THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR DIPLOMA IN SECONDARY EDUCATION EXAMINATION (DSEE) 2018

740 MATHEMATICS

THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

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740 MATHEMATICS

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FOREWORD

The National Examinations Council of Tanzania has prepared this report on the Candidates' Items Responses Analysis for Mathematics for the Diploma in Secondary Education Examinations (DSEE), 2018 in order to give feedback to students, teachers, parents, policy makers and other stakeholders on how the candidates responded to the questions.

This report analyses the factors which influenced students in their process of answering question correctly/incorrectly. The analysis also shows how some candidates were able to understand the demand of the question such that they gave best solution towards those question(s). On the other hand it analyses the average and poor performance of some students on attempting the questions. The strength and weakness of students in answering the question has been exposed practically by using the extracts directly extracted from their scripts.

It is the expectation of the Council that this report will serve as a useful tool in improving the candidates' performance in future Mathematics examinations.

The Council would like to thank all Examiners, Examination officers, and everyone who participated in preparing this report. The Council is looking forward to receiving constructive comments from all the stakeholders in order to improve future reports.

Dr. Charles Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report on the performance of candidates aims at providing feedback about performance of the candidates who sat for the Diploma in Secondary Education Examination in May, 2018 in Mathematics' subject. At total of 837 candidates sat for the examination, out of which 748 candidates were using University of Dodoma (UDOM) curriculum and 89 were using the Tanzania Institute of Education (TIE) curriculum. The examination tested the candidates' competences in interpreting and solving Mathematics problems, planning and developing Mathematics lesson, and pedagogical skills in teaching Mathematics. The general performance of the candidates was average as the following Table shows.

Table: Performance of Candidates in Mathematics' Examination

Candidates Type	No. of Cand. Sat	No. of Candidates and %					
		Passed	Grades				
			A	B	C	D	F
All (DSEE)	837	829 99.04	9 1.08	92 10.99	397 47.43	331 39.55	8 0.96
UDOM Curriculum (DSEE)	748	740 98.93	7 0.94	64 8.56	349 46.66	320 42.78	8 1.04
TIE Curriculum (DSEE)	89	89 100.00	2 2.25	28 31.46	48 53.93	11 12.36	0 0.00

The Table shows that all (100/%) candidates under TIE curriculum passed the examination and 98.93 percent of the candidates under the UDOM curriculum passed.

Since the assessment for the candidates who are pursuing DSEE using UDOM curriculum is in transition (2 years only as from 2018); in this report, the detailed analysis was done on the performance in individual examination questions and topics based on the candidates who sat for examination using TIE curriculum only.

The Mathematics’ paper consisted of sections A, B and C with a total of 16 questions. Section A was composed of ten (10) compulsory questions where by the candidate was to do all questions. Section B was composed of three (3) questions of which a candidate was to answer any two (2) questions. Section C was composed of three (3) questions of which a candidate was to answer any two (2) questions. Section A had 40 marks in total and each question had 4 marks. In both sections B and C each question had 15 marks.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH QUESTION

2.1 Question 1: Analysis of Mathematics Curriculum Materials

This question had four parts (a), (b), (c) and (d) with a total of 4 marks. In each part, the candidates were required to define terms which are commonly used in mathematics teaching methods. These terms were,
(a) Curriculum materials (b) Mathematics Syllabus (c) Lesson Plan
(d) Assessment

The question was attempted by all 89 (100%) candidates. The analysis shows that 2 (2.2%) candidates scored 0 to 1.5 out of 4 marks, 7 (7.9%) candidates scored 2 to 2.5 out of 4 marks and 80 (89.9%) candidates scored 3 to 4 out of 4 marks. Further analysis shows that 97.8% of the candidates passed this question with marks ranging from 2 to 4, which is a good performance. We observe that 62.9% of the candidates scored all 4 marks from this question. These candidates were able to correctly define all the four terms asked in the question. A sample of a solution from a candidate who answered this question correctly is shown in Extract 1.1.

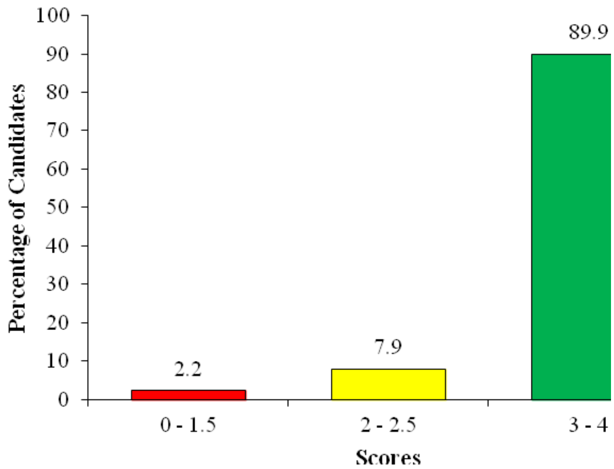


Figure 1: *Candidates performance in question 1*

Extract 1.1

1 a) Curriculum material - Are the material which are used in teaching and learning process

b) Mathematics syllabus - Is the academic book which are arranged systematic which contain the information for teaching and learning process. Example topic, Subtopic teaching and learning resources etc.

c) Lesson plan - Is the short time period which prepared by the teacher to guide in teaching and learning process

d) Assessment - Are those activities designed to measure the achievement of students in educational programmes.

Extract 1.1: A sample solution from a candidate whose answer was good.

However, further analysis also shows that 2.2% of the candidates scored low marks ranging from 0 to 1.5, and hence failed this question. The candidates could not define correctly some of the required terms. There was no any candidate who scored exactly zero marks Extract 1.2 presents a sample solution from a candidate who failed to define some of the terms correctly.

Extract 1.2

1: a: Curriculum Materials – Are ~~they~~ those materials which used in teaching and learning process It include syllabus, Text book and Teachers guid books

b: Mathematical syllabus is the syllabus which contain the structure, methods, techniques and topics of Mathematics.

c: Lesson Plan is the book which prepared and show the method, topic, subtopic and the material for teaching and learning. It is always prepared before teaching time/Period.

d: Assessment Refers to the Method of Measuring the effectiveness of teaching and learning Process. It is conducted at the end of course or subject;

Extract 1.2: A sample solution from a candidate with some incorrect responses

2.2 Question 2: Analysis of Mathematics Curriculum Materials

The question had two parts, namely (a) and (b) with a total of 4 marks. All the parts of this question required the candidates to differentiate between two mathematics teaching materials. These materials were,

(a) Mathematics textbook and Mathematics Reference book

(b) Mathematics Syllabus and Mathematics Teacher's Guide.

This question was attempted by all 89(100%) candidates. Analysis shows that 3 candidates (3.4%) scored 0 to 1.5 marks, 20 candidates (22.4%) scored 2 to 2.5 marks and 66 candidates (74.2%) scored 3 to 4 marks. The performance in this question was good since 96.6% of the candidates scored marks ranging from 2 to 4. Notably, 27.0% of the candidates scored 4 out of 4 in this question. These are the candidates who demonstrated good knowledge in identifying and differentiating the asked mathematics teaching materials. Extract 2.1 shows a sample solution picked from a candidate who correctly answered this question.

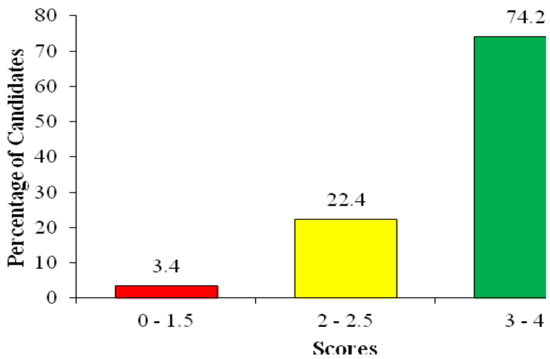


Figure 2: *Candidates performance in question 2*

Extract 2.1

2 (a) Mathematics textbook refers to the book or curriculum material which indicates the content to be tought in a logical, systematic and sequential form.
while
Mathematics reference books these are books which does not show the content indicated by the syllabus but they supply more knowledge and skills for extra reading.

2(b) Mathematics syllabus refers to an outline of the topics and and all materials required by the teacher in order to facilitate effectiveness of the teaching process

while

Teacher's guide book refers to the book which shows procedures and different methodologies to be used by the teacher when teaching

Extract 2.1: A sample solution from a candidate whose responses were correct

On the other hand, analysis shows that a few candidates (3.4%) performed weakly in this question as they only managed to get marks ranging from 0 to 1.5. These candidates lacked knowledge on how to distinguish the asked mathematics teaching materials. Their responses were full of mistakes and grammatical errors that made their answers meaningless. Extract 2.2 gives a sample solution from a group of candidates whose response had many mistakes.

Extract 2.2

2: a: Mathematics text book Refers to
the text book which ~~ated~~
used in note making
for teaching and learning

BUT

Mathematical Reference Book Refers
to the mathematical materials/book
which are used for mathemati
cal reference.

b: Mathematical Syllabus Refers to
the syllabus which contain
the structure, methods, techniques
and topics for teaching.
mathematics subject:

WHILE:

Mathematics teachers guid book is
that book which formulate
and structure for directing
a teacher in the whole
process of teaching mathema
tics,
Also it give out. the method
and techniques of teaching
mathematics:

Extract 2.2: A sample solution from a candidate whose answers had many mistakes.

2.3 Question 3: Probability

This question had two parts, (a) and (b) with a total of 4 marks. In part (a), the candidates were asked to state the Principle of Permutation as used in probability. The principle of permutation gives a counting procedure that can be used to predict the occurrence of a probabilistic event. The candidates were expected to state the principle as follows;

> *"If there are n objects and n different labels, there are n! different ways to place these labels so that there is one label on each object".*

In part (b), the candidates were required to find the number of ways of predicting an outcome. The expected knowledge was to understand the application of permutation in solving real life problems. This question read, "Ten candidates are contesting for presidency. How many ways are there of predicting the first three positions?" Candidates were supposed to use the permutation formula ${}^nP_r = \frac{n!}{(n-r)!}$, where $n = 10$ and $r = 3$.

The analysis on this question shows that 73(82.0%) candidates attempted the question, of which 25 (34.2%) scored 0 to 1.5 marks, 47 (64.4%) scored 2 to 2.5 marks and 1(1.4%) scored 3 to 4 marks. Moreover, 65.8% of the candidates passed this question with scores ranging from 2 to 3 marks, which indicates an average performance for this question. No candidate managed to score full marks in this question. This performance is associated with the candidates' lack of the required knowledge in permutation. A sample solution from a candidate who scored marks in the range of 2 to 3 is shown in Extract 3.1.

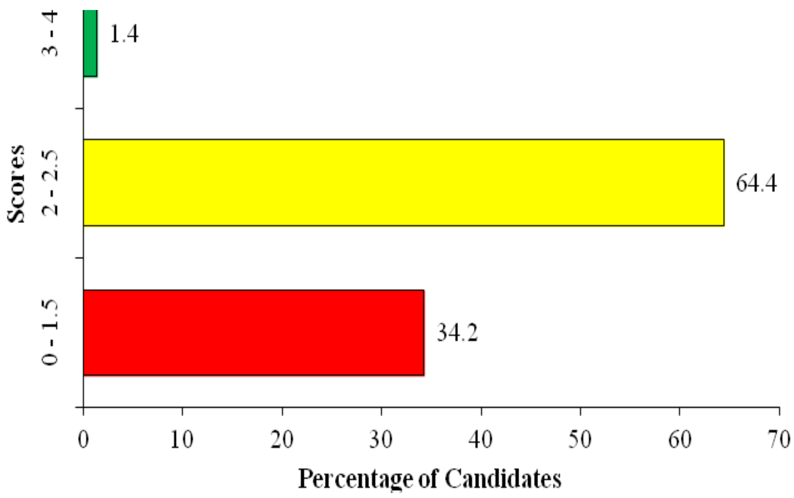


Figure 3: *Candidates performance in question 3*

Extract 3.1

3b. $^{10}P_3 = \frac{10!}{(10-3)!}$

$= \frac{10!}{7!}$

$= \frac{10\times9\times8\times7!}{7!}$

$= 10\times9\times8$

$^{10}P_3 = 720.$

Extract 3.1: A sample solution from a candidate with correct responses. No candidate answered part (a) correctly.

We can further observe from the analysis that 34.2% of the candidates who scored marks in the range of 0 to 1.5 failed the question. Within this group, there were candidates (30.1%) who scored 0. These candidates were not able to respond correctly in any part of the question. They gave a wrong statement of the principle of permutation, but also could not know how to use the permutation formula to solve the given problem. A sample solution extracted from one of the candidates who performed poorly in this question is shown in Extract 3.2.

Extract 3.2

3. (b) Soln.

10 Candidates

1st is predicting in 10 ways

2nd Predicting in 9 ways

3rd Predicting in 8 ways

$= 8!\times9!\times10!$

$= 8!\,9!\,10!$

Extract 3.2: A sample solution from a candidate with incorrect responses

2.4 Question 4: Assessment in Mathematics

The question required the candidates to make assumption that, they are part of the Micro-teaching and are observing a teacher who is teaching a mathematics lesson on the topic of 3-dimensional geometry in a form IV class. The teacher asked students **A** and **B** to mention any three prism geometrical objects they know. Students responses (in brackets) were, **A**(Rectangular, Cylinder, Cube) and **B**(Triangular, Cone, Pyramid). The teacher accepted all the responses from students **A** and **B** as correct. The candidate, as an observer in the micro-teaching, was asked to give his/her reaction to the teacher's comment. In order to give a valid comment to the teacher, the candidate was supposed to understand the properties of a prism, and one of the key properties of the prism is that, it must have two parallel surfaces. Thus, student **A** responses were all correct, but two of student **B** responses were not correct, since a cone and pyramid are both not prism objects as they have no parallel surfaces.

For this question, the analysis shows that 77(86.5%) candidates attempted this question, of which 71 (92.2%) scored 0 to 1.5 marks, 4 (5.2%) scored 2 to 2.5 marks and 2(2.6%) scored 3 to 4 marks. A few candidates (7.8%) scored marks within the pass range of 2 to 4, but no candidate scored all 4 marks in this question. This shows that the performance of candidates in this question was unsatisfactory. This highlights the fact that many candidates have no knowledge on prism geometrical objects. Extract 4.1 shows a sample solution from a candidate whose responses were partially correct.

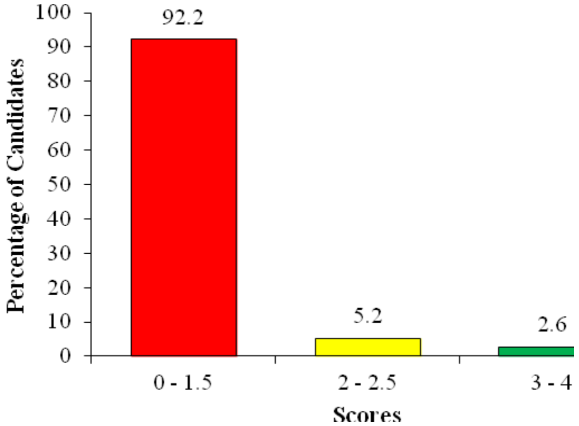


Figure 4: *Candidates performance in question 4*

Extract 4.1

4 - The responses of student A is correctly compared to the student be because all object that he/she try to mention is found in prism geometrical object but it is not the response of student B.
- He/she should avoid give wrong answer to student, if he/she don't understand it's better to leave as an assigment for both student and teacher to find in order to come with correct answer.
- He/she should make enough preparation before entering to the class for teaching a certain topic.

Extract 4.1: A sample solution from a candidate with partial correct answer

In particular, the analysis indicates that there were candidates (81.8%) who scored 0 in this question. These candidates produced wrong answers due to lack of knowledge about 3-dimensional geometry. This question was the most poorly performed in this examination. A sample solution from a candidate who answered this question incorrectly is shown in Extract 4.2.

Extract 4.2

4 All of them are correct except Rectangular is not a prism but both cylinder, cube, Triangle ~~and~~, cone and pyramid are ~~prism~~ prism geometrical objects.

Extract 4.2: A sample solution from a candidate with completely wrong answer. He/she had no knowledge about the properties of a prism.

2.5 Question 5: Logic

This question required the candidates to indicate the rules used to simplify the following logical proposition.

$$
\begin{aligned}
p \wedge (p \vee \neg q) &\equiv p \wedge (p \vee \neg q) \quad \rightarrow \text{given} \\
&\equiv (p \vee f) \wedge (p \vee \neg q) \rightarrow \_\_\_\_\_\_\_\_ \\
&\equiv p \vee (f \wedge \neg q) \rightarrow \_\_\_\_\_\_\_\_ \\
&\equiv p \vee f \quad \rightarrow \_\_\_\_\_\_\_\_ \\
p \wedge (p \vee \neg q) &\equiv p \rightarrow \_\_\_\_\_\_\_\_\_\_
\end{aligned}
$$

Taking the same order of the logic statements described in this question, the correct answer to this question was; Identity rule, Distributive rule, Identity rule, Identity rule.

The question was attempted by all 89 (100%) candidates, of which 24 (27.0%) scored 0 to 1.5 marks, 16 (17.9%) scored 2 to 2.5 marks and 49 (55.1%) scored 3 to 4 marks. Thus, 73.0% of the candidates passed the question with scores ranging from 2 to 4. The analysis shows that there were good candidates (28.1%) who scored all 4 marks. These candidates were able to give correct responses as the question required. Extract 5.1 presents a sample solution of candidates who answered this question correctly.

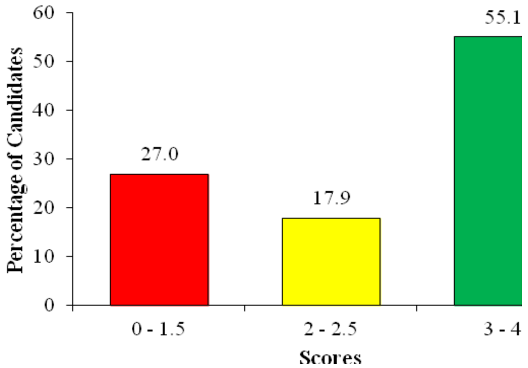


Figure 5: *Candidates performance in question 5*

Extract 5.1

$P \wedge (P \vee \sim q) \equiv P \wedge (P \vee \sim q) \to$ Given

$\equiv (P \vee F) \wedge (P \vee \sim q) \to$ Identity law

$\equiv P \vee (F \wedge \sim q) \to$ Distributive law

$\equiv P \vee F \to$ Identity law

$\therefore P \wedge (P \vee \sim q) \equiv P \to$ Identity law.

Extract 5.1: A sample solution from a candidate whose responses were correct.

It was noted that 5.6% of the candidates scored 0. The candidates in this range of scores gave wrong answers to the question. This signifies lack of knowledge and skills. A sample solution from a candidate who incorrectly responded to the question is shown in Extract 5.2.

Extract 5.2

5. $\equiv (P \vee f) \wedge (P \vee \sim q) \to$ Associative law

$\equiv \cancel{P \vee (f \wedge \sim q)} \to P \vee (f \wedge \sim q) \to$ distributive law

$\equiv P \vee f \to$ Idempotent law

$P \wedge (P \vee \sim q) \equiv P \to$ complementary law

Extract 5.2: A sample solution from a candidate whose responses were incorrect. He/she got only one (second) response correct, the rest of the responses were completely wrong.

2.6 Question 6: Teaching the Selected Topics

This question required the candidates to find two real numbers x and y to make the linear equation $(2+i)x+(3-2i)y=-1-4i$ with complex coefficients valid. The question examined the candidates' knowledge in complex numbers. It had a total of 4 marks. The real numbers x and y are easily obtained by comparing the real and imaginary parts of the given equation to get a system of simultaneous equations.

The question was attempted by 88 (98.9%) candidates, of which 11 (12.5%) scored 0 to 1.5 marks, 7 (8.0%) scored 2 to 2.5 marks and 70(79.5%) scored 3 to 4 marks. Further analysis shows that 77 (87.5%) candidates scored pass marks ranging from 2 to 4. The candidates' performance in this question was good as analysis shows that 61 (69.3%) candidates scored 4 out of 4 marks. A sample solution of the candidate who answered this question correctly is shown in Extract 6.1.

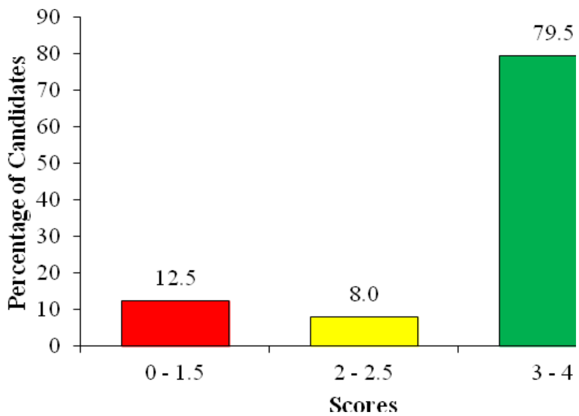


Figure 6: *Candidates performance in question 6*

Extract 6.1

6.	Soln
	$(2+i)x + (3-2i)y = -1-4i$
	$2x + ix + 3y - 2iy = -1-4i$
	$(2x+3y) + (ix - 2iy) = -1-4i$
	$(2x+3y) + (x-2y)i = -1-4i$
	By compairing between two sides
	$2x+3y = -1$ . . . . (i)
	$(x-2y)i = -4i$ . . . (ii)
	By solving simultleneous equation
	$2x+3y = -1$ . . . . .
	$x - 2y = -4$ . . . (ii)
	By make x from equation (ii)
	$x = -4+2y$ . . . (iii)
	By equationg in equation (i) eqn (iii)
	$2x + 3y = -1$
	$2(-4+2) + 3y = -1$
	$-8 + 4 + 3y = -1$
	$-4 + 3y = -1$
	$3y = -1+4$
	$3y = 3$
6	$3y = 3$
	$y = 1$
	To find x from equation (iii)
	$x = -4+2y$
	$x = -4+2(1)$
	$x = -4+2$
	$x = -2$
	$\therefore$ The value of $x = -2$ and $y = 1$

Extract 6.1: A sample solution from a candidate who answered correctly. He/she correctly identified the real and imaginary parts and was able to form the system of simultaneous equations and and solved it properly.

Despite of many candidates (87.5%) good performance, it was analysed that 2.3% of the candidates scored 0 in this question. This is an indication that these candidates were completely not able to find the real numbers *x* and *y* and the methods used in answering the question were inappropriate. Extract 6.2 shows a sample solution of a candidate who answered the question incorrectly.

Extract 6.2

06. $(2+i)x + (3-2i)y = -1-4i$

$2x + xi + 3y - 6iy = -1-4i$

compare

$xi = -4i$

$x = -4$

$\cancel{2x - 6}$

$2x + 3y = -1$

but $x = -4$

$-(2\times 4) + 3y = -1$

$-8 + 3y = -1$

$3y = -1 + 8$

$3y = -9\ 7$

$y = -3.7/3$

The value of $x = -4$ and

$y = -3.7/3$

Extract 6.2: Extract of a sample solution from a candidate whose response was incorrect. He/she failed to identify the real and imaginary parts of the given complex equation and was unable to solve the problem.

2.7 Question 7: Differentiation

This question required the candidates to find the derivative of a trigonometric function (a cosine function), $f(x) = \cos(x^2 + 2x + 1)$. It intended to examine the knowledge and skills of the candidates to understand and use the chain rule of differentiation, but also how to use algebraic substitution to get a derivative of a function. The weight of this question was 4 marks.

The question was attempted by 88 (98.9%) candidates, of which 5 (5.7%) scored 0 to 1.5 marks, 3(3.4%) scored 2 to 2.5 marks and 80 (90.9%) scored 3 to 4 marks. Many candidates (94.3%) had scores ranging from 2 to 4 marks. The analysis provides impressive information that 74 (84.1%) candidates scored 4 out of 4 marks, which is a good performance. In this case, the candidates were able to use the chain rule of differentiation to find the derivative of the given trigonometric function. A sample solution of a candidate who answered this question correctly is shown in Extract 7.1.

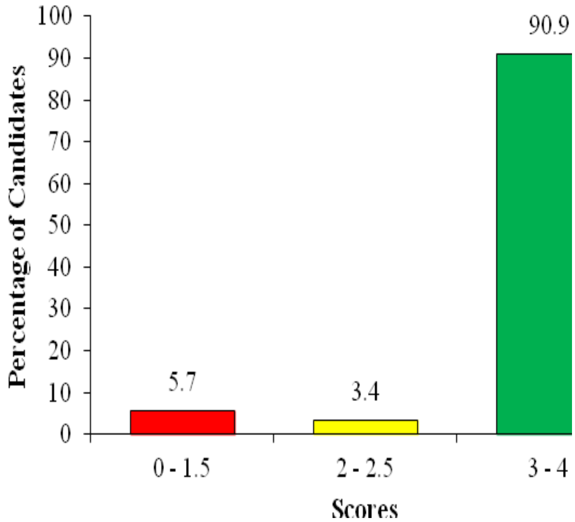


Figure 7: *Candidates performance in question 7*

Extract 7.1

7. Solution

$f(x) = \cos(x^2+2x+1)$

let

$f(x) = y$

$y = \cos(x^2+2x+1)$

let $u = x^2+2x+1$

By differentiating "u" with respect to 'x'

$du/dx = 2x+2$

$y = \cos u$

By differentiating "y" with respect to u

$dy/du = -\sin u$

$dy/dx = dy/du \times du/dx$

$dy/dx = -\sin u \cdot 2x+2$

7. $dy/dx = -\sin u \times (2x+2)$

But $u = x^2+2x+1$

$dy/dx = -\sin(x^2+2x+1) \times (2x+2)$

$dy/dx = -(2x+2)\sin(x^2+2x+1)$

$\therefore dy/dx = -((2x+2)\sin(x^2+2x+1))$

Extract 7.1: A sample solution from a candidate whose responses were correct. He/she used the chain rule properly and was able to make the right algebraic substitution in the trigonometric function.

The candidates (5.7%) who had scored low marks ranging from 0 to 1.5 produced weak solutions to this question. Their solutions contained many mistakes and failed to apply the chain rule of differentiation. This is an indication of lack of knowledge required to be able to differentiate a trigonometric function. The analysis also shows that 2.3% of the candidates scored 0 in this question. A sample solution from a candidate who responded incorrectly to this question is shown in Extract 7.2.

Extract 7.2

7. $f(x) = \cos(x^2 + 2x + 1)$.

soln.

let $u = \cos$

$\frac{du}{dx} = -\sin$

let.

$v = x^2 + 2x + 1$

$\frac{dv}{dx} = 2x + 2$.

by using Product rule.

$\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$

7. $\frac{dy}{dx} = v\frac{du}{dx} + u\frac{dv}{dx}$

$= x^2 + 2x + 1 \times -\sin + \cos \times 2x + 2$.

$= -\sin(x^2 + 2x + 1) + \cos(2x + 2)$.

$\therefore \frac{dy}{dx} = -\sin(x^2 + 2x + 1) + \cos(2x + 2)$.

Extract 7.2: A sample solution from a candidate with an incorrect method and answer. He/she used a wrong formula to differentiate the given function.

2.8 Question 8: Coordinate Geometry II

This question required the candidates to make a sketch of a square pyramid and identify the features of this pyramid. From the sketch, candidates are required to identify the following features of the square pyramid,

(a) number of faces
(b) number of vertices, and
(c) number of edges

To be able to answer this question, the candidates are expected to have knowledge of 3-dimensional geometry.

The question was attempted by 80 (89.9%) candidates, of which 57 (71.3%) of the candidates scored 0 to 1.5 marks, 9(11.2%) scored 2 to 2.5 and 14(17.5%) scored 3 to 4 out of 4 marks. This means that 23 (28.7%) candidates had passing scores that range from 2 to 4 marks, which is a weak performance in this question. Analysis shows that a few candidates (5%) scored 4 out of 4 marks. From this analysis, one can note that a few candidates were able to correctly sketch the square pyramid and identify its features as the question required. Extract 8.1 gives a sample solution of candidate who identified the features of the square pyramid correctly.

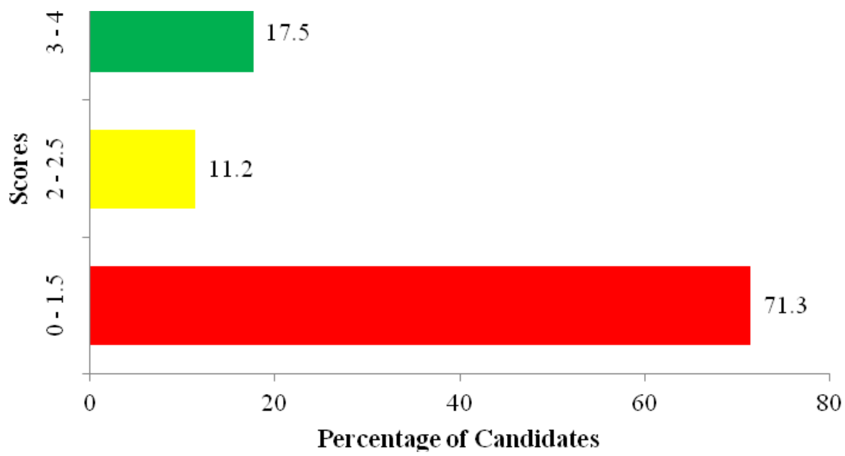
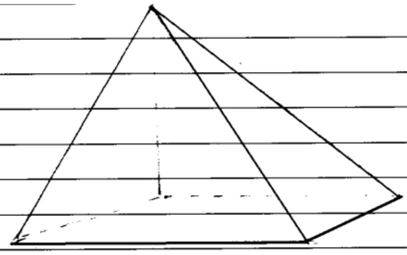


Figure 8: *Candidates performance in question 8*

Extract 8.1

8.



Number of faces are ~~4~~ 5 (five)

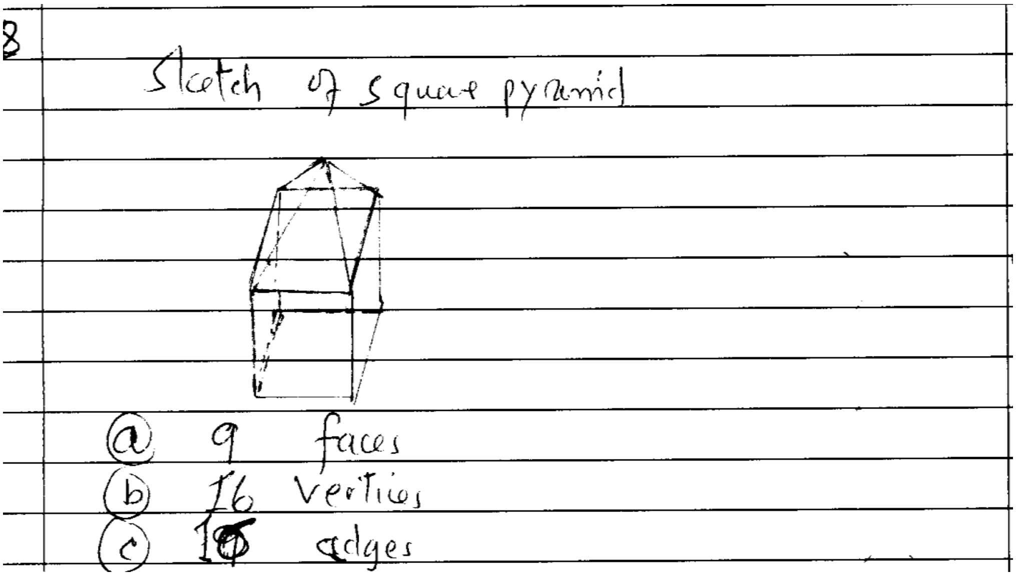
Number of Vertices five (5)

Number of edges 8 eight.

Extract 8.1: A sample solution from a candidate with (partially) good responses He/she sketched a rectangular pyramid and not a square pyramid, but was able to identify the number of faces, vertices and edges.

On the other hand, the analysis shows that a notable 47.5% of the candidates had scored 0 in this question. So, it is clear that these candidates (38) failed to respond to the question correctly. Here the candidates' solutions lacked proper knowledge of 3-dimensional figures and their geometrical features. A sample solution from a candidate whose responses were incorrect is shown in Extract 8.2.

Extract 8.2



Extract 8.2: A sample solution from a candidate whose answers were incorrect. He/she failed to sketch and identify the features of a square pyramid.

2.9 Question 9: Planning and Preparation for Teaching Mathematics

This question required the candidates to list any four characteristics of a learner centred teaching method. The candidates were expected to list any four characteristics among the following;

- Engages learners in hard work of learning (hands-on activities)
- Includes explicit skills instruction
- Encourages learners to reflect on what they are learning
- Motivates learners by giving them some control over learning process (that is learners feel that they own the learning process)
- Encourages collaboration (think-pair-share)

This question was attempted by 88 (98.9%) candidates, of which 10 (11.4%) had scores in the range of 0 to 1.5 marks, 28 (31.8%) scored 2 to 2.5 marks and 50 (56.8%) scored 3 to 4 out of 4 marks. The passing score for this question was reached by 78(88.6%) candidates who had scores in the range of 2 to 4 marks. There were 14 (15.9%) candidates who demonstrated good knowledge and their solutions were entirely correct, so they scored 4 out of 4 marks. The overall performance of the candidates in this question was generally good. Extract 9.1 shows a sample solution of a candidate whose responses were entirely correct.

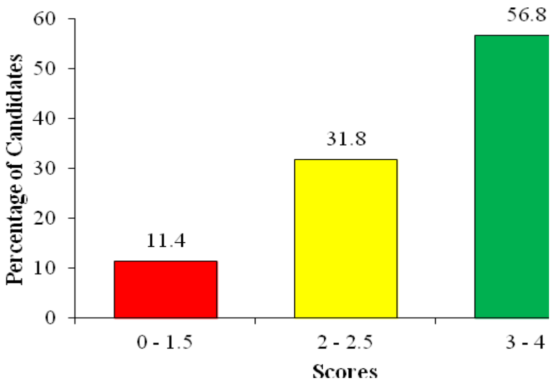


Figure 9: *Candidates performance in question 9*

Extract 9.1

9 (i) Learners are the source of knowledge.

(ii) The work of the teacher is facilitating or guiding.

(iii) Encourages enquiry and creativity

(iv) Based on making learners to callaborate for example group discussion and jigsaw.

Extract 9.1: A sample solution from a candidate with correct responses

Further analysis shows that 4.5% of the candidates scored 0. These scores signify that the candidates were not able to fully understand this pedagogical question and they lacked knowledge on the characteristics of learner centered teaching method. A sample solution of a candidate that shows an incorrect response is shown in Extract 9.2.

Extract 9.2

9. i]. Should have Critical thinking in high level

ii/ Should be Curiosity

iii/ Shoud have or be responsibility and accountability.

iv/ Should have the respect or Disiplne

Extract 9.2: A sample solution from a candidate whose responses were incorrect.

2.10 Question 10: Coordinate Geometry II

The question required the candidates to find the perpendicular distance from the point $(10,-11)$ to the line passing through the points $(2,-1)$ and $(1,1)$. The candidates were expected to first use the given two points to find the slope $m = -2$ of the line and its equation $2x + y - 3 = 0$, then use the distance formula $d = \left| \frac{ax_1 + by_1 + c}{\sqrt{a^2 + b^2}} \right|$, where $a = 2, b = 1, c = -3$ and $(x_1, y_1) = (10, -11)$. Substitution of these values gives the perpendicular distance $d = \frac{6}{\sqrt{5}}$ units.

This question was attempted by 85(95.5%) candidates, of which 53(62.4%) scored 0 to 1.5 marks, 16(18.8%) scored 2 to 2.5 marks and 16(18.8%) scored 2 to 4 out of 4 marks. Only 32(37.6%) candidates scored 2 to 4 marks in this question. This signifies that the performance of candidates in this question was unsatisfactory, even though some candidates (14.1%) scored 4 out of 4 marks. The candidates (12) who performed well in this question were able to give correct solutions as the question required. This means that they had good knowledge that was required to find a perpendicular distance of point from a line passing through two given points. A sample solution from a candidate who answered this question correctly is shown in Extract 10.1.

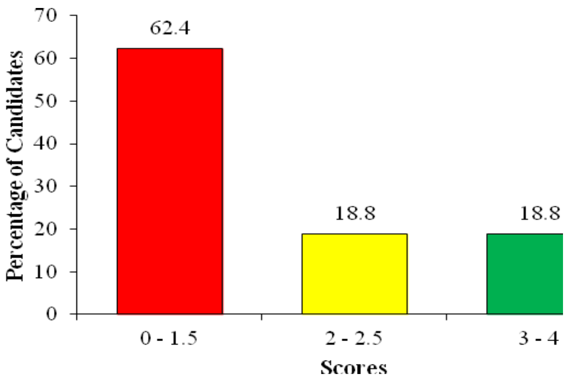


Figure 10: *Candidates performance in question 10*

Extract 10.1

10. Soln.

Given

P (10, −11)

Line Passes through (2, −1) and (1, 1)

x_1 y_1 x_2 y_2

Slope of the line $= \frac{\Delta y}{\Delta x} = \frac{1 - -1}{1 - 2} = \frac{2}{-1}$

Slope (m) = −2

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

$y - 1 = -2x + 2$

$y = -2x + 2 + 1$

$y = -2x + 3$

$2x + y - 3 = 0$

10 from

$D = \left| \frac{ax + by + c}{\sqrt{a^2 + b^2}} \right|$

$a = 2$, $b = 1$ and $c = -3$ $x = 10$ & $y = -11$

$D = \left| \frac{(2 \times 10) + (1 \times -11) + -3}{\sqrt{2^2 + 1^2}} \right| = \left| \frac{6}{\sqrt{5}} \right|$

$D = 2.683$

∴ Perpendicular distance is 2.683.

Extract 10.1: A sample solution from a candidate with correct answers. He/she was able to obtain the equation of a line and used the perpendicular distance formula properly.

Many candidates (62.4%) struggled to find the solution of the question since they did not know how to find the equation of the line and use the distance formula to find the perpendicular distance of the line from the point. This fact is verified by the information from the analysis that a significant number of candidates (28.2%) scored 0 in this question. A sample solution of a candidate whose answer was incorrect is shown in Extract 10.2.

Extract 10.2

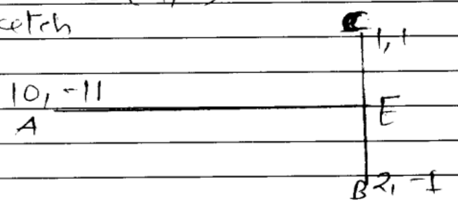
10 Given

Point A $(10, -11)$

B $(2, -1)$.

C $(1, 1)$.

Sketch



Find the perpendicular distance $\overline{AE}$

first find the mid point E

$$E(x, y) = \frac{(x_1 + x_2)}{2}, \frac{(y_2 + y_1)}{2}$$

$$E(x, y) = \left(\frac{2+1}{2}\right), \left(\frac{1+-1}{2}\right).$$

$$E(x, y) = \left(\frac{3}{2}, 0\right).$$

Now, find the distance AE

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

10

distance (d) = $\sqrt{\left(10-\frac{3}{2}\right)^2 + (-11-0)^2}$

$d = \sqrt{72\frac{1}{4} + 121}$

$d = \sqrt{193\frac{1}{4}}$ or $\sqrt{193.25} = 13.9$.

distance (d) = $\sqrt{193.25}$ unit length.

The perpendicular distance from point (10,-11) to the line passing through point (2,-1) and (1,1) is $\sqrt{193.25}$ unit length or 13.9 unit length.

Extract 10.2: A sample solution from a candidate with incorrect responses. He/she lacked knowledge on how to find the perpendicular distance from a line to a given point.

2.11 Question 11: Trigonometry

This question had two parts, (a) and (b). Part (a) had items (i) and (ii). All the items in part (a) required the candidates to find the value of x, where $0^o \le x \le 180^o$, by solving the equations (i) $\cos(x+30^o)-\cos(x+90^o)=\frac{1}{2}$ and (ii) $\cos(x+30^o)\cos(x-30^o)=\frac{1}{2}$. There might be some other ways of solving these equations to get suitable values of x, but the factor formulae reduce the equations into trigonometric equations that are easy to deal with. In item (a)(i) the factor formula to be used is $\cos P - \cos Q = -2\sin\left(\frac{P+Q}{2}\right)\sin\left(\frac{P-Q}{2}\right)$, where $P = x+30^o$ and $Q = x+90^o$. Using this formula, item (a)(i) is reduced to the equation $\sin(x+60^o)=\frac{1}{2}$ which is relatively easy to deal with. For the item (a)(ii) the factor formula $\cos P + \cos Q = 2\cos\left(\frac{P+Q}{2}\right)\cos\left(\frac{P-Q}{2}\right)$ can be used to reduce the equation. In this case, we must have $\frac{P+Q}{2}=x+30^o$ and $\frac{P-Q}{2}=x-30^o$ and get $\cos 2x+\cos 60^o=1$ which can be easily solved.

In part (b), the candidates were required to use the *t*-formula to solve the equation $\sin\theta+2\cos\theta=1$. Here, the candidates were expected to make the substitution $\sin\theta=\frac{2t}{1+t^2}$ and $\cos\theta=\frac{1-t^2}{1+t^2}$, where $t=\tan\left(\frac{\theta}{2}\right)$, derived from half angle formulae. The substitution will lead to a quadratic equation $3t^2-2t-1=0$, upon solving it we obtain the values of t and the values of θ can be obtained from $\theta=2\tan^{-1}(t)$.

The analysis indicates that 72 (80.9%) candidates opted to attempt this question, and the performance shows that 30 (41.7%) scored 0 to 5.5 marks, 31(43.0%) scored 6 to 10 marks and 11 (15.3%) scored 10.5 to 15 out of 15 marks. Further analysis shows that 42 (58.3%) candidates had pass scores ranging from 6 to 15 marks,. This means that a reasonable number of candidates had some knowlege of solving trigonometric equations by making right choices of formulae. A sample solution of a candidate whose method and answers were partially correct is shown in Extract 11.1.

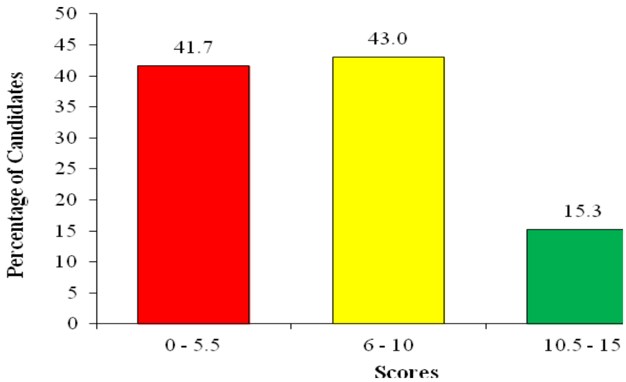


Figure 11: *Candidates performance in question 11*

Extract 11.1

11 (a) (i) $\cos(x+30^\circ) - \cos(x+90^\circ) = \frac{1}{2}$.

Soln.

$\cos(x+30^\circ) - \cos(x+90^\circ) = \frac{1}{2}$.

$-2\sin\left(\frac{x+30+90+x}{2}\right)\sin\left(\frac{x+30-x-90}{2}\right) = \frac{1}{2}$

$-2\sin(x+60)\sin(-30) = \frac{1}{2}$.

But $\sin(-30) = -\frac{1}{2}$.

$+\frac{2}{2}\sin(x+60^\circ) = \frac{1}{2}$.

$\sin(x+60^\circ) = \frac{1}{2}$.

$x+60^\circ = \sin^{-1}\left(\frac{1}{2}\right)$

$(x+60^\circ) = 30^\circ$.

$x = 30^\circ - 60^\circ = -30^\circ$

Also Recall

$\pi n + (-1)^n \alpha$

$\alpha = 30^\circ, n = 1, 2, 3 \ldots$

$180(0) + (-1)^0 30 = 30^\circ$

$x = 30 - 60^\circ = -30$

11 (a)(i) $180n + (-1)^n \alpha \quad n = 1, \alpha = 30°$

$180 - 30 = 150°$

but

$(x + 60) = 150$

$x = 150 - 60 = \cancel{110°}\ 90°$

$180n + (-1)^n \alpha \quad n = 2, \alpha = 30°$

$360 + 30 = 390$

$x + 60 = 390$

$x = 390 - 60 = 330°$

$\therefore x = \cancel{110°},\ 90°$

11 (a)(ii) $\cos(x + 30°)\cos(x - 30°) = \frac{1}{2}$.

Soln.

$2 \times \cos(x + 30°)\cos(x - 30°) = \frac{1}{2} \times \frac{2}{1}$

$2\cos(x + 30°)\cos(x - 30°) = 1$.

$\cos(2x + 30 - 30) + \cos(x + 30 - x + 30) =$

$\cos(2x) + \cos(60) = 1$.

but $\cos 60 = 0.5$

$\cos 2x = 1 - \cos 60$

$\cos 2x = 0.5$.

$1 - 2\sin^2 x = 0.5$

11 (a) (ii) $2\sin^2 x + 0.5 - 1 = 0$

$2\sin^2 x - 0.5 = 0$

$\sin x = 0.5$ or -0.5

$x = \sin^{-1}(0.5)$ or $\sin^{-1}-(0.5)$

$x = 30°$ or $-30°$

Recall for $\sin\theta$.

$\pi n + (-1)^n \alpha \quad n = 0, 1, 2, 3 \quad \alpha = \theta$

$180(1) + (-1)^1 30 = 150°$

$180(2) + (-1)^2 30 = 390°$

$\pi n + (-1)^n \alpha$

$n = 1$

$180 + + (+30) = 210°$

$n = 2$

$360 + (-1)^2(-30) = 330$,

$\therefore x = 30°, 150°,$

Extract 11.1: A sample solution from a candidate with correct responses

It can also be observed from the analysis that 41.7% of the candidates had a weak performance in this question as they only managed to get scores ranging from 0 to 5.5 out of 15 marks. This analysis shows that many candidates (30) lacked the skills to apply the factor formulae as well as the half angle formulae to make the right substitution. The candidates weak knowlege on trigonometric identities was also a reason for these candidates failing to get passing scores in this question. A sample solution from a candidate whose responses to this question were incorrect is shown in Extract 11.2.

Extract 11.2

11. (a). Equation for the value of x where,

$0^\circ \leq x < 180^\circ$

(i) $\cos(x+30^\circ) - \cos(x+90) = \frac{1}{2}$

$\cos x\cos 30^\circ - \sin x\sin 30^\circ - (\cos x\cos 90^\circ - \sin x\sin 90^\circ)$

$= \frac{1}{2}$

$\cos x\cos 30^\circ - \sin x\sin 30^\circ - (\cos x\cos 90^\circ - \sin x\sin 90^\circ) = \frac{1}{2}$

$\cos x\cos 30^\circ - \sin x\sin 30^\circ - \cos x\cos 90^\circ + \sin x\sin 90^\circ = \frac{1}{2}$

$\cos x\cos 30^\circ - \cos x\cos 90^\circ + \sin x\sin 90^\circ - \sin x\sin 30^\circ = \frac{1}{2}$

but

$\cos 90^\circ = 0$

$\sin 90^\circ = 1$

11 (a) (i)

$$\cos x \cos 30^\circ - \cos x(0) + \sin x (1) - \sin x \sin 30^\circ = \frac{1}{2}$$

$$\cos x \cos 30^\circ + \sin x - \sin x \sin 30^\circ = \frac{1}{2}.$$

but

$$\sin 30^\circ = \frac{1}{\sqrt{2}}.$$

$$\cos 30^\circ = \sqrt{3/2}.$$

$$\sqrt{\frac{3}{2}} \cdot \cos x + \sin x - \frac{1}{\sqrt{2}} \sin x = \frac{1}{2}$$

$$\cos x + \frac{\sin x}{\sqrt{3/2}} - \frac{\frac{1}{\sqrt{2}} \sin x}{\sqrt{3/2}} = \frac{1}{2} \times \sqrt{3/2}.$$

$$\cos x + \frac{1}{\sqrt{3/2}} \sin x - \frac{\sqrt{3/2}}{\sqrt{2}} \sin x = \frac{1}{2} \sqrt{3/2}$$

$$\text{but } \cos^2 x + \sin^2 x = 1.$$

$$\cos x = \sqrt{1 - \sin^2 x}$$

$$\sqrt{1 - \sin^2 x} + \frac{1}{\sqrt{3/2}} \sin x - \frac{\sqrt{3/2}}{\sqrt{2}} \sin x = \frac{1}{2} \sqrt{3/2}$$

$$\left(1 - \sin^2 x\right)^{1/2} + \frac{1}{\sqrt{3/2}} \sin x - \frac{\sqrt{3/2}}{\sqrt{2}} \sin x = \frac{1}{2} \sqrt{3/2}.$$

$$\left((1 - \sin x)(1 + \sin x)\right)^{1/2} + \frac{1}{\sqrt{3/2}} \sin x - \frac{\sqrt{3/2}}{\sqrt{2}} \sin x = \frac{1}{2} \sqrt{3/2}.$$

Extract 11.2(a): A sample solution from a candidate whose responses had mistakes. He/she chose a wrong method that complicated the equation and was unable to proceed to the final answer.

11. (b). $\sin \theta/2 = \frac{2t^2}{1+t^2}$.

$\cos \theta/2 = \frac{1-t^2}{1+t^2}$.

Then

$\sin\theta + 2\cos\theta = 1$.

$\frac{2t^2}{1+t^2} + 2\left(\frac{1-t^2}{1+t^2}\right) = 1$.

$\frac{2t^2}{1+t^2} + \frac{2-2t^2}{1+t^2} = 1$.

$2t^2 + 2 - 2t^2 = 1 + t^2$

$2t^2 - 2t^2 - t^2 + 2 - 1 = 0$

$-t^2 + 1 = 0$

$t^2 = 1$.

$\sqrt{t^2} = \sqrt{1}$

$t = \pm 1$.

$t = 1$ and -1.

From

$t = \tan\theta/2$. at $t = 1$

$\tan\theta/2 = 1$.

$\theta/2 = \tan^{-1}(1)$.

$\theta/2 = 45°$

$\theta = 45° \times 2$

$\theta = 90°$

At $t = -1$.

$\tan\theta/2 = -1$.

$\theta/2 = \tan^{-1}(-1)$

$\theta/2 = -45°$

$\theta = -45° \times 2$.

Extract 11.2(b): A sample solution from a candidate whose calculations were incorrect. He/she made a wrong substitution of the sine function that led to an incorrect quadratic equation.

2.12 Question 12: Vectors

This question had parts (a) and (b). In part (a), the candidates were given two points $A(1,1,3)$ and $B(4,5,8)$, and were required to find the displacement vector $\overrightarrow{AB}$ in terms of the unit vectors $\underline{i}, \underline{j}$ and $\underline{k}$, and hence represent this displacement vector in the xyz plane.

In part (b), they were required to find the velocity and acceleration of a moving particle after 3 seconds given that the particle had a path described by $\underset{-}{s}(t) = 3t^2 \underset{-}{i} + 2t \underset{-}{j} - e^t \underset{-}{k}$ in meters.

This question was attempted by 80(89.9%) candidates, of which 46(57.5%) scored 0 to 5.5 marks, 32(40.0%) scored 6 to 10 marks and 2(2.5%) scored 10.5 marks. Thus, 34(42.5%) candidates had obtained the passing scores which range from 6 to 10.5 out of 15 marks. Although the performance was average in this question, further analysis shows that a few candidates (2.5%) scored 10.5 marks. This suggests that candidates had little knowledge of vector calculus to differentiate the vector function in order to get the velocity, $\underset{-}{v}(t)$ and acceleration, $\underset{-}{a}(t)$ of the particle. No candidate scored more than 10.5 marks from this question. A sample solution of a candidate whose responses were partially correct is shown in Extract 12.1.

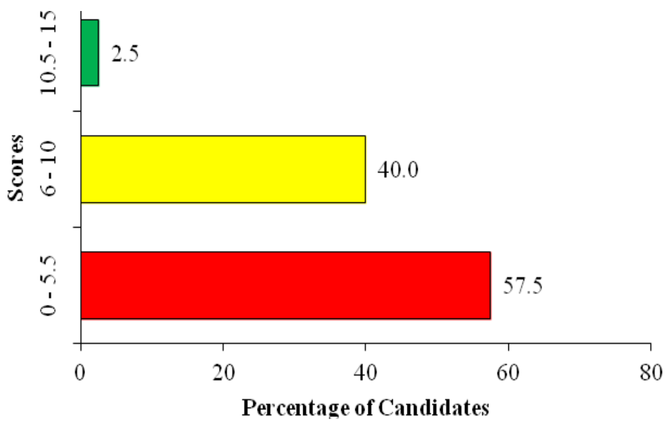
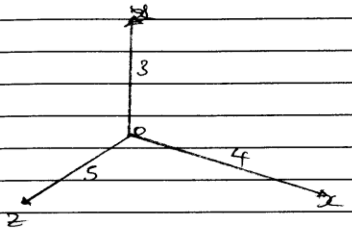


Figure 12: *Candidates performance in question 12*

Extract 12.1

displacement vector $(\overline{AB}) = 3\underset{\sim}{i} + 4\underset{\sim}{j} + 5\underset{\sim}{k}$.



(b) given $s(t) = 3t^2\underset{\sim}{i} + 2t\underset{\sim}{j} - e^t\underset{\sim}{k}$

$t = 3$ seconds

Velocity $(v) = ?$

acceleration$(a) = ?$

from

$$v = \frac{d(s)}{dt}.$$

then, $s(t) = 3t^2 i + 2t\underset{\sim}{j} - e^t \underset{\sim}{k}$

$$\frac{d(s)}{dt} = 6t\underset{\sim}{i} + 2\underset{\sim}{j} - e^t\underset{\sim}{k}$$

but $t = 3$

$$\frac{d(s)}{dt} = (6\times3)\underset{\sim}{i} + 2\underset{\sim}{j} - e^3\underset{\sim}{k}$$

$$= 18\underset{\sim}{i} + 2\underset{\sim}{j} - e^3\underset{\sim}{k} \text{ in m/s}$$

Then

Velocity $= 18\underset{\sim}{i} + 2\underset{\sim}{j} - e^3\underset{\sim}{k}$.

12 (b) Also,

$$a = \frac{dv}{dt}.$$

but $v = 6t\underset{\sim}{i} + 2\underset{\sim}{j} - e^t\underset{\sim}{k}$

$$\frac{dv}{dt} = 6\underset{\sim}{i} + 0 - e^t\underset{\sim}{k}$$

$$\frac{dv}{dt} = 6\underset{\sim}{i} - e^t\underset{\sim}{k}$$

substituting $t = 3$.

$$\frac{dv}{dt} = 6\underset{\sim}{i} - e^3\underset{\sim}{k} \text{ in m/s}^2$$

- Velocity $= (18\underset{\sim}{i} + 2\underset{\sim}{j} - e^3\underset{\sim}{k})$ m/s
- Acceleration $= (6\underset{\sim}{i} - e^3\underset{\sim}{k})$ m/s^2

Extract 12.1: A sample solution from a candidate with some correct responses

Further analysis shows that more than half (57.5%) of the candidates scored 0 to 5.5 out of 15 marks meaning that the question was weakly performed. Notably, 12.5% of the candidates scored 0. Many candidates sketched the *xyz*-plane, but failed to present the displacement vector in the plane as a result of lack of knowledge in 3-dimensional axes. A sample solution of a candidate whose responses were incorrect is shown in Extract 12.2.

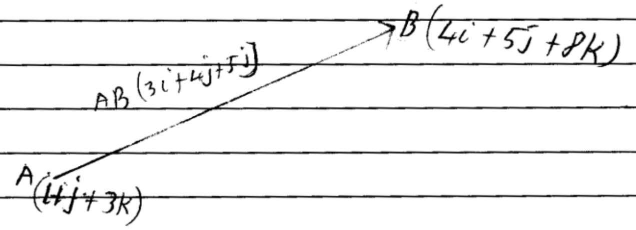
Extract 12.2

12 (a) Solution

from points A(1,1,3) and B(4,5,8)

$\overrightarrow{AB} = B - A = (3,4,5)$

displacement vector $= 3i + 4j + 5k$



(b) Solution

from $r(t) = 3t^2 i + 2tj + \cancel{\ } - e^t k$

velolocity $= 6t + 2 - \frac{1}{t}e^t$

$\therefore$ velocity $= 6t + 2 - \frac{1}{t}e^t$ m/s

from velocity $= \frac{\text{distance}}{\text{time}}$

distance of velocity × time

$d = 3 \times (6t + 2 - \frac{1}{t}e^t)$

$d = 18t + 6 - \frac{3e^t}{t}$ m

but Acceleration $18t + 6 - 3et$

$\therefore$ Acceleration $= (18t + 6 - \frac{3e^t}{t})$ m/s²

Extract 12.2: A sample solution from a candidate whose response was incorrect. He/she failed to sketch the displacement vector in *xyz*-plane and lacked knowledge on vector calculus.

2.13 Question 13: Algebra

This question had parts (a) and (b). In part (a), the candidates were required to use the Taylor's series to expand the sine function, $\sin\left(\frac{\pi}{6}+k\right)$ in ascending powers of k as far as the term containing k^3. In part (b), the candidates were required to find the turning points on the curve x^3-2x^2+x+1, and hence sketch the curve and show that it has only one real root.

Question 13 was attempted by 23(25.8%) candidates. Analysis shows that 13(56.5%) candidates scored 0 to 5.5 marks, 5(21.75%) candidates scored 6 to 10 marks and 5(21.75%) candidates scored 10.5 to 15 out of 15 marks. Further analysis shows that, less than half of the candidates (43.5%) scored 6 to 15 marks, although some candidates (8.7%) scored 15 out of 15 marks. A sample solution from a candidate who managed to give a correct answer is shown in Extract 13.1

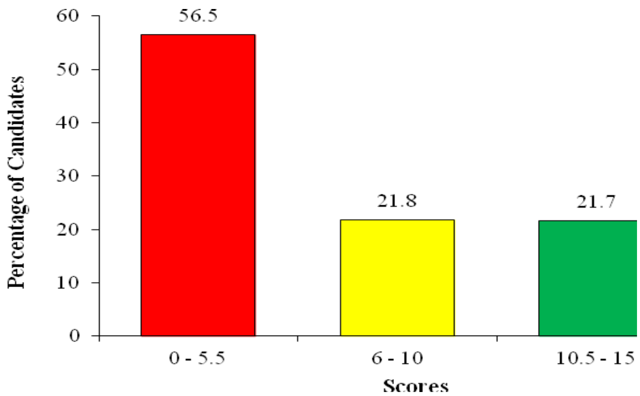


Figure 13: *Candidates performance in question 13*

Extract 13.1

13. (a) Solution:

Given:

$$\sin\left(\pi/6 + k\right)$$

from the Taylor's series

$$f(a+x) = f(a) + \frac{f'(a)x}{1!} + \frac{f''(a)x^2}{2!} + \frac{f'''(a)x^3}{3!} + \ldots$$

Then,

$f(a) = \sin \pi/6 = 1/2$

$f'(a) = \cos \pi/6 = \sqrt{3}/2$

$f''(a) = -\sin \pi/6 = -1/2$

$f'''(a) = -\cos \pi/6 = -\sqrt{3}/2$

Then, from the series above

$$\sin(\pi/6 + k) = \frac{1}{2} + \frac{\sqrt{3}/2\, x}{1!} + \frac{(-1/2\, x^2)}{2!} + \frac{(-\sqrt{3}/2\, x^3)}{3!}$$

But, $x = k$

$$\sin(\pi/6 + k) = \frac{1}{2} + \frac{\sqrt{3}/2\, k}{1!} - \frac{1/2\, k^2}{2!} - \frac{\sqrt{3}/2\, k^3}{3!}$$

$$\sin(\pi/6 + k) = \frac{1}{2} + \frac{\sqrt{3}}{2}k - \frac{1}{4}k^2 - \frac{\sqrt{3}}{12}k^3$$

13. (a)

$\therefore \sin(\pi/6 + k) = 1/2 + \sqrt{3}/2\, k - 1/4\, k^2 - \sqrt{3}/12\, k^3$

(b) Given:

$$x^3 - 2x^2 + x + 1$$

Let,

$$y = x^3 - 2x^2 + x + 1$$

$$dy/dx = 3x^2 - 4x + 1$$

Put, $dy/dx = 0$

$$0 = 3x^2 - 4x + 1$$

or

$$3x^2 - 4x + 1 = 0$$

$$x = 1 \text{ or } x = 0.33$$

Then,

Take $y = x^3 - 2x^2 + x + 1$

Put $x = 1$

$$y = (1)^3 - 2(1)^2 + 1 + 1$$

$$y = 1 - 2 + 1 + 1$$

$$y = 1$$

Again put $x = 0.33$

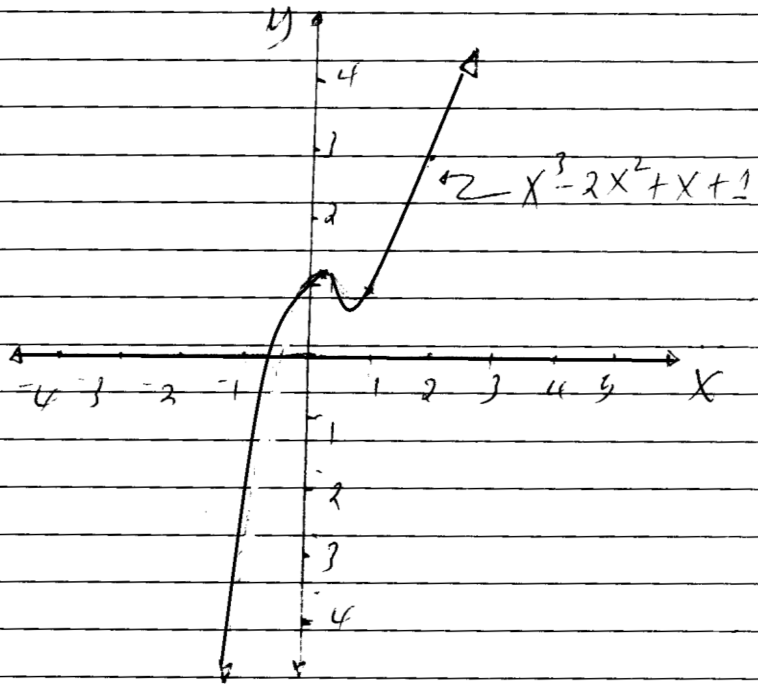
$$y = (0.33)^3 - 2(0.33)^2 + 0.33 + 1$$

$$y = 1.15$$

15. (b) Therefore, The turning points are $(1, 1)$ and $(0.33, 1.15)$.

→ To sketch the curve and to show that $x^3 - 2x^2 + x + 1$ has only one root

Consider, $y = x^3 - 2x^2 + x + 1$



Extract 13.1: A sample solution from a candidate who was able to compute the turning points of the curve and sketched it correctly.

More than half of the candidates (56.5%) scored below 6 marks. In part (a), the candidates could not use properly the Taylor's series to expand the function. They failed to get the successive derivatives of the sine function. In part (b), sketching the curve, $x^3 - 2x^2 + x + 1$ was a problem to the candidates. Extract 13.2 shows a sample solution from a candidate who was unable to respond to the question correctly.

Extract 13.2

13 (b) solution

from curve $x^3 - 2x^2 + x + 1$

but turning point $= \left(\frac{b}{2a}, 4ac\right)$

$b = -2$ and $a = 1$

and $c = 1$

$\frac{b}{2a} = \frac{-2}{2\times 1}, \; 4\times 1\times 1$

$= -1, 4$

$\therefore$ turning points $= (-1, 4)$

Extract 13.2: A sample solution from a candidate who failed to find the turning points of the curve.

2.14 Question 14: Assessment in Mathematics

Question 14 required the candidates to explain five factors which a classroom teacher has to consider during construction of good a mathematics test. For good responses, candidates were expected to give a brief introduction on the meaning of a classroom test as an essential tool of measurement used in assessing mathematics subject.

Among other factors, candidates were supposed to explain the following factors to merit marks.

(a) Intended teaching and learning competencies

(b) Objectives of the test

(c) Domain of learning (cognitive level, attitude or psychomotor)

(d) Setting items that suit both objective and competencies

(e) Test items set within the topic or subtopic to be tested

(f) Time allocation

(g) Consideration of learner's conceptual knowledge and skills.

After explaining the five factors, the candidates were expected to give a brief conclusion.

This question was attempted by 86(96.6%) candidates. Analysis indicates that 5(5.8%) scored 0 to 5.5 marks, 60(69.8%) scored 6 to 10 marks and 11(24.4%) candidates scored 10.5 to 15 out of 15 marks. Many candidates (94.2%) had pass scores ranging from 6 to 15 marks, which is a good performance, even though no candidate scored 15 out of 15 marks. The majority of the candidates (69.8%) scored 6 to 10 marks. A sample solution from a candidate whose score was in the range of 10.5 to 12 out of 15 marks is shown in Extract 14.1.

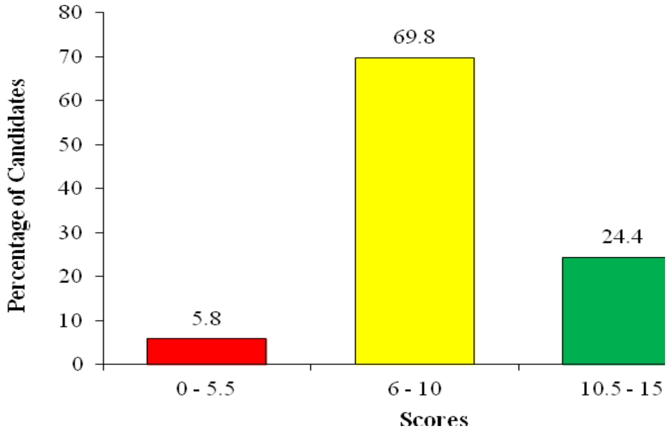


Figure 14: *Candidates performance in question 14*

Extract 14.1

14. Mathematics test refers to the careful list of questions prepared to measure the learning outcomes to the students in teaching and learning of mathematics. For the effective mathematics teachers some factors should be considered when constructing mathematics test. Here ~~befo~~ below are some of those factors which are:-

The purpose of the test. The teacher should be aware to why he or she want to assign the test to the students. Therefore he or she should have a purpose. For example whether he or she want to measure knowledge or speed on doing a examination or test.

The learning objectives. The good test should rely on the learning objectives that means that, to what a teacher is to measure is what indicated to be learned or have already learned previous or long time.

Table of specification. The teacher should consider the table of specification in order to construct the test which rely to all cognitive domain.

Forexample, through the use of table of specification a teacher may understand how many question items measure application.

Time. This is another factor by which a teacher should consider for administering the test. Forexample for how long since the previous test was administered. On other hand the time which is to be used in doing the test should be considered.

Moreover, The number of question items' Under this Case the teacher should be aware how many items is to be done and for how long. In this case the teacher will be able to allocate the time with respect to question items. Forexample the test contains twenty questions. this enable a teacher to calculate the time to be used in conducting the test.

Generally, Assessment is the part and parcel in teaching and learning mathematics. Teachers are advised to use effective assessment tools to measure students achievement.

Extract 14.1: A sample solution from a candidate who demonstrated good knowledge, but not all his/her responses were correct.

The few candidates (5.8%) who scored 0 to 5.5 marks had little knowledge on the factors that a teacher has to consider during construction of mathematics test. This is highlighted by their weak responses that are full of grammatical mistakes. It is important to note that no candidate scored 0 in this question. A sample solution from a candidate whose answer was weak is as shown in Extract 14.2.

Extract 14.2

14. Factor to be considered during Construction of Mathematics tests.
(i) All topic taught and well understood, is selected
(ii) Nature of questions calculating the time should be balanced.
(iii) Constructing from simple to complex especially section B and C,
(iv) Nature of the class considering the slow learners and faster learners
(v) Normally no matching items and multiple choices

14 Also when constructing he should start from simple to complex to not let students confuse since if you start with the difficult question it can loose hope to them that they are going to fail the test since it is difficult.

Also considering to the nature of the class since into the class there are fast learners and slow learners you balance all by standardize the test.

Normally in mathematics the matching items /and ~~[illegible]~~ question choices is not much considered indeed.

Extract 14.2: A sample solution from a candidate whose answers were weak and scored low marks.

2.15 Question 15: Planning and Preparation for Teaching Mathematics

This question had parts (a) and (b). In part (a), the candidates were given a sketch of a cuboid and required to prepare a part of the lesson development of a lesson plan for teaching "how to locate and name an angle between a line and plane of a cuboid". In part (b), the candidates were required to identify by giving reasons, two pre-requisite concepts (knowledge) that learners need to have in order to understand the procedures of calculating an angle between a line and a plane of a three dimensional figure. In part (a), the candidates were expected to prepare the lesson development that has two stages, namely; "Introduction" and "New knowledge and Skills". In each stage the candidates had to show in tabular form the Estimated Time(duration), Teaching Activities, Learner's Activities and Assessment.

In part (b), the candidates were expected to identify among others, the following pre-requisite concepts in order to understand the procedures for calculating an angle between a line and a plane of a three dimensional figure.

- How to sketch three dimensional figures.
- Use of Pythagoras theorem, because before angle calculations are made,one may need to find the length of the sides of the figure.
- Determine the tangent of an angle in order to find the angle in degrees.

Question 15 was attempted by only 4 (4.5%) candidates. The analysis shows that 2 (50.0%) candidates scored 6 to 10 marks and 2 (50.0%) candidates had scores ranging from 10.5 to 15 marks. No candidates had scores ranging from 0 to 5.5 out of 15 marks. But also, the analysis shows that no candidates scored 15 out of 15 marks. All the candidates (100%) passed this question with scores from 8 to 11 out of 15 marks. It is important to note that the majority (95.5%) of the candidates did not opt for this question. A sample solution from a candidate with many correct responses is shown in Extract 15.1.

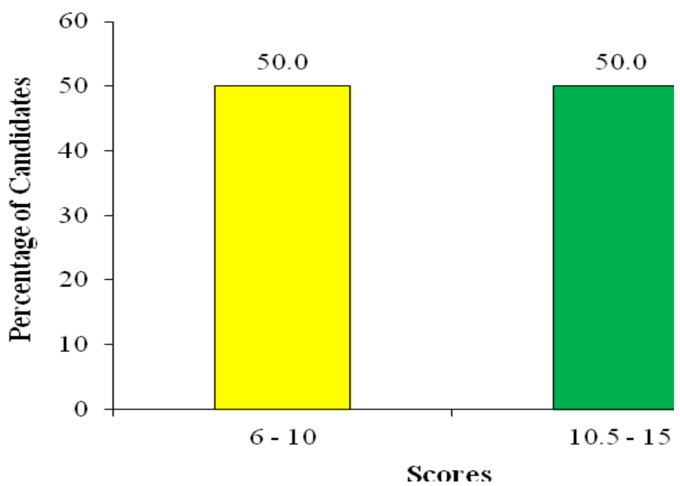


Figure 15: *Candidates performance in question 15*

Extract 15.1

15. (a) THE LESSON DEVELOPMENT.

SUBJECT: MATHEMATICS

STAGES	TIME(MIN)	TEACHING ACTIVITIE	LEARNING ACTIVITIES	ASSESSMENT ACTI TIES
Introduction	5	Brainstorming the students on the concept of an angle between a line and plane of a cuboid	Responding by answering the questions asked by a teacher	Observing if students are answering correctly.
New knowledge.	35	Demonstrating on how to locate and name an angle between a line and plane of a cuboid	Looking on how a teacher is locating and name an angle between a line and plane of cuboid	Checking if students are observing a teacher's demonstrations.
Reinforcement	15	Giving the students task in a group to discuss concerning angle between a line and plane of a cuboid	Participating fully by discussing the questions given by a teacher.	Looking if the students are discussing.
Reflection	15	Asking the students questions orally	Responding by answering the questions asked by teacher	Observing if students are answering questions.
Consolidation	10	Summarizing and giving homework.	Taking summary and homework	Observing if students are taking homework

15. (b) ~~The student~~
(i) The learners should have the knowledge on
the ~~two~~ trigonometric ratio inorder to under
stand the procedures for calculating an
angle between a line and a plane of
a ~~threen~~ three dimensional figures.
(ii) The learners should also know how to
use mathematical tables in order to calcu
late ~~the~~ an angle between a line and
a plane of a three dimensional figures.

Extract 15.1: A sample solution from a candidate who had some correct responses

2.16 Question 16: Planning and Preparation for Teaching Mathematics

This question required candidates to justify, by giving five points, the statement that "The use of a lesson plan plays an important role in teaching and learning mathematics". The candidates were expected to first give a brief definition of a lesson plan, and then choose to justify and explain any five of the following facts;

(a) Produces more unified lesson.
(b) Allows teachers to evaluate their own knowledge with regard to the content to be taught.
(c) Lesson plan makes a teacher more confident as it enables the teacher to clear on what is needed to be done, how and when.
(d) Lesson plan can be used in whole or in part in other future lessons
(e) Lesson plan can be useful for other people(substitute teachers).
(f) Lesson plan can serve as an evidence of teachers' professional performance.

This question was attempted by 88 (98.9%) candidates, of which 7 (8.0%) scored 6 to 10 marks, and 81 (92.0%) scored 10.5 to 15 out of 15 marks. No candidates (0%) scored 0 to 5.5 marks. Thus, all the candidates (100%) who attempted this question had pass scores ranging from 6 to 15 marks which is a good performance. A total of 9 (10.2%) candidates scored all 15 marks in this question. A sample of a solution from a candidate whose answer was good is shown in Extract 16.1

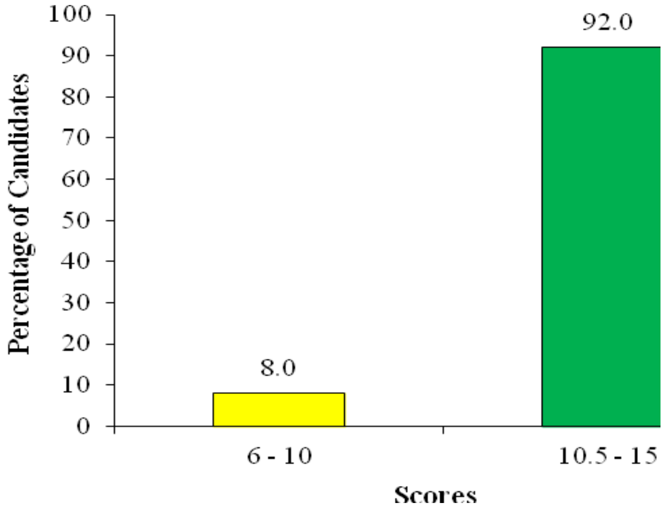


Figure 16: *Candidates performance in question 16*

Extract 16.1

16. lesson plan Is the framework prepared by a teacher ~~p~~ before entering the classroom for Implementing a lesson. the following are the roles played by lesson plan in teaching and learning mathematics as follows:-

Helps a teacher to use the appropriate teaching methodologies, example group discussions and brainstorming, through lesson plan a teacher gets to know what methodologies is going to be applicable in teaching and learning process.

Helps a teacher to maintain's time. example how much minutes is going to be applied on the Introduction, new knowledge, reinforcement and others because all these are Indicated on the lesson plan especially on the columns of lesson plan development, because through this it will enable teacher to present all the contents required according to the periods of the lesson.

Helps teacher to determine the type of assessment to be applied, is also the role played by lesson plan it also Indicates the type of assessment like observing what students doing and to make judgements based on the result obtained or obtained from these students.

Helps teacher to Identify the specific objectives. also through lesson plan, it Indicates the specific objectives to be attained by student hence through this it makes a teacher to make sure that every student achieves the stated objectives by using the methodologies which will help a student to attains these stated specific objectives.

Extract 16.1: A sample solution from a candidate whose responses were good.

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH TOPIC

The Mathematics examination for DSEE 2018 had 16 questions that were set from 11 topics. The analysis of the performance shows that 8 questions from 5 topics had good performance. These questions were set from the following topics (and total number): Analysis of Mathematics Curriculum Materials (2 questions), Planning and Preparation for Teaching Mathematics (3 questions), Differentiation (1 question), Teaching the Selected Topics (1 question) and Logic (1 question).

The analysis also shows that 6 questions from 5 topics (Probability, Trigonometry, Vectors, and Algebra (with one question each) and Assessment in Mathematics (with two questions) were averagely performed.

However, 2 questions both set from Coordinate Geometry II had weak performance as shown in the analysis.

In general, the analysis of the candidates' overall performance topic - wise shows that the candidates' performance was average.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 CONCLUSION

The analysis of the candidates' performance topic-wise shows that, the candidates had a weak performance in 1 out of 11 topics that were examined. This topic was; Coordinate Geometry II. The weak performance in this topic is associated with the candidates' inability to sketch the square pyramid, inability to identify faces, vertices and edges of a square pyramid, inability to find the equation of a line passing through two given points, inability to recall and use the distance formula to find the perpendicular distance from the line to the point.

In the topics (Probability, Trigonometry, Vectors, Algebra and Assessment in mathematics) that were performed averagely, some candidates' had difficulties in stating the principle of permutation and the use of law of choice in probability, lacked knowledge on factor formulae and half angle formulae in solving trigonometric equations, lacked knowledge on Taylor's series and its applications, lacked knowledge on vector calculus. But also some candidates had difficulties in understanding the essential features of a good Mathematics test.

4.2 RECOMMENDATIONS

From the analysis, we observed that three topics from the pedagogic content and two topics from the academic content have good performance that vary from 73.0% to 97.2%, which is commendable. However, there is a need to improve in some areas of these topics where candidates had difficulties in answering the questions.

Teachers are advised to identify suitable teaching methods and appropriate learning resources that suit their groups of learners. The use of learning materials which are available around the surrounding learning environment is important.

Proper use of Mathematics Curriculum materials and good preparation of lesson activities can improve the quality and competency of learners, and hence improve the performance of learners in the future.

Further analysis shows that, four topics from the academic content and one topic from the pedagogic content had average performance ranging from 42.5% to 65.8%. Here, proper selection of learning methods is needed.

Learning methods should be appropriate to learners in order to improve the performance in these topics.

We also recommend the learners to own the learning process by participating fully in all activities designed by the teacher, and put more effort in challenging topics. Teachers should also design and implement hands-on activities that motivate learners to be more involved in the learning process.

On the other hand, the analysis shows that one topic on the academic content was weakly performed (with pass rate of 33.1%). In this topic the candidates lacked examined knowledge and skills in all the questions. Appropriate choice of learning methods in this topic is highly needed. Also teachers are advised to design learning activities which involve the use of real objects and allow learners to construct these objects, sketch/draw them and identify their properties (features) as part of hands-on activities that can be done during the learning process. We hope that, the implementation of these recommendations will help to improve the future examinations performance.

APPENDICES

APPENDIX I

SUMMARY OF THE PERFORMANCE OF CANDIDATES TOPIC- WISE

S/N	Topics	Total Number of Questions	Percentages of Candidates' Performance	Remarks
1.	Analysis of Mathematics curriculum materials	2	97.2	Good
2.	Planning and Preparation for Teaching Mathematics	3	96.2	Good
3.	Differentiation	1	94.3	Good
4.	Teaching Selected Topics	1	87.5	Good
5.	Logic	1	73.0	Good
6.	Probability	1	65.8	Average
7.	Trigonometry	1	58.3	Average
8.	Vectors	1	42.5	Average
9.	Assessment in Mathematics	2	56.5	Average
10.	Algebra	1	42.5	Average
11.	Coordinate Geometry II	2	33.1	Unsatisfactory
Overall Performance			67.9	Average

APPENDIX II

CANDIDATES' PERFORMANCE TOPIC- WISE DSEE 2018