THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR THE CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (CSEE) 2015

041 BASIC MATHEMATICS
(For School Candidates)

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FOREWORD

This Analytical report on the Candidates' Item Response in the Basic Mathematics paper for the Certificate of Secondary Education Examination (CSEE) 2015, was prepared in order to inform teachers, policy makers and other education stakeholders on how the candidates responded to the examination items.

The analysis of candidates' responses was done so as to identify the topical areas where the candidates faced challenges and those which they did well or averagely. Basically, the report highlights the candidates' general strengths and weaknesses and thus provides a general picture of what the education system was able or unable to offer to students in their four years of ordinary level secondary education.

In general, the responses analysis shows that the overall performance in Basic Mathematics examination is still very low. The evidences observed for the poor performance include: inability to identify the requirements of the questions; lack of knowledge and skills to apply laws, concepts and formulae in answering questions; lack of knowledge and skills on interpreting word problems, solving algebraic equations and drawing graphs. The candidates also demonstrated poor computation skills and provision of answers that were not related to the question demands.

The National Examinations Council of Tanzania believes that this report will be used by educational stakeholders in developing better and more effective strategies for improving the performance in this subject.

Finally, the Council would like to thank the Examiners and all others who were involved in preparing and analysing the data used in this report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report is based on the analysis of the candidates' item responses in 041 Basic Mathematics examination for the Certificate of Secondary Education Examination (CSEE) 2015. The analysis highlights the areas in which the candidates faced challenges and those which they did well or averagely.

The 041 Basic Mathematics examination paper had sections A and B with a total of sixteen (16) questions and was set according to the 2008 Examination Format that was derived from the 2005 Revised Syllabus. Section A had 10 questions, each weighing 6 marks while section B had 6 questions each weighing 10 marks. The candidates were required to answer all questions in section A and four (4) questions of their choice in section B.

In 2015, 383,851 candidates sat for the 041 Basic Mathematics paper out of whom 64,332 (16.76%) candidates passed. In 2014, 240,160 candidates sat for the examination, of whom 47,001 (19.58%) candidates passed. This shows that the performance in 2015 has dropped by 2.82 percent.

The analysis of the candidates' performance in each question is presented in section 2.0; it includes a short description of the requirements of the question and on how the candidates responded to such questions. The evidences for the candidates performing either poorly, averagely or well in each question have been indicated and illustrated using samples of candidates' responses.

2.0 ANALYSIS OF CANDIDATES' PERFORMANCE PER QUESTION

The analysis categorizes the performance as either poor, average or good if the percentage of candidates who scored 30 percent or more of the marks allocated to a particular question lies in the interval 0 – 29, 30 – 44 and 45 – 100, respectively.

2.1 Question 1: Approximations and Logarithms

This question had parts (a) and (b). In part (a), the candidates were instructed to note that $p = 6.4 \times 10^4$, $q = 3.2 \times 10^5$ and they were required to find the value of (i) $p \times q$, (ii) $p + q$ and express the answers in standard form. In part (b), they were required to evaluate the numerical expression $\sqrt{\frac{0.684^3 \times 43.7}{3.26}}$ using mathematical tables and write the answer correctly to 3 significant figures.

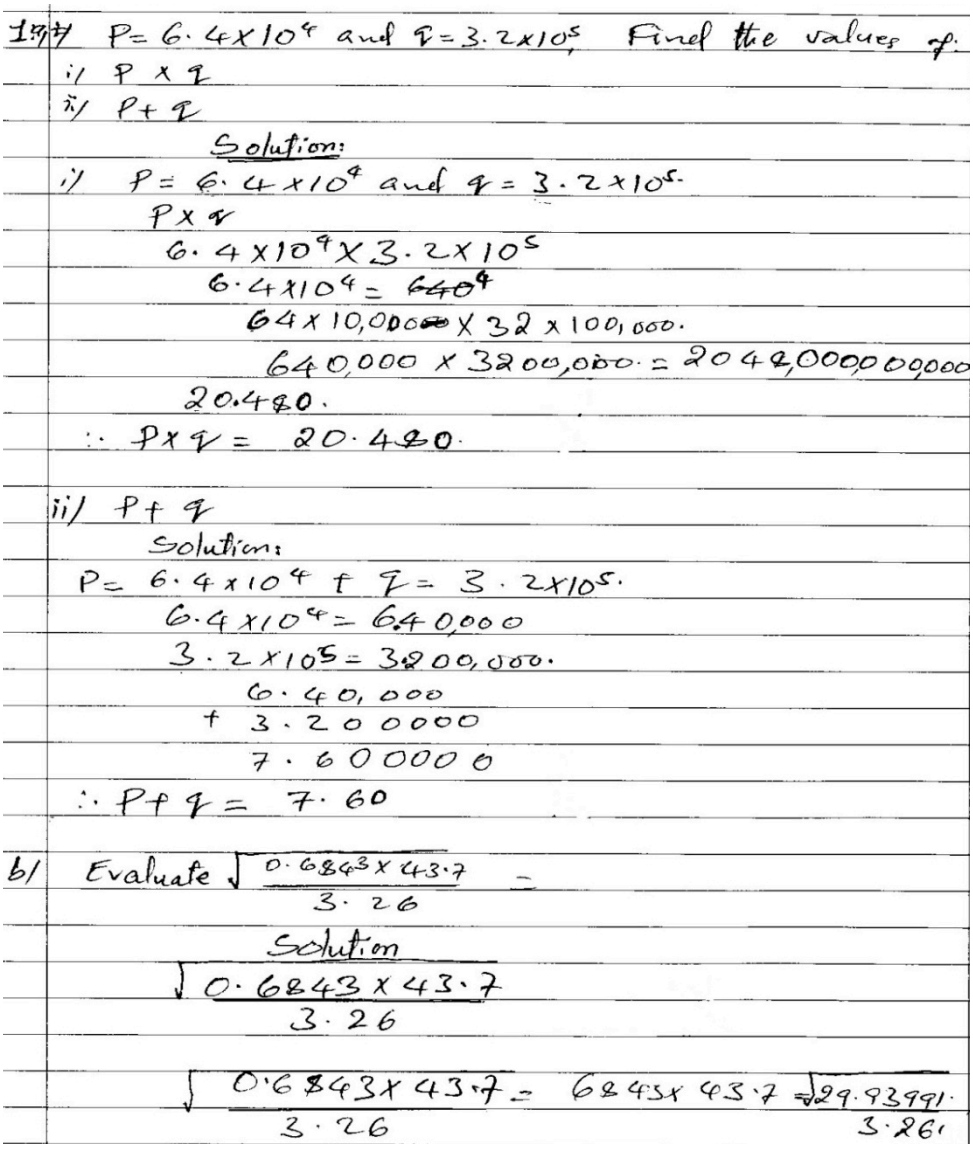
The question was attempted by 383,867 candidates of whom the majority (92.5%) scored below 2 out of 6 marks and among them 68.5 percent scored a 0 mark, indicating an overall poor performance in this question.

In part (a), only few candidates managed to find the product and the sum of the numbers and express the answers in standard form i.e. $A \times 10^n$ where $1 \leq A < 10$ and n is an integer. Most of the candidates could neither multiply the numbers nor add them correctly and hence scored 0 mark. These candidates lacked the skills to apply the laws of exponents in performing computations. For instance, some candidates in part (a)(i) multiplied $10^4 \times 10^5$ incorrectly to get $10^{4\times5} = 10^{20}$ instead of $10^{4+5} = 10^9$. Others provided solutions that were not related to the requirements of the question, indicating that they lacked knowledge on the concept of standard notation.

In part (b), majority of the candidates could not obtain the correct value of the given expression. The candidates lacked knowledge and skills to do computations involving multiplication, division, roots and powers of

numbers using mathematical tables. Extract 1.1 shows a sample answer from one of the candidates who performed this question poorly.

Extract 1.1

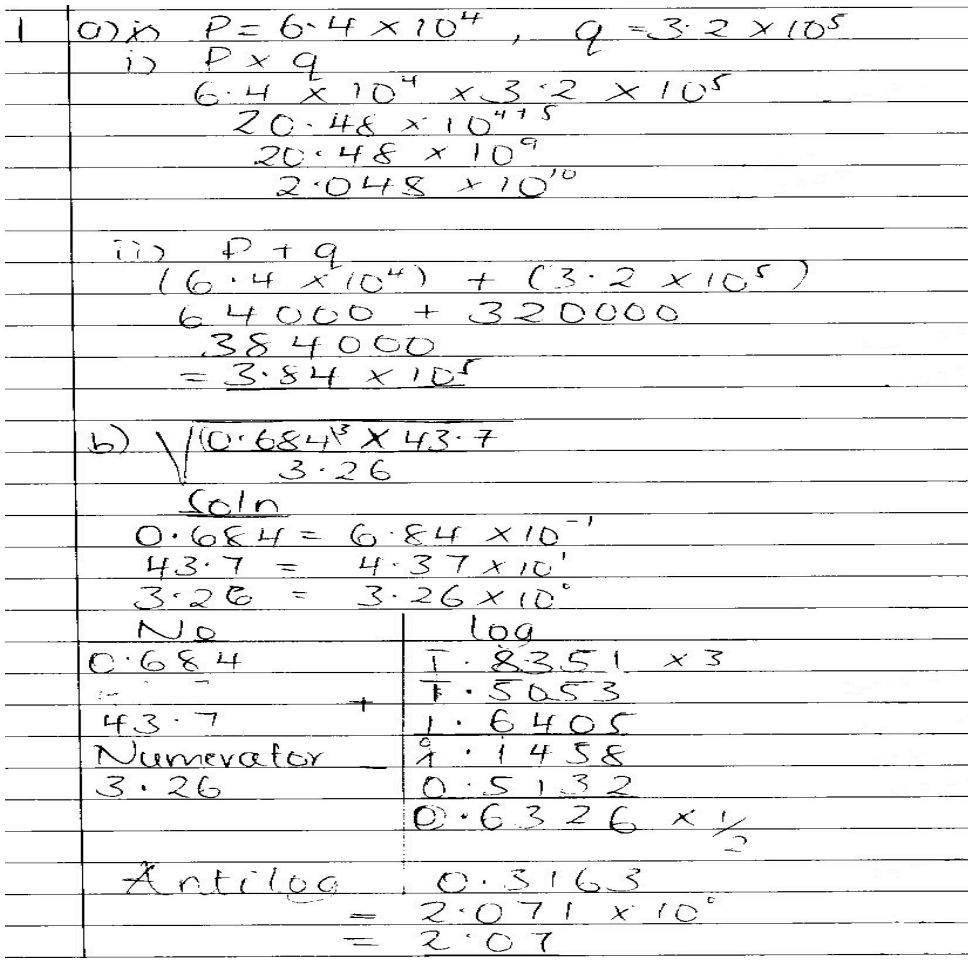


Extract 1.1 shows that the candidate could not perform operations on numbers expressed in standard notation and did not use mathematical tables in finding the value of the given expression as instructed.

Although this question was poorly performed, there were few candidates who applied the laws of exponents, the definition of the concept of

scientific notation and use mathematical tables correctly in answering this question as illustrated in Extract 1.2.

Extract 1.2



Extract 1.2 shows that the candidate's adequate knowledge on expressing numbers in standard notation and performing calculations using mathematical tables.

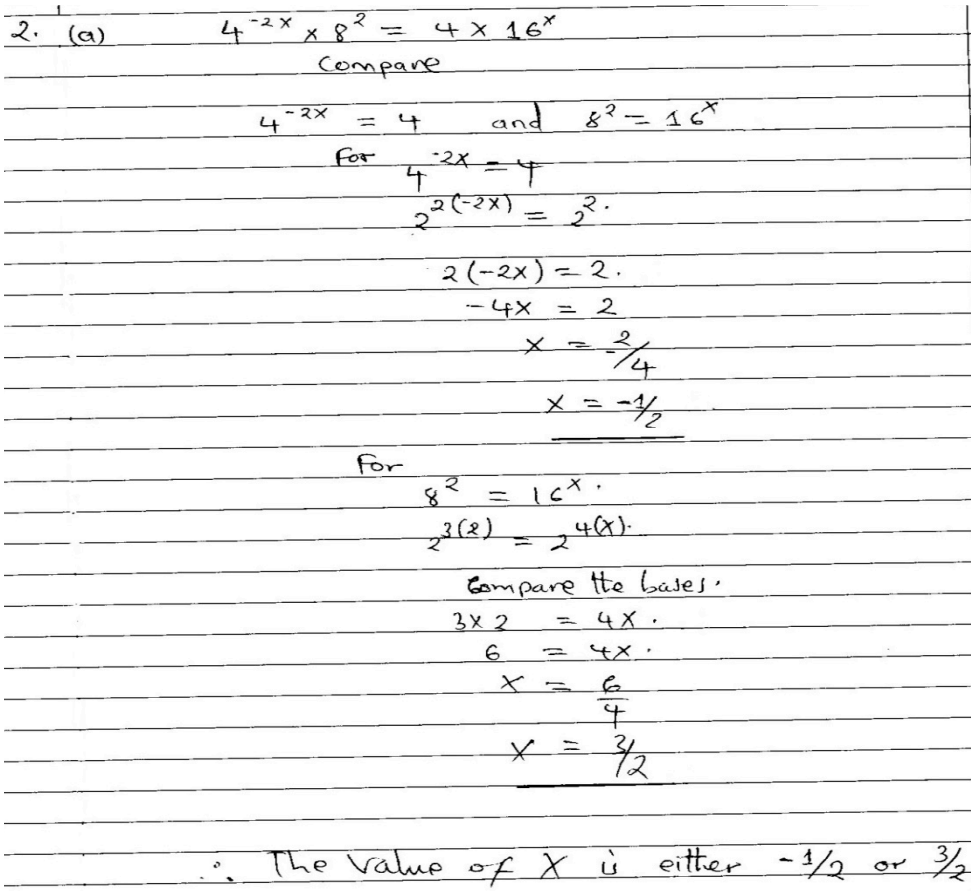
2.2 Question 2: Logarithms, Exponents and Radicals

In part (a) of question 2, the candidates were instructed to solve for x in the equation $4^{-2x} \times 8^2 = 4 \times 16^x$. In part (b), they were instructed to find the value of log 900 given that log 3 = 0.4771.

Almost all candidates attempted this question but the majority (87.7%) scored below 2 out of 6 marks while only 2.8 percent scored all 6 marks, showing that this question was poorly performed.

In part (a), only few candidates were able to use the laws of exponents correctly to express the terms in the given equation either in base 2 or 4 and thereafter equate the exponent terms of the left and right hand side of the equation in order to find the required value of *x*. Majority of the candidates lacked knowledge and skills on how to apply the laws of exponents in performing computations. Extract 2.1 is a sample answer from one of the candidates illustrating this case.

Extract 2.1

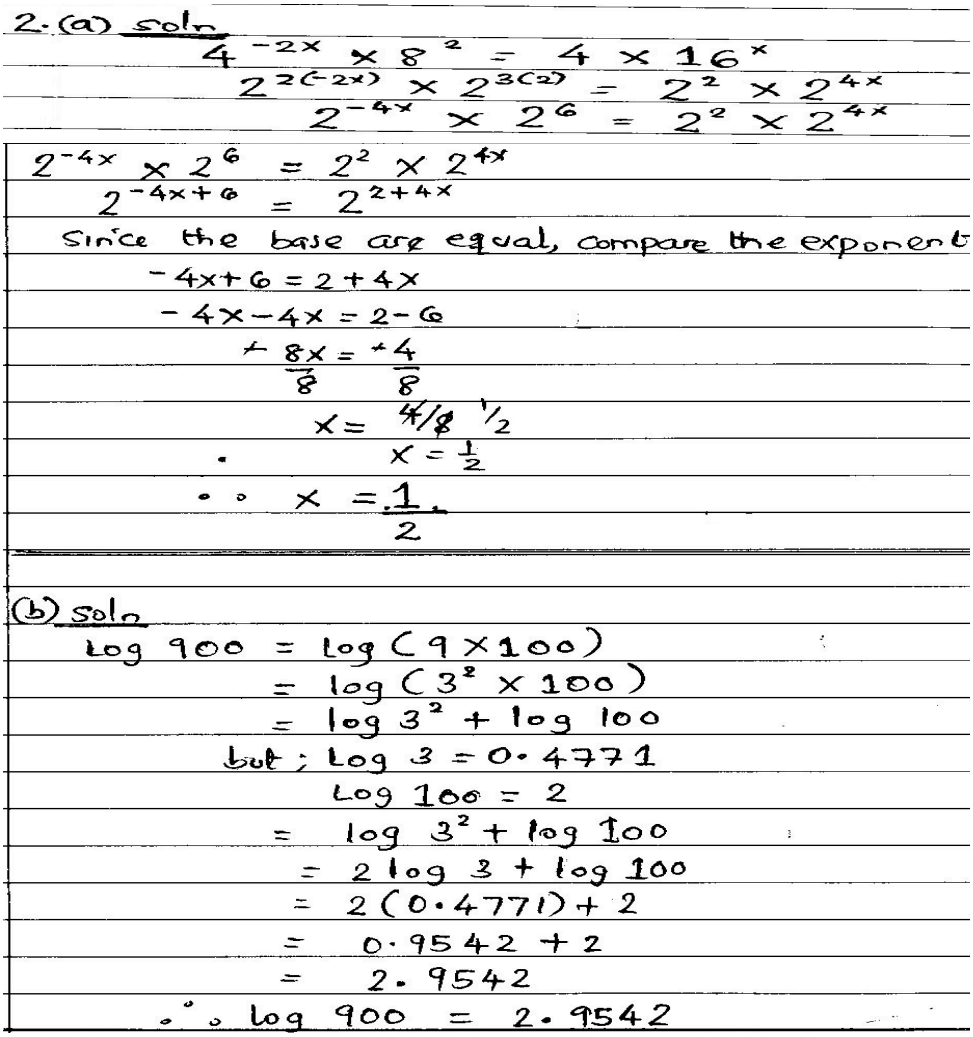


In Extract 2.1, the candidate wrongly separated the given equation into two equations: $4^{-2x} = 4$ and $8^2 = 16^x$. He/she then solved them independently to obtain two different values of *x*, indicating lack of knowledge on solving equations.

In part (b), most of the candidates could not apply the logarithm laws: $\log AB = \log A + \log B$, $\log x^n = n\log x$ and $\log_a a = 1$ to express $\log 900$ in terms of log 3. Several candidates misinterpreted these laws by replacing $\log AB = \log A + \log B$ with $\log AB = \log A \times \log B$, indicating that they did not comprehend well the logarithm and exponent laws.

However, there were few candidates who managed to use the laws of exponent and logarithm correctly in answering this question as shown in Extract 2.2.

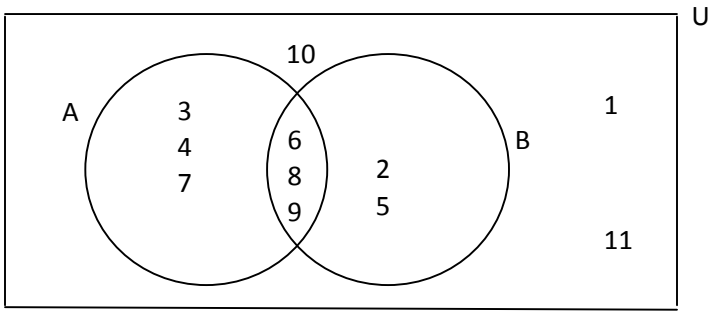
Extract 2.2



Extract 2.2 shows that the candidate had full knowledge on the laws of exponent and logarithm and was able to apply them correctly.

2.3 Question 3: Algebra and Sets

The question had three parts; (a), (b) and (c). In part (a), the candidates were instructed to find the solution set of the inequality $\frac{x}{3} - 1 \geq 2 - \frac{x}{2}$ and indicate it on a number line. In part (b), they were required to use the following Venn diagram to find (i) A' (ii) B' (iii) $A \cup B$ and (iv) $A' \cup B'$. In part (c), the candidates were required to verify that $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.



In this question, 92.2 percent of the candidates who attempted it scored from 0 to 1.5 out of 6 marks, showing that many candidates performed it poorly.

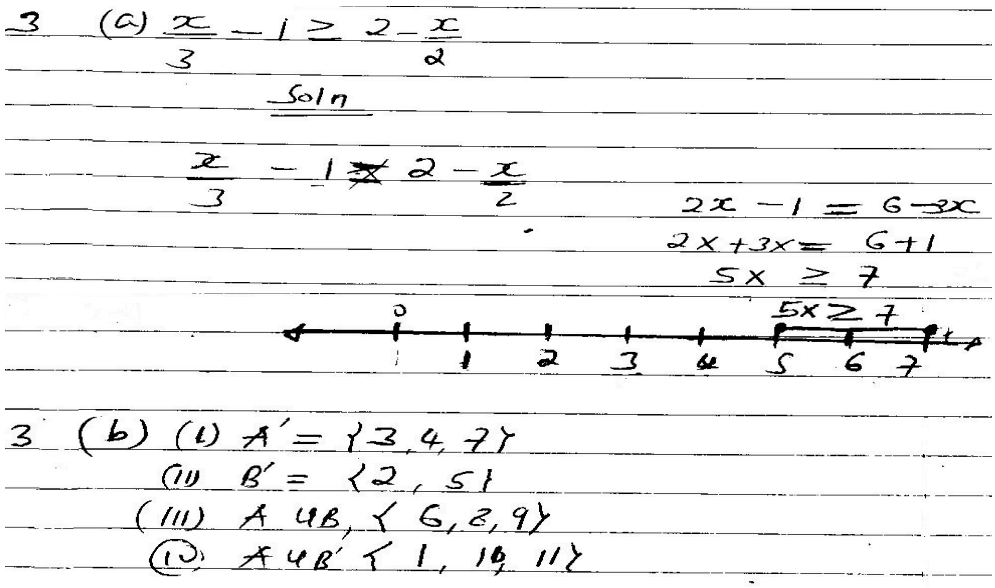
In part (a), many candidates were unable to solve correctly the given inequality. They were unable to collect like terms to obtain $\frac{x}{3} + \frac{x}{2} \geq 2 + 1$; $\frac{5x}{6} \geq 3$ and $x \geq 3\frac{3}{5}$ due to algebraic and sign errors. However, some candidates managed to obtain the required solution set but represented it wrongly on a number line. Others omitted the last part that was on representing the solution set on a number line. Further analysis of the candidates' responses shows that, some candidates replaced the inequality sign, with equal sign indicating that they could not differentiate equations from inequalities.

In part (b), many candidates were not able to apply the definition of complement of a set in answering this part. For example, they did not

recognize that the complement of a set is the collection of all elements which are not members of that set resulting to incorrect answers in parts (b) (i), (ii) and (iv) (see Extract 3.1). Some candidates confused the elements of set A and B with the elements of set A' and B' respectively. Other candidates failed to differentiate between listing the elements of a set and finding the number of elements of a set. It was also noted that, a number of candidates had insufficient knowledge on set notation, for instance some used round brackets ( ) instead of curl brackets { } and there were some candidates who did not use the curl brackets while listing the elements of the sets.

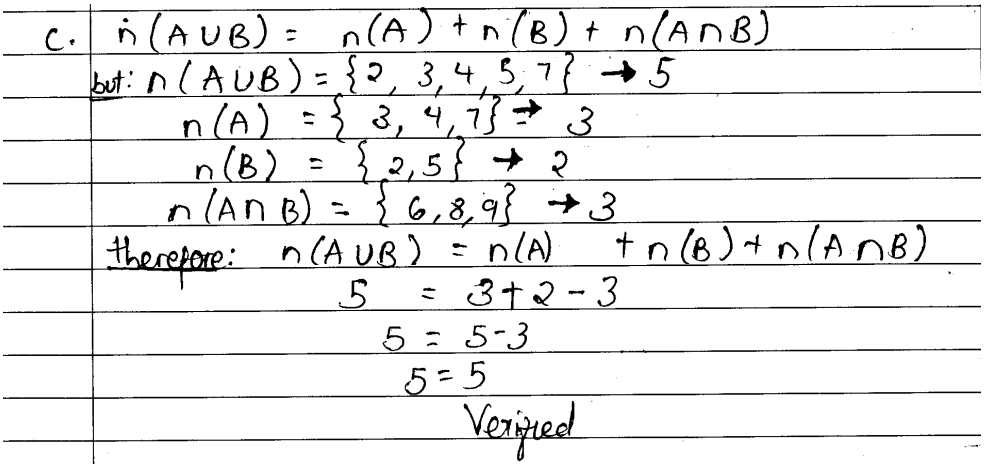
In part (c), many candidates were unable to identify the elements of sets A, B, $A \cap B$ and $A \cup B$ from the given Venn diagram and as a result failed to provide the required solution. Extract 3.2 illustrates this case. It was noted that some candidates were able to find the number of elements in these sets but failed to verify the formula as required. Generally, many candidates lacked skills to solve inequalities and interpret information from Venn diagrams.

Extract 3.1



Extract 3.1 shows that the candidate lacked knowledge on the concepts of sets and on how to solve inequalities in one unknown variable.

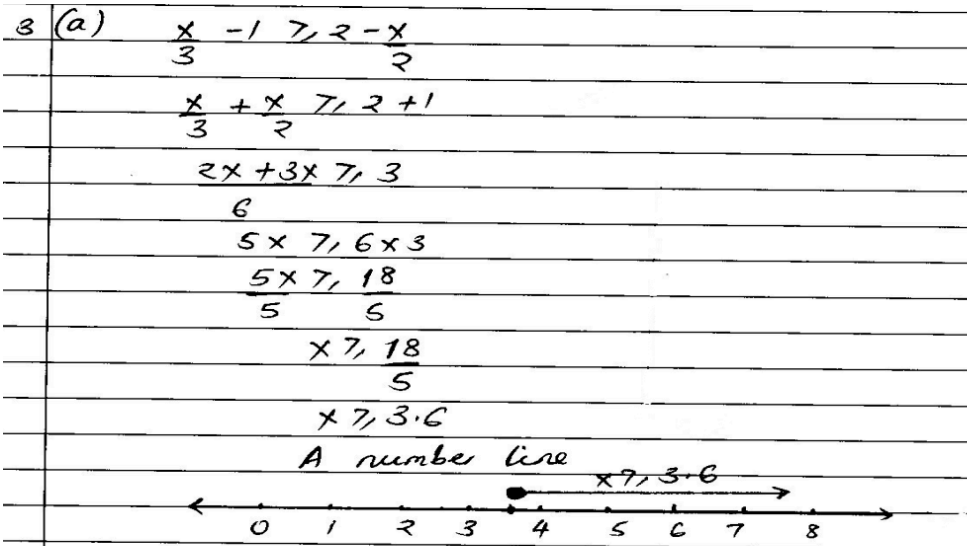
Extract 3.2

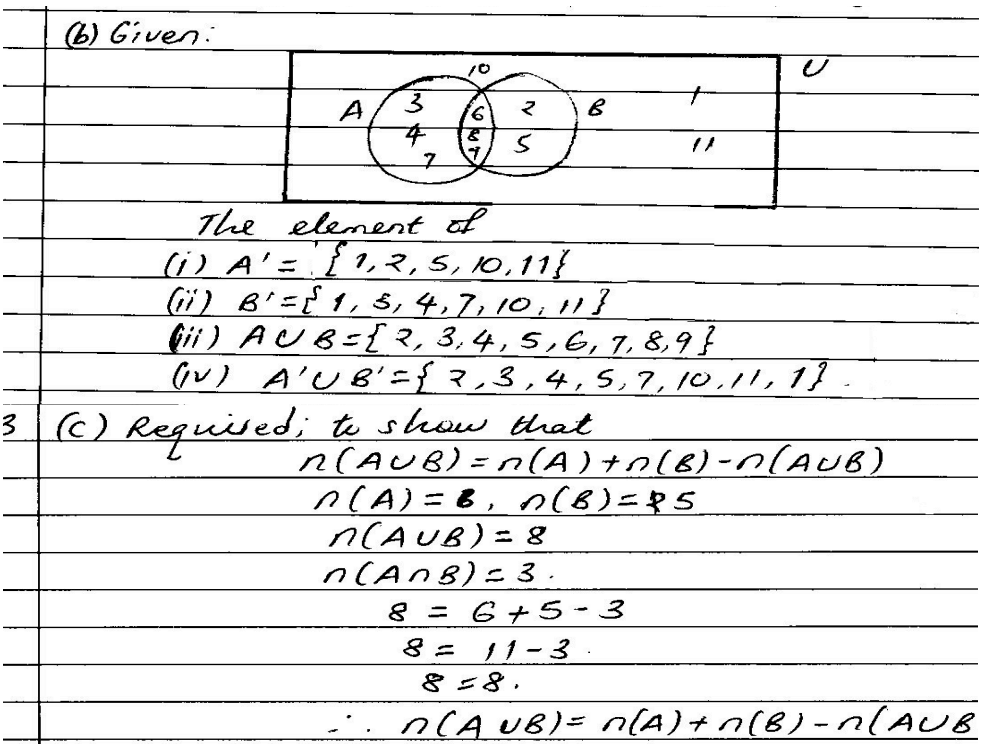


In Extract 3.2, the candidate was unable to find the elements in sets A, B and $A \cup B$ and hence failed to verify the formula.

Few candidates (0.7%) were able to answer this question correctly and scored all the 6 marks. A sample response from one of the scripts showing how the candidates provided correct answers is shown in Extract 3.3.

Extract 3.3





The solution presented in Extract 3.3 illustrates that the candidate had adequate knowledge on solving inequalities and on the concepts of sets.

2.4 Question 4: Vectors and Coordinate Geometry

The question had parts (a) and (b). In part (a), the candidates were given vectors $\underline{a} = 3\mathbf{i} + 2\mathbf{j}$, $\underline{b} = 8\mathbf{i} - 3\mathbf{j}$ and $\underline{c} = 2\mathbf{i} + 4\mathbf{j}$ and they were then instructed to find: (i) the vector $\underline{d} = 3\underline{a} - \underline{b} + \frac{1}{2}\underline{c}$ and (ii) a unit vector in the direction of vector $\underline{d}$. In part (b), they were instructed to find the equation of a line passing at point (6, -2) and it is perpendicular to the line that crosses the x – axis at 3 and y – axis at - 4.

This question was poorly performed as majority of the candidates (93.9%) scored from 0 to 1.5 out of 6 marks and among them, 81.0 percent scored a 0 mark.

Only few candidates were able to answer part (a)(i) correctly. These candidates managed to make correct substitution of the vectors $\underline{a}$, $\underline{b}$ and $\underline{c}$ in the given equation to obtain the vector

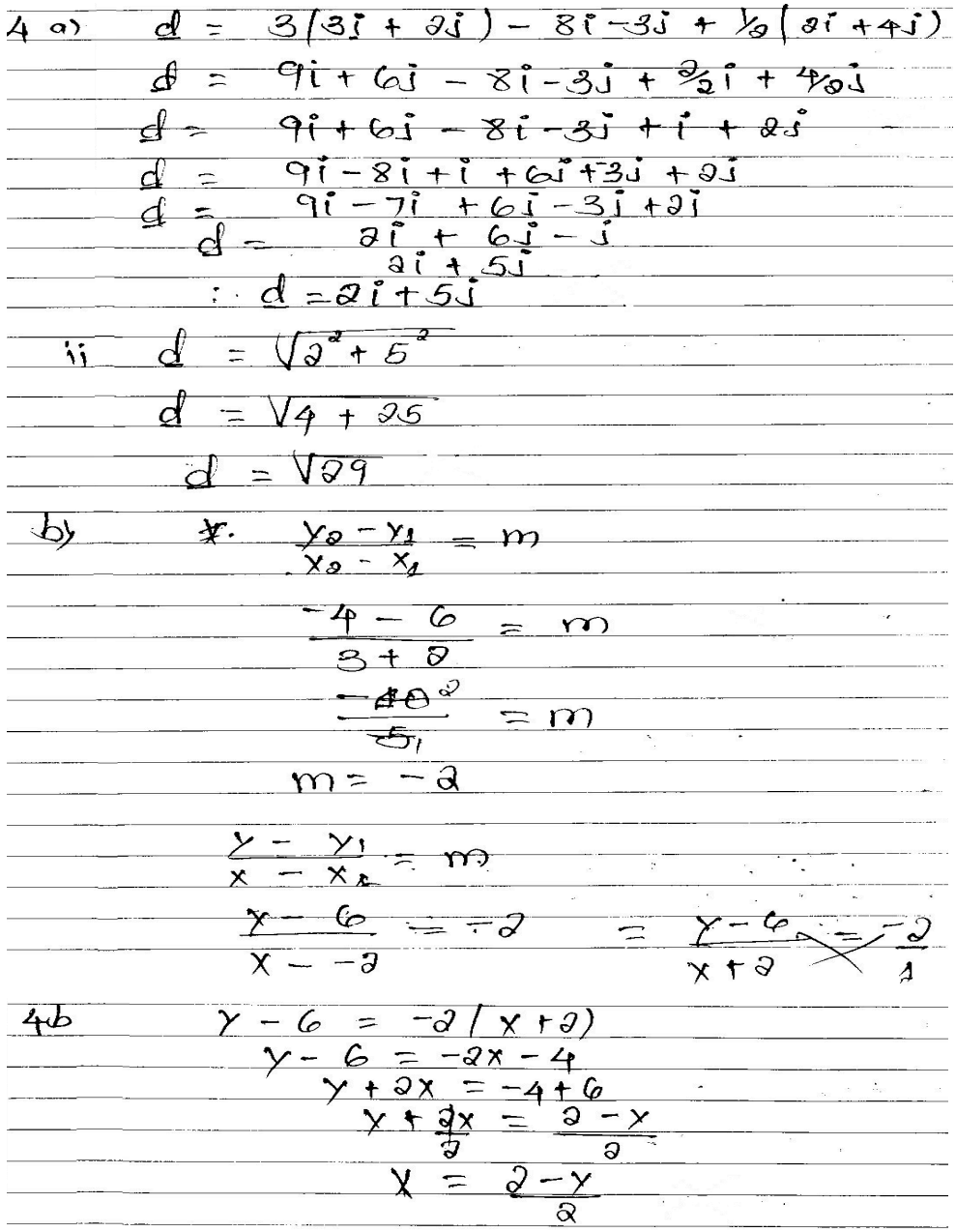
$\underline{d} = 3(3\underline{i} + 2\underline{j}) - (8\underline{i} - 3\underline{j}) + \frac{1}{2}(2\underline{i} + 4\underline{j})$. Then they simplified it further to get the required vector equation $\underline{d} = 2\underline{i} + 11\underline{j}$. It is disappointing to see that a good number of candidates while substituting the vectors $\underline{a}$, $\underline{b}$ and $\underline{c}$ omitted the brackets, a situation that led into an incorrect equation for vector $\underline{d}$. It was noted that several candidates faced difficulties on expanding the brackets for the middle term $-(8\underline{i} - 3\underline{j})$. They expressed this term wrongly as $-8\underline{i} - 3\underline{j}$ instead of $-8\underline{i} + 3\underline{j}$ ending up with incorrect vector $\underline{d}$. It was also observed that many candidates who scored 0 mark in part (a)(i), lacked the basic concepts of multiplying a vector by a scalar and finding the sum/difference of two or more vectors.

Further analysis of the candidates' responses shows that many candidates scored zero in part(a)(ii) because they failed to provide a correct solution in part (a)(i), which was a prerequisite in answering this part. It was noted that several candidates were using incorrect concepts or formulae to determine the magnitude of vector $\underline{d}$. For instance, some candidates were using the formula $|\underline{d}| = x^2 + y^2$ instead of $|\underline{d}| = \sqrt{x^2 + y^2}$ and hence ended up with an incorrect unit vector in the direction of vector $\underline{d}$. It was also observed that some candidates confused between a unit vector with a direction cosine of a vector while a number of candidates were unable to apply the definition of 'unit vector' correctly in finding the required solution.

In part (b), most of the candidates faced difficulties in determining the slope of the perpendicular line. The candidates were unable to write down the x and y intercepts i.e. $(3,0)$ and (0, -4); that were the coordinates in which the line crosses the axes. They wrote down incorrect coordinates and as a result the slope of the perpendicular line calculated was also incorrect. It was noted that a number of candidates were able to identify the coordinates but they could not find the slope of the line joining these points, because they applied incorrect formulae. It was further noted that some candidates were unable to apply the formula $m_1 \times m_2 = -1$ to calculate the slope for a perpendicular line while other candidates were unable to use the definition of gradient to determine the equation of the line

passing through point (6, -2). Extract 4.1 is a sample answer showing some of the difficulties the candidates faced while answering this question.

Extract 4.1



Extract 4.1 shows that the candidate was unable to expand the brackets correctly and hence ended up with an incorrect answer in part (a). In part (b), the candidate calculated the slope wrongly and consequently could not get the correct solution.

Despite the weakness shown, there were few candidates (0.8%) who managed to answer this question correctly and scored all 6 marks. Extract 4.2 is an example of good solution from one of such candidates.

Extract 4.2

4. Soln:

(a) $\underline{a} = 3\underline{i} + 2\underline{j}$

$\underline{b} = 8\underline{i} - 3\underline{j}$

$\underline{c} = 2\underline{i} + 4\underline{j}$.

(i) $\underline{d} = 3\underline{a} - \underline{b} + \frac{1}{2}\underline{c}$

$\underline{d} = 3(3\underline{i} + 2\underline{j}) - (8\underline{i} - 3\underline{j}) + \frac{1}{2}(2\underline{i} + 4\underline{j})$

$\underline{d} = 9\underline{i} + 6\underline{j} - 8\underline{i} + 3\underline{j} + \underline{i} + 2\underline{j}$

$\underline{d} = 2\underline{i} + 11\underline{j}$

$\therefore \underline{d} = 2\underline{i} + 11\underline{j}$

(ii) Soln:

$\underline{d} = 2\underline{i} + 11\underline{j}$

$|\underline{d}| = \sqrt{x^2 + y^2}$

$= \sqrt{2^2 + (11)^2}$

$= \sqrt{4 + 121}$

$= \sqrt{125}$

$= 5\sqrt{5}$

$\frac{\underline{d}}{|\underline{d}|} = \frac{2\underline{i} + 11\underline{j}}{5\sqrt{5}}$

$\hat{\underline{d}} = \frac{2\underline{i}}{5\sqrt{5}} + \frac{11\underline{j}}{5\sqrt{5}}$

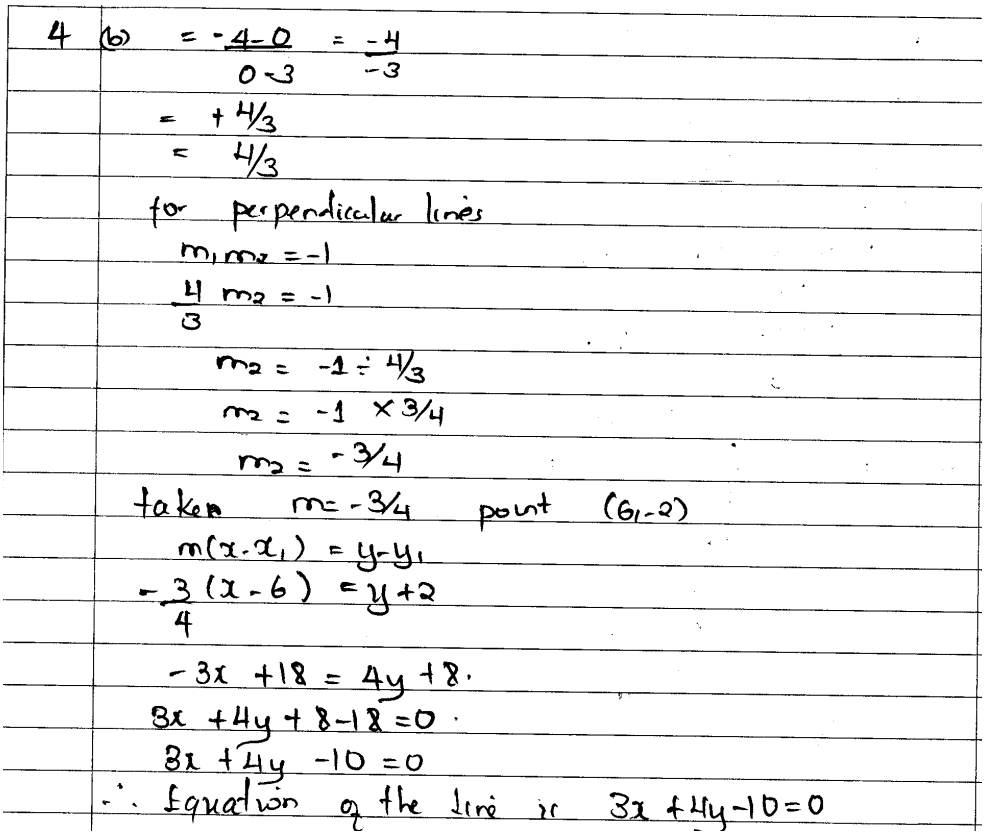
$\therefore$ Unit vector $= \frac{2\underline{i}}{5\sqrt{5}} + \frac{11\underline{j}}{5\sqrt{5}}$

(b) Soln:

x-axis at 3 (3,0)

y-axis at 4 (0,4)

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



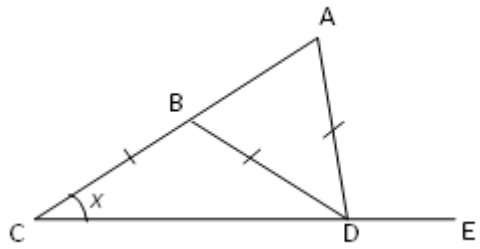
Extract 4.2 shows that, the candidate was able to perform well the basic operations with vectors and had adequate knowledge on the concepts of finding the equation of a straight line.

2.5 Question 5: Areas, Similarity and Geometry

The question was;

(a) A side of one triangle is 10 cm long while the length of the corresponding side of the other triangle is 18 cm. If the given sides are the bases of the triangles and the area of the smaller triangle is 40 cm^2, find the area and the height of the larger triangle.

(b) In the figure below, $\overline{CB} = \overline{BD} = \overline{DA}$ and angle ACD = x.

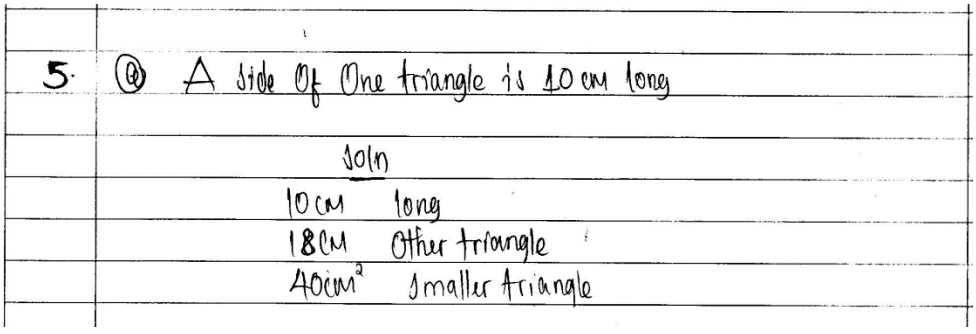


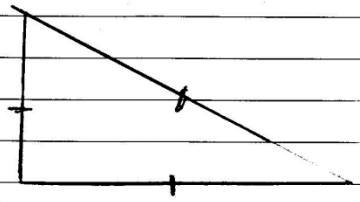
(i) Show that angle ADE = 3x,
(ii) Find the value of angle CDA if $x = 39^{o}$.

In this question, the majority of candidates (97.9%) scored 0 to 1.5 out of 6 marks and among them 92.7 percent scored a zero mark, indicating a poor performance in this question.

In part (a), many candidates were unable to apply the formula relating the area and length of sides of similar triangles i.e. $\frac{A_1}{A_2} = \left(\frac{L_1}{L_2}\right)^2$ where $A_1 : A_2 = 40 : A_2$ and $L_1 : L_2 = 10 : 18$ to find the area and height of the larger triangle. The candidates were using incorrect concepts and formulae and hence lost all the marks for this part. For instance, some candidates were wrongly applying the formula for the ratio of areas and side lengths of similar triangles as $\frac{A_1}{A_2} = \frac{L_1}{L_2}$. Other candidates wrongly used the lengths of 10 cm and 18 cm that were given to find $\text{area} = \frac{1}{2}bh = \frac{1}{2}(10)(18)\text{cm}^2 =$ 90 cm^2. Part (b) was also performed poorly. Many candidates were unable to use the information given on the isosceles triangles CBD and DBA together with the properties of triangles to prove that angle ADE = 3x. Extract 5.1 is a sample answer showing some of the problems the candidates encountered while answering this question.

Extract 5.1



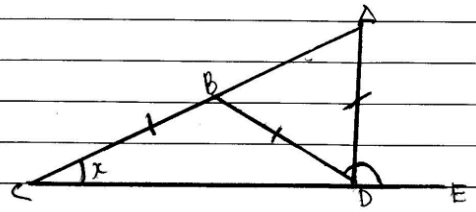


$\underline{10cm} \times 18cm \times \underline{40cm^3} = \underline{180^\circ}$

$\underline{10cm(45^\circ)} \times 18cm(45^\circ)\ 40cm(45) = 180$

$42cm$

(b) In the figure below $\overline{CB} = \overline{BD} = \overline{DA}$ and angle $ACD = x$



(i) Show that angle $ADE = 3x$

soln

$ADE = \overline{DAE} \times \overline{ADE} \times \overline{EAD} = ADE$

$= DAE(45^\circ) \times ADE(45^\circ) \times EAD(45) =$
$'ADE\ 180^\circ$

$= DAE\ 45^\circ \times ADE\ 45^\circ = 90^\circ$
$EAD\ 45 = \underline{180} =$

$= ADE\ \underline{180} \times 3x$

$= 540^\circ$

$\therefore$ The angle $ADE = 540$

(ii) Calculate the Measure of angle CDA if $x = 39^\circ$

$ADC \times DCA \times CAD = CDA$

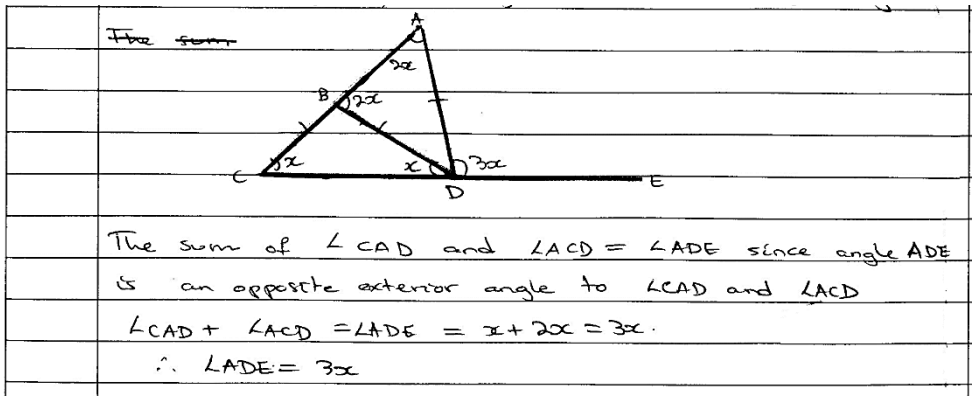
	∠ADC(45°) + ∠DCA(45°) + ∠CAD(45°) = 180°
	45° + 45° + 45° = 180° ∠CDA

In Extract 5.1, the candidate just multiplied the numbers that appeared in the question without understanding the requirements of the question.

Despite the general poor performance observed in this question, there were very few candidates (0.1%) with good responses, which deserved full marks. Extract 5.2 is a sample answer from one of such candidates.

Extract 5.2

5a)	From similarity $\frac{\text{Area 1}}{\text{Area 2}} = \left(\frac{\text{Side 1}}{\text{Side 2}}\right)^2$
	$\frac{40\,cm^2}{\text{Area 2}} = \left(\frac{10cm}{18cm}\right)^2$, let Area 2 be x
	$\frac{40cm^2}{x} = \frac{100cm^2}{324cm^2}$
	$100cm^2 x = 324cm^2 \times 40cm^2$
	$x = \frac{324cm^2 \times 40cm^2}{100cm^2} = \frac{1296}{10}$
	$x = 129.6cm^2$
	∴ Area of larger triangle is $129.6cm^2$
	Area of a triangle $= \frac{1}{2} \times b \times h$, $A = 129.6cm^2$, $B = 18cm$, $H = ?$
	$129.6cm^2 = \frac{1}{2} \times 18 \times h$
	$129.6cm^2 = 9h$
	$h = 14.4cm$
	∴ The height of the larger triangle is 14.4cm.
5b)	Consider triangle CBD and ADB
	∠BCD = ∠BDC ... Base angles of an isosceles triangle
	The sum of these two angles equals to the measure of
	the opposite exterior angle namely ∠ABD
	∠BCD + ∠BDC = ∠ABD = 2x
	∠ABD = ∠BAD ... Base angles of an isosceles triangle



In Extract 5.2, the candidate was able to apply the properties of triangles and that of angles on a straight line to answer the question correctly.

2.6 Question 6: Rates and Variations

The question had two parts; (a) and (b). In part (a), the candidates were notified that variable v varies directly as the square of x and inversely as y. They were instructed to find v when $x = 5$ and $y = 2$; given that when $v = 18$ and $x = 3$ the value of $y = 4$.

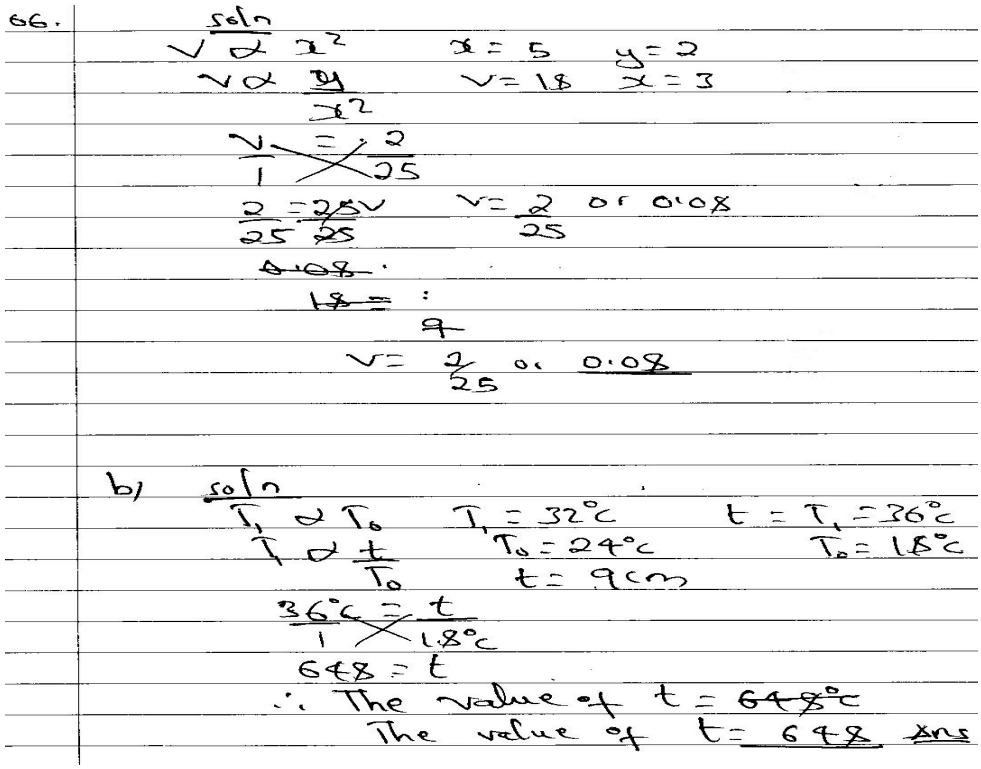
In part (b), they were informed that the temperature (T_i) inside a house is directly proportional to the temperature (T_o) outside the house and is inversely proportional to the thickness (t) of the house wall. They were also given that when $T_i = 32^\circ C$ then $T_o = 24^\circ C$ and $t = 9$ cm. The candidates were then required to find the value of t when $T_i = 36^\circ C$ and $T_o = 18^\circ C$.

In this question, only 13.6 percent of the candidates scored from 2 to 6 marks and among them 4.0 percent scored all the 6 marks, implying that majority of the candidates had inadequate knowledge and skills on rates and variation. The analysis of data also shows that 83.3 percent scored 0 in this question.

In part (a), the majority of the candidates were unable to formulate the variation equation $v \propto \frac{x^2}{y}$ i.e. $v = \frac{kx^2}{y}$ that was the key requirement in answering this part.

Similarly, in part (b), many candidates were unable to formulate the joint variation equation $T_i \propto \frac{T_\circ}{t}$ i.e. $T_i = k\frac{T_o}{t}$ using the given information and as a result they missed all the 3 marks that were allocated for this part. Generally, the candidates lacked knowledge and skills to formulate and solve joint variation equations. Extract 6.1 is a sample answer illustrating this case.

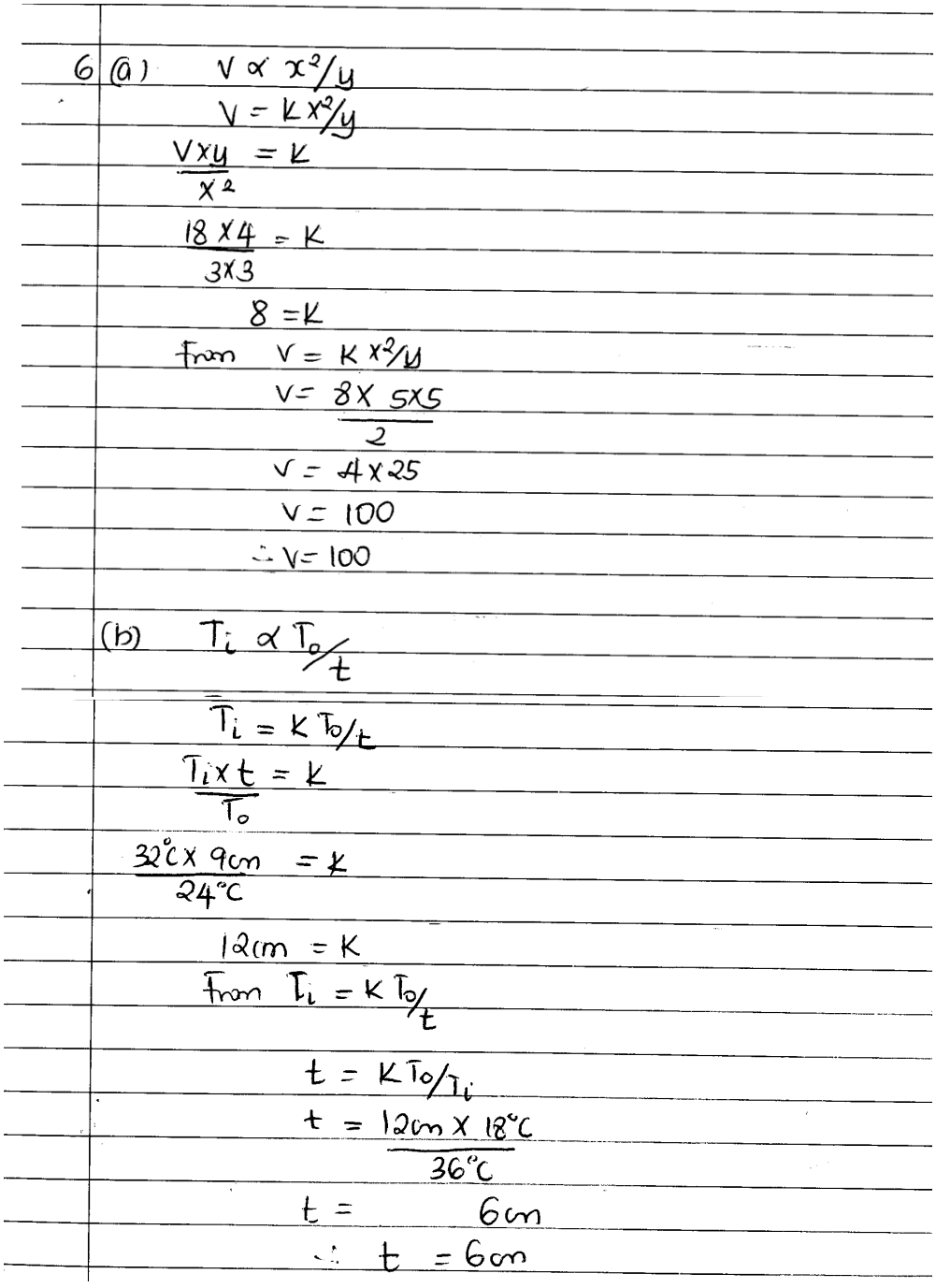
Extract 6.1



In Extract 6.1, the candidate formulated incorrect joint variation equations from the given information. He/she formulated $v = \frac{y}{x^2}$ and $T_1 \alpha \frac{t}{T_o}$ instead of $v = k\frac{x^2}{y}$ and $T_i = k\frac{T_o}{t}$ respectively.

Nevertheless, there were few candidates who answered the question correctly. Extract 6.2 is a sample answer from one of such candidates.

Extract 6.2



Extract 6.2 shows that the candidate formulated the required joint variation equations and applied them correctly in finding the required solution.

2.7 Question 7: Fractions, Ratios, Profit and Loss

The question had parts (a) and (b). In part (a), the candidates were informed that a shopkeeper makes a 20% profit by selling a radio for sh. 480,000. They were then instructed to find (i) the ratio of the buying price to the selling price and (ii) the percentage loss if the radio would be sold at sh. 360,000.

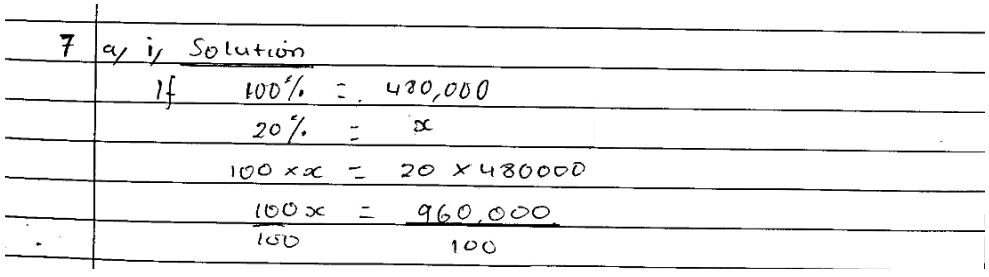
In part (b), they were notified that a farmer sold a quarter of his maize harvest and gave one third of the remaining to his relatives. They were instructed to find how many bags of maize the farmer harvested if he/she remained with 25 bags of maize.

This question was also poorly performed as 97.6 percent of the candidates scored from 0 to 1.5 out 6 marks with 95.7 percent of them scoring a 0.

In part (a)(i), many candidates were unable to identify the requirements of the question and as a result failed to provide the required solution. They could not translate the question mathematically either as $\frac{480{,}000 - x}{x} = \frac{20}{100}; \; x + 0.2x = 48{,}000$ or $\begin{matrix} 120\% & \rightarrow 480{,}000 \\ 100\% & \rightarrow x \end{matrix}$, where x is the buying price of the radio. This was an essential step in determining the ratio of buying and selling price as required.

Part (a)(ii) was also poorly performed. The poor performance in this part was due to the fact that some candidates substituted in the formula $\text{Percentage loss} = \frac{\text{buying price} - \text{selling price}}{\text{buying price}} \times 100\%$, the value of the buying price obtained in part (a)(i) which was incorrect. Other candidates were unable to interpret the question in order to identify the demands and the approprite formula to be used. Extract 7.1 is a sample answer taken from the script of one of the candidates to show how they failed to answer this question.

Extract 7.1



$x = 9600$

470400
480,000

∴ The ratio will be $\frac{470400}{480,000}$

7a ii/ Solution

If 100% = 480,000
x ? = 360,000

$480,000 \times x = 360,000 \times 100$

$\frac{480000x}{480000} = \frac{36000000}{480000}$

$x = 75\%$

$100\% - 75\% = 25\%$

∴ The percentage loss will be 25%.

7b/ Solution

$\frac{4}{4} \quad \frac{1}{4} \quad \frac{1}{3}$

$\frac{1}{4} + \frac{1}{3} - \frac{3+4}{12} = \frac{7}{12}$

$\frac{12}{12} - \frac{7}{12} = \frac{5}{12}$ remaining bags

If $\frac{5}{12} = 25$
$\frac{12}{12} = ? x$

$\frac{5}{12} \times x = \frac{12}{12} \times 25$

$12 \times \frac{5}{12} x = \frac{12}{12} \times 25 \times 12$

$5x = 12 \times 300$

$\frac{5x}{5} = \frac{3600}{5}$

$x = 720$

$x = 720$

∴ The farmer harvested 720 bags.

In Extract 7.1, the candidate represented the given information wrongly as $\begin{matrix}100\% & \rightarrow 480{,}000 \\ 20\% & \rightarrow x\end{matrix}$ instead of $\begin{matrix}120\% & \rightarrow 480{,}000 \\ 100\% & \rightarrow x\end{matrix}$ and as a result obtained incorrect answers in both parts (a)(i) and (ii).

In part (b), most of the candidates were unable to interpret the given information mathematically as:

Fraction of maize sold = $\frac{1}{4}$

Remained fraction = $1-\frac{1}{4}=\frac{3}{4}$

Fraction given to the relatives = $\frac{1}{3}\times\frac{3}{4}=\frac{1}{4}$

Fraction remained with the farmer = $\frac{3}{4}-\frac{1}{4}=\frac{1}{2}$

Thus, $\frac{1}{2}$ gives 25 bags and the total harvest = $25\times 2 = 50$ bags.

Failure of many candidates to provide appropriate solutions is an indicator that they lacked knowledge and skills of solving word problems involving fractions.

Nevertheless, there were few candidates (0.3%) who were able to give fully correct solutions with a variety of methods. Extract 7.2 is an example of such a solution.

Extract 7.2

7 (a).

B. P ——× 100%

480,000 ——→ 120%

$B.P = \frac{480{,}000 \times 100}{120}$

Buying price = 400,000

Ratio of buying price to selling price

$= \frac{B.P}{S.P}$

$= \frac{400,000}{480,000}$

$= \frac{5}{6}$

$= 5/6$

ii) 400,000 ⟶ 100.

360,000 ⟶ x.

$x = \frac{360,000 \times 100}{400,000}$

Percentage loss = 100 − 90

= 10%

= 10%

b) Soln.

let his maize harvest be y.

$\frac{1}{4}y + \frac{1}{2}(\frac{3}{4} \times \frac{1}{3})y = y - 25$

$\frac{1}{4}y + \frac{1}{4}y = y - 25$

$\frac{1}{2}y = y - 25$

$25 = \frac{1}{2}y$

$y = 50$

In Extract 7.2, the candidate was able to recall and apply the formula for percentage profit correctly and translated the word problem into an equation which he/she solved accurately.

2.8 Question 8: Sequence and Series

This question had parts (a) and (b). In part (a), the candidates were required to find the number of terms of the series $3+6+9+12+...$ needed for the sum to be 630. In part (b), they were notified that Jenifer saved sh. 6 million in a Savings Bank whose interest rate was 10% compounded annually. They were then instructed to find the amount of money in the account after 5 years.

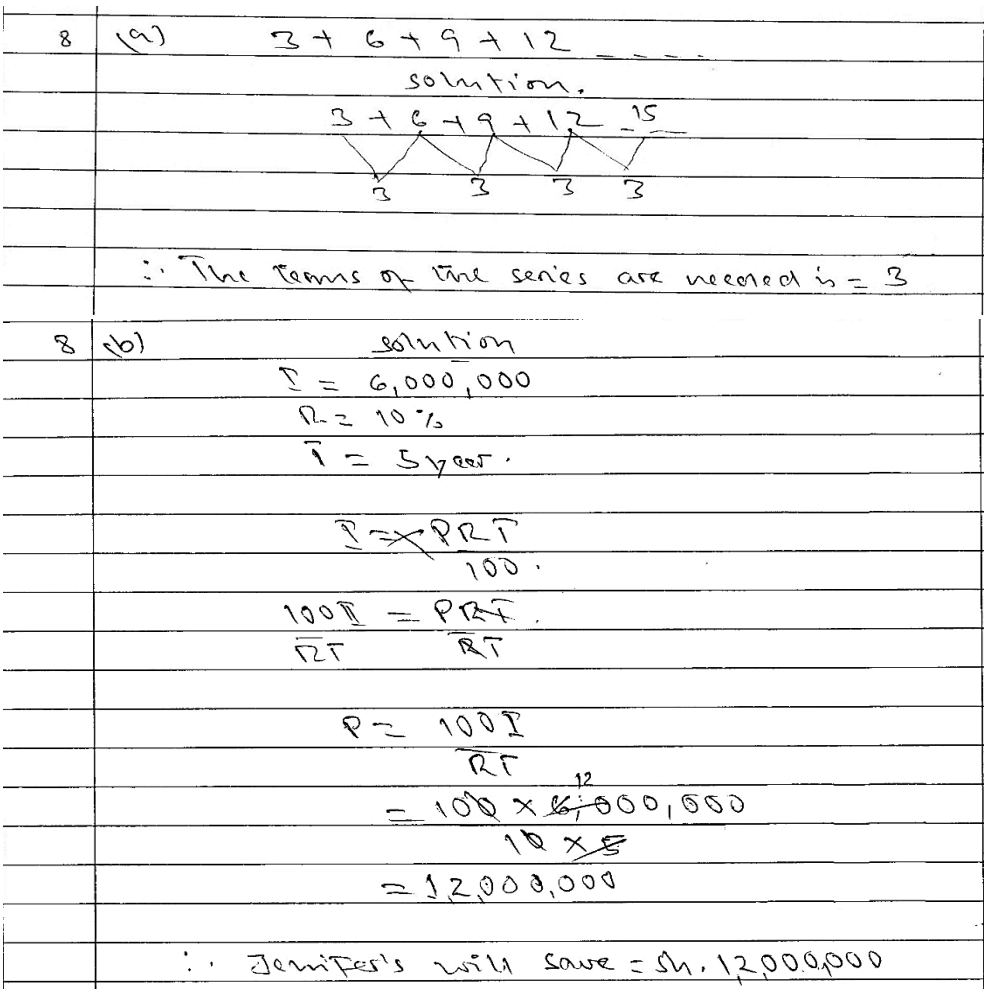
The question was poorly performed since many candidates (95.3%) scored from 0 to 1.5 out of 6 marks and among them 89.7 scored a 0.

In part (a), many candidates were unable to recall and apply the formula for the sum of n terms in an arithmetic progression i.e. $S_n = \frac{n}{2}(2a+(n-1)d)$ to get the equation $630 = \frac{n}{2}(2\times 3+(n-1)\times 3)$ that they would solve for n which was the required number of terms. Some candidates inserted the values correctly in the formula but then did not remember to put the brackets resulting in incorrect equation and an incorrect value of n. Analysis of the candidates' responses also revealed that the majority were able to substitute the values and put the brackets correctly but failed to expand them and simplify the equation in order to obtain the quadratic equation $n^2+n-420=0,$ which was necessary in getting the required answer. These candidates lacked algebraic skills. Some of those who managed to obtain this simplified quadratic equation failed to get the required value of $n = 20$ because of either sign or computational errors, or failure to apply correctly the methods of solving it. Other candidates confused between 'number of terms' and 'sum of terms'. The candidates in this category were adding the first few terms that were given or performed meaningless calculations instead of finding the required number of terms.

In part (b), many candidates were unable to apply correctly the formula $A_n = P\left(1+\frac{r}{100}\right)^n$ to find the amount of money in the savings account. Some used incorrect values of r and n while others wrote the formula wrongly. Further analysis of the candidates' responses shows that some

candidates used the simple interest formula $I = \frac{PRT}{100}$ and other formulae that were not related to the demands of the question. Extract 8.1 is a sample answer showing some of the difficulties the candidates faced while answering this question.

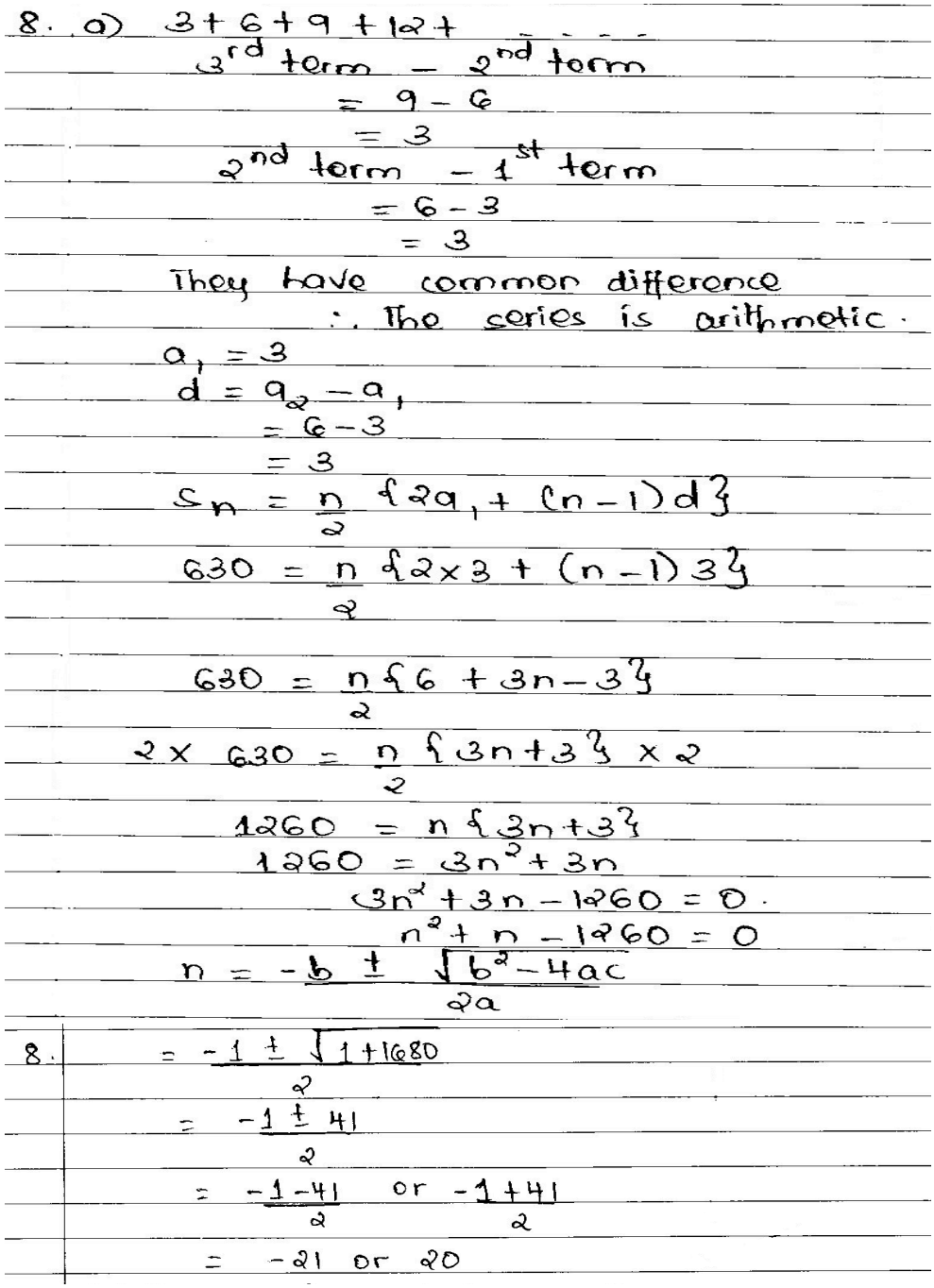
Extract 8.1

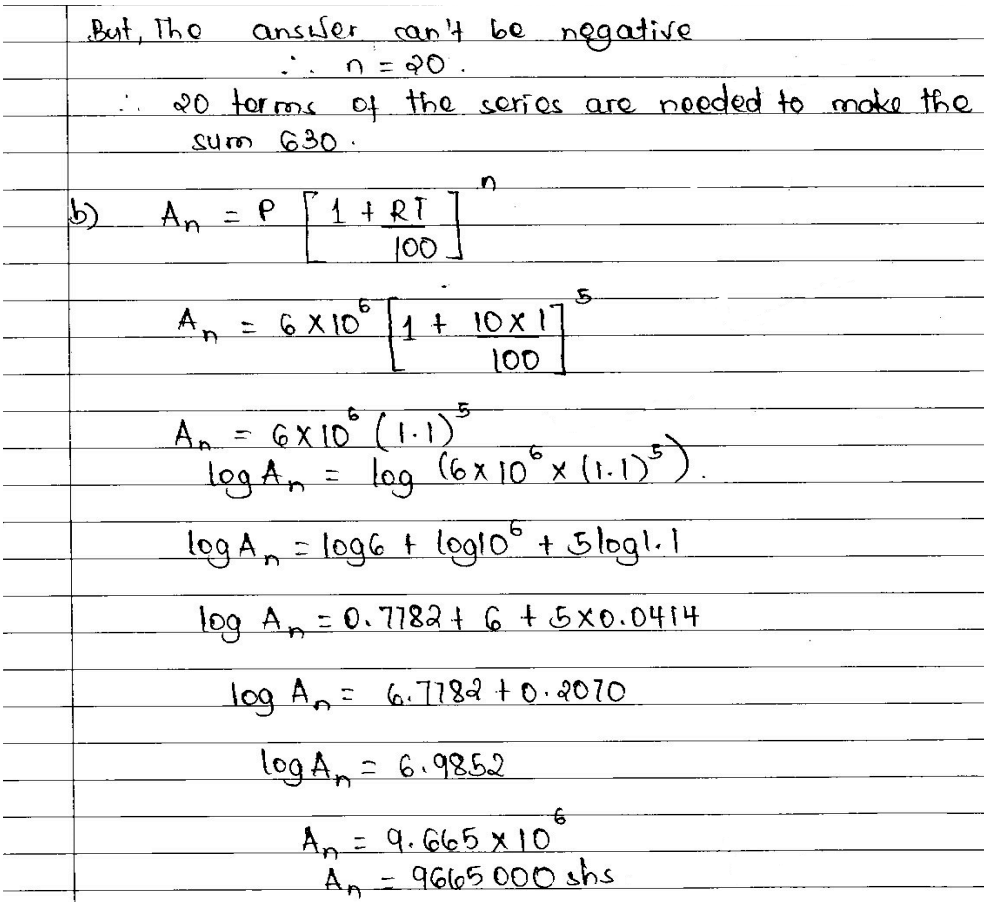


In Extract 8.1, the candidate did not understand the requirements of the question in part (a). Instead of finding the number of terms, the candidate found the common difference between the terms. In part (b), the candidate used the simple interest formula $I = \frac{PRT}{100}$ instead of the compound interest formula $A_n = P\left(1 + \frac{r}{100}\right)^n$.

Only 840 out of 383,875 candidates who answered this question managed to score all the 6 marks. Extract 8.2 is a sample answer illustrating the strengths that were shown by these candidates.

Extract 8.2





In Extract 8.2, the candidate was able to recall and apply the formula for the sum of n terms of an arithmetic progression and that of compound interest correctly.

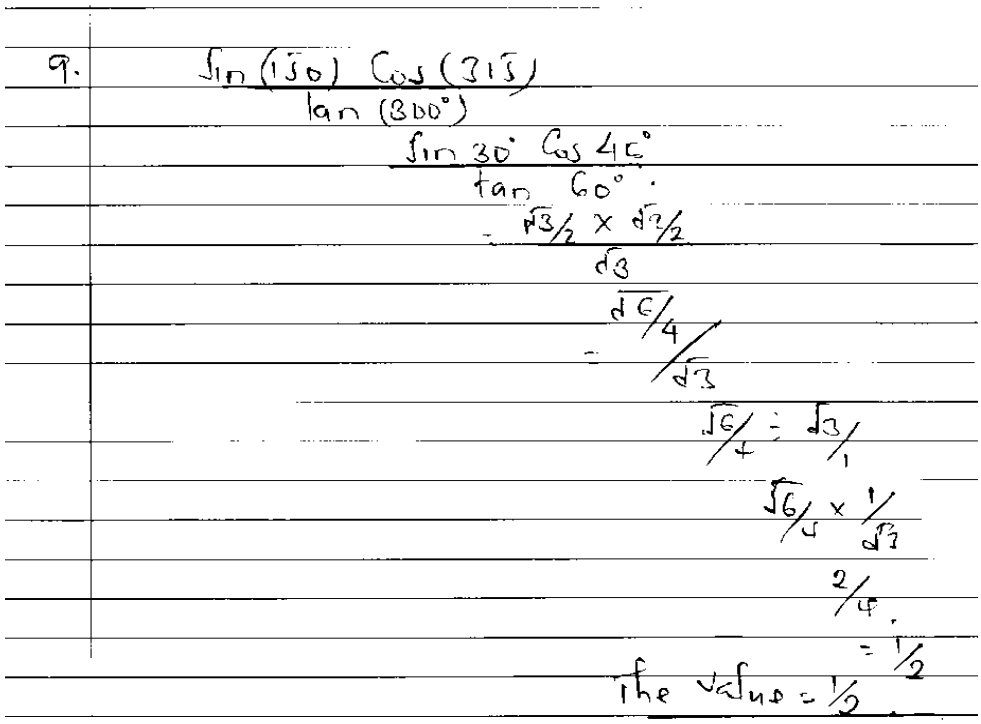
2.9 Question 9: Trigonometry

This was the worst performed question where 99.3 percent of the candidates scored below 2 out of 6 marks and among them 98.3 percent scored a 0.

In part (a), the candidates were instructed to find the value of $\frac{\sin(150^o)(\cos 315^o)}{\tan(300^o)}$ without using mathematical tables. Many candidates lacked knowledge on determining the sine, cosine and tangent of special angles which are greater than 90 degrees. Several candidates substituted incorrect trigonometrical ratios in the given expression and ended up with a wrong final answer. Extract 9.1 illustrates this case. However, there were

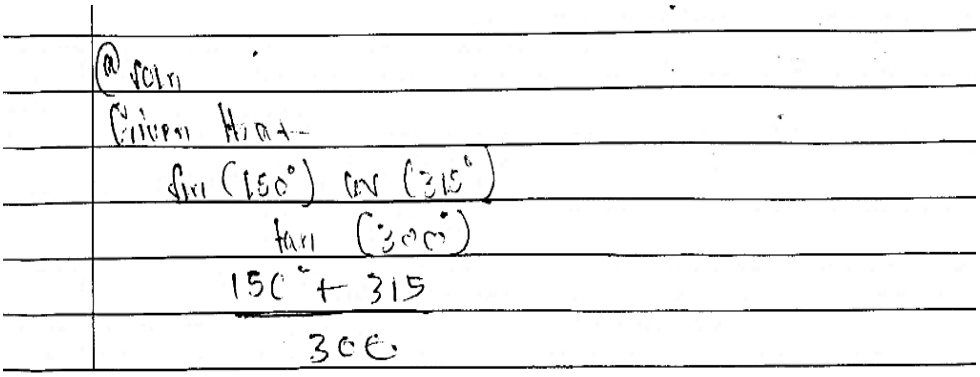
few candidates who substituted the correct values of trigonometric ratios in the given expression but failed to obtain the final correct answer because they were unable to perform accurate computations. Some candidates wrote answers which were outside the scope of the question. For example, a number of candidates ignored sin, cos and tan in the expression $\frac{\sin(150^o)(\cos 315^o)}{\tan(300^o)}$ and hence evaluated $\frac{150° \times 315°}{300°}$ wrongly. Other candidates picked the figures in the question and performed meaningless calculations (see Extract 9.2).

Extract 9.1



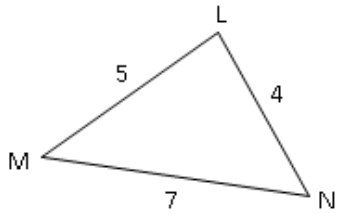
In Extract 9.1 the candidate substituted the value of $\sin 150°$ as $\frac{\sqrt{3}}{2}$ instead of $\frac{1}{2}$ and the value of $\tan 300°$ as $\sqrt{3}$ instead $-\sqrt{3}$, hence ended up with the final incorrect answer.

Extract 9.2



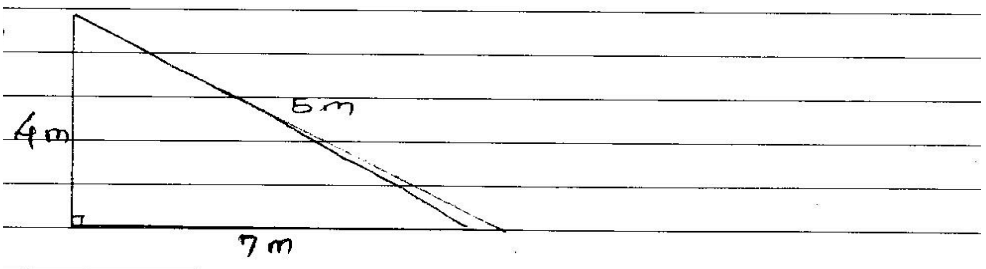
Extract 9.2 shows that the candidate lacked understanding on the meaning of trigonometric ratios.

In part (b), the candidates were required to calculate angles L, M and N in the following triangle.



This part was also poorly performed. Majority of the candidates did not recognize that they were supposed to apply either the cosine rule to find the values of two angles or use the cosine rule to find the value of one angle and the sine rule to find the value of the second angle. The value of third angle was to be obtained from the fact that the sum of the degrees of the angles in a triangle is 180 degrees. Extract 9.3 is a sample answer showing how the candidates failed to answer this question.

Extract 9.3



$\frac{1}{2} \times bh$

$= \frac{1}{2} \times 4m \times 5m \times 7m$

$= \frac{1}{2} \times 4m^2 \times 5m \times 7m$

$= 2m \times 5m \times 7m$

$= 10m^2 \times 7m$

$= 70m^2$ $= 70m^2$

In Extract 9.3, the candidate wrongly considered the triangle as right angled triangle and computed its area instead of calculating the angles of the triangle as required.

Although the performance was generally poor, 129 candidates managed to score all the 6 marks that were allocated for this question. Extract 9.4 shows work of one of the candidates who answered this question correctly.

Extract 9.4

9a. soln.

$\frac{\sin(150°)\cos(315°)}{\tan(300°)}$

Where

$\sin 150° = \sin 30°$

$\cos 315° = \cos 45°$

$\tan 300° = -\tan 60°$

Then

$\sin 30° = \frac{1}{2}$

$\cos 45° = \frac{\sqrt{2}}{2}$

$-\tan 60° = -\sqrt{3}$

Substituting

$\frac{\frac{1}{2} \times \frac{\sqrt{2}}{2}}{-\sqrt{3}}$

$= \frac{\frac{\sqrt{2}}{4}}{-\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

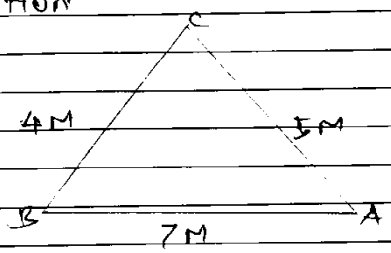
$= \frac{\frac{\sqrt{6}}{4}}{-3}$

$= \frac{\sqrt{6}}{4} \times \frac{1}{-3}$

$= -\sqrt{6}/12.$

∴ The value is $-\sqrt{6}/12.$

b. solution



9b. From,

$A^2 = B^2 + C^2 - 2CB\cos A$

$4^2 = 5^2 + 7^2 - 2(5 \times 7 \times \cos A)$

$16 = 25 + 49 - 70\cos A$

$16 = 74 - 70\cos A$

$70\cos A = 74 - 16$

$70\cos A = 58$

$\frac{70}{70} \quad \frac{}{70}$

$\cos A = 0.8285$

$A = \cos^{-1} 0.8285$

$A = 34^\circ 4'$

$B^2 = A^2 + C^2 - 2AC\cos B$

$5^2 = 4^2 + 7^2 - 2(4 \times 7\cos B)$

$25 = 16 + 49 - 56\cos B$

$25 = 65 - 56\cos B$

$56\cos B = 65 - 25$

$56\cos B = 40$

$\cos B = 0.7143$

$B = 44^\circ 24'$

$C = 180 - (A + B)$

$= 180 - (34^\circ 4' + 44^\circ 24')$

$= 180 - 78^\circ 28'$

$= 101^\circ 32'$

∴ The angles are

$101^\circ 32', \quad 44^\circ 24', \quad 34^\circ 4'$

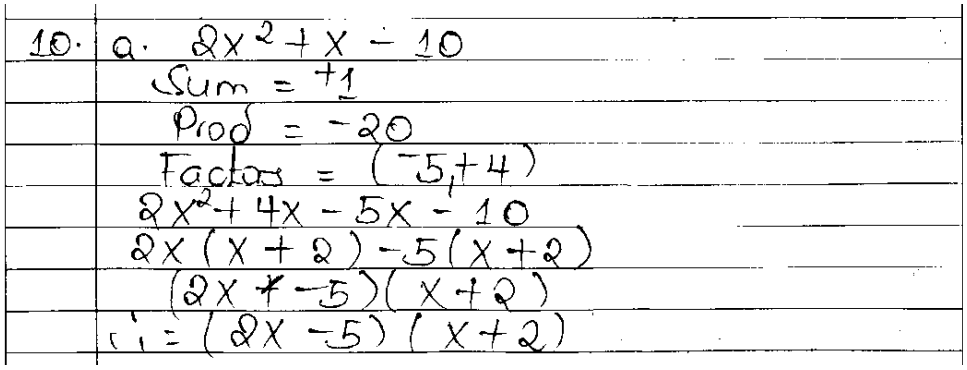
Extract 9.4 shows that the candidate was able to perform calculations related to special angles, apply the cosine rule and properties of triangles in answering the given question correctly.

2.10 Question 10: Quadratic Equations

Nearly all candidates answered this question, in which 88.2 percent scored 0 and only 7.3 percent scored from 2 to 6 marks. The question was therefore poorly performed.

In part (a), many candidates were ignorant of the factorization method by splitting the middle term as they provided solutions that were not related to the demands of the question. It is disappointing to note that some candidates equated the given quadratic expression with 0 and then solved it for x using various methods such as the quadratic formula, contrary to the requirements of the question. In factorizing the given expression by using the method of splitting the middle term, the candidates were supposed to identify two numbers whose sum is 1 and its product is -20. Through this condition, the two numbers were supposed to be 5 and -4 and therefore the required factorized expression would be $(x-2)(2x+5)$. Further analysis on candidates' responses revealed that, some candidates picked numbers that did not meet the condition stated and consequently ended up with incorrect factors. Extract 10.1 is a sample answer from one of the candidates illustrating this case.

Extract 10.1

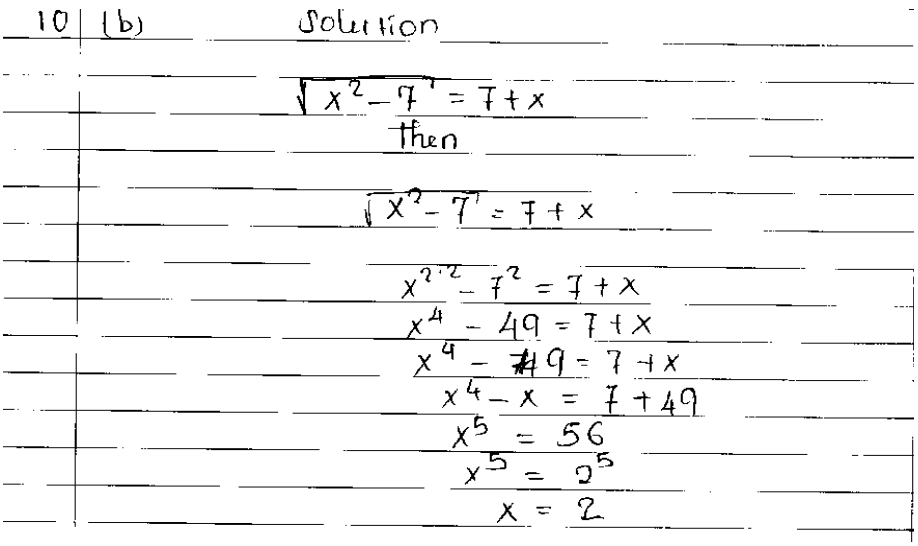


In Extract 10.1, the candidate failed to realize that the sum of -5 and 4 is -1 and not 1 and as a result ended up with the factorized expression $(x+2)(2x-5)$ instead of $(x-2)(2x+5)$.

Part (b) which was on solving the equation $\sqrt{x^2-7} = 7+x$ was also poorly performed. Many candidates failed to determine the value of x as they could not remove the radical sign from the given equation. In answering

this question, the candidates were supposed to square both the left and right hand side of the given equation to obtain the equation $x^2 - 7 = 49 + 14x + x^2$, which they would simplify and solve to get the required value of x. The analysis of candidates' response also indicates that most of the candidates ignored the radical sign and hence changed the question (see Extract 10.2). Other candidates provided meaningless solutions indicating lack of knowledge on how to solve quadratic equations.

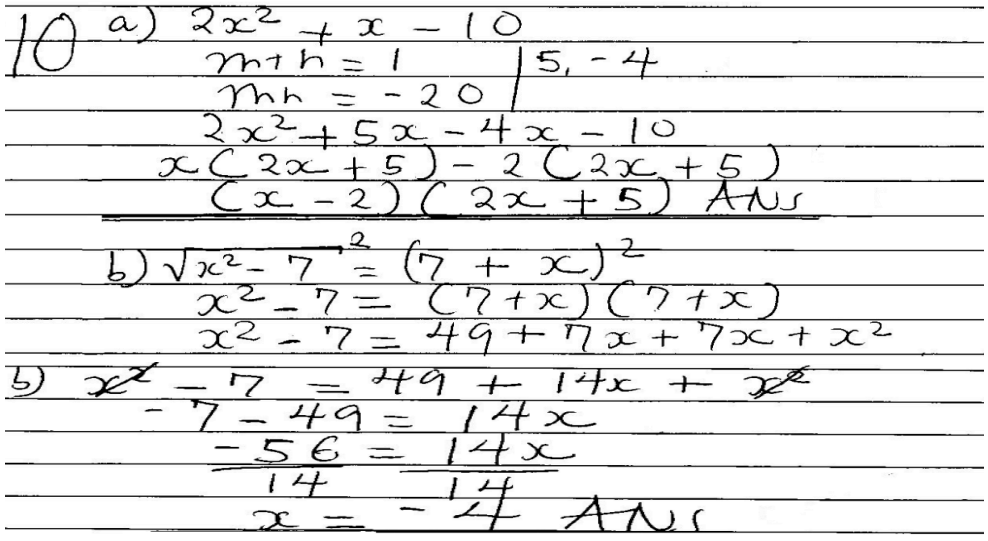
Extract 10.2



In Extract 10.2, the candidate removed the radical sign wrongly and consequently ended up with an incorrect solution.

Despite the poor performance in this question, few candidates (1.5%) picked up all the 6 marks. A sample answer from one of the candidates who answered the question correctly is shown in Extract 10.3.

Extract 10.3



In Extract 10.3, the candidate was able to factorize the quadratic expression as required and solved the given equation correctly.

2.11 Question 11: Linear Programming

The question was:
A small industry makes two types of clothes namely type A and type B. Each type A takes 3 hours to produce and uses 6 meters of material and each type B cloth takes 6 hours to produce and uses 7 meters of material. Workers can work for a total of 60 hours and there is 90 meters of material available. The profit on a type A cloth is 4,000/= shillings and on a type B is 6,000/= shillings. Find the number of clothes of each of types A and B that should be made in order to maximize profit.

This question was generally well answered with 53.6 percent of the candidates scoring from 3 to 10 marks and among them 5.5 percent gained all the 10 marks.

The candidates who scored highly were able to translate the linear programming problem into correct inequalities for the constraints and the objective function. They also managed to draw correct graphs representing the formulated inequalities. Furthermore, they managed to identify the corner points for the feasible region thus giving the correct solution. Extract

11.1 is a sample answer from one of the candidates who did well in this question.

Extract 11.1

11. Soln

Let; x – be number of clothes of type A made
y - be number of clothes of type B made

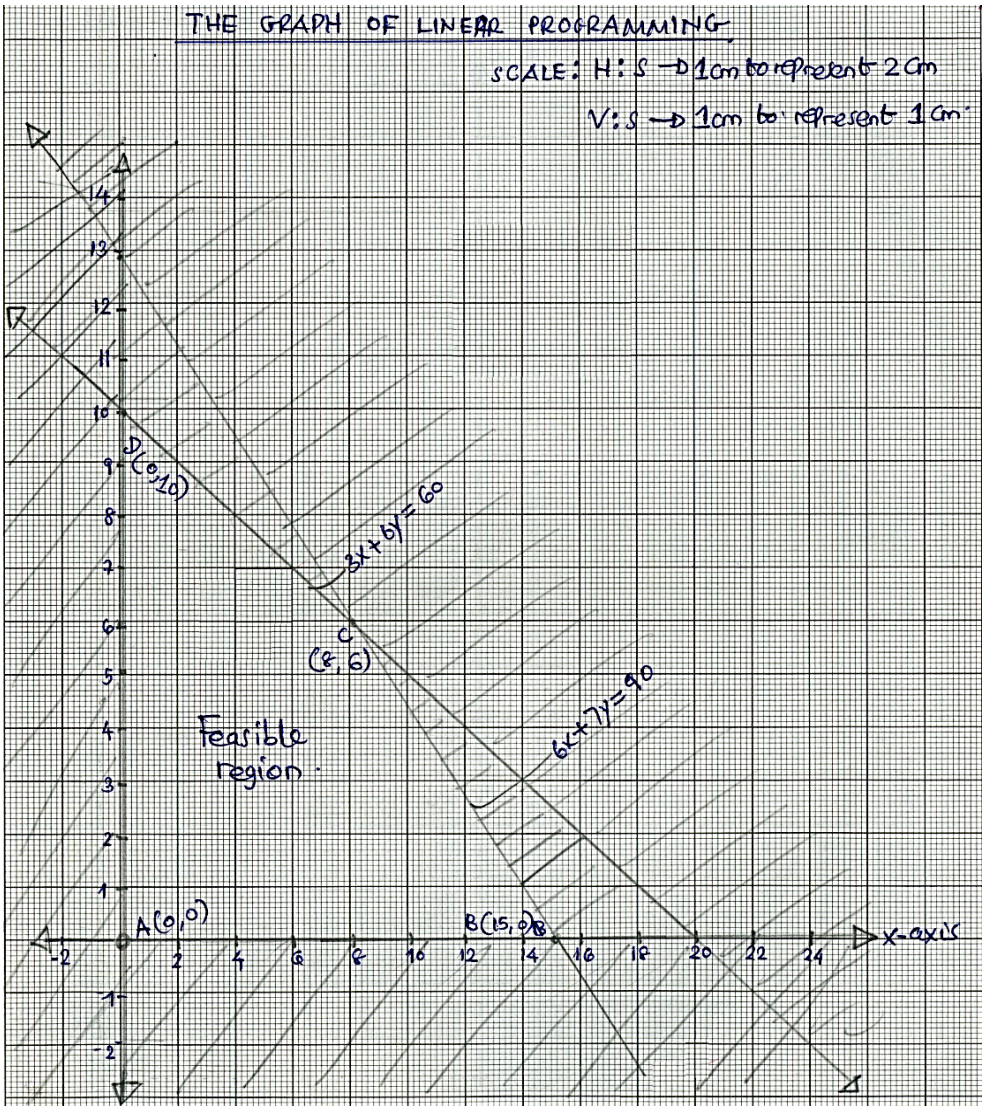
	Hours	Materials	Profit
Type A	3	6	4,000
Type B	6	7	6,000
Total	60	90	

Inequality	Equation
$3x + 6y \leq 60$	$3x+6y = 60$ (0,10) (20,0)
$6x + 7y \leq 90$	$6x+7y = 90$ (0,12.9) (15,0)
$x \geq 0$	$x = 0$
$y \geq 0$	$y = 0$

$f(x, y) = 4,000x + 6,000y$

Corner points (x, y)	$F(x, y) = 4,000x + 6,000y$	Results
A (0, 0)	$F(0, 0) = 4,000(0) + 6,000(0)$	0
B (15, 0)	$F(15, 0) = 4,000(15) + 6,000(0)$	60, 000
C (8, 6)	$F(8, 6) = 4,000(8) + 6,000(6)$	68, 000
D (0, 10)	$F(0, 10) = 4,000(0) + 6,000(10)$	60, 000

∴ For maximum profit; An Industry must make 8 clothes of type A and 6 clothes of type B.



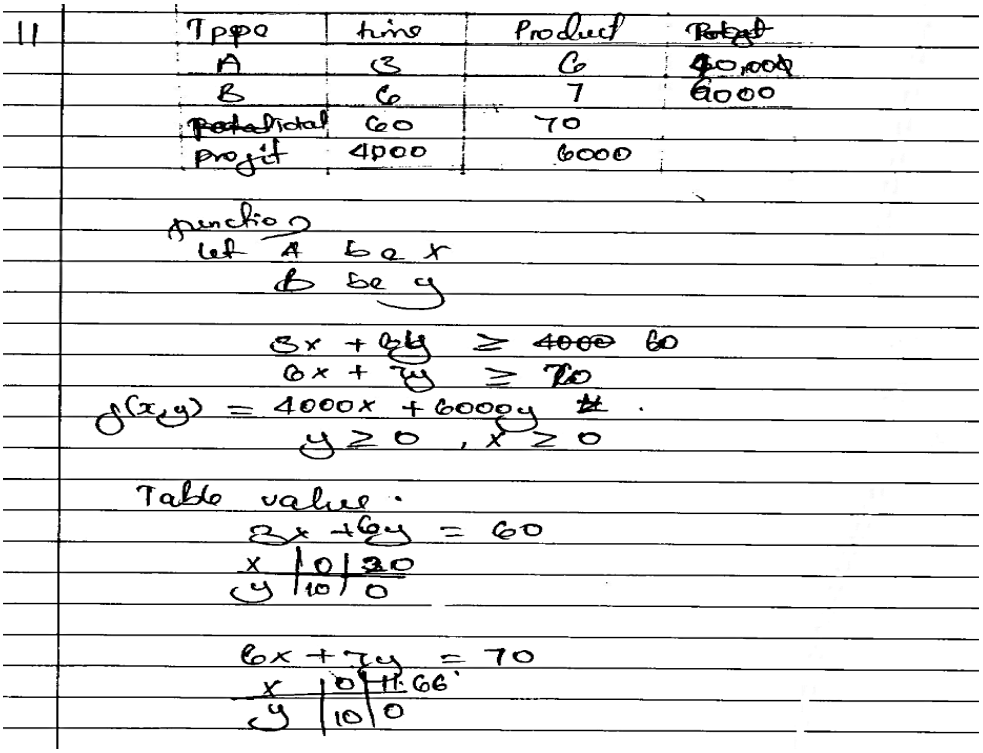
Extract 11.1 shows that the candidate was able to apply knowledge and skills of linear programming to solve the given simple real life problem correctly.

Further analysis revealed that several candidates formulated the constraints and the objective correctly but failed to plot the graphs for the inequalities and hence unable to indicate the feasible region. Most of these candidates earned from 4 to 5 marks.

On the other hand, the analysis of candidates' responses indicates that 33.9 percent of the candidates who scored a zero, were unable to define the decision variables; translate the given linear programming problem into inequalities and to determine the coordinates for the feasible region.

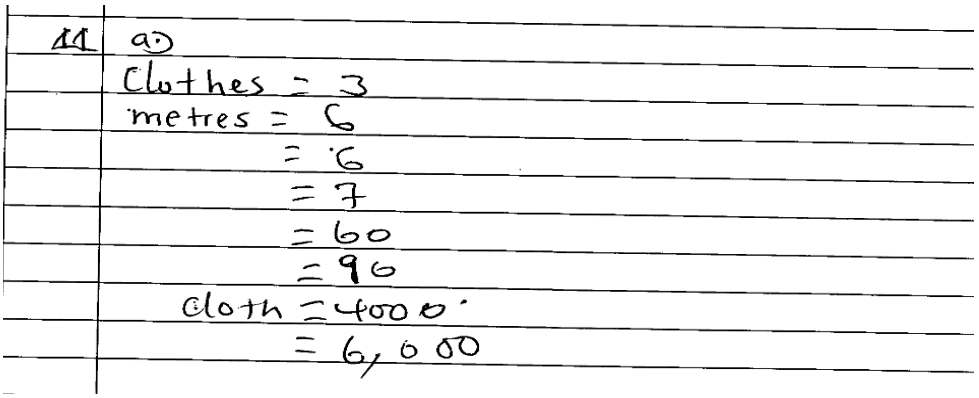
Generally these candidates lacked knowledge and skills on solving linear programming problems. Extracts 11.2 and 11.3 illustrate how these candidates failed to answer this question.

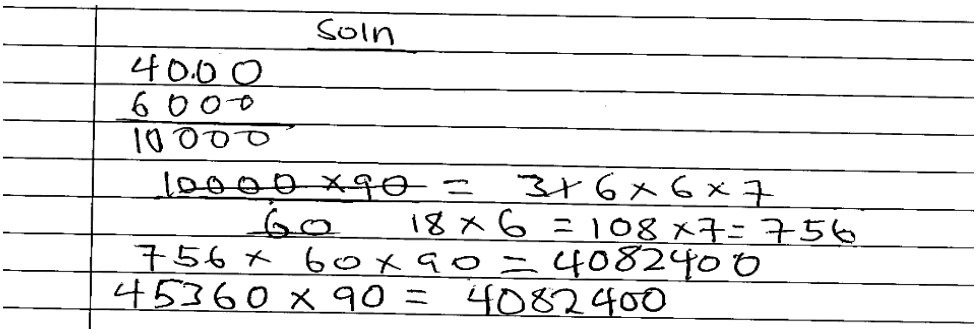
Extract 11.2



Extract 11.2 shows that the decision variables are not correctly defined and also the inequalities for the constraints are not correctly formulated.

Extract 11.3





In Extract 11.3, the candidate performed calculations which are not related to the demands of the question indicating poor understanding on the tested concepts of Linear Programming.

2.12 Question 12: Statistics

In this question, the candidates were given the marks obtained by 32 students in a Physics examination and were instructed to: (a) prepare a frequency distribution table using the class intervals: 24 – 29, 30 – 35 etc.; (b) draw the histogram; (c) draw the cumulative frequency curve and use it to estimate the median and (d) find the mean mark.

The question was opted by 73.2 percent of the candidates, in which 29.9 percent scored from 3 to 10 marks indicating an average performance in this question.

The analysis of data shows that only 1,075 (0.3%) candidates scored all the 10 marks. The candidates in this category were able to prepare the frequency distribution tables from the given data, draw well labelled graphs for the histogram and the cumulative frequency curve, estimate the median from the cumulative curve and computed the mean mark as required. Extract 12.1 illustrates this case.

Extract 12.1

12. (a)

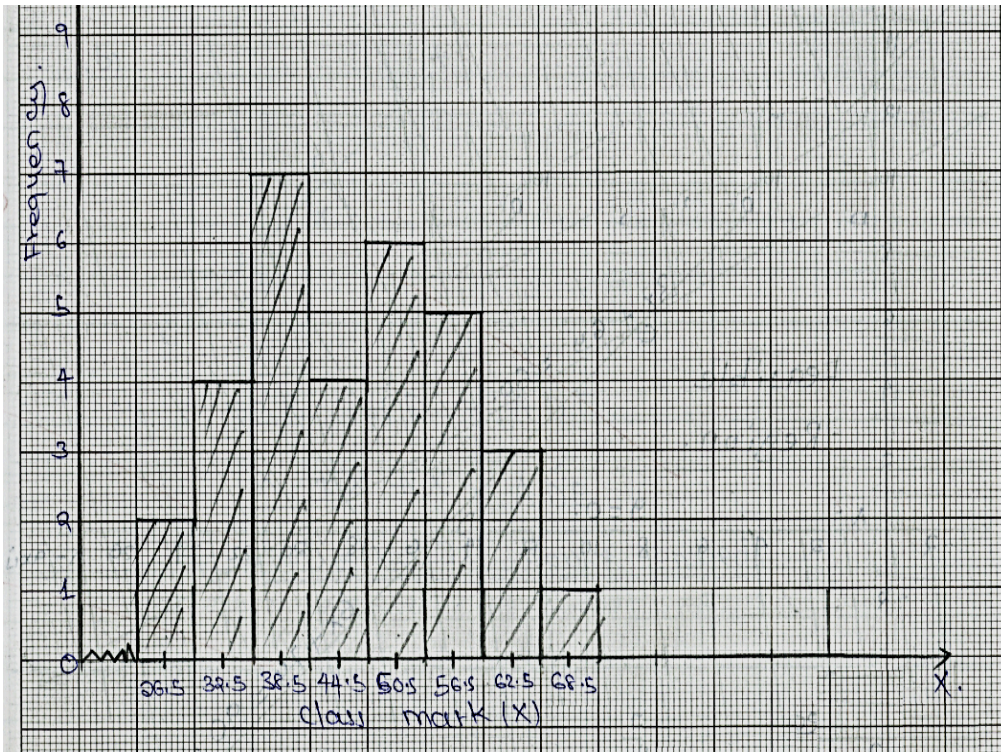
class Interval	class mark (x)	f	f(x)	Tallies	upper class limit boundary	cumulative frequency
24 – 29.	26.5	2	53.0	II	29.5	2
30 – 35	32.5	4	130.0	IIII	35.5	6
36 – 41.	38.5	7	269.5	HH II	41.5	13
42 – 47.	44.5	4	178.0	IIII	47.5	17
48 – 53.	50.5	6	303.0	HH I	53.5	23
54 – 59.	56.5	5	282.5	HH	59.5	28
60 – 65.	62.5	3	187.5	III	65.5	31
66 – 71.	68.5		68.5	I	71.5	32.
		N=32.	fx=1972			

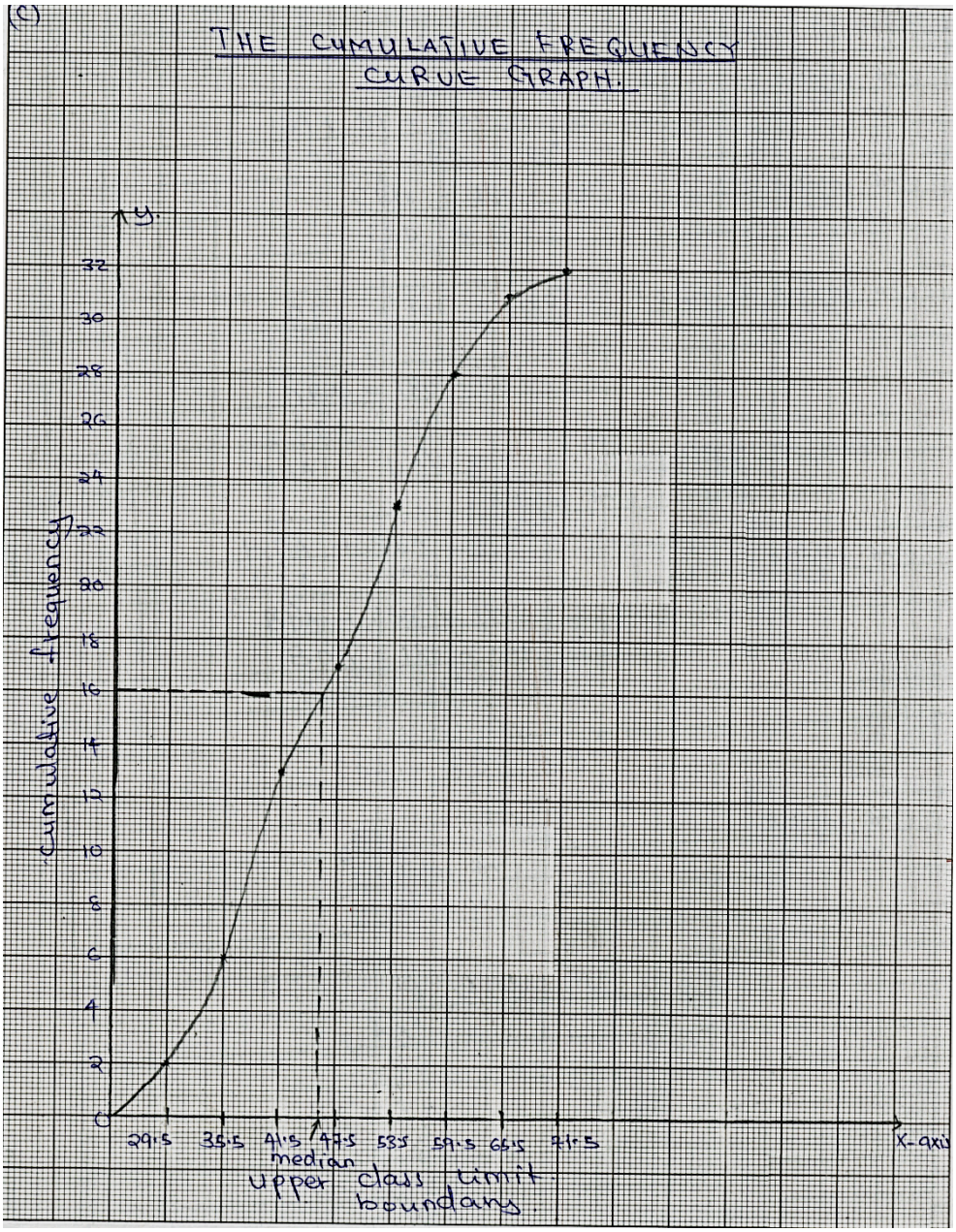
(c) From the graph the median is 46.

(d) mean mark = $\frac{\Sigma fx.}{N.}$

$= \frac{1472.}{32.}$

mean mark = 46.





In Extract 12.1, the candidate managed to apply the concepts acquired from the topic of statistics in answering the question correctly.

Further analysis of candidates' response shows that several candidates performed averagely. Most candidates managed to construct the frequency distribution table and compute the arithmetic mean by applying either the formula $\bar{x} = \frac{\sum fx}{N}$ or $\bar{x} = A + \frac{\sum fd}{N}$ but could not proceed further to draw

the histogram and the cumulative frequency curve. Such candidates scored from 3 to 4.5 out of 10 marks.

On the other hand, the 35.5 percent of the candidates who scored 0 mark were not able to prepare correct frequency distribution table for the grouped data and hence failed to draw the required graphs in part (b) and (c). In calculating the mean mark, some of the candidates applied wrong formulae such as $L+\left(\frac{t_1}{t_1+t_2}\right)\times i$ which is used to calculate the mode. Other candidates computed the median using the formula $L+\left(\frac{\frac{N}{2}-nb}{Nw}\right)\times i$ contrary to the requirements of the question. Furthermore, some candidates computed the median from a cumulative frequency curve which was drawn using incorrect cumulative frequencies and upper real limits. Extract 12.2 is a sample answer from one of the candidates illustrating how they failed to answer this question.

Extract 12.2

12 (c) To draw the commulative frequency

Soln

C. frequency	Ef	x	Efd
24 – 29	2	5	10
30 – 35	11	5	55
44 – 49	7	5	49
50 – 55	8	5	40
64 – 69	3	5	15
70 – 75			
Ef	32		159

Efd

To estimate the median

By using formular

$L+\left(\frac{N/2-b}{N_w}\right)i$

~~39~~5 +

The median in this is 7

(d) To find the mean

Soln

By using formular

~~L + D1 + D0~~

$L + \left(\frac{D_1}{D_1 + D_2}\right) i$

$29.5 + \left(\frac{4}{4 + 9}\right) 11$

$29.5 + \frac{44}{13}$

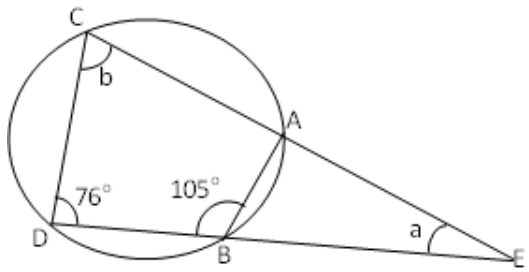
$29.5 + 3.5 = 33.0$

The means is 33.

In Extract 12.2, the candidate calculated the median using a formula contrary to the requirements of the question and also calculated the mean using an incorrect formula.

2.13 Question 13: Circles, Three Dimensional Figures and Earth as a Sphere

In part (a), the candidates were instructed to find the values of angles *a* and *b* in the following figure.

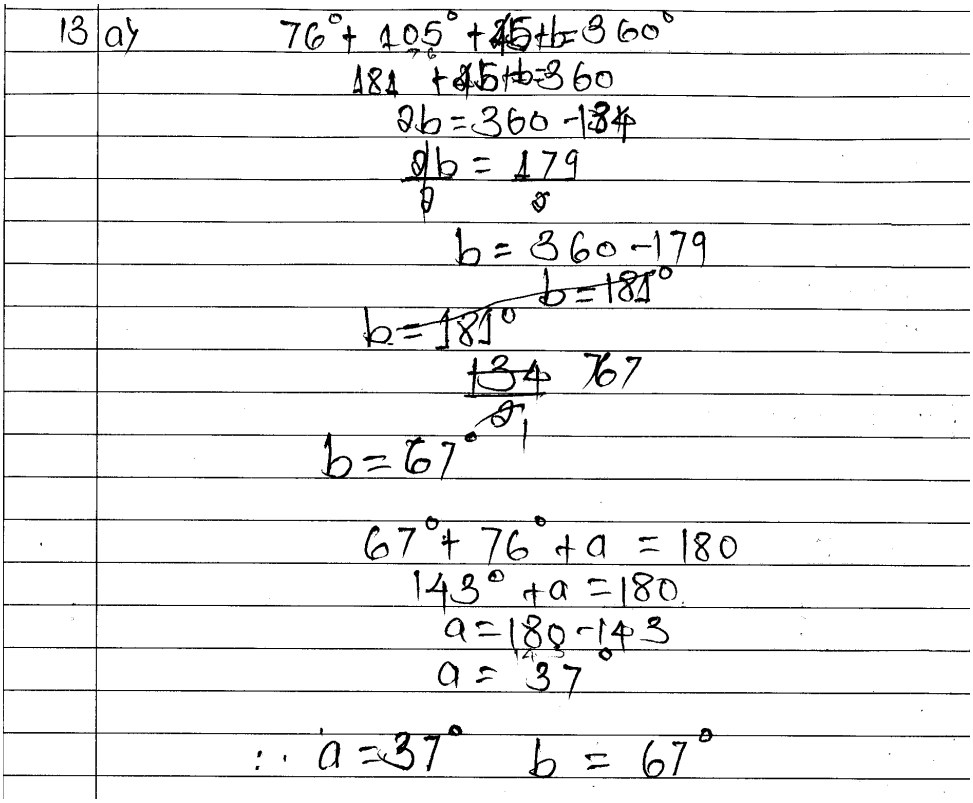


In part (b), the candidates were given a rectangular box with top *WXYZ* and base *ABCD*, in which $\overline{AB} = 9\ cm$, $\overline{BC} = 12$ cm and $\overline{WA} = 3$ cm. They were then instructed to calculate (i) the length $\overline{AC}$ and (ii) the angle between $\overline{WC}$ and $\overline{AC}$.

This question was opted by 30.9 percent of the candidates, of which the majority (87.1%) scored below 3 out of 10 marks, with 69.2 percent of them scoring 0 mark. The question was therefore poorly performed.

Part (a) was poorly performed. Most of the candidates lacked knowledge and skills on the application of the theorems on angle properties of circles and on the properties of triangles. They were unable to apply the theorem which states that "the opposite angles of a cyclic quadrateral are supplementary" in order to find the value of angle *b*. They also failed to apply the property of triangles which states that "the sum of the angles of a triangle is 180 degrees" that would have enabled them to determine angle *a*. Extract 13.1 is a sample answer from one of the candidates illustrating how they failed to answer part (a).

Extract 13.1

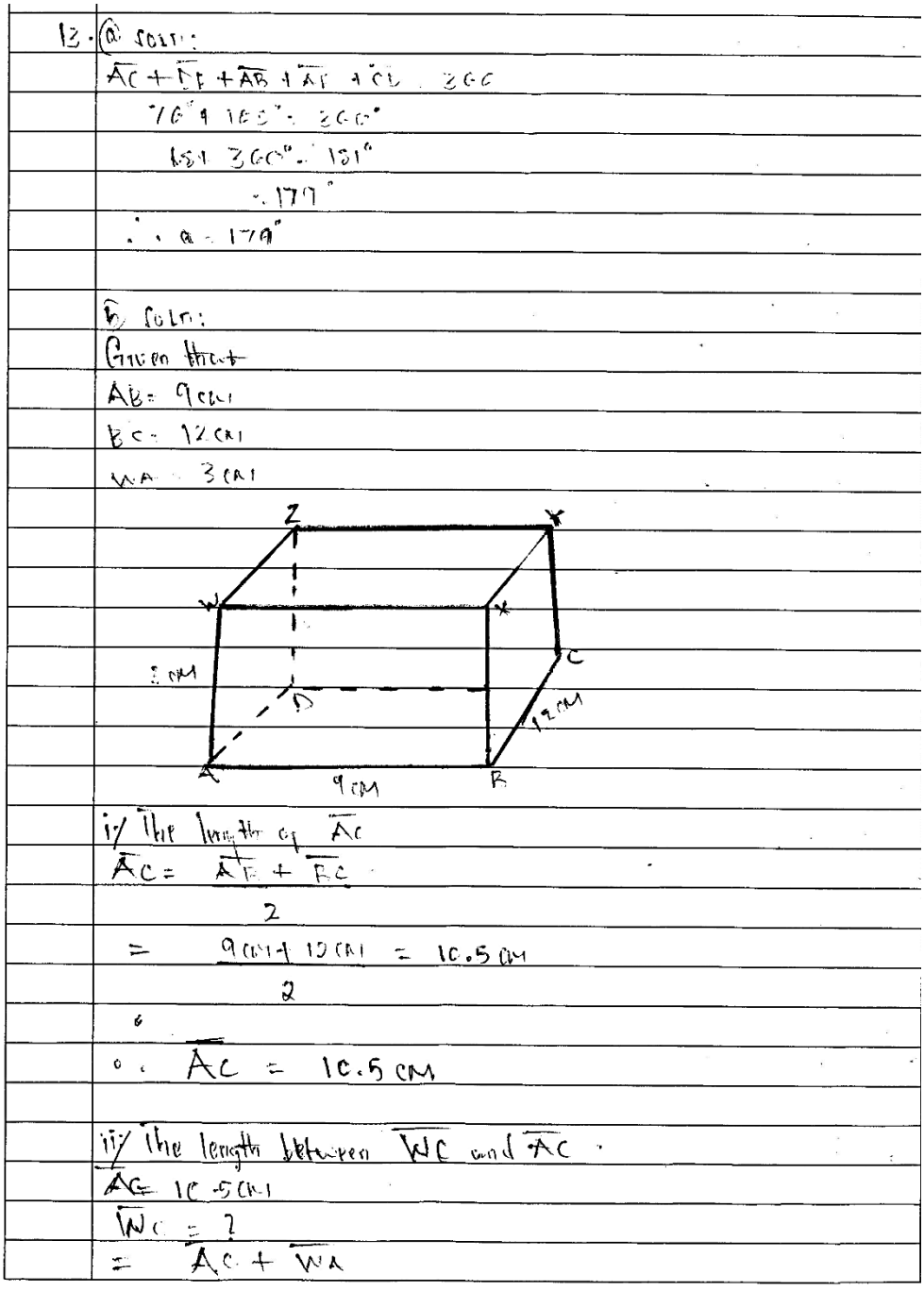


In Extract 13.1, the candidate performed meaningless computations on the values of the angles that were given, indicating poor knowledge and skills on the theorems on circles and properties of triangles.

Part (b) was also poorly performed as many candidates could not apply the Pythagoras theorem to find the length $\overline{AC}$. They could not also apply and the cosine rule or trigonometrical ratio in order to find the angle between

the lines $\overline{WC}$ and $\overline{AC}$. Extract 13.2 is a sample answer showing how the candidates failed to answer part (b).

Extract 13.2



= 10.5 cm + 3 cm

= 13.5

∴ The length is 13.5 cm.

In Extract 13.2 the candidate computed the length AC in part (b)(i) as an average of lengths AB and BC instead of applying the Pythagoras' theorem. In part (b)(ii), the candidates calculated the length between WC and AC instead of the angle between the two lines.

In part (c), the candidates were notified that two places P and Q both on the parallel of latitude 26^o N differ in longitude by 40^o. They were instructed to find the distance between them along their parallel of latitude. The analysis of candidates' responses indicates that many candidates did not have an idea on how to find distance along the small circles and therefore, they ended up performing erroneous computations (see Extract 13.3). It was noted that few candidates quoted the formula $\text{distance} = \frac{\theta}{360} \times 2\pi R \cos\alpha$ correctly but substituted incorrect values of α and θ while others applied wrong formulae such as $\text{distance} = 2\pi R \cos\theta$ (see Extracts 13.4 and 13.5).

Extract 13.3

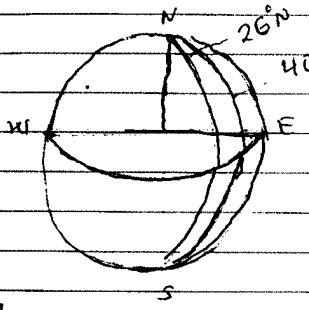
13 a) 105 + 76 = 360°

181 = 360°

360 − 181

179 Ans.

c)



Then

26° = 40°

26 + 40

66°N

where 360° = 1hr

15° = 66'

15° 15°

66 = 4·4

15

= 4·4 ans

Extract 13.3 shows that, the candidate lacked knowledge on how to calculate the distance along small circles.

Extract 13.4

13c. $\frac{\Delta\theta}{360}\ 2\pi R\cos\theta$

26 + 26

$\Delta\theta 52$

$\frac{52}{360} \times 2 \times 3{\cdot}14 \times 64000 \cos 40°$

$\frac{52}{360} \times 2 \times 3{\cdot}14 \times 0{\cdot}7660$

In Extract 13.4, the candidate wrote the correct formula but substituted incorrect data.

Extract 13.5

c) $D = 2\pi R\cos\theta$

$= 2 \times 3{\cdot}14 \times 6400 \times \cos 26$

$= 6{\cdot}28 \times 6400 \times 0{\cdot}8988$

$= 40192 \times 0{\cdot}8988$

$= 40492 \times 0{\cdot}8988$

$D =$

In Extract 13.5, the candidate applied incorrect formula to calculate the distance.

On the other hand, a small proportion of candidates (0.5%) performed question 13 well. Extract 13.6 shows a sample answer from one among the candidates who answered the question correctly.

Extract 13.6

13. a) $b + 105^\circ = 180^\circ$ ---- Sum of opposite angles in a cyclic quadrilateral

so:

$b = 180^\circ - 105^\circ = 75^\circ$

$\therefore b = 75^\circ$

$a = \frac{1}{2}(\overset{\frown}{CD} - \overset{\frown}{AB})$

but:

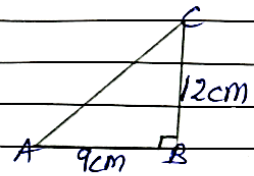
$a + b + 76^\circ = 180^\circ$ ---- Sum of angles in ΔCE

so:

$a = 180^\circ - (75^\circ + 76^\circ) = 180^\circ - 151^\circ = 29^\circ$

$\therefore a = 29^\circ$

~~10.~~ 13. b) i) consider ΔABC



by pythagoras theorem:

$a^2 + b^2 = c^2$

$12^2 + 9^2 = \overline{AC}^2$

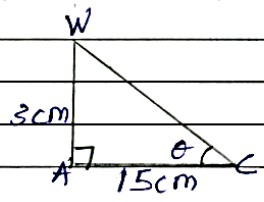
$144 + 81 = \overline{AC}^2$

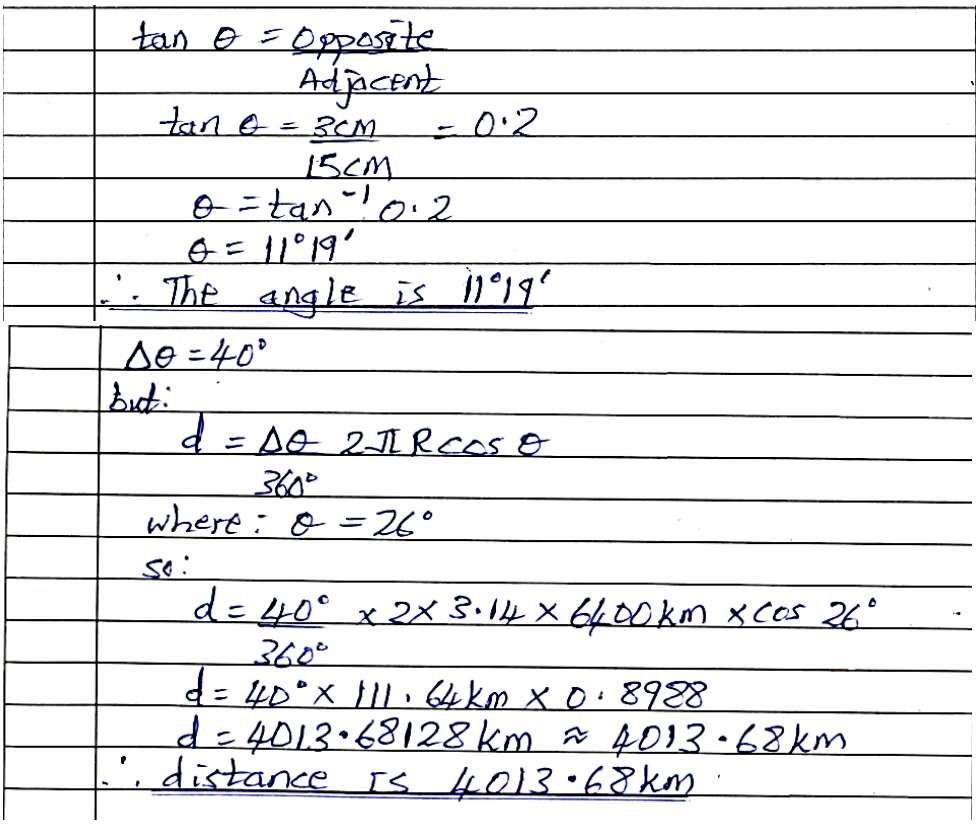
$225 = \overline{AC}^2$

$\overline{AC} = \sqrt{225} = 15cm$

$\therefore \overline{AC} = 15cm$

ii) consider ΔAWC





Extract 13.6 shows that, the candidate understood well the concepts of circles, three dimensional figures and the Earth as a sphere and was able to apply them correctly.

2.14 Question 14: Accounts

The question instructed the candidates to use the trial balance that was extracted from a businessman books' of Cheriko Ramaji to prepare Trading, Profit and Loss account for the year ended on 31st December 2006.

This question was opted by 40.5 percent of the candidates, of which 42 percent scored from 3 to 10 marks and among them 2.3 percent scored all the 10 marks. The question was therefore averagely performed.

The candidates who scored all the 10 marks prepared the Trading, Profit and Loss account correctly as they were able to:

(a) Less returns inwards from sales to get net sales; add purchases to opening stock to get net purchases and less returns outward from net purchases to get the cost of goods sold.
(b) Compute gross profit by calculating the difference between net sales and cost of goods sold; total expenses by adding wages, bad debts, insurance and trade expenses.
(c) Compute net loss by subtracting gross profit, discount received and commision received from total expenses.

Extract 14.1 is a sample answer illustrating how the candidates answered the question correctly.

Extract 14.1

14. DK TRADING, PROFIT AND LOSS ACCOUNT AS AT 31st DEC CR

Particulars	Amount	Particulars	Amount
Opening stock	500,000	sales	1,750,000
Add: Purchases	1,200,000	less: Return	
Net/total purchase	1,700,000	inwards	55,000
less: Return		Net/total sales	1,695,000
Outwards	64,000		
Cost of goods			
available for sale	1,636,000		
less: closing			
stock	-		
Cost of goods			
sold	1,636,000		
Gross profit c/d	59,000		
	1,695,000		1695,000
		Gross profit b/d	59,000
Wages	228,000	Discount received	27,000
Bad debts	36,000		
Insurance	16,000	Commision receivable	43,000
Trade expenses	22,000		
		Net loss c/d	173,000
	302,000		302,000
Net loss b/d	173,000		

In Extract 14.1, the candidate managed to prepare the trading, profit and loss account correctly.

A number of candidates (13.2%) scored from 3 to 4 marks. The candidates in this category managed to open the account and post correctly 6 to 8 out of the 11 transactions that were given but failed to obtain correct amount for net sales, cost of goods sold, gross profit and net profit because the remaining transactions were wrongly recorded and others were omitted. Extract 14.2 is a sample answer illustrating this case.

Extract 14.2

14 Dr TRADING, PROFIT AND LOSS ACCOUNT AS AT 31st DEC 2006 Cr

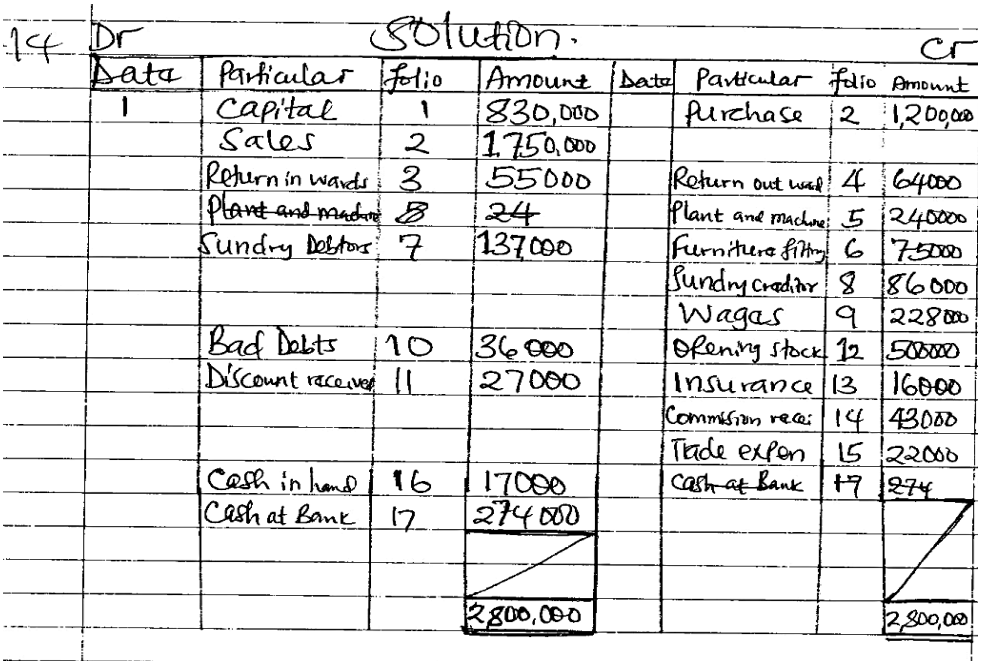
Opening stock	500,000	Sales	1,750,000
Add. Purchases	1,200,000	Ret less: R. Outward	64,000
less R. Inward	55,000		1,696,000
cost of goods			
available for sell	1645,000		
~~Gross profit b/d~~	b/d		
Gross profit b/d	51,000		
	1,696,000		1,696,000
		Gross profit	51,000
Wages	228,000	Discount received	27,000
Insurance	16,000	Commission receivable	43,000
Trade expenses	22,000		
			121,000
	266,000		
Net Loss b/d	139,000		
	121,000		121,000

Extract 14.2 shows how the candidate posted wrongly the entries for return outward and return inward indicating lack of skills in preparing profit and loss trading account. He/she obtained incorrect amount for the cost of goods available for sale, gross profit and net loss.

Further analysis of data revealed that 39.3 percent of candidates scored 0 mark. The candidates in this category showed the following weaknesses: opening the trading, profit and loss account without posting any transaction; failure to post the transactions to the appropriate side of the account; copying the trial balance without providing solution and recording transactions in other accounts such as the cash account contrary to the

requirements of the question. A sample answer from one of these candidates is shown in Extract 14.3.

Extract 14.3



14 Dr Solution. Cr

Data	Particular	folio	Amount	Data	Particular	folio	Amount
1	Capital	1	830,000		Purchase	2	1,200,000
	Sales	2	1,750,000				
	Return in wards	3	55000		Return out ward	4	64000
	~~Plant and machine~~	8	24		Plant and machine	5	240000
	Sundry Debtors	7	137000		Furniture fitting	6	75000
					Sundry creditor	8	86000
					Wages	9	228000
	Bad Debts	10	36000		Opening stock	12	50000
	Discount received	11	27000		Insurance	13	16000
					Commission rec:	14	43000
					Trade expen	15	22000
	Cash in hand	16	17000		~~Cash at Bank~~	17	274
	Cash at Bank	17	274000				
			2,800,000				2,800,000

In Extract 14.3, the candidate posted the transactions in a cash account indicating lack of understanding on how to construct trading, profit and loss account.

2.15 Question 15: Matrices and Transformations

The question consisted of four parts; (a), (b), (c) and (d). In part (a), the candidates were given matrices $Q = \begin{pmatrix} -3 & 1 \\ 0 & 2 \end{pmatrix}$ and $P = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ such that $QP = \begin{pmatrix} -2 & -2 \\ 2 & 2 \end{pmatrix}$ and were supposed to find the elements of matrix P. Part (b), required the candidates to determine the matrix A from the equation $\begin{pmatrix} 5 & 3 \\ 4 & 5 \end{pmatrix} - 2A = \begin{pmatrix} -2 & 1 \\ 3 & 5 \end{pmatrix}$. In part (c), they were given a triangle with vertices A (0, 0); B (3, 0) and C (3, 1) and required to find its image under the translation vector T (2, 3) and under the enlargement

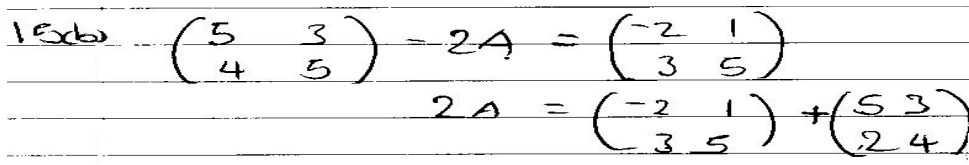
matrix $M = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}$. Part (d), tested candidates' ability to sketch the triangle and the images obtained in part (c) on the same pair of axes and then to comment on their sizes.

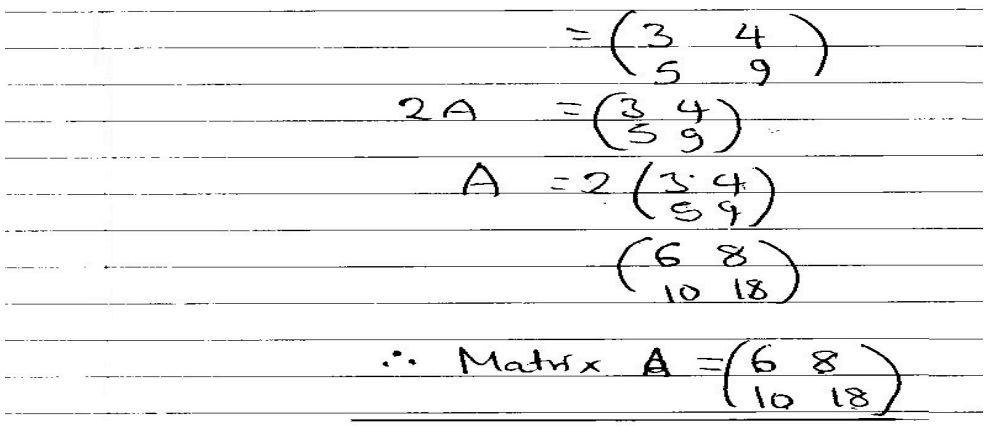
The question was opted by 51.4 percent of the candidates, of which 83.5 percent scored below 3 out of 10 marks and among them 71.7 percent scored 0 mark, indicating that this question was poorly performed.

The candidates who scored 0 failed to perform addition, subtraction and multiplication operations on the matrices in parts (a) and (b). For instance, some candidates expressed $\begin{pmatrix} 5 & 3 \\ 4 & 5 \end{pmatrix} - 2A = \begin{pmatrix} -2 & 1 \\ 3 & 5 \end{pmatrix}$ as either $2A = \begin{pmatrix} -2 & 1 \\ 3 & 5 \end{pmatrix} + \begin{pmatrix} 5 & 3 \\ 4 & 5 \end{pmatrix}$ or $2A = \begin{pmatrix} -2 & 1 \\ 3 & 5 \end{pmatrix} - \begin{pmatrix} 5 & 3 \\ 4 & 5 \end{pmatrix}$ instead of $2A = \begin{pmatrix} 5 & 3 \\ 4 & 5 \end{pmatrix} - \begin{pmatrix} -2 & 1 \\ 3 & 5 \end{pmatrix}$ and as a result ended up with a wrong answer, see Extract 15.1.

In part (c), the candidates were unable to find the image of the given triangle. In answering this part, the candidates were supposed to use the fact that if T is a translation vector (a, b), then T maps every point (x, y) into (x', y') where $\begin{pmatrix} x' \\ y' \end{pmatrix} = \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} a \\ b \end{pmatrix}$. The candidates were instead using concepts and formulae that were not related to the demands of the question. For example, some candidates multiplied the coordinates for the vertices of the triangle by the translation vector (2, 3), indicating lack of knowledge on Matrices and Transformations (see Extract 15.2). The candidates also encountered difficulties in finding the images of the given vertices under the given enlargement matrix in part (c) and as a result, failed to sketch the image of the triangle after being translated and enlarged as required in part (d).

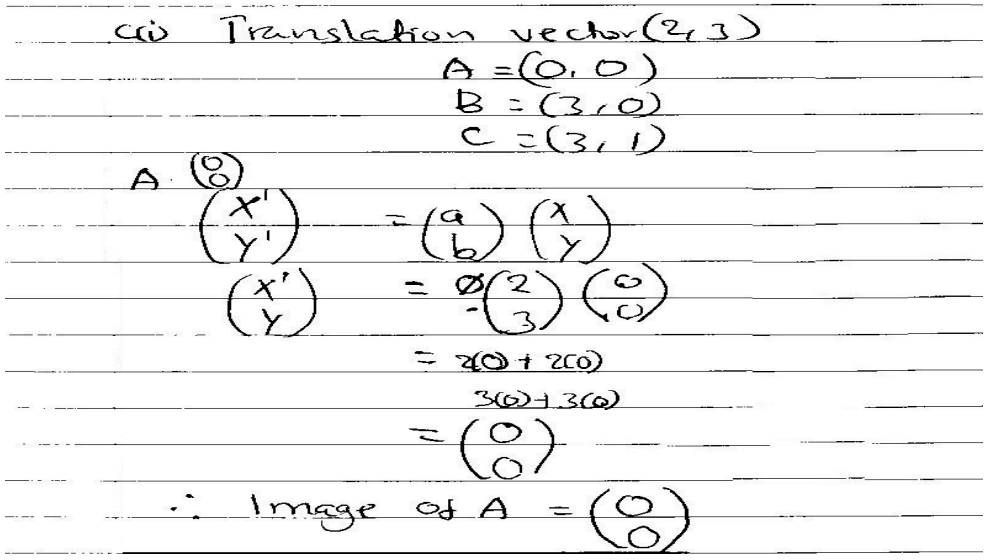
Extract 15.1





In Extract 15.1, the candidate was unable to make the matrix 2A subject of the equation. This illustrates a lack of knowledge and skills on how to add and subtract matrices.

Extract 15.2



Extract 15.2 shows that the candidate failed to find the image of the triangle under the translation vector (2, 3).

However, few candidates (0.5%) managed to apply correctly the concepts of matrices and transformation in answering this question. A sample answer from one of those candidates is shown in Extract 15.3.

Extract 15.3

15 $Q = \begin{pmatrix} -3 & 1 \\ 0 & 2 \end{pmatrix}$ $P = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$

Given $QP = \begin{pmatrix} -2 & -2 \\ 2 & 2 \end{pmatrix}$

$QP = \begin{pmatrix} -3 & 1 \\ 0 & 2 \end{pmatrix}\begin{pmatrix} a & b \\ c & d \end{pmatrix}$

$\begin{pmatrix} -2 & -2 \\ 2 & 2 \end{pmatrix} = \begin{pmatrix} -3a+c & -3b+d \\ 2c & 2d \end{pmatrix}$

From $2c = 2$

$c = 1$

$2d = 2$

$d = 1$

$-3a + c = -2$

$-3a + 1 = -2$

$-3a = -2-1$

$-3a = -3$

$a = 1$

$-3b + d = -2$

$-3b + 1 = -2$

$-3b = -2-1$

$-3b = -3$

$b = 1$

Elements of matrix P ; $a=1, b=1, c=1, d=1$

$P = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$

15(b) $\begin{pmatrix} 5 & 3 \\ 4 & 5 \end{pmatrix} - 2A = \begin{pmatrix} -2 & 1 \\ 3 & 5 \end{pmatrix}$

$\begin{pmatrix} 5 & 3 \\ 4 & 5 \end{pmatrix} - \begin{pmatrix} -2 & 1 \\ 3 & 5 \end{pmatrix} = 2A$

$\begin{pmatrix} 7 & 2 \\ 1 & 0 \end{pmatrix} = 2A$

$$\frac{1}{2}\begin{pmatrix} 7 & 2 \\ 1 & 0 \end{pmatrix} = \frac{2A}{2}$$

$$\begin{pmatrix} 7/2 & 1 \\ 1/2 & 0 \end{pmatrix} = A$$

$$\therefore A = \begin{pmatrix} 7/2 & 1 \\ 1/2 & 0 \end{pmatrix}$$

(c)(i) $(p',q') = (a,b) + (p,q)$

$(p',q') = (2,3) + (0,0)$

$p'q' = (2,3)$

$A' = (2,3)$

$(p',q') = (2,3) + (3,0)$

$B' = (5,3)$

$(p',q') = (2,3) + (3,1)$

$C' = (5,4)$

The Image is $A'(2,3)$, $B'(5,3)$, $C'(5,4)$

(ii) $\begin{pmatrix} p' \\ q' \end{pmatrix} = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}\begin{pmatrix} 0 \\ 0 \end{pmatrix}$

$A' = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$

15 (c) (ii) $B' = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}\begin{pmatrix} 3 \\ 0 \end{pmatrix}$

$= \begin{pmatrix} 6 \\ 0 \end{pmatrix}$

$C' = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix}\begin{pmatrix} 3 \\ 1 \end{pmatrix}$

$= \begin{pmatrix} 6 \\ 2 \end{pmatrix}$

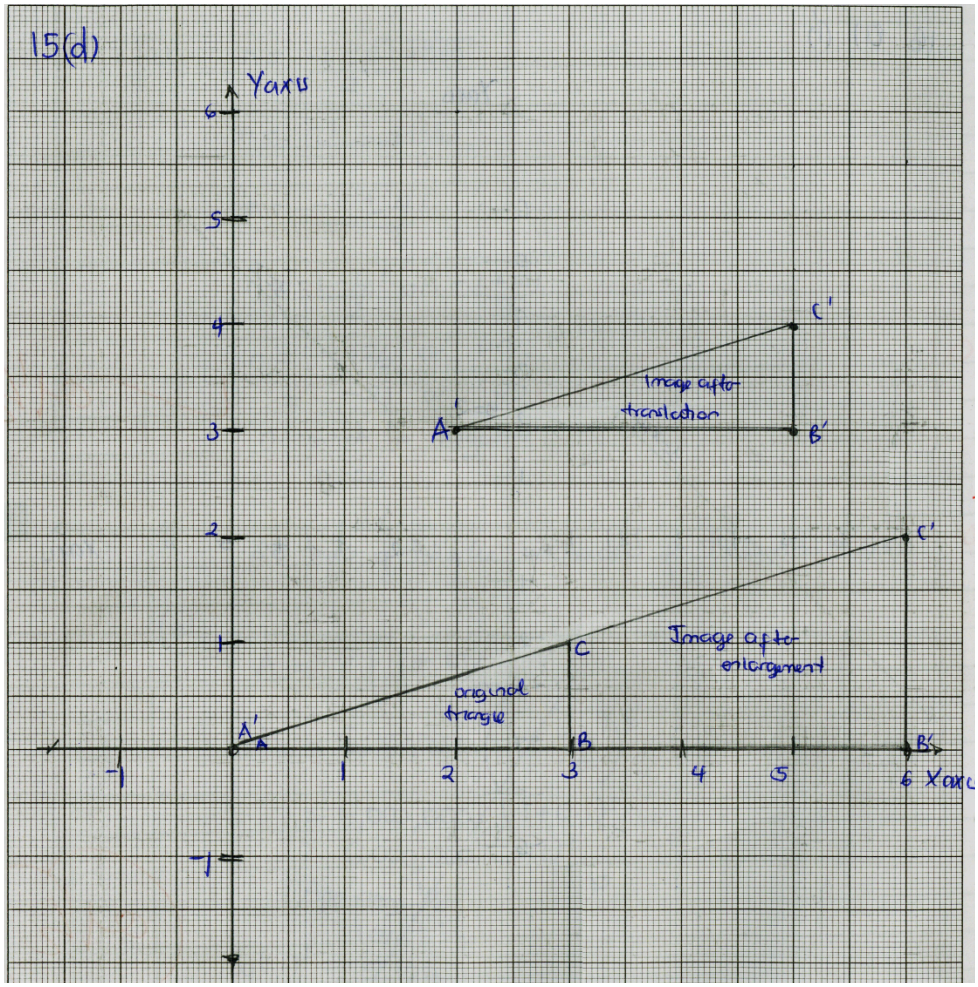
∴ The Image after enlargement $A'(0,0)$, $B'(6,0)$, $C'(6,2)$

(d) On the graph

The size of the Image after translation is the same as

the size of original triangle

The size of the image after enlargement is large than the size of original triangle by a scale factor of 2



Extract 15.3 shows that the candidate had adequate knowledge on performing matrix operations and on finding the image of a figure under a translation vector and an enlargement factor.

2.16 Question 16: Functions and Probability

In part (a), the candidates were given the function $f(x)=\begin{cases} x & \text{if } x>2 \\ 2 & \text{if } -2<x\le 2 \\ x+4 & \text{if } x\le -2 \end{cases}$ and were required to sketch the graph and state the domain and range of $f(x)$.

In part (b), the candidates were notified that Jeremia has two shirts, a white one and a blue one and he also has 3 trousers, a black, a green and a yellow one and were required to find the probability of putting on a white shirt and a black trouser.

In part (c), the candidates were given that, a number is to be chosen at random from the integers 1, 2, 3, …, 11, 12 and were then required to find the probability that it is an even number and it is divisible by 3.

In part (d), the candidates were instructed to use the information in part (c) to show whether or not E_1 and E_2 are mutually exclusive events, given that E_1 and E_2 are sets of even numbers and numbers that are divisible by 3 respectively.

This question was opted by 44.8 percent of the candidates, of which the majority (77.9%) scored below 3 out of the 10 marks that were allocated. This question was therefore poorly performed.

Majority of the candidates were unable to sketch the graph of the given function in part (a), as they lacked skills of drawing graphs. The axes were not correctly drawn and well labelled. Furthermore, most of the drawn graphs were either incorrect or poorly sketched.

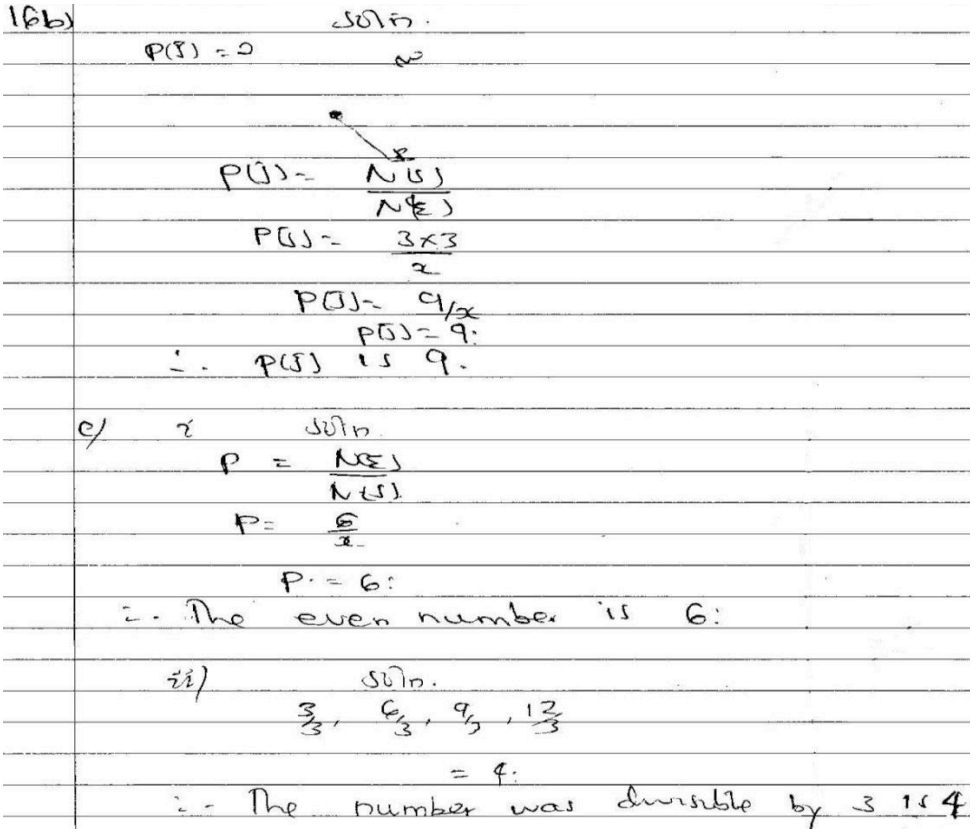
Part (b) was also poorly done as most of the candidates failed to find the probability of Jeremia putting on a white shirt and a black trouser. The candidates were unable to summarize the given information on a tree diagram that would have enabled them to establish the elements of the possibility set (S) for this scenario. This was a key step in finding the required solution. The candidates were also unable to establish the elements of the event (E), a subset of the possibility set, which defines the occurrence that Jeremia puts on a white shirt and a black trouser. Furthermore, the candidates were unable to use the

fact that probability of the event E was to be calculated from the formula $P(E) = \frac{n(E)}{n(S)}$, where $n(E)$ is the number of elements in the event E and n(S) is the number of elements in the possibility set S.

In part (c), the candidates were unable to define the events E_1 = {2, 4, 6, 8, 10, 12} and E_2 = {3, 6, 9, 12} that would be used together with the formula $P(E) = \frac{n(E)}{n(S)}$ in finding $P(E_1)$ and $P(E_2)$ as required in parts c(i) and (ii). Extract 16.1 is a sample answer illustrating this case.

In part (d), the candidates were unable to show that E_1 and E_2 are mutually exclusive events because they were unable to apply either the definition that two events (E_1, E_2) are mutually exclusive if $E_1 \cap E_2 = \phi$ or the formula $P(E_1) + P(E_2) \neq P(E_1 \cup E_2)$.

Extract 16.1



Extract 16.1 shows how the candidate failed to apply the knowledge of probability to determine the occurrence of events in real life situation.

Despite this poor performance, there were only 63 candidates who answered this question correctly and scored all the 10 marks. Extract 16.2 shows work of one of the candidates who answered this question correctly.

Extract 16.2

16. a)

$$f(x) = \begin{cases} x & \text{if } x > 2 \\ 2 & \text{if } -2 < x \leq 2 \\ x+4 & \text{if } x \leq -2 \end{cases}$$

$x + 4 = y$

x	-3	-2	-1	0
y	1	2	3	4

$x = y$

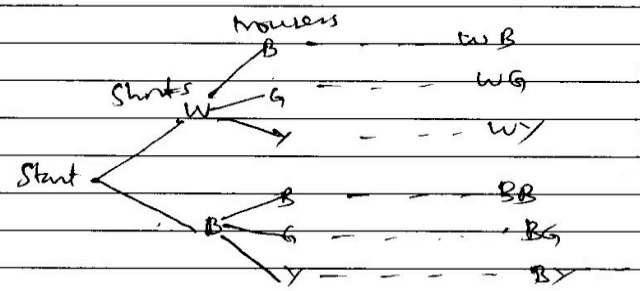
x	-2	-1	0	1	2
y	-2	-1	0	1	2

16 ii) ~~Domain = {x}~~

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

Range = $\{y : y \in \mathbb{R}\}$

b)



$S = \{WB, WG, WY, BB, BG, BY\}$

$n(S) = 6$

$E = \{WB\}$

$n(E) = 1$

$P(E) = \frac{n(E)}{n(S)} = \frac{1}{6}$

∴ probability that Juma will put on a white shirt and a black trousers $= 1/6$.

c) $S = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$

$n(S) = 12$

i) ~~A~~ Even number, $E = \{2, 4, 6, 8, 10, 12\}$

$n(E) = 6$

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

$= \frac{6}{12} = \frac{1}{2}$

∴ the probability that it's an even number $= \frac{1}{2}$

16 c) $E = \{3, 6, 9, 12\}$

$n(\xi) = 48$

$P(S) = \frac{n(\xi)}{n(\xi)} = \frac{4}{12} = \frac{1}{3}$

∴ the probability that the number is divisible by $3 = \frac{1}{3}$.

d) $E_1 = \{2, 4, 6, 8, 10, 12\}$

$E_2 = \{3, 6, 9, 12\}$

$n(\xi_1) = 6$

$n(\xi_2) = 4$

$n(E_1 \cap E_2) = 2$

$n(E_1 \cup E_2) = 8$

Mutually exclusive events. $n(E_1 \cap \xi_2) = 0$.

$n(E_1 \cup E_2) = n(E_1) + n(E_2) - n(E_1 \cap \xi_2)$

$8 = 6 + 4 - 2$

$8 = 10 - 2$

$8 = 8$

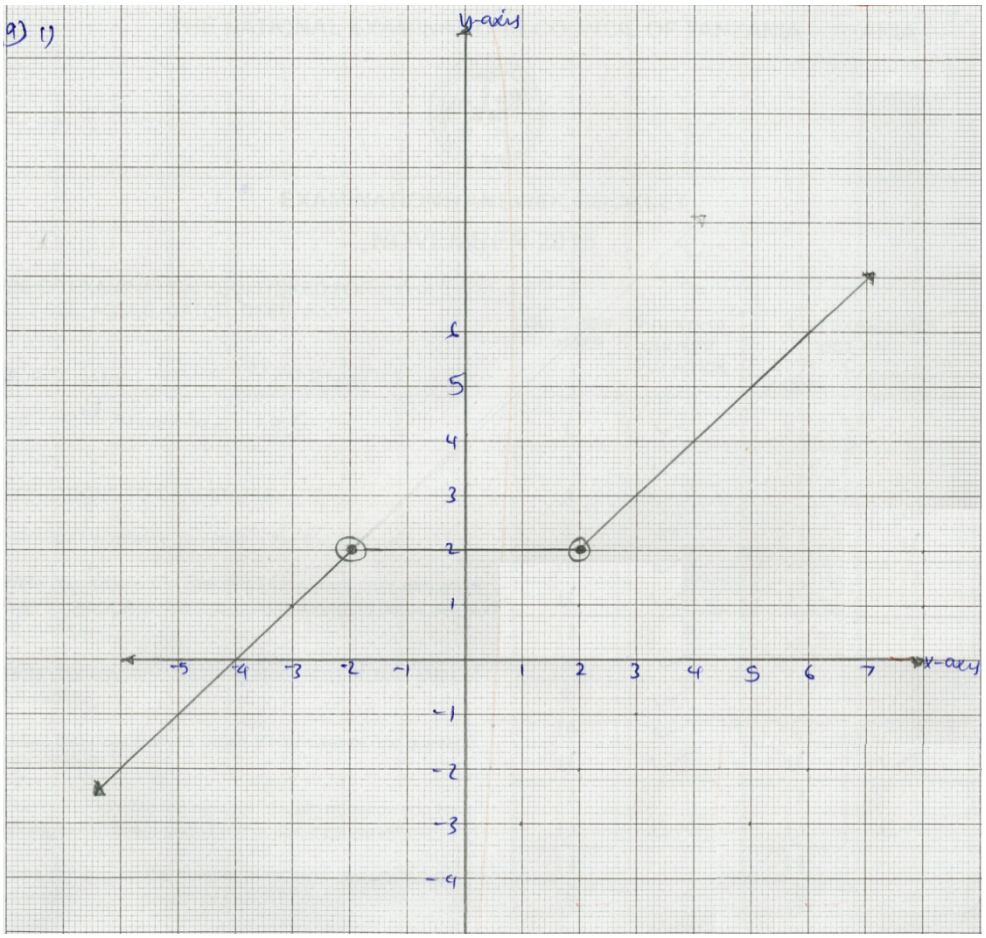
but mutually exclusive $n(E_1 \cap \xi_2) = 0$

$n(\xi_1 \cup E_2) = n(E_1) + n(\xi_2) - n(\xi \cap E_2)$

$8 = 6 + 4 - 0$

$8 = 10$

∴ E_1 and E_2 are not mutually exclusive.



In Extract 16.2, the candidate was able to draw the graph of the function and applied knowledge of probability in answering parts (b), (c) and (d) correctly.

3.0 TOPICWISE ANALYSIS OF CANDIDATES' PERFORMANCE

The Basic Mathematics paper had 16 questions that were set from 25 topics. The analysis of candidates' performance topic-wise in 2015 indicated that one (1) topic was well performed, two (2) topics were averagely performed and the rest (22) were poorly performed. The only topic which had good performance was *Linear Programming* while the topics which had average performance were *Accounts* and *Statistics*. The twenty two (22) topics which had poor performance were: *Functions; Probability; Matrices and Transformations; Rates and Variations; Circles*; *Three Dimensional Figures; Geometry; Earth as a Sphere*; *Logarithms; Exponents and Radicals*; *Algebra; Sets; Approximations*; *Quadratic Equations*; *Vectors; Coordinate Geometry; Sequences and Series*; *Fractions*; *Ratios, Profit and Loss; Areas; Similarity; Geometry* and *Trigonometry*.

The analysis of candidates' performance topic-wise in 2014 shows that one (1) topic was well performed, eight (8) topics were averagely performed and the remaining fourteen (14) topics were poorly performed. In 2014, the topic which had good performance was *Accounts* while the topics which were averagely performed were *Algebra; Sets*; *Rates and Variation*; *Linear Programming*; *Statistics*; *Matrices and Transformations* and *Functions and Probability.* The topics which had poor performance were *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 comparison of the candidates' performance topic-wise for the years 2014 and 2015 is presented in Appendix I and II. The data in these appendices show that the performance of the candidates has dropped in 2015 as compared to 2014. It is evident from Appendix II that the performance has dropped because, four (4) topics of Functions; Probability; Matrices and Transformation; and Rates and Variations which had average performance in 2014 were instead poorly performed in 2015. The factors that have contributed to the low performance in these topics includes: lack of knowledge and skills to formulate and solve joint variation equations; lack of knowledge and skills to perform addition, subtraction and multiplication operations on matrices; inability of candidates to find image of points under a translation vector and an

enlargement factor; lack of skills to draw graphs and inability of candidates to apply knowledge of probability in answering questions.

4.0 CONCLUSION

The analysis of the questions as well as the topics has shown that the overall performance in Basic Mathematics examination has not improved. The reasons that have contributed to low performance in this subject include: inability to identify the requirements of the questions; lack of knowledge and skills to apply laws, concepts and formulae in answering questions; lack of knowledge and skills on interpreting word problems, solving algebraic equations and drawing graphs. Other noted factors were poor computation skills and provision of answers that were not related to the question demands.

5.0 RECOMMENDATIONS

In order to improve the candidates' performance in future Basic Mathematics examinations it is recommended that;

(a) The students should make sure that they study all topics in the syllabus and understand how to apply various laws, definitions, formulae and concepts in answering questions.
(b) The students should check and verify their responses carefully for sign/algebraic errors.
(c) The students should make sure that they read and understand the demands of the question so that they provide related solutions.
(d) Students should practice on how to draw various graphs for functions, inequalities, histograms and ogives.
(e) The teachers should ensure that the syllabus is fully covered.
(f) The teachers should provide enough exercises to students in order to make sure that they understand how to apply various laws, definitions, formulae and concepts in answering questions.

(g) Teachers should encourage students to show all the necessary steps in solving questions.

(h) The teachers should provide enough exercises on word problems in order to enable the students to identify the questions' demands and the methods of solving them.

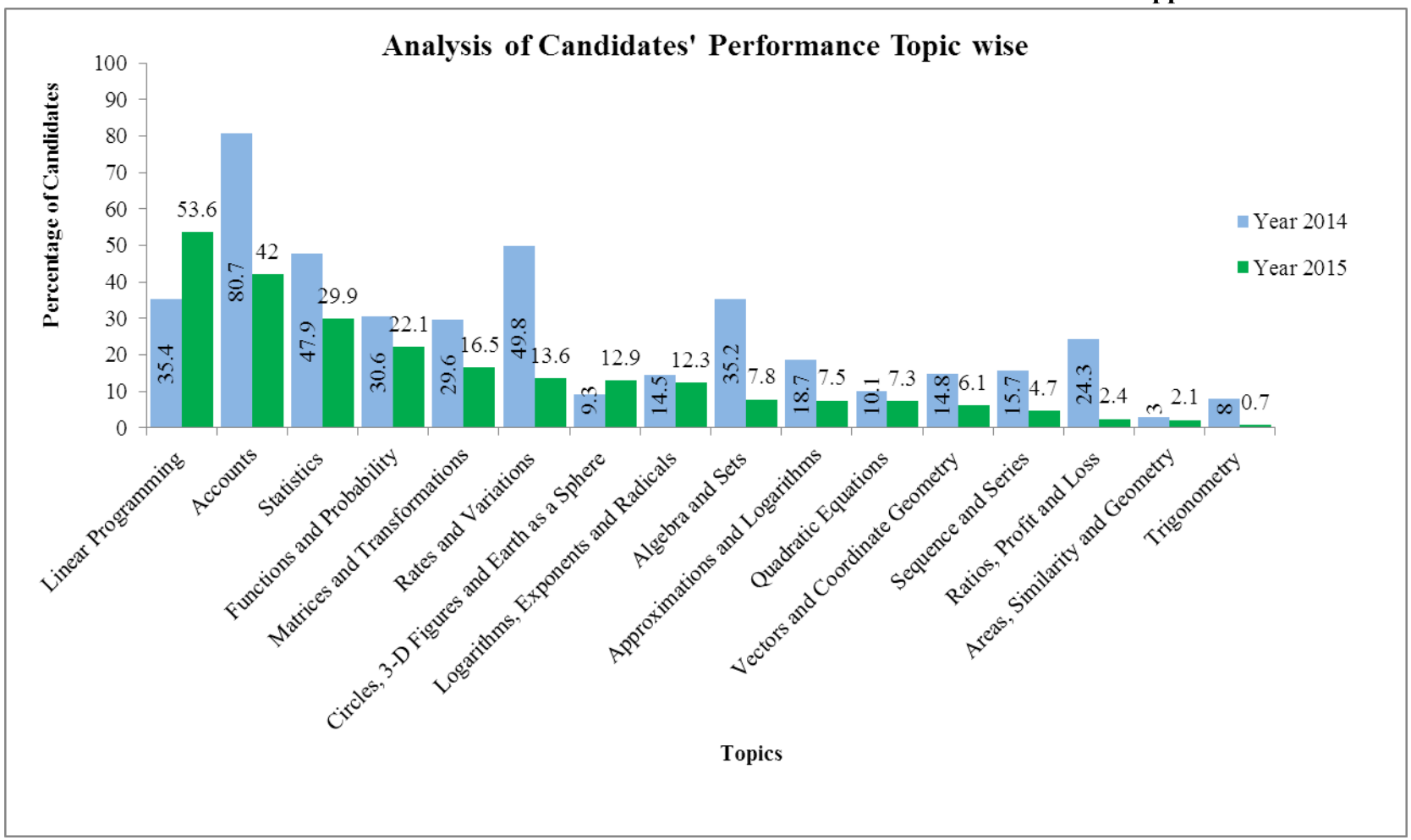
(i) Finally, education quality assurers should conduct school inspections in order to see that the factors which have contributed to low performance in this subject are dealt with.

Appendix I

Analysis of Candidates' Performance in each Topic

S/N	Topics	2014			2015		
		Number of questions	The Average Percentages of Candidates who Passed	Remarks	Number of questions	The Average Percentages of Candidates who Passed	Remarks
1	*Linear Programming*	1	35.4	Average	1	53.6	Good
2	*Accounts*	1	80.7	Good	1	42	Average
3	*Statistics*	1	47.9	Average	1	29.9	Average
4	*Functions and Probability*	1	30.6	Average	1	22.1	Weak
5	*Matrices and Transformations*	1	29.6	Average	1	16.5	Weak
6	*Rates and Variations*	1	49.8	Average	1	13.6	Weak
7	*Circles, 3D Geometry and Earth as a Sphere*	1	9.3	Weak	1	12.9	Weak
8	*Logarithms, Exponents and Radicals*	1	14.5	Weak	1	12.3	Weak
9	*Algebra and Sets*	1	35.2	Average	1	7.8	Weak
10	*Approximations and Logarithm*	1	18.7	Weak	1	7.5	Weak
11	*Quadratic Equations*	1	10.1	Weak	1	7.3	Weak
12	*Vectors and Coordinate Geometry*	1	14.8	Weak	1	6.1	Weak
13	*Sequence and Series*	1	15.7	Weak	1	4.7	Weak
14	*Fractions and Ratios, Profit and Loss*	1	24.3	Weak	1	2.4	Weak
15	*Areas and Similarity and Geometry*	1	3	Weak	1	2.1	Weak
16	*Trigonometry*	1	8	Weak	1	0.7	Weak

Appendix II


Analysis of Candidates' Performance Topic wise
Percentage of Candidates
100
90
80
70
60
50
40
30
20
10
0
Year 2014
Year 2015
35.4
53.6
80.7
42
47.9
29.9
30.6
22.1
29.6
16.5
49.8
13.6
9.3
12.9
14.5
12.3
35.2
7.8
18.7
7.5
10.1
7.3
14.8
6.1
15.7
4.7
24.3
2.4
3
2.1
8
0.7
Linear Programming
Accounts
Statistics
Functions and Probability
Matrices and Transformations
Rates and Variations
Circles, 3-D Figures and Earth as a Sphere
Logarithms, Exponents and Radicals
Algebra and Sets
Approximations and Logarithms
Quadratic Equations
Vectors and Coordinate Geometry
Sequence and Series
Ratios, Profit and Loss
Areas, Similarity and Geometry
Trigonometry
Topics