amount = ?

$A_n = P(1 \times \frac{RT}{100})^n$

$A_{12} = 9,600\,000(1 \times \frac{6 \times 5}{100})^{12}$

$A_{12} = 9600,000 \times \frac{360}{100}$

$A_{12} = 9600\,000 \times 3.6$

$A_{12} = 34560000$/=

In Extract 7.1, the candidate used the formula for finding the number of elements in the union of sets in answering part 7(a) which was on ratios. In part 7(b), the candidate applied the compound interest formula instead of the simple interest formula.

However, there were only a few candidates (0.1%) who managed to apply the concepts of ratios and the simple interest formula to obtain the required solution, see Extract 7.2.

Extract 7.2

7a. total number of books = 80 books.
Ratio = Okuli : Upendo : Kieku = 2 : 3 : 5
$2+3+5 = 10$.
Okuli = $\frac{2}{10} \times 80 = 16$ books
Upendo = $\frac{3}{10} \times 80 = 24$ books
Kieku = $\frac{5}{10} \times 80 = 40$ books.
∴ Okuli gets 16 books, Upendo got 24 books and Kieku gets 40 books.

7b. Interest rate = 6%
time (T) = ~~%~~ 2 time per year.
In five years = $2 \times 5 = 10$
$I = \frac{PRT}{100}$ where P = amount invested initially (principal)
R = ~~Ra~~ Interest rate.
T = time.
I = Interest.
but ~~I = Prin~~
Amount = Interest (I) + Principal (P)
$A = I + P$
$I = A - P$.
$A - P = \frac{PRT}{100}$
$9{,}600{,}000 - P = \frac{P \times 6 \times 10}{100}$
$9{,}60000000 - 100P = 60P$.
$\frac{~~9{,}60000000~~}{~~160~~} = \frac{160P}{160}$
$P = 6000{,}000/=$
∴ Amount invested initially was 60,000,000 shillings.

In Extract 7.2, the candidate was able to express the ratio of books Okuli, Upendo and Kieku would share as 2:3:5 and the amount of money invested as A = P + I and finally worked out the solution for question 7 correctly.

2.8 Question 8: Sequence and Series

This question had parts (a) and (b). In part 8(a), the candidates were required to find the sum of the first 40 terms of an arithmetic progression having the 20th term as 60 and the 16th term as 20. In part 8(b), the candidates were given that a shopkeeper invested sh. 4,800,000 for 5 years and the amount of money accumulated was sh. 7,730,450 and were required to find the compound interest rate.

This question was attempted by 98.1 percent of the candidates. It was poorly performed as the majority of the candidates (84.3%) scored low marks (from 0 to 1.5 out of 6) and among them 77.3 percent scored zero.

In part 8(a), the candidates were unable to apply the formula for the nth term $A_n = A_1 + (n-1)d$ to formulate the equations $\mathrm{A}_1 + 19\mathrm{d} = 60$; $\mathrm{A}_1 + 15\mathrm{d} = 20$ and thereafter to solve them to obtain $A_1 = -130$ and $d = 10$. The candidates were expected to substitute these values in the formula $S_n = \frac{n}{2} \times \left[2A_1 + (n-1)d\right]$ to obtain the sum of the first 40 terms that was required. It was noted that some candidates were able to formulate the two equations but failed to obtain the correct values of A_1 and d because they lacked the skills to solve equations. It was also observed that, other candidates were answering part 8(a) using formulas/concepts that were not related to the tested concepts of arithmetic progression. For instance, some candidates used the formula $A_n = G_1 r^{n-1}$ instead of $A_n = A_1 + (n-1)d$ as they could not differentiate a geometrical progression from an arithmetic progression.

In part 8(b), the candidates failed to apply the formula for the compound interest, $A_n = P\left(1 + \frac{R}{100}\right)^n$ to determine the interest rate *R*. Some candidates interchanged the given figures for *P* and A_n while others were unable to write correctly the compound interest formula. The quality of the responses was also affected by the candidates' inability to make *r* subject of the equation and to use mathematical tables to do computations. Extract 8.1 is a sample answer from one of the candidates showing how they failed to answer this question.

Extract 8.1

8 A. Given:

$A_{20} = 60$

$A_{16} = 20$

From $A_{20} = A_1 + 59d$

$A_{16} = A_1 + 19d$

$60 = A_1 + 59d$

$20 = A_1 + 19d$

From. $60 = A_1 + 59d$

$A_1 = 60 - 59d$

$20 = A_1 + 19d$

$20 = 60 - 59d + 19d$

$20 = 60 - 40d$

$20 - 60 = -40d$

$\frac{-40}{-40} = \frac{-40d}{-40}$

$d = 1$

From $60 = A_1 + 59d$

$60 = A_1 + 59$

$A_1 = 60 - 59$

$A_1 = 1$

From $S_n = \frac{n}{2}\left(2A_1 + (A-1)d\right)$

$S_{40} = \frac{40}{2}\left(2 + 0\right)$.

$S_{40} = 20 \times 2$

$S_{40} = 40$

$S_{40} = 40$

(b) From $I = P\left(1 + \frac{RT}{100}\right)$

$I = P\left(1 + \frac{RT}{100}\right)$

$7,730,450 = 4,800,00\left(1 + \frac{5R}{}\right)$

$7,730,450 = 4800,00(100+5R)\ 100$

$7,730,450 = 48000000 + 2400000R$

$7730,450 = (1 + 5R)\ 4800,00\cancel{7}$

$7730,450 = 480000 + 240000R$

$R = \frac{250450}{240000} = \frac{2400000R}{2400000}$

In Extract 8.1, the candidate substituted incorrect values of n in the nth term formula to obtain $A_1 + 59d = 60$; $A_1 + 19d = 20$ instead of $A_1 + 19d = 60$; $A_1 + 15d = 20$ and also applied the formula $I = P(1 + \frac{RT}{100})$ instead of $A_n = P\left(1 + \frac{R}{100}\right)^n$.

Only 112 out of 240,171 candidates managed to score full marks in this question. As illustrated in Extract 8.2, the candidates used the correct formulas, substituted correct values and performed accurate calculations.

Extract 8.2

8. (a) Solution

from

$A_{20} = 60$

$A_{16} = 20$

from

$A_n = A_1 + (n-1)d$

$A_{20} = A_1 + 19d$

$A_1 + 19d = 60$ —(i)

also

$20 = A_{16} = A_1 + 15d$ —(ii)

simultaneously by elimination method

$\begin{cases} A_1 + 19d = 60 \\ A_1 + 15d = 20 \end{cases}$ (−)

$4d = 40$

$d = 10$

d = 10

$A_1 + 15d = 20$

$A_1 + 150 = 20$

$A_1 = -130$

from

$S_n = \frac{n}{2}[2A_1 + (n-1)d]$

$S_{40} = \frac{40}{2}[2 \times -130 + 39 \times 10]$

$= 20[-260 + 390]$

$= 20[130] = 2600$

The sum of the first 40 terms is $\underline{2600}$

8. (b) from

$P = 4,800,000$

$A_n = 7,730,450$

$n = 5$

from

$A_n = P\left(1 + \frac{r}{100}\right)^n$

$7,730,450 = 4,800,000\left(1 + \frac{r}{100}\right)^5$

$\frac{7,730,450}{48,00000} = \left(1 + \frac{r}{100}\right)^5$

$1,6105 = \left(1 + \frac{r}{100}\right)^5$

$\left(1 + \frac{r}{100}\right) = \sqrt[5]{1.6105}$

$1 + \frac{r}{100} = 1,1$

$\frac{r}{100} = 0,1$

$r = 10\%$

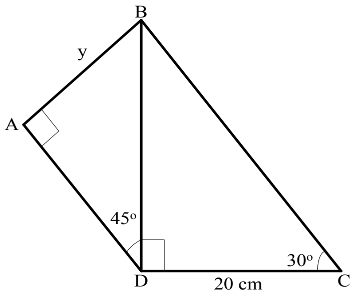
Hence

Compound interest rate is 10%

In Extract 8.2, the candidate applied correctly the formulas and managed to perform the associated computations as required.

2.9 Question 9: Trigonometry

In part 9(a), the candidates were required to find the length marked *y*, writing the answer in four significant figures.



In part 9(b), they were given that a 4 m ladder rests against a vertical wall with its foot 2 m from the wall and were required to find how far up the wall does the ladder reach, giving the answer in two decimal places.

The analysis showed that most of the candidates (92%) scored from 0 to 1.5 out of 6 marks and among them 88.2 percent scored a 0 mark, showing that this question was poorly performed. This poor performance was due to the fact that the candidates were unable to recall and apply either the sine and cosine ratios, the sine rule or the Pythagoras theorem in answering part 9(a). In part 9(b), the candidates were unable to translate the word problem into a right angled triangle and thereafter apply either the trigonometrical ratios or the Pythagoras theorem in finding the required length. It was noted that some candidates were using incorrect trigonometrical ratios of 30^o, 45^o and 60^o, a situation that affected the quality of their responses. It was also observed that some candidates were unable to obtain the final correct answer in both parts 9 (a) and (b) because they were unable to use the mathematical tables to read the values of the trigonometrical ratios accurately. Extract 9.1 is a sample answer illustrating how the candidates failed to answer this question.

Extract 9.1

9 a) Soln:

$\text{Tan } 90^\circ = \frac{x}{20}$

$1 = \frac{x}{20}$

$x = 20$

$\overline{BC} = 20 \text{ cm}$

$\text{Sin } 30^\circ =$

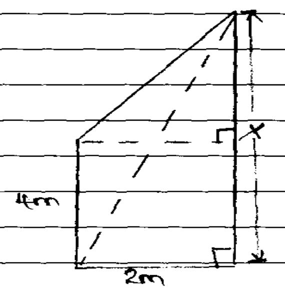
$\text{Tan } 30^\circ = \frac{\overline{BD}}{20}$

$\sqrt{3}/3 = \frac{\overline{BD}}{20}$

$0.5774 = \frac{\overline{BD}}{20}$

$\overline{BD} = 1.1548 \text{ cm}$

9 b)



Soln:

$\cos 90^\circ = \frac{2}{x}$

$\cos 90^\circ = \frac{2}{x-4}$

In Extract 9.1, the candidate used the trigonometrical ratio $\tan 90° = \frac{x}{20}$ wrongly instead of $\tan 30° = \frac{x}{20}$ to find the length BD in part 9(a). The candidate also translated the word problem in part 9(b) into a trapezium instead of a right angled triangle.

Very few candidates (0.4%) performed well and scored full marks in this question. These candidates were able to apply the concepts of trigonometry correctly and their solutions were clearly presented, see extract 9.2.

Extract 9.2

9 (a) SOLUTION

To find length y

To get length y, find length $\overline{BD}$ first

Where Tan 30° = $\frac{BD}{20\text{ cm}}$

$0.5774 \times 20\text{ cm} = BD$

$BD = 11.548\text{ cm}$

$BD = 11.55\text{ cm}$

Then, Sin 45° = $\frac{y}{BD}$

9

Sin 45 = $\frac{y}{11.55\text{ cm}}$

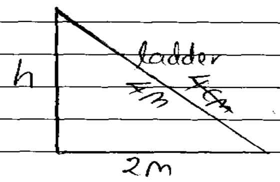
$0.7071 \times 11.55\text{ cm} = y$

$y = 8.167\text{ cm}$

Therefore, $y = 8.167\text{ cm}$

(b) SOLUTION

By using a diagram



From the Pythagoras' theorem

$h^2 + (2m)^2 = (4m)^2$

$h^2 + 4m^2 = 16m^2$

$h^2 = 16m^2 - 4m^2$

$\sqrt{h^2} = \sqrt{12m^2}$

$h = \sqrt{12}\text{ m}$

$h = 3.464\text{ m}$

$h = 3.46\text{ m}$

Therefore, the height of the wall reached by the ladder = 3.46 m.

Extract 9.2 shows that the candidate managed to recall and apply the definitions of trigonometric ratios and the Pythagoras theorem appropriately.

2.10 Question 10: Quadratic Equations

In part 10(a), the candidates were required to solve $x^2 + 4x - 21 = 0$ by using the quadratic formula. In part 10(b), they were given that a garden measuring 12 by 16 meters is to have a pedestrian pathway of equal width constructed all around it, increasing the total area to 285 square meters and were required to find the width of the pathway.

This question was attempted by 98 percent of the candidates, of which 89.9 percent scored from 0 to 1.5 out of 6 marks with 74.7 percent of them scoring a 0 mark. The question was therefore poorly performed. In part 10(a), some candidates were unable to apply the general quadratic formula $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. These candidates were either substituting incorrect values of *a, b* and *c* in the formula or failing to handle the basic arithmetic operations after the substitution. It was noted that, several candidates used the incorrect formula $x = -b \pm \dfrac{\sqrt{b^2 - 4ac}}{2a}$ while others used other methods such as completing the square and splitting the middle term that were contrary to the requirements of this question.

In part 10(b), many candidates were unable to realize that the rectangular garden would have new width of $12 + 2x$ cm and length of $16 + 2x$ cm and they were supposed to find the value of x (the width of the pathway) from the equation for the new area i.e. $(16 + 2x)(12 + 2x) = 285$. Extracts 10.1 (a) and 10.1(b) are sample answers illustrating how the candidates failed to answer this question.

Extract 10.1 (a)

10. (a) $x^2+4x-21=0$

By splitting the middle term

$x^2+7x-3x-21=0$

$x^2+7x-\cancel{3x}-21=0$

$x(x+7)-3(x+7)=0$

$(x-3)(x+7)=0$

Either

$x-3=0$ or $x+7=0$

$x=3$ or $x=-7$

(b) $12\times16=192\ m^2$

$A_1+A_2=$ Total width

$192+285=\frac{477m^2}{2}$

The width $= 238.5m$

In Extract 10.1 (a), the candidate used the method of splitting the middle term in part 10(a) contrary to the instructions given and in part 10 (b), the candidate did not manage to translate the word problem mathematically.

Extract 10.1 (b)

10 a) $x^2-4x-21=0$

Soln.

$x^2-(2x\times2)^2-21=0$

$x^2-2x\times2-2x\times2-21=0$

$(x^2-2x)x2(-2x\times2)=21$

$x(x-2)\ \cancel{+}(-2\ 2(-x\times1)=21$

$(x-2),(x\times1)=21$

$\therefore x=-2$

$x-2=21$ $-x=1=21$

$x=21-2$, or $x-$

$x=19$ or $x=-21$

b) $x =$

$\frac{16mx}{16} = \frac{285}{16}$

$x = 18m$

$\therefore$ The width of The pathway $= 18m$

In Extract 10.1(b), the candidate did not use the quadratic formula as instructed and instead he/she used the method of completing the square wrongly. The candidate could not solve the word problem given in part 10(b).

Only 102 out of 240,135 candidates managed to score full marks. Extract 10.2 is a sample answer which shows how these candidates applied correctly their knowledge and skills to solve quadratic equations.

Extract 10.2

10. a) Soln.

To solve $X^2+4X-21=0$ by Quadratic formula.

From $X = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$ where $a=1, b=4$ and $c=-21$

$X = \frac{-4 \pm \sqrt{4^2-4(1)(-21)}}{2(1)}$

10. $X = \frac{-4 \pm \sqrt{16+84}}{2}$

$X = \frac{-4 \pm \sqrt{100}}{2}$

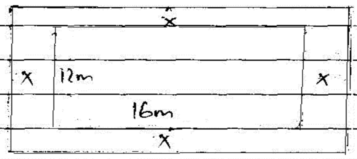
$X = \frac{-4 \pm 10}{2} = \frac{6}{2}, \frac{-14}{2}$.

$X = 3$ or $X = -7$.

$\therefore X = 3$ or $X = -7$.

10. B) Soln

Consider a garden below.



Pedestrian pathway
let x be the increased width in all side.

Area of a garden + Gardener's pathway = length × width

But length = $16+2x$ and width = $12+2x$.

Area $= (16+2x)(12+2x)$

The total area of a garden + Gardener's path = $285m^2$

$$(16+2x)(12+2x) = 285$$

$$192+32x+24x+4x^2 = 285$$

$$192+56x+4x^2=285$$

By taking it into quadriatic equation of $ax^2+bx+c=0$.

$$4x^2+56x+192-285=0$$

$$4x^2+56x-93=0$$

10. B) By Quadriatic formular

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$ where $a=4$, $b=56$, $c=-93$.

$$x=\frac{-56\pm\sqrt{(56)^2-4(4)(-93)}}{2(4)}$$

$$x=\frac{-56\pm\sqrt{3136+1488}}{8}$$

$$x=\frac{-56\pm\sqrt{4624}}{8}$$

$$x=\frac{-56\pm68}{8}=\frac{12}{8},\frac{-124}{8}$$

$$x=1.5m \text{ or } x=-15.5m$$

But there is no negative distance.

∴ Width of the pathway = 1.5m.

In Extract 10.2, the candidate was able to apply the quadratic formula correctly in answering question 10.

2.11 Question 11: Linear programming

The question was;

A farmer has 20 hectares for growing tomatoes and cabbages. The cost per hectare for tomatoes is sh. 48,000 and for cabbages is sh. 32,000. The farmer has budgeted sh. 768,000. Tomatoes require one man-day per hectare and cabbages require two man-days per hectare. There are 36 man-days available. The profit on tomatoes is sh. 160,000 per hectare and on cabbages is sh. 192,000 per hectare. Find the number of hectares of each crop the farmer should plant to maximize the profit.

Question 11 was optional and was attempted by 31.7 percent of the candidates, of which 35.4 percent scored from 3 to 10 marks and among them 0.3 percent scored all the 10 marks. Thus the performance in this question was satisfactory. The candidates who performed well were able to formulate the objective function and the inequalities for the constraints, draw the graphs for these inequalities, identify the feasible region and its corresponding corner points and finally find the number of hectares of each crop the farmer would plant to maximize the profit. Extract 11.1 shows a sample answer from one of the candidates who did well in this question.

Extract 11.1

11.

Let x be the number of hectares for the tomatoes to be grown

y be the number of hectares for the cabbages to be grown

Inequalities

$$48000x + 32000y \leq 768000$$

$$x + 2y \leq 36$$

$$x + y \leq 20$$

$$x \geq 0$$

$$y \geq 0$$

11 The inequalities can further be written as follows

$$3x + 2y \leq 48$$
$$x + y \leq 20$$
$$x + 2y \leq 36$$
$$x \geq 0$$
$$y \geq 0$$

Objective function, $f(x, y) = 160000x + 192000y$

x and y intercepts.

For $3x + 2y = 48$

x	0	16
y	24	0

For $x + y = 20$

x	0	20
y	20	0

For $x + 2y = 36$

x	0	36
y	18	0

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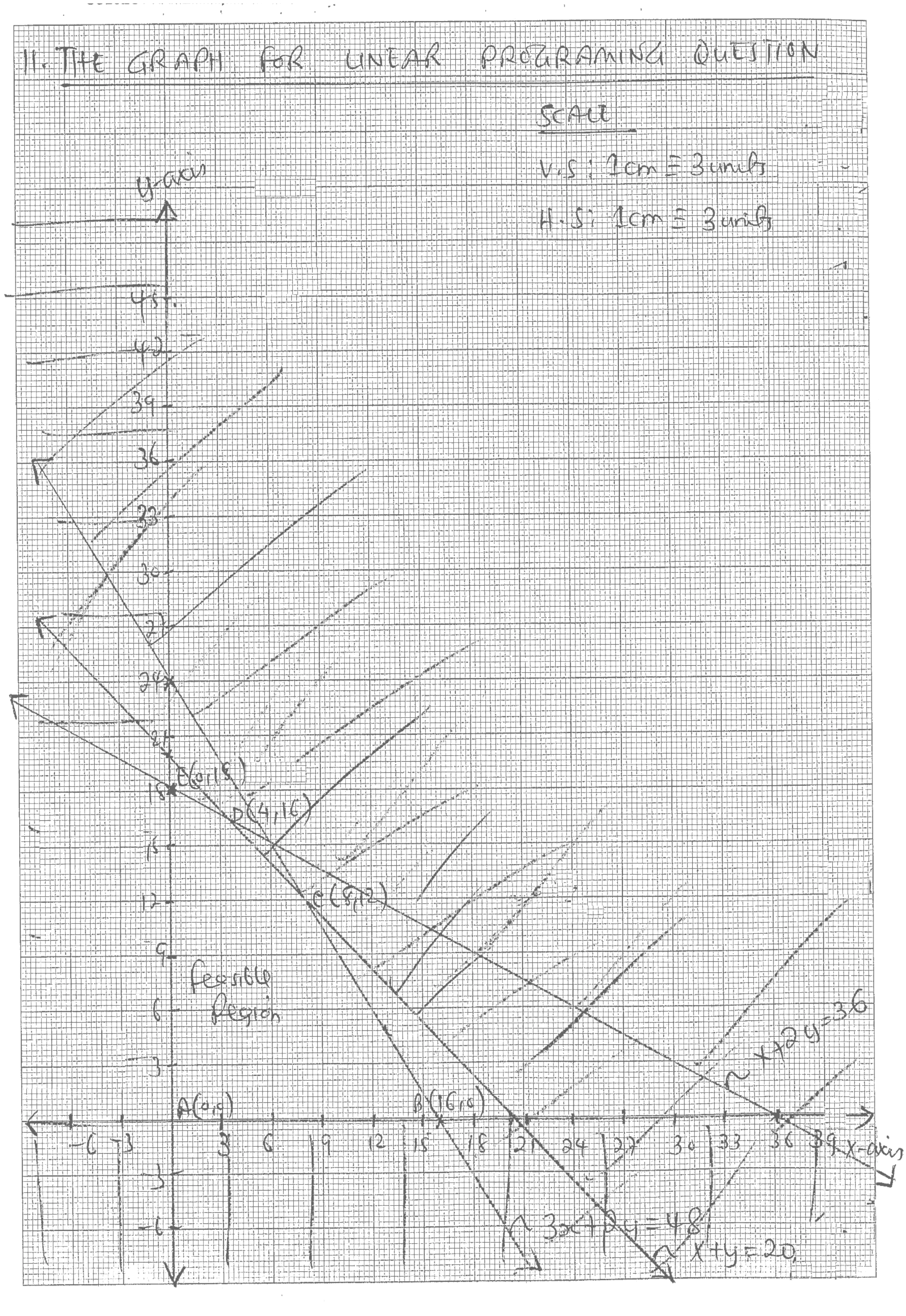
Corner points	Objective function: $f(x, y) = 160000x + 192000y$
A (0, 0)	$f(0,0) = 160000(0) + 192000(0) = 0$
B (16, 0)	$f(16, 0) = 160000(16) + 192000(0) = 2560000$
C (8, 12)	$f(8, 12) = 160000(8) + 192000(12) = 3584000$
E ~~D~~ (0, 18)	$f(0, 18) = 160000(0) + 192000(18) = 3456000$
D ~~E~~ (4, 16)	$f(4, 16) = 160000(4) + 192000(16) = 3712000$

11 For maximizing profit

Optimal point is D(4, 16)

Optimal solution is 3712000

∴ The farmer should plant 4 hectares of tomatoes and 16 hectares of cabbages in order to maximize profit



In Extract 11.1, the candidate managed to formulate the objective function and the inequalities for the constraints and followed all necessary steps for solving a linear programming problem.

In this question 64.6 percent scored below 3 out of 10 marks and among them 34.2 percent scored a 0 mark. The candidates who scored zero lacked knowledge and skills to deal with linear programming problems. It was noted that, some candidates only managed to write down the inequalities for the constraints but failed to graph them as they lacked the drawing skills. Other candidates managed to identify the constraints and graph the inequalities but failed to find the corner points. It was also observed that, some candidates were providing solutions that were unrelated to the requirement of this question, indicating lack of knowledge on the topic of linear programming. Extract 11.2 illustrates this case.

Extract 11.2

11 i/ $48,000 \times 20/100$

Soln

$48,000 \times 20/100$

$= 9600$ Tomatoes

ii/ $32,000 \times 20/100$

Solution

$32,000 \times 20/100$

$= 6400$ Cabbages

iii/ $768,000 \times 36/100$

Solution

$768,000 \times 36/100$

$= 275480$ per hectare

iv/ $160,000 \times 20/100$

Soln

$160,000 \times 20/100$

$= 32000$ profit Tomatoes

11 $192{,}000 \times \frac{20}{100}$

solution

$192{,}000 \times \frac{20}{100}$

$= 38400$ profit cabbages

solution

9600 Tumatoes

+6400 cabbages

16000

$16000 \div 20$

$= 800$

$20\overline{)16000}$

160

--- 0

0

- 0

0

∴ The number of hectare of each crop the farmer should plant to maximeze the profit 800

In Extract 11.2, the candidate performed calculations that were not related to the tested concepts of linear programming.

2.12 Question 12: Statistics

The candidates were required to (a) calculate the mean and the mode, (b) draw a cumulative frequency curve for the data and (c) estimate the median from the graph using the given frequency distribution table.

Height (cm)	11 - 15	16 - 20	21 - 25	26 -30	31 - 35	36 - 40
Frequency	4	8	20	21	12	3

This question was attempted by many candidates (86.6%), of which 47.9 percent scored from 3 to 10 marks and among them (0.2%) scored all the 10 marks, indicating that this question was averagely performed. The candidates who performed well in this question were able to use the formulas: mean $\overline{X} = \frac{\sum Xf}{\sum f}$ or $\overline{X} = A + \frac{\sum fd}{N}$, $\text{Mode} = \text{L} + \frac{\text{t}_1}{\text{t}_1 + \text{t}_2}\text{i}$ and they also managed to use the cumulative frequencies and the upper class boundaries to draw the cumulative frequency curve. Extract 12.1 is a sample answer from one of the candidates who answered question 12 correctly.

Extract 12.1

12. soln

Class Interval	f	x	fx
11 − 15	4	13	52
16 − 20	8	18	144
21 − 25	20	23	460
26 − 30	21	28	588
31 − 35	12	33	396
36 − 40	3	38	114
	$N = 68$		$\sum fx = 1754$

(a) from $\text{Mean} = \frac{\sum fx}{N}$

$= \frac{1754}{68}$

$= 25.794$

$= 25.79$

$\therefore \text{Mean} = 25.79$

(ii) Mode

Modal class $= 26 - 30$

$L = 25.5$

$t_1 = 1$

$t_2 = 9$

$i = 5$

from $\text{mode} = L + \left(\frac{t_1}{t_1 + t_2}\right) i$

12 a) (ii) $\text{Mode} = 25.5 + \left(\frac{1}{1+9}\right) 5$

$= 25.5 + \frac{1}{10} \times 5$

$= 25.5 + \frac{1}{2}$

$= 25.5 + 0.5$

$= 26$

$\therefore \text{Mode} = 26$

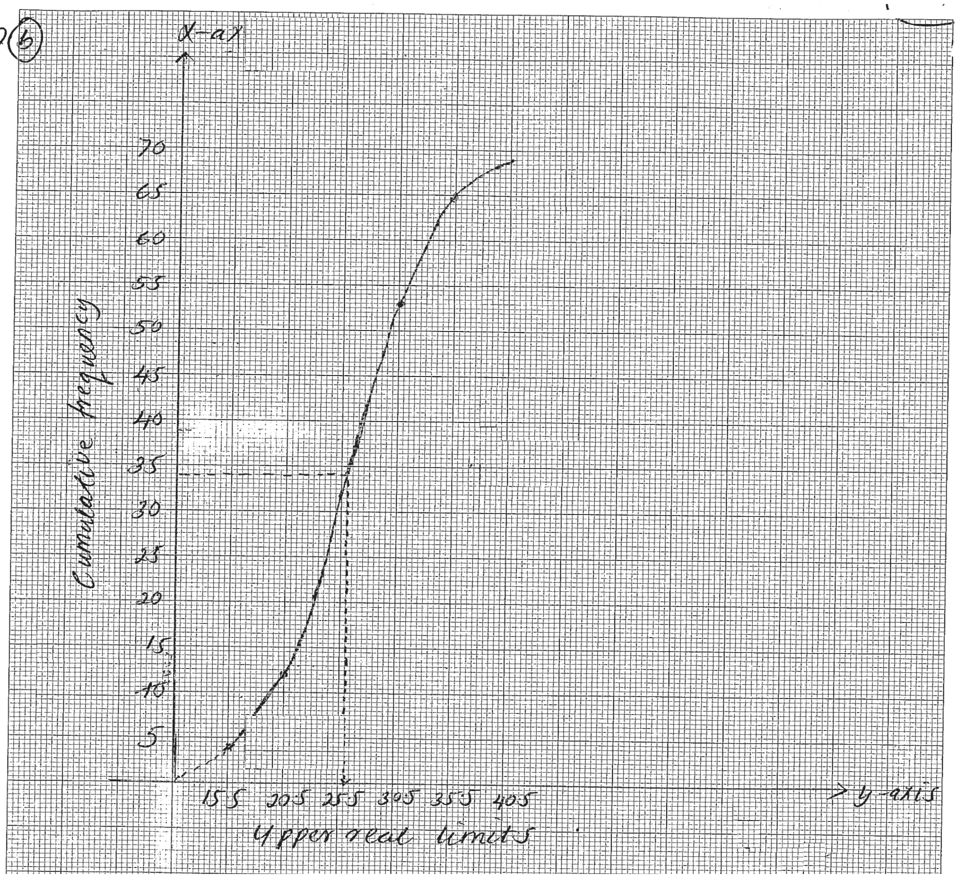
(b) Class Interval	f	cf
11 - 15	4	4
16 - 20	8	12
21 - 25	20	32
26 - 30	21	53
31 - 35	12	65
36 - 40	3	68
	N=68	

Scale: Vertical scale 1cm ≡ 5 units
Horizondal scale 1cm ≅ 1 unit.

(c) soln

∴ from the graph the estimated median is 26.

12(b)



Extract 12.1 shows that the candidate had sufficient knowledge on the topic of statistics and was able to apply it correctly.

Further analysis shows that, 52.1 percent of the candidates who attempted this question scored low marks (below 3 out of 10 marks). Some of these candidates failed to recall the formulas for mean and the mode while others were able to recall the formulas but failed to apply them. Some candidates failed to draw the cumulative frequency curve correctly and hence failed to get correct estimate of the median. Some of the graphs were drawn using a ruler instead of a free hand, and worse enough, some candidates decided to draw histograms and other types of graphs that were not demanded. Extract 12.2 illustrates some of these weaknesses.

Extract 12.2

12 soln

Heights	Frequeny	FX
11 - 15	4	
16 - 20	8	
21 - 25	20	
26 - 30	21	
31 - 35	12	
36 - 40	3	

a/ Mean $= \frac{\Sigma F}{F}$

$= \frac{4+8+20+21+12+3}{6}$

$= \frac{68}{6}$

$= 11.3$

$\therefore$ 11.3

Mode $= \frac{20+21}{2}$

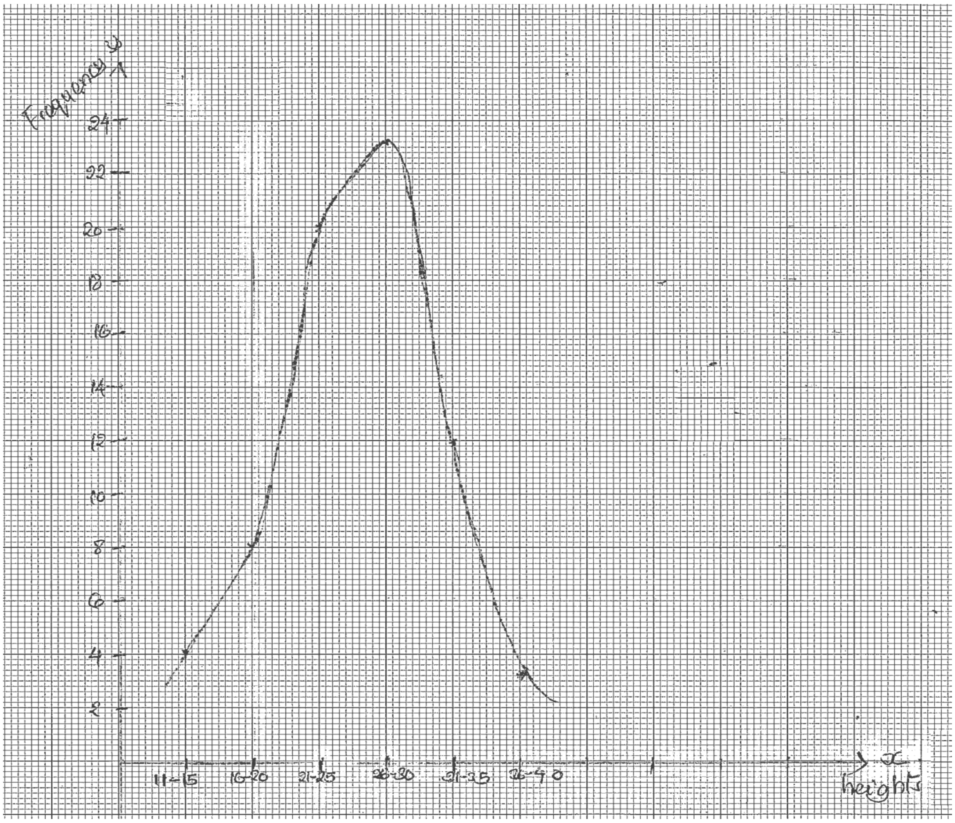
$= \frac{41}{2}$

$= 20.5$

$\therefore$ Mode $= 20.5$

b/ Plotted on the graph paper.

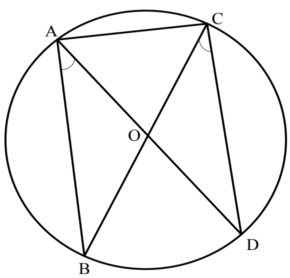
c/ But the median is 21



In Extract 12.2, the candidate applied the incorrect formula $\bar{x} = \frac{\sum f}{f}$ instead of $\bar{x} = \frac{\sum fx}{\sum f}$ to find the mean, computed wrongly the mode and plotted frequencies against class intervals instead of cumulative frequencies against upper class boundaries to draw the ogive.

2.13 Question 13: Circles and the Earth as a Sphere

This question had three parts; 13(a), (b) and (c). In part 13(a), the candidates were required to prove that the sizes of the angles in the same segment of a circle are equal. In part 13(b), they were required to find angle BCD in the following figure, given that O is the center of the circle and AD bisects angle BAC.



In part 13(c), the candidates were required to find the difference in longitudes in two significant figures between Kicheko and Mtakuja villages which are located at latitude 60°, given that the distance between them measured along the parallel of latitude is 1111 km.

This question was opted by only 7.1 percent of the candidates, of which 90.7 percent scored below 3 out of 10 marks and among them 80 percent scored a 0 mark, indicating that this question was highly omitted and poorly performed.

The candidates failed to use the angle properties of circles to prove the given theorem. In particular, the candidates failed to make use of the property which states "the angle which an arc subtends at the centre is double that which it subtends at any point on the remaining part of the circumference". They also failed to use the formula of the distance along the small circles in order to find the difference in longitudes between the two places, see Extract 13.1.

Extract 13.1

13 (a) $45^\circ \times 45^\circ = 180^\circ$

$180^\circ = 45^\circ * 45^\circ$

$\cancel{90^\circ} - 180^\circ - 90$

90°

∴ The size of the angle in the same segment $= 90^\circ$

(b) $O = 90^\circ$

$AD =$

$BAC = 90^\circ$

$BCD = 90^\circ$

Solution

$BAC = 45^\circ \times 90^\circ \times 45^\circ =$

$BCD = 45 \times 90^\circ$

In Extract 13.1, the candidate used the numbers that appeared in the question to do computations that did not have any meaning, indicating lack of knowledge on the topic of Circles and the Earth as a Sphere.

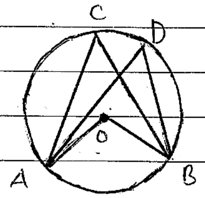
Very few candidates (0.5%) managed to answer this question correctly and scored full marks. Extract 13.2 shows a sample answer from one of these candidates.

Extract 13.2

13(a) Solution:

Required to prove: Sizes of the angle in the same segment of a circle are equal.

Consider the circle below: ACB



with O the centre of a circle.

Required to prove $A\hat{C}B = A\hat{O}B$

From the figure:

$A\hat{O}B = 2A\hat{C}B$ {Central angle is twice angle at the point on the circumference}.

also $A\hat{O}B = 2A\hat{D}B$ {Central angle is twice angle at the point on the circumference}.

So

$2A\hat{C}B = 2A\hat{D}B = A\hat{O}B$ {Similar angles}

$\frac{2A\hat{C}B}{2} = \frac{2A\hat{D}B}{2}$

$A\hat{C}B = A\hat{D}B$

But $A\hat{C}B$ and $A\hat{D}B$ are angles in the same segment.

Therefore sizes of the angles in the same segment of a circle are equal

Hence proved.

13(b) Solution.

Given: Circle ABDC.

O centre:

$\bar{AD}$ bisects $B\hat{A}C$.

Required to find: $B\hat{C}D$.

From: Given circle:

$B\hat{A}D = D\hat{A}C$ {Angle bisected by AD}.

But:

$B\hat{A}C = 90^\circ$ {Angle in a semi circle}.

also:

$B\hat{A}C = B\hat{A}D + D\hat{A}C$

$\frac{90^\circ}{2} = \frac{2B\hat{A}D}{2}$.

$B\hat{A}D = 45^\circ$

But:

$B\hat{A}D = B\hat{C}D$ {Angles in the same segment of a circle}. $= 45^\circ$

Therefore angle BCD is 45°.

13(c) Solution.

latitude $60^\circ S$.

distance between 1111 km

To find difference in longitudes (2 sf).

Consider relation.

$$\frac{l}{2\pi R\cos\theta} = \frac{\alpha}{360^\circ}$$

where

R = Radius of earth.

θ = Angle of latitude.

α = diffence in longitudes

l = distance along the latitude.

By using $R = 6400$ km and $\pi = 3.14$.

$$\frac{1111 \text{ km}}{2(3.14)(6400)\cos 60^\circ} = \frac{\alpha}{360^\circ}$$

$$\frac{1111}{20096} = \frac{\alpha}{360}$$

$$\alpha = \frac{1111 \times 360^\circ}{20096}$$

$$= \frac{399960}{20096}$$

$$= 19.90^\circ$$

$$= 20^\circ \text{ correct to } (2sf).$$

Therefore difference between their longitudes is 20° correct to two significant figures.

In Extract 13.2, the candidate applied the angle properties of circles and the formula to find the difference in longitudes correctly to obtain the required solution.

2.14 Question 14: Accounts

The question was;

Mr. Kijembe started business on 16th March, 2011 with capital in cash 2,066,000/=

March 17 bought goods for Cash 1,000,000/=
19 bought shelves for Cash 110,000/=
20 sold goods for Cash 900,000/=
21 purchases for Cash 800,000/=
22 sold for cash 1,400,000/=
26 paid Rent 300,000/=

Record the above transactions in a cash account ledger and extract a trial balance. State two uses of the trial balance you have prepared.

Many candidates (68.7%) attempted the question, out of which 80.7 percent scored from 3 to 10 marks, indicating that this question was well answered. It was the best performed question in this examination. The factors that accounted for such good performance includes: the candidates ability to post the given transactions in the cashbook account correctly and balance it, see Extract 14.1.

Extract 14.1

14. DR CASH A/C CR

Date	Particulars	F	Amount	Date	Particulars	F	Amount
16/3/2011	Capital	2	2,066,000	17/3/2011	Purchases	3	1,000,000
20/3/2011	Sales	5	900,000	19/3/2011	Shelves	4	110,000
22/3/2011	Sales	5	1,400,000	21/3/2011	Purchases	3	800,000
				26/3/2011	Rent	6	300,000
				31/3/2011	Balance	c/d	2,156,000
			4,366,000				4,366,000
1/4/2011	Balance	b/d	2,156,000				

Trial Balance as at 31/3/2011

DETAILS	DEBIT	CREDIT
1. CASH	2,156,000	
2. CAPITAL		2,066,000
3. PURCHASES	1,800,000	
4. SHELVES	110,000	
5. SALES		2,300,000
6. RENT	300,000	
Total	4,366,000	4,366,000

(i) Trial balance helps in maintaining and correcting the accounts when the calculation are wrong.
(ii) It helps in preparing the trade, profit and loss accounts.

In Extract 14.1, the candidate was able to post the given transactions in the cash account, balance it, extracted the trial balance and stated the use of the trial balance correctly.

In this question, 19.3 percent of the candidates who attempted it scored below 3 out of 10 marks and among them 7.8 percent scored a 0 mark. The candidates who scored low marks in this question were unable to identify the transactions which were to be posted in the credit side and the ones to be posted in the debit side. Some candidates posted all the entries wrongly whereas some posted correctly only some of the entries, indicating that they did not master well the principles of debiting and crediting. It was noted that, several candidates were creating accounts which were not needed in the question like sales, purchases and rent accounts, see Extract 14.2.

Extract 14.2

14

CAPITAL 01

DR CR

Date	particular	folio	amount	Date	particul	Folio	amount
16 march	capital		2,066,000	17 march	bought		1,000,000
				18 march	shelves		110,000
				20 march	sold		900,000
				21 march	purchases		800,000
				22 march	sold		1,400,000
				26 march	Paid		300,000
			4400,000				44,00,000

SALES 02

DR CR

Date	particular	folio	amount	Date	particular	folio	amount
1 jun	capital		20,66,000	2 jun	capital	b/d	44,00,000
31 jun	balance	c/d	44,00,000		balance		44,00,000

BOUGHT 03

DR CR

Date	particular	folio	amount	Date	particular	folio	amount
1 july	bought		1,000,000			b/d	
31 july	balance	c/d	1,000,000				

SHELVES 04

DR CR

Date	particular	folio	amount	Date	particular	folio	amount

14

SHELVES D4

DR CR

Date	particular	folio	amount	Date	particular	folio	amount
				1 august	shelves		110,000
						b/d	
31 august	balance	c/d	110,000				110,000

SOLD D5

DR CR

Date	particular	folio	amount	Date	particular	folio	amount
1 Sep	sold		900,000				
				31 Sep	balance	c/d	900,000

PURCHASES D6

DR CR

Date	particular	folio	amount	Date	particular	folio	amount
1 oct	purchases		800 000				
			800, 000				
			1600 000	31 oct	balance	c/d	1600,000

SOLD D7

DR CR

Date	particular	folio	amount	Date	particular	folio	amount
				nov	sold		1,400,000
31 nov	balance.	c/d	1,400,000				

In Extract 14.2, the candidate opened accounts which were not required and did not post the transactions to the cash account ledger and extracted the trial balance as demanded.

2.15 Question 15: Matrices and Transformations

The question had two parts, 15(a) and 15(b). In part 15(a) (i), the candidates were required to determine a matrix M which represents a reflection on the line $y - x = 0$. In part 15(a)(ii), the candidates were asked to find the image of the line $x + 2y - 4 = 0$ after a reflection in the line $y - x = 0$. In part 15(b) (i), the candidates were required to find $|A|$ and

A^{-1} if $A = \begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}$ and in 15(b)(ii), the candidates were required to use the inverse matrix obtained in 15(b) (i) to solve $3x + 2y = 12$ and $4x - y = 5$.

This question was opted by 54.3 percent of the candidates, of which 29.6 percent scored from 3 to 10 marks. In addition, among those who answered this question, 1.0 percent scored full marks, indicating a satisfactory performance in this question. The candidates who scored high marks were able to find the matrix which represents the reflection in the line $y - x = 0$ and the image of the line $x + 2y - 4 = 0$ after the reflection. Moreover, they managed to apply the knowledge of matrices to find the determinant of the given matrix and its inverse. They also managed to solve the given simultaneous equations by the inverse method. Extract 15. 1 is sample answer from one of the candidates who performed well in this question.

Extract 15.1

15 (i) Line $y - x = 0$.

$y = x$.

$\theta = 45$.

$$\begin{pmatrix} \cos 2\theta & \sin 2\theta \\ \sin\theta & -\cos 2\theta \end{pmatrix}$$

$$\begin{pmatrix} \cos 90 & \sin 90 \\ \sin 90 & -\cos 90 \end{pmatrix}$$

$\cos 90 = 0$

$\sin 90 = 1$.

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$$

$\therefore$ The Matrix M representing the reflection on line $y - x = 0$

is $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

15 (ii) line $x+2y-4=0$.

$x+2y-4=0$.
$2y=4-x$.

15 $y=2-x/2$.

~~y=~~

X	Y.
0	2
4	0

$\cancel{2}\cancel{x}x/\cancel{2} = 2\times 2$.
$x=4$

Hence we have the following points.

$(X\ Y) = (0\ \ 2)$
$(X\ Y) = (4\ \ 0)$

Then
$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 0 \\ 2 \end{pmatrix} = \begin{pmatrix} 0+2 \\ 0 \end{pmatrix}$$
$$= \begin{pmatrix} 2 \\ 0 \end{pmatrix}.$$

$$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 4 \\ 0 \end{pmatrix} = \begin{pmatrix} 0+0 \\ 4+0 \end{pmatrix}$$
$$= \begin{pmatrix} 0 \\ 4 \end{pmatrix}$$

Hence we have.

$(2,0)$ and $(0\ 4)$

the gradients.

$$\frac{\Delta y}{\Delta x}$$

$$= \frac{4-0}{0-2} = \frac{4}{-2} = -2.$$

then.

$$\frac{4-y}{0-x} = -2.$$

$$4-y = -2(-x)$$

$$4-y = 2x.$$

$$4-2x = y.$$

or

$$2x+y-4=0$$

$\therefore$ The image of the line is

$$\underline{2x+y-4=0}$$

(b) $A = \begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}$

$$|A| = (3\times -1) - (4\times 2)$$

$$= -3 - 8$$

$$= -11$$

$\therefore$ $|A| = -11$

15 (b)

$$A^{-1} = \frac{1}{|A|}\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

$$= -\frac{1}{11}\begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}$$

$$= -\frac{1}{11}\begin{pmatrix} -1 & -2 \\ -4 & 3 \end{pmatrix}$$

$$A^{-1} = \begin{pmatrix} \frac{1}{11} & \frac{2}{11} \\ \frac{4}{11} & \frac{-3}{11} \end{pmatrix}$$

$\therefore$ the A^{-1} is $\begin{pmatrix} \frac{1}{11} & \frac{2}{11} \\ \frac{4}{11} & -\frac{3}{11} \end{pmatrix}$

(ii) $3x+2y=12$

$4x-y=5$

$$\begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 12 \\ 5 \end{pmatrix}$$

Multiply Both side by the Inverse of ~~Multi~~ Matrix

$$\begin{pmatrix} \frac{1}{11} & \frac{2}{11} \\ \frac{4}{11} & \frac{-3}{11} \end{pmatrix}\begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} \frac{1}{11} & \frac{2}{11} \\ \frac{4}{11} & \frac{-3}{11} \end{pmatrix}\begin{pmatrix} 12 \\ 5 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} \frac{12}{11}+\frac{10}{11} \\ \frac{48}{11}-\frac{15}{11} \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} \frac{22}{11} \\ \frac{33}{11} \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$$

$\therefore x = 2$ and $y = 3$.

Extract 15.1 shows that the candidate was able to apply correctly the knowledge and skills of matrices and geometrical transformations in answering question 15.

Further analysis shows that 70.4 percent of the candidates who attempted this question scored from 0 to 2.5 out of 10 marks and among them 39 percent scored a 0 mark. The factors that contributed to the candidates scoring low marks in this question include: lack of knowledge on the topic of matrices, failure to perform correctly the basic operations such as addition, multiplication, division and subtraction, confusion between matrix of reflection and rotation and failure to follow the instructions, for instance some of the candidates used Cramer's rule and the elimination method instead of inverse matrix, see Extract 15.2.

Extract 15.2

15(a)(i) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix} - \begin{pmatrix} x \\ y \end{pmatrix} = 0$

$\begin{vmatrix} 0 & -1 \\ 1 & 0 \end{vmatrix} - \begin{vmatrix} x \\ y \end{vmatrix} = 0$

$\begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix}$

$\therefore$ $x = 1$ and $y = 0$

(ii) $x + 2y - 4 = 0$

Solution

$x + 2y - 4 = 0$

$2xy = 0 + 4$

$\frac{\cancel{2}xy}{\cancel{2}} = \frac{4}{2}$

$xy = 2$

(b) If $A = \begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}$ find $|A|$ and A^{-1}

Solution

$$|A| = \begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}$$

$$|A| = \left| \begin{matrix} 3 & 2 \\ 4 & -1 \end{matrix} \right|$$

$$|A| = |3 \times -1 + 4 \times 2|$$

$$|A| = |3 + 8|$$

$$\therefore \quad |A| = |11|$$

15(b) $A^{-1} = \begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}$

Solution

$$A^{-1} = \begin{pmatrix} 3 & 2 \\ 4 & -1 \end{pmatrix}$$

$$A^{-1} = \left| \begin{matrix} -1 & 2 \\ 4 & 3 \end{matrix} \right|$$

$$A^{-1} = \left| \begin{matrix} 3 & {}^{-}2 \\ {}^{-}4 & -1 \end{matrix} \right|$$

$$A^{-1} = 3 \times -1 + {}^{-}4 + {}^{-}2$$

$$A^{-1} = 3 + -2$$

$$\therefore \quad A^{-1} = 1$$

(ii) $3x + 2y = 12$ and $4x - y = 5$

Solution

$$3x + 2y = 12$$
$$4x - y = 5$$

$$\begin{pmatrix} 3 \\ 4 \end{pmatrix} + \begin{pmatrix} 2 \\ 1 \end{pmatrix} + \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 12 \\ 5 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 5 \\ 5 \end{pmatrix} - \begin{pmatrix} 12 \\ 5 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -7 \\ 0 \end{pmatrix}$$

Extract 15.2, shows that the candidate could not find the matrix of reflection, the inverse matrix and solve the given simultaneous equations. The candidate lacked knowledge on the topic of matrices and transformations.

2.16 Question 16: Functions and Probability

The task for part 16(a) was;

A bag contains 6 white balls and 3 yellow balls. A ball is selected at random and not replaced. Another ball is then selected. Find the probability of selecting one white ball and one yellow ball.

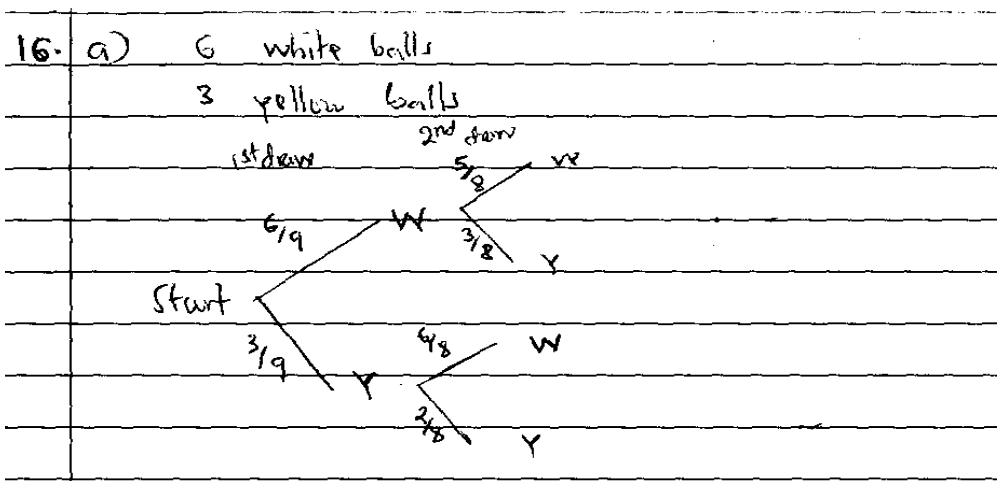
In part 16(b), the candidates were given the function

$$f(x) = \begin{cases} -4 \text{ when } x < -1 \\ x^2 + 1 \text{ when } -1 \le x \le 2 \\ 5 \text{ when } x \ge 2 \end{cases}$$

and they were required to: (i) sketch the graph of $f(x)$, (ii) state the domain and range of $f(x)$ and (iii) state with reason(s) as whether $f(x)$ is a one to one function or not.

The question was attempted by 58.6 percent of the candidates; of which 30.6 percent scored from 3 to 10 marks and among them 0.2 percent scored all the 10 marks, showing that the performance in this question was satisfactory. As illustrated in Extract 16.1, the candidates who performed well in this question were able to draw correctly probability tree diagrams to answer part 16(a) and had good drawing skills that enabled them to draw the required graph in part 16(b).

Extract 16.1



Probability of white and yellow is $P(W \cap Y)$.

$P(W \cap Y) + P(Y \cap W)$

$\left(\frac{2}{3} \times \frac{3}{8}\right) + \left(\frac{1}{3} \times \frac{3}{4}\right)$

$\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$

$\therefore$ Probability of selecting one white ball and one yellow ball is $\frac{1}{2}$

b) $f(x) = \begin{cases} -4 \text{ when } x \leq -1 \\ x^2+1 \text{ when } -1 \leq x \leq 2 \\ 5 \text{ when } x \geq 2 \end{cases}$

Table of values

x^2+1

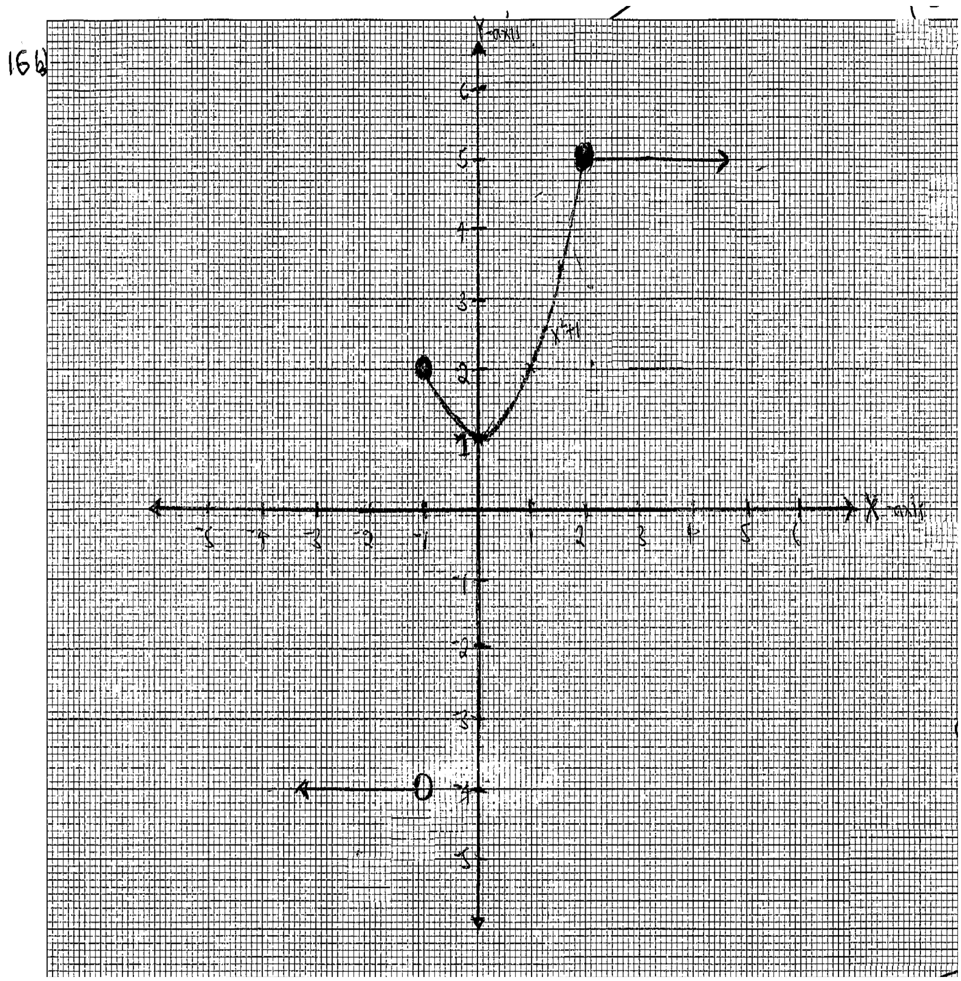
x	-1	0	1	2
x^2+1	2	1	2	5

i) Graph is on graph paper

ii) Domain $= \{x : x \in \mathbb{R}\}$

Range $= \{y : y = -4, 1 \leq y \leq 5\}$

iii) It is not a one to one function because if you draw a line parallel to x-axis it cuts the graph to more than one point



Extract 16.1, shows a sample answer from one the candidates who answered question 16 correctly.

On the other hand, 69.4 percent of the candidates who attempted this question scored low marks from 0 to 2.5 and among them 17.6 percent scored zero. The factors which contributed to poor performance in this question include: candidates' inability to apply knowledge of probability to answer part 16(a), failure of candidates to use probability tree diagrams and lack of knowledge and skills to draw graphs and find domain and range. Extract 16.2 is a sample answer showing how the candidates failed to answer this question.

Extract 16.2

16 a) Soln

Given $S = \{w, w, w, w, w, w, y, y, y\}$

$n(S) = 9$

$n(E) = 1$

$P.E = \frac{n(E)}{n(S)}$

$P.E = \frac{1}{9}$ Probability for white ball

$n(S) = 9$

$n(E) = 1$

$P.E = \frac{n(E)}{n(S)}$

$P.E = 1/9$ probability for yellow ball

$1/9 + 1/9 = 2/9$

∴ The probability of white ball and yellow ball is $2/9$

16 b) (i) Soln

Table of value for $-4x-1$

x	-1	-2	-3
y	-1	-2	-3

Table of value for x^2+1 when $-1 \leq x \leq 2$

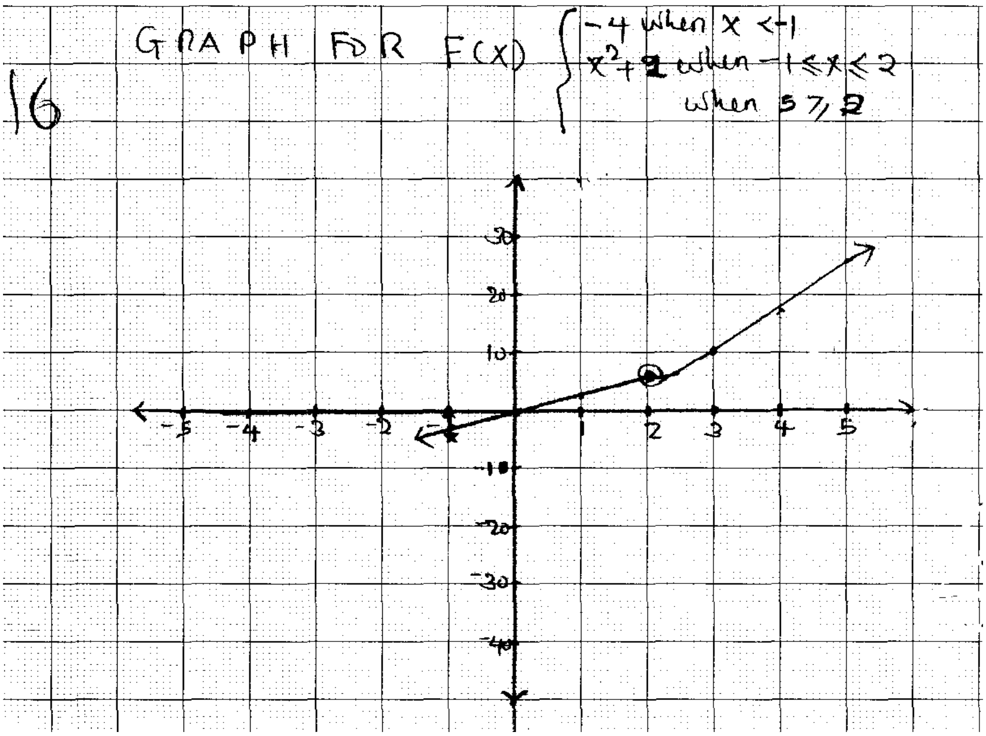
x	2	1	0	-1
y	5	2	1	2

Table of value for x^2+1 when $x \geq 2$

x	2	3	4	5
y	5	10	17	26

b) ii) Domain $= \{x : x > 2\}$.

Range $= \{y : y > 5\}$.



In Extract 16.2, the candidate was unable to interpret part 16(a) and also failed to use correct formulas for finding the probability of combined events. In part 16(b), the candidate could not draw the required graph, an indicator of lack of knowledge and skills on functions.

3.0 CONCLUSION AND RECOMMENDATIONS

3.1 Conclusion

Basing on the average percentage of the candidates who managed to score 30 percent or more of the marks in all the questions that were examined from the same topic(s); the following conclusion was drawn.

Out of the 23 topics that were examined, the candidates performed well in only one (01) topic of *Accounts* and averagely in eight (08) topics of *Algebra; Sets; Rates and Variation; Linear Programming; Statistics; Matrices and Transformations; Functions* and *Probability.*

On the other hand, the candidates had weak performance in fourteen (14) topics of *Numbers; Units; Exponents and Radicals; Vectors; Coordinate Geometry; Similarity; Areas and Perimeters; Ratio, Profit and Loss; Sequences and Series; Trigonometry; Pythagoras Theorem; Quadratic Equations; and Circles* and *Earth as Sphere*. The analysis of the candidates' performance for each topic is presented in the Appendix. In this

Appendix, green, yellow and red colours represent good, average and weak performance respectively.

The factors which have contributed to the general poor performance in this examination include: candidates lack of knowledge and skills on the examined topics, candidates inability to use concepts/formulas/laws correctly, failure of candidates to identify the demand of the questions, lack of skills to interpret word problems mathematically or diagrammatically and failure of candidates to draw graphs correctly.

3.2 Recommendations

In order to raise the standard of performance in this subject it is recommended that;

(a) The students should study all topics in the syllabus and make sure they understand thoroughly the underlying concepts, formulas, laws and that they are able to apply them.

(b) The students should be encouraged to do enough exercises to get experience in applying various formulas/concepts and skills to draw graphs.

(c) The students should be encouraged to build the habit of reading the questions carefully and identify the requirements before performing any task.

(d) The teachers should make sure that all topics in the syllabus are covered before the start of the examination and that during the learning process they are advised to identify students with learning difficulties so that they can be given special assistance.

(e) The teachers should give the students enough exercises particularly on word problems in order to build the skills to solve them.

(f) Finally, the Ministry of Education and Vocational Training is advised to use the information in this report to make sure that there is close monitoring on how the teaching and learning are conducted in schools so as to raise the standard of performance in this subject.

Appendix

Analysis of Candidates' Performance Per Topic in Basic Mathematics

S/N	Topic	Question Number	The Percentage of Candidates who Scored an Average of 30% or More	Remarks
1	*Accounts*	14	80.7	Good
2	*Rates and Variation*	06	49.8	Average
3	*Statistics*	12	47.9	Average
4	*Algebra and Sets*	3	35.2	Average
5	*Linear Programming*	11	35.4	Average
6	*Functions and Probability*	16	30.6	Average
7	*Matrices and Transformations*	15	29.6	Average
8	*Ratio, Profit and Loss*	7	24.3	Weak
9	*Numbers and Units*	1	18.7	Weak
10	*Sequences and Series*	8	15.7	Weak
11	*Vectors and Coordinate Geometry*	4	14.8	Weak
12	*Exponents and Radicals*	2	14.5	Weak
13	*Quadratic Equations*	10	10.1	Weak
14	*Circles & Earth as Sphere*	13	9.3	Weak
15	*Trigonometry and Pythagoras Theorem*	9	8.0	Weak
16	*Similarity, Areas and Perimeters*	5	3.0	Weak