THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA



CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR DIPLOMA IN SECONDARY EDUCATION EXAMINATION (DSEE) 2019

740 MATHEMATICS

THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA



CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR DIPLOMA IN SECONDARY EDUCATION EXAMINATION (DSEE) 2019

740 MATHEMATICS

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P.O BOX 2624,
Dar es Salaam, Tanzania.
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TABLE OF CONTENTS

FOR	EWORD		iv
1.0	INTROD	UCTION	. 1
2.0	ANALYS	SIS OF CANDIDATES' RESPONSES ON EACH QUESTION	. 2
	2.1 Section	on A: Short Answer Questions	. 2
	2.1.1	Question 1: Foundations of Mathematics	. 2
	2.1.2	Question 2: Foundations of Mathematics	. 4
	2.1.3	Question 3: Logic	. 6
	2.1.4	Question 4: Similarity and Congruence	. 7
	2.1.5	Question 5: Analysis of Mathematics Curriculum Materials	. 9
	2.1.6	Question 6: Probability	10
	2.1.7	Question 7: Coordinate Geometry II	12
	2.1.8	Question 8: Coordinate Geometry II	14
	2.1.9	Question 9: Hyperbolic Functions	17
	2.1.10	Question 10: Vectors	19
	2.2 Secti	ion B: Essay Answer Questions (Academic)	22
	2.2.1	Question 11: Algebra	22
	2.2.2	Question 12: Logic	25
	2.2.3	Question 13: Similarity and Congruence	28
	2.3 Secti	ion C: Essay Answer Questions (Pedagogy)	31
	2.3.1	Question 14: Assessment in Mathematics	31
	2.3.20	Question 15: Planning and Preparation for Teaching Mathematics	35
	2.3.3	Question16: Assessment in Mathematics	36
3.0	THE AN	ALYSIS OF CANDIDATES PERFORMANCE PER TOPIC	39
4.0	CONCLU	JSION	39
5.0	RECOM	MENDATIONS	40
APP	ENDIX		41

FOREWORD

The report on the Candidates' Item Responses Analysis for Diploma in Secondary Education Examination in Mathematics was prepared for the purpose of providing feedback to candidates, tutors, policy makers, curriculum developers and other education stakeholders on how the candidates answered the examination questions.

The analysis of responses shows that some of the reasons that made the candidate fail to answer the examination questions correctly include; making errors while performing mathematical operations, failure to recall some basic formulae, lack of knowledge and skills on various concepts which were examined, applying incorrect formulae and failure to identify the requirements of the questions.

The National Examinations Council of Tanzania believes that this analysis will provide feedback to various education stakeholders in order to take appropriate measures in improving mathematics teaching techniques as well as creating some more strategies in teaching and learning mathematics subject.

Finally, the Council would like to extend sincere appreciation to the Examination Officers and all others who participated in the preparation of this report.

Ma

Dkt. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

The Diploma in Secondary Education Examinations is done every year with the aim of assessing knowledge and skills that have been achieved throughout the two years of implementing the Diploma in education curriculum. A total of 420 candidates were registered in the 2019 DSEE in Mathematics subject of which 417 (99.3%) candidates sat for the Examination.

The paper had a total of sixteen (16) questions divided into three sections namely A, B and C. Section A consisted of 10 short answer questions from both academic and pedagogic contents. Candidates were required to answer all questions in this section. Each correct answer had 4 marks, making a total of 40 marks. Section B consisted of 3 essay questions from academic subject matter. Candidates were required to answer 2 questions where each question had 15 marks, making a total of 30 marks. Section C consisted of 3 essay questions from pedagogy subject matter. Candidates were required to answer 2 questions; the total marks for each question were 15, so the section had a total of 30 marks. Candidates' responses for every question were analysed in order to identify the reasons for either better performance or failure. The analysis involved worked out scripts for each question. Extracts for every question were placed as a sample to the general performance of the question.

The analysis involved all questions that were in the examination paper. It based on the percentage of candidates who performed well the assessment in every question. The analysis on the performance for each question in section A had three categories of marks as follows: 3 - 4 marks; indicating good performance, 2 - 2.5 marks; indicating average performance and 0 - 1.5 marks; indicating poor performance. In sections, B and C, the performance analysis for each question was also categorised into three groups of marks as follows: 10.5 - 15 marks; indicating good performance, 6 - 10 marks; indicating average performance and 0 - 5.5 marks; indicating poor performance.

2.0 ANALYSIS OF CANDIDATES' RESPONSES ON EACH QUESTION

The analysis of candidates' responses for each of the sixteen questions in mathematics was observed as follows:

2.1 Section A: Short Answer Questions

2.1.1 Question 1: Foundations of Mathematics

In this question, the candidates were required to identify four great Mathematicians in mathematics history and explain briefly the contribution of each one.

This question examined candidates' ability to remember the contributions of greater mathematicians on developments of various properties and ideals in mathematics subject.

A total of 352 candidates (83.8%) attempted this question. The analysis of responses in this question shows that 225 candidates (63.9%) scored from 0 to 1.5 marks, 79 candidates (22.4%) scored from 2 to 2.5 marks while 48 candidates (13.6%) scored from 3 to 4 marks. The analysis shows that out of 225 candidates who scored from 0 to 1.5 marks, 68 candidates (19.3%) got a 0 mark. Therefore the general performance for this question was poor because the majority of the candidates (63.9%) scored from 0 to 1.5 marks as indicated in figure 1.

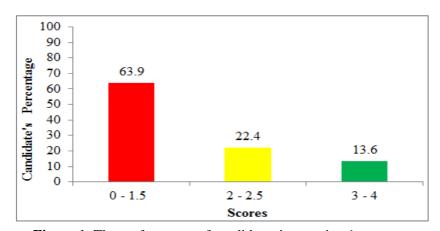


Figure 1: The performance of candidates in question 1.

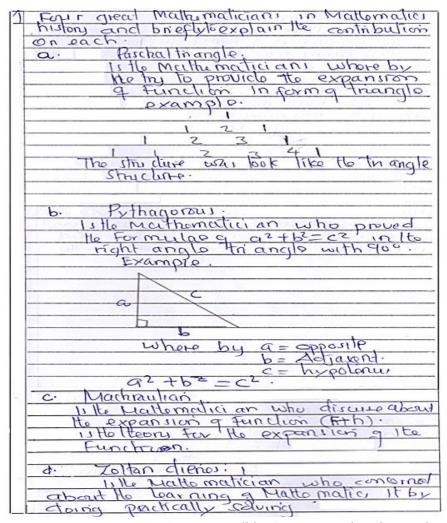
Extract 1.1 shows the sample of answers from a candidate who failed to remember any of the contributions of the great mathematicians. And therefore he/she presented imaginary answers for each of the mathematician mentioned.

Ľ.	oplato contributes and state children should
	be stron undurine learning environment and he
	was Greek.
	(2) Pascal said learner should learn by
	playing and he was French
	1 tralliles intofute to the learning arm
	Grmente
- 1	
	(4) Zuitan Diener visa learning is pleying

Extract 1.1: Sample of incorrect candidate's response in question 1.

This implies that the candidates who failed in this question were not aware of the great mathematicians and their contribution on the subject. They focused on the contribution of education in general instead of mathematics subject.

On the contrary, a total of 48 candidates (13.6%) remembered the contributions of the great mathematicians and presented the correct responses as shown in extract 1.2.



Extract 1.2: Sample of correct candidate's response given in question 1.

2.1.2 Question 2: Foundations of Mathematics

In this question, the candidates were required to explain briefly Zoltan Dienes view in learning Mathematics.

This question assessed candidates' knowledge about the view of the mathematician Zoltan Dienes and his contributions in mathematics field. A total of 272 candidates (64.8%) attempted the question. The analysis of data for this question shows that 163 candidates (59.9%) scored from 0 to 1.5 marks, 32 candidates (11.8%) scored from 2 to 2.5 marks and 77 candidates (28.3%) scored from 3 to 4 marks. Out of 77 candidates who scored from 3 to 4 marks, 43 candidates (10.2%) scored full marks that were allocated to this question. The general performance for this question was poor because those who performed poorly were 59.9% compared to those who scored

from 2 to 4 marks who were only 109 (40.1%). Figure 2 shows the performance of the candidates in this question.

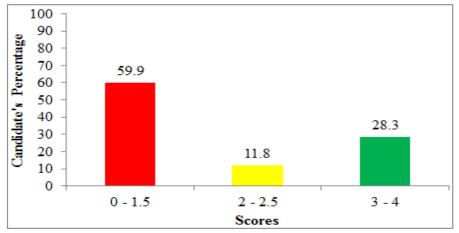


Figure 2: The performance of candidates in question 2.

There were candidates who managed to score full marks as can be seen in extract 2.1 below which is the sample of a candidate's response who managed to remember the Zoltan Dienes view in learning Mathematics.

2.	Zalt an Dienes view in learning Mathematic
	if Emphasize learning through practices
	il Emphasize critical thinking
	in Brings the rules and theories of
	tearning mathematics.

Extract 2.1: Sample of a correct candidate's response in question 2.

However, 163 candidates (59.9%) of those who attempted this question failed to get it correctly. The reasons for failure were inability to remember and write the Zoltan Dienes view in learning Mathematics. For instance some of the candidates wrote about capacity, experience and age. Extract 2.2 is a sample of a candidate's response who failed to recall the view of the mathematician Zoltan Dienes.

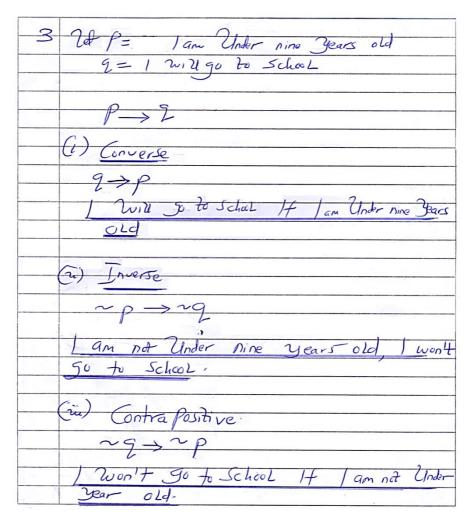
R	20	tan	Die	Lans	he s	avel	the	ma	thans	this
					king					
	exp	QViQ	10		J		1	7,	0	

Extract 2.2: Sample of incorrect response of a candidate in question 2.

2.1.3 Question 3: Logic

The candidates were required to write the Converse, Inverse and Contrapositive of the statement "If I am under nine years old, then I will go to school".

This question examined candidates' ability to apply logic for solving problems in their real life. The question was attempted by 417 (99.3%) out of 420 registered candidates. A total number of 146 candidates (35.0%) answered this question correctly; displayed a high level of interpretation of the given statements and presented the correct answers as shown in extract 3.1.



Extract 3.1: Sample of candidate's correct response given in question 3.

Despite the fact that the question reflected a simple logical application of simple compound statement, 82 (19.7%) of the candidates who attempted

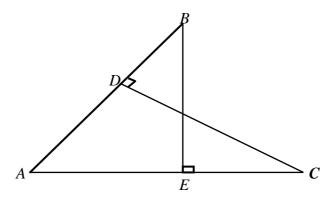
the question, failed to answer it correctly. The failure was due to lack of basic skills to interpret and use correctly the symbols used to represent converse, inverse and contrapositive of a statement. They wrote compound statements which had different meaning in logical statements. Extract 3.2 is the sample of the responses of a candidate who failed to make the correct interpretation that could lead him/her to attain the correct statements.

3.	30/n:
	let P be if I am Under nine years old
A 100 A	9 be I will go to school
100	and, = V
	1.00 J - 10 1
	Connection will be PV9
	PV 9 - p Statement
	9, VP - Converse.
	~q, V~P -> Contapositive
	apvag to Inverse

Extract 3.2: Sample of the incorrect candidate's response in question 3.

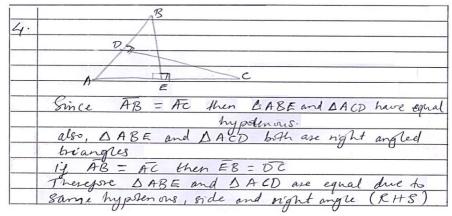
2.1.4 Question 4: Similarity and Congruence

The candidates were required to prove that triangle ABE and ACD are congruent by considering that, in the following figure, $\overline{AB} = \overline{AC}$, D and E are midpoints of \overline{AB} and \overline{AC} respectively.



This question aimed at measuring candidates' ability to identify the given figure and apply the similarity and congruence properties of figures to prove the congruence of triangles *ABE* and *ACD*.

A total of 389 candidates (92.6%) attempted this question. The performance of candidates for this question was good as 165 candidates (42.4%) scored from 3 to 4 marks and 98 candidates (25.2%) scored from 2 to 2.5 marks. Those candidates who responded to this question correctly were able to identify the similar triangles and the sides which were equal as well as applying their properties to conclude. See extract 4.1 which is a sample of the response of candidates who managed to answer this question correctly.



Extract 4.1: Illustrates a sample of correct candidate's response in question 4.

On the other hand, a total of 126 candidates (32.4%) failed to respond correctly to this question. The reasons for failure were due to lack of knowledge of identifying equal sides, equal triangles as well as failing to apply the properties to prove congruence of triangles. Extract 4.2 shows the situation where one of the candidates attempted the questions using incorrect procedures.

On 4	Constd	er 1	1	A	BE	an	d AC	D -		
	For a	man.	gle	to	bee	ome	cond	nier	ncy	it
	must	have	SEN	ne	sho	ape	and	1,20	•	
	There	tere	the	li	re	cr	midpon	h E	av	T.D

Extract 4.2: Sample of an incorrect response of the candidate in question 4.

2.1.5 Question 5: Analysis of Mathematics Curriculum Materials

The candidates were required to mention four curriculum materials applied in teaching and learning of mathematics subject.

This question assessed candidates' knowledge about curriculum materials relevant for teaching and learning mathematics. It required the candidates to remember and write the taught curriculum materials.

A total of 351 candidates (84.6%) of those who attempted this question responded it correctly; as a result the performance for this question was good. The candidates who performed well in this question were able to remember and write the curriculum materials required as indicated in extract 5.1.

5	Chriculum material applied in teaching and learning mothernation
	D Reference book
	Text book
	iii) Sillebus
	IV) Teacher guide

Extract 5.1: Illustrates a sample of candidate's correct response in question 5.

However, a total of 21 candidates (5.1%) failed to give correct answers to this question due to lack of knowledge about teaching and learning materials in mathematics. Some of them wrote about IT materials instead of writing the taught learning materials applied in mathematics as extract 5.2 reveals this analysis.

5	(i) Computer games
	(li) Andio-visual Villers
	(ii) Projector
	(14) Youtube Videos

Extract 5.2: Sample of the incorrect candidate's response in question 5.

2.1.6 Question 6: Probability

The candidates were required to calculate the probability that number 5 has appeared at least once as a die is thrown twice and the sum of the number appearing is observed to be 8.

The question assessed candidates' ability to apply the formulae $P(A/B) = \frac{P(A \cap B)}{P(B)}$ where *A* is the event of getting number 5 appearing at least once and *B* is the event of getting the sum of numbers appeared equal to 8.

A total of 364 candidates (86.7%) attempted this question. The analysis of candidates' responses shows that 248 candidates (68.1%) scored from 0 to 1.5 marks, 55 candidates (15.1%) scored from 2 to 2.5 marks and 61 candidates (16.8%) scored from 3 to 4 marks. Among the 61 candidates who scored from 3 to 4 marks, 53 candidates (12.6%) scored full marks that were allocated to this question.

The general performance of candidates in this question was poor because those who scored from 0 to 1.5 marks were 68.1% compared to 31.9% of the candidates who scored between 2 to 4 marks as shown in figure 3.

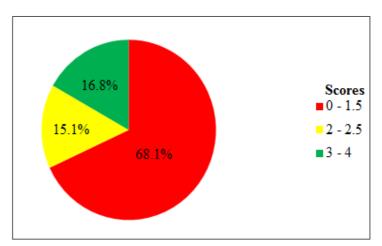
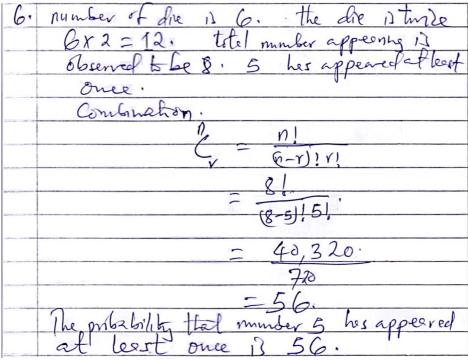


Figure 3: The performance of candidates in question 6.

Some of the candidates who responded wrongly to this question were using combination formula which was not needed in this case. Extract 6.1 shows an example of a response of the candidate who used incorrect formula.



Extract 6.1: Illustrates the incorrect candidate's response to question 6.

Some candidates who failed to respond correctly to this question used wrong formulae by using the combination formulae ${}^{n}C_{r} = \frac{n!}{r!(n-r)!}$ and replaced n by 8 and r by 5 which lead them to an incorrect answer because of the wrong procedure.

However, 61 candidates (16.8%) managed to get the correct answer. Some of the candidates used the method of listing the events to get the required probability as in extract 6.2.

Die 1	en that
1	1 2 3 4 5 6
2	2,1 2,2 2,3 2,4 2,5 2,6
3	3/1 3/2 3/3 3/4 3/5 3/6
4	411 412 413 414 415 416
_5	5,1 8,2 8,3 5,4 5,5 5,6
6	
The	o 8 are
	. 3,5 4,4,5,3,6,2
1265)= 5
	7 = No 5 to appear atteast one
	3,5 and $5,3$
	7 (8)
) = 2/5 = 0.4
/4	appear attens one = 2/0004
	/5

Extract 6.2: Sample of a correct response of a candidate in question 6.

2.1.7 Question 7: Coordinate Geometry II

The candidates were required to find the equation of the tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at point $(a\cos\theta, b\sin\theta)$.

This question was intended to examine candidates' ability to apply chain rule in establishing the equation $\frac{dy}{dx} = \frac{dy}{d\theta} \times \frac{d\theta}{dx} = \frac{dy}{d\theta} \div \frac{dx}{d\theta} = \frac{-b\cos\theta}{a\sin\theta}$ and use it to get the required equation.

A total of 383 candidates (91.2%) attempted this question. The analysis shows that 232 candidates (60.6%) scored from 0 to 1.5 marks, 36 candidates (9.4%) scored from 2 to 2.5 marks and 115 candidates (30.0%) scored from 3 to 4 marks. Out of 115 candidates who scored from 3 to 4 marks, 101 candidates (24.0%) scored full marks which were allocated to this question.

The general performance of candidates to this question was poor because 232 candidates (60.6%) scored from 0 to 1.5 marks compared to those who

scored from 2 to 4 marks who were only 39.4% of those who attempted the question. The candidates who failed to solve this question assigned the given coordinates with the letters *x* and *y* and simplify instead of applying the differentiation methods with the chain rule as shown in extract 7.1.

7.	a cost = >c, bsind = 1
	$= (\alpha \cos \alpha)^2 + (6 \sin \alpha)^2 = 1$
	a2 62
	$=\frac{g^2(08^2Q+b^2sin^2Q=1)}{g^2}$
	Ces ² Q + $\sin^2Q = 1$ -: The equivation is $\cos^2Q + \sin^2Q = 1$
	· : The equilition is Cos20 +Sin20 =1

Extract 7.1: Sample of an incorrect response of a candidate.

On the other hand 115 candidates (30%) of those who attempted this question got it correct. This is due to the fact that they correctly used the method of differentiation and chain rule to find the equation as shown in extract 7.2.

$\frac{7}{dx} = \frac{-20cb^2}{2ya^2}$
dx 2ya2
$\frac{d\eta}{dx} = -\frac{xb^2}{vn^2}$
$-\frac{1}{\sqrt{\eta x}} \frac{\sqrt{\eta x}}{\sqrt{\eta x}}$
also given points = (aloso, blino)
(X, Y)
$\frac{9 \text{ adinf} = 9 - 6 \text{ mo} = -\infty b^2}{x - a \cos \theta}$
x - a Coso 9a2
$(y - b fino) ya^2 = (x - a loso) - xb^2$
$y^2a^2 - ya^2bfino = -x^2b^2 + xb^2a \cos \alpha$
$y^2a^2 + \chi^2b^2 = xb^2a\cos + ya^2b\sin a.$
Unde by ay' both side.
year + x42 = x62aloso + ya45mo
$y^{2}a^{2} + xy^{2} = xb^{2}a(ax) + yaysmo$ $ay^{2} ay^{2} a^{2}b^{2} a^{2}b^{2}$ $y^{2} + x^{2} = x(ax) + ysmo$ $b^{2} a^{2} a$ $b^{3} a^{2} a$
1 + 12 = x Coso + 58mo
b^{r} a^{r} a b
but
$\frac{b^2 + x^2 = 1}{b^2 a^2}$
b^{2} a^{2}
$\frac{2 \cos + 9 \sin \circ = 1}{a}$
a b
$\frac{1}{1000} = \frac{1}{1000} = 1$
1 u b

Extract 7.2: Sample of the correct response of a candidate in question 7.

2.1.8 Question 8: Coordinate Geometry II

The candidates were required to find the coordinates of point P by considering a point P which divides internally the line joining point (4, 2, 2) and (10, 6, 4) in the ratio 1:1.

This question assessed candidates' knowledge of finding the coordinates of a point by using the concept of ratios and internal division of lines. It was intended to evaluate the candidates' ability to remember and use the formulae $\underline{P} = \left(\frac{n}{n+m}\right)\underline{a} + \left(\frac{m}{n+m}\right)\underline{b}$ in finding the required coordinates.

Where *n* and *m* are the given ratio i.e., n = 1 and m = 1.

The question was attempted by 341 candidates (81.2%). The analysis of data shows that 116 candidates (34.0%) scored from 0 to 1.5 marks, 18 candidates (5.3%) scored from 2 to 2.5 marks and 177 candidates (60.7%) scored from 3 to 4 marks. This means that the performance of the candidates for this question was average because those who scored from 2 to 4 marks were 195 (66.0%). Figure 4 shows the performance of the candidates for this question.

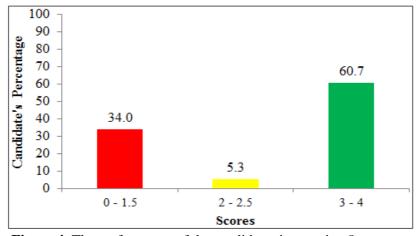


Figure 4: The performance of the candidates in question 8.

The candidates who managed to get the correct answer were able to remember the formulae and apply it correctly to find the coordinates of a point in a line which is $\underline{P} = \left(\frac{n}{n+m}\right)\underline{a} + \left(\frac{m}{n+m}\right)\underline{b}$ and attain the correct answer as indicated in extract 8.1.

08 hiver that
Duho 1:1 = 1:11
points (4,2,2) and (10,6,4) pako 1: 1 = 1:11 let (cy, b, C,) = (4,2,2)
$(a_2/b_2, C_2) = (1076/4)$
Reccell from internal division
62 1 4 61 11
$\left(\begin{array}{c c} c_2 \end{array}\right) \left(\begin{array}{c c} c_1 \end{array}\right)$
k . A . / .
6 x2-1/2 x £
6 12 1 2 142
1 + 1
(10)
6 + 2
4/
o
(0+4)+(6+2)+(4+2)
2
14+8+6
2
2 2
$\frac{28}{2} = 14$
For the coordinate
(C2) (C2) (C2) (C2)
(22x+agre), (Bex+b,al), (Cex+GM)
X+M 10 L A+M / 1 / 1/11
(10x1+4x1) = (6x1+2x1) (4x1+2x1)
$ \frac{\left(10x1+4x1\right)}{1+1} 7 \left(\frac{6x1+2x1}{1+1}\right) / \left(\frac{4x1+2x1}{1+1}\right) $
(10+4), $(6+2)$, $(4+2)$
2/1/2/
$\frac{14}{2}$, $\left(\frac{8}{2}\right)$, $\left(\frac{6}{2}\right)$
(7,4,3)
. (ourdinate of P = (7,4,3)

Extract 8.1: A sample of candidate's correct response given in question 8.

However, 116 candidates (34.0%) of those who attempted this question failed to get it correctly due to incapability of remembering and using the relevant formula. Some of them were just adding the given coordinates to get the midpoint coordinates as indicated in extract 8.2 where candidate

failed to recall and apply the formula to get the coordinates required because he/she added the given coordinates, i.e.; 4+10=14, 2+6=8 and 2+4=6 instead of using the formula.

8.	Soul.
	milen points. (4,2,1) and (10,6,4).
	POINT P = (H, 2, 2) + (10, 6, 4)
	= 14, 8, 6
	3 6 7 6 6 1 6 6 6
	~ 1001ND 10= (14,8,6)

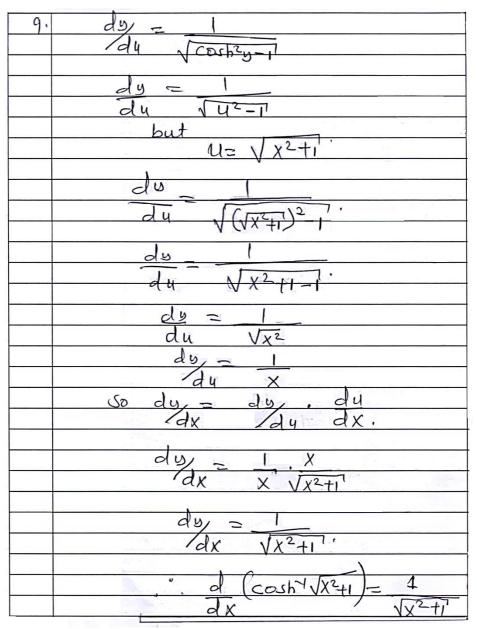
In Extract 8.2: Illustrates an incorrect response of a candidate in question 8.

2.1.9 Question 9: Hyperbolic Functions

The candidates were required to differentiate $\cosh^{-1}(\sqrt{x^2+1})$ with respect to x.

This question evaluated the candidates' ability to differentiate hyperbolic functions by using the substitution method.

A total of 398 candidates (94.8%) attempted this question. The analysis of data shows that 153 candidates (38.4%) scored from 0 to 1.5 marks, 62 candidates (15.6%) scored from 2 to 2.5 marks and 183 candidates (46.0%) scored from 3 to 4 marks. Out of 183 candidates who scored from 3 to 4 marks, 121 candidates (28.8%) scored all marks that were allocated for this question. So the general performance of candidates for this question was average since 61.6% of the candidates who attempted the question scored from 2 to 4 marks. Extract 9.1 illustrate this analysis.



Extract 9.1: Sample of a correct candidate's response given in question 9.

On the other hand, 38.4% of the candidates who attempted this question failed to get it correctly due to inability to make the substitution over the given expression so that it becomes simple before starting to differentiate. They were required to let $u = \cosh^{-1}(\sqrt{x^2 + 1})$ so that $\cosh u = \sqrt{x^2 + 1}$ then proceed with the process of differentiating. Extract 9.2 is a sample of a response from a candidate who failed to differentiate properly the given expression.

9	Solution Girls Dog t
	Given that
	Corch-1 (V21+1
	Given that $\frac{(osh^{-1}(\sqrt{5}^{2}+1)}{1+1}$ Let $y = (osh^{-1}\sqrt{5}^{2}+1)$ now
	now
	Cores u = Vn2+1
	Cosh y = \n2+1 Differentiate with respect to n
	organistic with respect to
	+ Sub 4 du = 1 (224) 22
	+ Such y dy = - 1 (n2+1). 2n
	Suchydy = - y (n2+1)
	1 2312
	dy - x3+x1 dr Suihy
	dh smny
	P.12 1/12 -1
	now from - Suiting + (osting = 1 Suiting = 1 - Cesting
	Sunhy = 1- lestry
	Sunhy = VI-Cothy
	Jan My = VI = With y
	2001
	$\frac{\text{now}}{\text{dx}} = \frac{\chi^3 + \chi}{\sqrt{1-(\alpha \beta \lambda^2 \gamma)}}$
	dh /12 (oshy
	1 3
	$\frac{dy}{dx} = \frac{x^3 + x}{\sqrt{1 - \sqrt{x^2 + 1}}}$
	$\langle 1 - \sqrt{\gamma^2 + 1} \rangle$
	$\frac{dy}{dn} = \frac{n^3 + n}{\sqrt{1 - \sqrt{n^2 + 1}}}.$
	dn VI-Vn+1.

Extract 9.2: Illustrates the incorrect response of a candidate in question 9.

2.1.10 Question 10: Vectors

The candidates were required to find the angle between $\underline{a} = 2\underline{i} + \underline{j} - 2\underline{k}$ and $\underline{b} = \underline{i} - 2\underline{j} + \underline{k}$ by using the cross product of vectors.

The question examined candidates' skills on how to use the cross product formula which is $|\underline{a} \times \underline{b}| = |\underline{a}||\underline{b}|\sin\theta$ where \underline{a} and \underline{b} are two different vectors, in order to get the angle between the two vectors.

The question was attempted by 409 candidates (97.4%). The analysis of data for this question shows that 167 candidates (40.8%) scored from 0 to

1.5 marks, 48 candidates (11.7%) scored from 2 to 2.5 marks and 194 candidates (47.5%) scored from 3 to 4 marks. Out of 194 candidates who scored from 3 to 4 marks, 164 (39.0%) scored full marks that were allocated for this question. Figure 5 shows the performance of the question in question 10.

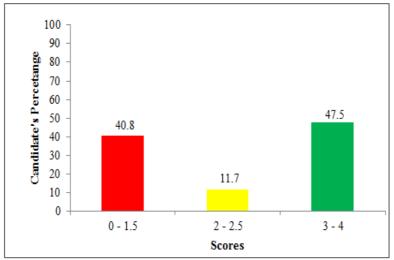


Figure 5: The performance of the candidate question 10.

The candidates who got the correct answer had enough skills on how to use cross product for calculating the angle between two different vectors. They managed to use the formula $|\underline{a} \times \underline{b}| = |\underline{a}| |\underline{b}| \sin \theta$ and proceed by finding $|\underline{a}| = \sqrt{4+1+4} = 3$ and $|\underline{b}| = \sqrt{1+4+1} = \sqrt{6}$ to attain the final answer as shown in extract 10.1.

10	A& /
	Cross produc = A×8.
- 2	(A x B = 1 A 1 1 B) SIO (B) Q = . 2 i + j - 2 k b = i - 2 j + k.
-761	d=-21+1 -2K
	B = 1 -2; +2.
	9xb = 10 i 12 1
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
19	14 -2 1 1
3	1 i((1x1) - 4) - j[2x1++2] + k(2x-2) - (1x1)]] 1 (1-4) i - 4j + (-4-1) k1 1 -3i-4j J5k1
	1(1-4); -4: -4 (-4-1) 21
	1-31-41 Jakl
	axb = -3:-4 -5x:/ axb =(x+y++2+
	axb) = ((-34 +(4)2+(52)
	~9+16+25
	250
	axb = 150.
	9xb = 1Allb/sinB
	19= 122+12+(-2)2
	191- 14+1+4 (91=d9 (01=3.
	19= 122+12+(-2)2 19= 14+14 (9)=19 (01=3. 16=12+(-2)2+12=1+4+1=6
	AND THE RESERVE OF THE PROPERTY OF THE PROPERT
	150 = 3xd6 Sin B
	dão = sin B
	2 7 7 5 1 7 6
	7.67 = 7.348
	2 X2-4 49.
	SIDB = 0.9623
	0 2 74.2°
	0 - 14.8
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	; , the Avel Str 13 74.2°

Extract 10.1: Is a sample of candidate's correct response in question 10.

Meanwhile, there were 167 candidates (40.8%) who attempted this question and performed poorly due to inability to remember and improper use of vector cross product techniques so as to get the required angle. Some of them just calculated the magnitude of both vectors and subtract before equating to $\sin\theta$ and find the angle θ resulting into incorrect answer as revealed in extract 10.2.

10 From Cost gooded formula
A-A - WHIBI GAG , a= 2i+j-2a 1= i-2;+k
1 & j k)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
1 -2 1
2 (1+-4)-1(2+2)+-2(-4-1)
= -4 - 4 + 10
-6-4+10 = V22+12+2× 12+22+12 + bene.
-6,-4, thore V9 + V6 52ns
1462+-61+104 = 156 SIRA
V88 +16+100
Viez Va
o = VB fire
Ono = O
6= 6n7 (950) =0
Thanker for intended angle will be o

Extract 10.2: Is a sample of candidate's incorrect response in question 10.

2.2 Section B: Essay Answer Questions (Academic)

2.2.1 Question 11: Algebra

This question had three parts where by the candidates were to:

- (a) Evaluate $\sum_{1}^{10} n^2 + 3n$, given that $\sum_{1}^{10} r^2 = \frac{n}{6} (n+1)(2n+1)$ and $\sum_{1}^{10} r = \frac{n}{2} (n+1)$.
- (b) Show that $ac^3 = db^3$, if the roots of polynomial equation $ax^3 + bx^2 + cx + d = 0$ are in geometric progression.
- (c) Find an equation whose roots are $\alpha^2 \beta$ and $\alpha \beta^2$, when the roots of quadratic equation $2x^2 7 = 0$ are α and β .

This question had three parts, in part (a) the question assessed candidates' ability to expand the expressions and apply the given information to substitute the values in order to get the required answer; in part (b) the question assessed the candidates' knowledge about roots of polynomials and part (c) assessed the candidates' ability to factorise and apply the factors obtained to form an equation.

The question was attempted by 132 candidates (31.4%) out of 420 registered candidates. Among these candidates; 95 (72.0%) scored from 0 to 5.5 marks, 35 candidates (26.4%) scored from 6 to 10 marks and 2 candidates (1.6%) scored from 10.5 to 15 marks. The analysis indicates that the general performance for this question was poor because the candidates who passed were only 28%. Figure 6 shows the performance of candidates for question 11.

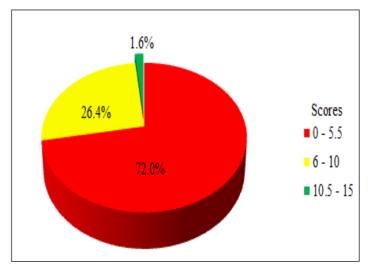


Figure 6: The general performance of candidates in question 11.

The candidates who failed to answer correctly this question lacked knowledge about the application of the given information; some of them substituted the given limits direct into the given expression and obtained incorrect answer as shown in extract 11.1.

11a) $\sum r^2 = ry(n+1)(2n+1)$ and $2r = ry(n+1)$
Z no +30.
4
tolution:
2 7 10
1-
E 1/6 (n+1) (2n+1) where = 4, 5, 6, 7, 8, 9, 10
4
10 2 4 (4+1) (2x4+1) + 5 (5+1) (2x5+1) + 6 (6+1) (2x6+1)
4 + 7/ (7+4)(2x7+1) + 8/ (8+1) (2x8+1) + 9/ (9+1)(2x9+1)
+ 10/ (10+12) (2x10+1) + 3 f 0/2 (n+1)] (1/2 (4+1)+
5/(5+1) + 6/(6+0) + 7/(7+1) + 8/(8+0) + 9/(9+1)
1/2 (10+11).

Extract 11.1: Is the sample of incorrect response of a candidate in part (a).

Despite the failure of many candidates in this question, there were 37 candidates (28.0%) who managed to score from 6 to 13.5 marks. They managed to apply the given formula and able to factorise it as well as interpreting the values before making the substitution to attain the correct answer in part (a) as shown in extract 11.2.

AA	a). Given
11.	a). Given $\Sigma r^2 = n/(n+1)(2n+1)$ and
	Z1 = 1/6 (1171) (1171) (119
	Σr= n/ (n+1) but required.
	10
	> n2 + sn. where n= 4,5,6,7,8,9 and
75.5	4
	10
	$\sum_{n} {}^{10} = (4^{2} + 9 \times 4) + (5^{2} + 9 \times 5) + (6^{2} + 9 \times 6) + (9^{2} + 9 \times 7)$
	Z11 +311 = (4 +3x4)+15 +3x3)+(6 +3x6)+(1 +3x1)
	4
	+ (82+3x8)+(92+3x9)+(102+3x10)
	,
	= 28+40+54+70+88+108+130,
	- 20 0 2 1 2 3 3 3 3 3 3 3 3 3
	- 518.
	= 518
	10
	$1.7 \times 10^{2} + 20 = 518$
	4

Extract 11.2: Illustrates the sample of a correct response of a candidate.

2.2.2 Question 12: Logic

In this question, the candidates were required to:

- (a) Draw an electrical network of the simplified form of the compound statement; $\sim \lceil (P \land \sim Q) \lor (\sim P \land Q) \lor (\sim P \land \sim Q) \rceil$.
- (b) Determine the validity of the argument "If it rains, the seedlings will survive. If seedlings survive well, animals will not die. But animals are dying. Therefore it is not raining", by using the laws of algebra of propositions.

This question assessed candidates' knowledge about logical properties and its application in simplification of compound statements. It was attempted by 355 candidates (84.5%) whereby 134 candidates (37.7%) scored from 0 to 5.5 marks, 134 (37.7%) scored from 6 to 10 marks and 87 (24.6%) scored from 10.5 to 15 marks. Out of 87 candidates who scored from 10.5 to 15 marks, 24 (5.7%) scored all marks that were allocated to this question.

The analysis indicates that the general performance of candidates in this question was average because those who scored from 6 to 15 marks were 221 (62.3%). Figure 7 presents the performance of candidates for question 12.

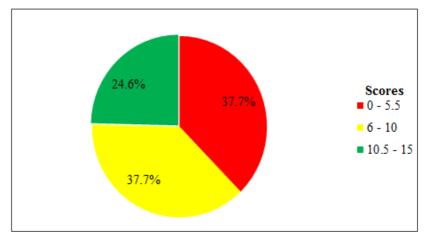


Figure 7: The performance of candidates in question 12.

Some of the candidates had adequate knowledge about formulating the compound statements and applying the laws of algebra of propositions to simplify as indicated in extract 12.1 which is the sample of the answers that were given by one of the candidates.

12a. ~[(PA~Q) V (~PAQ) V (~PA~Q)]
Let's simplify by using algebric laws of proposition
~[(PA~Q) V ~PA(QV~Q)] - distributive law
~ [(PN~Q) V~PNT] - regation law ~ [(PN~Q) V~P] - identity law.
~ [(PA~Q) V~P] - identity law.
~ [(PV~P) / (~UV~P)] - dign butive law
~ [PV~P) \(\alpha\nu\nu\nu\nu\nu\nu\nu\nu\nu\nu\nu\nu\nu\
(C) A D) - (dentity (aw
(QMP) - double negation.
The electric net work will be in cines
The electric net work will be in series. Q P
QP
126 let; p be It rains a be the seedling survive to be animals are dying In booic form the stranment will be as dellaws
g be the seedling survive
be animals are dying
In logic form the targument will be as follows. [(\mathbf{p} \rightarrow g) \Lambda (g \rightarrow r) \Lambda r) \rightarrow p \lambda g definition [(\mathbf{p} \rightarrow r) \Lambda r] \rightarrow p \lambda g definition [(\mathbf{p} \rightarrow r) \Lambda r] \rightarrow p \lambda g definition [(\mathbf{p} \rightarrow r) \Lambda r] \rightarrow p \rightarrow p \lambda g definition
$ \frac{(\phi \rightarrow g) \wedge (g \rightarrow b \rightarrow r) \wedge r}{(p \rightarrow q) \wedge (g \rightarrow r)} $
then [10 - p ~ r) yr] - p by deprition = p-p-
[The part of the
[~ DA (~hAx)] -D~D Associative law
[~DNF] -D~P Negation law
F-D~D Identity low
~ FVP by deposition
[PPN-W) N+]-D~P negation [~PN(~MN)]-D~P Associative law [~PNF]-D~P Negation law F-D~P ldentity law ~FVP by depinition TVP Negation law I dentity law I dentity law
Therefore the argument is valid.

Extract 12.1: Illustrates the response of a candidate statement correctly.

On the other hand, 134 candidates (37.7%) failed to get the correct answer to this question due to inability to remember the logical properties like; Distributive law, Negation law, Identity law and Double negation law. The analysis shows that some of them were using the laws which are not used in logic like Absorption law and Demogan's law. Therefore, they failed to simplify, ended up with the wrong statement as shown in extract 12.2.

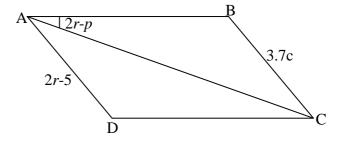
12-a)	Suh.		
Cit	1000		
~1	PARQ)V(-PAG	2) V (~PA~6	7)] - liver.
= .	-[PV-PA-0		
	~ [TV (~ P)	1~97 -	Absortion law.
	~ (~ bV0	-Q) - j	Lebentity low.
	PVE	$\delta - \delta$	Edentity low.
			9
	. electorical	network	or pro.
1 3 31		_	
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T			
			12
		6	
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1	0		
5).	Sours.	50 ° 2 0	1
	het P = 1	urvive d	
	7 = d	animed	
	(P→2)1 (2->	Mandi	P~0
	rush Jabl		
111	PAGA GAY)	1~~~	Drp.
	1 4 11 A-14.1)		

Extract 12.2: is the response of a candidate who failed to simplify the statements in question 12(a), (b).

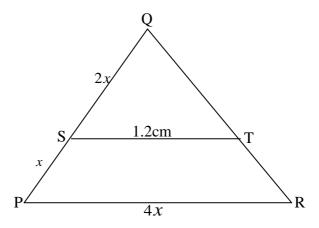
2.2.3 Question 13: Similarity and Congruence

In this question, the candidates were required to:

(a) Find the value of r and p in the following figure, where $\triangle ABC$ is congruent to $\triangle CDA$.



(b) Find the value of x in the following figure if $\triangle PQR \sim \triangle SQT$.



This question assessed candidates' ability to identify different figures and relate them in order to solve for values of r and p in part (a) and x in part (b).

A total of 349 candidates (83.1%) attempted this question. The analysis shows that 38 candidates (10.9%) scored from 0 to 5.5 marks, 118 (33.8%) scored from 6 to 10 marks and 193 candidates (55.3%) scored from 10.5 to 15 marks. Figure 8 presents the performance of the candidates in this question.

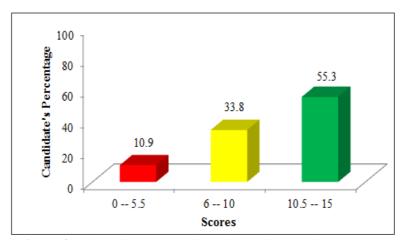


Figure 8: The performance of candidates for question 13.

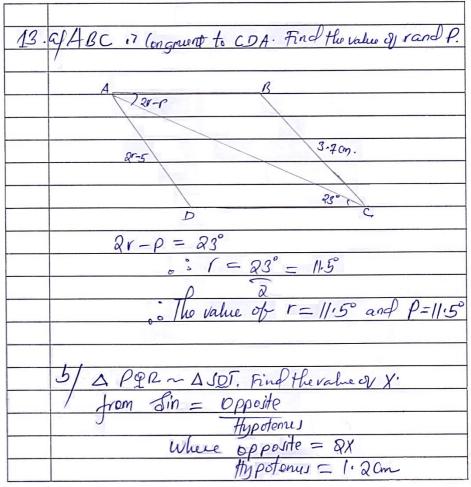
The candidates who scored 10.5 marks and above, were able to solve for values of r and p in part (a) and determine the value of x in part (b) after detecting the angles which are equal and the corresponding sides. Extract 13.1 is a sample of a candidate's correct responses given in question 13 (a) and (b).

13	Required rand P.
	AD = BC
	2r-5=317cm.
	24=317+5
	スト、ニ ミュナ・
	J 2.
	r = 4,35.cm.
	"! The value of r = 4,35cm.
	100 4 - 3
	2r-P = 23 Because of Attack
	But r= 4.35. angles.
_	
_	817-P=23.
-	P = -14.3.
	Value of P = -1413.
	blen PO - DP.
	b/from. Pq. = PR.
	93 37.
	3X. = 4X.
	By crossing multiplication
	By crossing multiplication
	3x (1,2cm) = 4x (2x)
-	3.6xcm = 8x2.
_	XX.
	3-6cm = 8X.
	8 8.
	" The value of . X = 0145 CI

Extract 13.1: Illustrates the correct response of a candidate in question 13.

Among 38 candidates (10.9%) who scored from 0 to 5.5 marks, some of them got incorrect answers to this question because they did not know the corresponding sides and angles in part (a) which are $\overline{AD} = \overline{BC}$ and BAC = ACD also the corresponding sides in part (b) which are $\frac{PQ}{QS} = \frac{PR}{ST}$.

Therefore, they were unable to solve for values for r, p and x as shown in extract 13.2.



Extract 13.2: Is a sample of candidate's incorrect response given in question 13(a) and (b).

2.3 Section C: Essay Answer Questions (Pedagogy)

2.3.1 Question 14: Assessment in Mathematics

The candidates were required to justify the statement that "Mathematics is a mother of various disciplines" by giving five points.

This question examined candidates' ability to express the application of Mathematics in various fields of life. It was attempted by 224 candidates (53.3%). The analysis of data shows that 22 candidates (9.8%) scored from 0 to 5.5 marks, 92 (41.1%) scored from 6 to 10 marks while 110 candidates (49.1%) scored from 10.5 to 15 marks. The general performance in this question was good because 90.2 percent of the candidates scored from 6 to 15 marks. This performance is indicated in figure 9.

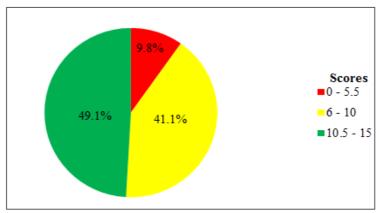


Figure 9: The performance of candidates in question 14.

The candidates who answered this question correctly had wide knowledge on the application of mathematics in their daily life. This implies that they were able to explain the applications of mathematics in their daily life. An example of a correct response is shown in extract 14.1.

14	Mathematic is the subject which doc
	with abstrating idea, contral thinking, and
	reasoning at given a particular section
	making, The wathenate is also the subject
95	deal with dwelpment of mental ability
	of the people and making Correct deusion
- 1	making of a particular phonomene.
	The methenetie is a mother of various
	otsplines as shown below;
4	Science subject like Chamistry,
	plusous, and other subject of art like
	geograph it next depend to some extent
	the sondert to have the knowledge of
	operation like addition, tuberrutos,
	operation the addition, tilbutaition,
	muliploteties, and division it were needed
	to be applicable for the feld of vanous
or discipline which need the	subject dila physicis, chemistry and geograph
	or discipline which need the knowledge
	of mathemetics application, the collection of
	date and partiting different measurement
	date and performing different measurement during surver time, the natheratic celculation to needed inorder to ensure the accounting
	is needed inorder to ensure the according

In Extract 14.1: Is a sample of candidate's correct response in question 14.

However, 9.8% of the candidates who attempted this question failed to do it correctly. The reasons for the failure were lack of knowledge and ability to explain the application of mathematics in different fields in their daily life. Extract 14.2 shows a poor response from one of the candidate who failed to answer correctly this question.

14	Mathematics this is an at which deals with
	the study of logic, number, theory principles in
	rarion a virtiment must us a mother of
	various disaplaces. The following and the points for
	order to justify this statement
	Jana: Mythe Rugties Also is a sound which
	used typimatically to solve different problems.
	Mony round subject depend on Musthemetrics
	for example charactery and Physics
	Theory: Mathematics comprises different
	the ones concern about different concepts which
	explain, product the truth of a action concept.
	For example the some som of two interior angle
	of a triangle is equal to the one opposite exterior
	angle of a towngh.
	Number: Also WestHamerten Cleany wow or
	explain vernous concept by wing numbers
	this can be natural numbers, whole numbers, real
	num bers and Integers
	Logic: this subject is a mother of other
	disciplines this is because of using recording, it
	arems also husthementice deals with the stray
	of reasoning that is how, why, if a=0 thin a>-1
	Systematic: Mathematics Alm different
	buspour it itemetically put toplaned the biacognic
	of solving a certain problem
	of solving a certain problem The above an the point which justify the
	Statement that ruthemetics is a mother of
	como dunplia. Also Muth mutics have got
	King application in our daily life. For example

Extract 14.2: Sample of incorrect response of a candidate in question 14.

2.3.2 Question 15: Planning and Preparation for Teaching Mathematics

The candidates were required to describe five criteria for selection of teaching and learning techniques in the teaching and learning of Mathematics.

This question assessed candidates' knowledge about Planning and Preparation for Teaching Mathematics. It required the candidates to recall and describe the criteria for selection of teaching and learning techniques.

A total of 251 candidates (65.6%) scored from 10.5 to 15 marks, 128 (33.5%) scored from 6 to 10 marks while only 3 candidates (0.9%) scored from 0 to 5.5 marks. Therefore the performance for this question was generally good.

The candidates who got the correct answer were able to remember and describe clearly the criteria for selection of teaching and learning techniques in the teaching and learning of Mathematics as indicated in extract 15.1.

15	(riteria for selection of feeding and learning
	technique in tracking and learning of mather
	atics
	leaching is the process of facilitating loo
	roing but learning is the relative permanent th
	and of behaviour which results from exponen
	ces. Therefore teaching and learning technique imp
	lies or means devices or plans used in the
	process of teaching and barning. When feullitate
-	teaching and learning mathematics there are critic
	teaching and learning mathematics there are criteria to consider. The following below are criteria
	for selection of touching and learning technique
_	in the teaching and barring of mathematic. Firstly djective of the lesson or subject matter
_	tirstly affective of the lesson or abject madeer
	Refore you plan to teach a professional tracker must
	Consider the objective of the topic to be taught. A Leather teach that subject for which trason. Hero
	It have that suspect for which reason the
	the term why is considered. A teacher teaches what
	intended to be taught and to be covered in a lesson
	Socondly cognitive ability of the barner. The
	becames or that are all to respond the losses
	This is because you can teach a lesson which is
	above the cognitive level a ability of the learner
	or student.
	Thirdly, class level or developmental lovel of
	the student. The student can master what you
	intend or need to teach. If the lesson toward
	is above his or her class level he or she can
	not master it effectively. The learning result
	will be difficult

Extract 15.1: Is a sample of a correct answer given in question 15.

However, 3 candidates (0.9%) answered this question incorrectly due to lack of knowledge about criteria used for selection of teaching and learning techniques in the teaching and learning of Mathematics. Some of them just provided the definition of a teacher and described the terms like audience, behaviour condition and degree as extract 15.2 reveals.

15 Teaching refers to the transmission of kno
intedge from one people to another, while
teaching techniques are methods used by
a tracker to facilitates a learning proce
2x est time selections a recorning proce
35 effectively, also Learning to changues
are methods used by the students given
by their teacher to enhance them to
participate well in teaching and bearning
process, The following are some of the criti
ria of for selection of teaching and
Learning to al in the train
learning to chiniques in the teaching and learning of matternatics.
A Dis - March Market
Andience, Means that the population of
the participant in a particular learning
Behavioral, means the characteristics of
the participants in a particular hearning
of the course.
Condition, means an environment that
the location take aloca
the barning take place
Degree means what the facilitator
expected to implement to the learners
Time, means of what facilitator
prepare to hoplement to the learners,
· · · · · · · · · · · · · · · · · · ·

Extract 15.2: A sample of a candidate's incorrect response in question 15.

2.3.3 Question16: Assessment in Mathematics

In this question, the candidates were required to briefly describe three functions of an effective mathematics teacher.

This question was attempted by 229 candidates (54.5%). Out of 229 candidates who attempted this question, 196 (85.7%) failed by scoring from

0 to 5.5 marks. This is the question which was poorly performed in this paper as can be seen in figure 10.

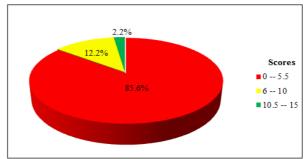


Figure 10: The performance of candidates in question 16.

The candidates who answered incorrectly this question failed to distinguish between the function of a mathematics teacher and the qualifications of a teacher. They wrote the definitions of a mathematics teacher and other requirements of a teacher when teaching in the classroom as shown in Extract 16.1.

16.	Mathie matics Teacher
	and few once that facilitate
	the methic matrix Controls
	to bearmers the following
	are three functions of
7	mathie matics of leacher, as
	For a king Te ach er.
	To Bre Good solver
	by Proble in of the Stydients in
	Madhue maker mwhoch the
	Ishe want to be with
	Ewough smowledges to
	Pacelitadue mathia metres.
	methods and techniques
	Re Leg letaluel les commen par less

Extract 16.1: illustrates the candidate's incorrect response in question 16.

On the other hand, there were only 5 candidates (2.2%) who managed to score from 10.5 to 14 marks. This shows that there were very few candidates who had adequate knowledge on the topic of assessment in

mathematics. Extract 16.2 shows the response of a candidate who managed to answer this question correctly.

16 Effective notherestres tracher -
16 LA Fredtre Morthematics fraction -
and professinally well grapared
toacher in mathemators Subject
The following are the three
Functions of an effective Mathena-
tics teacher
Executive functions - an
effective mathematics teacher
have a leadership role or function
In a class, he/sho has a duty to
load, Facilitate for effective treading
and learning.
Interactive function _ an
Effective mathematics teacher has
a function to employ various nothers
tochnique and strategies for estedin
Interaction lotwoon Student and
materials and student to touching
and learning struction (tracher)
Organization Function - also
an effective Mathementics toucher
has to make sure heldre work
and cooparate with other toucher
to boing Botter environment for
to boing softer environment for
teaching and learning morthmetics
Generally apart from Those
Generally apart from Those Functions the government Should
a so an orrowing range many funda
such as with incontives so that hel
Extract 162: Is a comple of the condidate's correct response in question 1

Extract 16.2: Is a sample of the candidate's correct response in question 16.

Generally the performance of the candidates in this question was poor, which means that this topic was not understood by most of the candidates before they sat for the examination.

3.0 THE ANALYSIS OF CANDIDATES PERFORMANCE PER TOPIC

The topics that were examined in the 2019 mathematics examination paper were; Foundations of Mathematics, Logic, Similarity and Congruence, Analysis of Mathematics Curriculum Materials, Probability, Coordinate Geometry II, Hyperbolic Functions, Vectors, Algebra, Assessment in Mathematics and Planning and Preparations for Teaching Mathematics.

The analysis of candidates' performance per topic shows that, four topics had good performance, namely; *Planning and Preparation for Teaching Mathematics* (99.1%), *Analysis of Mathematics Curriculum Materials* (94.9%), *Similarity and Congruence* (78.4%) and *Logic* (71.3%).

In addition to that, there were four topics with average performance, namely; *Hyperbolic Functions* (61.6%), *Vectors* (59.2%), *Coordinate Geometry II* (53.1%) and *Assessment in Mathematics* (52.3%).

However, the data shows that the candidate had poor performance on three topics which are; *Foundations of Mathematics* (38.1%), *Probability* (31.9%) and *Algebra* (28%). This poor performance was due to lack of skills and competence of the candidates on these topics.

Further analysis was done on each topic by finding the average of the percentages of the candidates who correctly answered the questions in a particular topic. The analysis of the performance in each topic was categorised in three groups according to the average of the percentages of the candidates who correctly answered the questions. These groups were 70–100, 40–69 and 0–39 percent for good, average and poor performance respectively.

4.0 CONCLUSION

The general performance for 740-Mathematics subject, was average by an overall average of 55.7%. The analysis of performance per topics reveals that the reasons that contributed to the topics having an average and weak performances include; making errors while performing mathematical operations, lack of skills on various concepts which were examined in the questions, applying incorrect formulae and failure to identify the requirements of the questions by the candidates.

5.0 **RECOMMENDATIONS**

In order to improve the performance of mathematics subject for Diploma in Secondary Education in future, the following opinions are recommended:

- (a) Tutors should make sure that all topics in the syllabus are clearly taught and covered so as to equip the candidates with wide skills in answering the examination questions.
- (b) Candidates should be given enough exercise in order to improve their capacity in answering examination questions.
- (c) Candidates should be encouraged to read various materials such as books and pamphlets of mathematics in order to increase their knowledge and ability on different mathematics concepts particularly in the topics with poor performance.
- (d) Tutors should provide monthly tests especially in the poorly performed topics in order to improve the performance.

APPENDIX

ANALYSIS OF PERFORMANCE OF CANDIDATES IN EACH TOPIC

S/N	Торіс	Number of question	Performance Candidates in Percentage Percentage for Each		Remarks
			Question		
1	Planning and Preparation for Teaching Mathematics	15	99.1	99.1	Good
2	Analysis of Mathematics Curriculum Materials	5	94.9	94.9	Good
	Similarity and	4	67.6	78.4	Good
3	Congruence	13	89.1		
	Logic	3	80.3	71.3	Good
4		12	62.3		
5	Hyperbolic Functions	9	61.6	61.6	Average
6	Vectors	10	59.2	59.2	Average
7	Coordinate Geometry II	7	39.4	52.7	Average
,	Coordinate Geometry II	8	66.0	52.7	Average
8	Assessment in Mathematics	14	90.2	52.3	Average
		16	14.4	3 2.3	77 18
	Foundations of	1	36.1	38.1	Poor
9	Mathematics	2	40.1		
10	Probability	6	31.9	31.9	Poor
11	Algebra	11	28	28	Poor

THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA



CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR DIPLOMA IN SECONDARY EDUCATION EXAMINATION (DSEE) 2019

740 MATHEMATICS

The National Examinations Council of Tanzania,
P.O BOX 2624,
Dar es Salaam, Tanzania.
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TABLE OF CONTENTS

FOR	EWORD	iv
1.0	INTRODUCTION	1
2.0	ANALYSIS OF CANDIDATES' RESPONSES ON EACH	QUESTION 2
	2.1 Section A: Short Answer Questions	2
	2.1.1 Question 1: Foundations of Mathematics	2
	2.1.2 Question 2: Foundations of Mathematics	4
	2.1.3 Question 3: Logic	6
	2.1.4 Question 4: Similarity and Congruence	7
	2.1.5 Question 5: Analysis of Mathematics Curriculum	Materials 9
	2.1.6 Question 6: Probability	10
	2.1.7 Question 7: Coordinate Geometry II	12
	2.1.8 Question 8: Coordinate Geometry II	14
	2.1.9 Question 9: Hyperbolic Functions	17
	2.1.10 Question 10: Vectors	19
	2.2 Section B: Essay Answer Questions (Academic)	22
	2.2.1 Question 11: Algebra	22
	2.2.2 Question 12: Logic	25
	2.2.3 Question 13: Similarity and Congruence	28
	2.3 Section C: Essay Answer Questions (Pedagogy)	31
	2.3.1 Question 14: Assessment in Mathematics	31
	2.3.2Question 15: Planning and Preparation for Teaching	g Mathematics 35
	2.3.3 Question16: Assessment in Mathematics	36
3.0	THE ANALYSIS OF CANDIDATES PERFORMANCE PE	ER TOPIC 39
4.0	CONCLUSION	39
5.0	RECOMMENDATIONS	40
APP	NDIX	41

FOREWORD

The report on the Candidates' Item Responses Analysis for Diploma in Secondary Education Examination in Mathematics was prepared for the purpose of providing feedback to candidates, tutors, policy makers, curriculum developers and other education stakeholders on how the candidates answered the examination questions.

The analysis of responses shows that some of the reasons that made the candidate fail to answer the examination questions correctly include; making errors while performing mathematical operations, failure to recall some basic formulae, lack of knowledge and skills on various concepts which were examined, applying incorrect formulae and failure to identify the requirements of the questions.

The National Examinations Council of Tanzania believes that this analysis will provide feedback to various education stakeholders in order to take appropriate measures in improving mathematics teaching techniques as well as creating some more strategies in teaching and learning mathematics subject.

Finally, the Council would like to extend sincere appreciation to the Examination Officers and all others who participated in the preparation of this report.

Ma

Dkt. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

The Diploma in Secondary Education Examinations is done every year with the aim of assessing knowledge and skills that have been achieved throughout the two years of implementing the Diploma in education curriculum. A total of 420 candidates were registered in the 2019 DSEE in Mathematics subject of which 417 (99.3%) candidates sat for the Examination.

The paper had a total of sixteen (16) questions divided into three sections namely A, B and C. Section A consisted of 10 short answer questions from both academic and pedagogic contents. Candidates were required to answer all questions in this section. Each correct answer had 4 marks, making a total of 40 marks. Section B consisted of 3 essay questions from academic subject matter. Candidates were required to answer 2 questions where each question had 15 marks, making a total of 30 marks. Section C consisted of 3 essay questions from pedagogy subject matter. Candidates were required to answer 2 questions; the total marks for each question were 15, so the section had a total of 30 marks. Candidates' responses for every question were analysed in order to identify the reasons for either better performance or failure. The analysis involved worked out scripts for each question. Extracts for every question were placed as a sample to the general performance of the question.

The analysis involved all questions that were in the examination paper. It based on the percentage of candidates who performed well the assessment in every question. The analysis on the performance for each question in section A had three categories of marks as follows: 3 - 4 marks; indicating good performance, 2 - 2.5 marks; indicating average performance and 0 - 1.5 marks; indicating poor performance. In sections, B and C, the performance analysis for each question was also categorised into three groups of marks as follows: 10.5 - 15 marks; indicating good performance, 6 - 10 marks; indicating average performance and 0 - 5.5 marks; indicating poor performance.

2.0 ANALYSIS OF CANDIDATES' RESPONSES ON EACH QUESTION

The analysis of candidates' responses for each of the sixteen questions in mathematics was observed as follows:

2.1 Section A: Short Answer Questions

2.1.1 Question 1: Foundations of Mathematics

In this question, the candidates were required to identify four great Mathematicians in mathematics history and explain briefly the contribution of each one.

This question examined candidates' ability to remember the contributions of greater mathematicians on developments of various properties and ideals in mathematics subject.

A total of 352 candidates (83.8%) attempted this question. The analysis of responses in this question shows that 225 candidates (63.9%) scored from 0 to 1.5 marks, 79 candidates (22.4%) scored from 2 to 2.5 marks while 48 candidates (13.6%) scored from 3 to 4 marks. The analysis shows that out of 225 candidates who scored from 0 to 1.5 marks, 68 candidates (19.3%) got a 0 mark. Therefore the general performance for this question was poor because the majority of the candidates (63.9%) scored from 0 to 1.5 marks as indicated in figure 1.

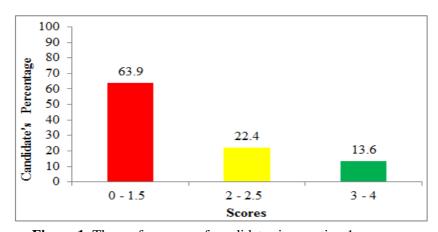


Figure 1: The performance of candidates in question 1.

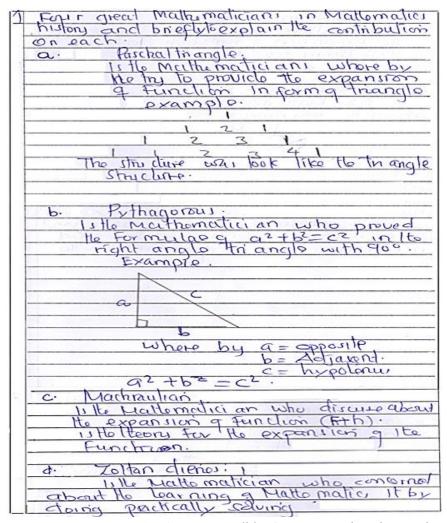
Extract 1.1 shows the sample of answers from a candidate who failed to remember any of the contributions of the great mathematicians. And therefore he/she presented imaginary answers for each of the mathematician mentioned.

Ľ.	oplato contributes and state children should
	be stron undurine learning environment and he
	was Greek.
	(2) Pascal said learner should learn by
	playing and he was French
	1 tralliles intofute to the learning arm
	Grmente
- 1	
	(4) Zuitan Diener visa learning is pleying

Extract 1.1: Sample of incorrect candidate's response in question 1.

This implies that the candidates who failed in this question were not aware of the great mathematicians and their contribution on the subject. They focused on the contribution of education in general instead of mathematics subject.

On the contrary, a total of 48 candidates (13.6%) remembered the contributions of the great mathematicians and presented the correct responses as shown in extract 1.2.



Extract 1.2: Sample of correct candidate's response given in question 1.

2.1.2 Question 2: Foundations of Mathematics

In this question, the candidates were required to explain briefly Zoltan Dienes view in learning Mathematics.

This question assessed candidates' knowledge about the view of the mathematician Zoltan Dienes and his contributions in mathematics field. A total of 272 candidates (64.8%) attempted the question. The analysis of data for this question shows that 163 candidates (59.9%) scored from 0 to 1.5 marks, 32 candidates (11.8%) scored from 2 to 2.5 marks and 77 candidates (28.3%) scored from 3 to 4 marks. Out of 77 candidates who scored from 3 to 4 marks, 43 candidates (10.2%) scored full marks that were allocated to this question. The general performance for this question was poor because those who performed poorly were 59.9% compared to those who scored

from 2 to 4 marks who were only 109 (40.1%). Figure 2 shows the performance of the candidates in this question.

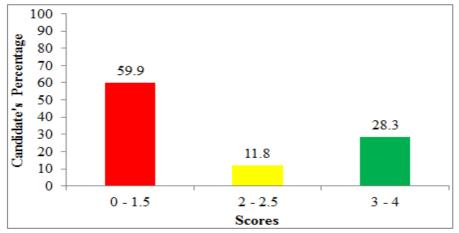


Figure 2: The performance of candidates in question 2.

There were candidates who managed to score full marks as can be seen in extract 2.1 below which is the sample of a candidate's response who managed to remember the Zoltan Dienes view in learning Mathematics.

	Zalt an Dienes view in learning Mathematic				
	if Emphasize learning through practices				
	I'l Emphasize critical thinking				
	in Brings the rules and theories of				
	tearning mathematics.				

Extract 2.1: Sample of a correct candidate's response in question 2.

However, 163 candidates (59.9%) of those who attempted this question failed to get it correctly. The reasons for failure were inability to remember and write the Zoltan Dienes view in learning Mathematics. For instance some of the candidates wrote about capacity, experience and age. Extract 2.2 is a sample of a candidate's response who failed to recall the view of the mathematician Zoltan Dienes.

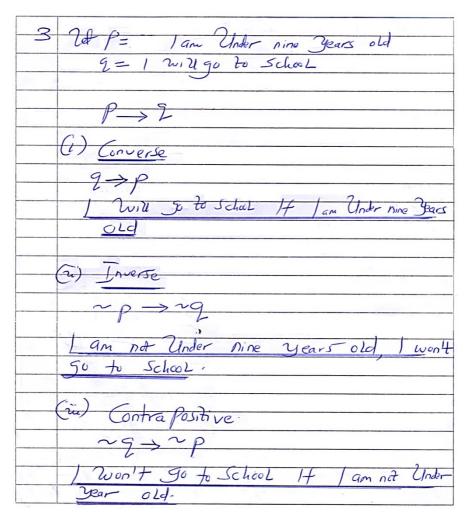
R	20	tan	Die	Lans	he s	avel	the	ma	thans	this
					king					
	exp	QViQ	10		J		1	7,	0	

Extract 2.2: Sample of incorrect response of a candidate in question 2.

2.1.3 Question 3: Logic

The candidates were required to write the Converse, Inverse and Contrapositive of the statement "If I am under nine years old, then I will go to school".

This question examined candidates' ability to apply logic for solving problems in their real life. The question was attempted by 417 (99.3%) out of 420 registered candidates. A total number of 146 candidates (35.0%) answered this question correctly; displayed a high level of interpretation of the given statements and presented the correct answers as shown in extract 3.1.



Extract 3.1: Sample of candidate's correct response given in question 3.

Despite the fact that the question reflected a simple logical application of simple compound statement, 82 (19.7%) of the candidates who attempted

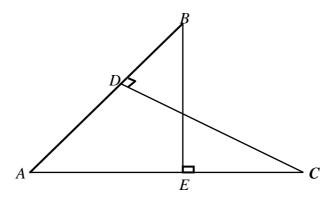
the question, failed to answer it correctly. The failure was due to lack of basic skills to interpret and use correctly the symbols used to represent converse, inverse and contrapositive of a statement. They wrote compound statements which had different meaning in logical statements. Extract 3.2 is the sample of the responses of a candidate who failed to make the correct interpretation that could lead him/her to attain the correct statements.

3.	30/n:
	let P be if I am Under nine years old
A 100 A	9 be I will go to school
100	and, = V
	1.00 J - 10 1
	Connection will be PV9
	PV 9 - p Statement
	9, VP - Converse.
	~q, V~P -> Contapositive
	apvag to Inverse

Extract 3.2: Sample of the incorrect candidate's response in question 3.

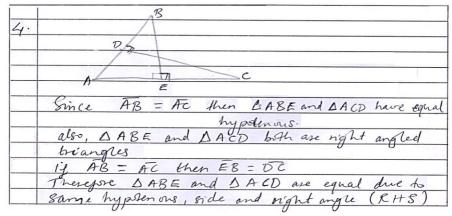
2.1.4 Question 4: Similarity and Congruence

The candidates were required to prove that triangle ABE and \overline{ACD} are congruent by considering that, in the following figure, $\overline{AB} = \overline{AC}$, D and E are midpoints of \overline{AB} and \overline{AC} respectively.



This question aimed at measuring candidates' ability to identify the given figure and apply the similarity and congruence properties of figures to prove the congruence of triangles *ABE* and *ACD*.

A total of 389 candidates (92.6%) attempted this question. The performance of candidates for this question was good as 165 candidates (42.4%) scored from 3 to 4 marks and 98 candidates (25.2%) scored from 2 to 2.5 marks. Those candidates who responded to this question correctly were able to identify the similar triangles and the sides which were equal as well as applying their properties to conclude. See extract 4.1 which is a sample of the response of candidates who managed to answer this question correctly.



Extract 4.1: Illustrates a sample of correct candidate's response in question 4.

On the other hand, a total of 126 candidates (32.4%) failed to respond correctly to this question. The reasons for failure were due to lack of knowledge of identifying equal sides, equal triangles as well as failing to apply the properties to prove congruence of triangles. Extract 4.2 shows the situation where one of the candidates attempted the questions using incorrect procedures.

On 4	Consta	er 1		ABE	and	AC	0-	
	For a	man	gle to	bei	ome	cong	niena	, it
	must	have	same	sh	ape	and	size.	
	There	tere	the 1	ine	or r	nidpont	7 8 0	ug.D

Extract 4.2: Sample of an incorrect response of the candidate in question 4.

2.1.5 Question 5: Analysis of Mathematics Curriculum Materials

The candidates were required to mention four curriculum materials applied in teaching and learning of mathematics subject.

This question assessed candidates' knowledge about curriculum materials relevant for teaching and learning mathematics. It required the candidates to remember and write the taught curriculum materials.

A total of 351 candidates (84.6%) of those who attempted this question responded it correctly; as a result the performance for this question was good. The candidates who performed well in this question were able to remember and write the curriculum materials required as indicated in extract 5.1.

5	Chriculum material applied in teaching and learning mothernation
	D Reference book
	Text book
	iii) Sillebus
	IV) Teacher guide

Extract 5.1: Illustrates a sample of candidate's correct response in question 5.

However, a total of 21 candidates (5.1%) failed to give correct answers to this question due to lack of knowledge about teaching and learning materials in mathematics. Some of them wrote about IT materials instead of writing the taught learning materials applied in mathematics as extract 5.2 reveals this analysis.

5	(i) Computer games
	(li) Andio-visual Villed
	(ii) Projector
	(14) Voutube Videos

Extract 5.2: Sample of the incorrect candidate's response in question 5.

2.1.6 Question 6: Probability

The candidates were required to calculate the probability that number 5 has appeared at least once as a die is thrown twice and the sum of the number appearing is observed to be 8.

The question assessed candidates' ability to apply the formulae $P(A/B) = \frac{P(A \cap B)}{P(B)}$ where A is the event of getting number 5 appearing at least once and B is the event of getting the sum of numbers appeared equal to 8.

A total of 364 candidates (86.7%) attempted this question. The analysis of candidates' responses shows that 248 candidates (68.1%) scored from 0 to 1.5 marks, 55 candidates (15.1%) scored from 2 to 2.5 marks and 61 candidates (16.8%) scored from 3 to 4 marks. Among the 61 candidates who scored from 3 to 4 marks, 53 candidates (12.6%) scored full marks that were allocated to this question.

The general performance of candidates in this question was poor because those who scored from 0 to 1.5 marks were 68.1% compared to 31.9% of the candidates who scored between 2 to 4 marks as shown in figure 3.

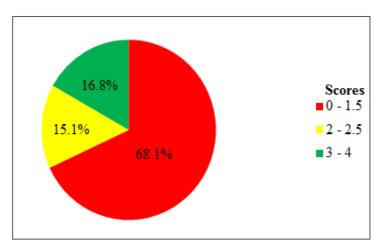
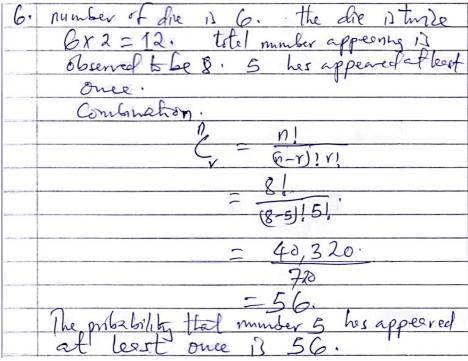


Figure 3: The performance of candidates in question 6.

Some of the candidates who responded wrongly to this question were using combination formula which was not needed in this case. Extract 6.1 shows an example of a response of the candidate who used incorrect formula.



Extract 6.1: Illustrates the incorrect candidate's response to question 6.

Some candidates who failed to respond correctly to this question used wrong formulae by using the combination formulae ${}^{n}C_{r} = \frac{n!}{r!(n-r)!}$ and replaced n by 8 and r by 5 which lead them to an incorrect answer because of the wrong procedure.

However, 61 candidates (16.8%) managed to get the correct answer. Some of the candidates used the method of listing the events to get the required probability as in extract 6.2.

Die 1	en that
1	1 2 3 4 5 6
2	2,1 2,2 2,3 2,4 2,5 2,6
3	3/1 3/2 3/3 3/4 3/5 3/6
4	411 412 413 414 415 416
_5	5,1 8,2 8,3 5,4 5,5 5,6
6	
The	o 8 are
	. 3,5 4,4,5,3,6,2
1265)= 5
	7 = No 5 to appear atteast one
	3,5 and $5,3$
	7 (8)
) = 2/5 = 0.4
/4	appear attens one = 2/0004
	/5

Extract 6.2: Sample of a correct response of a candidate in question 6.

2.1.7 Question 7: Coordinate Geometry II

The candidates were required to find the equation of the tangent to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at point $(a\cos\theta, b\sin\theta)$.

This question was intended to examine candidates' ability to apply chain rule in establishing the equation $\frac{dy}{dx} = \frac{dy}{d\theta} \times \frac{d\theta}{dx} = \frac{dy}{d\theta} \div \frac{dx}{d\theta} = \frac{-b\cos\theta}{a\sin\theta}$ and use it to get the required equation.

A total of 383 candidates (91.2%) attempted this question. The analysis shows that 232 candidates (60.6%) scored from 0 to 1.5 marks, 36 candidates (9.4%) scored from 2 to 2.5 marks and 115 candidates (30.0%) scored from 3 to 4 marks. Out of 115 candidates who scored from 3 to 4 marks, 101 candidates (24.0%) scored full marks which were allocated to this question.

The general performance of candidates to this question was poor because 232 candidates (60.6%) scored from 0 to 1.5 marks compared to those who

scored from 2 to 4 marks who were only 39.4% of those who attempted the question. The candidates who failed to solve this question assigned the given coordinates with the letters *x* and *y* and simplify instead of applying the differentiation methods with the chain rule as shown in extract 7.1.

7.	a cost = >c, bsind = 1
	$= (\alpha \cos \alpha)^2 + (6 \sin \alpha)^2 = 1$
	a2 62
	$=\frac{g^2(08^2Q+b^2sin^2Q=1)}{g^2}$
	Ces ² Q + $\sin^2Q = 1$ -: The equivation is $\cos^2Q + \sin^2Q = 1$
	· : The equilition is Cos20 +Sin20 =1

Extract 7.1: Sample of an incorrect response of a candidate.

On the other hand 115 candidates (30%) of those who attempted this question got it correct. This is due to the fact that they correctly used the method of differentiation and chain rule to find the equation as shown in extract 7.2.

$\frac{7}{dx} = \frac{-20cb^2}{2ya^2}$
dx 2ya2
$\frac{d\eta}{dx} = -\frac{xb^2}{vn^2}$
$-\frac{1}{\sqrt{\eta x}} \frac{\sqrt{\eta x}}{\sqrt{\eta x}}$
also given points = (aloso, blino)
(X, Y)
$\frac{9 \text{ adinf} = 9 - 6 \text{ mo} = -\infty b^2}{x - a \cos \theta}$
x - a Coso 9a2
$(y - b fino) ya^2 = (x - a loso) - xb^2$
$y^2a^2 - ya^2bfino = -x^2b^2 + xb^2a \cos \alpha$
$y^2a^2 + \chi^2b^2 = xb^2a\cos + ya^2b\sin a.$
Unde Bis ays Loth Side.
year + x42 = x62aloso + ya45mo
$y^{2}a^{2} + xy^{2} = xb^{2}a(ax) + yaysmo$ $ay^{2} ay^{2} a^{2}b^{2} a^{2}b^{2}$ $y^{2} + x^{2} = x(ax) + ysmo$ $b^{2} a^{2} a$ $b^{3} a^{2} a$
1 + 12 = x Coso + 58mo
b^{r} a^{r} a b
but
$\frac{b^2 + x^2 = 1}{b^2 a^2}$
b^{2} a^{2}
$\frac{2 \cos + 9 \sin \circ = 1}{a}$
a b
$\frac{1}{1000} = \frac{1}{1000} = 1$
1 u b

Extract 7.2: Sample of the correct response of a candidate in question 7.

2.1.8 Question 8: Coordinate Geometry II

The candidates were required to find the coordinates of point P by considering a point P which divides internally the line joining point (4, 2, 2) and (10, 6, 4) in the ratio 1:1.

This question assessed candidates' knowledge of finding the coordinates of a point by using the concept of ratios and internal division of lines. It was intended to evaluate the candidates' ability to remember and use the formulae $\underline{P} = \left(\frac{n}{n+m}\right)\underline{a} + \left(\frac{m}{n+m}\right)\underline{b}$ in finding the required coordinates.

Where *n* and *m* are the given ratio i.e., n = 1 and m = 1.

The question was attempted by 341 candidates (81.2%). The analysis of data shows that 116 candidates (34.0%) scored from 0 to 1.5 marks, 18 candidates (5.3%) scored from 2 to 2.5 marks and 177 candidates (60.7%) scored from 3 to 4 marks. This means that the performance of the candidates for this question was average because those who scored from 2 to 4 marks were 195 (66.0%). Figure 4 shows the performance of the candidates for this question.

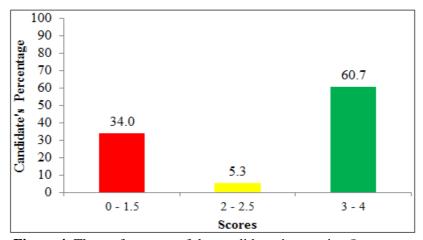


Figure 4: The performance of the candidates in question 8.

The candidates who managed to get the correct answer were able to remember the formulae and apply it correctly to find the coordinates of a point in a line which is $\underline{P} = \left(\frac{n}{n+m}\right)\underline{a} + \left(\frac{m}{n+m}\right)\underline{b}$ and attain the correct answer as indicated in extract 8.1.

08 heven that
Paro 1:1 = X:N
points (4,2,2) and (10,6,4) pako 1: 1 = 1:11 let (cy, b, C,) = (4,2,2)
$(a_2/b_2, C_2) = (1076/4)$
Reccell from internal division
62 1 4 61 11
$\left(\begin{array}{c c} c_2 \end{array}\right) \left(\begin{array}{c c} c_1 \end{array}\right)$
k . A . / .
6 x2-1/2 x £
6 12 1 2 142
1 + 1
(10)
6 + 2
4/
o
(0+4)+(6+2)+(4+2)
2
14+8+6
2
2 2
$\frac{28}{2} = 14$
For the coordinate
(C2) (C2) (C2) (C2)
(22x+agre), (Bex+b,al), (Cex+GM)
X+M 10 L A+M / 1 / 1/11
(10x1+4x1) = (6x1+2x1) (6x1+2x1)
$ \frac{\left(10x1+4x1\right)}{1+1} 7 \left(\frac{6x1+2x1}{1+1}\right) / \left(\frac{4x1+2x1}{1+1}\right) $
(10+4), $(6+2)$, $(4+2)$
2/1/2/
$\frac{14}{2}$ / $\frac{8}{2}$ / $\frac{6}{2}$
2
(7,4,3)
[(ourdinate of P = (7,4,3)

Extract 8.1: A sample of candidate's correct response given in question 8.

However, 116 candidates (34.0%) of those who attempted this question failed to get it correctly due to incapability of remembering and using the relevant formula. Some of them were just adding the given coordinates to get the midpoint coordinates as indicated in extract 8.2 where candidate

failed to recall and apply the formula to get the coordinates required because he/she added the given coordinates, i.e.; 4+10=14, 2+6=8 and 2+4=6 instead of using the formula.

8.	Soul.
	milen points. (4,2,1) and (10,6,4).
	POINT P = (H, 2, 2) + (10, 6, 4)
	= 14, 8, 6
	3 6 7 6 11 0 0 1
	~ 1001ND 10= (14,8,6)

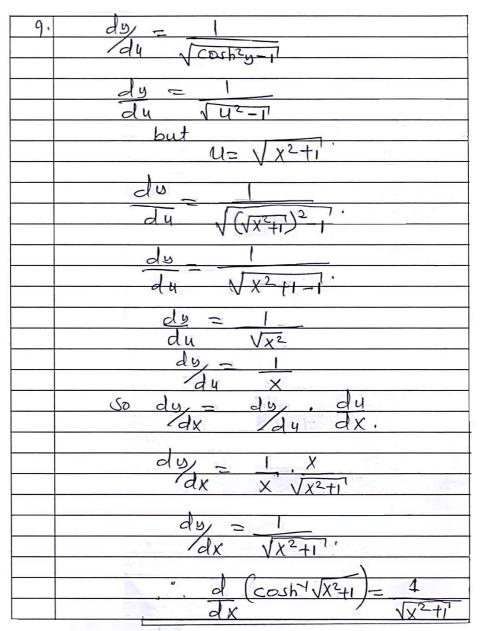
In Extract 8.2: Illustrates an incorrect response of a candidate in question 8.

2.1.9 Question 9: Hyperbolic Functions

The candidates were required to differentiate $\cosh^{-1}(\sqrt{x^2+1})$ with respect to x.

This question evaluated the candidates' ability to differentiate hyperbolic functions by using the substitution method.

A total of 398 candidates (94.8%) attempted this question. The analysis of data shows that 153 candidates (38.4%) scored from 0 to 1.5 marks, 62 candidates (15.6%) scored from 2 to 2.5 marks and 183 candidates (46.0%) scored from 3 to 4 marks. Out of 183 candidates who scored from 3 to 4 marks, 121 candidates (28.8%) scored all marks that were allocated for this question. So the general performance of candidates for this question was average since 61.6% of the candidates who attempted the question scored from 2 to 4 marks. Extract 9.1 illustrate this analysis.



Extract 9.1: Sample of a correct candidate's response given in question 9.

On the other hand, 38.4% of the candidates who attempted this question failed to get it correctly due to inability to make the substitution over the given expression so that it becomes simple before starting to differentiate. They were required to let $u = \cosh^{-1}(\sqrt{x^2 + 1})$ so that $\cosh u = \sqrt{x^2 + 1}$ then proceed with the process of differentiating. Extract 9.2 is a sample of a response from a candidate who failed to differentiate properly the given expression.

9	Solution Girls Dog t
	Given that
	Corch-1 (V22+1
	Given that $\frac{(osh^{-1}(\sqrt{5}^{2}+1)}{1+1}$ Let $y = (osh^{-1}\sqrt{5}^{2}+1)$ now
	now
	Cores u = Vn2+1
	Cosh y = \n2+1 Differentiate with respect to n
	organistic with respect to
	+ Sub 4 du = 1 (224) 22
	+ Such y dy = - 1 (n2+1). 2n
	Suchydy = - y (n2+1)
	1 2312
	dy - x3+x1 dr Suihy
	dh smny
	P.12 1/12 -1
	now from - Suiting + (osting = 1 Suiting = 1 - Cesting
	Sunhy = 1- lestry
	Sunhy = VI-Cothy
	Jan My = VI = With y
	no.\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
	$\frac{\text{now}}{\text{dx}} = \frac{\chi^3 + \chi}{\sqrt{1-(\alpha \beta \lambda^2 \gamma)}}$
	dh /12 (oshy
	1 3
	$\frac{dy}{dx} = \frac{x^3 + x}{\sqrt{1 - \sqrt{x^2 + 1}}}$
	(h /1-/n2+1
	$\frac{dy}{dn} = \frac{n^3 + n}{\sqrt{1 - \sqrt{n^2 + 1}}}.$
	dn VI-Vn+1.

Extract 9.2: Illustrates the incorrect response of a candidate in question 9.

2.1.10 Question 10: Vectors

The candidates were required to find the angle between $\underline{a} = 2\underline{i} + \underline{j} - 2\underline{k}$ and $\underline{b} = \underline{i} - 2\underline{j} + \underline{k}$ by using the cross product of vectors.

The question examined candidates' skills on how to use the cross product formula which is $|\underline{a} \times \underline{b}| = |\underline{a}||\underline{b}|\sin\theta$ where \underline{a} and \underline{b} are two different vectors, in order to get the angle between the two vectors.

The question was attempted by 409 candidates (97.4%). The analysis of data for this question shows that 167 candidates (40.8%) scored from 0 to

1.5 marks, 48 candidates (11.7%) scored from 2 to 2.5 marks and 194 candidates (47.5%) scored from 3 to 4 marks. Out of 194 candidates who scored from 3 to 4 marks, 164 (39.0%) scored full marks that were allocated for this question. Figure 5 shows the performance of the question in question 10.

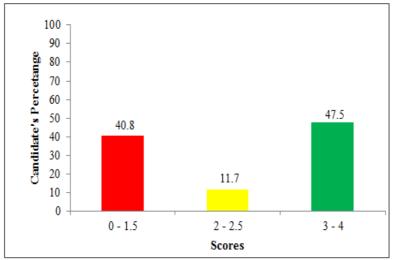


Figure 5: The performance of the candidate question 10.

The candidates who got the correct answer had enough skills on how to use cross product for calculating the angle between two different vectors. They managed to use the formula $|\underline{a} \times \underline{b}| = |\underline{a}| |\underline{b}| \sin \theta$ and proceed by finding $|\underline{a}| = \sqrt{4+1+4} = 3$ and $|\underline{b}| = \sqrt{1+4+1} = \sqrt{6}$ to attain the final answer as shown in extract 10.1.

10	A& /
	Cross produc = Ax8.
	6 = 1 -21 + 2.
-7-5	d= 21 +1 -2K
	B = 1 -21 +2.
	9xb = 10 ; 12 1
	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
- 4	4 -2 1 1
	1 i ((1x1) - 4) - j [2x1++2] + k (2x-2) - (1x1)] 1 1 (1-4) i - 4 j + (-4-1) k 1 1 - 3 i - 4 j 5 k 1
	1(1-4): -4: -4 (-4-1)21
	1-30-41 Jakl
	axb = 1-3:-4; -5x:/ , axb = (x+y++2)
	axb) = ((-34+(4)2+(52)
	79+16+25
	d 50
	axb = 50.
	9xb = [Allb] sinB
	19= 122+12+(-2)2
	191- 14+1+4 (9)=d9 (0)=3.
	19= 122+12+(-2)2 19= 14+1+4 (9=19 191=3. 16=12+(-2)2+12=1+4+1=6
	150 = 3xd6 Sin B
	dEo = Sin B
	2 2 7 7:07 5:08
	7.67 - 7.348
	2 X24 49.
	VIOB = 0.9623
	8 z 74.2°
	; the Argle Ist 13 74.2°
	11 10- 11100 2001 13 1/412

Extract 10.1: Is a sample of candidate's correct response in question 10.

Meanwhile, there were 167 candidates (40.8%) who attempted this question and performed poorly due to inability to remember and improper use of vector cross product techniques so as to get the required angle. Some of them just calculated the magnitude of both vectors and subtract before equating to $\sin\theta$ and find the angle θ resulting into incorrect answer as revealed in extract 10.2.

10 From Cost gooded formula
A-A - WHIBI GAG , a= 2i+1-2a 1= i-2;+k
1 & j k)
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
1 -2 1
2 (1+-4)-1(2+2)+-2(-4-1)
= -4 - 4 + 10
-6-4+10 = V22+12+2× 12+22+12 + 6246.
-6,-4, thore V9 + V6 52ns
1462+-61+104 = 156 SIRA
V88 +16+100
Viez Va
o = VB fire
Ono = O
6= 6n7 (950) =0
Thanker for intended angle will be o

Extract 10.2: Is a sample of candidate's incorrect response in question 10.

2.2 Section B: Essay Answer Questions (Academic)

2.2.1 Question 11: Algebra

This question had three parts where by the candidates were to:

- (a) Evaluate $\sum_{1}^{10} n^2 + 3n$, given that $\sum_{1}^{10} r^2 = \frac{n}{6} (n+1)(2n+1)$ and $\sum_{1}^{10} r = \frac{n}{2} (n+1)$.
- (b) Show that $ac^3 = db^3$, if the roots of polynomial equation $ax^3 + bx^2 + cx + d = 0$ are in geometric progression.
- (c) Find an equation whose roots are $\alpha^2 \beta$ and $\alpha \beta^2$, when the roots of quadratic equation $2x^2 7 = 0$ are α and β .

This question had three parts, in part (a) the question assessed candidates' ability to expand the expressions and apply the given information to substitute the values in order to get the required answer; in part (b) the question assessed the candidates' knowledge about roots of polynomials and part (c) assessed the candidates' ability to factorise and apply the factors obtained to form an equation.

The question was attempted by 132 candidates (31.4%) out of 420 registered candidates. Among these candidates; 95 (72.0%) scored from 0 to 5.5 marks, 35 candidates (26.4%) scored from 6 to 10 marks and 2 candidates (1.6%) scored from 10.5 to 15 marks. The analysis indicates that the general performance for this question was poor because the candidates who passed were only 28%. Figure 6 shows the performance of candidates for question 11.

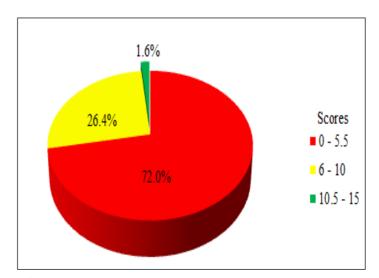


Figure 6: The general performance of candidates in question 11.

The candidates who failed to answer correctly this question lacked knowledge about the application of the given information; some of them substituted the given limits direct into the given expression and obtained incorrect answer as shown in extract 11.1.

11a) $\sum r^2 = ry(n+1)(2n+1)$ and $2r = ry(n+1)$
Z no +30.
4
tolution:
2 7 10
1-
5 1/6 (n+1) (2n+1) where = 4, 5, 6, 7, 8, 9, 10
4
10 Z 4 (4+1) (2x4+1) + 5/(5+1) (2x5+1) + 6/(6+1) (2x6+1)
4 + 7/ (7+4)(2x7+1) + 8/ (8+1) (2x8+1) + 9/ (9+1)(2x9+1)
+ 10/ (10+12) (2x10+1) + 3 f 0/2 (n+1)] (1/2 (4+1)+
5/(5+1) + 6/(6+0) + 7/(7+1) + 8/(8+0) + 9/(9+1)
1/2 (10+11).

Extract 11.1: Is the sample of incorrect response of a candidate in part (a).

Despite the failure of many candidates in this question, there were 37 candidates (28.0%) who managed to score from 6 to 13.5 marks. They managed to apply the given formula and able to factorise it as well as interpreting the values before making the substitution to attain the correct answer in part (a) as shown in extract 11.2.

AA	a). Given
11.	a). Given $\Sigma r^2 = n/(n+1)(2n+1)$ and
	Z1 = 1/6 (1171) (1171) (119
	Σr= n/ (n+1) but required.
	10
	> n2 + sn. where n= 4,5,6,7,8,9 and
75.5	4
	10
	$\sum_{n=1}^{10} (4^{2} + 3x4) + (5^{2} + 3x5) + (6^{2} + 3x6) + (7^{2} + 3x7)$
	Z11 +311 = (4 +3x4) +15 +3x3) + (6 +3x6) + (1 +3x1)
	4
	+ (82+3x8)+(92+3x9)+(102+3x10)
	,
	= 28+40+54+70+88+108+130,
	- 20 0 0 1 1 1 1 1 1 1
	- 518.
	= 518
	10
	1.2 + 20 = 518
	4

Extract 11.2: Illustrates the sample of a correct response of a candidate.

2.2.2 Question 12: Logic

In this question, the candidates were required to:

- (a) Draw an electrical network of the simplified form of the compound statement; $\sim \lceil (P \land \sim Q) \lor (\sim P \land Q) \lor (\sim P \land \sim Q) \rceil$.
- (b) Determine the validity of the argument "If it rains, the seedlings will survive. If seedlings survive well, animals will not die. But animals are dying. Therefore it is not raining", by using the laws of algebra of propositions.

This question assessed candidates' knowledge about logical properties and its application in simplification of compound statements. It was attempted by 355 candidates (84.5%) whereby 134 candidates (37.7%) scored from 0 to 5.5 marks, 134 (37.7%) scored from 6 to 10 marks and 87 (24.6%) scored from 10.5 to 15 marks. Out of 87 candidates who scored from 10.5 to 15 marks, 24 (5.7%) scored all marks that were allocated to this question.

The analysis indicates that the general performance of candidates in this question was average because those who scored from 6 to 15 marks were 221 (62.3%). Figure 7 presents the performance of candidates for question 12.

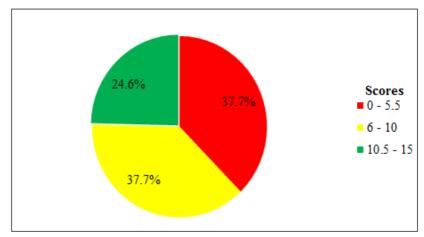


Figure 7: The performance of candidates in question 12.

Some of the candidates had adequate knowledge about formulating the compound statements and applying the laws of algebra of propositions to simplify as indicated in extract 12.1 which is the sample of the answers that were given by one of the candidates.

[10.4] [(0.4) (0.4) (0.4)
12a. ~[(PA~Q) V (~PAQ) V (~PA~Q)]
Let's simplify by using algebric laws of propositi
~[(PA~Q) V ~PA(QV~Q)] - distributive lan
~ [(PA~Q) V~PAT] - negation (am
~ [(PN~Q) V~PN T] - negation law ~ [(PN~Q) V~P] - identity law.
~ [(PV~P) \(\lambda\) (~QV~P)] - dign butive law ~ [T \(\lambda\) (~QV~P)] - negation ~ (~QV~P) = identity (aw (\(\hat{G}\) \(\lambda\) P) - double negation.
~ TT / (~ Q v~p)] - regation
~ (~QV~P) = identity (as
(BAD) - downe neartism
The electric net work will be in cones
The electric net work will be in series.
12 h. let D he It was
126 let; p be It rains a be the seedling survive to be animals are dying In pair from the strongent will be a seed to see
g be the seeding survive
The animals are aying
In which from the digument will be as follows.
11 The 12
then [10-D~r) 1/r] - p by definition = p-
[PV +) A - D' by definition
[[PA~ [] A F] - P negation
[~pA(~pA+)] -D~p Associative law
[~prF] -D ~ Negation law
F - D ~ D I dentity law
In bogic form the targument will be as follows. [(P -> g) N (g -> r) N r] -> -> P then [(P -> r) N r] -> ~ P by definition [(PN r) N r] -> ~ P by definition [(PN r) N r] -> ~ P negation [~ pN (~ r N r)] -> ~ P Negation law [~ pN F] -> ~ P Negation law F -> ~ P Identity law ~ F V P by definition TV P Negation law Thesefore the argument is valid.
TVP Negation law
T' identity law
Therefore the argument is valid.
Company of the Compan

Extract 12.1: Illustrates the response of a candidate statement correctly.

On the other hand, 134 candidates (37.7%) failed to get the correct answer to this question due to inability to remember the logical properties like; Distributive law, Negation law, Identity law and Double negation law. The analysis shows that some of them were using the laws which are not used in logic like Absorption law and Demogan's law. Therefore, they failed to simplify, ended up with the wrong statement as shown in extract 12.2.

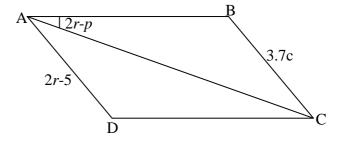
12-a)	Sehr.		
l Ci	1/10-10.	.a	
~	[PARQ)V(-PA	0) V (~PA~Q)] - liver.
	~[PV~PA~O		
	~ TV (~ P)	1~97 -	Absoption law.
	~ (~ bV	$\sim Q) - 1$	emogars lew.
	PVC	$\delta - \delta$	emogars bew.
			2 4.70
-	· electorical,	network e	DUF 10 VQ.
		<u> </u>	
3 4 4 1		Υ	
I I			10
			12
		6	
		9	
1	Soun.		
0).	het P = 1	Cario 8	1
	$\theta = 0$	Burvive 1	
	r = 0	animed	
1.	(1P->9)1 (2->	M1~2)-	»~p.
	ruch Jabl		
11	P-P9 N 9-PY)	1-17-1	anp.
		to the latest and the	

Extract 12.2: is the response of a candidate who failed to simplify the statements in question 12(a), (b).

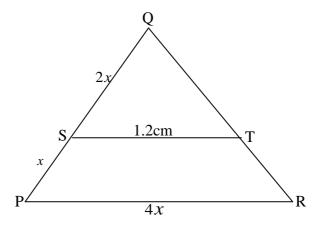
2.2.3 Question 13: Similarity and Congruence

In this question, the candidates were required to:

(a) Find the value of r and p in the following figure, where $\triangle ABC$ is congruent to $\triangle CDA$.



(b) Find the value of x in the following figure if $\triangle PQR \sim \triangle SQT$.



This question assessed candidates' ability to identify different figures and relate them in order to solve for values of r and p in part (a) and x in part (b).

A total of 349 candidates (83.1%) attempted this question. The analysis shows that 38 candidates (10.9%) scored from 0 to 5.5 marks, 118 (33.8%) scored from 6 to 10 marks and 193 candidates (55.3%) scored from 10.5 to 15 marks. Figure 8 presents the performance of the candidates in this question.

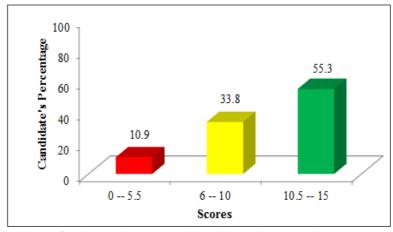


Figure 8: The performance of candidates for question 13.

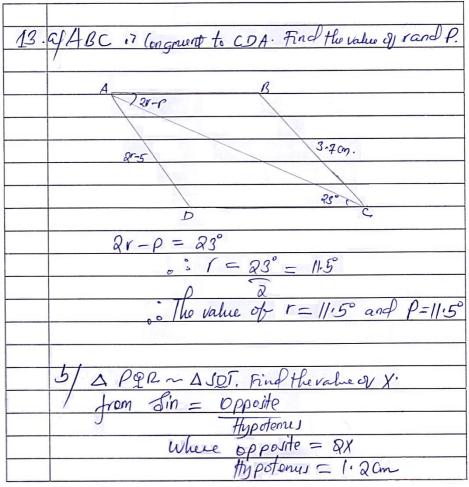
The candidates who scored 10.5 marks and above, were able to solve for values of r and p in part (a) and determine the value of x in part (b) after detecting the angles which are equal and the corresponding sides. Extract 13.1 is a sample of a candidate's correct responses given in question 13 (a) and (b).

3	DRequired rand P.
	Ab = Bc:
	2r-5=317cm.
	24=317+5.
	スト、ニ と、子・
	2 2.
	r = 4.35.cm.
	1: The value of r = 4,35cm.
	2r-P = 23 Because of Attom
	country. Attemation
	But ra 4.35. angles.
	8.7 - P = 23. P = 14.3.
	· · · Value of P = -14.3.
	bl from. PQ. = PR.
	77 20
	3X 4X.
-	34, 2 44.
	2 x 1,2 cm.
	By crossing multiplication
	3x (1,2cm) = 4x (2x
-	
	3.6xcm = 8x2.
	X ×.
	3.6cm = 8x.
	8 8.
_	": The value 04. X = 0,45 C

Extract 13.1: Illustrates the correct response of a candidate in question 13.

Among 38 candidates (10.9%) who scored from 0 to 5.5 marks, some of them got incorrect answers to this question because they did not know the corresponding sides and angles in part (a) which are $\overline{AD} = \overline{BC}$ and BAC = ACD also the corresponding sides in part (b) which are $\frac{PQ}{QS} = \frac{PR}{ST}$.

Therefore, they were unable to solve for values for r, p and x as shown in extract 13.2.



Extract 13.2: Is a sample of candidate's incorrect response given in question 13(a) and (b).

2.3 Section C: Essay Answer Questions (Pedagogy)

2.3.1 Question 14: Assessment in Mathematics

The candidates were required to justify the statement that "Mathematics is a mother of various disciplines" by giving five points.

This question examined candidates' ability to express the application of Mathematics in various fields of life. It was attempted by 224 candidates (53.3%). The analysis of data shows that 22 candidates (9.8%) scored from 0 to 5.5 marks, 92 (41.1%) scored from 6 to 10 marks while 110 candidates (49.1%) scored from 10.5 to 15 marks. The general performance in this question was good because 90.2 percent of the candidates scored from 6 to 15 marks. This performance is indicated in figure 9.

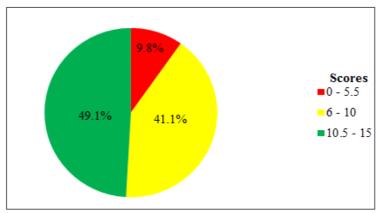


Figure 9: The performance of candidates in question 14.

The candidates who answered this question correctly had wide knowledge on the application of mathematics in their daily life. This implies that they were able to explain the applications of mathematics in their daily life. An example of a correct response is shown in extract 14.1.

14	Mathematic is the subject which doc
	with abstrating idea, contral thinking, and
	reasoning at given a particular section
	making, The wathenate is also the subject
95	deal with dwelpment of mental ability
	of the people and making Correct decision
- 1	making of a particular phonomene.
	The methenetie is a mother of various
	otsplines as shown below;
4	Science subject like chamistry,
	plusous, and other subject of art like
	geograph it next depend to some extent
	the sondert to have the knowledge of
	operation like addition, tuberrutos,
	operation the addition, tilbutaition,
	muliploteties, and division it were needed
	to be applicable for the feld of vanous
	subject dila physicis, chemistry and geograph
	or discipline which need the knowledge
	of mathemetics application, the collection of
	date and partiting different measurement
	date and performing different measurement during surver time, the natheratic celculation to needed inorder to ensure the accounting
	is needed inorder to ensure the according

In Extract 14.1: Is a sample of candidate's correct response in question 14.

However, 9.8% of the candidates who attempted this question failed to do it correctly. The reasons for the failure were lack of knowledge and ability to explain the application of mathematics in different fields in their daily life. Extract 14.2 shows a poor response from one of the candidate who failed to answer correctly this question.

14	Mathematics this is an at which deals with
	the study of logic, number, theory principles in
	rarion a virtamentens. Europe a mother of
	various disaplaces. The following and the points for
	order to justify this statement
	Jana: Mythe Rugties Also is a sound which
	used typimatically to solve different problems.
	Mony round subject depend on Musthemetrics
	for example charactery and Physics
	Theory: Mathematics comprises different
	the ones concern about different concepts which
	explain, product the truth of a action concept.
	For example the some som of two interior angle
	of a triangle is equal to the one opposite exterior
	angle of a towngh.
	Number: Also WestHamertin Cleany wow or
	explain vernous concept by wing numbers
	this can be natural numbers, whole numbers, real
	num bers and Integers
	Logic: this subject is a mother of other
	disciplines this is because of using recording, it
	arems also husthementice deals with the stray
	of reasoning that is how, why, if a=0 thin a>-1
	Systematic: Mathematics Alm different
	buspour it itemetically put toplaned the biacognic
	of solving a certain problem
	of solving a certain problem The above an the point which justify the
	Statement that ruthemetics is a mother of
	como dunplia. Also Muth mutics have got
	King application in our daily life. For example

Extract 14.2: Sample of incorrect response of a candidate in question 14.

2.3.2 Question 15: Planning and Preparation for Teaching Mathematics

The candidates were required to describe five criteria for selection of teaching and learning techniques in the teaching and learning of Mathematics.

This question assessed candidates' knowledge about Planning and Preparation for Teaching Mathematics. It required the candidates to recall and describe the criteria for selection of teaching and learning techniques.

A total of 251 candidates (65.6%) scored from 10.5 to 15 marks, 128 (33.5%) scored from 6 to 10 marks while only 3 candidates (0.9%) scored from 0 to 5.5 marks. Therefore the performance for this question was generally good.

The candidates who got the correct answer were able to remember and describe clearly the criteria for selection of teaching and learning techniques in the teaching and learning of Mathematics as indicated in extract 15.1.

15	(riteria for selection of feeding and learning
	technique in tracking and learning of mather
	atics
	leaching is the process of facilitating loo
	roing but learning is the relative permanent th
	and of behaviour which results from exponen
	ces. Therefore teaching and learning technique imp
	lies or means devices or plans used in the
	process of teaching and barning. When feullitate
-	teaching and learning mathematics there are critic
	teaching and learning mathematics there are criteria to consider. The following below are criteria
	for selection of touching and learning technique
_	in the teaching and barring of mathematic. Firstly djective of the lesson or subject matter
_	tirstly agedine of the lesson or abject madee
	Refore you plan to teach a professional tracker must
	Consider the objective of the topic to be taught. A Leather teach that subject for which trason. Hero
	It have that suspect for which reason the
	the term why is considered. A teacher teaches what
	intended to be taught and to be covered in a lesson
	Socondly cognitive ability of the barner. The
	becames or that are all to respond the losses
	This is because you can teach a lesson which is
	above the cognitive level a ability of the learner
	or student.
	Thirdly, class level or developmental lovel of
	the student. The student can master what you
	intend or need to teach. If the lesson toward
	is above his or her class level he or she can
	not master it effectively. The learning result
	will be difficult

Extract 15.1: Is a sample of a correct answer given in question 15.

However, 3 candidates (0.9%) answered this question incorrectly due to lack of knowledge about criteria used for selection of teaching and learning techniques in the teaching and learning of Mathematics. Some of them just provided the definition of a teacher and described the terms like audience, behaviour condition and degree as extract 15.2 reveals.

15 Teaching refers to the transmission of kno
intedge from one people to another, while
teaching techniques are methods used by
a tracker to facilitates a learning proce
2x est time selections a recorning proce
35 effectively, also Learning to changues
are methods used by the students given
by their teacher to enhance them to
participate well in teaching and bearning
process, The following are some of the criti
ria of for selection of teaching and
Learning to al in the train
learning to chiniques in the teaching and learning of matternatics.
A Dis - March Market
Andience, Means that the population of
the participant in a particular learning
Behavioral, means the characteristics of
the participants in a particular hearning
of the course.
Condition, means an environment that
the location take aloca
the barning take place
Degree means what the facilitator
expected to implement to the learners
Time, means of what facilitator
prepare to hoplement to the learners,
· · · · · · · · · · · · · · · · · · ·

Extract 15.2: A sample of a candidate's incorrect response in question 15.

2.3.3 Question16: Assessment in Mathematics

In this question, the candidates were required to briefly describe three functions of an effective mathematics teacher.

This question was attempted by 229 candidates (54.5%). Out of 229 candidates who attempted this question, 196 (85.7%) failed by scoring from

0 to 5.5 marks. This is the question which was poorly performed in this paper as can be seen in figure 10.

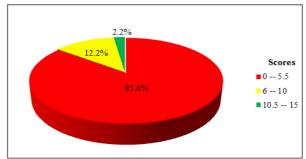


Figure 10: The performance of candidates in question 16.

The candidates who answered incorrectly this question failed to distinguish between the function of a mathematics teacher and the qualifications of a teacher. They wrote the definitions of a mathematics teacher and other requirements of a teacher when teaching in the classroom as shown in Extract 16.1.

16.	Mathie matics Teacher
	and few once that facilitate
	the methic matrix Controls
	to bearmers the following
	are three functions of
- 4	mathie matics of leacher, as
	For a king Te ach er.
	To Bre Good solver
	by Problem of the Stydnests in
	Madhie matice mathely the
	Ishe want to be with
	Enough smowledges to
	Pacelitadue mathia metres.
	methods and techniques
	Re Leg letaluel les commen par less

Extract 16.1: illustrates the candidate's incorrect response in question 16.

On the other hand, there were only 5 candidates (2.2%) who managed to score from 10.5 to 14 marks. This shows that there were very few candidates who had adequate knowledge on the topic of assessment in

mathematics. Extract 16.2 shows the response of a candidate who managed to answer this question correctly.

16	Effective mothematics fraction -
	15 the one who is a caderiscally
	and professinally well grapared
	toacher in mathematics Subject.
	The following are the three
	Functions of an effective Mathenna-
	tics teacher
	Executivo functions - an
	effective mathematics teacher
	have a leadership role or function
	In a class, he/sho has a duty to
	load, facilitate for effective treading
	and learning
	Interactive function_ an
	Effective Mathematics teacher has
	a function to employ various nothers
	tochnique and strategies for estedire
<u> </u>	Interaction Lotwoon Student and
	materials and student to teaching
	and learning streation (fraction)
	Organization Function - also
	an effective Mathematics toucher
	has to make sure holder work
	and cooparate with other teacher
-	and students and the community to being botton environment for teaching and learning morthmatics.
	To soing sotter proviount for
	realing and learning Mathamatics
	Generally apart from Those
-	Then offour fle government should
-	Functions the government Should also span offective mathematic teacher such as with inconstruct so that hel
	Such as with incongress so great hel
	She can accomplish his/her fasks,

Extract 16.2: Is a sample of the candidate's correct response in question 16.

Generally the performance of the candidates in this question was poor, which means that this topic was not understood by most of the candidates before they sat for the examination.

3.0 THE ANALYSIS OF CANDIDATES PERFORMANCE PER TOPIC

The topics that were examined in the 2019 mathematics examination paper were; Foundations of Mathematics, Logic, Similarity and Congruence, Analysis of Mathematics Curriculum Materials, Probability, Coordinate Geometry II, Hyperbolic Functions, Vectors, Algebra, Assessment in Mathematics and Planning and Preparations for Teaching Mathematics.

The analysis of candidates' performance per topic shows that, four topics had good performance, namely; *Planning and Preparation for Teaching Mathematics* (99.1%), *Analysis of Mathematics Curriculum Materials* (94.9%), *Similarity and Congruence* (78.4%) and *Logic* (71.3%).

In addition to that, there were four topics with average performance, namely; *Hyperbolic Functions* (61.6%), *Vectors* (59.2%), *Coordinate Geometry II* (53.1%) and *Assessment in Mathematics* (52.3%).

However, the data shows that the candidate had poor performance on three topics which are; *Foundations of Mathematics* (38.1%), *Probability* (31.9%) and *Algebra* (28%). This poor performance was due to lack of skills and competence of the candidates on these topics.

Further analysis was done on each topic by finding the average of the percentages of the candidates who correctly answered the questions in a particular topic. The analysis of the performance in each topic was categorised in three groups according to the average of the percentages of the candidates who correctly answered the questions. These groups were 70–100, 40–69 and 0–39 percent for good, average and poor performance respectively.

4.0 CONCLUSION

The general performance for 740-Mathematics subject, was average by an overall average of 55.7%. The analysis of performance per topics reveals that the reasons that contributed to the topics having an average and weak performances include; making errors while performing mathematical operations, lack of skills on various concepts which were examined in the questions, applying incorrect formulae and failure to identify the requirements of the questions by the candidates.

5.0 **RECOMMENDATIONS**

In order to improve the performance of mathematics subject for Diploma in Secondary Education in future, the following opinions are recommended:

- (a) Tutors should make sure that all topics in the syllabus are clearly taught and covered so as to equip the candidates with wide skills in answering the examination questions.
- (b) Candidates should be given enough exercise in order to improve their capacity in answering examination questions.
- (c) Candidates should be encouraged to read various materials such as books and pamphlets of mathematics in order to increase their knowledge and ability on different mathematics concepts particularly in the topics with poor performance.
- (d) Tutors should provide monthly tests especially in the poorly performed topics in order to improve the performance.

APPENDIX

ANALYSIS OF PERFORMANCE OF CANDIDATES IN EACH TOPIC

	Торіс	Number of question	Performance of Candidates in Percentage		
S/N			Percentage for Each Question	Average	Remarks
1	Planning and				
	Preparation for Teaching Mathematics	15	99.1	99.1	Good
2	Analysis of Mathematics Curriculum Materials	5	94.9	94.9	Good
3	Similarity and Congruence	4	67.6	78.4	Good
		13	89.1		
4	Logic	3	80.3	71.3	Good
		12	62.3		
5	Hyperbolic Functions	9	61.6	61.6	Average
6	Vectors	10	59.2	59.2	Average
7	Coordinate Geometry II	7	39.4	52.7	Average
		8	66.0		
8	Assessment in Mathematics	14	90.2	52.3	Average
		16	14.4		
9	Foundations of Mathematics	1	36.1	38.1	Poor
		2	40.1		
10	Probability	6	31.9	31.9	Poor
11	Algebra	11	28	28	Poor

