

THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA



**EXAMINERS' REPORT ON THE PERFORMANCE
OF CANDIDATES CSEE, 2012**

041 BASIC MATHEMATICS

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FOREWORD

The National Examinations Council of Tanzania is pleased to issue this Examiners' Report on the Performance of Candidates in Basic Mathematics CSEE 2012. The report was prepared to provide feedback to students, teachers, parents, policy makers and other education stakeholders on how the students answered the questions. Essentially, candidates' responses to the examination questions is one indicator of what the students were able or unable to understand their secondary education mathematics syllabus.

The analysis of candidates' responses shows that there were several factors which contributed to the candidates scoring low marks in the examination questions including: lack of understanding of the required concepts, failure to identify the requirements of the questions and incompetency in translating word problems into mathematical equations. Each factor is explained by using extracts from the scripts of candidates. The extracts therefore show the evidence of what was written by the candidates, illustrating the seriousness of the problem.

The feedback given in this report will enable various education stakeholders to identify proper measures to be taken in order to improve candidates' performance on Basic Mathematics in future examinations administered by the Examinations Council.

The Council will highly appreciate comments from students, teachers and the public that can be used to improve future Examiners' Reports. Each school will be provided with a complimentary copy of this report; extra copies are available for sale and can be purchased from the Council. Information on the cost and postage charges can be provided on request.

Finally, the Council would like to thank all the Examinations Officers, subject teachers and all others who participated in the preparation of this report. We would also like to thank the staff of the Department of Information and Communication Technology who participated in analysing the data used in this report.



Dr. Charles E. Msonde
Ag. EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report analyses the performance of the candidates in the CSEE 2012 Basic Mathematics paper. The purpose of this analysis is to draw attention to some of the problems that the candidates faced when sitting for this examination.

The CSEE Basic Mathematics paper had 16 questions set in accordance with the revised 2005 syllabus. The paper consisted of section A with 10 compulsory questions and section B with 6 questions of which the candidates had to choose any of 4. Each question in section A carried 6 marks, whereas in section B each carried 10 marks.

In 2012, a total of 396,678 candidates sat for the examination out of which 44,964 (12.14%) candidates passed the examination. In 2011 however, a total of 338,973 candidates sat for the Basic Mathematics examination, out of which 48,886 (14.55%) candidates passed the examination. This is a 2.41 percent drop in the number of the candidates who passed.

The analysis on the individual questions is presented in the next sections. It includes a short description of the requirement of the questions and the performance of the candidates. The factors that attributed to the poor performance in each question have been pointed out and illustrated using samples of the candidates' responses. For each question, samples of good responses have been included to know the answers that the candidates were expected to write and also the responses may serve as a guide on how to answer examination questions.

2.0 ANALYSIS ON INDIVIDUAL QUESTIONS

2.1 Question 1: Numbers

This question was attempted by 96.2 percent of the candidates of which 291,164 (73.4%) candidates scored a 0 mark and only 10,897 (2.8%) candidates scored from 3 to 6 marks. Thus, the question was poorly performed by most candidates.

Part 1 (a) which was on evaluating $\frac{\sqrt[3]{0.0072} \times (81.3)^2}{\sqrt{23140}}$ to three significant figures by using mathematical tables was poorly performed. Some of the candidates failed to read tables for logarithms of each component while others failed to identify the requirements of the question, see Extract 1.1 (a). The presence of many candidates who failed to answer this question indicates that the topic of Logarithm was not clear among candidates. In obtaining the correct answer, the candidates were supposed to use the method as shown in Extract 1.1 (b).

Extract 1.1 (a)

1

$$\frac{\sqrt[3]{0.0072} \times (81.3)^2}{\sqrt{23140}}$$

soln

$$\frac{\sqrt{3 \times 4 \times 6} \times 81.3 \times 81.3}{\sqrt{23140}}$$
$$\frac{\sqrt[3]{24} \times 66.0999}{\sqrt{23140}} = \frac{\sqrt[3]{24} \times 66.0999}{\sqrt{23140}}$$
$$= \frac{\sqrt[3]{24} \times 22.0333}{\sqrt{23140}} = \frac{\sqrt[3]{24} \times 22.0333}{\sqrt{7794.3}}$$
$$= \frac{\sqrt[3]{24} \times 22.0333}{\sqrt{7794.3}}$$
$$= \frac{\sqrt[3]{8} \times 22.0333}{\sqrt{7794.3}}$$
$$= \frac{\sqrt{176.2664}}{\sqrt{7794.3}} \text{ Answer}$$

As seen in Extract 1.1 (a), the candidate was unable to identify the requirements of the question indicating that he/she lacked the knowledge and skills on how to use mathematical tables, since he/she answered this part without using them.

Extract 1.1 (b)

1a

Number	logarithm	Operation
$(7.2 \times 10^{-3})^{\frac{1}{3}}$	$\frac{1}{3} \times 3.8573$	$1.2858 +$
$(8.13 \times 10^1)^2$	2×1.9101	3.8202
		<hr/>
		3.1060
$(2.314 \times 10^4)^{\frac{1}{2}}$	$\frac{1}{2} \times 4.3643$	$2.1822 -$
		<hr/>
		0.9238
Antilog of 0.9238 $= 10^0 \times 8.390$		
The answer is 8.39 .		

It is evident from Extract 1.1 (b) that the candidate demonstrated the required skills in using mathematical tables and hence was awarded full marks for part 1 (a).

Part 1 (b) required the candidates to rationalize $\frac{2+\sqrt{3}}{1-\sqrt{3}}$. This part was poorly answered as the majority of the candidates lacked the knowledge and skills of simplifying radicals by rationalizing the denominator. Extract 1.2 (a) illustrates this case.

Extract 1.2 (a)

1. b)

$$\frac{2+\sqrt{3}}{1-\sqrt{3}} \times \frac{1+\sqrt{3}}{1+\sqrt{3}}$$
$$\frac{2+\sqrt{9}}{1+\sqrt{9}}$$
$$\frac{2+3}{1-3}$$
$$\frac{5}{-2} = -\frac{5}{2}$$

Extract 1.2 (a) is a sample from the script of one of the candidates who did not know how to carry out the procedures of rationalizing the denominator. After rationalizing the denominator, the candidate multiplied $2+\sqrt{3}$ and $2-\sqrt{3}$ of the numerator incorrectly to obtain $2+\sqrt{9}$ instead of $2+2\sqrt{3}+\sqrt{3}+\sqrt{9}$.

Only a few candidates were able to follow the correct procedures in rationalizing the denominator. Extract 1.2(b) shows a sample response from one of the candidates who answered question 1 (b) as required.

Extract 1.2 (b)

1(b)	<p style="text-align: center;">Solution:-</p> $\frac{2 + \sqrt{3}}{1 - \sqrt{3}}$ <p style="text-align: center;">Rationalize factor $1 + \sqrt{3}$</p> $= \frac{2 + \sqrt{3}}{1 - \sqrt{3}} \cdot \frac{1 + \sqrt{3}}{1 + \sqrt{3}}$ $= \frac{2 + 2\sqrt{3} + \sqrt{3} + 3}{1 + \sqrt{3} - \sqrt{3} - 3}$ $= \frac{2 + 3 + 3\sqrt{3}}{1 - 3}$ $= \frac{5 + 3\sqrt{3}}{-2}$ $\therefore \frac{2 + \sqrt{3}}{1 - \sqrt{3}} = \frac{5 + 3\sqrt{3}}{-2}$
------	---

2.2 Question 2 : Exponents & Logarithms

The question tested the knowledge of exponents and logarithms. It was attempted by 96.2 percent of the candidates of which 82.3 percent scored a 0 mark and only a few candidates (7.8%) scored from 3 to 6 marks.

Part 2 (a) which required the candidates to find the value of x for which $2^x \cdot 16 = \frac{1}{8^x}$ was poorly attempted. As illustrated in Extract 2.1 (a), most candidates experienced difficulties in applying the laws of exponents and as a result ended up with an incorrect value of x . The correct method they were supposed to use is as shown in Extract 2.1 (b).

Extract 2.1 (a)

2.(a)	$2^x \cdot 16 = 8^{x-1}$
	$2^x \cdot 2^4 = 2^{3x-1}$
	$3x - 1 = 4$
	$3x = 4 + 1$
	$\frac{3x}{3} = \frac{5}{3}$
	$x = \frac{1.6}{3}$

In Extract 2.1 (a), the candidate expressed the right hand side of the given equation i.e $\frac{1}{8^x}$ as 8^{x-1} instead of 8^{-x} and as a result ended up with a wrong value of x .

Extract 2.1 (b)

2a.	$2^x \times 16 = \frac{1}{8^x}$	$8 = 2^3$
		$16 = 2^4$
	$\therefore 2^x \times 2^4 = \frac{1}{2^{3x}}$	
	$2^{x+4} = 2^{-3x}$	taking the exponents
	$x+4 = -3x$	
	$4 = -3x - x$	
	$\frac{4}{-4} = \frac{-4x}{-4}$	$x = -1$
	$\therefore x = -1$	

As noted in Extract 2.1 (b), the candidate managed to apply correctly the appropriate laws of exponents in solving the given equation in part 2 (a).

Extract 2.2 (b)

$$\begin{aligned} 2b. \quad \log_a (x^2 + 3) - \log_a x &= 2 \log_a 2 \\ \log_a \left(\frac{x^2 + 3}{x} \right) &= \log_a 4 \\ \frac{x^2 + 3}{x} &= 4 \\ x^2 + 3 &= 4x \\ x^2 - 4x + 3 &= 0 \\ x^2 - x - 3x + 3 &= 0 \\ x(x-1) - 3(x-1) & \\ (x-3)(x-1) & \quad x-3=0 \quad x=3 \quad \text{or} \quad x-1=0 \\ \therefore x &= 1 \text{ or } 3 \\ \therefore x &= 1 \text{ or } 3 \end{aligned}$$

In Extract 2.2 (b), the candidate applied correctly the laws of logarithms that enabled him/her to obtain the quadratic equation that he/she solved for the required value of x .

2.3 Question 3: Algebra & Sets

This question was attempted by 396,865 (96.2%) candidates whereby 93.2 percent of them scored a zero mark and only 6,473 (1.5%) candidates scored from 3 to 6 marks.

In Part 3 (a), the candidates were required to find the age of Mr Bean when he died, given that he lived a quarter of his life as a child, a fifth as a teenager, a third as an adult and 13 years as an old man. It was observed that this part was poorly done indicating that the candidates did not have the skills in translating the given statement into the mathematical equation. Extract 3.1(a) is a sample response from one of the candidates who faced difficulties in solving the word problem.

Extract 3.1 (a)

3	a) Mr. Bean	Child
	$\frac{1}{4}x + \frac{1}{5} + \frac{1}{3} = 13$	x
	$\frac{1}{4}x + \frac{1}{5} + \frac{1}{3} = 13$	$\therefore \frac{1}{4}x + \frac{1}{5} + \frac{1}{3} + 13 = \text{the age he dies}$
	$\frac{1}{4}x + \frac{3+5}{15} = 13$	$\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$
	$\frac{1}{4}x + \frac{8}{15} = 13$	$\frac{1}{12} + \frac{1}{5} + \frac{1}{3}$
	$\frac{1}{4}x = 13 - \frac{8}{15}$	$\frac{5+12+20}{60} = \frac{37}{60} + 13$
	$\frac{13-8}{15} = \frac{5}{15} = \frac{1}{3}$	

As noted in Extract 3.1 (a), the candidate did not have the skills in formulating the required equation. The candidate represented the given word problem with the equation $\frac{1}{4}x + \frac{1}{5} + \frac{1}{3} = 13$ instead of $x = \frac{1}{4}x + \frac{1}{5}x + \frac{1}{3}x + 13$ and hence missed all the marks for part (a).

However, there were a few candidates who answered part 3 (a) correctly. Extract 3.1 (b) is a sample answer from one of those candidates.

Extract 3.1 (b)

3	a)	$x = \frac{1}{4}x + \frac{1}{5}x + \frac{1}{3}x + 13$
		$x = 15x + 12x + 20x + 780$
		60
		$60x = 47x + 780$
		$60x - 47x = 780$
		$\frac{13x}{13} = \frac{780}{13}$
		$x = 60$
		\therefore He was 60 years old when he died.

In Extract 3.1 (b), the candidate showed competences in formulating the algebraic equation from the given word problem and managed to solve the resulting equation correctly.

Part 3 (b) required the candidates to find $n(A \cap B)$ given that $n(A) = 39$, $n(A' \cap B') = 4$, $n(B') = 24$, $n(U) = 65$ and A, B are subsets of the universal set U . This part was poorly performed as many candidates lacked knowledge on sets and in particular how to apply Venn diagrams and the formula $n(A \cap B) = n(A) + n(B) - n(A \cup B)$ in finding the number of elements in the intersection of two sets. Extract 3.2 (a) illustrates this case.

Extract 3.2 (a)

b)	$n(A \cap B) = n(A) + n(B) - n(A \cup B)$
	$n(A \cap B) = 39 - 24 - 4$
	$= 39 - 28$
	$= 11$
	<u>$n(A \cap B) = 11$</u>

In Extract 3.2 (a), the candidate applied a wrong formula, an indication of a lack of solid understanding on the topic of sets.

Only a few candidates were able to answer part 3 (b) correctly. These candidates were conversant in performing the basic operations on sets and used Venn diagrams correctly. Extract 3.2 (b) is an example of a good answer from one of those candidates.

Extract 3.2 (b)

3 | b.) Soln:

$$n(U) = 65 \quad n(A) = 39 \quad n(B') = 24 \quad n(A' \cap B') = 4$$
$$n(A \cap B)$$
$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$
$$n(B) = n(U) - n(B')$$
$$= 65 - 24$$
$$n(B) = 41$$
$$n(A \cup B) = n(U) - n(A' \cap B')$$
$$= 65 - 4$$
$$= 61$$
$$n(A \cup B) = n(A) + n(B) - n(A \cap B)$$
$$61 = 39 + 41 - n(A \cap B)$$
$$n(A \cap B) = 80 - 61$$
$$= 19$$
$$\therefore n(A \cap B) = 19$$

2.4 Question 4 : Vectors

In this question, the candidates were given that $\underline{a} = (3, 4)$, $\underline{b} = (1, -4)$ and $\underline{c} = (5, 2)$ and required to determine (a) $\underline{d} = \underline{a} + 4\underline{b} - 2\underline{c}$; (b) magnitude of vector \underline{d} in the form $m\sqrt{n}$; (c) the direction cosines of \underline{d} and hence show that the sum of the squares of these direction cosines is one.

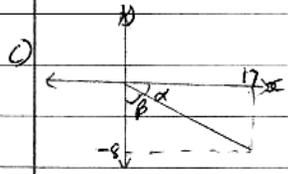
The question was attempted by 396,878 (96.2%) candidates, out of which 92.8 percent scored marks from 0 to 2 out of 6 marks.

Generally, this question was poorly performed. The candidates lacked the knowledge and skills on how to find the sum and difference of vectors and also lacked the skills on how to find the magnitude and direction cosine of a vector. Extract 4.1 illustrates how the candidates performed poorly in this question.

Extract 4.1

4 a) $d = a + ub - 2c$
 $d = (3, 4) + 4(1, -4) - 2(5, 2)$
 $d = (3, 4) + (4, -16) - (-10, -4)$
 $d = (3+4+10, 4-16+4)$
 $d = (17, -8)$

b) $|d| = \sqrt{x^2 + y^2}$
 $= \sqrt{17^2 - 8^2}$
 $= \sqrt{289 - 64}$
 $= \sqrt{225}$
 $= \sqrt{5 \times 5 \times 9}$
 Magnitude = $5\sqrt{9}$



$\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$
 $a^2 + b^2 = c^2$
 $17^2 + 8^2 = c^2$
 $289 + 64 = c^2$
 $\sqrt{353} = \sqrt{c^2}$
 $c = \sqrt{353}$
 $\cos \theta = \frac{17}{\sqrt{353}}$
 $=$

In Extract 4.1, the candidate could not obtain the final correct answer in part 4 (a), because he/she made addition and subtraction errors along the way. In part (b), the candidate used the incorrect formula $|d| = \sqrt{x^2 - y^2}$ instead of $|d| = \sqrt{x^2 + y^2}$ in finding the magnitude of the given vector. Thus, the candidate failed to obtain the correct answer in part 4 (c) because of the errors made in parts 4 (a) and 4 (b).

Only 685 (0.2%) candidates scored full marks in this question. Extract 4.2 shows a sample answer from one these candidates.

Extract 4.2

4a	$\text{Given } a = (3, 4) \quad b = (1, -4) \quad c = (5, 2)$ $d = a + 4b - 2c$ $d = (3, 4) + 4(1, -4) - 2(5, 2)$ $d = (3, 4) + (4, -16) + (-10, -4)$ $d = (-3, -16)$
4b	$ d = \sqrt{x^2 + y^2}$ $ d = \sqrt{(-3)^2 + (-16)^2}$ $ d = \sqrt{9 + 256}$ $ d = \sqrt{265} \text{ units}$
4c i)	<p>Direction cosine = $\frac{\text{Adjacent}}{\text{Hypotunese}}$</p> $\text{Direction cosine} = \frac{-16}{\sqrt{265}}$ $\text{Direction cosine} = \frac{-16}{16.28}$ $\text{Direction cosine}_1 = -0.9828$ $\text{Direction cosine}_1 = S 10^\circ 45' W$ $\text{Direction cosine}_2 = \frac{-3}{16.28}$ $\text{Direction cosine}_2 = -0.1853 = S 79^\circ 15' W$
ii)	$\left(\frac{-16}{\sqrt{265}}\right)^2 + \left(\frac{-3}{\sqrt{265}}\right)^2$ $\frac{256}{265} + \frac{9}{265} = \frac{265}{265} = 1 \text{ (shown)}$

As seen in Extract 4.2, it is evident that the candidate had an adequate knowledge of vectors and trigonometry and managed to apply it correctly. The candidate also presented his/her working systematically and this made it easier for the marking exercise.

2.5 Question 5: Geometry

This question was attempted by 396,828 (96.2%) candidates, of which 92.6 percent of them scored a 0 mark and only 1.6 percent of those who attempted the question scored from 3 to 6 marks.

In part 5 (a), the candidates were given two similar polygons X and Y with the area of 16 cm^2 and 49 cm^2 respectively and were required to calculate the length of a side of polygon Y given that the corresponding side of polygon X is 28 cm. Most candidates were unable to calculate the required length because they failed to use the fact that if two figures are similar and the ratio of corresponding sides is k , then the ratio of their areas is k^2 . Extract 5.1 (a) is a sample answer which illustrates how the candidates failed to answer this part.

Extract 5.1 (a)

The image shows handwritten work on lined paper. The first line is the equation:
$$\frac{\text{Area of X}}{\text{Area of Y}} = \frac{28}{y} = \frac{16}{49} \times \frac{28}{y}$$
 The second line shows the calculation:
$$y = \frac{49 \times 28 \times 7}{16 \times 4} = 273$$
 The third line shows the final answer:
$$y = 68.25 \text{ cm}$$

In Extract 5.1 (a), the candidate used the wrong formula $\frac{\text{Area of X}}{\text{Area of Y}} = \frac{28}{Y}$ instead of

$$\frac{\text{Area of X}}{\text{Area of Y}} = \left(\frac{28}{Y}\right)^2$$

for finding the length of a side of polygon Y, an indication of lack of adequate knowledge and skills in solving problems related to similar polygons.

Only a few candidates scored full marks for part 5 (a). These candidates were able to use correctly the theorem relating ratio of areas and lengths of corresponding sides of similar polygons in solving this question. Extract 5.1 (b) illustrates this case.

Extract 5.1 (b).

5a) $k^2 = \frac{\text{Area of large polygon } (y)}{\text{Area of small polygon } (x)}$

$$\sqrt{k^2} = \frac{\sqrt{49}}{\sqrt{16}}$$

$$k = \frac{7}{4}$$

$$k = \frac{\text{side of polygon } Y}{\text{side of polygon } X}$$

$$k = \frac{7}{4} = \frac{y}{28}$$

$$\frac{4y}{4} = \frac{7 \times 28}{4}$$

$$y = 49.$$

$$= \underline{49\text{cm}}$$

In part 5 (b), the candidates were given triangles PQR and ABC and required to show whether they were similar or not. They were also required to find the relationship between sides x and y in the triangles. This part was also poorly performed as the majority of the candidates were unable to apply theorems about similar triangles to find the relationship between the sides x and y . Those candidates did not understand that two triangles are similar if their corresponding angles are equal or corresponding sides are proportional. Extract 5.2 (a) is a sample answer from one of the candidates who failed to answer this question correctly.

Extract 5.2 (a)

5 | b | i | $\frac{PR}{PQ} = \frac{AB}{CB}$

$\frac{25}{15} = \frac{15}{x}$

$\frac{25x}{25} = \frac{225}{25} \quad x = 9$

When x is substituted as 9

$\frac{25}{15} = \frac{15}{9} \quad \therefore 225 = 225$

So the triangles are similar because the corresponding sides are equal.

$PQR \cong ABC$ (proven)

In Extract 5.2 (a), the candidate was solving for x instead of proving that the given triangles were similar. Also the candidate ended up with an incorrect conclusion “So the triangles are similar because the corresponding sides are equal” an indication of lack of knowledge on the topic of Similarity.

Despite the poor performance in part 5 (b), there were a few candidates who were able to answer this part correctly and scored full marks. Extract 5.2 (b) shows a sample answer from one of these candidates.

Extract 5.2 (b)

5b) i) Given: $\triangle PQR$ and $\triangle ABC$
to prove: $\triangle PQR \sim \triangle ABC$
proof: $\triangle PQR$ and $\triangle ABC$
 $\hat{R}PQ = \hat{C}AB$ (given 49°)
 $\hat{R}QP = \hat{A}CB$ (given 109°)
 $\hat{P}RQ = \hat{C}BA$ (third angle)
 $\therefore \triangle PQR \sim \triangle ABC$ (AAA-theorem).

5b) ii) $\frac{PR}{AB} = \frac{PQ}{AC} = \frac{Y}{X}$
 $\frac{25}{15} = \frac{10}{6} = \frac{Y}{X}$
 $\frac{5}{3} = \frac{Y}{X}$
 $Y = \frac{5}{3}X$
 $\frac{Y}{X} = \frac{5}{3}$

It is evident from Extract 5.2 (b), that the candidate understood well the concept of similarity and its application in finding the relationship between the sides x and y as required.

2.6 Question 6: Variations and Algebra

This question was attempted by 396,848 (96.2%) candidates with 76.3 percent of those candidates scoring a 0 mark. Only 53,669 (13.5%) candidates scored at least half of the marks that were allocated for this question.

In part 6 (a), the candidates were given that the power (P) used in an electric circuit is directly proportional to the square of the current (I). The candidates were also given that when the current is 8 Amperes, the power used is 640 Watts and were required to: (i) write down the equation relating the power (P) and the current (I) and (ii) calculate the current I when the circuit uses 360 Watts. This part was poorly done as many candidates failed to formulate the equation $P = 10I^2$ that was essential in computing the current (I). Thus the candidates lacked the skills to find the direct variation equation that was connecting P and I . Extract 6.1 (a) shows a sample response from one of the candidates who did not answer part 6 (a) correctly.

Extract 6.1 (a)

604 $P \propto I^2$

ie $k = \frac{P}{I^2}$, $k = \frac{I^2}{P}$

$$k = \frac{8^2}{640}$$
$$k = \frac{64}{640}$$
$$k = \frac{1}{10}$$
$$\frac{1}{10} = \frac{I^2}{360}$$
$$\frac{101^2}{10} = \frac{360}{10}$$
$$I^2 = 36$$
$$I = 1296$$
$$= 1296 \text{ Ampere}$$

As noted in Extract 6.1 (a), the candidate managed to express $P \propto I^2$ but failed to determine the constant of proportionality from this relationship. He/she obtained the value of the constant of proportionality as $k = \frac{1}{10}$ instead of $k = 10$ and as a result obtained an incorrect value of the current I.

There were very few candidates who performed well in part 6 (a) and were therefore awarded full marks for this part. A solution from one of the candidates who managed to answer this part correctly is shown in Extract 6.1 (b)

Extract 6.1 (b)

6(a) $P \propto I^2$

$$P \propto I^2$$
$$P = kI^2$$
$$640 = k64$$
$$k = \frac{640}{64}$$
$$k = 10$$

Here the equation is $P = 10I^2$

Answer $P = 10I^2$

(ii) $P = 10I^2$

$$360 = 10I^2$$
$$\frac{360}{10} = \frac{10I^2}{10}$$
$$I^2 = 36$$
$$I = \sqrt{36}$$
$$I = 6$$

Answer $I = 6$ Amperes

In Extract 6.1 (b), it is evident that the candidate had an adequate knowledge on the topic of variation as he/she managed to: formulate correctly the equation $P = kI^2$; obtain the correct value of the constant of proportionality ($k = 10$) and consequently obtain the required value of current I .

In part 6 (b), the candidates were required to find, $(5 * -2) * (3 * -4)$ where $x * y$ was defined as $\frac{1}{2}(x + y)$. This part was also poorly performed as most of the candidates did not know how to carry on the given binary operation. They did not understand that a binary operation is simply a rule to combine the given numbers with the instruction given to the operation. It was noted that some candidates were only carrying out either additions or subtractions or multiplications ignoring the required binary operation. Extract 6.2 (a) illustrate this case.

Extract 6.2 (a)

Q6 If $x * y$ is defined $\frac{1}{2}(x+y)$ find $(5^*-2)^*(3^*-4)$

Solo!

$$\frac{1}{2}(5+2)(3-4)$$

$$\frac{1}{2}(5-2+3-4)$$

$$\frac{1}{2}=3+1$$

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

$$=4 \times \frac{1}{2}(x,y)^* = 2$$

In Extract 6.2 (a), the candidate did not carry out the required binary operation and instead performed addition and subtraction on the given numbers contrary to the requirements of the question.

There were a few candidates who managed to answer part 6 (b) correctly and scored full marks. A sample response of one of the candidates is shown in Extract 6.2 (b).

Extract 6.2 (b)

Solo.

$$x * y = \frac{1}{2}(5-2) * \frac{1}{2}(3-4)$$

$$x * y = \frac{1}{2}(3) * \frac{1}{2}(-1)$$

$$\frac{3}{2} * -\frac{1}{2}$$

$$x * y = \frac{1}{2}(x+y)$$

$$x * y = \frac{1}{2}\left(\frac{3}{2} - \frac{1}{2}\right) = \frac{1}{2}\left(\frac{2}{2}\right)$$

$$x * y = \frac{1}{2}$$

2.7 Question 7 : Ratio, Profit And Loss

Question 7 was attempted by 96.2 percent of the candidates, with the majority of them (90.3%) scoring a 0 mark indicating an overall poor performance in this question.

In part 7 (a), the candidates were given that by selling an article at shs. 22,500/= a shopkeeper makes a loss of 10%. They were required to find the price at which the shopkeeper would sell the article in order to get a profit of 10%. This part was poorly performed by many candidates because they were unable to identify the requirements of the question. They did not realize that they were supposed to calculate first the buying price (x) of the article:

$$x = \frac{22500 \times 100}{90} = 25,000/= \text{ and thereafter to calculate the selling price}$$

$\frac{110}{100} \times 25,000 = 27,500/=$. An example of a response from one of the candidates who performed poorly in this part is shown in Extract 7.1 (a).

Extract 7.1 (a).

7a	$10 = \frac{\text{loss}}{22,500} \times 100$
	$225000 = 100 \text{ loss}$
	$\frac{225000}{100} = \text{loss}$
	$2250 = \text{loss}$
	$\text{loss} = \text{selling pr} - \text{buying price} - \text{selling price}$
	$2250 = 22500 - \text{S/p}$
	$\text{S/p} = 22500 - 2250$
	$\text{S/p} = 20250$
	$\% \text{ Profit} = \frac{\text{Profit}}{\text{buying price}} \times 100\%$
	$\text{Profit} = \text{buying price} - \text{selling price}$
	$\frac{10 \times x}{100} = 22500 - x$

$$\begin{aligned}
 10x &= 2,250,000 - 100x \\
 110x &= 2,250,000 \\
 110 & \quad 110 \\
 x &= 20454.54 \\
 \text{profit} &= 2045.454 + 225,000 \\
 &= 24545.454 \\
 \text{He sold it at } &24545.454
 \end{aligned}$$

In Extract 7.1 (a), the candidate used the incorrect formula $10 = \frac{\text{loss}}{22,500} \times 100$ to calculate the loss made as he/she did not realise that the buying price was not equal to 22,500. The candidate was supposed to find the buying price using the formula $10\% = \frac{(P - 22,500)}{P} \times 100\%$ and thereafter proceed with the calculations of the selling price.

Very few candidates were able to answer part 7(a) correctly. A sample answer from one of those candidates is shown in Extract 7.1 (b).

In part 7 (b), the candidates were given that an alloy consists of three metals A, B and C in the proportions A: B = 3: 5 and B: C = 7: 6 and were required to calculate the proportion A: C. This part was also poorly performed as the majority of the candidates could not manoeuvre the given ratios for instance writing $\frac{A}{B} = \frac{B}{C} = \frac{A}{C}$ in order to get the required answer. Nevertheless, there were a few candidates who were able to answer this part correctly. Extract 7.1 (b) is a sample solution of one of those candidates who performed well in this question.

Extract 7.1 (b)

$$\begin{aligned}
 a. \quad 100\% &= x \\
 90\% &= 22,500 \\
 \frac{90x}{90} &= \frac{22500 \times 100}{90}
 \end{aligned}$$

	$x = 25000/1 =$	
	$100\% = 25,000$	$= 27,500/1 =$
	$110\% = ?$	
	$\frac{110 \times 25,000}{100} = \frac{100 \times x}{100}$	
	$x = 27500/1 =$	
7-b.	$A/B = 3/5$	$B/C = 7/6$
	$A/C = ?$	
	$\frac{5A = 3B}{5}$	$\frac{6B = 7C}{7}$
	$A = \frac{3}{5}B$	$C = \frac{6}{7}B$
	$\frac{A}{C} = \frac{\frac{3}{5}B}{\frac{6}{7}B}$	$\frac{3 \times 7}{5 \times 6} = \frac{7}{10}$
	$A:C = 7:10$	

In Extract 7.1 (b), the candidate was able to find the buying and the selling price as required, an indication that he/she understood well the tested concepts on ratio and proportions.

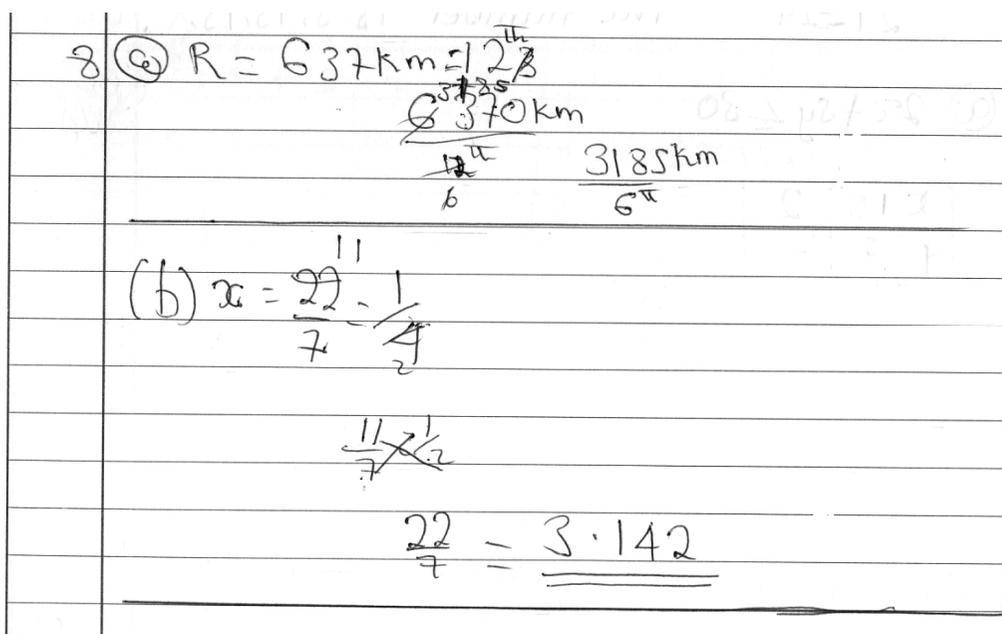
2.8 Question 8: Sequence & Series

Many candidates (96.2%) answered the question and 79.6 percent of them scored 0 out of 6 marks, while only 8.2 percent scored above 3 marks. It was therefore a poorly performed question.

In part 8 (a), the candidates were required to find the first term and the common difference of an arithmetic progression with 23 as the 5th term and 37 as the 12th term. This part was poorly performed because the majority of the candidates were unable to formulate the two equations involving the first term 'A₁' and the common difference 'd' i.e. $A_5 = A_1 + 4d = 23$ and $A_{12} = A_1 + 11d = 37$ that were essential in obtaining the required answer. It was noted that some candidates scored low marks in this part as they were unable to solve the two equations because of poor algebraic/computation skills, see Extract 8.1 (b). The Examiners were disappointed to see that some candidates completely lacked the knowledge on sequences and series and hence resorted to answering this part using concepts that were not related to the question. Extract 8.1 (a) illustrates this case.

In part 8 (b), the candidates were required to find the sum of the first four terms of a geometric progression which has a first term of 1 and a common ratio of $\frac{1}{4}$. This part was also poorly performed as the majority of the candidates were unable to recall the formula $S_n = G_1 \left[\frac{1-r^n}{1-r} \right]$ that was required in answering the question. It was noted that some candidates managed to apply this formula and obtain $S_4 = 1 \times \left[\frac{1-(1/4)^4}{1-1/4} \right]$ but failed to obtain the correct answer as they were unable to simplify this fraction because of poor computation skills.

Extract 8.1 (a)



The candidate in Extract 8.1 (a) completely lacked the knowledge of series and sequences and an understanding of mathematics as a whole and hence performed calculations that were not related to the given question.

Extract 8.1 (b)

8	Soln	
	$A_5 = A_1 + 4d$	but $A_5 = 23$ and $A_{12} = 87$
	$A_{12} = A_1 + 11d$	
	$\begin{cases} 23 = A_1 + 4d \\ 87 = A_1 + 11d \end{cases}$	
	$\frac{15}{7} = \frac{7d}{7}$	
	$d = \frac{15}{7}$	

b	$G_1 = 1, r = \frac{1}{4}$
	$S_4 = G_1 \frac{(r^n - 1)}{r - 1}$
	$= 1 \frac{(\frac{1}{4}^4 - 1)}{\frac{1}{4} - 1}$
	$= 1 \frac{(\frac{1}{16} - 1)}{-\frac{3}{4}}$
	$= \frac{\frac{1}{16} \times 4}{-3}$
	$= \frac{1}{16} \times \frac{4}{-3}$
	$= \frac{1}{48}$
	$S_4 = -\frac{1}{48}$

In extract 8.1 (b), the candidate seemed to have some understanding of the concepts of arithmetic progressions tested in part 8(a) but failed to apply them to obtain correct values of the common difference and that of the first term because of poor algebraic skills in solving the two equations. In part 8(b), the candidate used an incorrect formula

$$S_n = G_1 \left[\frac{r^{n-1}}{1-r} \right] \text{ instead of } S_n = G_1 \left[\frac{r^n - 1}{1-r} \right] \text{ and hence missed all the marks for}$$

this part. This error could have been avoided by mastering the formula and also through thorough checking of the work.

Despite the poor performance in this question, there were few candidates (3.3%) who performed well and scored full marks. Extract 8.2 shows the work of one of the best score in this question.

Extract 8.2

8a. $A_5 = 23 = A_1 + 4d$
 $A_{12} = 37 = A_1 + 11d$

soln.

$$\begin{cases} A_1 + 11d = 37 \\ - \{ A_1 + 4d = 23 \end{cases}$$

$$7d = 14$$

$$d = 2$$

$$A_1 + 4d = 23$$

$$A_1 = 23 - 8$$

$$A_1 = 15$$

\therefore The first term, $A_1 = 15$ and common difference, $d = 2$.

b. $r = \frac{1}{4}$, $G_1 = 1$.

$$S_n = \frac{G_1(r^n - 1)}{r - 1} \text{ or } \frac{G_1(1 - r^n)}{1 - r}$$

$$S_4 = \frac{1(1 - (\frac{1}{4})^4)}{1 - \frac{1}{4}}$$

$$= \frac{1(1 - 4^{-4})}{1 - \frac{1}{4}} = \frac{1(1 - \frac{1}{256})}{\frac{3}{4}}$$

$$= \frac{1 \times (\frac{256 - 1}{256})}{\frac{3}{4}}$$

$$= \frac{255}{256} \times \frac{4}{3} = \frac{255}{64}$$

$$= \frac{85}{64}$$

$\therefore S_4 = \frac{85}{64}$

2.9 Question 9 : Trigonometry

The question was attempted by 96.2 percent of the candidates out of which 88.3% scored a 0 mark and very few candidates (3.5%) scored from 3.5 to 6 marks.

In part 9 (a), the candidates were required to find the length \overline{AC} from the given figure.

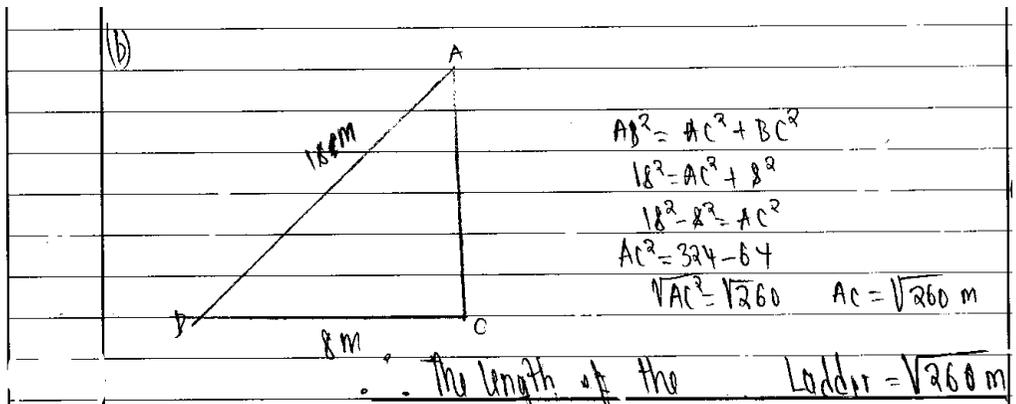
The majority of the candidates were unable to apply the sine rule $\frac{\sin A}{a} = \frac{\sin B}{b}$ to obtain the required $\overline{AC} = \frac{22.2 \times \sin 86}{\sin 26} = 50.5$. The candidates lacked the basic knowledge on the concepts of trigonometry. It was noted that some candidates managed to write down the sine rule correctly but failed to get the correct final answer because of poor computation skills and an inability to use mathematical tables. The majority of the candidates did not know how to tackle this part of the question and hence ended up applying concepts not related to the question (see Extract 9.1).

In part 9 (b), the candidates were required to find the length of a ladder which reaches the top of a wall 18m high when the other end on the ground is 8 m from the wall.

This part was also poorly performed. As illustrated in Extract 9.1, most of the candidates could not represent the given information using a correct right angled triangle and thereafter to apply the Pythagoras theorem to get the required answer.

Extract 9.1

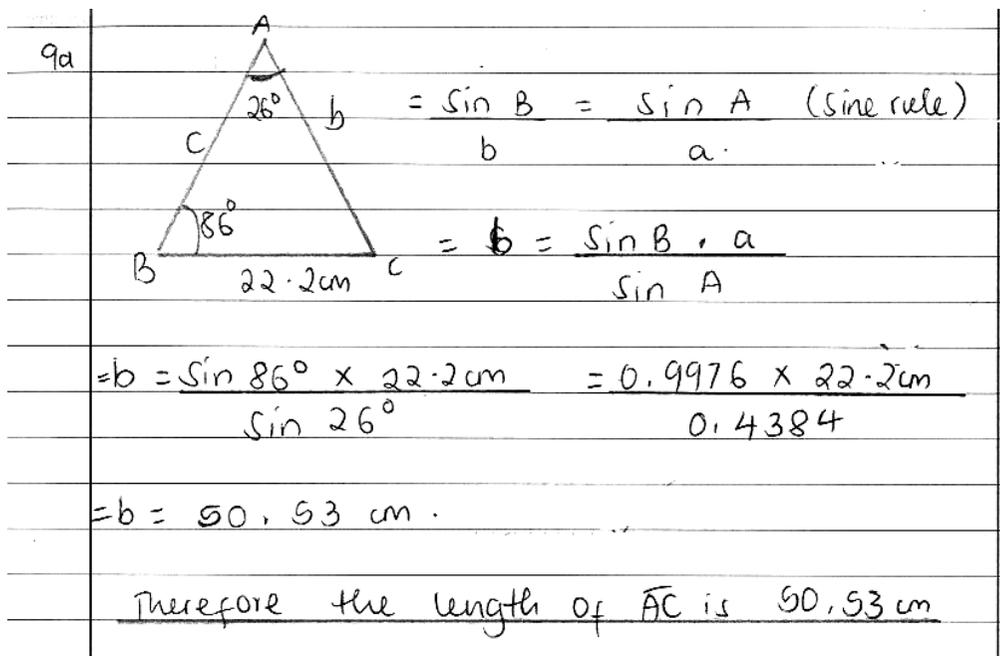
9.	(a) $\tan \theta = \frac{\text{opposite}}{\text{Adjacent}}$ Where $\theta = 26$ Opposite = 22.2 cm Adjacent = b.
	$\tan 26 = \frac{22.2 \text{ cm}}{b} = 0.4877 = \frac{22.2 \text{ cm}}{b}$
	$0.4877b = 22.2 \text{ cm}$
	$b = \frac{22.2 \text{ cm}}{0.4877}$
	$b = 45 \text{ cm.}$



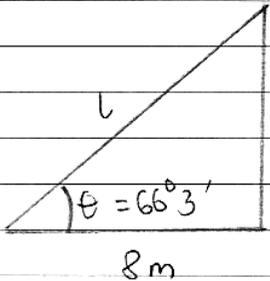
In extract 9.1, the candidate failed to answer part 9(a) because of a lack of adequate knowledge of trigonometry. He/she wrongly considered the given triangle as a right angled triangle and in so doing applied inappropriate concepts in answering this part. In part 9(b), the candidate failed to translate the information from the given word problem in order to draw a correct right angled triangle. The candidate indicated the 18m on the hypotenuse instead of putting it on the vertical side of the triangle and hence scored a 0 mark in this part.

Only a few candidates (0.6%) managed to score full marks in this question, a sample response from one of such candidates is shown in Extract 9.2.

Extract 9.2



9 b.



$\tan \theta = \frac{\text{Opposite}}{\text{Adjacent}}$
 $= \frac{18\text{m}}{8\text{m}} = 2.25$

$\sin \theta = \frac{\text{Opposite}}{\text{hypotenuse}}$
 $\sin \theta = \frac{18\text{m}}{l}$
 $l = \frac{18\text{m}}{\sin 66^\circ 3'}$
 $l = 19.70\text{m}$

Therefore the length of the ladder is 19.70 m.

Extract 9.2 shows the response from one of the candidates who performed well in this question. The candidate was conversant in applying the sine rule and the Pythagoras theorem in solving triangles. In addition, the candidate's work is well presented.

2.10 Question 10 : Quadratic Equations

This question was attempted by 96.2 percent of the candidates, of which the majority (83.7%) scored a 0 mark, indicating that this question was also poorly performed.

Part 10 (a) which was on finding the value of x from the equation $\frac{6}{x-4} = 1 + \frac{4}{x}$ was poorly done. The majority of the candidates were unable to cross multiply the given equation to obtain the quadratic equation $x^2 - 6x - 16 = 0$ and to subsequently solve for x . Extract 10.1(a) illustrates how the candidates failed to answer this question.

In part 10 (b), the candidates were given that *the sum of two numbers is 3 and the sum of their squares is 29* and were required to find the numbers. This part was also poorly done as the majority of the candidates could not formulate the two equations: $x + y = 3$ and $x^2 + y^2 = 29$ which they were supposed to solve simultaneously to obtain the required numbers. A sample response from one of such candidates is shown in Extract 10.1 (a). The Examiners were

disappointed to see that a significant number of candidates were able to formulate the required equations in part 10(b) but failed to solve them correctly, (see Extract 10.1(b)).

Extract 10.1 (a)

$$10 \text{ (a) } \frac{6}{x-4} = 1 + \frac{4}{x}$$

soln

$$\frac{6}{x-4} = 1 + \frac{4}{x}$$

$$6x = x - 4(1 + 4)$$

$$6x = x + 4x - 4 + 16$$

$$6x = 5x - 20$$

$$\frac{11x}{11} = \frac{20}{11}$$

$$11 \quad 11 = x = 1.88$$

(b) $2x = 3$ and $y^2 = 29$

soln

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

$$x = 1.5 \text{ and } y^2 = 29.$$

Extract 10.1(a) shows the work presented by one of the candidates who performed poorly in this question. The candidate forgot to express the right hand side of the given equation under a common denominator before cross multiplying the equation in part 10 (a). He/she also lacked the ability of formulating equations from word problems in part 10 (b).

Extract 10.1 (b)

b) let them be x and y

$$x + y = 3$$

$$x^2 + y^2 = 29$$

$$x + y = 3, \quad x = 3 - y$$

$$(3 - y)^2 + y^2 = 29$$

$$9 - 6y + y^2 + y^2 = 29$$

$$\begin{aligned}
 9 - 6y &= 29 \\
 -6y &= 20 \\
 \frac{-6y}{-6} &= \frac{20}{-6} \\
 y &= -\frac{10}{3} \\
 x &= 3 - y \\
 3 - \left(-\frac{10}{3}\right) &= 3 + \frac{10}{3} \quad \frac{9+10}{3} = \frac{19}{3} \\
 \therefore x &= \frac{19}{3} \quad \text{and} \quad y = -\frac{10}{3} \\
 \text{The two numbers are} \\
 &\frac{19}{3} \quad \text{and} \quad -\frac{10}{3}
 \end{aligned}$$

The candidate in Extract 10.1(b) was able to translate the given word problem mathematically but made an error that made him/her to obtain $(3 - y)^2 - y^2 = 29$ instead of $(3 - y)^2 + y^2 = 29$ and consequently failing to obtain the required values of x and y .

However, 8,122 (2.0%) candidates were able to answer this question correctly and scored full marks. A sample answer from one of such candidates is shown in Extract 10.2.

Extract 10.2

10a	$\frac{6}{x-4} = 1 + \frac{4}{x}$
	$\frac{6}{x-4} = \frac{x+4}{x}$
	$6x = (x+4)(x-4)$
	$6x = x^2 - 4x + 4x - 16$
	$6x = x^2 - 16$
	$x^2 - 16 - 6x = 0$
	$x^2 - 8x + 2x - 16 = 0$
	$x(x-8) + 2(x-8) = 0$

	$(x+2)(x-8)=0$
	$x = 8 \text{ or } -2$
10b	let the first number be x the second number be y
	$x+y = 3 \dots (i)$
	$x^2+y^2 = 29 \dots (ii)$
	$x = 3-y$
	$(3-y)(3-y)+y^2 = 29$
	$9-3y-3y+y^2+y^2 = 29$
	$2y^2-6y+9 = 29$
	$2y^2-6y+9-29 = 0$
	$2y^2-6y-20 = 0$
	$2y^2+4y-10y-20 = 0$
	$2y(y+2)-10(y+2) = 0$
	$(2y-10)(y+2) = 0$
	$y = 5 \text{ or } -2$
	$x = 3-y$
	when $y = 5$ when $y = -2$
	$x = 3-5 = -2$ $x = 3-(-2) = 5$
	\therefore The numbers are 5 and -2

Extract 10.2 presents a solution from one of the candidates who performed well in this question. The candidate had adequate knowledge of formulating and solving quadratic equations. The candidate scored full marks in this question.

2.11 Question 11 : Linear Programming

This question was opted by 28.0 percent of the candidates. Most of the candidates (95.4%) scored between 0 and 5.5 out of 10 marks with 39.0 percent of the candidates obtaining a 0 mark, indicating a general poor performance in this question.

The question examined candidates' knowledge and understanding of the concepts of linear programming. The majority of the candidates were unable to identify the requirements of the question in order to extract the data that would enable them to formulate the required constraints. Extract 11.1 illustrates this case.

Other reasons which contributed to the poor performance in this question included: the candidates inability to draw correct graphs for the inequalities

that represented the constraints and the inability to identify the feasible region in order to calculate the corner points.

Extract 11.1

11.	<p>Anna and Mary are tailors. They make blouses and skirts each week. Anna does all the cutting and Mary does all the sewing. To make a blouse it takes 5 hours of cutting and 9 hours of sewing. To make a skirt it takes 6 hours of cutting and 10 of sewing. Neither tailor works for more than 60 hours a week.</p> <p style="text-align: center;">soln</p> $\begin{array}{r} 23,000 \\ - 10,000 \\ \hline 13,000 \end{array}$ $\begin{array}{r} 13000 \\ \times 60 \\ \hline 78000 \\ + 00000 \\ \hline 780000 \end{array}$ <p>The profit for week will be 780000/2.</p>
-----	---

In Extract 11.1, the candidate failed to translate the given information into inequalities (the constraints) and an objective function and instead performed calculations that were not related to the demands of the question. In addition, the candidate copied the question word by word which is a wastage of examination time.

Only 12 out of 115,489 candidates who attempted this question earned full marks. A sample response from one of such candidates is shown in Extract 11.2.

Extract 11.2

	SECTION B			
11	Let x - represent cutting blouses			
	y - represent sewing skirts			
		blouse	skirts	
	cutting	$5x$	$6y$	60
	sewing	$4x$	$10y$	60

(a) for sewing

$$4x + 5y \leq 60$$

$$\frac{4x}{2} + \frac{5y}{2} \leq \frac{60}{2}$$

$$\underline{2x + 2.5y \leq 30}$$

(b) for cutting inequality

$$\underline{5x + 6y \leq 60}$$

(c) If they make atleast 8 blouses

$$\underline{x \geq 8}$$

d

(d) (i) $2x + 5y \leq 30$

(ii) $5x + 6y \leq 60$

$$x \geq 8$$

By using intercepts

$$2x + 5y = 30$$

x	0	15
y	6	0

11. (d) (ii) $5x + 6y \leq 60$

x	0	12
y	10	0

(iii) $x \geq 8$

$$x = 8$$

$$x \geq 0$$

$$y \geq 0$$

(e) To maximize the profit

$$3000x + 10,000$$

A	8, 0	$24000 + 0 = 24000$
B	8, 2	$24000 + 20000 = 44000$
C	9, 2	$27000 + 20000 = 47,000$
D	12, 0	$36000 + 0 = 36,000$

The maximum profit = 47000f
 at 27,000f of blouses and 20,000 of skirts

Extract 11.2 shows the response from one of the candidates who performed well in this question. The candidate was able to formulate the objective function, express the constraints as a system of inequalities, draw the graph for the inequalities, find the corner points from the graph and finally maximize correctly the objective function. The Examiners were impressed with such a candidate's work as he/she managed to follow all the steps required in answering a linear programming question.

2.12 Question 12: Statistics

Question 12 consisted of three parts a, b and c. The candidates were required: in part (a) to show the given information regarding the number of children per house in a frequency distribution table; in part (b) to draw the histogram and frequency polygon to represent the data given and in part (c) to calculate the mean and mode of children per house.

The question was attempted by 66.4 percent of the candidates. Among those who attempted the question, only 11.7 percent managed to score more than half of the marks allocated indicating a general poor performance in this question. The majority of the candidates lacked knowledge and skills to present data in frequency distribution table, histogram and frequency polygon. Extract 12.1 is a sample response illustrating how the candidates performed poorly in this question.

Extract 12.1

12.	SECTION "B" Answers four (4) questions		
	No. of child		
	1		
	2		
	3		
	4		
	2		
	2		
	1		
	3		
	4		
	5		
	5		
	3		
	No. child	f	x
(b)	0-2	2	.
	2-4	6	

From the answer given in Extract 12.1, it is evident that the candidate lacked the knowledge on the topic of statistics because he/she could not represent data given in part 12 (a) in a frequency distribution table. The candidate did not attempt part 12 (b) and (c).

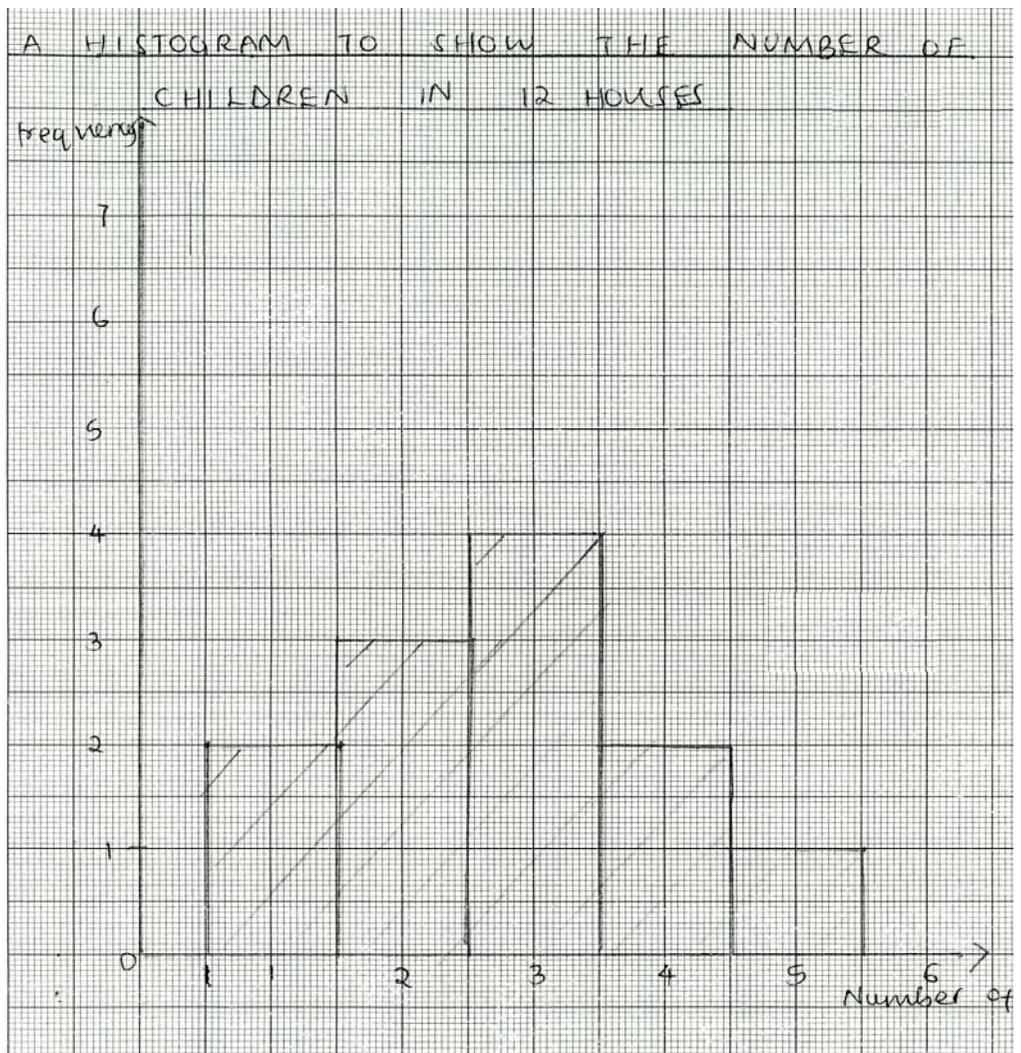
Only 0.1 percent of the candidates managed to answer this question correctly and scored full marks. The candidates in this category were able to prepare frequency distribution tables from the given data, to draw properly labelled graphs for the histogram and frequency polygon and to compute the mean and the mode as required. Extract 12.2 illustrate this case.

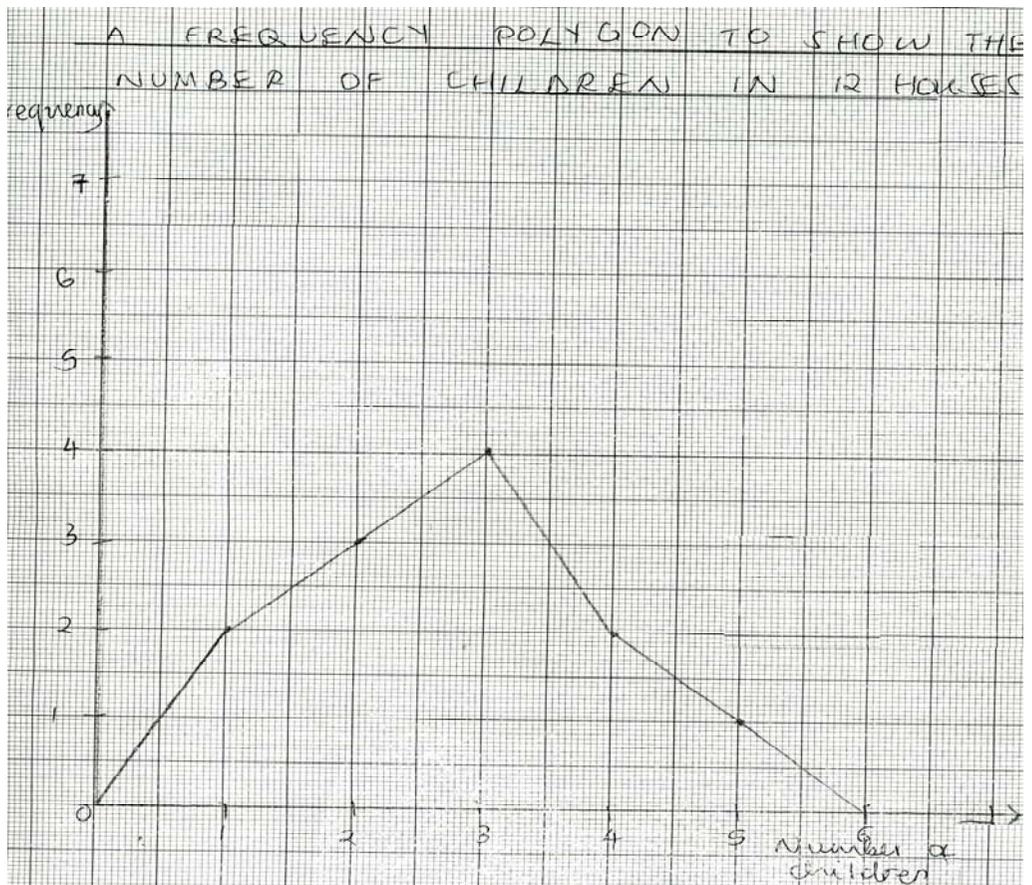
Extract 12.2

FREQUENCY DISTRIBUTION TABLE

Number of children (x)	1	2	3	4	5
Frequency (f)	2	3	4	2	1

Histogram and frequency polygon in graph





12c. Mean = $\frac{\sum fx}{\sum f}$

$$= \frac{(2 \times 1) + (2 \times 3) + (3 \times 4) + (4 \times 2) + (5 \times 1)}{12}$$

$$= \frac{2 + 6 + 12 + 8 + 5}{12} = \frac{33}{12}$$

$$= 2.75 \text{ children} \approx 3.$$

The mean is 2.75 \approx 3 children

12c. Mode = 3. Has the highest frequency.

The response in Extract 12.2 shows that the candidate had a good understanding of the topic of statistics and managed to apply it correctly in answering this question.

2.13 Question 13: Three Dimensional Figures and Earth as Sphere

This question was opted by 22.4 percent of the candidates, of which 95.8 percent scored from 0 to 4 out of 10 marks with 59.7 percent of them scoring a 0 mark.

In part 13 (a), the candidates were given an open rectangular box which measures externally 32 cm long, 27 cm wide and 15cm deep. They were also given that the box was made of wood 1cm thick and were required to find the volume of wood used. This part was poorly done as the majority of the candidates could not identify the requirements of the question. They did not realize that in order to get the volume of wood used they were supposed to subtract the internal volume of the box from the external volume. Extract 13.1 (a) is a sample answer from one of the candidates who failed to answer this part correctly.

Extract 13.1 (a)

Q 2) An open rectangular box measures externally 32 cm long, 27 cm wide and 15 cm deep its thickness 1 cm. To find the volume of wood.
<u>GAA Solution</u>
Given
length = 32 cm
Width = 27 cm
Height = 15 cm
Thickness = 1 cm
The volume of rectangular = $(L \times W) \times$ Thickness

$$\begin{aligned}
 &= (30 \times 15) \times 3 \times 2 = 480 \\
 &= 15 \times \underbrace{(1440)}_{1} \times \underbrace{3}_{1} \\
 \text{The volume} &= 21600 \text{ cm}^3
 \end{aligned}$$

In Extract 13.1 (a), the candidate performed calculations which were not related to the requirements of the question, indicating that the candidate lacked knowledge and skills on the topic of volume of three dimensional figures.

Part 13 (b) which required the candidates to find the distance in km between two towns along given latitudes correct to 4 decimal places was also poorly answered. The majority of the candidates completely lacked the knowledge on the topic of spheres and some candidates were using incorrect formula (see Extract 13.1(b)). These candidates did not realise that the distance between the two towns was supposed to be computed using the formula $\frac{2\pi R \alpha \cos \theta}{360}$.

Extract 13.1 (b)

(b) latitude =

$$\begin{aligned}
 \overline{AB} &= \frac{\pi R \theta}{180} \\
 \overline{PQ} &= \frac{\pi R \theta}{180} \\
 \overline{PQ} &= \frac{\pi R \theta}{180} \\
 180 \times \overline{PQ} &= \pi R \theta \\
 180 \times \overline{PQ} &= \frac{22}{7} \times 6370 \times 93 \\
 180 \times \overline{PQ} &= \frac{22}{7} \times 592710 \\
 \frac{180 \times \overline{PQ}}{180} &= \frac{22 \times 84630}{180}
 \end{aligned}$$

$$\frac{176 \overline{PQ}}{180} = \frac{135186 \text{ km}}{180}$$

$$\therefore \overline{PQ} = 123.444 \text{ km}$$

$$\text{Distance } \overline{PQ} = 123.444 \text{ km.}$$

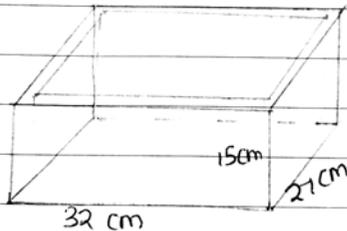
Extract 13.1 (b) demonstrates the work of a candidate who failed to differentiate between the small circles and great circles. The candidate did not realize that the given towns were along the small circles. He/she used the formula computing distances along

great circles $\frac{\pi R \theta}{180}$ instead of the formula for the distance along the small circles.

Only 39 out of 92,278 candidates scored full marks in this question. Extract 13.2 shows the answer from one of the candidates who performed well in this question.

Extract 13.2

13 a)



$$\begin{aligned} \text{Total volume} &= 32 \text{ cm} \times 27 \text{ cm} \times 15 \text{ cm} \\ &= 412960 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Internal volume} &= (32 \text{ cm} - 2 \text{ cm})(27 \text{ cm} - 2 \text{ cm})(15 \text{ cm} - 1 \text{ cm}) \\ &= 30 \text{ cm} \times 25 \text{ cm} \times 14 \text{ cm} \\ &= 10500 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Volume of wood} &= 12960 \text{ cm}^3 - 10500 \text{ cm}^3 \\ &= 2460 \text{ cm}^3 \end{aligned}$$

\therefore The volume of wood is 2460 cm^3 .

$$\begin{aligned}
 \text{b) Distance} &= \frac{\Delta\alpha}{360^\circ} \times 2\pi R \cos \theta \\
 &= \frac{(39.8^\circ - 30.5^\circ)}{360^\circ} \times 2 \times \frac{22}{7} \times 6370 \times \cos 12.4 \\
 &= \frac{9.3}{360} \times \frac{44}{7} \times 6370 \times \cos 12.4 \\
 &= \frac{9.3}{360} \times 44 \times 910 \times 0.9767 \\
 &= \frac{31}{120} \times 44 \times 91 \times 0.9767 \\
 &= 1010.06 \\
 \therefore \text{Distance} &= \underline{1010.06 \text{ km}}
 \end{aligned}$$

The candidate seemed to have adequate knowledge on finding the volume of three dimensional figures and was also conversant in calculating distance between two points on the Earth's surface.

2.14 Question 14: Accounts

Question 14 was attempted by a few candidates (43.2%), of which 75 percent obtained marks from 0 to 4.5 with 53.3 percent of them scoring a 0 mark. On the other hand, very few candidates (1.4%) scored all the 10 marks, indicating a general poor performance in this question.

In part 14 (a), the candidates were required to prepare a trial balance by using the balances which were extracted from the ledgers of Mr and Mrs Mkombo business on 31st January. This part was poorly done as many candidates failed to construct the trial balance. These candidates did not understand that a trial balance is 'the list of debit and credit account balances in a ledger at a particular point of time. Extract 14.1 (a) presents an answer from one of the candidates who had no knowledge concerning trial balances.

Extract 14.1 (a)

14 | a, b ~~but~~ The balances were extracted from the ledgers of Mr and Mrs Mhoro business on 31st January. Prepare a trial balance

Capital	30,000/=
Furniture	25,000/=
Motor vehicle	45,000/=
Sales	68,000/=
Purchases	54,000/=
Creditors	76,000/=
Debtors	15,000/=
r	313,000
Insurance	30,000/=
Cash	18,000/=
Discount received	7,000/=
Discount allowed	4,000/=
Drawing	12,000/=
Electricity	5,000/=
	<u>362,000/=</u>
Prepare a trial balance sh 362,000	

The candidate did not indicate a clear understanding of the question and also seemed to lack general knowledge on trial balance. In addition, he/she did not attempt 14 (b) on trading, profit and loss account.

However, there were a few candidates who managed to answer part 14(a) correctly. Those candidates managed to post the balances of debits and credits accounts properly. They also managed to ensure that the total of all debits is equal to the total of all credits. Extract 14.1 (b) presents a sample response from one of such candidates

Extract 14.1 (b)

14(a) MR AND MRS M TOMO
TRIAL BALANCE AS AT 31ST JANUARY.

Date	Details	F	DR	CR
31, jan	capital			30,000
31, jan	Furniture		25000	
31, jan	Motor vehicle		45000	
31, jan	Sales			68000
31, jan	Purchases		54000	
31, jan	creditors			76000
31, jan	Debtors		15000	
31, jan	Insurance		3000	
31, jan	cash		18000	
31, jan	Discount received			7000
31, jan	Discount allowed		4000	
31, jan	Drawing		12000	
31, jan	Electricity		5000	
			181000	181,000

Extract 14.1 (b) shows a sample response from one of the candidates who managed to set out the trial balance correctly and scored the full marks for this part.

In part 14 (b), the candidates were required to determine the gross profit and net profit from the given information. This part was also poorly done indicating that the candidates did not have a good understanding of the concept of trading, profit and loss account that was tested. It is only a few candidates who were able to recognize that gross profit is equal to the cost of sale of goods minus the cost of goods sold and that the net profit is what remains after any other costs are taken from the gross profit. A sample answer from one of the candidates who managed to answer part 14 (b) correctly is shown in Extract 14.2.

Extract 14.2

14b)	gross profit
	= Sales - (opening stock + purchases - closing stock)
	= 38000 - (8000 + 25000 - 5000)
	= 38000 - 28000
	= 10000
	gross profit is 10,000/=
	Net profit
	= Gross profit - (electricity + discount allowed)
	= 10,000 - (40,000 + 2,000)
	= 10,000 - 6000
	= 4,000
	Net profit is 4000/=

Extract 14.2 shows the response from one of the candidates who computed the gross profit and net profit correctly.

2.15 Question 15 : Matrix And Linear Transformations

This question was attempted by 61.2 percent of the candidates, of which 62.7 percent of them scored a 0 mark and only 9.9 percent of those who attempted the question scored from 5 to 10 marks.

Part 15 (a) which was on finding the value of k such that the matrix

$\begin{pmatrix} 2k+2 & k \\ 4k-3 & k+3 \end{pmatrix}$ is singular was poorly done by the majority of the candidates.

It was noted that some of the candidates completely lacked the knowledge on the topic of matrices (see Extract 15.1) and many others failed to expand the

determinant $\begin{vmatrix} 2k+2 & k \\ 4k-3 & k+3 \end{vmatrix}$ to obtain the correct quadratic expression

$-2k^2 + 11k + 6$ which they were to equate to zero in order to determine the value of k .

In part 15 (b), the candidates were required to find the image of a triangle with vertices A(1,2), B(3,1) and C(-2,1) after the coordinates have been reflected on the x-axis. This part was also poorly performed as the majority of the candidates completely lacked the knowledge on the topic of matrices and transformations.

Part 15 (c) which was on solving the simultaneous equations $\begin{cases} 2x+3y-2=0 \\ -9y+8x-1=0 \end{cases}$ by the matrix method was also poorly answered. It was disappointing to see that the candidates were not aware of the 'matrix method', which many candidates did not realise it meant the 'inverse method'.

Extract 15.1

15 a $\begin{pmatrix} 2k+2 & k \\ 4k-3 & k+3 \end{pmatrix}$

solution

$$\begin{array}{r} 4k - k \\ 1k \quad 3k \\ 5k^2 \quad 3k^2 \\ 1k \quad 3k^2 \\ 3k - 5k^2 \\ = 5 \quad 2 \end{array}$$

\therefore The value of $k = 2$

b Given

$$\begin{array}{l} A = (1, 2) \\ B = (3, 1) \\ C = (-2, 1) \end{array}$$

$$1, 2 + 3, 1$$

$$\begin{array}{c} 4 \quad 2 \\ \therefore A = (4, 2) \end{array}$$

$$+ \begin{array}{c} (3, 1) \\ (1, 2) \end{array} = 4, 3$$

$$\therefore B = (4, 3)$$

$$3, 1 + -2, 1$$

$$\therefore A \text{ \& } C = (1, 2)$$

$$\begin{aligned}
 2x + 3y - 2 &= 0 \\
 -9y + 8x - 1 &= 0 \\
 \text{solution} \\
 2x + 3y - 2 &= 0 \\
 8x + 9y - 1 &= 0 \\
 8 + 9 - 1 &= 0 \\
 2 + 3 - 2 &= 0 \\
 \frac{10}{5} \quad \frac{12}{3} &= 3 = 0 \\
 3 \quad 4 - 3 &= 0 \\
 \therefore \text{The equation by matrix} &= 3 \quad 4 - 3 = 0
 \end{aligned}$$

Extract 15.1 represents the answer from one of the candidates who completely had no knowledge on the topic of matrices and transformation. Such candidates were awarded a 0 mark.

However, there were a few candidates who managed to answer this question correctly and scored full marks. A sample answer from one of such candidates is shown in Extract 15.2.

Extract 15.2

$$\begin{aligned}
 15. \quad a) \quad & \begin{vmatrix} 2k+2 & k \\ 4k-3 & k+3 \end{vmatrix} \\
 & (2k+2)(k+3) - (4k-3)(k) = 0 \\
 & 2k^2 + 6k + 2k + 6 - (4k^2 - 3k) = 0 \\
 & 2k^2 + 8k + 6 - 4k^2 + 3k = 0 \\
 & 2k^2 - 4k^2 + 8k + 6 + 3k = 0 \\
 & -2k^2 + 8k + 3k + 6 = 0 \\
 & -2k^2 + 11k + 6 = 0 \\
 & \frac{-12k^2}{-k} \qquad \qquad \text{sum of factors} \\
 & \qquad \qquad \qquad 12k \qquad \qquad 11k
 \end{aligned}$$

$$-2k^2 - k + 12k + 6 = 0$$

$$(-2k^2 - k)(12k + 6) = 0$$

$$-k(2k+1) 6(2k+1) = 0$$

$$(6-k)(2k+1) = 0$$

$$6-k=0 \quad 2k+1=0$$

$$k=6 \quad 2k=-1$$

$$k=6 \text{ or } k=-\frac{1}{2}$$

\therefore The value of $k = 6$ or $-\frac{1}{2}$.

15. b) A (1, 2)

B (3, 1)

C (-2, 1)

$$M_x (x, -y)$$

Reflected on x-axis $(x, y) \rightarrow (x, -y)$

15. b) A (1, 2)

A' (1, -2)

B (3, 1)

B' (3, -1)

C (-2, 1)

C' (-2, -1)

\therefore The coordinates of the vertices of its image are A' (1, -2) B' (3, -1) and C' (-2, -1) when reflected in the x-axis.

15. (c)

$$\begin{aligned} 2x + 3y &= 2 \\ -9y + 8x &= 1 \end{aligned}$$

$$\begin{aligned} 2x + 3y &= 2 \\ 8x - 9y &= 1 \end{aligned}$$

$$\begin{pmatrix} 2 & 3 \\ 8 & -9 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

det.

$$\begin{vmatrix} 2 & 3 \\ 8 & -9 \end{vmatrix}$$

$$\begin{aligned} &= 2 \times -9 - 8 \times 3 \\ &= -18 - 24 \\ &= -42 \end{aligned}$$

15. (c)

$$\frac{1}{-42} \begin{pmatrix} -9 & -3 \\ -8 & 2 \end{pmatrix}$$

$$\begin{pmatrix} -9/42 & -3/42 \\ -8/42 & -2/42 \end{pmatrix}$$

$$\begin{pmatrix} 9/42 & 3/42 \\ 8/42 & -2/42 \end{pmatrix}$$

$$\begin{pmatrix} 9/42 & 3/42 \\ 8/42 & -2/42 \end{pmatrix} \begin{pmatrix} 2 & 3 \\ 8 & -9 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 9/42 & 3/42 \\ 8/42 & -2/42 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 9/42 & 3/42 \\ 8/42 & -2/42 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix}$$

$$\begin{matrix} x = (9/42 \times 2 + 3/42 \times 1) \\ y = (8/42 \times 2 + -2/42 \times 1) \end{matrix}$$

$$\begin{matrix} x = (18/42 + 3/42) \\ y = (16/42 - 2/42) \end{matrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 21/42 \\ 14/42 \end{pmatrix}$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 1/2 \\ 1/3 \end{pmatrix}$$

$$x = 1/2 \text{ and } y = 1/3 \text{ Ans}$$

In Extract 15.2, the candidate demonstrated an understanding of the concepts of singular matrices, reflection of points in the x – axis and of solving simultaneous equations by the inverse method.

2.16 Question 16: Probability

This question was attempted by few candidates (26.3%) of which the majority of them (83.9%) scored a 0 mark.

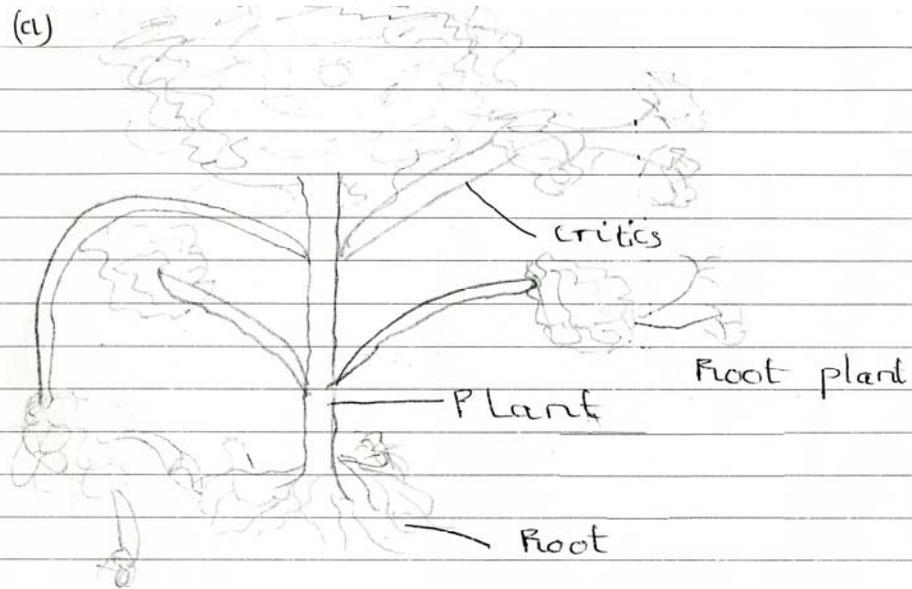
In this question, the candidates were given information that a box contains 7 red balls and 14 black balls. They were also instructed that two balls are drawn at random without replacement and were required to: (a) draw a tree diagram to show the results of the drawing; (b) find the probability that both are black; (c) find the probability that they are of the same colour; (d) find the probability that the first is black and the second is red and (e) verify the probability rule $P(A) + P(A') = 1$ by using the results in part (b).

Generally, this question was poorly done. Many candidates failed to construct the tree diagram that was essential in answering parts (a), (b), (c) (d) and (e) and hence scored a 0 mark in this question. It was noted that some candidates completely lacked the knowledge on the topic of probability and hence

resorted to writing whatever came from their mind. Extract 16.1 shows the work of a candidate whose response was not related to the requirements of the question.

Extract 16.1

16 (a)



(b) Tree are is brobabability that both are blackes

(c) same $\frac{1}{2} + 3 = 5$ colour

5 colour

(d)

(e) $P(A) + P(A') = 1$

$P(A) + P(A') = 2 = 3 + 1 = 4$

4

In Extract 16.1, the candidate seemed to lack knowledge on probability tree diagrams. In part 16 (a), the candidate drew a normal tree instead of the probability tree diagram. The answers in parts 16 (b), (c) and (e) indicate that the candidate was unfamiliar with the concepts and rules of probability.

Despite the poor performance in this question, there were a few candidates (0.3%) who managed to answer the question well. Extract 16.2 provides a sample answer to illustrate how such candidates managed to answer this question correctly.

Extract 16.2

16. Given that $n(R) \rightarrow$ red balls = $6+1 = 7$
 $n(B) \rightarrow$ black balls = 14
 2 Balls are drawn without replacements.

(a).

```

graph LR
    Start((start)) -- 7/21 --> R1((R))
    Start -- 14/21 --> B1((B))
    R1 -- 6/20 --> RR((R --- RR))
    R1 -- 14/20 --> RB((B --- RB))
    B1 -- 7/20 --> BR((R --- BR))
    B1 -- 13/20 --> BB((B --- BB))
  
```

(b) Find probability that both are black
 $P(B \cap B)$
 $P(B) \times P(B) = \frac{14}{21} \times \frac{13}{20}$
 $= \frac{2 \times 13}{3 \times 20} = \frac{13}{30} = \frac{13}{30}$

Probability of both blacks = $\frac{13}{30}$

(c) Probability of same colour
 $P(R \cap R) + P(B \cap B) = \left(\frac{7 \times 6}{21 \times 20} \right) + \left(\frac{14 \times 13}{21 \times 20} \right)$

$$= \left(\frac{1}{3} \times \frac{3}{10} \right) + \left(\frac{2}{3} \times \frac{13}{20} \right)$$

$$= \frac{1}{10} + \frac{13}{30}$$

$$\frac{3+13}{30} = \frac{16}{30} = \frac{8}{15}$$

∴ Probability of being of same colour = $\frac{8}{15}$

(d) Probability

of the first (B) and second (R)

$$P(BR) = P(B) \times P(R) = \frac{14}{21} \times \frac{7}{20}$$

$$= \frac{2 \times 7}{3 \times 20} = \frac{7}{30}$$

Probability of black and red = $\frac{7}{30}$

(e) $P(A) + P(A') = 1$

Hence we have

$$P(B \cap B) = \frac{13}{30}$$

Probability $P(B \cap B)' = P(RR) + P(RB) + P(BR)$

$$= \frac{1}{10} + \frac{7}{30} + \frac{7}{30}$$

$$= \frac{3+7+7}{30} = \frac{17}{30}$$

$$P(B \cap B)' = \frac{17}{30}$$

let $B \cap B$ be A

and $(B \cap B)'$ be A'

$$\text{Hence } P(B \cap B) = P(A) = \frac{13}{30}$$

$$P(B \cap B)' = P(A)' = \frac{17}{30}$$

$$P(A) + P(A)' = \frac{13}{30} + \frac{17}{30} = \frac{30}{30}$$

$$\therefore \underline{P(A) + P(A)' = 1.}$$

In Extract 16.2, the candidate was able to construct a probability tree diagram correctly that enabled him/her to answer the other parts 16 (a) to (e) as required.

3.0 SUMMARY OF THE CANDIDATES' PERFORMANCE

This section provides a summary of the overall performance of the candidates in tabular form and in graphs for the questions of sections A and B.

3.1 A summary of performance in section A

Table 1 contains the data about the performance of the candidates in Section A. The data consists of the number and percentage of candidates who scored a 0 mark, from 0.5 – 3 marks and those who scored from 3.5 – 6 marks in each question.

Table 1 shows the performance of the candidates in Section A

Question number	Topic	Candidates who scored a 0 mark	Candidates who scored from 0.5 to 3 marks	Candidates who scored from 3.5 to 6 marks
1	Numbers	291,164 (73.4%)	98,239 (24.8%)	7,376 (1.9%)
2	Exponents and Logarithms	326,556 (82.3%)	42,107 (10.6%)	28,186 (7.1%)
3	Algebra and sets	369,786 (93.2%)	24,716 (6.2%)	2,363 (0.6%)
4	Vectors	274,632 (69.2%)	116,786 (29.4%)	5,460 (1.4%)
5	Geometry	367,442 (92.6%)	24,078 (6.1%)	5,308 (1.3%)
6	Variations and Algebra	302,836 (76.3%)	59,115 (14.9%)	34,897 (8.8%)
7	Ratio, Profit and Loss	358,208 (90.3%)	33,817 (8.5%)	4,827 (1.2%)
8	Sequence and Series	315,938 (79.6%)	48,591 (12.2%)	32,334 (8.1%)
9	Trigonometry	350,230 (88.3%)	32,611 (8.2%)	14,014 (3.5%)
10	Quadratic functions	331,934 (83.7%)	42,769 (10.8%)	21,853 (5.5%)

The data in Table 1 can easily be understood when referred to Figure 1, the graphical representation.

Figure 1: The candidates' Performance in section A

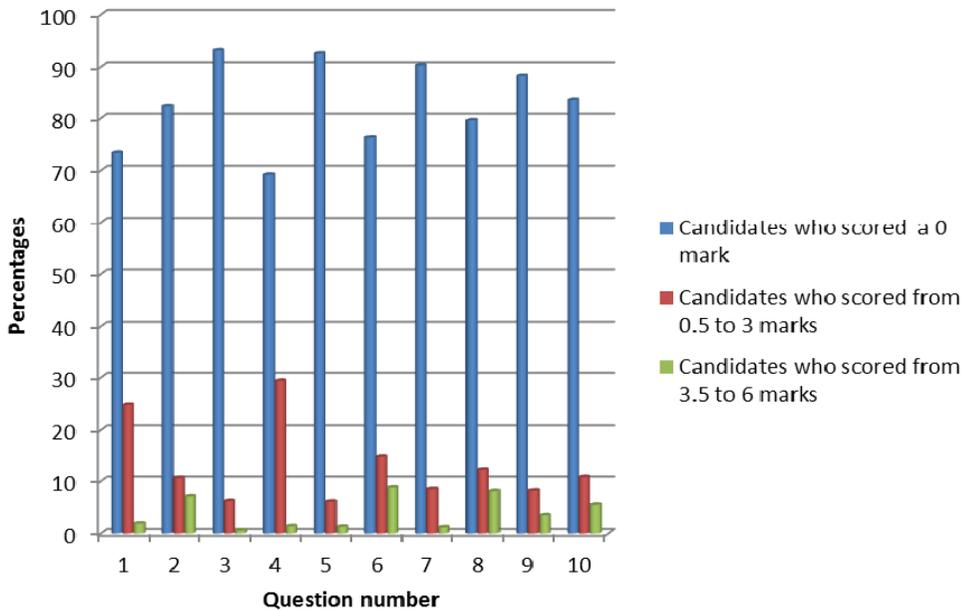


Table 1 and Figure 1 show that on average 82.9 percent of the candidates scored a 0 mark in all questions of section A. The most poorly performed questions were question 3 on Algebra and Sets; question 5 on Geometry and question 7 on Ratio, Profit and Loss of which more than 90 percent of the candidates who attempted the questions scored a 0 mark.

On the other hand, on average 3.9 percent of the candidates scored more than half of the marks allocated for each question (i.e. from 3.5 to 6 marks). The questions that were comparatively performed better were question 2 on Exponents and Logarithms, question 6 on Variations and Algebra and question 8 on Sequence and Series.

It is evident from Figure 1 that the distributions of scores for the percentage of candidates who scored a 0 mark, from 0.5 to 3 marks and from 3.5 to 6 marks in each question are highly positively skewed. This is to mean that the majority of candidates scored a 0 mark, a smaller number of candidates scored from 0.5 to 3 and very few scored above 3.

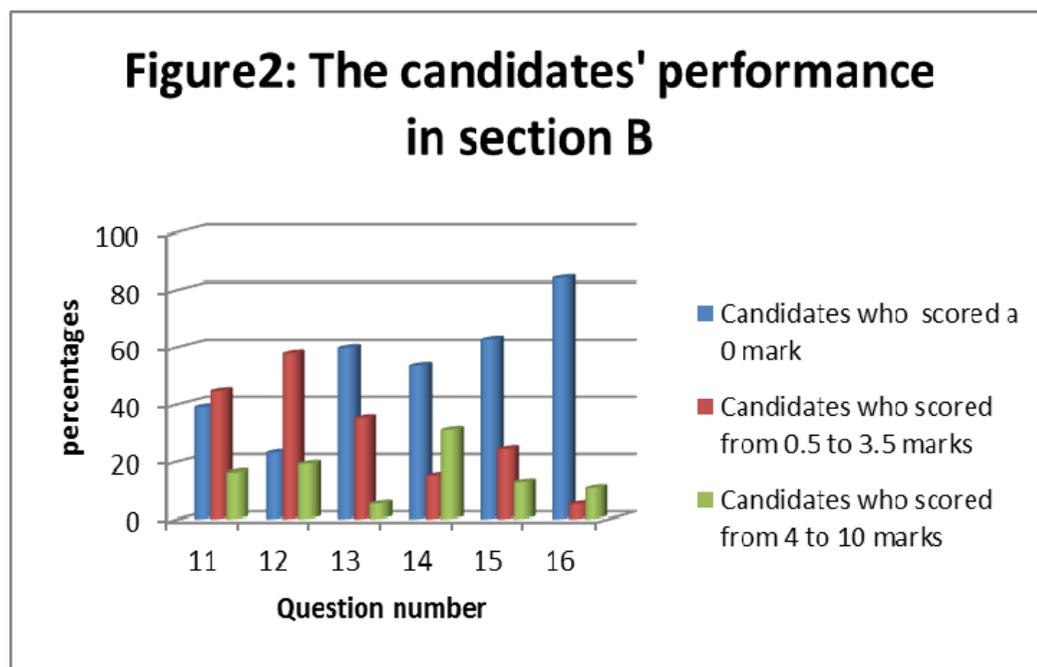
3.2 A Summary of Results for Section B

Table 2 shows the data about the performance of the candidates in Section B. The data comprises of the number and percentages of candidates who scored a 0 mark; from 0.5 to 3.5 marks and from 4 to 10 marks.

Table 2: The Candidates' Performance in Section B

Question Number	Topic	Candidates who scored a 0 mark	Candidates who scored from 0.5 to 3.5 marks	Candidates who scored from 4 to 10 marks
11	Linear Programming	45082 (39%)	51571 (44.7%)	18836 (16.3%)
12	Statistics	63568 (23.2%)	157950 (57.7%)	52425 (19.1%)
13	Three dimensional figures and Spheres	55076 (59.7%)	32327 (35.0%)	4875 (5.3%)
14	Accounts	95119 (53.3%)	27289 (15.3%)	55890 (31.3%)
15	Matrices and Transformations	158083 (62.7%)	61547 (24.4%)	32673 (12.9%)
16	Functions and Probability	91152 (83.9%)	5653 (5.2%)	11788 (10.9%)

The data in Table 2 is represented graphically in Figure 2 below.



It is evident from Table 2 and Figure 2 that, questions 15 on Matrices and Linear Transformations and question 16 on Probability had the highest number of candidates who scored a 0 mark and hence were the most poorly performed questions in Section B. On average 53.6 percent of candidates who attempted the questions in Section B scored a 0 mark, indicating a general poor performance in the questions of section B.

On the other hand, question 14 on Accounts had more candidates who scored from 4 to 10 marks and therefore it was performed better compared to other questions in Section B.

4.0 CONCLUSION AND RECOMMENDATIONS

3.2 Conclusion

The question-wise analysis of the candidates' performance shows that the average of 82.9 percent of the candidates scored a 0 mark in all questions in section A and also the average of 53.6 percent of candidates who attempted the questions in Section B scored a 0 mark. This therefore implies a poor performance on the CSEE 2012 Basic Mathematics paper.

The analysis of the individual items indicates that many candidates performed poorly in all questions. The reasons that have contributed to the poor performance include lack of understanding of the required concepts, failure to identify the requirements of the questions, incompetence to translate word problems into mathematical equations or diagrams. Other factors include insufficient skills to draw correct graphs and diagrams, inability to use mathematical tables, poor algebraic and poor computation skills.

3.3 Recommendations

Based on the performance in this paper, candidates should ensure that they:

- (a) practice attempting questions on all topics listed in the syllabus in order to gain experience in answering questions and competence with the material.

- (b) read carefully the examination questions so as to be able to identify the demand/requirement of the questions
- (c) show their working clearly and use well labelled diagrams/graphs to enable them to score good marks.

In order to enhance candidates' knowledge the teachers are advised to:

- (a) Ensure that students are provided with enough tests and assignments to monitor their progress and eventually identify areas which needs more support.
- (b) Prepare the students for examinations by encouraging them to revise all topics in the syllabus.
- (c) Encourage the students to read textbooks in order to acquire more knowledge on mathematics.
- (d) Encourage the students to prepare a self-studying schedule showing how they go about revising all topics in the syllabus.

