THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT ON THE ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (ACSEE) 2023

BIOLOGY

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133 BIOLOGY

Published by:

The National Examinations Council of Tanzania,
P.O Box 2624,
Dar es Salaam, Tanzania.

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FOREWORD

The National Examinations Council of Tanzania (NECTA) is pleased to issue this Candidates' Item Response Analysis (CIRA) report on the Biology for the Advanced Certificate of Secondary Education Examination (ACSEE), 2023. The purpose of this report is to provide feedback to all education stakeholders on the candidates' performance. This is because the candidates' performance is a primary indicator of the effectiveness of classroom teaching and learning.

The report reveals that the performance in Biology ACSEE 2023 was good. The majority (98.94%) of the candidates passed the examination. The candidates' good performance was a result of their good mastery of the fundamental concepts, principles and skills of biological science as specified in the syllabus.

The topics in which the candidates performed well are: Growth and Development, Evolution, Cytology, Comparative Studies of Natural Groups of Organisms, Principles of Classification and Coordination. The topics of Gaseous Exchange and Respiration, Nutrition, Reproduction, Transportation and Genetics had an average performance while the topics of Ecology and Regulation/Homeostasis had weak performance. Weak performance was due to candidates' inadequate knowledge of the concepts examined, misspelling of scientific names and failure to meet the demands of the questions.

The Council expects that this report will help the future candidates to rectify the mistakes identified in the course of learning before sitting for the next ACSEE. The feedback will also help teachers to identify areas where students have serious learning problems and take appropriate measures to improve teaching and learning. Moreover, the Council expects that, education stakeholders will continue to take necessary measures for strengthening the teaching and learning of the Biology subject particularly, the areas that are identified as challenges to the candidates. This will help to improve students' gained competencies as stipulated in the syllabus for Biology subject and lead to better performance in future examinations administered by NECTA.

Finally, NECTA extends its gratitude to all examination officers and others who participated in preparing this report.

Dr. Said Ally Mohamed
EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents an analysis of the candidates' performance in ACSEE in the Biology subject administered on May 2023. The examination was set based on the 2019 Biology Subject Examination Format. It had three papers namely; 133/1 Biology 1, 133/2 Biology 2 and 133/ Biology 3. Biology 1 and 2 were theory papers while Biology 3 was a practical paper. The 133/3 Biology 3 practical paper was categorised into alternative papers 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology C. The candidate was to sit for only one alternative. The 133/1 Biology 1 and 133/2 Biology 2, carried a total of 100 marks each while the 133/3 Biology 3 weighed 50 marks.

The 133/1 Biology 1 paper had a total of 10 questions in sections A and B. Section A had seven (7) short answer questions. The candidates were required to respond to all questions. Each question carried 10 marks. Section B had three (3) structured/essay questions. The candidates were required to answer two (2) questions of which each carried 15 marks. The 133/2 Biology 2 paper had six (6) structured/essay questions and the candidates were required to answer five (5) questions. Each question carried 20 marks. The 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology C papers had three (3) questions each. Question one (1) carried 20 marks and the other two questions carried 15 marks each. The candidates were required to answer all the questions.

A total of 30,473 candidates sat for the examination and 98.94 per cent of them passed. An analysis of the pass grades based on sex is presented in the following Table.

Table: The Candidates' Performance in Biology ACSEE 2023

Sex	Grades					
	A	B	C	D	E	S
Male	50	1,091	5,805	7,270	2,222	213
Female	21	594	3,446	6,235	2,825	309
Total	**71**	**1,685**	**9,251**	**13,505**	**5,047**	**522**

The Table shows that most of the candidates (13,505) attained D grade while few of them (71) attained A grade, the majority (50) of them being

males. Comparatively, the candidates' performance in the ACSEE in 2023 has dropped by 0.32 per cent from that of 2022.

The next part of this report shows the analysis of the candidates' performance on each question in 133/1 Biology 1, 133/2 Biology 2 and 133/3 Biology 3 in the 2023 ACSEE.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH QUESTION

The candidates' performance on each question in each paper for the Biology subject is analysed by indicating the topic examined, the requirement of each question and the percentage of the candidates who attempted the question. In addition, the percentage of the candidates who had good, average or weak performance is shown. The performance on a question is considered to be *good* if the percentage of candidates who passed ranges from 60 to 100, *average* if the percentage ranges from 35 to 59, and *weak* if the percentage is from 0 to 34. Green, yellow and red colours are used in charts/tables to indicate good, average and weak performance respectively.

2.1 133/1 Biology 1

The paper comprised a total of 10 questions set from seven (7) topics, namely; Cytology, Principles of Classification, Coordination, Nutrition, Gaseous Exchange and Respiration, Reproduction and Transportation. The candidates' response analysis for each question is as follows:

2.1.1 Question 1: Cytology

This question consisted of part (a) and (b). The candidates were required to: (a) justify the statement that "mitochondrion can be regarded as a cell within a cell" and (b) draw a diagram of a mitochondrion showing its parts.

Data reveal that 30,471 (100%) candidates responded to the question. Further analysis shows that the performance was good since the majority (89.17%) passed. The analysis of their performance is shown in Figure 1.

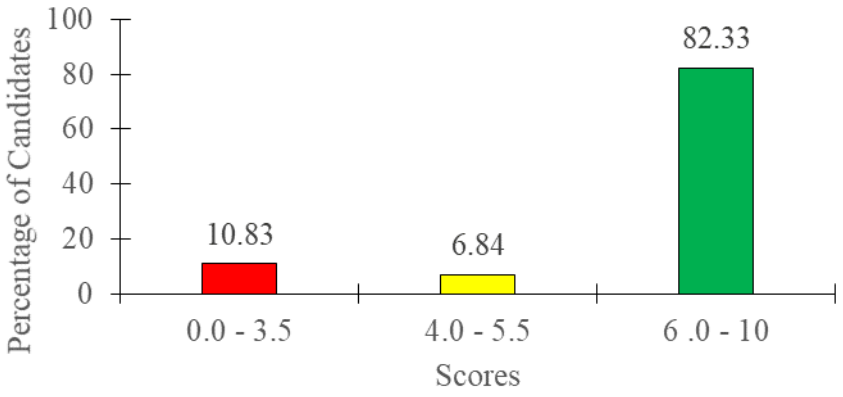
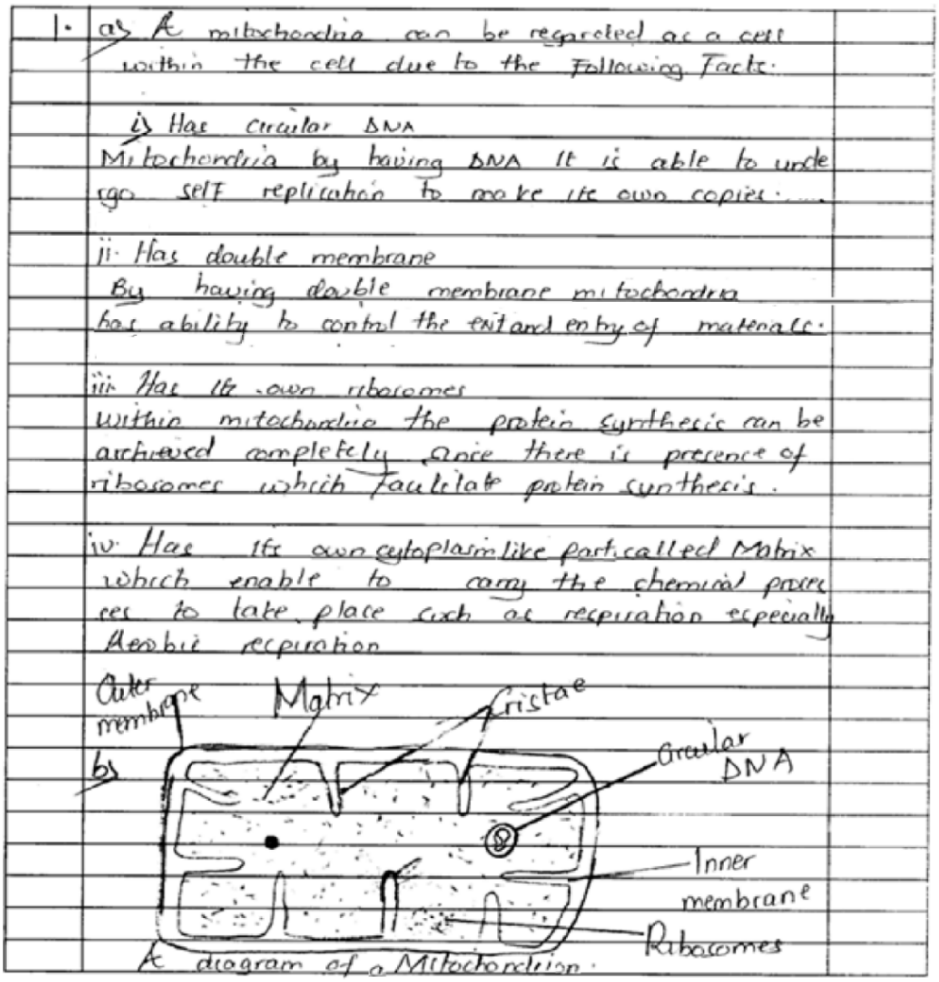


Figure 1: *Distribution of Candidates' Scores on Question 1*

Figure 1 shows that the candidates had good performance in question 1 since more than three quarters (82.33%) scored high marks ranging from 6 to 10 while a few (10.83%) of them scored from 0 to 3.5 marks.

The candidates who scored high marks exhibited that they were knowledgeable about the structure of the cell and mitochondrion as their responses were correctly written to justify the similar structures which appear in both, the cell and mitochondrion. In addition, they had good drawing skills which enabled them to present correctly the structure of mitochondrion diagrammatically. Extract 1.1 is an example of the candidates' correct responses to this question.



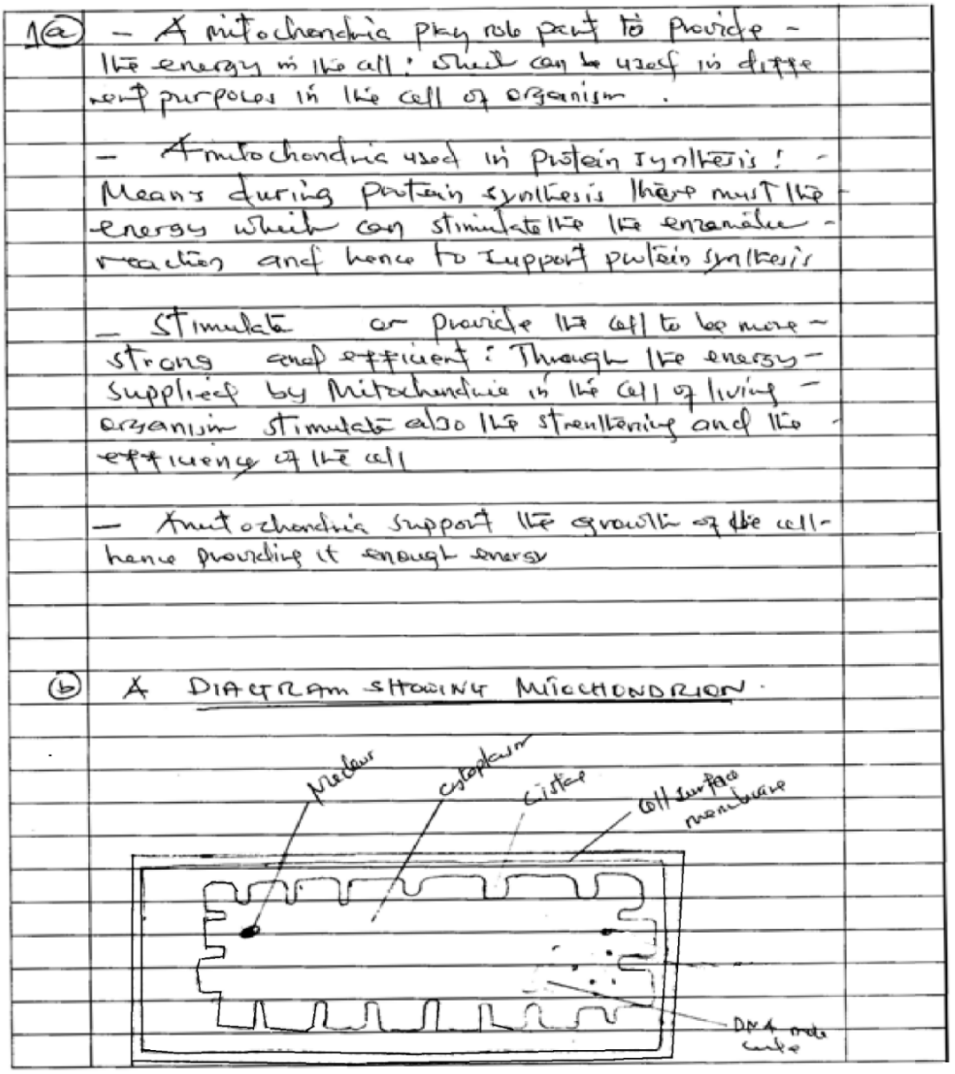
Extract 1.1: A sample of correct responses to question 1.

Extract 1.1, is a response from a candidate who correctly identified the features of the mitochondrion which qualify it as a cell. She/he also drew a well labelled diagram of a mitochondrion.

On the other hand, the candidates who had average scores (4.0 - 5.5) obtained some marks from part (a) and (b) since they gave one to two correct features of the mitochondrion which are similar to that of a cell. These candidates managed to draw a correct diagram of the mitochondrion but they labelled only some parts.

The candidates who scored low marks (0.0 - 3.5), exhibited inadequate knowledge of the features of a cell and a mitochondrion as they failed to make a comparison between them and identify the structures which appear

in both, the cell and mitochondrion. There were some candidates who mentioned the parts of a mitochondrion (eg. Cristae) instead of its features, while others wrote the organelles found in a cell such as *Golgi apparatus, endoplasmic reticulum and chloroplast*. In responding to part (b), some of the candidates drew a mitochondrion with three layers instead of two while others drew a diagram with incorrect labels. There were some who drew a diagram of a chloroplast instead of mitochondrion and others who drew structures which could not be identified. Extract 1.2 is a sample of a candidate's incorrect responses to question 1.



Extract 1.2: A sample of incorrect responses to question 1.

In Extract 1.2, the candidate stated the roles of a mitochondrion instead of the features that it shares with a cell. In addition, she/he drew an incorrect diagram with labels of nucleus and a cytoplasm, which are not parts of a mitochondrion.

2.1.2 Question 2: Gaseous Exchange and Respiration

This question had parts (a) and (b). The candidates were required to: (a) describe the effects of severely damaged pleural membrane and (b) explain why alveoli in the lungs are efficient in gaseous exchange.

The question was attempted by 30,471 (100%) candidates. The analysis indicates an average performance as only 52.21 per cent of the candidates passed in this question. The candidates' performance is presented as shown in Figure 2.

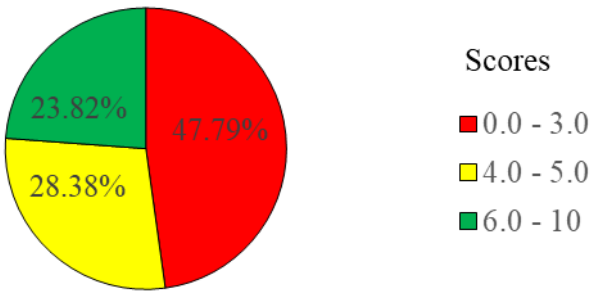
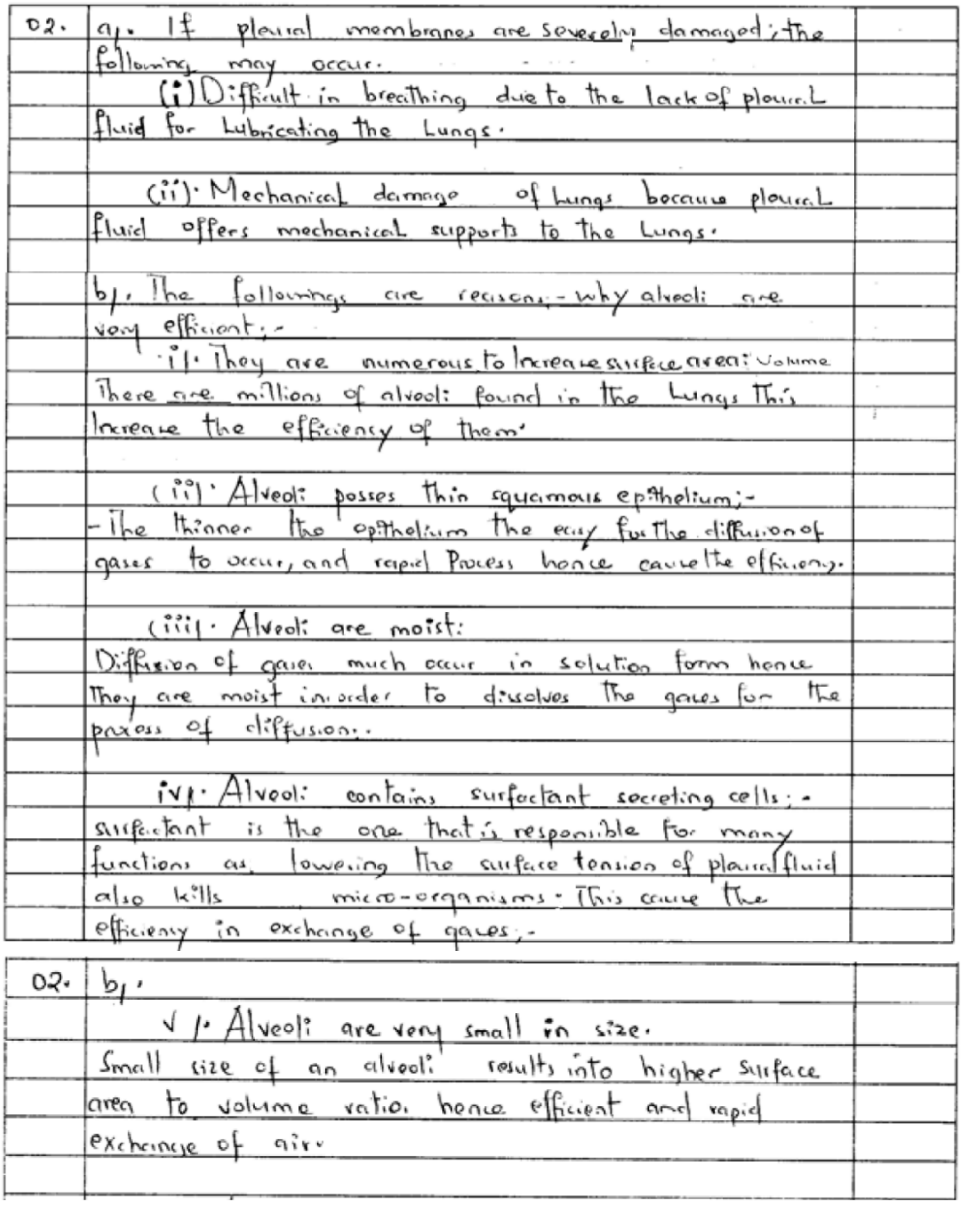


Figure 2: *Distribution of the Candidates' Scores on Question 2*

Figure 2 indicates that about half (52.21%) of the candidates scored 4 to 10 marks while the remaining (47.79%) scored low marks (0.0 - 3.0).

The candidates who scored high marks (6.0 - 10) gave correct description of the effects of a severely damaged pleural membrane in the lungs. They also correctly outlined the adaptive features of the alveoli that make it perform gaseous exchange efficiently. As well, they clearly elaborated how each adaptive feature favours efficient functioning of the alveoli. Extract 2.1 is part of a sample of responses from the candidates' who answered the question correctly.


02. a). If pleural membranes are severely damaged; the following may occur.

(i) Difficult in breathing due to the lack of pleural fluid for lubricating the Lungs.

(ii). Mechanical damage of Lungs because pleural fluid offers mechanical supports to the Lungs.

b). The followings are reasons - why alveoli are very efficient;-

i). They are numerous to increase surface area: Volume There are millions of alveoli found in the Lungs This increase the efficiency of them.

(ii). Alveoli posses thin squamous epithelium;- - The thinner the epithelium the easy for the diffusion of gases to occur, and rapid Process hence cause the efficiency.

(iii). Alveoli are moist: Diffusion of gases much occur in solution form hence they are moist in order to dissolves the gases for the process of diffusion.

iv). Alveoli contains surfactant secreting cells;- surfactant is the one that is responsible for many functions as, lowering the surface tension of pleural fluid also kills micro-organisms. This cause the efficiency in exchange of gases;-

02. b).

√ i. Alveoli are very small in size.

Small size of an alveoli results into higher surface area to volume ratio. hence efficient and rapid exchange of air.

Extract 2.1: A sample of correct responses to question 2.

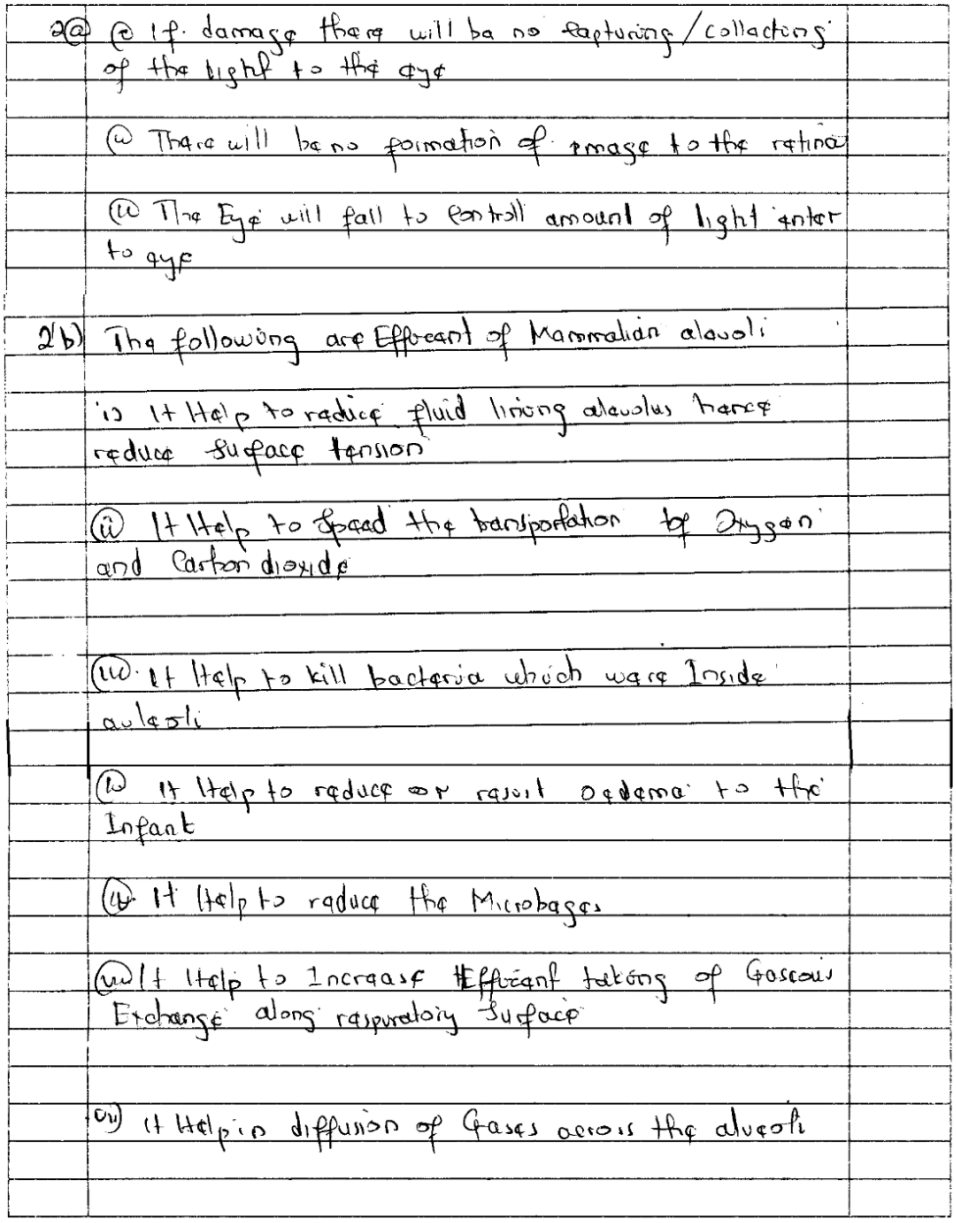
Extract 2.1 shows that, in part (a) the candidate correctly described the effects of a damaged pleural membrane in the lung and explained correctly the adaptive features of the alveoli in part (b).

However, 28.38 per cent of the candidates who scored average marks (4.0 - 6.0) gave unclear descriptions of the effects of a damaged pleural

membrane in part (a). They also explained one or two correct adaptive features of the alveoli for gaseous exchange correctly in part (b).

On the other hand, 47.79 per cent of the candidates scored low (0.0 – 3.0) marks as they exhibited inadequate knowledge of the functions of the pleural membrane. Therefore, they either scored zero in this part of the question or scored one mark. Those who scored zero mistook the pleural membrane as the structure found in the eye. Thus, they gave descriptions of the structures found in the eye instead of the lung. For example, one candidate wrote that *if the pleural membrane is severely damaged the person will get blurred vision, the person will be visually impaired*, *if the pleural membrane is severely damaged the person would not be able to see objects in dim light*. Another candidate mistook the pleural membrane as part of the ear. She/he gave the effects of damaged tympanic membrane such as *if the pleural membrane is severely damaged the sound waves entering inner ear will not be amplifiedif the pleural membrane is severely damaged the person would develop disability not able to hear sounds.* However, those who scored 1 to 3 marks were able to give one to three effects to a severe damaged pleural membrane.

Likewise, in part (b), these candidates demonstrated inadequate knowledge of the adaptive features of the alveoli for efficient gaseous exchange. Some of them outlined the structures of alveoli instead of its adaptive features such as *they have a good supply of blood vessels, they consist macrophages, they have thin walls*. Others gave incorrect responses such as *alveoli are small size which increase their volume to surface area ratio for the diffusion of gases during breathing*, *alveoli are found in the lungs to enable them work properly.* Those who scored 1 to 3 marks were able to describe one to three adaptive features of the alveoli. Extract 2.2 is a sample candidates' incorrect responses to the question.



Extract 2.2: A sample of incorrect responses to question 2.

In Extract 2.2, the candidate wrote wrong responses in part (a) such that *on entry of light into the eye there will be no formation of an image on retina* instead of the effects which occur when the pleural membrane is damaged while in part (b), he/she gave the roles of the alveoli instead of its adaptive features.

2.1.3 Question 3: Principles of Classification

This question consisted of part (a) and (b). The candidates were required to: (a) identify the mistakes made by a scientist who wrote a scientific name of a human being as homo sapiens and (b) identify organisms shown in Figure 1 by using a dichotomous key.

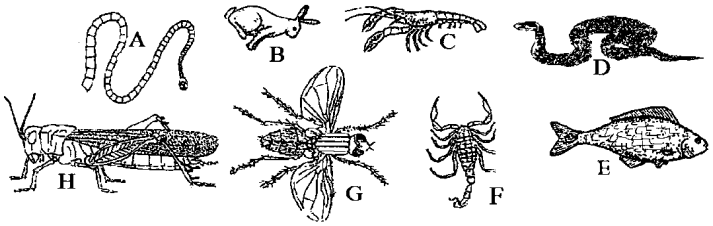


Figure 1

Key

1a. Antennae present..... 2
1b. Antennae absent..... 4
2a. Wings absent..... Anostraca
2b. Wings present..... 3
3a. Wings stretched/open..... Diptera
3b. Wings not stretched/closed..... Orthoptera
4a. Body with legs 5
4b. Body without legs 6
5a. Legs two pair.....7
5b. Legs four pair..... Scorpiones
6a. Body with segments..... Cestoda
6b. Body without segmented.....8
7a. Tail present..... Primate
7b. Tail absent.....9
8a. Dorsal fin present..... Teleostei
8b. Dorsal fin absent..... Squamata
9a. Body elongated.....10
9b. Body not elongated.....11

The question was attempted by 30,471 (100%) candidates. The analysis shows that 30.15 per cent scored high marks (6.0 - 10), a few (4.19%) scored average (4.0 - 5.0) marks and 65.66 per cent scored low marks (0.0 - 3.0). The candidates' performance is as shown in Figure 3.

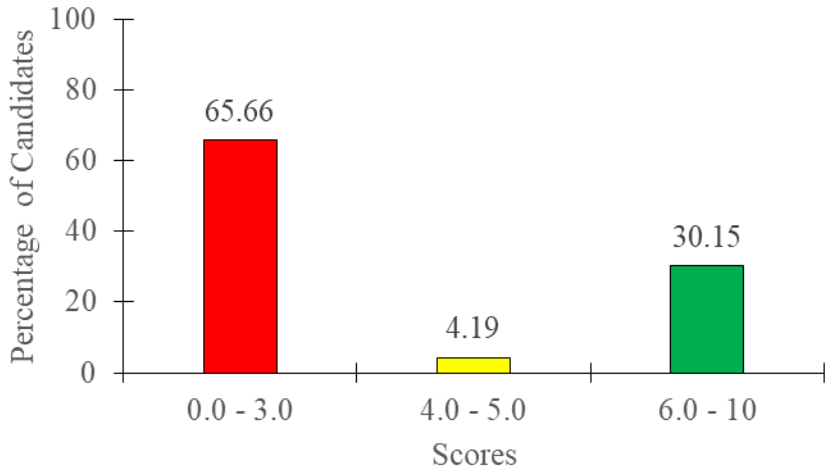


Figure 3: *Distribution of the Candidates' Scores on Question 3*

Figure 3 shows that the candidates had the average performance in question 3 since only 34.34 per cent of them passed in this question. However, the majority (65.66%) scored low marks.

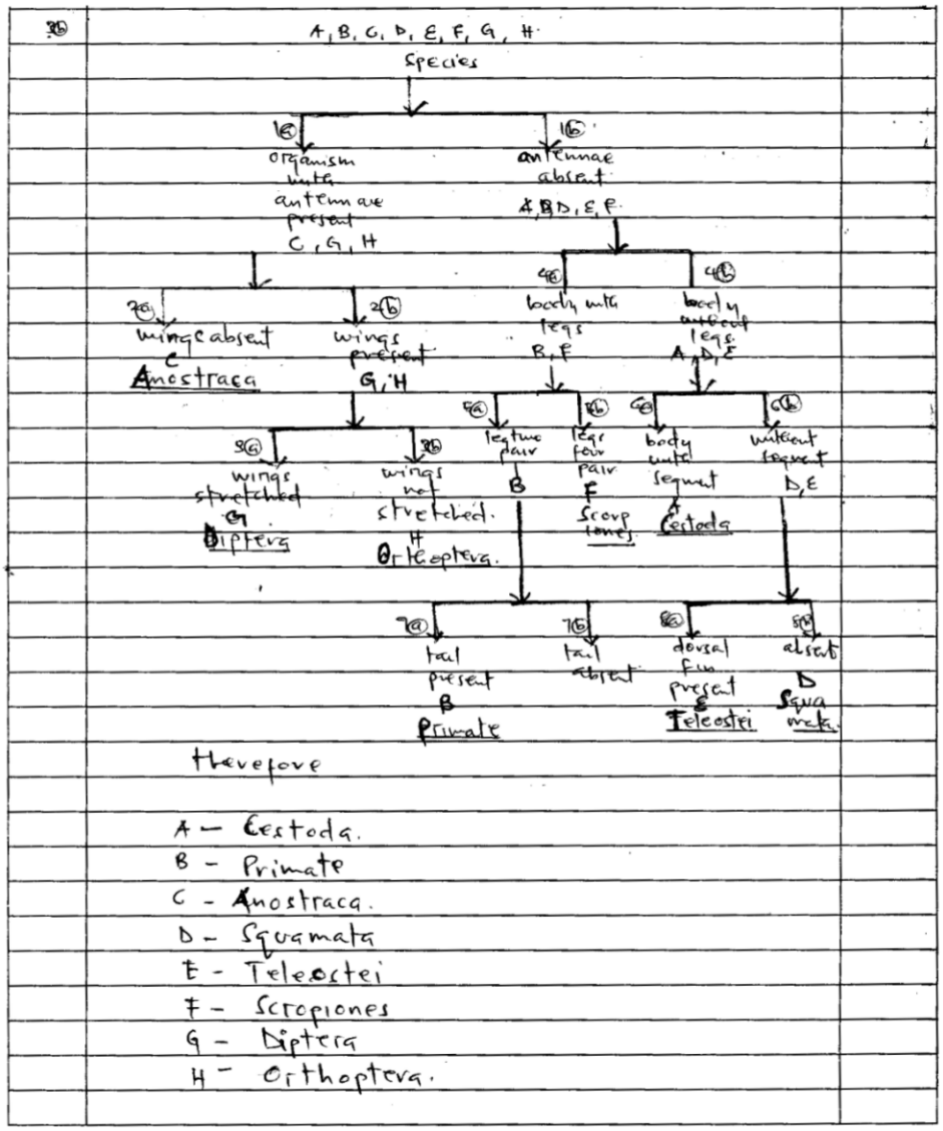
The candidates who scored low marks (0.0 - 3.0) demonstrated a lack of skills of using the system of biological nomenclature. Hence, they failed to identify the rules which were violated for the scientific name. Those who scored zero were not aware of the principles governing writing scientific names. For example, one candidate wrote that *scientific name should be capitalised, the first name should be underlined.* They didn't know that a scientific name consists two parts; the first part is a generic name which begins with a capital letter while the second part is a specific name which begins with a lower case and must be underlined or italicized. However, those who scored 1 to 3 marks correctly identified some organisms by using a dichotomous key in part (b). Extract 3.1 shows a sample of the candidates' incorrect responses to the question.

3; The mistakes which were done by the young scientist on the writing of the scientific name was.

(a)

i) they wrote the genus name of the species in small letter.

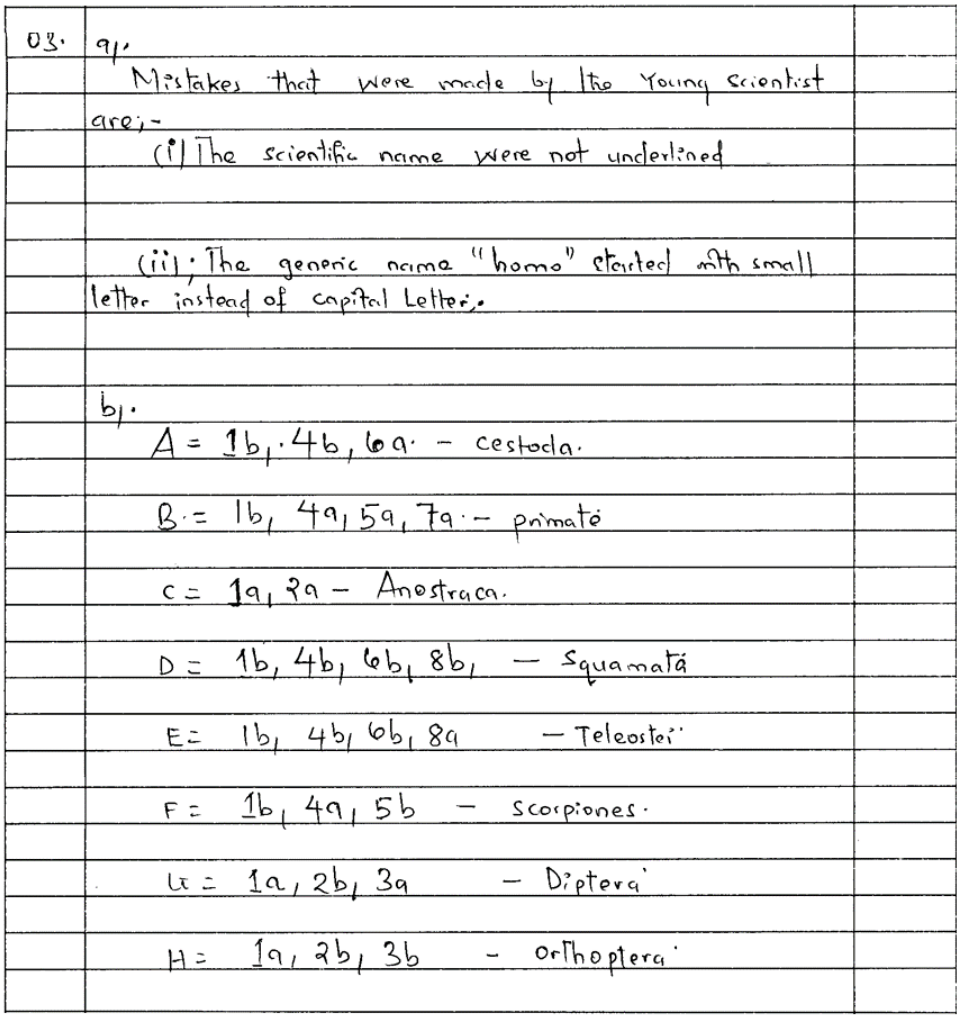
ii) the young scientist when writing of the scientific name they let a gap or space between the genus and specie s name that is in correct they should have not let the gap or space it should be like example Homosapiens.



Extract 3.1: A sample of incorrect responses to question 3.

In Extract 3.1, the candidate wrote *the mistake that a scientist made was to leave a gap between genus and species* in part (a) and constructed a branched key in part (b).

The candidates who scored high marks (6.0 - 10) managed to state the principles of writing scientific names. Most of them correctly identified each of the organisms given by writing sequentially the numbers of the true statements in the dichotomous key in part (b). Extract 3.2 is a sample of candidates' correct responses to question 3.



Extract 3.2: A sample of correct responses to question 3.

Extract 3.2, the candidate responded correctly in the question, exhibiting mastering of the rules of binomial nomenclature and using dichotomous keys.

2.1.4 Question 4: Cytology

This question consisted of parts (a), (b) and (c). The candidates were required to: (a) calculate the magnification of a specimen which had a linear dimension of about 2 cm and its drawing had 6 cm, (b) observe carefully and identify the principles of biological drawing that in Figure 2 and (c) state the purposes of recording using biological drawing.

Figure 2

Data reveals that 30,471 (100%) candidates attempted this question and their performance was average. The distribution of candidates score is presented in Figure 4.

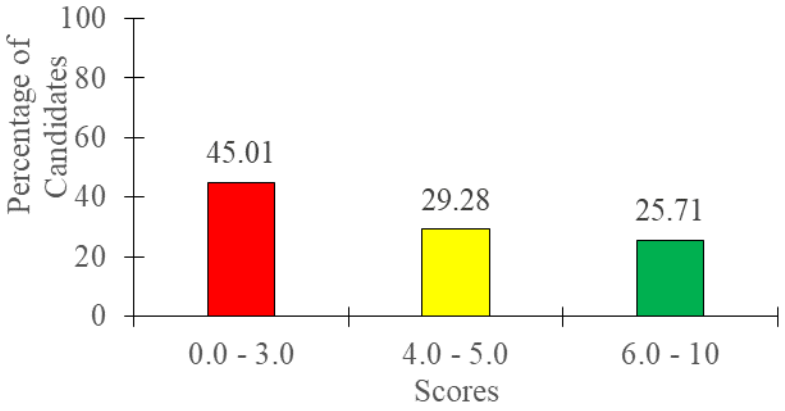
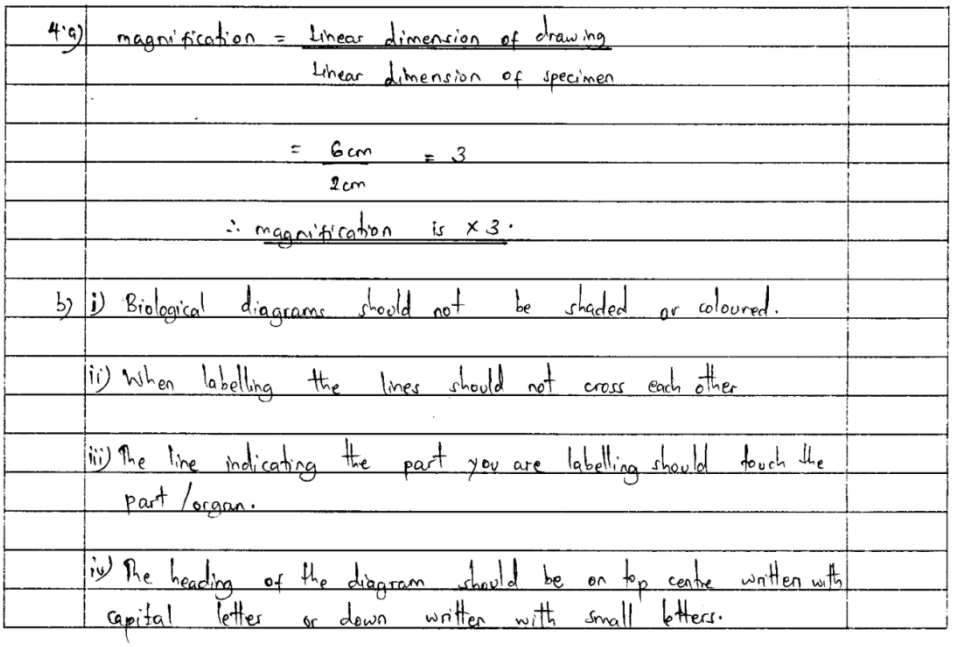


Figure 4: *Distribution of the Candidates' Scores on Question 4*

Figure 4 shows that the candidates had an average performance since 54.99 per cent of the candidates passed by scoring from 4.0 to 10 marks in this question while the 45.01 per cent scored low marks (0.0 - 3.0).

The candidates who scored high marks (6.0 - 10) demonstrated ability to use biological knowledge, principles and skills related to the concepts tested. They were conversant with the application of formula and data to calculate the magnification of the specimen correctly. In addition, they provided correct purposes about keeping records using biological drawing by giving responses such as *helps future reference, simplifies future learning and aids memory of what you see by actively recording*. Extract 4.1 is a sample of the candidates' responses to this question.



Extract 4.1: Part of a sample of correct responses to question 4.

In Extract 4.1, the candidate computed correctly the magnification of specimen from provided dimensions and outlined the principles of biological drawing correctly.

On the other hand, 29.28 per cent of the candidates who scored average marks (4.0 - 5.0), gave correct responses in both part (a) and (b). However, most of the responses in part (c) were incorrect. This indicates that the candidates in this category were not conversant with the purposes of recording biological drawing.

Those who scored low marks (0.0 - 3.0), failed to calculate magnification from the given information. For example, some candidates used wrong formulae to calculate the magnification such as *"Magnification = linear dimension of specimen x Linear dimension of the drawing"* and *"Magnification = linear dimension of the specimen /linear dimension of the drawing"* instead of *"Magnification = Linear dimension of the drawing /Linear dimension of the specimen"*.

Likewise, in part (b) they exhibited a lack of knowledge of principles for drawing skilful biological diagrams as some of them scored zero in this part while others scored very low marks as they identified only one principle instead of six. Some of the incorrect responses such as *It saves time* and *to*

link the lesson of biological drawing were observed in candidates' scripts. Extract 4.2 is a sample of candidates' incorrect responses to the question.

4(a) Magnification = linear dimension x linear dimension of its drawing

Magnification = 2cm x 6cm
Magnification = 12cm

∴ Magnification of the specimen is 12.

4(b): Violated principles of biological drawings;

i. Any biological drawing should consist of a head.

ii. Any biological drawing should have margin surrounding it.
=> According to the diagram of the fish by the student there is no margin on either sides.

iii. Any biological drawing should have labels which begin with capital letters.
=> According to the diagram of the fish by the student there is no capital letter on the beginning of every label for instance "operculum", "eye".

iv. Biological drawing should have well arranged labels whereby there should be a straight and clear arrow from the point/structure shown and label. Also accuracy and neatness.
=> According to the diagram of the fish by the student there is no accuracy of the drawing also the points are not well located for instance "eye" furthermore the diagram isn't neat as other features shown are not clear.

(c) Purposes of recording by biological drawing;

i. To specify the subject since sometimes the diagrams are too general that they may rise different topics hence specifity ensures or rise the topic intended forinstance "biological drawing of a fish" this shows that living characteristics are to be discussed.

ii. To link the diagram "biological drawing" and the topic.

Extract 4.2: A sample of incorrect responses to question 4.

In Extract 4.2, the candidate used a wrong formula to calculate the magnification of the specimen in part (a), gave disorganised principles and lacked clarity in part (b) and provided incorrect responses in part (c).

2.1.5 Question 5: Reproduction

This question had parts (a) and (b). The candidates were required to: (a) arrange labels **A**, **B**, **C**, **D**, **E** and **F** as per the correct sequence of the stages of oogenesis and in part (b) give reasons for not performing surgical removal of an ovary (Figure 3) in the first three weeks of pregnancy.

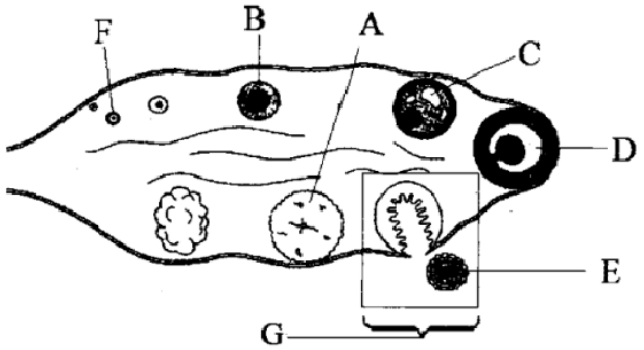


Figure 3

This question was attempted by 30,471 (100%) candidates and their general performance is as shown in Figure 5.

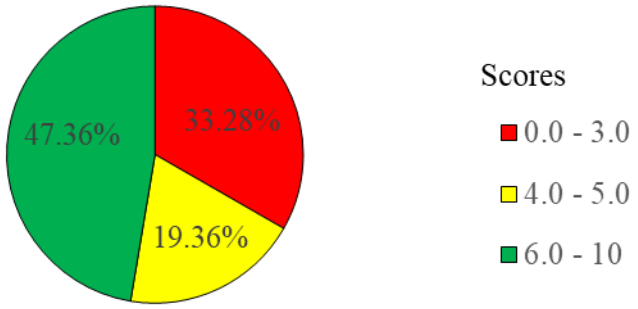
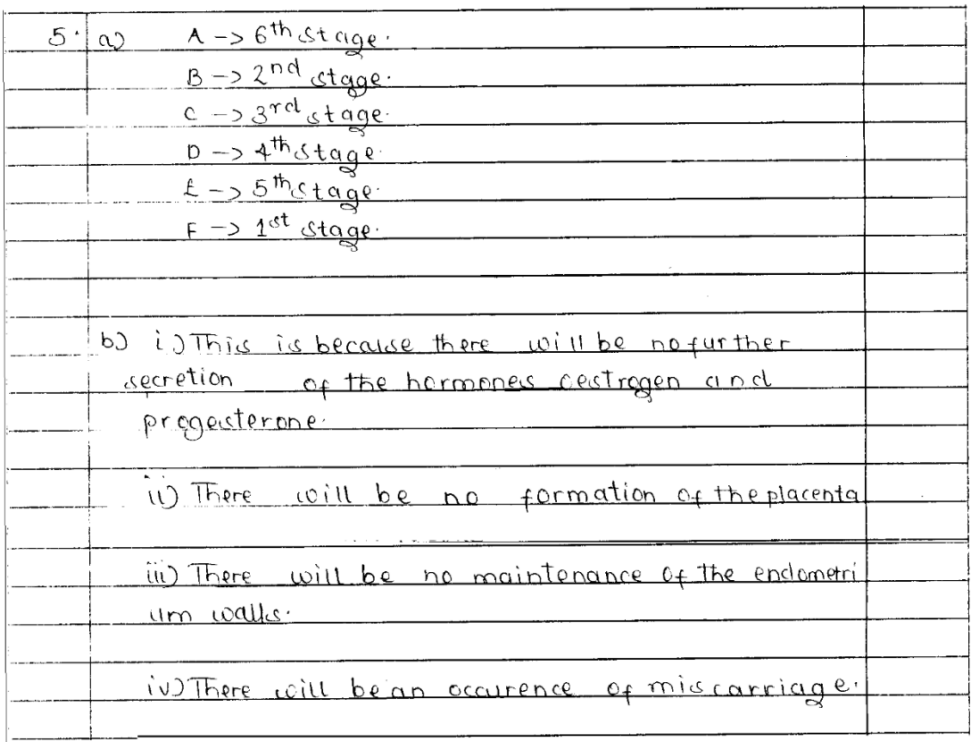


Figure 5: *Distribution of the Candidates' Scores on Question 5*

Figure 5 reveals that 66.72 per cent of the candidates passed in this question with the majority (47.36%) scoring from 6 to 10 marks.

The candidates who scored high marks arranged the labels in a correct order from the first to the last stage of oogenesis. In addition, they were aware that the corpus luteum in the ovary produces progesterone hormone responsible for embryo development and retention at early stages of pregnancy up to 12 weeks when the placenta takes over. Thus, they correctly elaborated the effects of removing the ovary during the first three weeks of pregnancy. Extract 5.1 is a sample of the candidate's correct responses to question 5.



Extract 5.1: A sample of correct response to question 5.

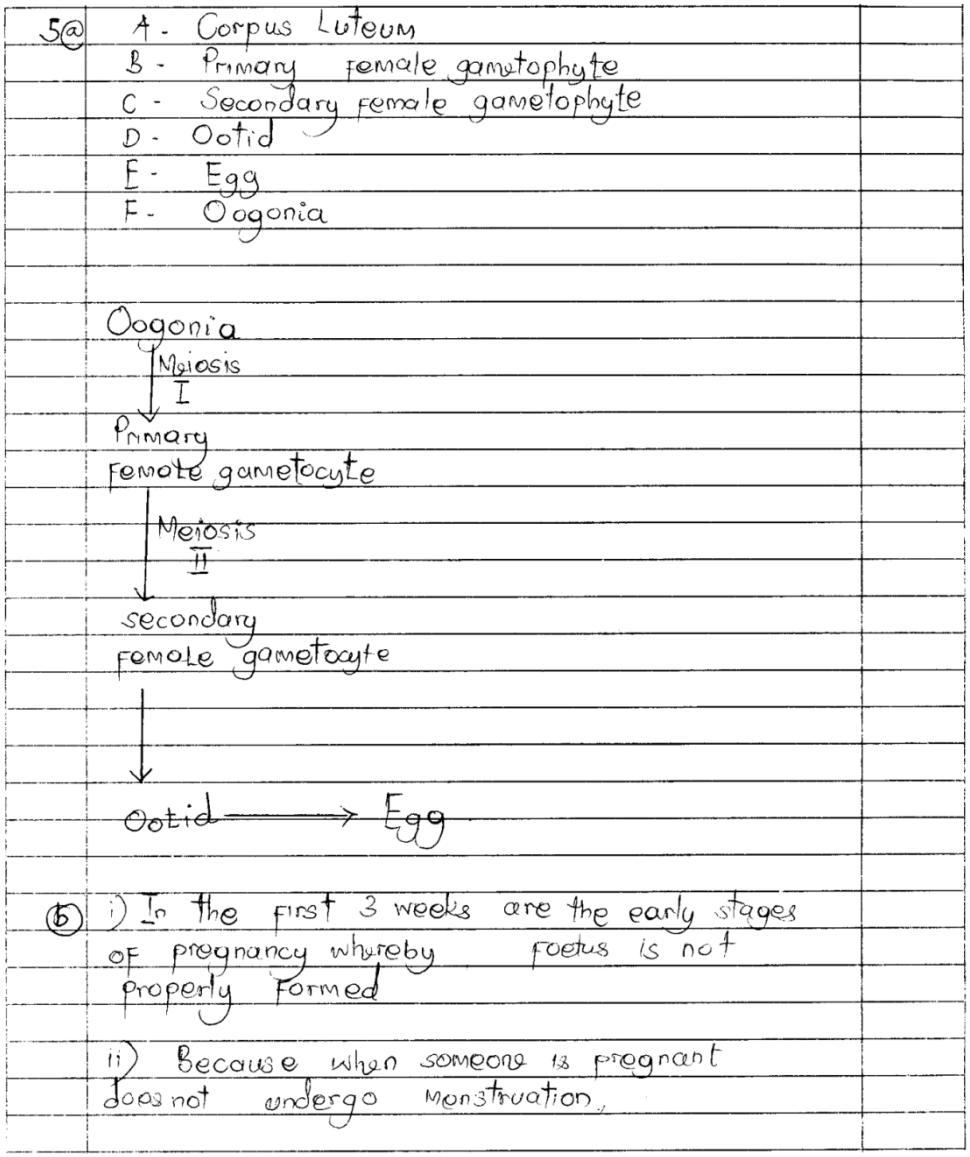
In Extract 5.1, the candidate correctly arranged the stages of oogenesis in sequential order and gave the effects of removing ovary during first three weeks of pregnancy.

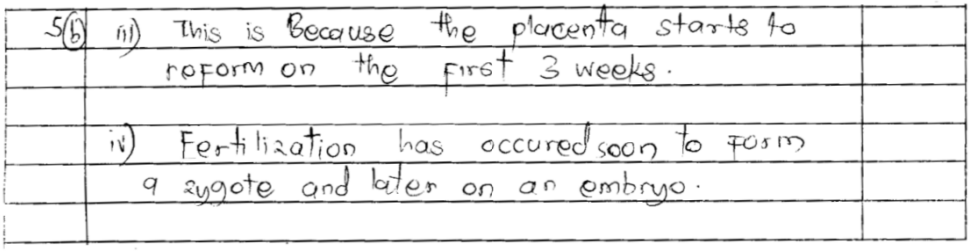
However, most of the candidates who scored low marks (0.0 – 3.0) had demonstrated insufficient knowledge of the stages of oogenesis as they failed to arrange the labels sequentially. For example, they gave incorrect sequences such as *"A, B, C, D, E, F"* and *"F, B, A, C, D, E, G"*. Also, they wrote the names of the parts of ovary on the diagram instead of arranging the given letters in sequential order of stages of oogenesis. Those who scored 1 to 3 marks were able to arrange up to three letters in a correct order.

Similarly, these candidates gave incorrect response regarding the effect of surgical removal of the ovary at early stages of pregnancy. Such responses were: *it may lead to death of mother, it will cause implantation of the pregnancy more difficult* and *it causes death of pregnant woman since there will be excessive loss of blood*. These responses signify that the candidates were unaware of the function of the corpus luteum in the ovary and embryo

development which its existence depends on the corpus luteum to secrete progesterone hormone during the early stages of pregnancy.

The candidates who scored 1 to 3 marks recognised the presence of the corpus luteum in the ovary but failed to identify the hormone which is secreted in ovary as they wrote other hormones such as thyroxine instead of progesterone. For example, one candidate wrote; *Aldosterone hormone secreted by corpus luteum reduces the risk of abortion.* Extract 5.2 is a sample of the candidates' incorrect responses to the question.





Extract 5.2: A sample of incorrect responses to question 5.

In Extract 5.2, the candidate constructed incorrect diagram showing the stages of oogenesis instead of arranging the labels in a proper sequence in part (a) and gave an incorrect description in part (b).

2.1.6 Question 6: Nutrition

This question comprised parts (a) and (b). The candidates were required to: (a) state the conditions under which temperature and carbon dioxide concentration would limit photosynthesis and (b) state six digestive processes which would be impaired in the body of a person whose Brunner's glands are severely damaged.

This question was attempted by 30,471 (100%) candidates whose distribution of their scores is shown in Figure 6.

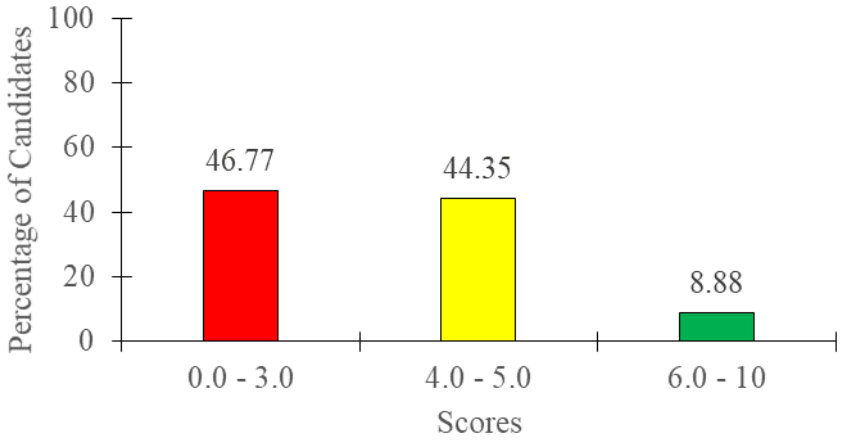
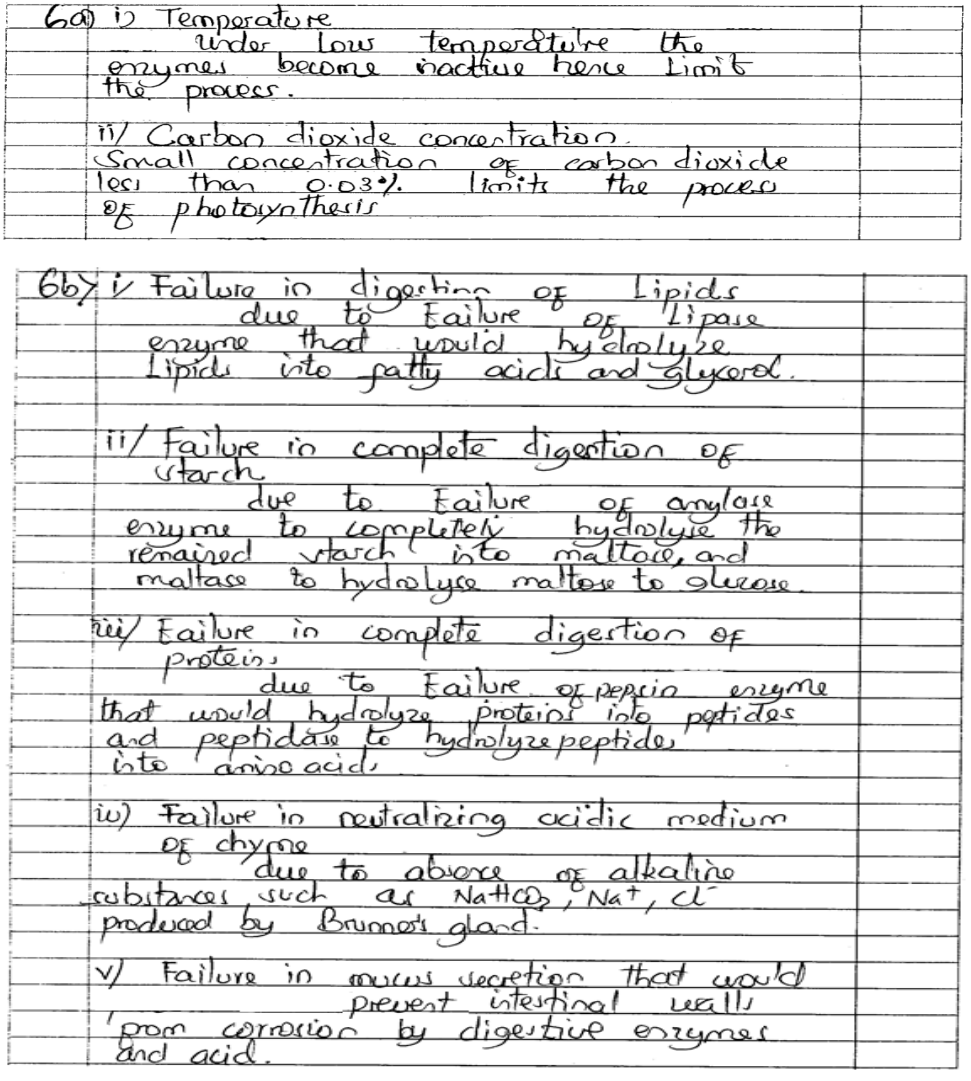


Figure 6: *Distribution of the Candidates' Scores on Question 6*

Figure 6 shows that the candidates' performance was average as more than half (53.23%) of the candidates passed by scoring 4 to 10 marks out of the

10 marks allotted to this question. However, a few scored high (6 -10) marks.

Candidates who scored high marks correctly stated temperature and carbon dioxide concentration as limiting factors in part (a). They also gave correct responses to the impaired digestive processes in the body of a person who had severely damage Brunner's glands. These responses indicate that most of the candidates in this category were knowledgeable of the limiting factors for photosynthesis to take place and the roles of Brunner's glands in part (b). Extract 6.1 is a part of a sample of the candidates' correct responses to the question.

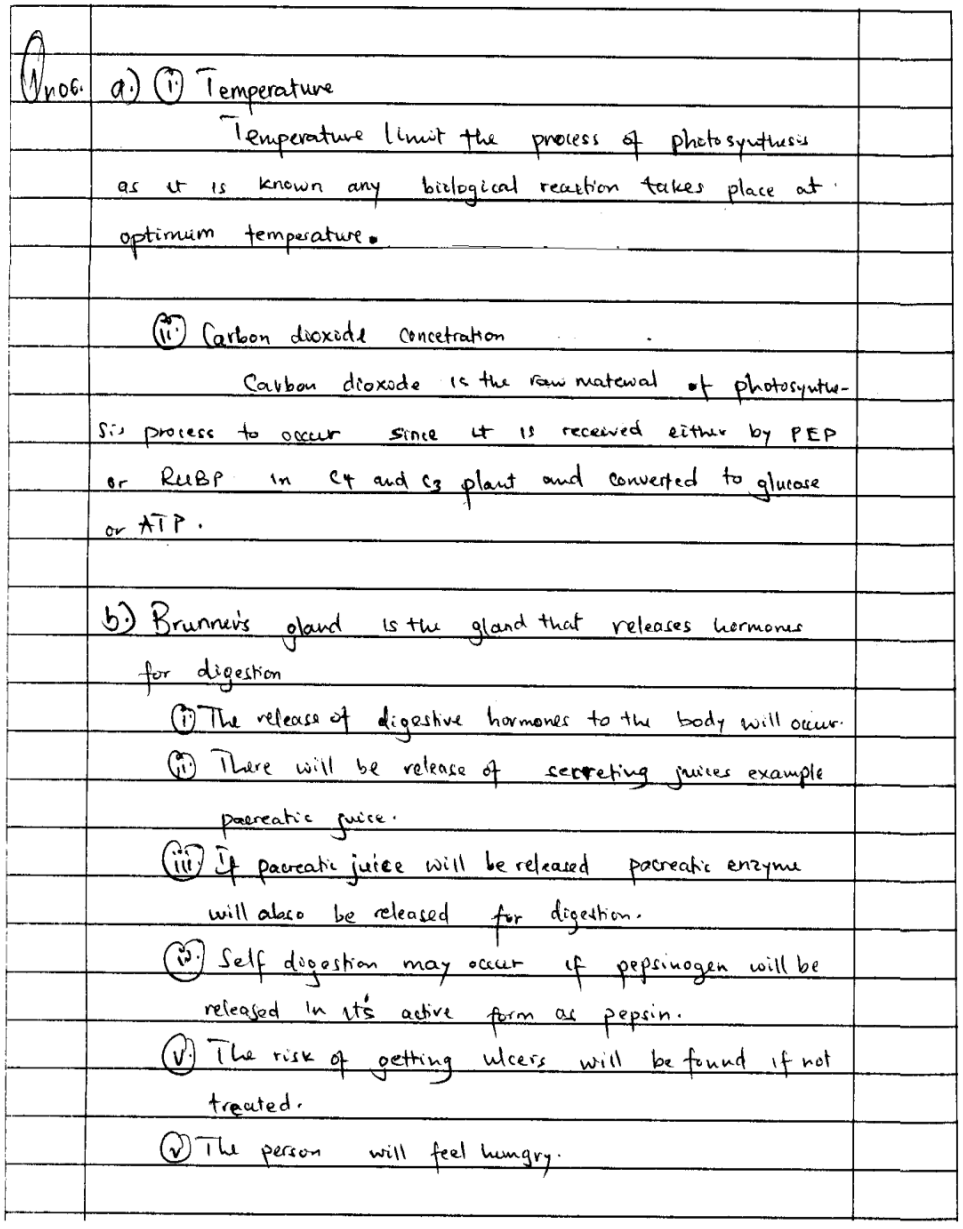


Extract 6.1: A sample of correct responses to question 6.

In Extract 6.1, the candidate gave correct description of the limiting condition of photosynthesis and analysed correctly the impaired digestive processes that would be impaired as a result of severe damage to Brunner's glands.

On the other hand, 44.35 per cent of the candidates who scored average marks (4.0 - 5.0) had insufficient knowledge of the roles of Brunner's glands but they knew the functions of temperature and carbon dioxide in photosynthesis. However, in part (b), they stated correctly two or three impaired digestive processes that are impaired by severe damage to Brunner's glands.

The candidates who scored zero marks had insufficient knowledge about the conditions that limits photosynthesis since they mentioned factors which affect the rate of photosynthesis. They gave incorrect responses regarding temperature such as *under very high temperature enzymes are denatured because of their protein nature hence limit the process*. Likewise, they provided incorrect responses on carbon dioxide concentration such as *carbon dioxide is a raw material of photosynthesis process in C_4 and C_3 plants.* As well, these candidates were not able to identify the digestive processes that would be impaired if Brunner's glands were damaged in part (b). Some of these regarded it as glands for production of hormones. They wrote incorrect responses such as, *if Brunner's gland is severely damaged will lead to deficiency in secretion of insulin from the pancreas, if Brunner's gland is severely damaged there will be little production of the bile in the liver*. Others did not know the location of Brunner's glands as they explained digestive processes which take place in the mouth and stomach instead of those taking place in the duodenum. For example, one of the candidates wrote that *lipids will not be converted into fatty acids and glycerol.* Another wrote *there will be no milk coagulation, ptyalin will not be able to digest cooked and uncooked starch.* Nevertheless, those who scored 1 to 3 marks had partial knowledge about the process of photosynthesis and the roles of the Brunner's glands. They gave 1 to 3 correct points in part (b). Extract 6.2 is a sample of the candidates' incorrect responses to the question.



Extract 6.2: A sample of incorrect responses to question 6.

In Extract 6.2, the candidate incorrectly stated the effects of damaged Brunner's glands to human body instead of its effects to the digestive processes. Also, she/he gave incorrect explanation to the limiting factors of photosynthesis.

2.1.7 Question 7: Coordination

This question had parts (a) and (b). The candidates were required to: (a) differentiate endocrine coordination from nervous coordination and (b) explain the adaptive features of the nervous tissues to their roles.

Data analysis revealed that 30,471 (100%) candidates attempted this question and 38.72 per cent scored high marks, 28.49 per cent scored average marks while 32.80 per cent scored low marks. Candidates' performance is as illustrated in Figure 7.

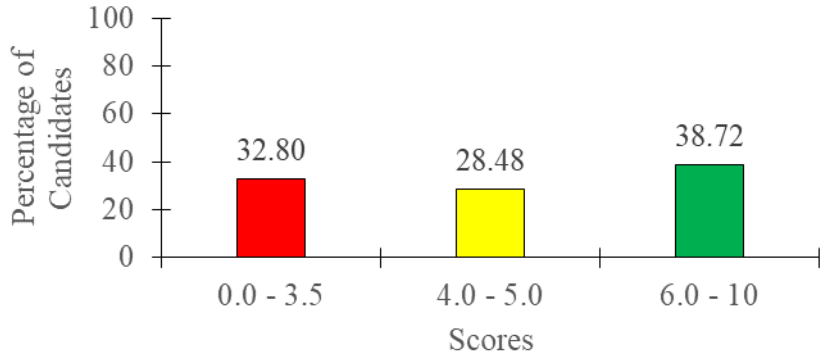


Figure 7: *Distribution of the Candidates' Scores on Question 7*

As shown in Figure 7, the candidates' performance was good as the majority (67.20%) of the candidates scored from 4 to 10 marks out of 10 marks allocated to this question.

The candidates who scored high marks (6.0 - 10.0) demonstrated good understanding of the differences between nervous coordination and endocrine coordination. They correctly pointed out their characteristic features based on the nature of communication, mode of transmission, targeted areas, how responses take place and the resulting effects. Moreover, they correctly described their adaptive features by analysing each feature in relation to the function that enhances the ability of the nervous tissue to perform its role efficiently. Extract 7.1 is a sample of a part of the candidates' correct responses to the question.

7 a) Difference of Endocrine and nervous coordination

Endocrine coordination	nervous coordination
i) The pathway is not specific because it is transported by blood but the target is specific.	i) The pathway is through nervous tissues which transmitt the nerve impulse.
ii) The response occur slowly	ii) The response occur rapidly
iii) The effect is often long lasting	iii) The effect is only short term effect.
iv) The impulse is transmitted slowly.	iv) There is rapid transmission of the Impulse
v) The effect is wide spread	v) It affect only the targeted organ.

b) Adaptations of Nervous tissue to its function.

i) They have receptor cells which detects the changes. Example sensory hairs of the skin.

ii) The neuroplasm have numerous mitochondria which help to provide energy for the active transportation of nerve impulse.

iii) The nervous tissue have axon for the transmittion of nerve impulse away from the cell body.

iv) They have schwann cell which synthesize myeline sheath and hence it helps in the propagation of nerve impulse

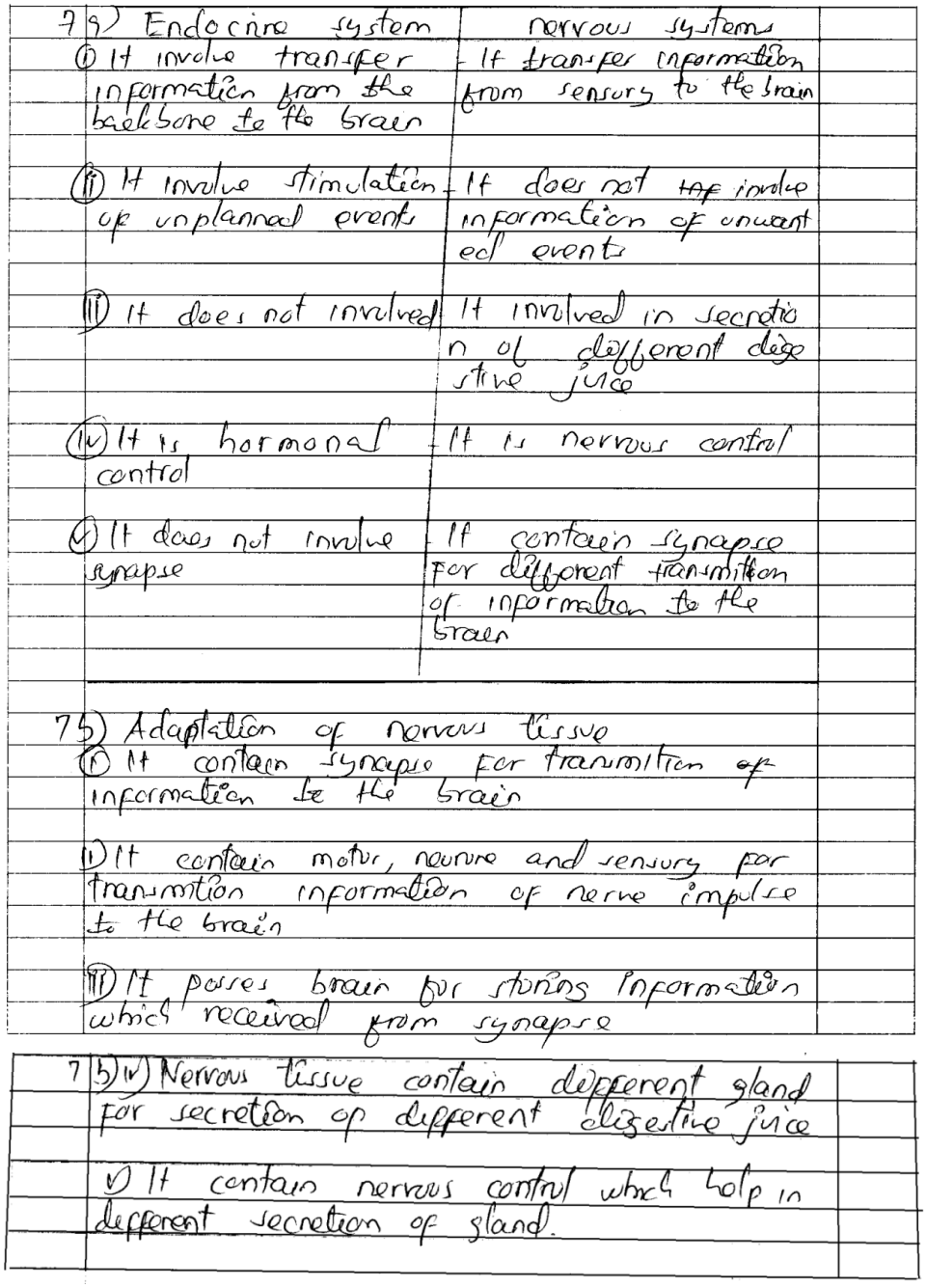
v) It have nodes of Ranvier which help to increase the transmittion speed by saltatory movement.

Extract 7.1: A sample of correct responses to question 7.

In Extract 7.1, the candidate gave correctly gave out the characteristic features of both nervous coordination and endocrine coordination and explained well the adaptive features of the nervous tissues.

The candidates who scored average marks (4.0 - 5.0) managed to differentiate nervous coordination from endocrine coordination in part (a). However, they gave few adaptive features of the nervous tissues such that they scored 1 to 2 marks in part (b).

The candidates who scored zero had inadequate knowledge of essential features of nervous tissues, endocrine coordination and nervous coordination. They gave incorrect responses regarding endocrine and nervous coordination. For example, one of them responded that *the endocrine is located in various parts of the body while nervous coordination is limited to the brain, endocrine coordination is controlled by hormones while nervous coordination does not involve hormones, endocrine coordination has fluid like speed while nervous coordination has speed like that of electricity.* Furthermore, they were not aware of how the nervous tissue is adapted to its role, thus they provided incorrect responses such as *nervous tissues have capillaries for supply of respiratory gases and nutrients, nervous tissue has a gap for exchange of impulses.* Moreover, those who scored 1 to 3 marks provided one to three correct differences between endocrine and nervous coordination. Thus, they lost most of the marks in this part. Extract 7.2 is a sample of the candidates' incorrect responses to question 7.



Extract 7.2: A sample of incorrect responses to question 7.

In Extract 7.2, the candidate wrote incorrect differences between endocrine and nervous coordination. He/she also stated incorrect adaptive features to the nervous tissues.

2.1.8 Question 8: Gaseous Exchange and Respiration

This question required the candidates to describe the structure of the mammalian lungs.

The question was opted by 17,742 (58.22%) of the candidates. Figure 8 presents the candidates' performance in question 8.

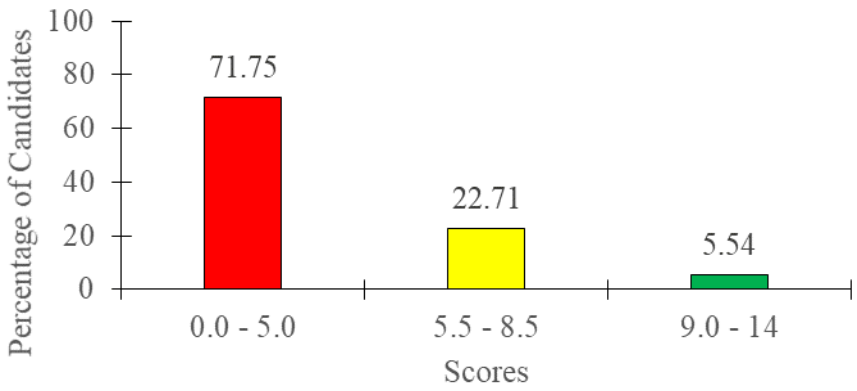


Figure 8: *Distribution of the Candidates' Scores on Question 8*

Figure 8 illustrates weak candidates' performance where more than half of the candidates (71.75%) scored 0 to 5 marks. No candidates scored all the marks allotted to this question.

Most of the candidates who scored low marks (0 – 5) either lacked adequate knowledge of the structure of the mammalian lungs. Some of them either mentioned the parts of the lung without giving any description or described one or two parts. Some stated the adaptive features of the respiratory surfaces while others drew poor diagrams of the mammalian lungs. Others drew a correct diagram of mammalian lungs but with no description. Even those who wrote some descriptions on the structure of the mammalian lungs mostly had neither introduction nor ended with a conclusion. This indicates that they had incomplete knowledge on the structure of the mammalian lungs and lacked skills on essay writing. Extract 8.1 is a sample of the candidates' incorrect responses to the question.

8 Describing the structure of mammalian lungs.

A DIAGRAM OF MAMMALIAN LUNGS

Describing the structure of mammalian lungs

(i) Mammalian lungs are well supplied with blood vessels so as the transportation of gases in and out of the lung is conducted.

(ii) Mammalian lungs have large surface area so as to ensure easily absorption of gases.

(iii) Mammalian lungs are moist, this enable gases to diffuse easily across the lungs.

(iv) Mammalian lungs are thin so as gases to diffuse across the surfaces from one point to another easily.

(v) Mammalian lungs have concentration gradient. Concentration gradient means gases on one side are in high concentration compared to the other side, this make gases to pass across the surfaces of the lungs.

(vi) Have large surface area to volume ratio. Mammalian lungs have large surface area to volume ratio

(vi) so as to ensure easy flow of gases across the surfaces

(vii) Lungs of mammals are extensible which ensure that when gases are inhaled volume of lungs increase and when gases are exhaled volume of lungs decrease.

(viii) Mammalian lungs are well ventilated so as gases can go in and out of the lungs.

Extract 8.1: A sample of a part of incorrect responses to question 8.

In Extract 8.1, the candidate described the adaptive features of the mammalian lungs instead of the structure of the lungs.

The candidates who scored average marks (5.5 - 8.5) correctly described few points on the structure of the mammalian lungs as per demand of the question. However, they did not include an introduction and conclusion in their essays. This implies that they had partial knowledge on the structure of the mammalian lungs and lacked essay writing skills.

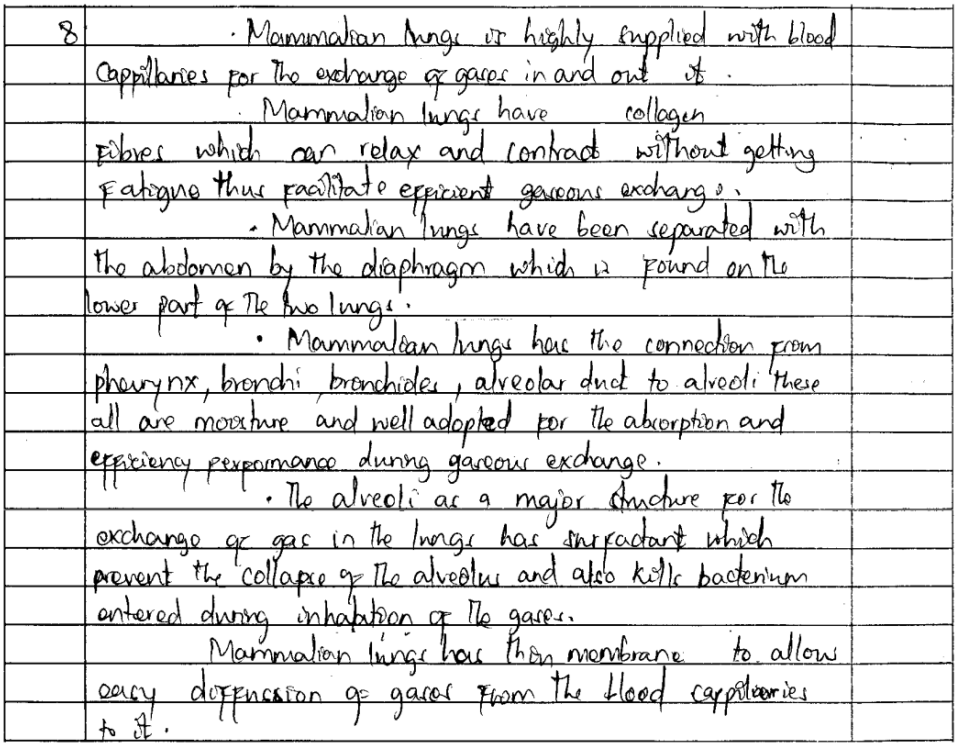
Those who scored high marks (9.0 - 14) demonstrated good understanding of the structure of the mammalian lungs as they clearly described the parts of the mammalian lungs which are interconnected to perform the role of gaseous exchange. However, most of their essays did not have concluding remarks. Extract 8.2 is a sample of the candidates' correct responses to question 8.

8. STRUCTURE OF MAMMALIAN LUNGS.

•Mammalian lungs; Are the structure responcible in gaseous exchange. In mammalian body there are two lungs which are located in the thoracic part above the abdomen one on the left another one on the right part.

•Mammalian lungs has double pleural membrane which is filled with the fluid between them to allow easy expansion and contraction without any abrasion.

• Mammalian lungs has numerous alveoli; which also are essential feature for gaseous exchange in which the exchange of gases occur inside the alveoli and the blood capillaries found between them.


8
· Mammalian lungs is highly supplied with blood capillaries for the exchange of gases in and out it.
· Mammalian lungs have collagen fibres which can relax and contract without getting fatigue thus facilitate efficient gaseous exchange.
· Mammalian lungs have been separated with the abdomen by the diaphragm which is found on the lower part of the two lungs.
· Mammalian lungs have the connection from pharynx, bronchi, bronchioles, alveolar duct to alveoli these all are moisture and well adopted for the absorption and efficiency performance during gaseous exchange.
· The alveoli as a major structure for the exchange of gas in the lungs has surfactant which prevent the collapse of the alveolus and also kills bacterium entered during inhalation of the gases.
Mammalian lungs has thin membrane to allow easy diffusion of gases from the blood capillaries to it.

Extract 8.2: A part of correct responses to question 8.

In Extract 8.2, the candidate gave out the role of mammalian lungs in the introductory part of the essay. The main body of the essay described the parts of the lungs, hence signifying adequate knowledge of the subject matter.

2.1.9 Question 9: Transportation

In this question, candidates were required to differentiate active from passive transportation of materials in an organism.

This question was chosen by 23,228 (76.22%) of the candidates and had an average performance. The distribution of candidates scores in this question is summarised in Figure 9.

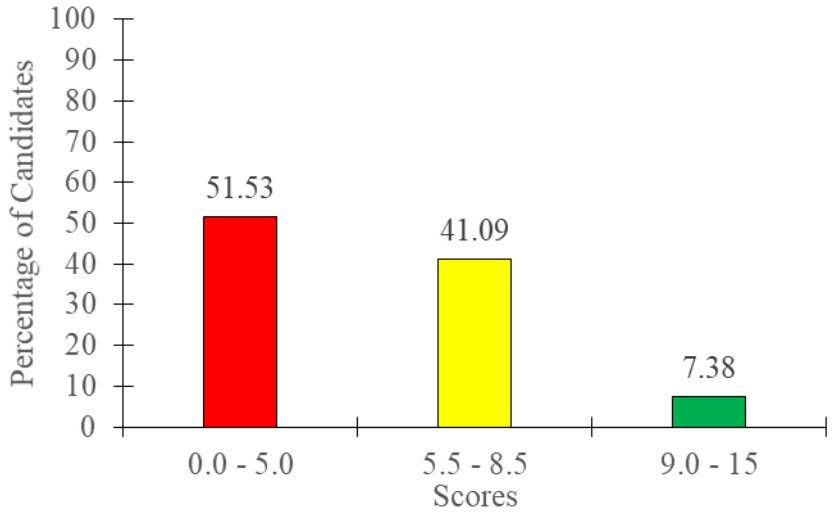
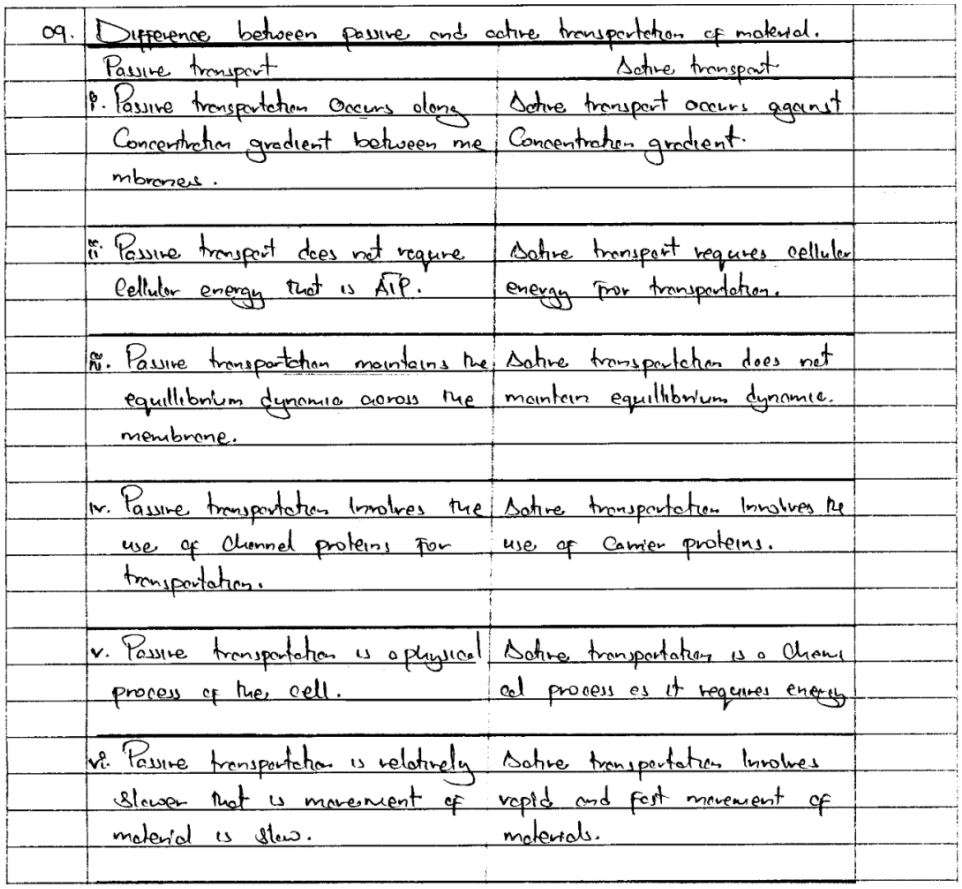


Figure 9: *Distribution of the Candidates' Scores on Question 9*

Figure 9 shows that 48.47 per cent of the candidates passed by scoring from 5.5 to 15 marks out of the 15 marks allocated to this question, which indicates an average performance. However, about half (51.53%) of the candidates who attempted this question scored low marks (0.0 – 5.0).

The candidates who scored high marks (9.0 - 15) demonstrated understanding of biological concepts and principles related to transportation of materials in the body of living organisms. They were knowledgeable about the concept of active transport which involves the movement of molecules from lower to higher concentration with the use of energy while passive transport involves the movement of molecules from higher to lower concentration and no amount energy is required. This knowledge helped them to correctly describe the differences between movements of materials in various organisms. The candidates demonstrated good essay writing skills by including relevant introduction and conclusion apart from explaining well the differences in the main body. Extract 9.1 illustrates a sample of the candidates' correct responses to the question.

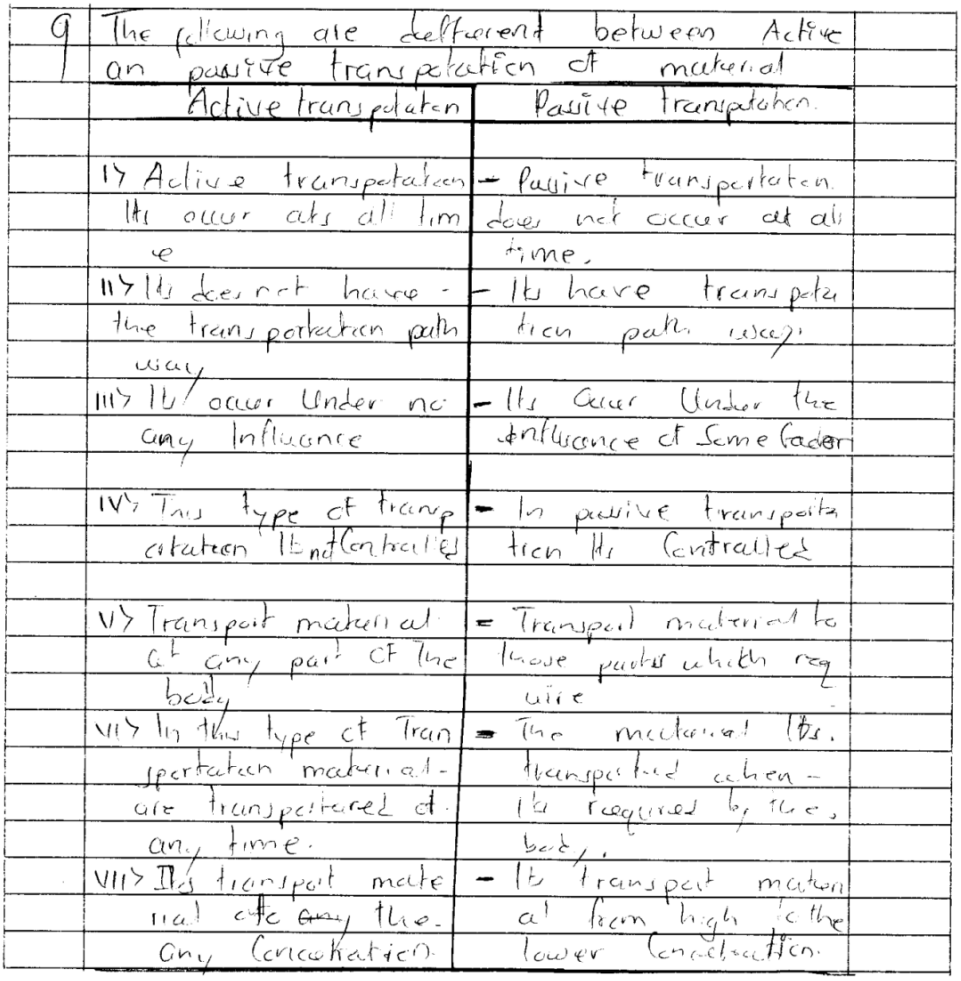

09. Difference between passive and active transportation of material.

Passive transport	Active transport
i. Passive transportation occurs along Concentration gradient between me mbranes.	Active transport occurs against Concentration gradient.
ii. Passive transport does not require Cellular energy that is ATP.	Active transport requires cellular energy for transportation.
iii. Passive transportation maintains the equilibrium dynamic across the membrane.	Active transportation does not maintain equilibrium dynamic.
iv. Passive transportation involves the use of channel proteins for transportation.	Active transportation involves the use of carrier proteins.
v. Passive transportation is a physical process of the cell.	Active transportation is a chemi cal process as it requires energy
vi. Passive transportation is relatively slower that is movement of material is slow.	Active transportation involves rapid and fast movement of materials.

Extract 9.1: A sample of correct responses to question 9.

In Extract 9.1, the candidate demonstrated good understanding of the transport mechanisms as they differentiated active transport from passive transport based on their characteristic features.

The candidates who scored low marks (0 - 5), were either unaware or had insufficient knowledge of the concepts of active and passive transport of materials in organisms. Most of them gave incorrect statement to the differences between active and passive transport of materials in organisms. For example, one candidate wrote *active transport occurs in animals while passive transport occurs in plants*. Another candidate wrote *active transport involves force while passive transport involves animals*. However, the majority of the candidates did not include introduction and conclusion in their essays. Extract 9.2 is a sample of the candidates' incorrect responses to question 9.



9	The following are different between Active an passive transportation of material	
	Active transpotation	Passive transpotation.
	i) Active transpotation Its occur acts all time	- Passive transpertation does not occur at all time.
	ii) Its does not have the transportation path way	- Its have transpotation path ways
	iii) Its occur Under no any Influence	- Its occur Under the influence of Some factor
	iv) This type of transportation Its not Controlled	- In passive transpotation Its Controlled
	v) Transport material at any part of the body	- Transport material to those parts which req uire
	vi) In this type of Transpertation material are transpertered at any time.	- The material Its transported when - Its required by the body.
	viii) Its transport material ~~any~~ the any Concentration	- Its transport material from high to the lower Concentration.

Extract 9.2: A sample of incorrect responses to question 9.

In Extract 9.2, the candidate failed to state the differences between active transport and passive transport of materials in organisms instead she/he incorrectly stated the differences.

2.1.10 Question 10: Reproduction

In this question, the candidates were required to describe the process which leads to the formation of embryo and endosperm in flowering plants.

The question was opted by 19,957 (65.50%) of the candidates and their performance was average as illustrated in Figure 10.

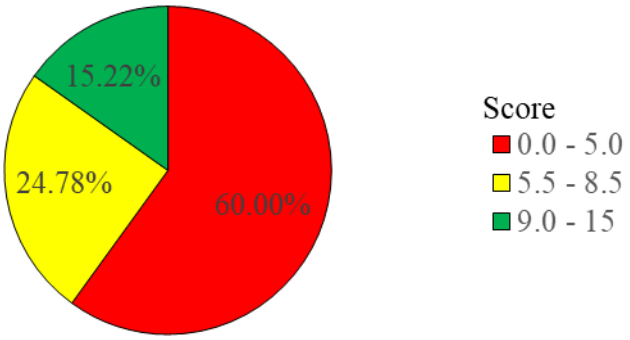


Figure 10: *Distribution of the Candidates' Scores on Question 10*

Figure 10 shows that the majority (60.00%) of the candidates scored low marks (0.0 - 5.0) out of the 15 marks allocated to this question. This is an average performance as only 40.00 per cent of the candidates passed.

The ccandidates who scored high marks (9 - 15) responded correctly to a question. They were conversant with double fertilization which leads to the formation of embryo and endosperm in flowering plants. They managed to trace what occurs when one male nucleus fuses with an ovum (egg cell) to produce a zygote and another male nucleus fuses with polar nuclei (binucleate cell) to form a triploid body called endosperm. In addition, they had good command of English language and wrote good essays with relevant introductions and conclusions. Extract 10.1 is part of a sample of candidates' correct responses to question 10.

10. The process which leads to the formation of embryo and endosperm in flowering plants is called Double fertilization.

Mechanisms of Double fertilization.

- The mature pollen grain lands on the stigma and starts to germinate forming pollen tube through its pollen tube nucleus. The mature pollen grain carries two male nuclei which are generative nucleus for fertilization and pollen tube nucleus for formation of pollen tube

- The pollen tube grows downward to the ovary while carrying its generative nucleus.

- Due to chemical secreted by the ovary attracts the pollen tube towards the Micropyle where the generative nucleus divides mitotically to form two male sperm nuclei

- On reaching the Mature embryo sac one of the male sperm nucleus fuses with the polar nuclei and another fuses with ovum.

- The Mature embryo sac in the ovary contains three cells at the upper part called antipodal cells and two cells at the Lower part called synergids while in between there is female gamete called ovum. At the centre there are two polar nuclei (2n)

- So when the male sperm nuclei enters through the Micropyle toward the ovary one sperm nuclei fuses with the ovum to form a zygote which develops to form an embryo.

- Another male nuclei fuses with polar nuclei to form Primary triploid endosperm(3n) which is generally known as endosperm of the seed. Hence double fertilization. as two fusion of nuclei occurs simultaneously.

- Other cells like synergids and antipodal cells. disappears and the ovary part of the flower remains as fruit.

Extract 10.1: A sample of correct responses to question 10.

In Extract 10.1, the candidate correctly described the process that leads to the formation of embryo and endosperm in flowering plants. She/he showed the entire process in which the ovum is fertilized by a male gamete to form a diploid zygote (embryo). In addition, she/he knew the process of forming endosperm from a male nucleus and polar nuclei.

The candidates who scored zero marks gave incorrect responses. This signifies that they were not aware of the process that leads to the formation of embryo and endosperm in flowering plants. For example, one candidate provided wrong responses such as *flowering plants have a pollen tube entering towards the embryo sac*, *the endosperm enters the ovum, endosperm causes fertilization to occur in the ovum.* Another candidate drew the pistil part of the flower showing the stigma, style, ovary and ovule with no any description. Others did not understand the demand of the question as they described the process of oogenesis and spermatogenesis in animals instead of double fertilization in plants. However, those who scored 1 to 5 described few points and most of them did not include an introduction and a conclusion in their essays. Extract 10.2 is a sample of a candidates' incorrect responses to this question.

10. - The process which lead to the formation of an embryo is called Oogenesis. Oogenesis, is the process of production of an ovum from female reproductive cells.

- The formation of an embryo it involves the three stages which includes
  (i) Multiplication phase
  (ii) Degeneration phase
  (iii) Mitotic phase.

(i) Multiplication phase
- The premodial germ cells undergo meiosis i to form two cells to form two cells (dyad) which undergo meiosis II to form four haploid cells (tetrad)

(ii) Degeneration phase
- The three formed nuclei undergo degeneration while the remaining one develop to form the large single cell

(iii) Mitotic phase
- The remaining cell undergo three mitotic cell division to form eight nuclei in which;-
  3 - Antipodal cell.
  2 - Polar nuclei.
  2 - Synergid.
  1 - Ovum.

10 The process of formation of the endosperm is called Spermiogenesis.

Spermiogenesis, is the process of production of the sperm and pollein grain from male reproductive cells.

Also the process of formation of endosperm it involve three steps which are;-

(i) Multiplication phase
(ii) Formation of membrane
(iii) Mitotic phase

(i) Multiplication phase
- The promodial germ cells undergo meiosis I to form two cells (dyad) which in turn undergo meiosis II to form four cells (tetrad)

(ii) formation of membrane
- Each formed cells develop in formation of membrane around itself

(iii) Mitotic phase
- The nucleus of the cells devide by mitosis to form two nuclei which are pollein tube nuclei and generative nuclei.

Extract 10.2: A sample of incorrect responses to question 10.

In Extract 10.2, the candidate incorrectly described spermatogenesis as a process that leads to the formation of endosperm. She/he provided a wrong description of the steps of the formation of endosperm such as *multiplication phase, mitotic phase* and *formation of membrane*. She/he demonstrated lack of adequate essay writing skills.

2.1 133/2 Biology 2

This paper was composed from six topics, namely; Comparative Studies of Natural Groups of Organisms, Regulation (Homeostasis), Growth and Development, Genetics, Evolution and Ecology. Each topic contributed one question carrying 20 marks. The candidates were required to attempt five questions.

2.1.1 Question 1: Comparative Studies of Natural Groups of Organisms

The question required the candidates to describe the lytic and lysogenic life cycles of the bacteriophage.

This question was opted by 1,929 (66.33%) candidates. The analysis indicates that 49.84 per cent of the candidates passed which is an indication of an average performance. Figure 11 presents the distribution of the candidates' scores.

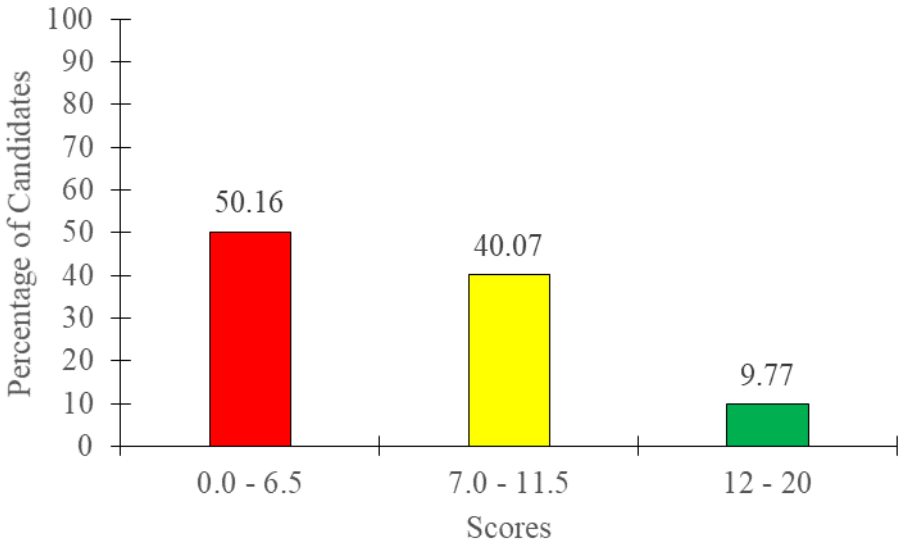
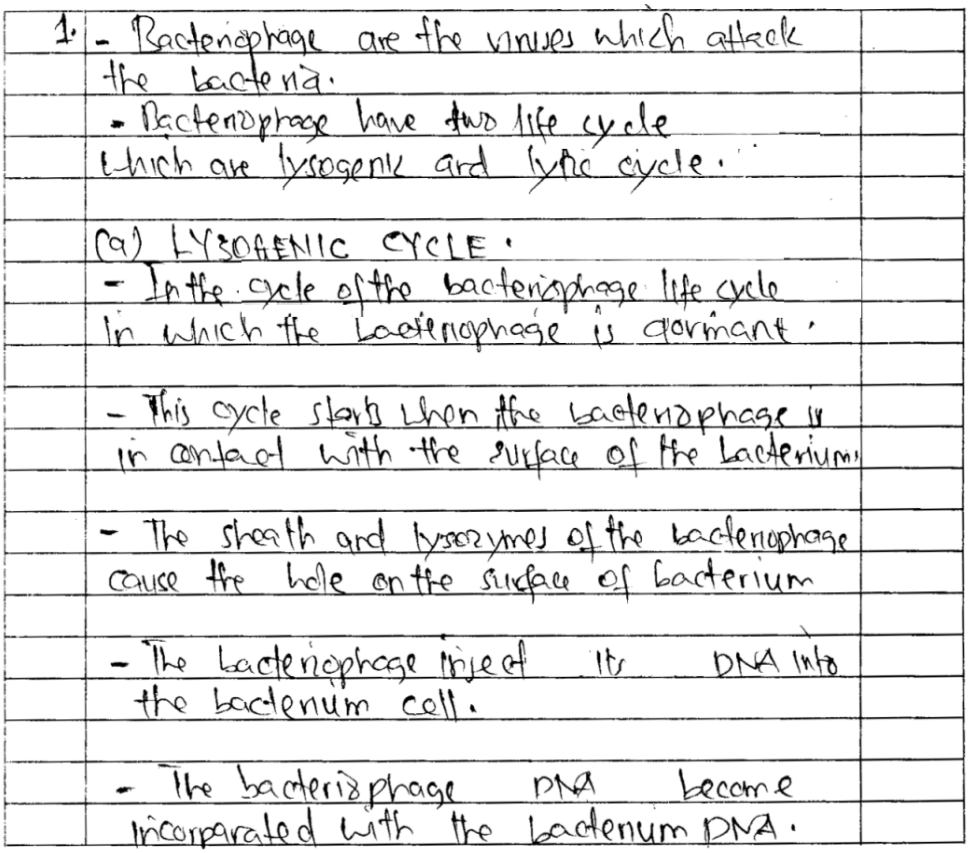


Figure 11: *Distribution of Candidates' Scores on Question 1*

Figure 11 indicates an average performance because only 49.84 per cent of the candidates were able to score 7.0 to 20 marks. However, a few (9.77%) scored high marks (12 - 20).

The candidates who scored high marks (12 - 20) clearly described the lytic and lysogenic life cycles of bacteriophage. In addition, they were competent in assay writing as their responses as they wrote good introductions, main bodies and conclusions. Extract 11.1 is a part of a sample of the candidates' correct responses to the question.



1. - Bacteriophage are the viruses which attack the bacteria.
- Bacteriophage have two life cycle which are lysogenic and lytic cycle.

(a) LYSOGENIC CYCLE.
- In the cycle of the bacteriophage life cycle in which the bacteriophage is dormant.

- This cycle starts when the bacteriophage is in contact with the surface of the bacterium.

- The sheath and lysozymes of the bacteriophage cause the hole on the surface of bacterium

- The bacteriophage inject its DNA into the bacterium cell.

- The bacteriophage DNA become incorporated with the bacterium DNA.

- Therefore once the bacterial DNA replicate also the viral DNA increase in number because the viral DNA is attached to the bacterial DNA.

- The lysogenic cycle end in this stage where large number of viral DNA are produced due to replication in the bacterial DNA.

- Also some viral DNA can be activated from the lysogenic cycle and enter to the lytic cycle.

LYTIC CYCLE

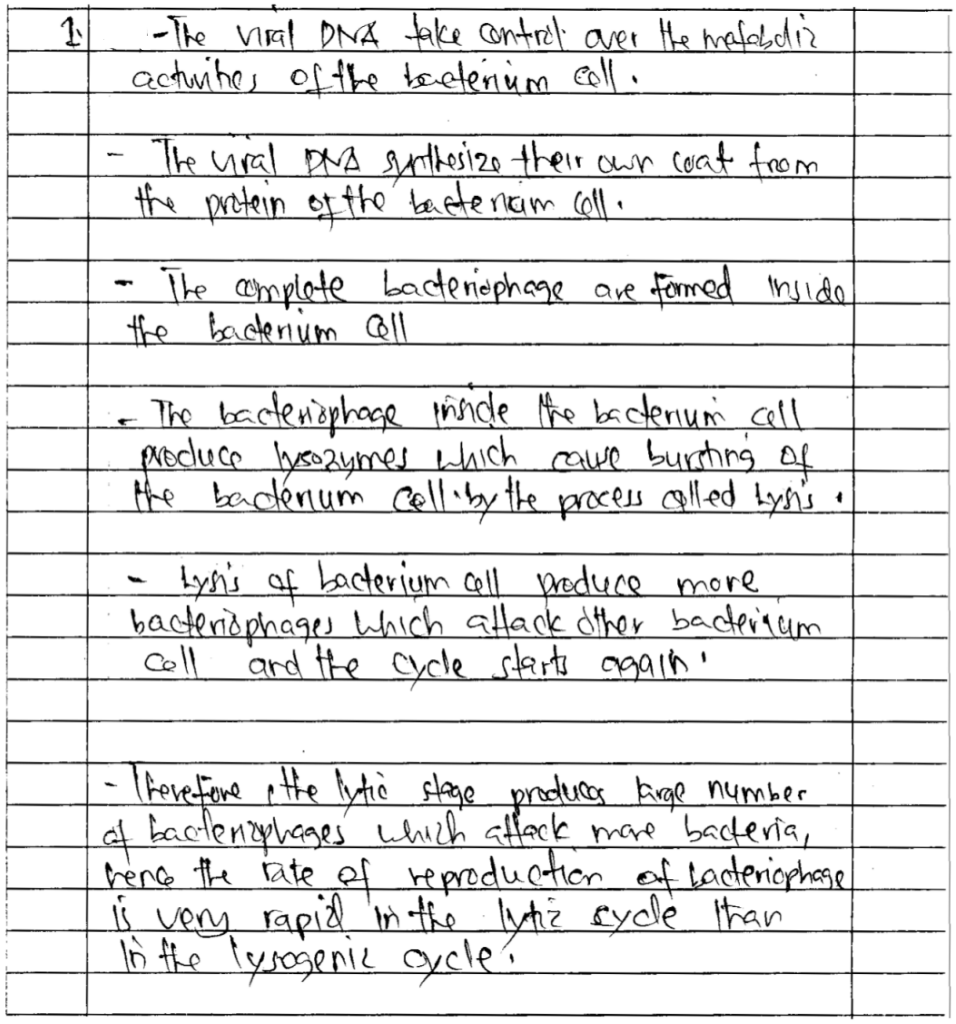
This is the bacteriophage cycle in which the bacteriophage has the effect on the bacterium cell.

- The cycle starts when the bacteriophage is in contact with the bacterium cell wall.

- The tail sheath and lysozymes of the bacteriophage enable to create a hole on bacterium cell wall.

- The bacteriophage inject its DNA through the hole on bacterium cell wall.

- The viral DNA replicate and produce many viral DNA in the bacterium cell.



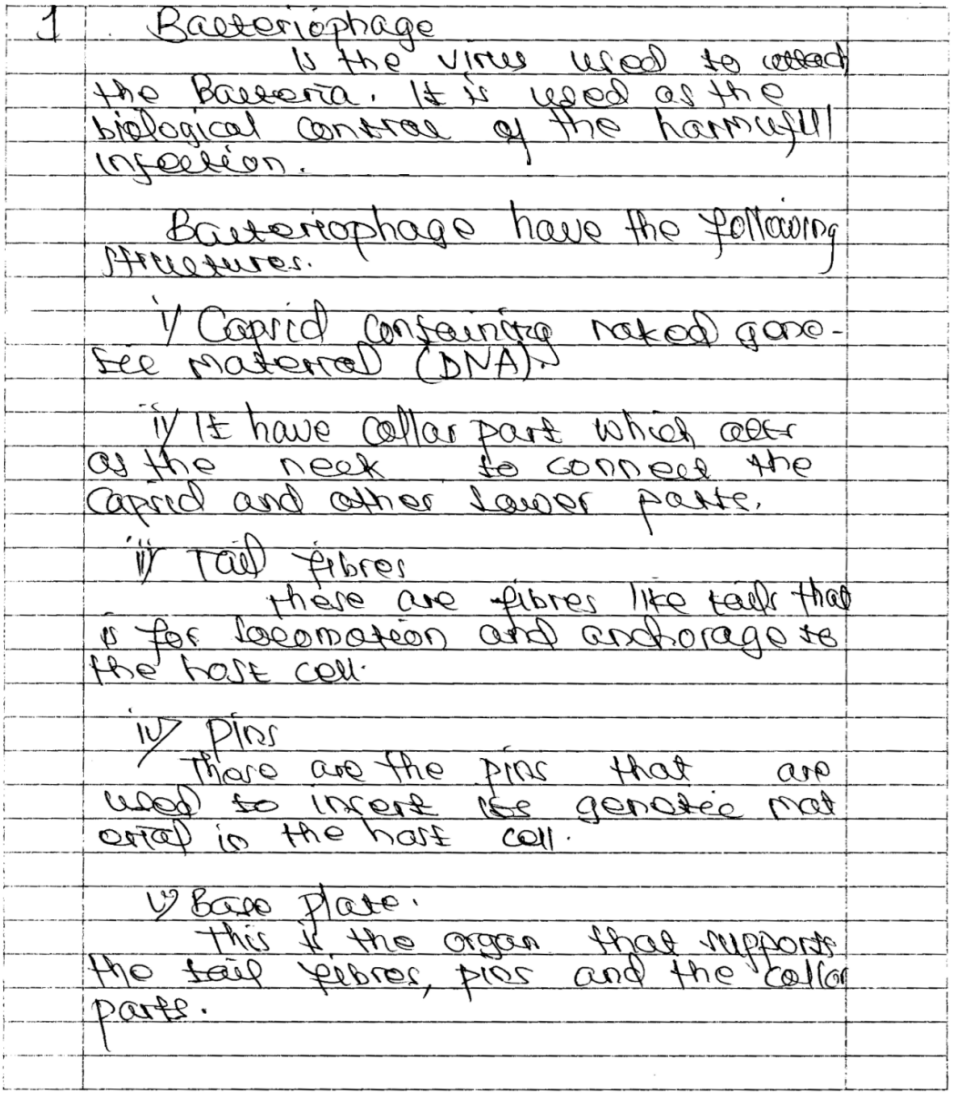
Extract 11.1: A sample of correct responses to question 1.

In Extract 11.1, the candidate provided correct descriptions of the lytic and lysogenic life cycles of the bacteriophage. In addition, she/he wrote skilful essay.

The candidates who scored average marks (7.0 - 11.5) wrote correct introductions and correct descriptions in one of the cycles but their explanations were incorrect in the other cycle or lacked clarity. This means the candidates had partial knowledge on viral replication.

On the other hand, most of the candidates who scored low marks (0.0 - 6.5), had inadequate knowledge on viral replication as they gave few correct responses in either of the cycles and scored marks ranging from 1.0

to 6.5. A few candidates scored zero due to a lack of knowledge about the concept tested. They were not aware of the features of the reproductive cycles in bacteriophage. They failed to understand that, in the lytic cycle multiplication involves immediate destruction and death of the host cell to release new phages while lysogenic cycle involves the integration of phage DNA into the host cell's genome and replication without causing immediate destruction to the host cell as they have latency period. The incorrect responses provided about the lytic cycle were such as *it involves the digestion of the bacteria cell and* lytic cycle *involves reproduction of more viruses while lysogenic cycle produces few viruses, lytic cycle used in genetic engineering reproduction by bacteria.* Likewise, one candidate gave incorrect responses about lysogenic cycle by writing; *it is involved in genetic engineering procedures for multiplication through bacteriophage, lysogenic cycle involves cell division in bacteria cell*. In addition, some of the candidates failed to meet the demand of the question. For example, one of them wrote the mechanisms of asexual and sexual reproduction in bacteria such as, *asexual reproduction is by binary fission and sexual reproduction is by conjugation in bacteriophage.* Others only drew a diagram of the bacteriophage. Moreover, some candidates described the structure of the bacteriophage instead of describing its life cycles. Extract 11.2 is a sample of incorrect responses to the question.


1 Bacteriophage
is the virus used to attack the Bacteria. It is used as the biological control of the harmfull infection.

Bacteriophage have the following structures.

i/ Capsid containing naked gene-tic material (DNA).

ii/ It have collar part which act as the neck to connect the capsid and other lower parts.

iii/ Tail fibres
there are fibres like tails that is for locomotion and anchorage to the host cell.

iv/ Pins
there are the pins that are used to insert the genetic mat erial in the host cell.

v/ Base plate.
this is the organ that supports the tail fibres, pins and the collar parts.

Extract 11.2: A sample of incorrect responses to question 1.

In Extract 11.2, the candidates described the structure of bacteriophage instead of the lytic and lysogenic life cycles of bacteriophage.

2.1.2 Question 2: Regulation (Homeostasis)

The question required the candidates to describe the ways in which mammals are adapted to cold and hot environments.

A total of 30,395 (99.75%) candidates opted for this question. The analysis of candidates' performance shows that only 30.72 per cent of them passed, which is a weak performance. The distribution of the candidates' scores is presented in Figure 12.

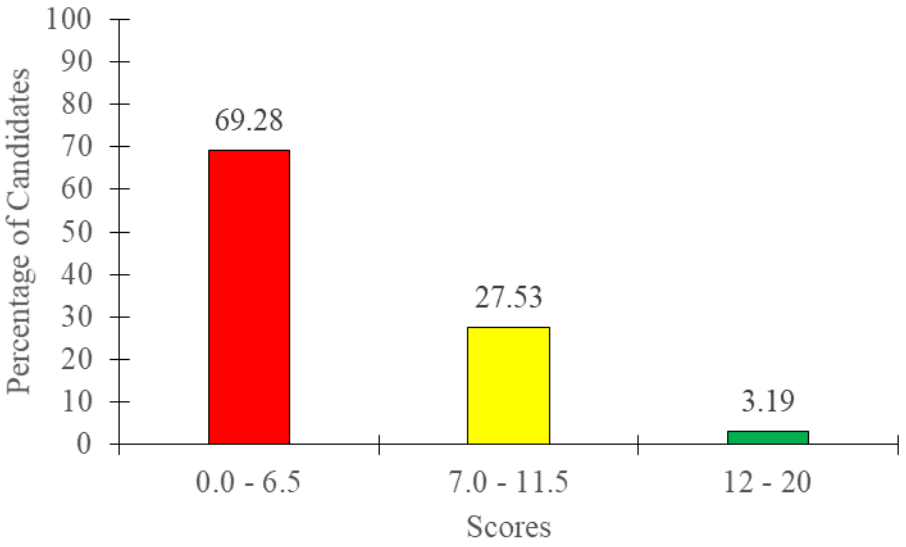
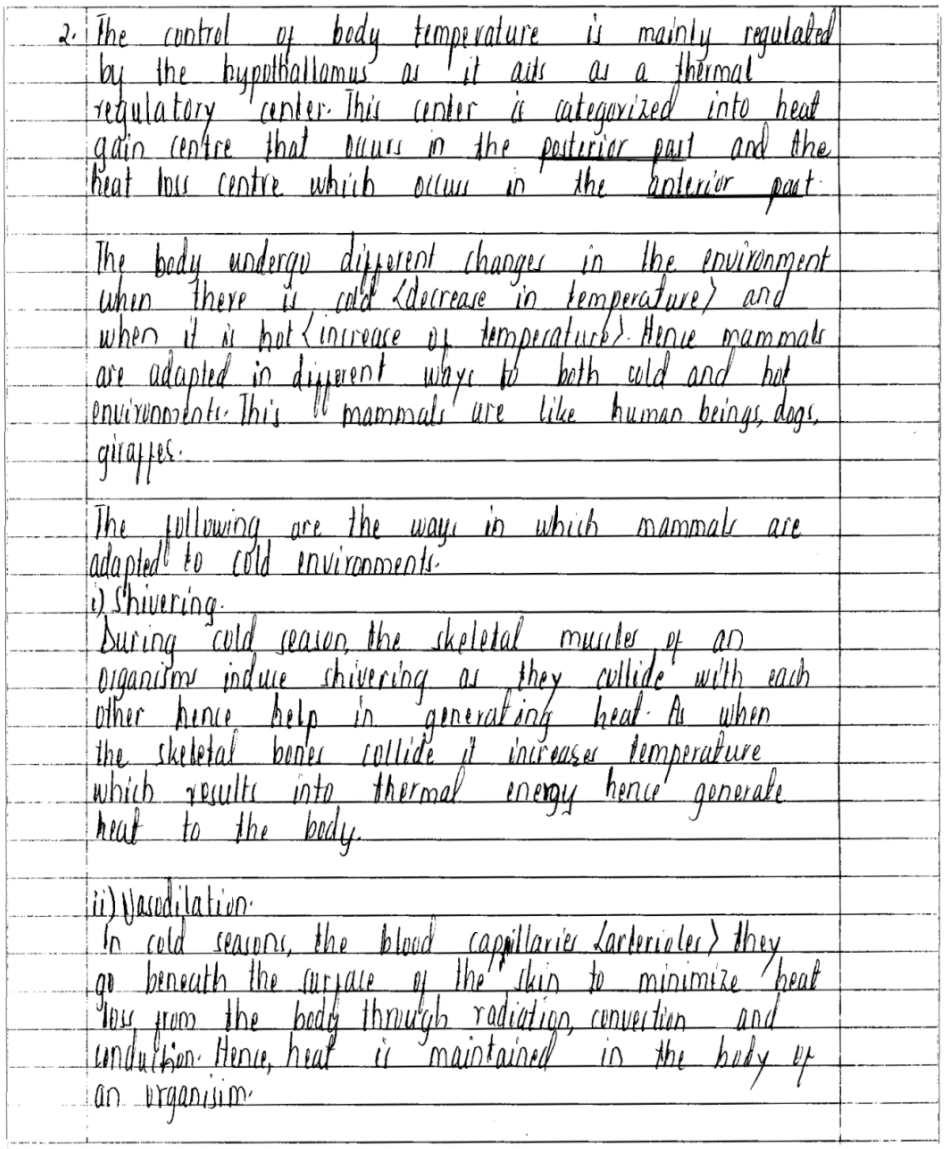


Figure 12: *Distribution of Candidates' Scores on Question 2*

Figure 12 shows that the candidates had a weak performance because the majority (69.28%) of them scored low marks (0.0 - 6.5) while only a few (3.19%) scored high marks (12 - 20).

The weak performance in this question was attributed to the failure of the candidates to respond correctly on adaptive feature of mammals in cold and hot environments. The candidates who scored (1.0 - 6.5), the majority had partial knowledge of temperature regulation in mammals, hence they gave one to two correct adaptive features rather than the required five points. Some of the candidates scored zero outlined the mechanisms of temperature regulation in animals instead of the features that mammals used to adapt to cold and hot environments. These responses indicate that, the candidates lacked understanding of the concept tested and therefore they were not able to precisely identify the correct adaptive features which

help mammals to live in a particular environment. Extract 12.1 is a sample of candidates' incorrect responses to the question.



2. The control of body temperature is mainly regulated by the hypothallamus as it aits as a thermal regulatory center. This center is categorized into heat gain centre that occurs in the posterior part and the heat loss centre which occurs in the anterior part.

The body undergo different changes in the environment when there is cold (decrease in temperature) and when it is hot (increase of temperature). Hence mammals are adapted in different ways to both cold and hot environments. This mammals are like human beings, dogs, giraffes.

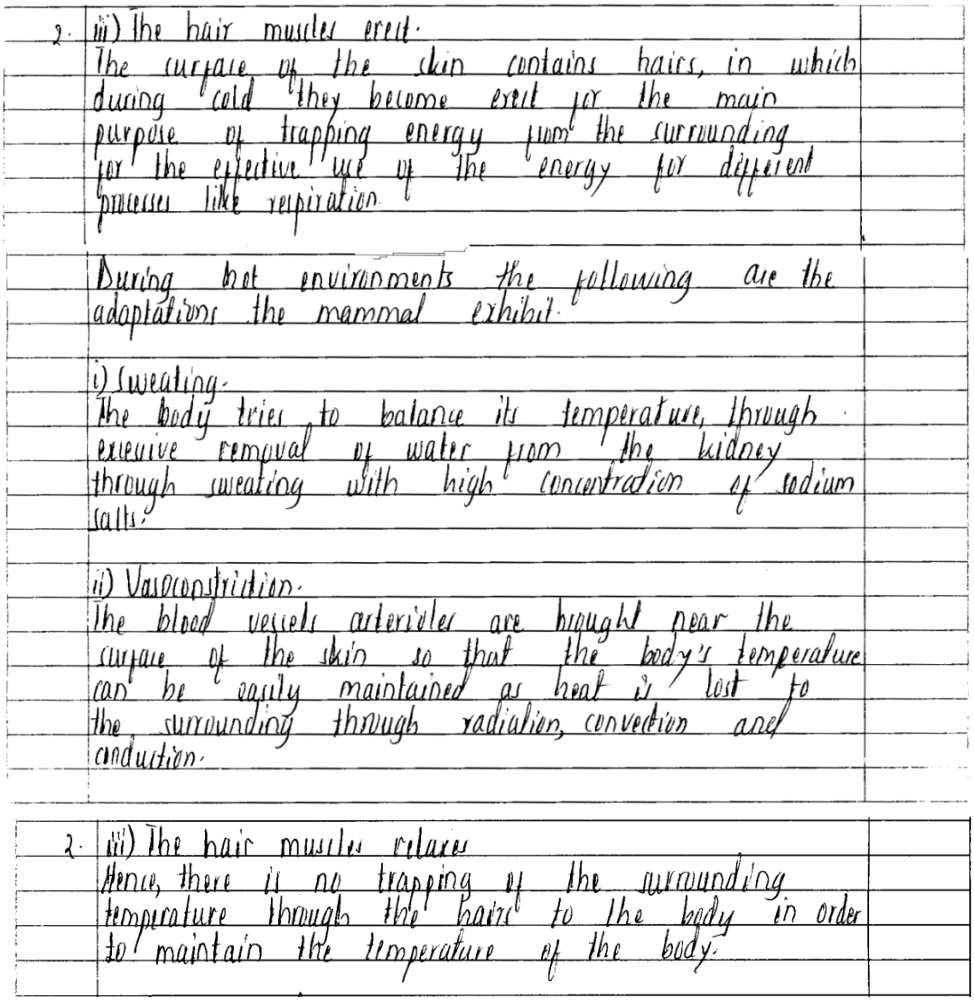
The following are the ways in which mammals are adapted to cold environments.

i) Shivering.

During cold season, the skeletal muscles of an organisms induce shivering as they collide with each other hence help in generating heat. As when the skeletal bones collide it increases temperature which results into thermal energy hence generate heat to the body.

ii) Vasodilation.

In cold seasons, the blood capillaries (arterioles) they go beneath the surface of the skin to minimize heat loss from the body through radiation, convection and conduction. Hence, heat is maintained in the body of an organism.



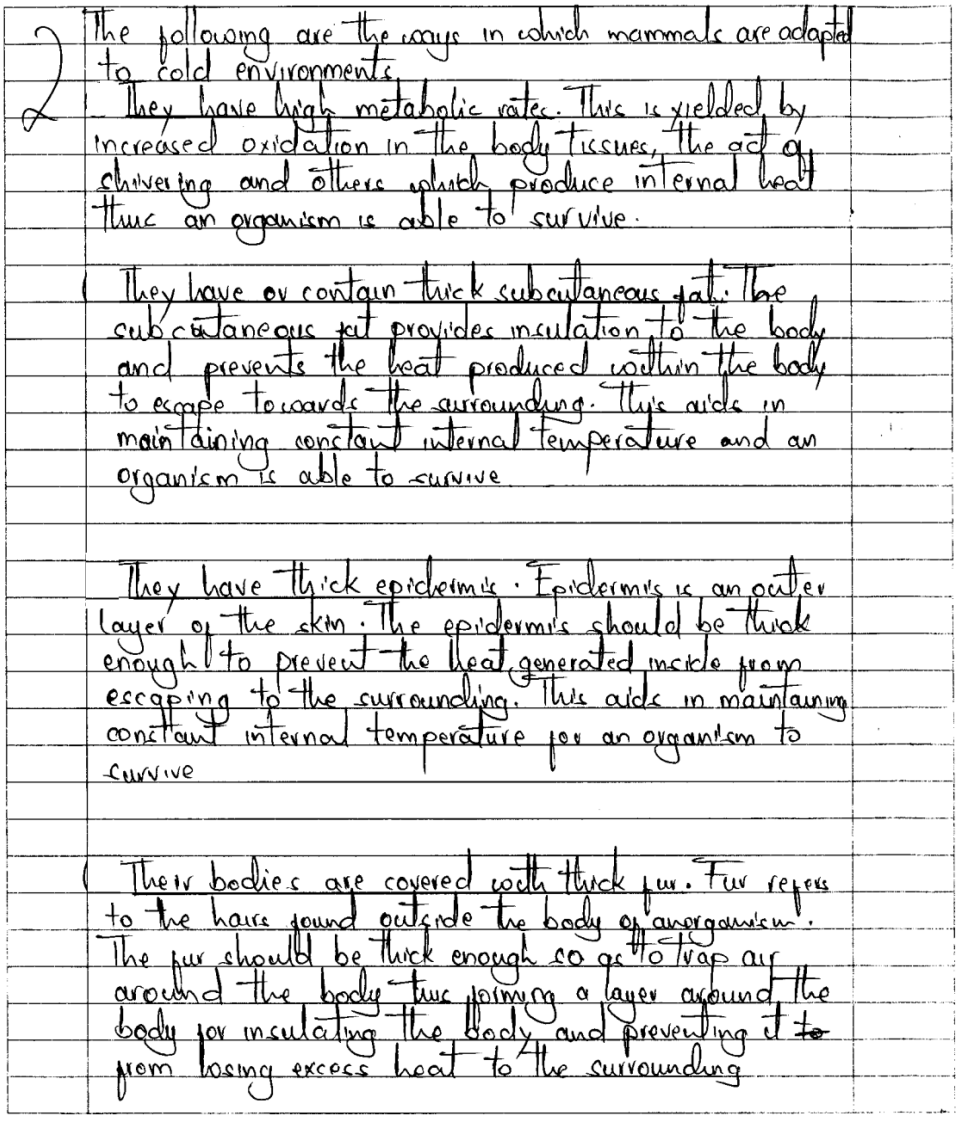
Extract 12.1: A sample of incorrect responses to question 2.

In Extract 12.1, the candidate wrote the mechanisms of temperature regulation such as, *vasodilation, vasoconstriction, sweating and relaxation of hair erector muscles* instead of the features that mammals used to adapt the cold and hot environments.

The analysis also revealed that candidates who scored averagely from 7.0 to 11.5 marks, gave correct introduction and clear description of one to two adaptive features out of the five points required in this question. In addition they demonstrated good essay writing skills.

Despite weak performance in this question, there were a few (3.19%) candidates who scored high marks (12 - 20). These candidates gave clear descriptions of the adaptive features of mammals which enable them adapt

to cold and hot environments. These responses signify good understanding of the topic *Regulation* specifically thermoregulation. Extract 12.2 is a sample of the candidates' correct responses to the question.



2 The following are the ways in which mammals are adapted to cold environments.

- They have high metabolic rates. This is yielded by increased oxidation in the body tissues, the act of shivering and others which produce internal heat thus an organism is able to survive.

- They have or contain thick subcutaneous fat. The subcutaneous fat provides insulation to the body and prevents the heat produced within the body to escape towards the surrounding. This aids in maintaining constant internal temperature and an organism is able to survive

- They have thick epidermis. Epidermis is an outer layer of the skin. The epidermis should be thick enough to prevent the heat generated inside from escaping to the surrounding. This aids in maintaining constant internal temperature for an organism to survive

- Their bodies are covered with thick fur. Fur refers to the hairs found outside the body of an organism. The fur should be thick enough so as to trap air around the body thus forming a layer around the body for insulating the body and preventing it ~~to~~ from losing excess heat to the surrounding

2 They have small surface area to volume ratio. Most parts of the organism's body like ears are small, thus providing small surface area to volume ratio for an organism to lose excess heat to the surrounding since most of the heat is needed to the body to maintain constant internal temperature of the organism

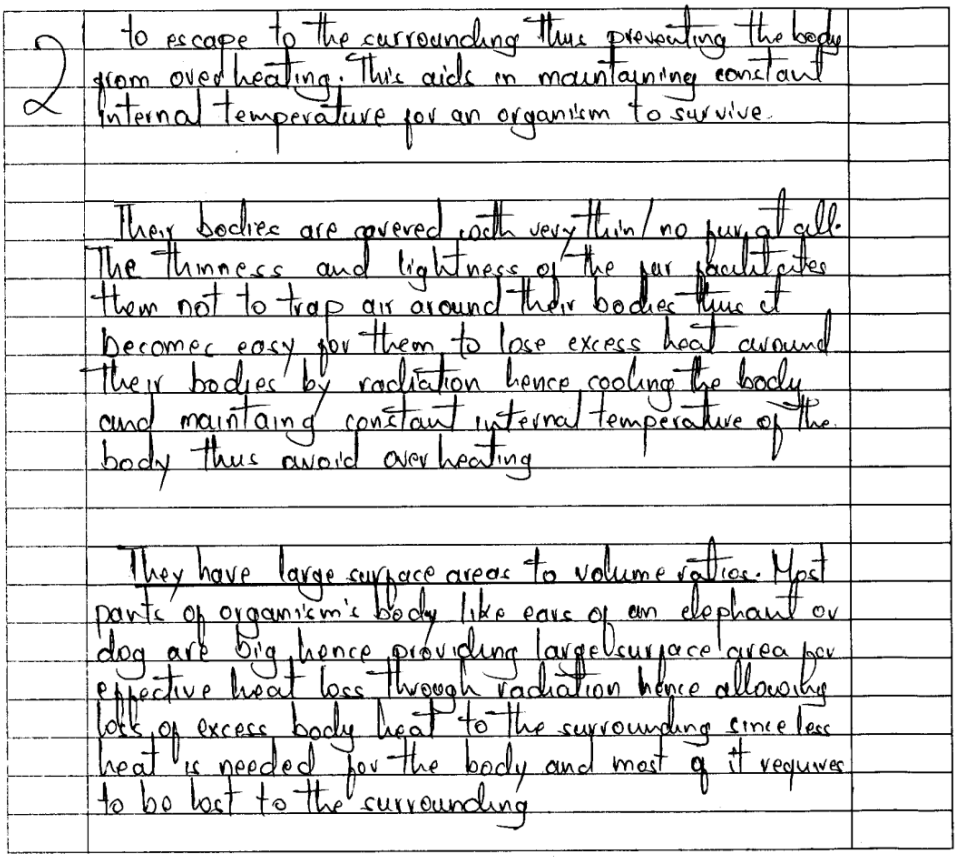
-Examples of organisms living in cold environments are bears

The following are the ways in which mammals are adapted to hot conditions

They have low metabolic rates. This is mainly done by decreasing the level of oxidation in the body tissues. This leads to the loss of excess heat to the surrounding preventing the body from overheating

They have/contain thin subcutaneous fat. The thin sub cutaneous fat will reduce the level of insulation to the body and hence allowing heat produced within the body to escape towards the surrounding. This aids in maintaining constant internal temperature and an organism is able to survive

They have thin epidermis. The epidermis should be thin enough to allow excess heat generated inside



Extract 12.2: A sample of correct response to question 2.

In Extract 12.2, the candidate correctly described the adaptive features of mammals, hence demonstrating that he/she was conversant with how mammals are adapted to hot and cold environments.

2.1.3 Question 3: Growth and Development

The question required the candidates to describe the growth patterns of fish, human beings and arthropods with the help of diagrams.

This question was opted by a total of 30,310 (99.50%) candidates who attempted it. Equally, the analysis shows that most of the candidates performed well as 82.60 per cent of them passed. The distribution of candidates' score is presented in Figure 13.

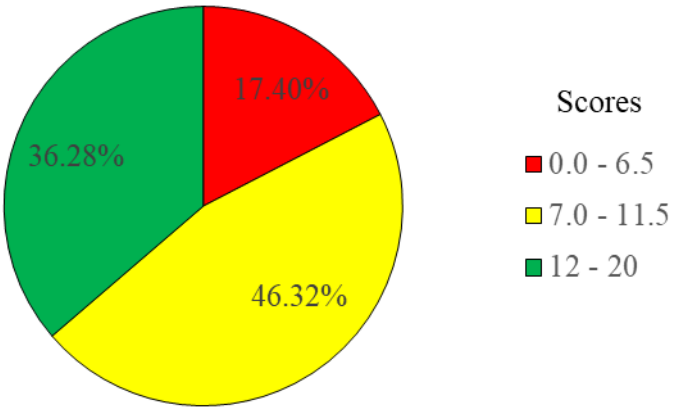


Figure 13: *Distribution of Candidates' Scores on Question 3*

Figure 13 indicates a good performance as 82.60 per cent of the candidates scored from 7.0 to 20 marks. The analysis shows that 36.28 per cent of the candidates scored high marks while 46.32 per cent had an average performance and a few (17.40%) scored low marks ranging from 0.0 to 6.5.

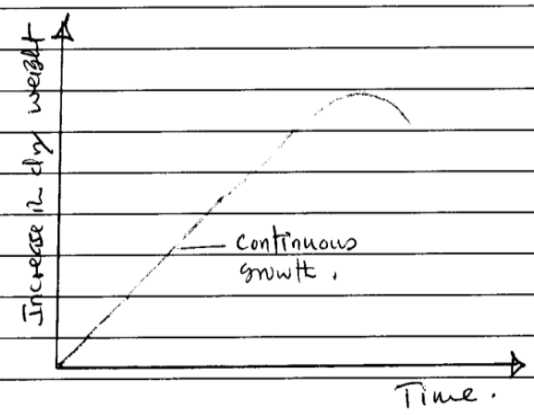
The candidates who scored high marks (12 - 20) in this question, gave correct description for each growth pattern and drew relevant graphs to support their answers. They were aware that fishes exhibit isometric growth pattern with cumulative frequency curve, human beings exhibit allometric growth pattern with sigmoid growth curve and arthropods exhibit discontinuous growth pattern with a step-like curve. These responses indicate that, the candidates had adequate knowledge on growth of those organisms and were skillful in drawing the relevant curves. In addition, they demonstrated good essay writing skills as essays were organised into introduction, main body and conclusion. Extract 13.1 is a sample of the candidates' correct responses to question 3.

03. Growth is the permanent irreversible increase in the size and dry weight of an organism. Different organisms exhibit different growth patterns. For example, fishes exhibit isometric growth, where all body parts grows at equal rate, while Human being exhibit allometric growth, where different body parts grows at different rates.

(i) Growth pattern of fish.

- They exhibit isometric growth pattern.
- This is the type of continuous growth pattern in which all parts of the body grows at equal rate, except genitalia.

- Since this isometric growth is the type of continuous growth and limited growth, then it exhibits sigmoid curve.



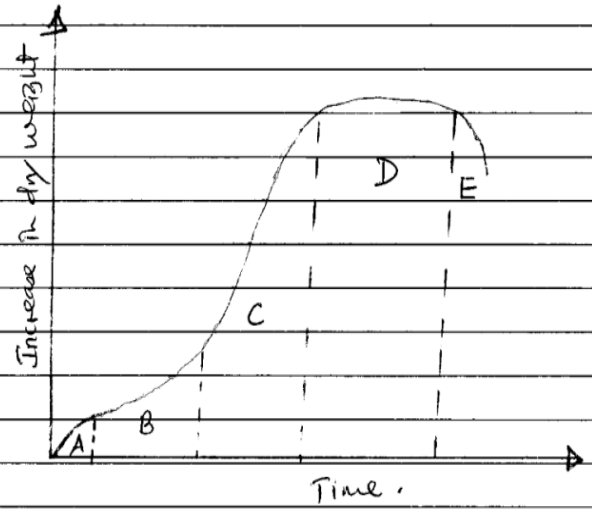
The growth pattern of fish.

This type of growth results into equal or same shape of adult and young individuals.

03. (ii) Growth pattern of Human being :-

- Exhibit Allometric growth pattern
- This is the type of growth pattern in which different parts of the body grow at different rates, resulting into differentiation in the shape of the matured individuals.

- Human growth curve has five major phase, as described below:-



The growth curve of Human being

Description

A: Infant stage :-

- This is the stage of growth, ranging from birth to the age of 5 years.
- It is characterized by rapid growth due to rapid cell dividing.

B'. Juvenile stage :-

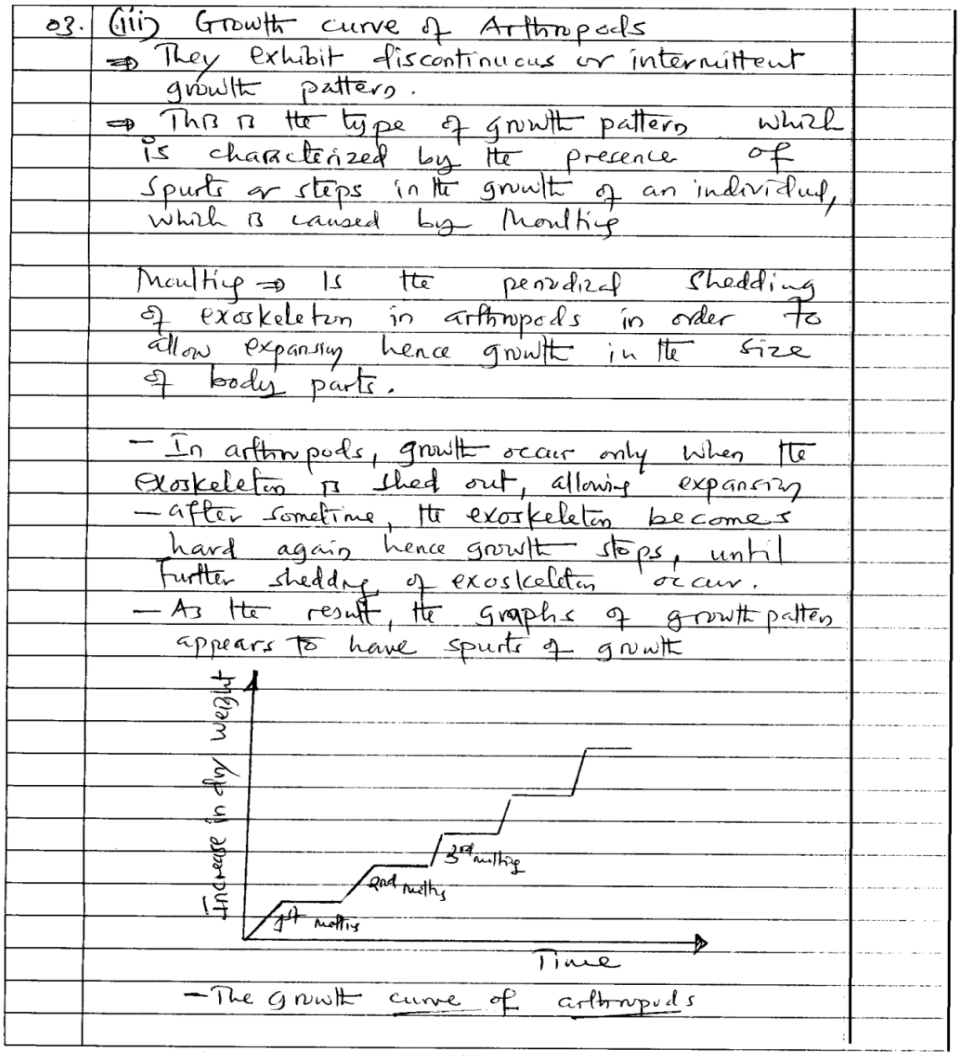
- Is the stage ranging from 7 to the onset of puberty.
- This stage is accompanied with very little growth.

03. (iii) – Little growth in Juvenile stage is due to the fact that the individuals in this phase are more active hence more energy is spent
– Also more energy is being used to prepare genitalians or development of reproductive organs for puberty in the subsequent stage

C: Adolescence
– Is the period ranging from onset of puberty to the adulthood. It ranges from 9–12 years for female and 12–14 years for male
– There is rapid growth rate due to:-
⇒ Simultaneous release of growth hormone and Thyroid hormone which increase Growth and Metabolisms respectively.

D: Adult
– Is the phase or stage which is accompanied by very little or no growth, since anabolism equalize with catabolism.

E: Senescence:
– This is the stage where there is negative growth.
– The rate of catabolism is higher than the rate of anabolism.

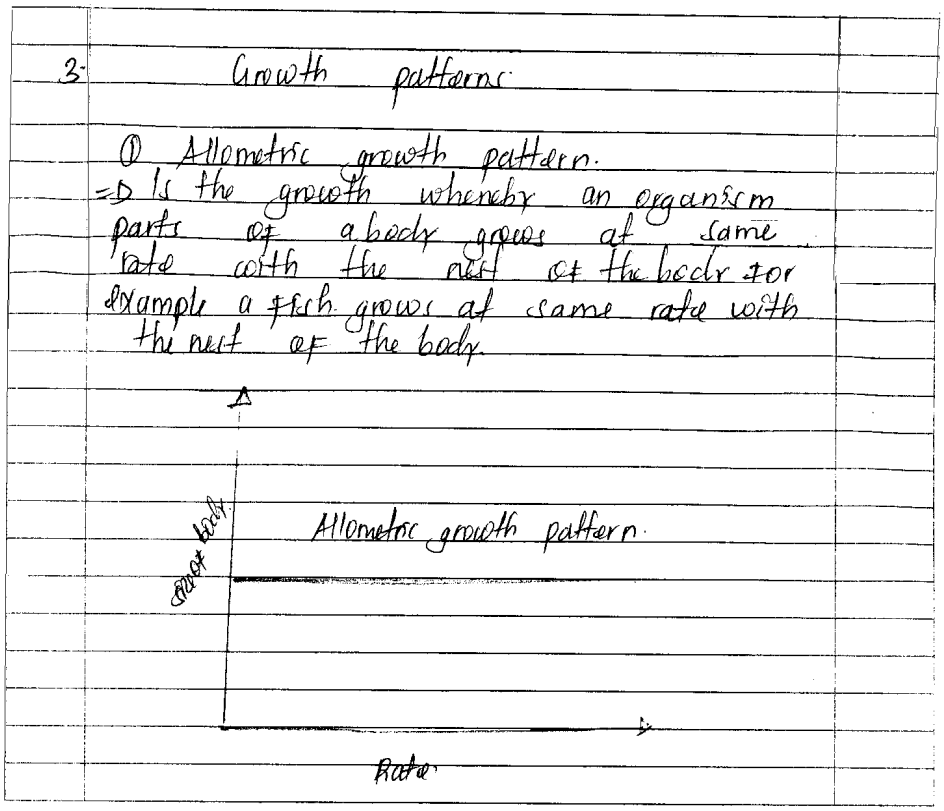


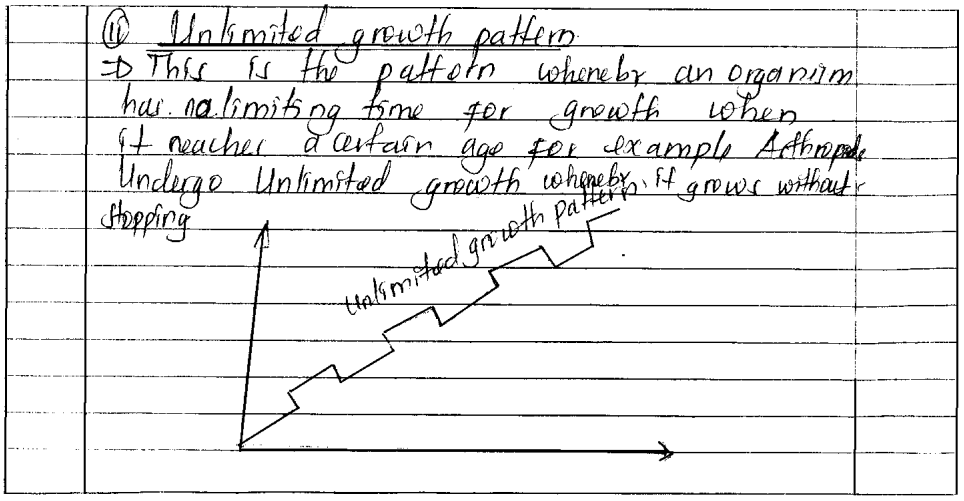
Extract 13.1: A sample of correct responses to question 3.

In Extract 13.1, the candidate provided a correct description of the growth pattern in fishes, humans and arthropods and drew correct growth curves.

The candidates who had average performance scored 7.0 to 11.5 marks. They gave clear descriptions to the growth patterns of human beings and arthropods. However, their responses on the growth pattern of fishes were partially correct or improper. Most of the candidates in this category drew fish of different sizes in an ascending order, which represent a sequence of developmental stages of fish. These responses indicate that the candidates misunderstood the growth patterns.

Further analysis indicated that (17.40%) of the candidates scored low marks ranging from 0.0 to 6.5 marks. The candidates who scored from 1.0 to 6.5 marks gave correct description with or without correct diagrams of the growth curve, especially arthropods. Those who scored zero had insufficient knowledge about growth patterns in living organisms. They gave incorrect points on growth patterns of all three organisms. For example, one candidate described the phases of growth which occur in several organisms such as *lag phase, log phase, stationary phase and deceleration phase*. Others confused the growth patterns as their explanation were interchanged. For example, one candidate described a growth pattern of fish as allometric rather than isometric and the growth pattern of humans as isometric rather than allometric. Others drew the diagrams of fish with different sizes, diagrams of humans at different stages and the life cycles of arthropods instead of describing their growth patterns with relevant graphs. Extract 13.2 is a sample of candidates' incorrect responses to the question.





Extract 13.2: A sample of incorrect responses to question 3.

In Extract 13.2, the candidate described incorrectly the growth patterns of fish as allometric and that of arthropods as unlimited growth pattern, hence she/he constructed incorrect graphs.

2.1.4 Question 4: Genetics

The question required the candidates to describe the mode of inheritance of haemophilia and sickle cell anaemia by using genetic crosses.

A total of 23,134 (75.92%) candidates opted this question. The analysis shows that more than half (53.96%) scored low marks ranging from 0.0 - 6.5. The candidates who scored average marks from 7.0 - 11.5 were 31.01 per cent while a few (15.02%) scored from 12 - 20 marks which is a good performance. The distribution of the candidates' score is presented in Figure 14.

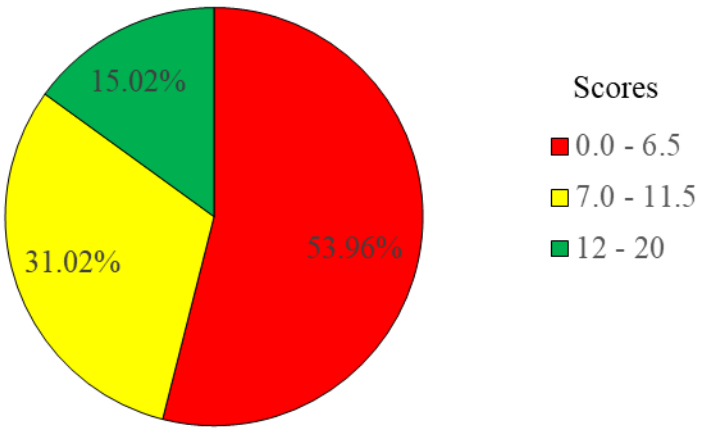


Figure 14: *Distribution of Candidates' Scores on Question 4*

Data in Figure 14 shows an average performance of the candidates in this question since 46.04 per cent managed to score from 7.0 to 20 marks.

The candidates who scored high marks (12 - 20) clearly described how haemophilia and sickle cell anaemia are inherited through generations. They correctly used genetic crosses to illustrate the mode of inheritance from parents to the offspring by determining the nature of the gamete and the possible ratio of the traits inherited in the first filial generation. In addition, their essays were skilfully organised. Extract 14.1 is a sample of candidates' correct responses to the question.

4 Required mode of inheritance of haemophilia and sickle celled anaemia.

> Mode of inheritance of haemophilia.

~Haemophilia is the sex linked disorder which results to delay in blood clotting.

~Haemophilia is controlled by recessive gene carried on sex X-chromosome.

~The disorder is commonly in man because;

- For man to be haemophilia it requires only a single dose while for woman since are homogametic double dose is required for the disorder to express itself.
- Man does not undergo menstruation while for female who are haemophilic they do not survive beyond the onset of puberty due to excessive bleeding.
- It is controlled by a recessive allele "h"

Thereby;

X^HX^h → Normal woman but carrier of the disorder.
X^hX^h → Haemophilic woman.
X^HX^H → Normal woman
X^HY → Normal man.
X^hY → Haemophilic man.

> Now for inheritance of the disorder the cross must be between;

> A haemophic man and haemophilic woman.
> Normal man and carrier woman.
> Haemophilic man and carrier woman
> Haemophic man and normal woman

4 Example, A cross between Normal man and haemophilic woman.

Let, H – normal

h – haemophilia

X^HY – Normal man

X^hY – Haemophilia man

X^HX^H – Normal woman

X^HX^h – Carrier woman

X^hX^h – Haemophilia woman.

Parental phenotype : Normal man × Haemophilic woman.

Genotype : X^HY × X^hX^h.

Meiosis

Gametes X^H Y X^h X^h

Fertilisation

F_1 : X^HX^h X^HX^h X^hY X^hY.

Results :

> Phenotype : 2 carrier woman

2 haemophic man.

Ratio : $\frac{2:2}{2} = 1:1$

> Genotype : 2 - X^HX^h (Carrier)

2 - X^hY (haemophilic)

Ratio 2:2 = 1:1. hence shown.

Q4

> Mode of inheritance of sickle celled Anaemia

Sickle cell Anaemia: Refers to the situation whereby the Redblood cells tends to assume moon shape.

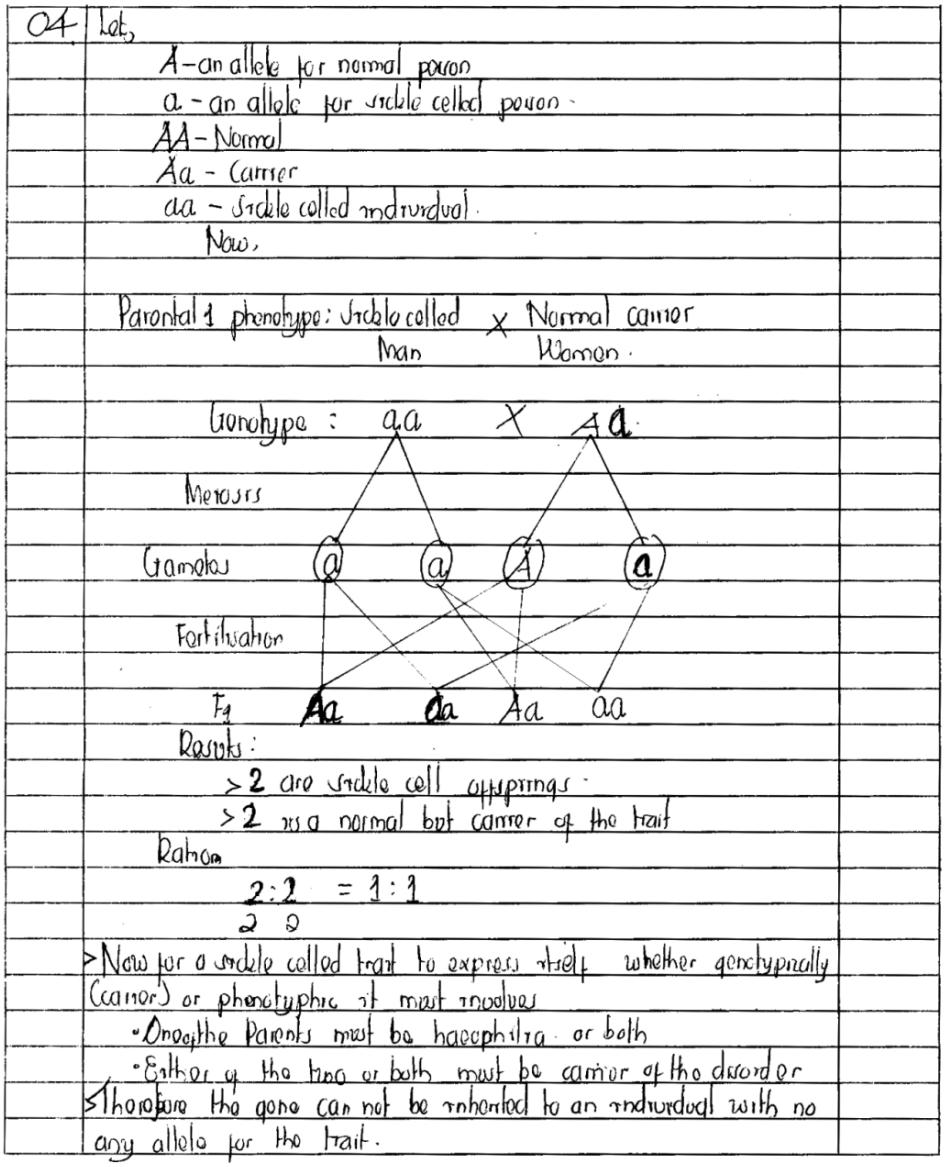
> Sickle celled Anaemia is caused due to Mutation whereby Glutamine at position 6 of the β-chain tends to replace the Valine at position 1 of the same chain.

> Sickle celled Anaemia is controlled by a recessive gene located in the Autosomal chromosome.

> The inheritance of sickle celled Anaemia is equally to both sexes female and male since the allele for expression of the gene are located in autosomal chromosome rather than Sex chromosome.

> A person suffering from sickle cell Anaemia is not affected by Malaria parasite because Malaria parasites are aerobes and thus requires high amount of oxygen for their survival.

Example Consider a cross between sickle celled man and Normal woman.



Extract 14.1: A sample of correct responses to question 4.

In Extract 14.1, the candidate gave correct responses on how haemophilia and sickle cell anaemia are passed from one generation to the next. She/he also made correct genetic crosses to illustrate the mode of inheritance to both disorders.

Further analysis indicates that 31.01 per cent of the candidates performed averagely. They had insufficient knowledge on the mode of inheritance of haemophilia and sickle cell anaemia. They either correctly described

inheritance of one of the disorders or gave correct explanations with incorrect genetic crosses or without genetic cross diagrams at all.

On the other hand, the candidates who scored low marks (0.0 - 6.5) had insufficient skills and mastery of performing genetic crosses. Most of the candidates who scored 1.0 to 6.5 marks, failed to give clear explanation on inheritance of the disorders but they managed to draw genetic crosses for one of the disorders. Some of the candidates scored zero because their responses were completely incorrect. They were not able to distinguish inheritance of traits through sex and autosomal chromosomes. Most of them used X and Y chromosomes to present alleles for sickle cell anaemia. Others wrote the alleles for inheritance of haemophilia with no link to the sex chromosome while others wrote the blood antigen instead of sex chromosomes. These candidates lacked the understanding that haemophilia is a result of failure of the blood to clot which is controlled by a recessive gene carried on X chromosome, and sickle cell anaemia is another genetic disorder which is controlled by a recessive gene carried by the autosomal chromosome. Other candidates scored zero because they failed to understand the demand of the question. For example, one candidate listed the effects of haemophilia instead of explaining how it is inherited. They gave incorrect responses such *as haemophilia can cause death in females* and the effects of sickle cell anaemia such as *sickle cell anaemia lead to insufficient supply of oxygen*. Extract 14.2 is a sample of the candidates' incorrect responses to question 4.

4. Let $I^H I^H$ be male homozygous dominant gene for haemophilia
$I^h I^h$ be female homozygous recessive gene.

Parental Phenotype: Male homozygous dominant × Female homozygous.

Parental genotype (2n): $I^H I^H$ $I^h I^h$.

Meiosis.

Gametes (n): I^H I^H I^h I^h.

Fertilization.

Genotypic ratio: $I^H I^h$ $I^H I^h$ $I^H I^h$ $I^H I^h$.

Phenotypic ratio: 1:1.

Phenotype: All are haemophilic.

4. Parental Phenotype: Male haemophilic x Heterozygous haemophilic.

Parental Genotype(s) I^HY I^hI^h

Meiosis

Gamete (n) I^H Y I^h I^h

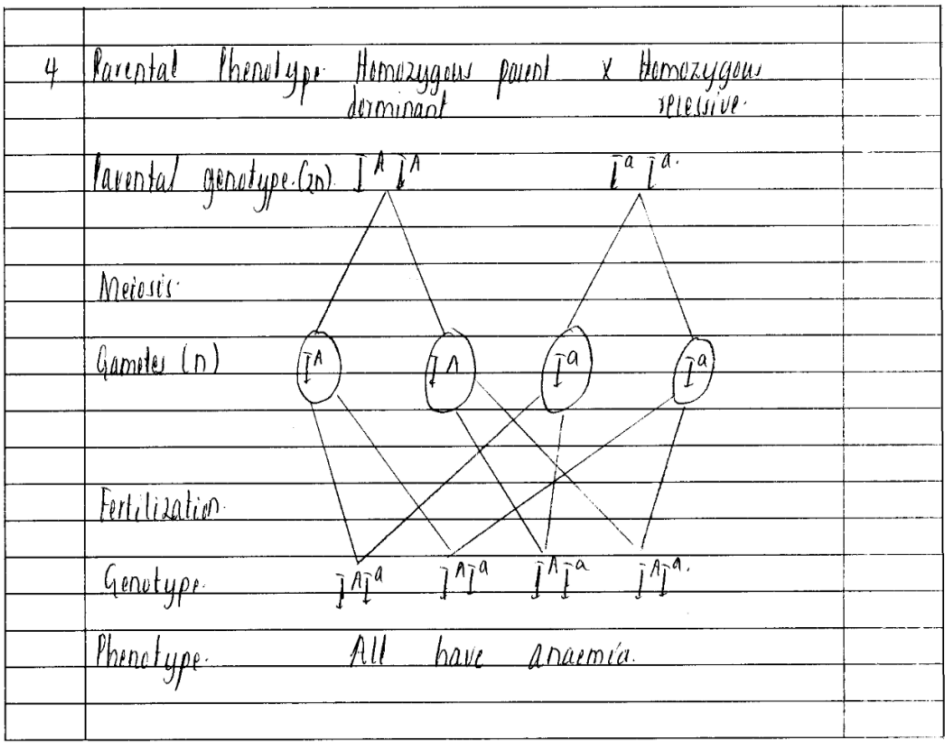
Fertilization

Genotype. I^HI^h I^HY I^hI^h I^hY

Phenotype. Haemophilic Not-haemophilic.

For sickle cell anaemia.

Let I^AI^A be a homozygous parent with anaemia.
I^AI^a be a homozygous recessive parent with no anaemia.



Extract 14.2: A sample of incorrect responses to question 4.

In Extract 14.2, the candidate incorrectly used the standard letter **I** for a blood gene instead of the X and Y chromosome for inheritance of haemophilia. Likewise, for sickle cell anaemia she/he used a standard letter **I** with linked alleles.

2.1.5 Question 5: Organic Evolution

This question comprised parts (a) and (b). The candidates were required to (a) explain essential features of natural selection, and (b) describe how geographical, reproductive and genetic isolations bring about speciation.

The question was opted by 28,661 (94.06%) of the candidates. The analysis shows that 60.10 per cent scored from 7.0 to 20 marks. Further analysis of the candidates' performance is shown in Figure 15.

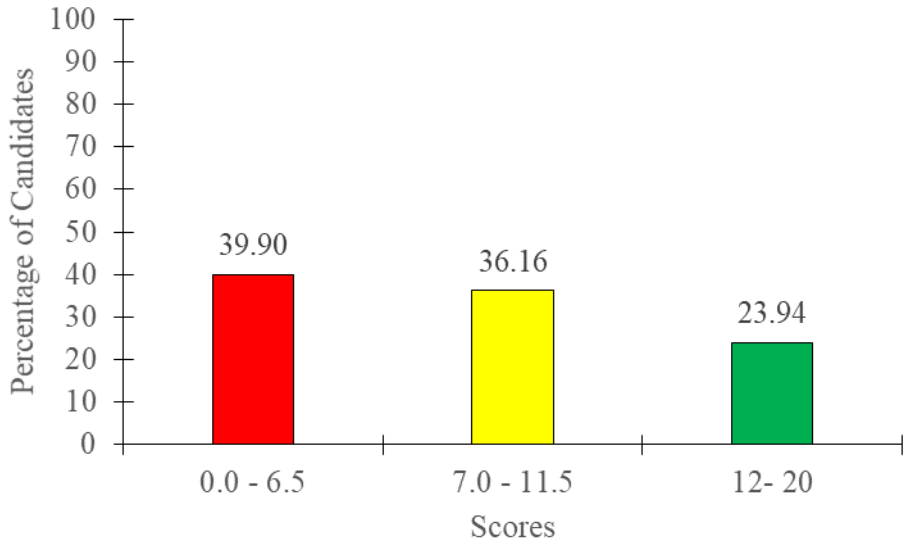
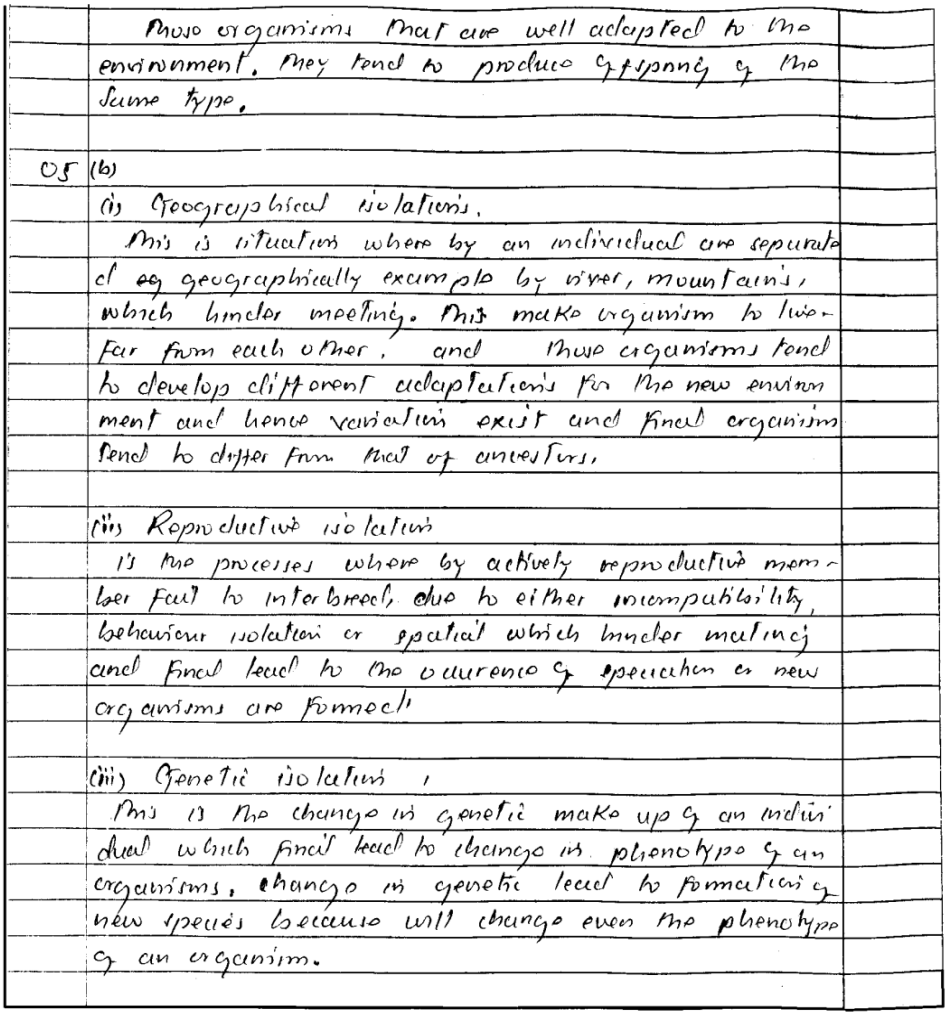


Figure 15: *Distribution of Candidates' Scores on Question 5*

According to Figure 15, the majority (60.10%) of the candidates scored from 7.0 to 20 marks and 39.90 per cent scored from 0.0 to 6.5 marks. The general performance of the candidates on this question was average.

Most of the candidates who scored higher marks described correctly the essential features of natural selection as suggested by Darwin and Wallace in part (a). In part (b), they explained correctly the ways in which geographical, reproductive and genetic isolations favour the formation of new species (speciation). This is an indication that they had good mastery on mechanism of organic evolution and speciation. Extract 15.1 is a sample of the candidates' correct responses to the question.

05	Natural selection is a condition where by environment tend to select organism, where by better adapted organism are selected and those fail to adapt the environmental changes disappears.	
	The following are essential features of natural selection.	
	(i) Overproduction of offsprings.	
	an organisms always tend to reproduce more than environment can support. Organisms produces more - offspring than that required in the environment.	
	(ii) Constancy within the population	
	Even organism reproduce more than environment can support, but the population of organisms tends to remain constancy.	
	(iii) Struggle for existence.	
	Due to high in number organisms in the populati on tend to struggle for the limited resources available this lead to constancy in population.	
	(iv) Variation exists among individuals in populations.	
	Organisms that are better adapted to the environmental changes, tends to pass their traits to the next generation and hence variation starts.	
	(v) Survival of the fittest	
	Organism in the environment tends to remains only IF the environment select. those that fail to adapt the environmental changes will perish and disappears.	
	(vi) Like produce like	



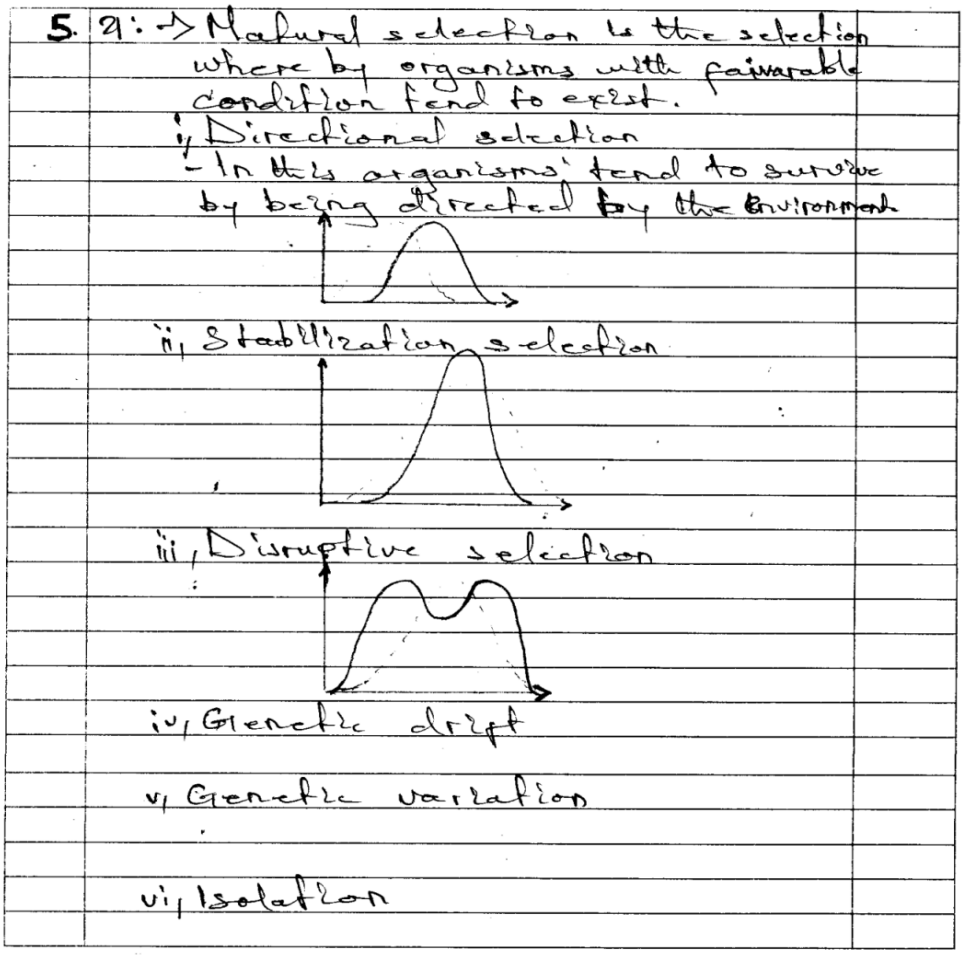
Extract 15.1: A sample of correct responses to question 5.

In extract 15.1, the candidate correctly described the essential features of natural selection in part (a) and described correctly the mechanisms of speciation in part (b). This shows that she/he was aware of the theories of organic evolution.

The analysis revealed that the candidates who scored average marks (7.0 - 11.5) were categorised based on their responses. Some of them explained three or four correct features of natural selection out of nine points required in part (a). Likewise, they described two mechanisms of speciation correctly but the rest of their points were incorrect.

Further analysis indicated that the candidates who scored low marks (0 - 6.5). Some of these candidates managed to give a few points on natural selection and scored 1.0 to 6.0 marks. Others lacked knowledge of the theories of natural selection and the mechanisms of organic evolution, hence they scored zero because their responses were incorrect. Others scored zero because they failed to understand the requirement of the question in part (a). Moreover, there were those who explained, comparative embryology, biochemistry and selective breeding as the evidence of evolution while others mentioned factors such as *temperature, rainfall, natural calamities, famine and hunger* as features of natural selection.

Likewise, in part (b), the candidates failed to explain the features of isolation mechanisms. They wrote incorrect description about reproduction *such as acrosomal and cortical reaction*. These occur in the fertilization process. Another candidate explained the types of selection such as *stabilising, disruptive and directiona*l instead of essential features of natural selection. These candidates had insufficient knowledge about the mechanisms of speciation. Extract 15.2 is a sample of the candidates' incorrect response to the question.



Extract 15.2: A sample of incorrect responses to question 5.

In Extract 15.2, the candidate outlined incorrect types of selection instead of describing the essential features of natural selection in part (a).

2.1.6 Question 6: Ecology

This question had parts (a) and (b). The candidates were required to (a) describe the typical marine food chain with the help of a diagram and (b) justify the fact that food chains in the ecosystem are limited to a certain number of trophic levels.

The question was attempted by 20,538 (67.40%) of the candidates where 15.83 per cent of them passed. The distribution of the candidates' score is presented in Figure 16.

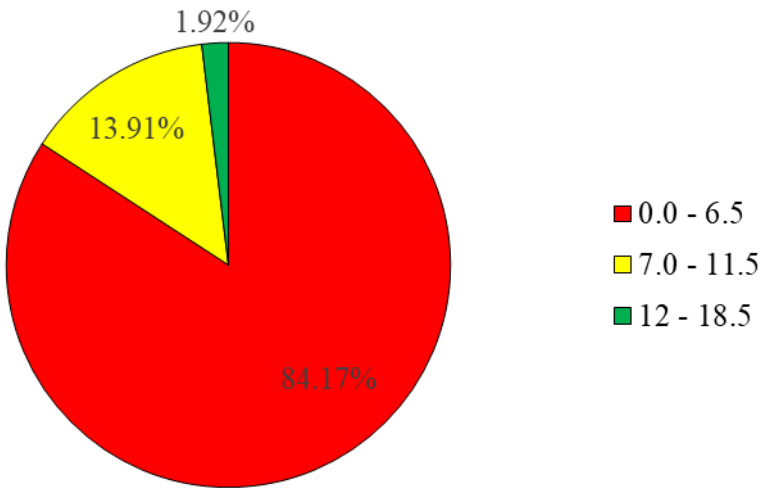


Figure 16: *Distribution of Candidates' Scores on Question 6*

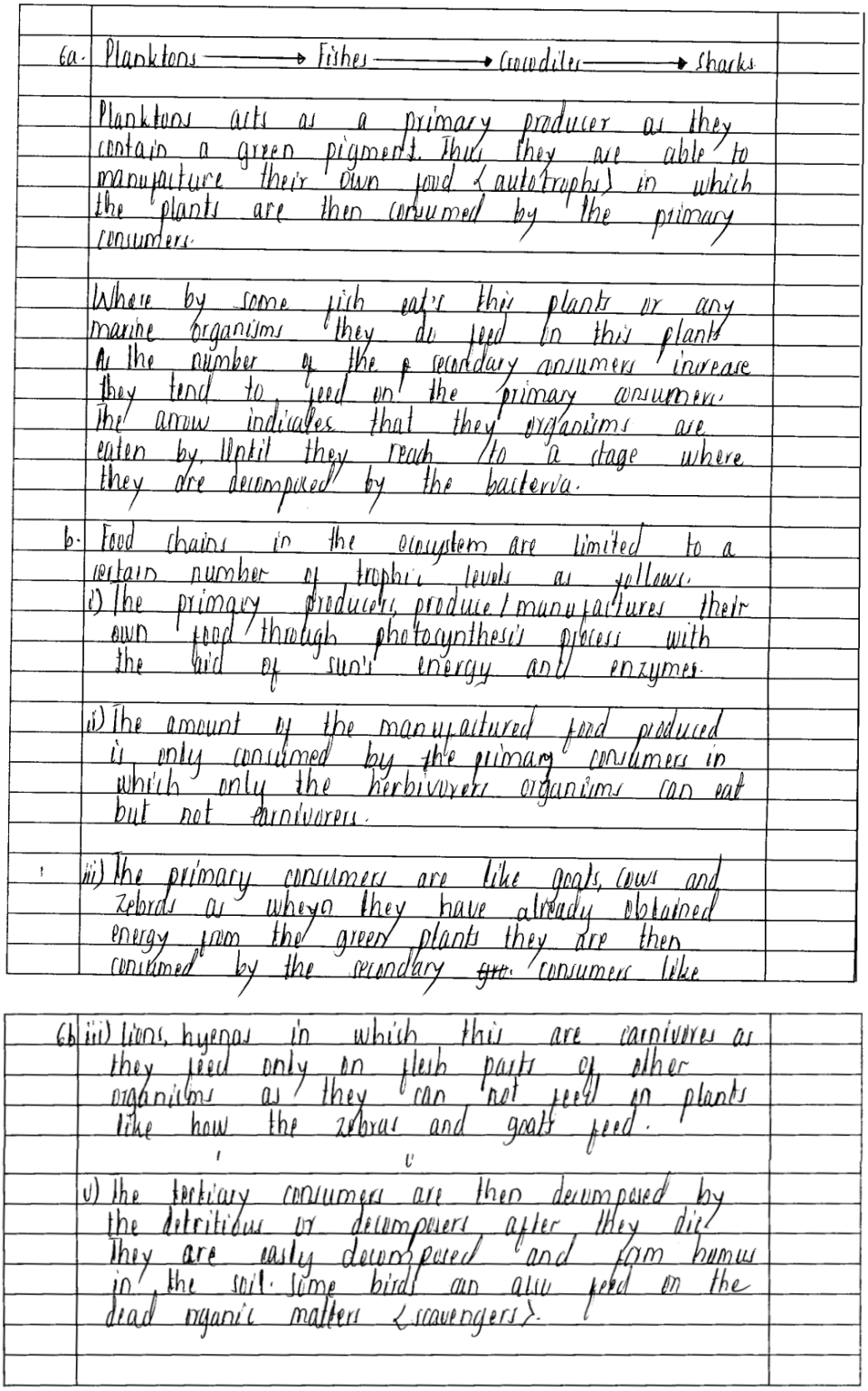
Figure 16 shows that 15.83 per cent of the candidates scored from 7.0 to 18.5 marks, whereas 84.17 per cent scored from 0.0 to 6.5 marks indicating a weak performance in this question. No candidates managed to score full 20 marks allotted to this question.

The analysis revealed that the weak candidates' performance in the question is attributed to the lack or insufficient knowledge of the candidates. The candidates who scored 1.0 to 6.5 managed to give correct justification about the limitation of food chain in a certain number of trophic levels in part (b) while their responses in part (a) were incorrect. These candidates lacked understanding of the marine ecosystem. They drew a terrestrial food chain consisting of *grass*, *cow, goat and bacteria*. Others drew a food web instead of describing the marine food chain. Others drew the ecological pyramids showing the number of organisms in the respective trophic level.

Further analysis indicated that those who scored zero not only that they were incompetent on marine organisms but also, they had insufficient knowledge about the concept of food chain and trophic levels hence gave incorrect responses to all parts of the question. In part (a), they failed to identify the correct marine organisms supposed to constitute the particular trophic level in a food chain hence some organisms were misallocated. For example, some candidates resided phytoplanktons at consumer level and

zooplanktons as producer. Other candidates in this category listed the names of organisms found in aquatic ecosystem such as *shark, whale, small fish and large fish* instead of describing marine food chain.

Likewise, in part (b) they described biogeochemical cycling in the marine ecosystem wrongly. For example, one of the candidate described by writing *abiotic component depends on nutrients from abiotic components such as oxygen in water*. Others explained the interactions among marine organisms such as *competition* and *parasitism.* These candidates had inadequate understanding of the concept of food chain, trophic levels, energy flow, utilization and distribution of the energy throughout the ecosystem. This knowledge could have helped them to justify the limitation of food chain depending on the number of trophic levels in a particular ecosystem. Extract 16.1 is a sample of the candidates' incorrect responses to the question.


6a. Planktons → Fishes → Crocodiles → Sharks

Planktons acts as a primary producer as they contain a green pigment. Thus they are able to manufacture their own food (autotrophs) in which the plants are then consumed by the primary consumers.

Where by some fish eats this plants or any marine organisms they do feed on this plants As the number of the secondary consumers increase they tend to feed on the primary consumers. The arrow indicates that they organisms are eaten by Until they reach to a stage where they are decomposed by the bacteria.

b. Food chains in the ecosystem are limited to a certain number of trophic levels as follows.

i) The primary producers produce / manufactures their own food through photosynthesis process with the aid of sun's energy and enzymes.

ii) The amount of the manufactured food produced is only consumed by the primary consumers in which only the herbivorous organisms can eat but not carnivores.

iii) The primary consumers are like goats, cows and zebras as whereas they have already obtained energy from the green plants they are then consumed by the secondary ~~pri~~ consumers like

6b iii) lions, hyenas in which this are carnivores as they feed only on flesh parts of other organisms as they can not feed on plants like how the zebras and goats feed.

iv) The tertiary consumers are then decomposed by the detritivous or decomposers after they die. They are easily decomposed and form humus in the soil. Some birds can also feed on the dead organic matters (scavengers).

Extract 16.1: A sample of incorrect responses to question 6.

In extract 16.1, the candidate wrote incorrect responses about marine food chain and the diagram. Also, she/he described biotic components instead of the limitation of the food chain in relation to the number of trophic levels.

The analysis of the results also shows that the candidates who did well managed to score 12.0 to 18.5. These candidates were able to give correct description of marine food chain by showing their interdependence in the ecosystem. They also identified correctly most of marine organisms which comprise the particular trophic level, hence they constructed correct food chain. However, their understanding was limited to four trophic levels instead of six trophic levels existing in the marine ecosystem. In part (b), the candidates were able to give correct explanations to justify the limitation of food chain to a certain number of trophic levels in the ecosystem. Extract 16.2 is a sample of the candidates' correct responses to the question.

06. (a) Food chain is the linear sequence which tends to show the flow of nutrients and energy from one organism to another organism, whereby one organism is the food for the next organism in the sequence.

Marine food chain starts with the producers which are mainly marine plants like phytoplanktons which tend to grow in water thus they photosynthesize food by their own and pass it to the next trophic level

There are primary consumers which are mainly the marine zooplanktons which tend to eat the phytoplanktons

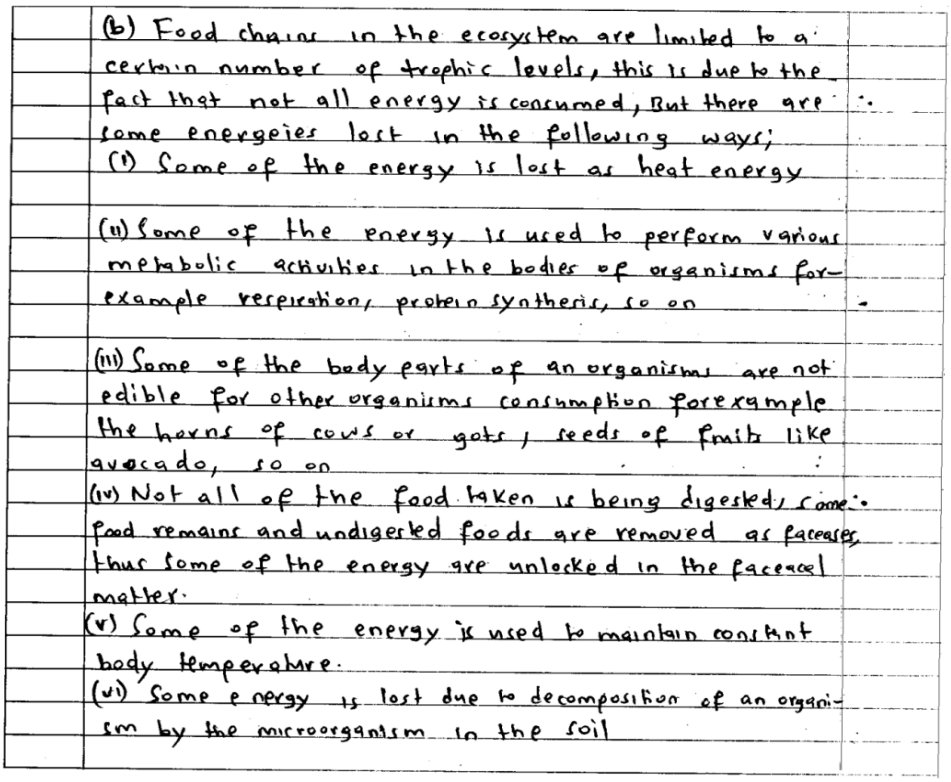
Secondary consumers, this are small fishes which tend to eat the primary consumers which are the zooplanktons.

Tertiary consumers, this are large fishes, which tend to feed on the small fishes, thus this tend to behave like tertiary consumers

Conclusively, marine food chain tend to behave in such a way that energy flows from one energy level to another energy level.

phytoplanktons ——→ zooplanktons ——→ small fish ——→ large fish

Marine food chain


(b) Food chains in the ecosystem are limited to a certain number of trophic levels, this is due to the fact that not all energy is consumed, But there are some energeies lost in the following ways;
(i) Some of the energy is lost as heat energy
(ii) Some of the energy is used to perform various metabolic activities in the bodies of organisms for-example respiration, protein synthesis, so on
(iii) Some of the body parts of an organisms are not edible for other organisms consumption forexample the horns of cows or goats, seeds of fruits like avocado, so on
(iv) Not all of the food taken is being digested, some food remains and undigested foods are removed as faeces, thus some of the energy are unlocked in the faecael matter.
(v) Some of the energy is used to maintain constant body temperature.
(vi) Some energy is lost due to decomposition of an organism by the microorganism in the soil

Extract 16.2: A sample of correct responses to question 6.

Extract 16.2, the candidate gave correct a description of marine food chain and demonstrated competence in constructing the relevant food chain in part (a). However, the chain ended with the tertiary consumer, hence lost one mark. Also, the responses on limitation of food chain to the number of trophic level were correct.

Further analysis revealed that the average performance was attributed to partial responses provided by the candidates. They managed to give correct explanation about the limitation of food chain depending on the number of trophic levels and correctly drew the marine food chain but without giving descriptions. Most of them failed to describe the marine food chain in part (a), hence, losing some marks. This indicates that candidates had partial knowledge about marine food chains.

2.2 133/3 Biology 3

133/3 Biology 3 was a practical examination with three alternative papers, namely 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology 3C. Each candidate was required to attempt one of these alternatives.

Each paper comprised three (3) questions. Question 1 of each paper was set from the topic of Comparative Studies of Natural Groups of Organisms, question 2 was set from the topics of Nutrition and Transportation and question 3 was set from the topic of Principles of Classification and Comparative Studies of Natural Groups of Organisms. Question 1 carried twenty (20) marks while questions 2 and 3 carried fifteen (15) marks each. The pass mark for question 1 was from 7.0 to 20.0 marks while for questions 2 and 3, it was from 9.0 to 15 marks each.

The analysis of the candidates' performance on each paper in Biology 3 starts with question 1 of all three alternative papers followed by question 2 and 3.

2.2.1 Question 1: Comparative Studies of Natural Groups of Organisms

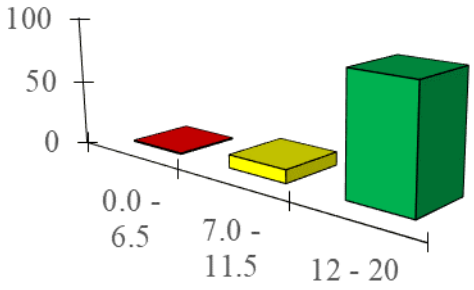
The three alternatives 3A, 3B and 3C, the question measured the candidates' skills in dissecting selected animals to display various systems. In Biology 3A, the candidates were provided with specimen B which was a mouse/guinea pig/rat. They were instructed to dissect it to fully display the digestive system, and then, were required to (a) draw the diagram of a mouse/guinea pig/rat and label ten parts of the digestive system, (b) explain the five adaptations of the digestive system to its roles and (c)(i) identify two structures of the digestive system which are more developed in a mouse/guinea pig/rat than in human being and (c)(ii) explain the effects which a mouse/guinea pig/rat will face if the structures mentioned at (c)(i) would fail to function normally.

Likewise, in Biology 3B, the candidates were provided with the specimen S_1 which was a freshly killed cockroach. They were instructed to dissect it to display its digestive system and pin the ileum to their right hand side. Then, they were required to (a) draw a large diagram of the specimen and label nine parts, (b) explain the adaptations of a structure used for mechanical digestion in cockroach, (c)(i) state the enzymes found in the structure used for mechanical digestion and (c)(ii) give the digestive role played by each of the enzymes named in (c)(i) and (d) state two locations in cockroach where absorption takes place in the cockroach's body

Similarly, in Biology 3C, the candidates were provided with specimen T, which was a frog/toad and instructed to dissect it in a usual way to fully

display the urinogenital system. They were instructed to make sure that the alimentary canal was pinned to the left hand side of the specimen. The candidates were required to (a) draw a large neat diagram of a dissected frog/toad and label eight parts, (b) identify the sex of the frog/toad and give one external feature used for identification, (c)(i) name the type of nitrogenous waste excreted by frog/toad (c)(ii) state the structure of the kidney responsible for excretion of nitrogenous waste in frog/toad (c)(iii) state specific part of the structure named in (c)(ii) where glucose and salt ions are reabsorbed and (d) explain the adaptations of frog/toad to its environment.

A total of 30,469 (100%) candidates from all alternative 3A, 3B and 3C attempted this question. The analysis shows that, the majority (99.1%) passed. Further analysis of the candidates' performance is shown in Figure 17.



	0.0 - 6.5	7.0 - 11.5	12 - 20
Percentage of Candidates	0.85	10.00	89.15

Figure 17: *Distribution of Candidates' Scores on Question 1*

Figure 17 shows that 89.15 per cent of the candidates scored high marks ranging from 12.0 to 20 whereas a few (0.85%) scored low marks ranging from 0.0 to 6.5. The indicates had a good performance in this question.

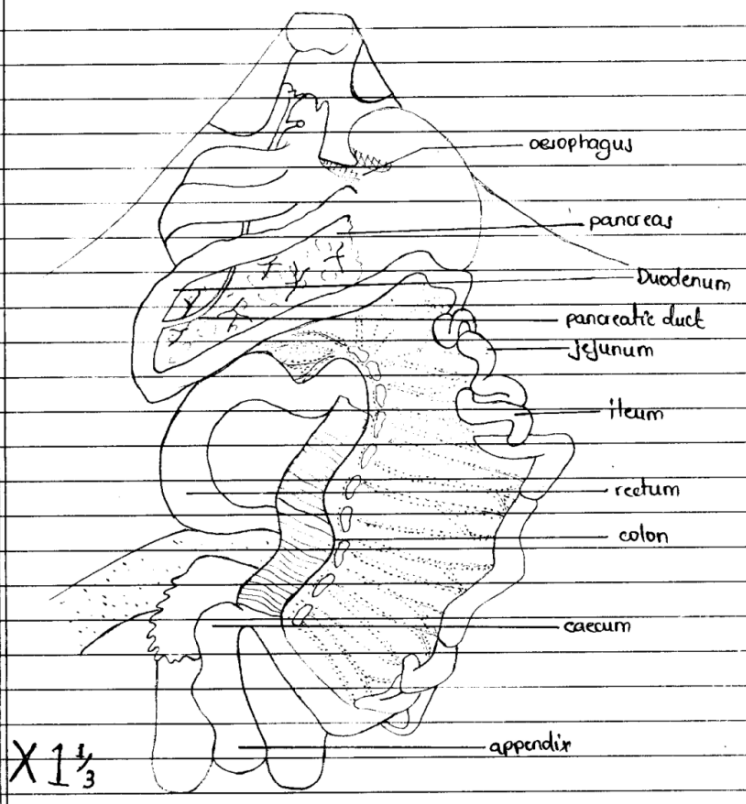
Further analysis shows that the candidates who scored high marks (12.0 - 20) in all three alternatives 3A, 3B and 3C demonstrated adequate competence in the topic of Comparative Studies of Natural Groups of Organisms. They had sufficient knowledge about the dissection of small animals, arthropods and frog. That is why they fully displayed the required system, thus deserving to get all the 5 marks allocated to the on sport

assessment. In addition, they drew correct diagrams of their dissections with correct labels. On top of that the captions and magnification were correct and appropriate to the diagrams.

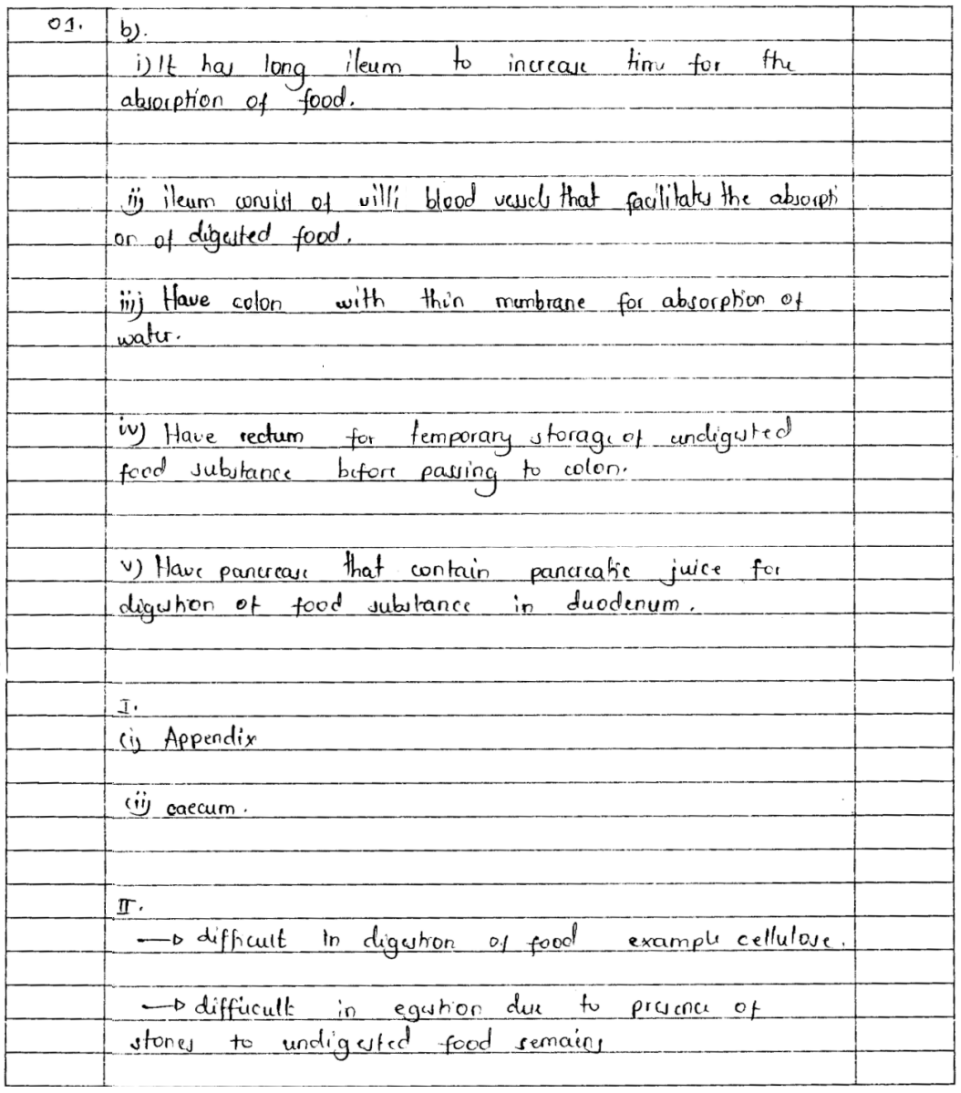
In Biology 3A, the candidates managed to dissect mouse/guinea pig/rat to fully display the digestive system and drew good diagrams of their dissections in part (a). They correctly described the adaptive features of the digestive system for it to be effective. In part (c)(i) they gave correct structures of the digestive system which are more developed in a mouse/guinea pig/rat than in a human being such as appendix and cecum and in part (c)(ii) they managed to explain how the digestion of cellulose will be impaired if the cecum and appendix fail to function. These responses indicate that the candidates had mastered the skills for dissecting and drawing. Extract 17.1(a) is a sample of correct responses from one of the candidates.

A DISSECTED DIAGRAM OF SPECIMEN B MALE SHOWING, DIGESTIVE SYSTEM.

01. a)



X 1 1/3

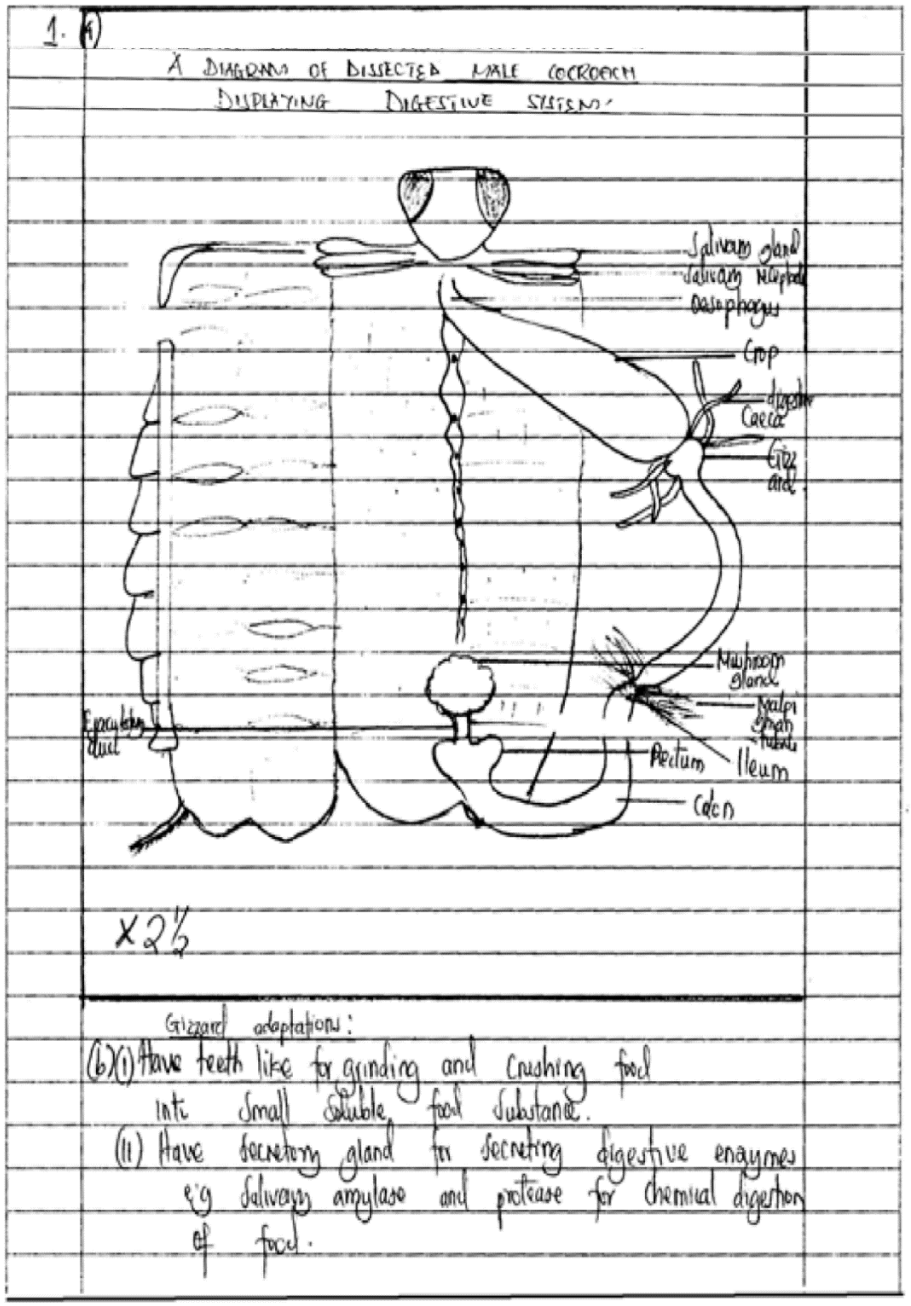


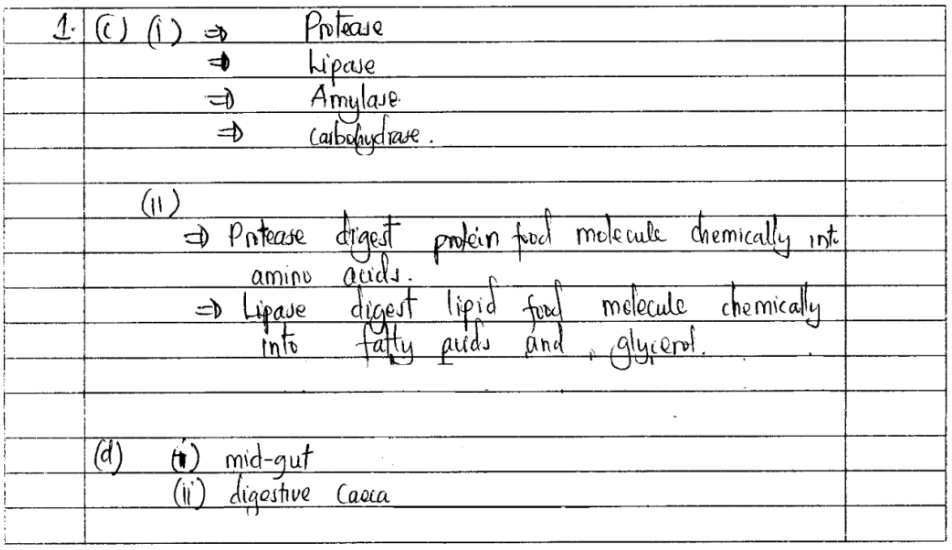
Extract: 17.1 (a): A sample of correct responses to question 1 in Biology 3A.

In Extract 17.1 (a), the candidate exhibited good drawing skills and his/her responses on the digestive system of a rat/mouse/guinea pig were correct.

In Biology 3B, the analysis indicated that candidates demonstrated good skills about dissection of the cockroach. They managed to dissect it and display the digestive system with the ileum pinned to the left side of the animal. Also, they correctly drew the diagram of the dissection of the digestive system with correct labels, captions and magnification. In addition, they correctly explained how gizzard in a cockroach is adapted to

grind food materials. Moreover, they correctly named the enzymes found in crop, including amylase, proteases, erapsin, trypsin, lipases and carbohydrases and their digestive roles. On top of that, they correctly pointed the mid-gut and digestive caeca as parts of the digestive system of cockroaches where absorption of digested food takes place. Extract 17.1(b) is a sample of candidates' correct responses.





Extract 17.1(b): A sample of correct responses to question 1 in Biology 3B.

In Extract 17.1 (b), the candidate demonstrated good drawing skills and his/her responses regarding the digestive system of a cockroach were correct.

Likewise, in Biology 3C, the candidates who got high scores demonstrated good skills on dissecting the frog/toad and displayed the urinogenital system. They drew neat diagrams of a dissected frog/toad with relevant captions and magnification. In addition, they identified the sex of frog/toad using external features. They correctly identified the size of the abdomen, presence of black patches on the thumb and copulatory pad as the indicators of the sex. Moreover, they precisely stated urea as the nitrogenous waste excreted by the adult frog/toad. On top of that, the candidates correctly stated the function of the nephrons, which secrete excretion of nitrogenous waste in frog/toads. Extract 17.1 (c) is a sample of candidates' correct responses to this question.

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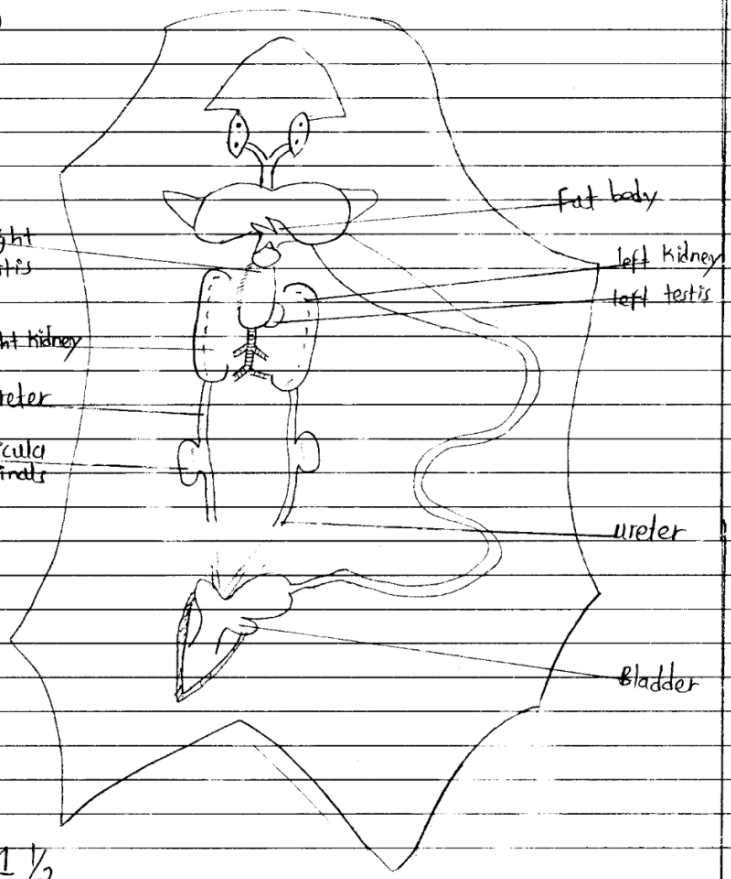
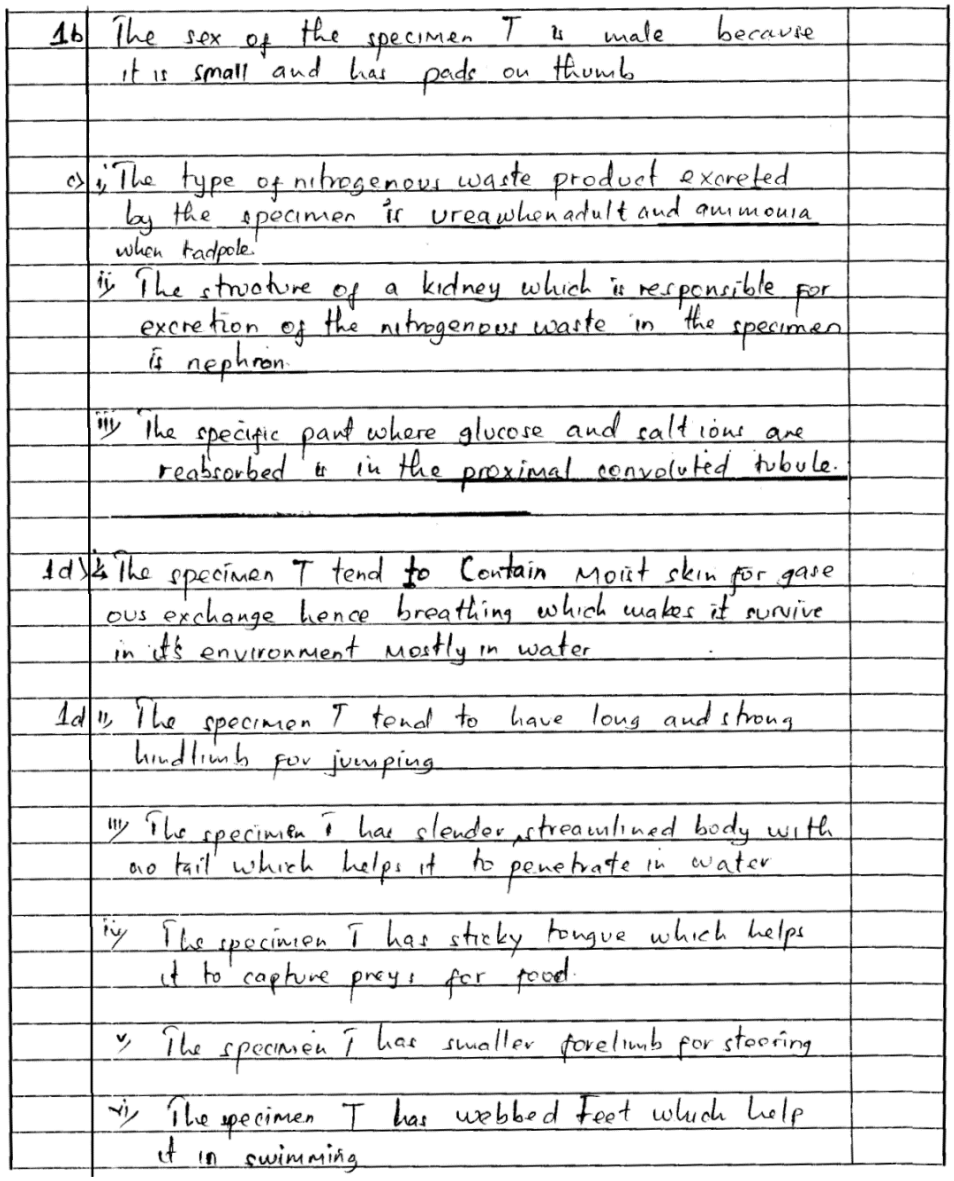
1a)



X 1 ½

A diagram of male specimen T showing urinogenital system



Extract 17.1(c): A sample of correct responses to question 1 in Biology 3C.

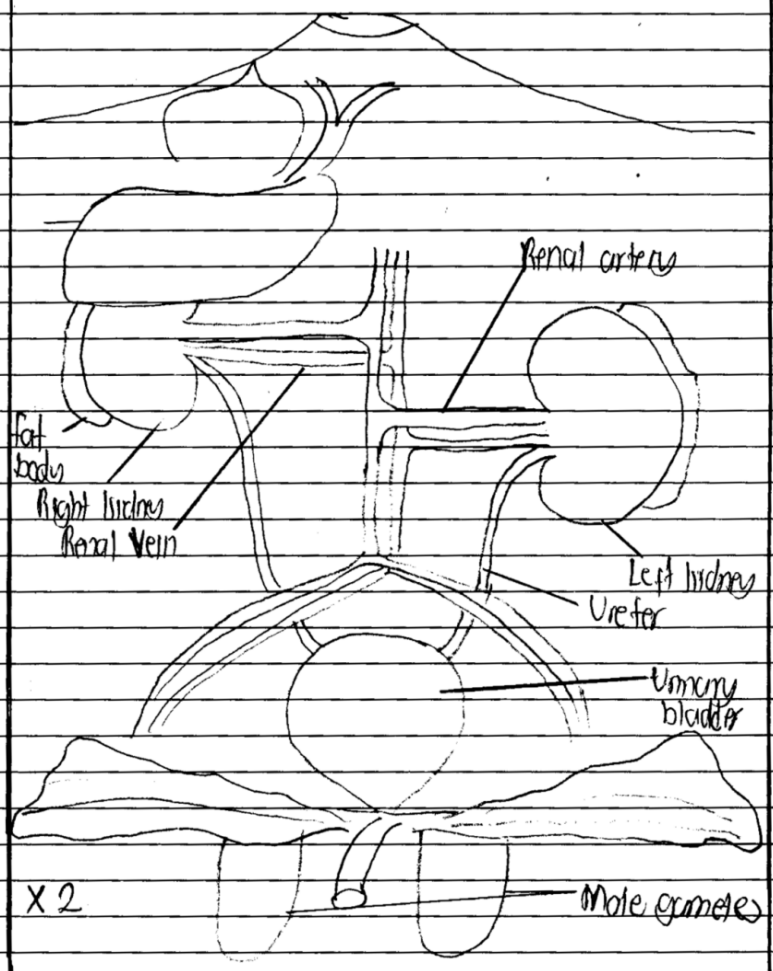
In Extract 17.1 (c), the candidate had good drawing skills and his/her responses related to the frog/toad urinogenital system were correct.

Despite the good candidates' performance of the candidates to question 1, a few (0.85%) of them scored low marks (0 to 6.5) in either alternatives Biology 3A, 3B and 3C. These candidates demonstrated either a lack of

understanding or a lack of competence required to perform dissection of the small mammal, frog and cockroach. Their dissection had some structure either damaged or not clearly displayed to convince the examiner to award them of full 5 marks allotted to on sport assessment. They either drew incorrect diagrams of their dissection without adhering to principles of drawing and consequently their diagrams were either shaded or had no captions or had their label lines crossed each other hence they lost some marks.

The analysis show that the weak performance in Biology 3A were attributed to insufficient skills in dissecting small mammals such as a mouse/guinea pig/rat. The candidates who scored 1.0 to 6.5 marks drew the diagrams with few correct labels or included the parts of other organisms on the digestive system of mouse/guinea pig/rat such as gizzard and *urethra*. In addition, they explained one to two adaptive features out of the five points required in this question. Incorrect features observed were such as *it has some parts that are more coiled to reduce the speed of food for effective digestion, it has structures for maximum absorption of the end products of digestion, it has tube for passage of food, it has blood vessels for absorption of food*. Moreover, the candidates failed to state the structure which are more developed in frog/toads than in humans. They gave incorrect responses such as *stomach, ileum and homodont teeth* instead of caecum and appendix that are more developed in herbivores. One candidate scored zero because she/he provided incorrect responses to all parts of the question. Extract 17.2 (a) is a sample of the candidates' incorrect responses to the question.

1(a) A WELL LABELLED DIAGRAM OF SPECIMEN B SHOWING THE URINOGENITAL SYSTEM IN MALE ORGANISM (RAT)



1 (b) ADAPTATIONS OF THE DIGESTIVE SYSTEM TO ITS ROLE IN SPECIMEN B

(i) It has the liver that deals with destoxyication of the food substances that have entered in the body in digestion of food

(ii) It has the stomach that digest food materials together with temporary storage of food for complete digestion to occur

(iii) It has the fat body that help in production of energy due to its breakdown in the body to allow different metabolic activities to take place

(iv) It has oesophagus for transmission of digested food particles or materials from the mouth to the stomach where it stored temporary

(v) It has ileum for maximum digestion of the food materials for ensuring the formation of the digestive products that is faeces that is released out from the body by anus in the process of defaecation

(c) (i) Fleum

(ii) Rectum

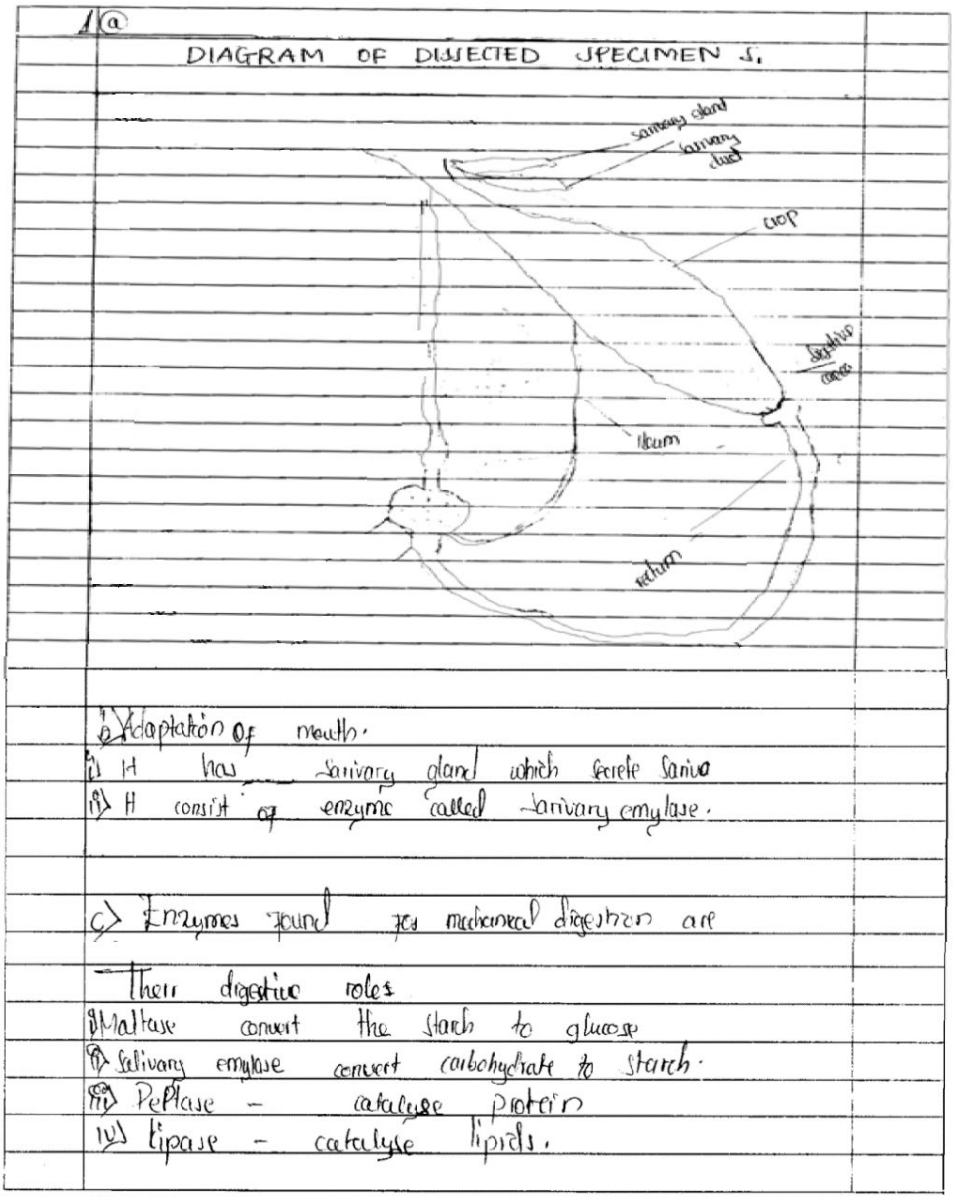
(ii) (i) failure in digestion of the food materials from the stomach

(ii) failure in formation of faeces as the end product of digestion

Extract 17.2 (a): A sample of incorrect responses to question 1 in Biology 3A.

In Extract 17.2 (a), the candidate demonstrated a lack of knowledge about the digestive system of mouse/guinea pig/rat. She/he drew an incorrect diagram of the urinogenital system instead of the digestive system. In addition, the responses regarding the adaptations of the digestive system were incorrect. Similarly, in Biology 3B, most of the candidates who scored low marks from 1 to 6.5 were not competent in dissecting the

cockroaches. They also drew incorrect diagrams or correct diagrams with the digestive system deflected to the right hand side instead of the left hand side of the animal. However, the diagrams had fewer correct labels than the nine parts required or quit incorrect labels. In addition, some of these candidates failed to state the adaptive features of gizzard associated with the mechanical digestion. They gave incorrect responses such as *it has pouches for storage of stone and sand materials which affect mechanical digestion, it has hard skin to facilitate digestion, it is well developed to receive and grind food material.* These candidates were not aware of the presence of teeth-like structures in cockroaches used for crushing of food materials. Moreover, some of them failed to identify the enzymes found in gizzard and consequently failed to precisely state their digestives roles. For example, one candidate wrote *salivary amylase is present in the gizzard for digestion*. Since these candidates lacked a good understanding of the digestive system, hence they failed to state the parts of the digestive system where absorption of the digested food takes place in a cockroach. For example, one candidate mentioned *mouth* as part of the digestive system for absorption instead of the mid-gut and digestive caeca. One candidate scored zero because she/he provided incorrect responses to all parts of the question. Extract 17.2 (b) is a part of a sample of candidates' incorrect responses.



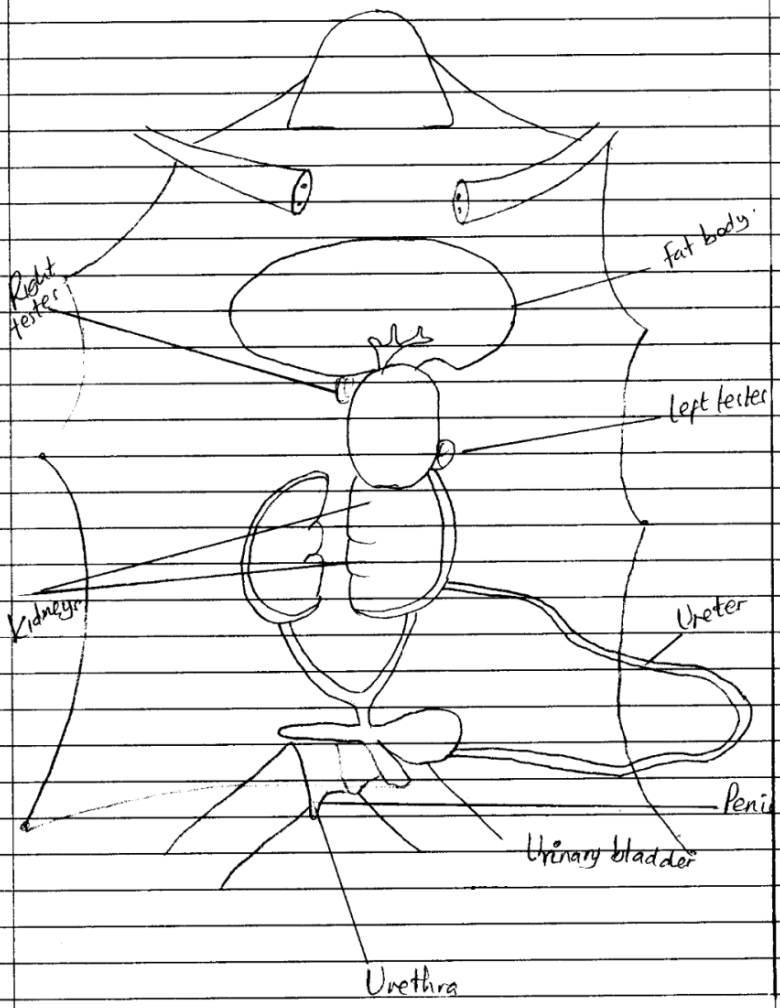
Extract 17.2(b): a sample of incorrect responses to question 1 in Biology 3B.

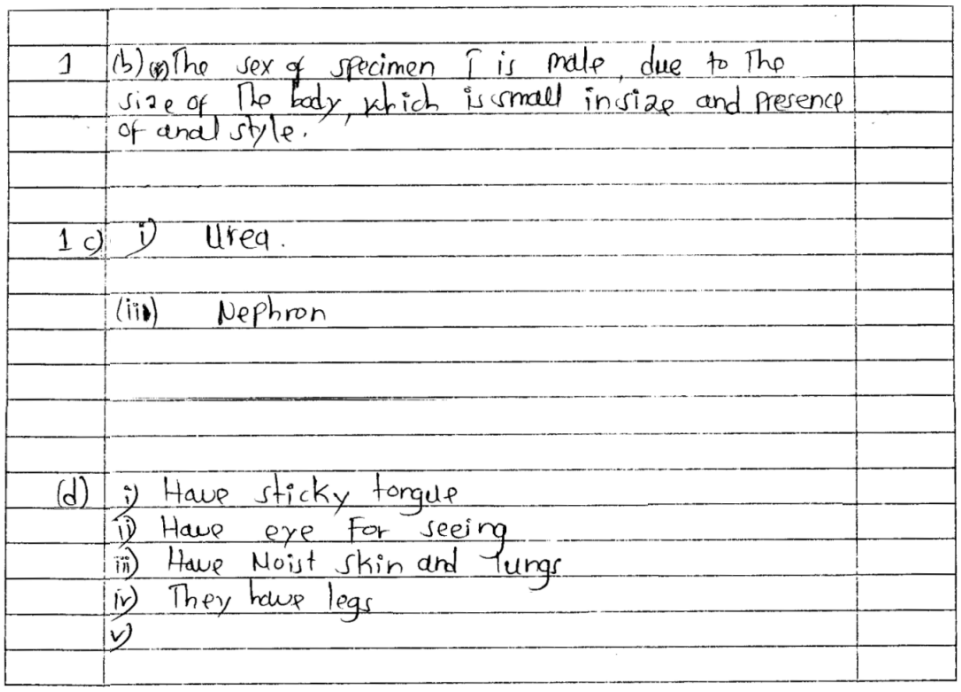
In Extract 17.2(b), the candidate wrote an incorrect caption which was not informative such as *diagram of dissected specimen S1.* Similarly, the diagram was poorly drawn. She/he also labelled the mouth as a structure of mechanical digestion in cockroach instead of gizzard. In addition, the roles of enzymes in digestion were incorrect.

In Biology 3C, the candidates who scored low marks (0 to 6.5) demonstrated inadequate competence in dissecting frog/toad and were not able to display the urinogenital system. They drew incorrect diagram in part (a). In addition, some of the candidates drew diagrams with irrelevant captions. Others wrote neither the caption nor the magnification used. Moreover, other candidates wrote wrong labels centrally to what was demanded by the question. For examples, one of the candidates wrote irrelevant caption such as *diagram of a dissected female instead* of diagram of the dissected frog/toad showing the male/female urinogenital system. These candidates were not aware that a caption should include the name of the system displayed in the dissected animal.

In part (b) (i), most of the candidates were not able to correctly identify the sex of the frog/toad by using external features. For example, one candidate wrote *the sex of specimen T is male because it is small and has thick thumb pads and penis*. Some of them gave incorrect nitrogenous waste products excreted by frog/toad in part (c). However, some candidates failed to name the part of the kidney in frog/toad responsible for excretion of nitrogenous waste. Instead, they mentioned other parts of the system such as ureter. bladder and cloaca rather than the nephron. Consequently, they failed to correctly identify the specific part in that structure where glucose and salt ions are reabsorbed in that structure. In part (d), some of the candidates failed to state the adaptive features of frog/toads which enable them to survive in their environment. For example, one candidate wrote, *it has moist skin*, *it has smaller forelimbs.* Extract 17.2 (c) is a sample of the candidates' incorrect responses to the question.

1a) THE DIAGRAM OF DISSECTED SPECIMEN T SHOWING DISPLAY OF URINOGENITAL SYSTEM.





Extract 17.2(c): Part of a sample of incorrect responses to question 1 in Biology 3C.

In Extract 17.2(c), the candidate drew a diagram of the urinogenital system of mammals instead of the urinogenital system of frog/toads as it had the urethra and penis parts and the magnification was missing. In addition, descriptions of adaptive features of the frog were incorrect.

2.2.2 Question 2: Nutrition and Transportation

In Biology 3A, the question examined the candidates' competence in carrying out biochemical tests to identify the food substances. The candidates were provided with sucrose solution labeled solution **Q** and then, were instructed to perform the following procedures;

(i) Take three test tubes and label them as test tube **A**, **B** and **C**.
(ii) Put 2 ml of solution **Q** to each of the test tubes **A**, **B** and **C**.
(iii) Add 2 ml of dilute hydrochloric acid to test tube **A** and warm the mixture. Then add 4 ml of Benedict's solution and observe the changes.

(iv) Add 2 ml of hydrochloric acid to test tube **B** and warm the mixture. Then add 3 ml of sodium hydroxide followed by 4 ml of Benedict's solution and observe the changes.
(v) Warm the solution contained in test tube **C**, then add 2 ml of Benedict's solution and observe the changes.

The candidates were also required to (a) present their observations in experiment (iii) - (v) in a tabular form, (b) name the type of food substance contained in solution **Q**, (c) give two reasons in each case for different results provided by experiment (iii) - (v) on Benedict's test and (d) briefly explain how temperature and pH affected enzyme activity and experiment (iv).

Similarly, in Biology 3B alternative the candidates were provided with 6g of sugar crystals labeled sample **M**, boiled and unboiled potatoes, water trough, knife/scalpel, scooper and water, and then they were instructed to perform the following procedure:

(i) Cut the cross section to obtain two equal halves for each Irish potato by using a knife/scalpel.
(ii) Label the 2 halves of the unboiled Irish potato as **A** and **B** respectively, and one half of the boiled potato as **C**.
(iii) Use a scooper to make the holes of about 2.5 cm deep from the cut surface for the three halves of Irish potatoes **A**, **B** and **C** while making sure that the wall of the holes must be thin (about 5 - 8 mm thick) to create a semi-permeable membrane and not damaged.
(iv) Put 3 g of sample M in each hole of **B** and **C** while keeping hole **A** empty.
(v) Place all the three Irish potatoes in a trough.
(vi) Put water in a trough until the Irish potatoes are half immersed. Carefully observe the experiment and note the set up and the level of water at the beginning.
(vii) Leave the experiment for 30 minutes thereafter observe the experiment again and note the changes.

The candidates were also required to (a) state the changes observed after 30 minutes of the experiment, (b) explain how the solute potential in hole **A**, **B** and **C** acted to bring about the observed results of the experiment, (c) explain the necessity of potato **A** for this experiment and (d) explain the six ways in which the investigated process is important in nature.

Likewise, in Biology 3C the candidates were provided with 2% hydrogen peroxide solution and fresh liver tissue. Then, they were required to carry out a guided experiment to investigate the reaction of hydrogen peroxide with enzymes (termed as substance **X**) present in the liver tissue. Then, they were instructed to perform the following procedures:

(i) Label three test tubes 1, 2 and 3.
(ii) Cut the liver tissue to obtain three cubes of about 1 cm^3.
(iii) Place one of the cube in test tube 1. Add 2ml of hydrogen peroxide solution. Observe the changes.
(iv) Take the second cube of the liver tissue and grind it. Place the ground liver in test tube 2. Add 2 ml of hydrogen peroxide in the test tube. Observe the changes.
(v) Take the third cube of the liver tissue and grind it. Place the ground liver in test tube 3. Boil it and allow it to cool. Add 2 ml of hydrogen peroxide solution, and then observe the changes.

The candidates were required to (a) present their observations of test tubes 1, 2 and 3 in tabular form and give reasons for the observed changes, (b)(i) identify a cellular organelle where substance **X** can be found (b)(ii) name the biochemical reaction catalyzed by substance **X** in the liver, (c) state the purpose of grinding and boiling the liver and (d)(i) write the balanced chemical equation for the reaction between substance **X** and hydrogen peroxide and (d)(ii) state the biological significance of the reaction in living organisms.

The question was attempted by 30,469 (100%) candidates whereby 37.32 per cent scored low marks ranging from 0.0 to 5.5. The candidates who scored average marks ranging from 6.0 to 8.5 were 31.31 per cent and 31.37 per cent scored high marks ranging from 9.0 to 15. The distribution of the candidates' score is presented in Figure 18.

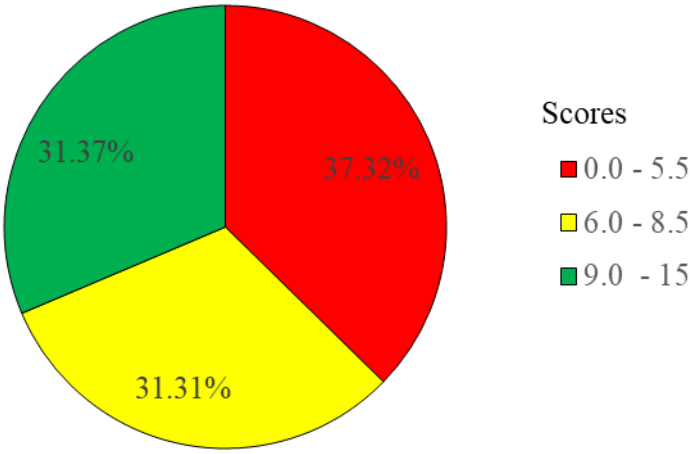


Figure 18: *Distribution of Candidates' Scores on Question 2*

Figure 18 shows that the candidates' general performance on this question was good since more than half (62.68 %) of them passed.

The analysis of the candidates' responses in Biology 3A reveals that the candidates who scored (9.0 to 15.0) marks were competent in performing food test experiments. These candidates demonstrated mastery of the food testing skills as they managed to make correct observations and correct interpretation of colour changes of the non-reducing sugar, the food substance that was present in the sucrose solution. These candidates were knowledgeable of the correct procedures of the Benedict' test, which helped them to identify the steps skipped in each experiment (iii) and (iv). Also, they were aware of the basis of Benedict's test which helped them to give a correct justification of the differences in the observed colours in experiment (iii) and (iv) as well as the effects of pH value and temperature required to break glyosidic bonds. Hence, they precisely explained the effect of temperature and pH to experiment (v). Extract 18.1(a) is a sample of the candidates' correct responses to the question.

2(a)	REPORT OF THE EXPERIMENT.	
	EXPERIMENT	OBSERVATION.
	(iii) 2ml of dilute hydrochloric acid were added to test tube A and the mixture was warmed. Then, 4ml of Benedicts were added.	The solution in test tube A retained blue colour of Benedicts solution, though the colour was a little bit lighter.
	(iv) 2ml of dilute hydrochloric acid were added to test tube B and the mixture was warmed. 3 drops of sodium hydroxide solution were added followed by 4ml of Benedicts solution.	The solution in test tube B turned into yellowish orange colour upon addition of Benedicts solution.
	(v) The solution contained in solution C was warmed and then 2ml of Benedicts solution were added.	The solution retained the blue colour of Benedicts solution.

2(b) Non-reducing sugar (sucrose)

(c) Experiment (iii)

Reasons:

(i) The solution was acidic since it were not neutralised, dilute hydrochloric acid which was in it. But reduced sugars were present.

(ii) Benedicts solution was not reduced due to absence of neutral medium. Therefore, its colour was retained, Although it contained non reducing sugars.

Experiment (iv)

Reasons:

(i) The solution was neutral since it was neutralised by sodium hydroxide solution. Therefore, hydrochloric acid was neutralised and it contained non-reducing sugars.

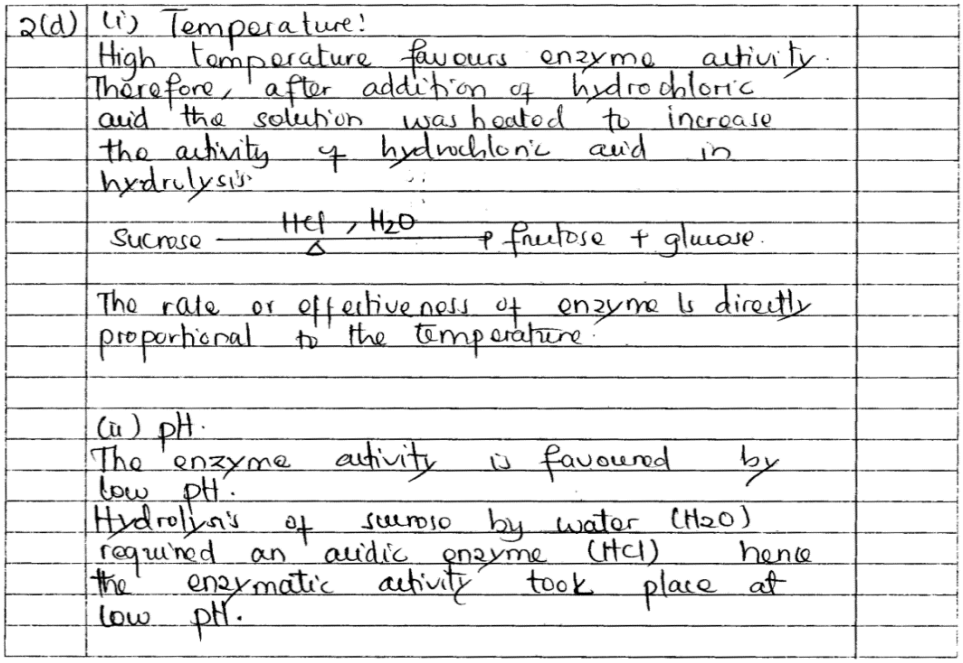
(ii) Benedicts solution was reduced by the solution since the medium was both neutral and warm, and it contained reducing sugars.

Experiment (v)

Reasons:

(i) No any hydrolysis took place in the solution due to absence of dilute hydrochloric acid, hence the solution was still non-reducing.

(ii) Benedicts solution was not reduced by this solution due to absence of reducing sugars. Therefore the colour of Benedicts solution was retained.


2(d) (i) Temperature:
High temperature favours enzyme activity. Therefore, after addition of hydrochloric acid the solution was heated to increase the activity of hydrochloric acid in hydrolysis.

Sucrose $\xrightarrow[\Delta]{HCl\ ,\ H_2O}$ fructose + glucose.

The rate or effectiveness of enzyme is directly proportional to the temperature.

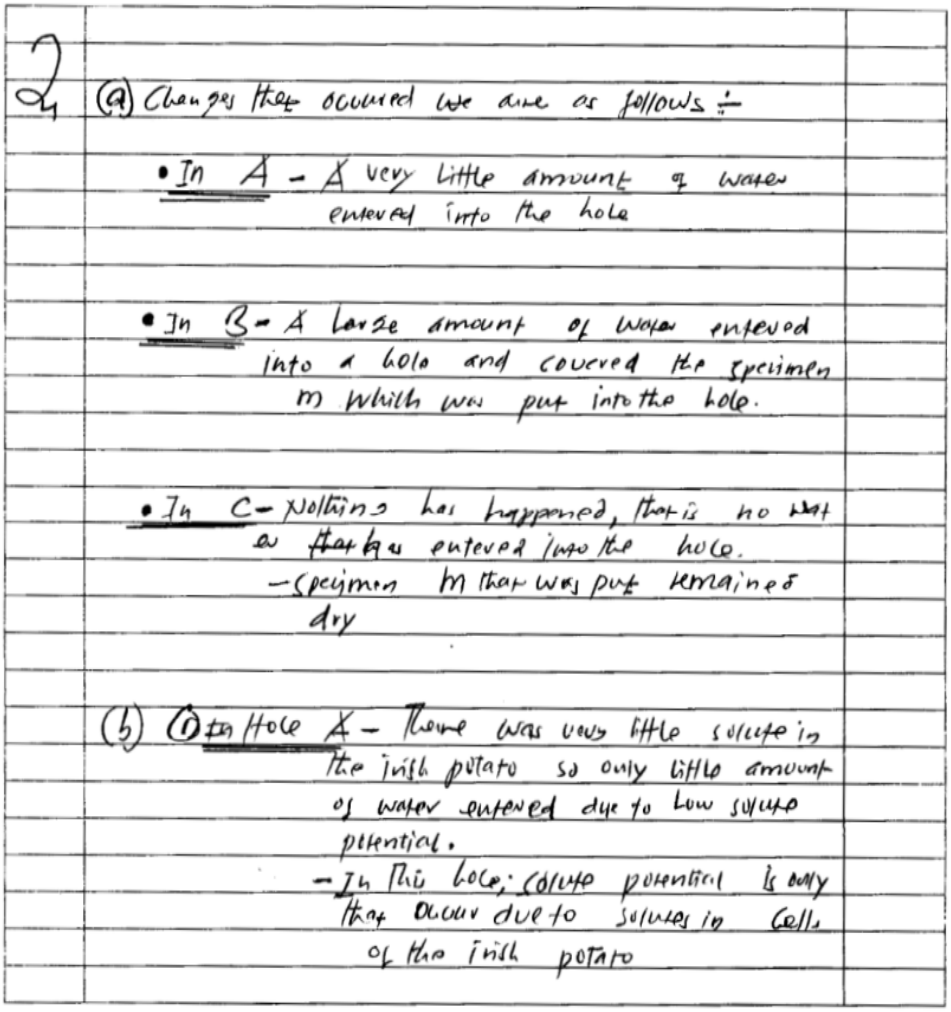
(ii) pH.
The enzyme activity is favoured by low pH.
Hydrolysis of sucrose by water (H_2O) required an acidic enzyme (HCl) hence the enzymatic activity took place at low pH.

Extract 18.1 (a): A sample of correct responses to question 2 in Biology 3A.

In Extract 18.1 (a), the candidate recorded the observations correctly. Also, she/he correctly explained the effects of pH and temperature on the workability of Benedict's solution. As well the responses to other parts of the question were correct.

Likewise, in Biology 3B, the candidates who scored from 9.0 to 15.0 marks were competent in conducting osmosis experiments in plant tissues as they made correct observations after 30 minutes. They managed to identify the decreased volume of distilled water in the water trough, very small rise in the hole of **A**, rise of water in the hole of potato **B** and in hole of potato **C**, the volume remained the same. They gave clear explanation about the solute potential in relation to the observed results. These candidates noted that the water in **A** slightly rose because the solute potential in the cell sap was slightly higher than in water in the trough. The rise in level of water in **B** indicated that the solute potential in a hole was higher than in the trough. Thus, water in the trough moves along a gradient between the relatively higher water potential to lower water potential. Potato **C** had dead cells. thus the pressure potential was disabled by boiling. Moreover, they were able to state the necessity of potato **A** for this experiment as it acted as a

control experiment in which all conditions necessary for the movement of water in a plant cell were available. Furthermore, they correctly explained the importance of osmosis in plants and animals. Extract 18.1(b) is a sample of the candidates' correct responses to the question.



2 (b) (M) Hole B; The specimen M that was put to increased solute potential, that is, it has lowered water potential, so a very large amount of water entered by osmosis due to created concentration gradient between irish potato and water in trough.

(M) Hole C; When Irish potato was boiled its cells are already damaged so, the osmosis has not happened as cells are already killed. As we know that osmosis occur only in the living cells.

(C) Necessity of potato A

- It helps to compare the effect of solute potential in osmosis process. Where by in it there was no specimen M. but a very little solute potential was created by its cells, hence this has lead to little water entered to it. But in potato B there was an extra solute potential due to specimen M, so osmosis was highly observed.

2 (d) The process is called – Osmosis

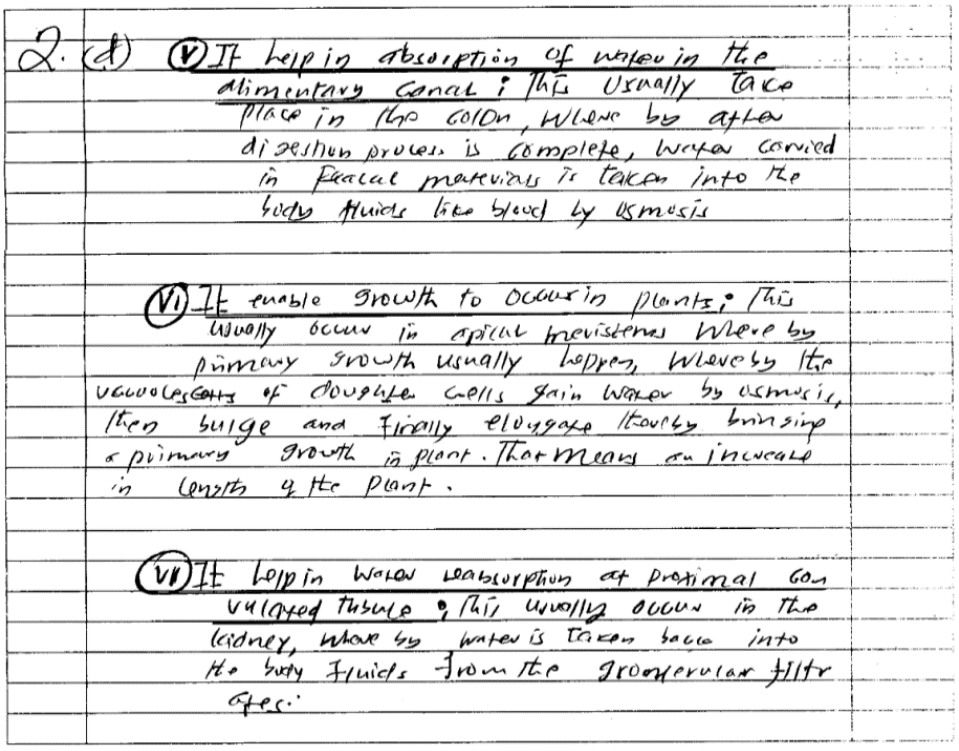
Importance of Osmosis in nature

(i) It help in water uptake by plant roots: This imply that after mineral salts are actively taken up by plants roots, water enter by osmosis into the plant roots due to low water potential in plant roots than in soil solution.

(ii) It help in opening and closing of stomata: This means that in guard cells there is high solute potential so water will enter into it by the osmotic process thereby opening stomatal aperture.

(iii) It maintain turgidity in plant cells: This imply that if water enter into the plant cells by osmosis it exert a turgor pressure that maintain cells shape.

(iv) It enable movement of water and other substances from one cell to another: This imply that if one cell has low water potential water will enter into it by osmosis, but if it has high water potential other solutes will enter into it.



Extract 18.1(b): A sample of correct responses to question 2 in Biology 3B.

In extract 18.1 (b), the candidate recorded the observation correctly. Also, she/he gave correct explanation on the observed results and the workability of solute potential in living tissues. In addition, his/he provided a correct explanations of osmosis.

Further analysis revealed that in Biology 3C, the candidates who scored from 9.0 to 15.0 demonstrated competent in performing experiment pertaining to enzymes activities. They made correct observations and gave correct reasons to support their answers. In addition, they correctly identified the cellular organelle in which catalase enzymes are found particularly the microbodies or peroxisomes. Also, they pointed detoxification as the biochemical reaction catalysed by catalase enzymes in the liver tissues and gave the purpose of grinding as increases the surface area for enzymic reaction whereas boiling created heat which affected the enzymes. Moreover, the candidates wrote a correct balanced equation of the reaction between catalase enzyme and hydrogen peroxide and gave correct biological significance of the reaction. Extract 18.1(c) is a sample of the candidates' correct responses to the question.

02. (a). TABLE OF RESULT.

TEST TUBE	OBSERVATION	REASONS.
1.	Effervescence is observed	Hydrogen peroxide react with catalase to produce oxygen ga.
2	High effervescence is observed	High rate of reaction of H_2O_2 with catalase to produce oxygen gas
3.	NO effervescence	Enzyme (catalase) is denatured hence no reaction with H_2O_2.

(b) i. Substance X is found in Microbodies. (Peroxisome)

ii. The biochemical reaction catalysed by substance X is Detoxification or Decomposition reaction.

(c) i. Grinding the liver.

To increase the surface area of the liver for rapid rate of the chemical reaction that led to High effervescence.

ii. Boiling the liver.

To denature the enzyme (catalase) that led to NO reaction with Hydrogen peroxide and hence no effervescence is observed

H_2O_2 + Boiled liver ⟶ No reaction.

(d) i. Balanced chemical equation.

$2H_2O_2$ + catalase ⟶ $2H_2O + O_2$

ii. Biological significance of the reaction in living organisms is to remove toxic substances from the cell (Detoxification)

Extract 18.1(c): A sample of correct responses to question 2 in Biology 3C.

In extract 18.1 (c), the candidate correctly recorded the observations in tabular form. Also, she/he gave correct explanation on purpose of grinding the liver tissue in relation to the reaction and gave correct balanced chemical equation.

Despite the candidates' good performance on this question, the analysis shows that 37.32 per cent of the candidates in either of the alternative 3A, 3B or 3C scored low marks (0.0 - 5.0). This performance was an outcome to either inadequate or lack of knowledge of the concepts tested. In Biology 3A, the candidates demonstrated inadequate knowledge about food test experiments. They made incorrect observations or wrote incorrect colours. Examples of incorrect observations were *the solution not changed*, *the solution acquired the colour of Benedict's solution, the solution retained the colour of Benedict's solution, the mixture retained the colour of Benedict's solution* instead of blue colour. These responses indicated that the candidates lacked knowledge about the colour changes in part (a). Likewise, they had insufficient knowledge of making relevant interpretation of the colours which could aid in identification of the non-reducing sugar which was present in sucrose solution.

Moreover, the candidates had insufficient knowledge of the procedures of Benedict's test and about the basis of Benedict's reaction as they failed to provided correct reasons for the observed changes in experiment (iii) to (v). These candidates were unaware that the blue colour observed in experiment (iii) was due to presence of hydrochloric acidic which hindered the ability of reducing sugar to reduce copper (II) ions in Benedict's solution. Also, lacked understanding that experiment (iv) had complete procedures, therefore, free aldehyde and ketone present in solution had a chance for successive reduction of copper (II) ions into copper (I) ion, which had brick red colour.

In addition, the blue colour observed in experiment (v) indicated no reaction because the solution was purely non-reducing sugar thus not expected to show positive result with Benedict's solution. However, some steps for testing non-reducing sugar were skipped including the hydrolysis of non-reducing sugars into reducing ones which hindered reduction of copper (II) ions found in Benedict's solution to copper (I) ions. This knowledge was essential to help the candidates to respond correctly in part (c) of the question which was poorly done by most of the candidates. For the example, one of the candidates wrote *the colour was different because* of *absence of proper conditions for converting the solution to form colour appearance*, *the colour observed different because non reducing sugar was not present in experiment (iii) and (iv), observed difference was due to using Benedict's reagent in each stage while other required chemical*

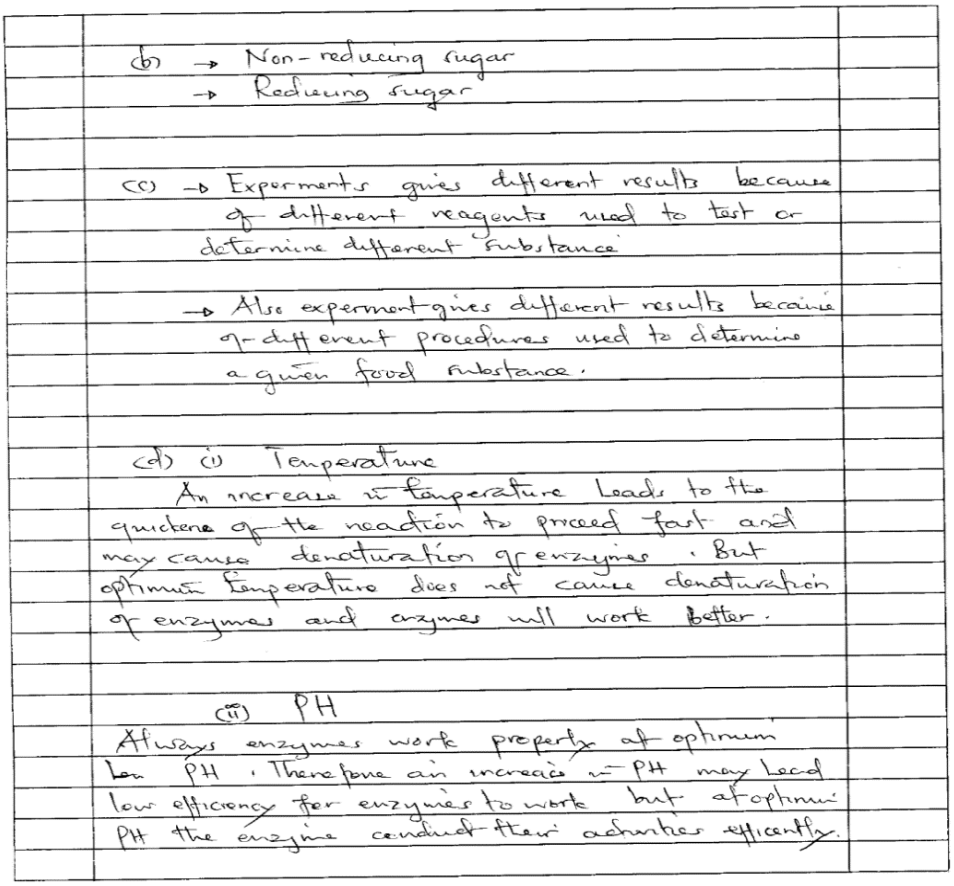
reagents were missing. This response signifies that the candidate was not aware of the reducing property of simple carbohydrate and the principles for testing it. They failed to recognize that Benedict's solution contains cupric ions (Cu^{2+}) which are reduced to cuprous ions (Cu^{+}). These cuprous form copper (1) oxide which precipitate out as a brick-red coloured compound. Therefore, in order to obtain positive results, the complex sugars such as sucrose sugar must be hydrolysed by using hydrochloric acid into glucose and fructose. Glucose contains an aldehyde functional group whereas fructose contains a ketone functional group. Sodium hydroxide solution is required to neutralize the acid and allow the release of free electrons from aldehyde and ketone groups of sugars to reduce copper (II) ions in Benedict's solution to copper (I) ion.

Moreover, the candidates lacked knowledge about the effects of temperature and pH which lead to loss of marks. Examples of incorrect responses given were such as *under low temperature the reaction is high hence cause the rate of biological reaction to occur at high rate*, *high temperature is required to kill the cells of the substance present in the solution, when the temperature increase the solution is in good environment to change from blue to brick red.* These candidates were not aware that temperature in Benedict's test was required to provide the kinetic energy to speed up the rate of breaking the glycoside bonds.

Likewise, the candidate demonstrated poor understanding of the effects of neutralising the acidic solution to slightly alkaline which provides a conducive environment for a positive Benedict's test. Extract 18.2(a) is part of a sample of the candidates' incorrect responses to the question.

Q2. (a)

	Experment	observation
	2ml of the sample solution	
(iii)	Q was put into a test tube	The colour
	A, then 2ml of dilute	was changed
	hydrochloric acid was added	into series
	and then the mixture warmed	form
	and followed by addition of	
	4ml of Benedict's solution	
(iv)	2ml of a sample solution Q	There were
	was placed into a test tube	series of colour
	B, then 2ml of dilute	from yellow,
	hydrochloric acid was added	blue, green
	and the mixture warmed. Then	orange and
	three-drops of sodium hydroxide	finally brick
	solution added followed by	red
	4ml of Benedict's solution	
	2ml of a sample solution Q	There was no
(v)	was put into a test tube C	colour change,
	then ~~it~~ warmed 2ml of Benedict's solution	since
	was added to the warmed	colour was
	solution Q	retained as
		initial colour


(b) → Non-reducing sugar
→ Reducing sugar

(c) → Experments gives different results because of different reagents used to test or determine different substance.

→ Also experment gives different results because of different procedures used to determine a given food substance.

(d) (i) Temperature
An increase in temperature leads to the quickens of the reaction to proceed fast and may cause denaturation of enzymes. But optimum temperature does not cause denaturation of enzymes and enzymes will work better.

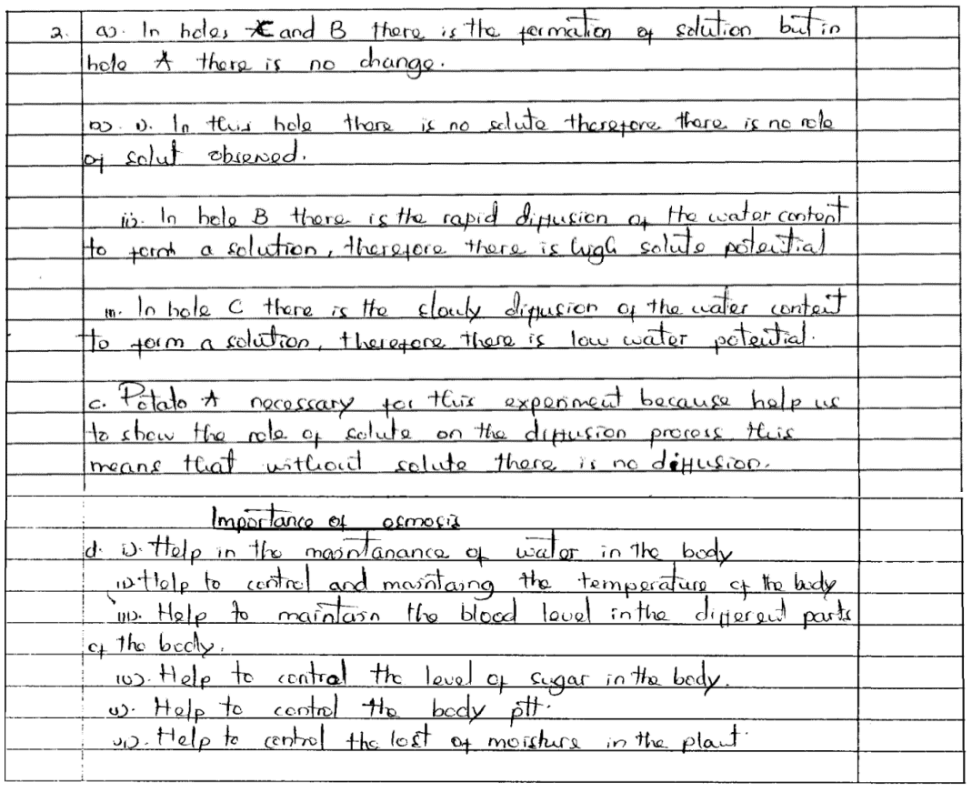
(ii) PH
Always enzymes work properly at optimum ion PH. Therefore an increase in PH may lead low efficiency for enzymes to work but at optimum PH the enzyme conduct their activities efficently.

Extract 18.2 (a): A sample of incorrect responses to question 2 in Biology 3A.

In Extract 18.2 (a), the candidate poorly responded to all parts of the question by giving incorrect responses. For example, she/he wrote *the colour changed into series form, there was no colour change since the colour was retained.*

Some candidates who scored low marks (0.0 – 5.0) in Biology 3B were incompetent in conducting experiments which involved transport of materials in living organisms. Also, they were not able to correctly report experimental observations. For example, one candidate wrote *hole A remained as before, hole B became hardened and turgid, hole C became more soft and smooth*. As a result, she/he failed to correctly explain how solute potential in the potato holes affected the experimental results. Another candidate wrote *solute potential of hole A remained as before due to the fact that glucose in water was present but also in potato A there was glucose, the solute potential became balanced, this is called isotonic*

solution. In addition, the candidates incorrectly explained the necessity of potato A in the experiment. For example, one of them wrote *potato A is necessary because it help to determine the aim of the experiment which is investigation about osmosis*. Extract 18.2(b) is a sample of the candidates' incorrect responses to the question.



2. a) In holes A and B there is the formation of solution but in hole A there is no change.

b) i. In this hole there is no solute therefore there is no role of solut observed.

ii. In hole B there is the rapid diffusion of the water content to form a solution, therefore there is high solute potential

iii. In hole C there is the slowly diffusion of the water content to form a solution, therefore there is low water potential.

c. Potato A necessary for this experiment because help us to show the role of solute on the diffusion process this means that without solute there is no diffusion.

Importance of osmosis

d. i. Help in the maintanance of water in the body

ii. Help to control and maintaing the temperature of the body

iii. Help to maintain the blood level in the different parts of the body.

iv. Help to control the level of sugar in the body.

v. Help to control the body pH.

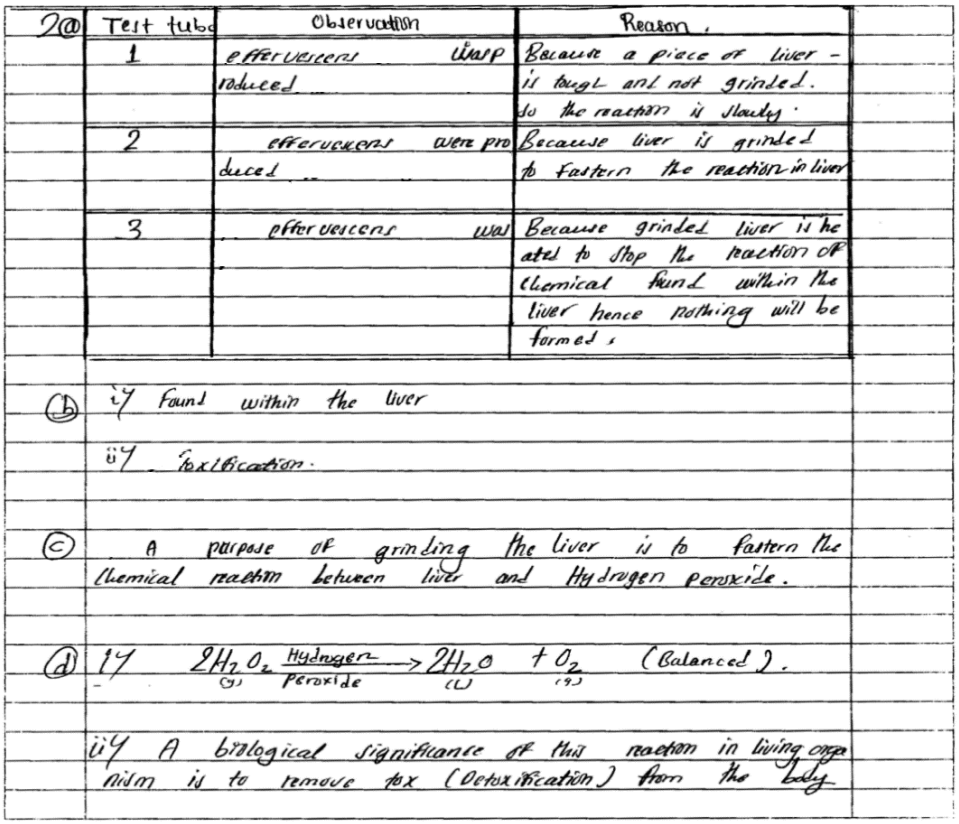
vi. Help to control the lost of moisture in the plant

Extract 18.2(b): A sample of incorrect responses to question 2 in Biology 3B.

In Extract 18.2 (b), the candidate responded incorrectly to both parts of the question. For example, she/he wrote that osmosis controls water, sugar and pH in the body.

Similarly, candidates who scored from 0.0 to 6.5 in Biology 3C demonstrated incompetent skills of conducting experiments pertaining to enzymes activities as they failed or provided correct observations with partial reasons for changes in part (a). They also failed to name the enzymes and the organelle in which they were found. In the same way, they failed to construct a balanced chemical equation for the reaction of hydrogen peroxide and catalase enzymes. Most of these candidates wrote

incorrect or unbalanced chemical reactions. For example, one candidate wrote the equation as $X + Catalase \longrightarrow H_2O_{(l)} + O_{2\ (g)}$ and another candidates wrote $X + H_2O_2 \longrightarrow H_2O + O_2$ and $H_2O + H_2O_2 \longrightarrow H_2O + O_2$. This indicates that the candidates lacked knowledge about the decomposition of hydrogen peroxide. Hence, they were not able to explain correctly the significance of the reaction. They wrote incorrect responses such as *to clean dead cells, to engulf unwanted material, to destroy microorganisms invading the body* instead of catalase enzyme helps to catalyse decomposition of toxic waste H_2O_2 into less harmful product water (H_2O) and oxygen (O_2). Extract 18.2(c) is a sample of incorrect responses to the question.



2@	Test tube	Observation	Reason
	1	effervescens was reduced	Because a piece of liver - is tough and not grinded. So the reaction is slowly.
	2	effervescens were produced	Because liver is grinded to fastern the reaction in liver
	3	effervescens was	Because grinded liver is heated to stop the reaction of chemical found within the liver hence nothing will be formed.

(b) i) Found within the liver

ii) Toxification.

(c) A purpose of grinding the liver is to fastern the chemical reaction between liver and Hydrogen peroxide.

(d) i) $2H_2O_2 \xrightarrow[\text{Peroxide}]{\text{Hydrogen}} 2H_2O + O_2$ (Balanced).
(g) (l) (g)

ii) A biological significance of this reaction in living organism is to remove tox (Detoxification) from the body

Extract 18.2(c): A sample of incorrect responses to question 2 in Biology 3C.

In Extract 18.2(c), the candidate wrote incorrect responses to all part of the question. For example, he/she used hydrogen peroxide in place of peroxidase enzyme in the equation of chemical reaction.

2.2.3 Question 3: Principles of Classification and Comparative Studies of Natural Groups of Organisms

Question 3 in alternative paper 3A, 3B and 3C measured the candidates' competence in principles of classifying organisms into their respective taxonomic groups. In Biology 3A, the candidates were provided with specimens P_1 (Crab), P_2 (Grasshopper), P_3 (Bee), P_4 (Spider) and P_5 (Millipede). Then, they were required to carefully observe them and to (a) give two reasons why specimens P_1, P_2, P_3, P_4 and P_5 were formally placed in the same phylum, (b) use the classification key provided to identify specimens P_1, P_2, P_3, P_4 and P_5. The Key was as follows;

1a Wings present……2
1b Wings absent…….3
2a Outer wings are soft……_____
2b Outer wings are harder ……_____
3a Have numerous similar limbs.…….....____
3b Similar limbs absent …….……....4
4a The first appendage bear prehensile chelicerae……_____
4b The first appendage serves as jaw……_____

The candidates were also required to (c) identify the structures concerned with gaseous exchange in each of the specimen P_1, P_2, P_3, P_4 and P_5, (d) outline two common adaptive features for the structures you named in (c) and (e) draw a large, neat and well labelled diagram of specimen P_1.

Similarly, in Biology 3B, candidates were provided with specimens S_2 (yeast), S_3 (Housefly) and S_4 (Beetle). Then, they were required to study them carefully and then to (a) name the phylum in which the specimen S_3 and S_4 belong, (b) classify the specimen S_2, S_3 and S_4 to class level, (c) identify features in both specimen S_3 and S_4 which justify their representation of their respective classes, (d) state where specimen S_3 is found naturally, (e) give ways in which specimen S_2 is useful for economic development and (f) explain to how specimen S_4 adapted to its environment.

Likewise, in Biology 3C, candidates were provided with specimen Z_4 (Grasshopper), Z_5 (Crab) and Z_6 (Cockroach). Then, they were required to observe them and (a)(i) explain why it is not advised to identify specimens Z_4, Z_5 and Z_6 by their common names (a)(ii) identify the habitat of each of

the specimen Z_5 and Z_6, (b) classify each of the specimen Z_4, Z_5 and Z_6 to Class level, (c)(i) identify two observable differences between specimen Z_5 and Z_6 at Class level (c)(ii) state three observable features shared by specimen Z_5 and Z_6 and (d) give three observable features of specimen Z_6 at Class level.

This question was attempted by 30,469 (100%) candidates from all alternatives 3A, 3B and 3C of which 78.05 per cent scored from 9.0 to 15.0. Further analysis of their performance is shown in Figure 19.

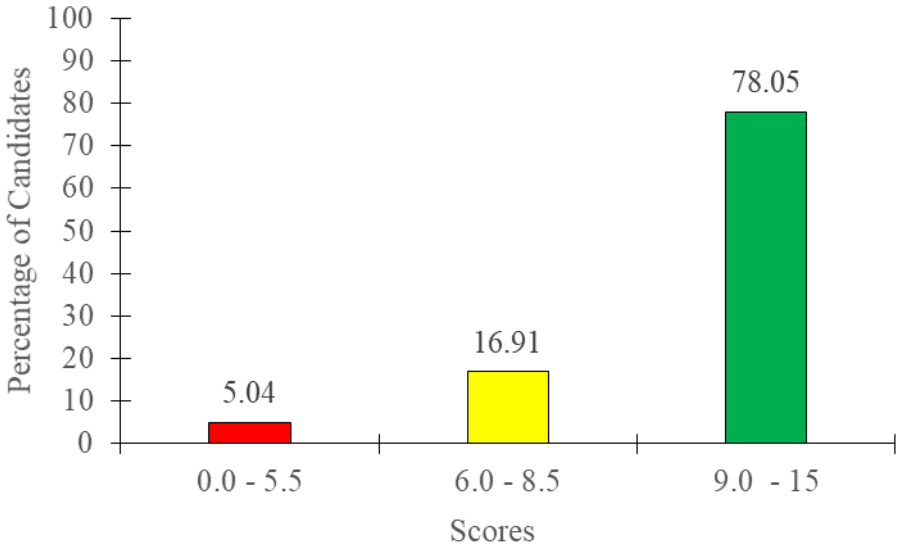


Figure 19: *Distribution of Candidates' Scores on Question 3*

Figure 19 shows that the majority (94.96%) of the candidates passed while a few (5.04%) scored low marks ranging from 0 to 5 marks. This indicates that the general performance in this question was good.

The analysis shows that the good performance in this question was an outcome of adequate skills in classifying living organisms among the candidates. Hence, the majority of candidates who attempted this question had their responses well clarified. In 3A, the candidates who scored from 9.0 to 15 marks demonstrated adequate understanding of the concept tested. They were aware of the distinctive features of Phylum Arthropoda, hence

the responses about the observed features that make bee, spider and millipede to be placed in the same phylum. They also, managed to use dichotomous key to identify the specimen as required. In addition, they correctly identified the structures concerned with gaseous exchange in crab, grasshopper, bee, spider and millipede and gave out the correct adaptive features of each structure in part (d). Moreover, the candidates demonstrated good drawing skills by applying all principles of drawing to a diagram of a crab. Extract 19.1(a) is a sample of the candidates' correct responses to this question.

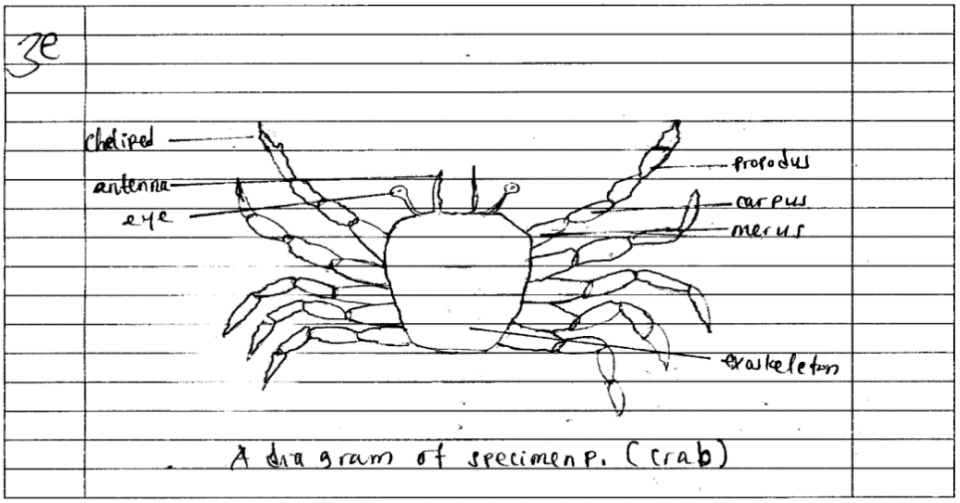
3 a) Specimen P_1, P_2, P_3, P_4 and P_5 are placed in the same Phylum due to the following reasons
i) They have chitinous or calcerous exoskeleton
ii) Both are triploblastic coelomate organism with open circulatory system. And also they have jointed paired appendages.

b)
2 a ⇒ P_3 = Bee
2 b ⇒ P_2 = Grasshopper
3 a ⇒ P_5 = Millipedde
4 a ⇒ P_4 = Spider
4 b ⇒ P_1 = Crab

c)

Specimen	Structure of gaseous exchange
P_1	Gills
P_2	tracheal system
P_3	Tracheal system
P_4	Book lung
P_5	Tracheal system

d) Adaptations
i) They are very thin for easy diffusion of gases
ii) They are moist so that gas can dissolve easily and transported in solution form



Extract 19.1 (a): A sample of correct responses to question 3 in Biology 3A.

In extract 19.1 (a), the candidates gave correct responses in all parts of the question. Also, she/he demonstrated adequate competence in drawing.

Further analysis showed that in Biology 3B, the candidates who scored high (9 to 15) marks had adequate skills to perform the classification of living organisms. They managed to identify correct distinctive features of phylum in which housefly and beetle belong in part (a). They gave correct distinctive features which place housefly and beetle in Phylum Arthropoda and gave correct kingdom, phylum and the classes in which housefly, beetle and yeast belong in part (b). In addition, they correctly gave out the features which justify the placement of houseflies and beetle into Class Insecta. Moreover, they correctly identified the natural habitat of houseflies. Furthermore, in part (e) they correctly explained the usefulness of yeast in economic development and in part (f) they precisely described correct adaptive features of beetle to its environment. Extract 19.1(b) is a sample of the candidates' correct responses.

03. a) Given

Specimens: S_2 - Yeast
S_3 - Housefly
S_4 - Beetle

a) Specimen S_3 and S_4 belong to Phylum Arthropoda

b) Classification of specimen to class level

Specimen	S_2	S_3	S_4
Kingdom	Fungi	Animalia	Animalia
Phylum	Ascomycota	Arthropoda	Arthropoda
Class	Saccharomycetes	Insecta	Insecta

c) Features that make specimen S_3 and S_4 in their respective classes

- They have three body parts that is head, thorax and abdomen
- They have three pairs of legs.
- They have one or two pairs of wings
- They have one pair of antennae
- They have three parts of mouth
- They have compound eyes.

d) Specimen S_3 is naturally found in Terrestrial habitat whereby in most cases found in places with dirt such as damp sites, toilets

03 b) Usefulness of specimen S_2 for economic development.

i) Specimen S_2 can be used in bakeries for baking different types of foods such as bread, buns doughnuts.

ii) Specimen S_2 can be used in breweries. In breweries specimen S_2 can be used for the production of alcohol and beer.

f) Adaptation of specimen S_4 to its environment.

- It has a pair of compound eyes for sight.

- It has three pair of jointed appendages and two pairs of wings that are useful in motion or movement and help to escape predator.
- It has a Mouth parts which are responsible for biting, chewing of food.

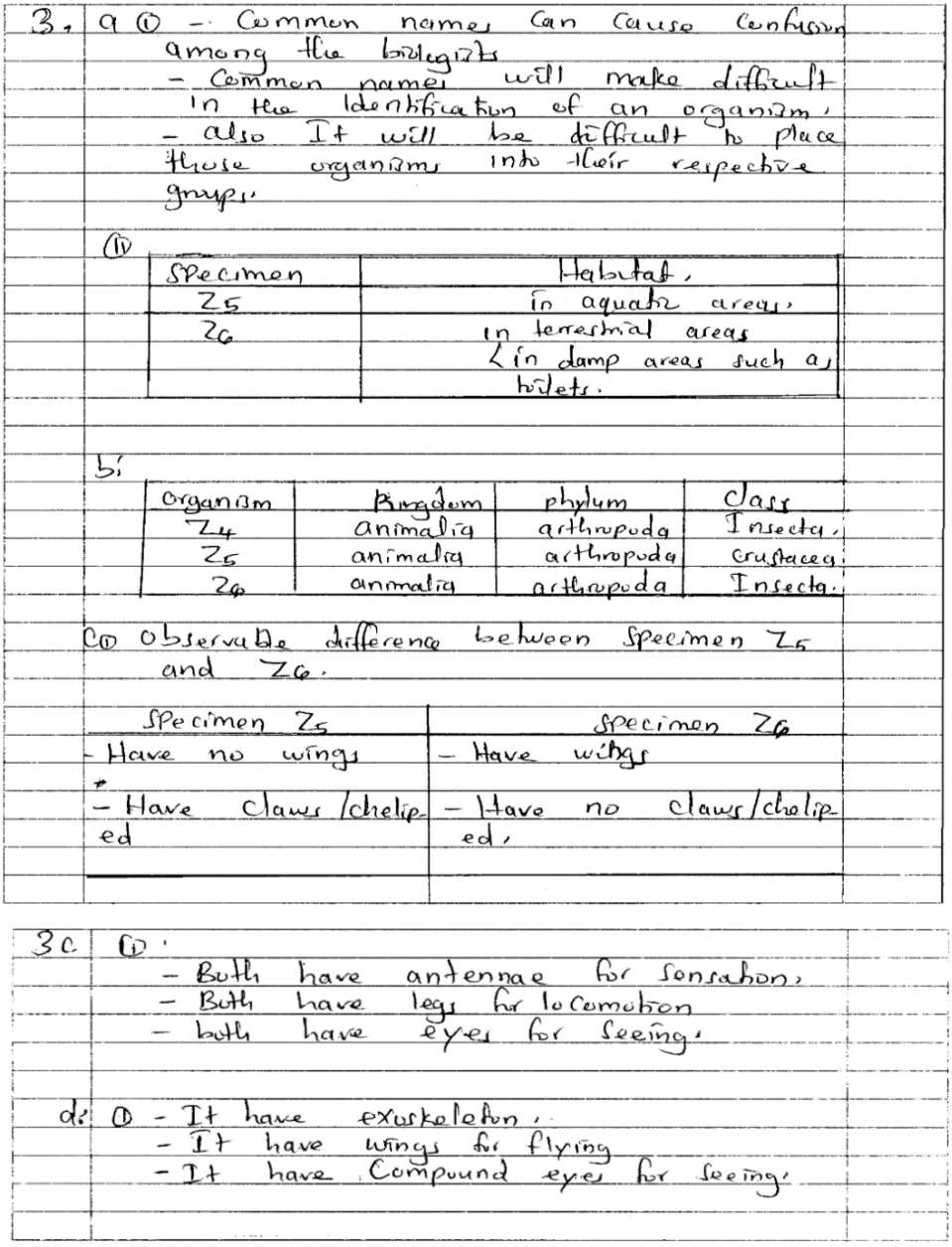
- It excrete uric acid which enable it save from excess water loss

- It possess antennae which help in increasing the sensitivity.

Extract 19.1(b): A sample of correct responses to question 3 in Biology 3B.

In Extract 19.1 (b), the candidate gave correct responses in all parts of the question. Thus, she/he demonstrated adequate competence in classifying the living organisms.

The analysis further revealed that the candidates who scored high marks in Biology 3C had adequate skills of classifying living organisms. They correctly described the distinctive features of Phylum Arthropoda. Also, their responses on the observed features of the specimens at the kingdom, phylum and classes level were mostly correct. They stated correctly the reasons for the rigidity of scientist using scientific names instead of common names, and mentioned the correct habitat for crabs and cockroaches in part (a). These candidates had adequate skills in making classification of the organisms based on their similarities and differences. This knowledge enabled them to place grasshoppers, **c**rabs and **c**ockroaches into their respective kingdom, phylum and classes in part (b). In addition, they managed to differentiate the features used to place **c**rabs in the Class Crustacea and **c**ockroaches in Class Insecta. Moreover, they managed to give differences of distinctive features that made to place grasshopper to be placed in the Class Insecta and crab into the Class Crustacea. They also identified the features of the Phylum Arthropoda in which the crabs and the grasshopper belong. Extract 19.1(c) is part of a sample of the candidates' correct responses to the question.



3. a (i) - Common names can cause confusion among the biologists
- Common names will make difficult in the identification of an organism.
- also It will be difficult to place those organisms into their respective groups.

(iv)

Specimen	Habitat.
Z5	in aquatic areas.
Z6	in terrestrial areas (in damp areas such as toilets.

b:

Organism	Kingdom	phylum	Class
Z4	animalia	arthropoda	Insecta.
Z5	animalia	arthropoda	crustacea.
Z6	animalia	arthropoda	Insecta.

(c) observable difference between specimen Z5 and Z6.

Specimen Z5	Specimen Z6
- Have no wings	- Have wings
- Have claws /chelip- ed	- Have no claws/cholip- ed.

3c (i).
- Both have antennae for sensation.
- Both have legs for locomotion
- both have eyes for seeing.

d: (i) - It have exoskeleton.
- It have wings for flying
- It have Compound eyes for seeing.

Extract 19.1(c): A sample of correct responses to question 3 in Biology 3C.

In Extract 19.1 (c), the candidate demonstrated good understanding of the concept of classification as he/she provided correct responses to all parts the question.

Although the candidates' performance on this question was good, the analysis of candidates' responses in alternative Biology 3A, 3B and 3C

indicated that a few (5.04%) of the candidates scored low marks ranging from 0 to 5.5. This weak performance was attributed to inadequate skills in classifying living organisms. Some candidates under this category gave few points than the required. On the other hand, very few (14) candidates scored 0 to 0.5 marks because they gave responses that were completely wrong. In Biology 3A, they failed to identify the phylum to which bees, spiders and millipedes belong. This signifies that they were not aware of the distinctive features of Phylum Arthropoda. However, some of them wrote incorrect spelling of scientific word. For example, one candidate misspelt the name of the phylum as athopoda instead of Arthropoda. In addition, the candidates were not able to identify the organisms using a dichotomous key in part (b) as some of them constructed a branched key instead of writing the numbers of correct leads with description that best fits the specimen. These responses imply that candidates lacked skills in using a dichotomous key.

Moreover, some candidates gave incorrect structures used for gaseous exchange in crab, grasshopper, bee, spider and millipede and gave incorrect adaptive features for those structure in part (d). For example, one candidate wrote, *grasshopper use spiracles and bee use lungs* instead of tracheal system. This means they were not aware that all respiratory organs must have structures that allow gaseous exchange to take place efficiently. Furthermore, they drew poor diagrams of a crab as they failed to adhere to drawing principles. Extract 19.2(a) is a sample of the candidates' incorrect responses.

3. (a) ⊙ They both live in terrestrial areas.
⊙

(b) 1a Wings present P_2, P_3 and P_4
1b Wings absent P_1 and P_2

2a outer wings are soft P_3 and P_4
2b outer wing are harder P_2

3a Have numerous similar limb P_5
3b Similar limbs - absent P_1

4a The first appendage bear prehensile chelicerae P_4 and P_5
4b The first appendage serves as jaw P_4 and P_1

(c) P_2 Uses spiracles for gaseous exchange
P_3 Uses spiracle for gaseous exchange
P_4 Uses spiracle for gaseous exchange
P_5 Uses book lung for gaseous exchange

(d) Adaptive features
⊙ They both have pairs of legs for walking
⊙ They both antennae for sensation;

(e)

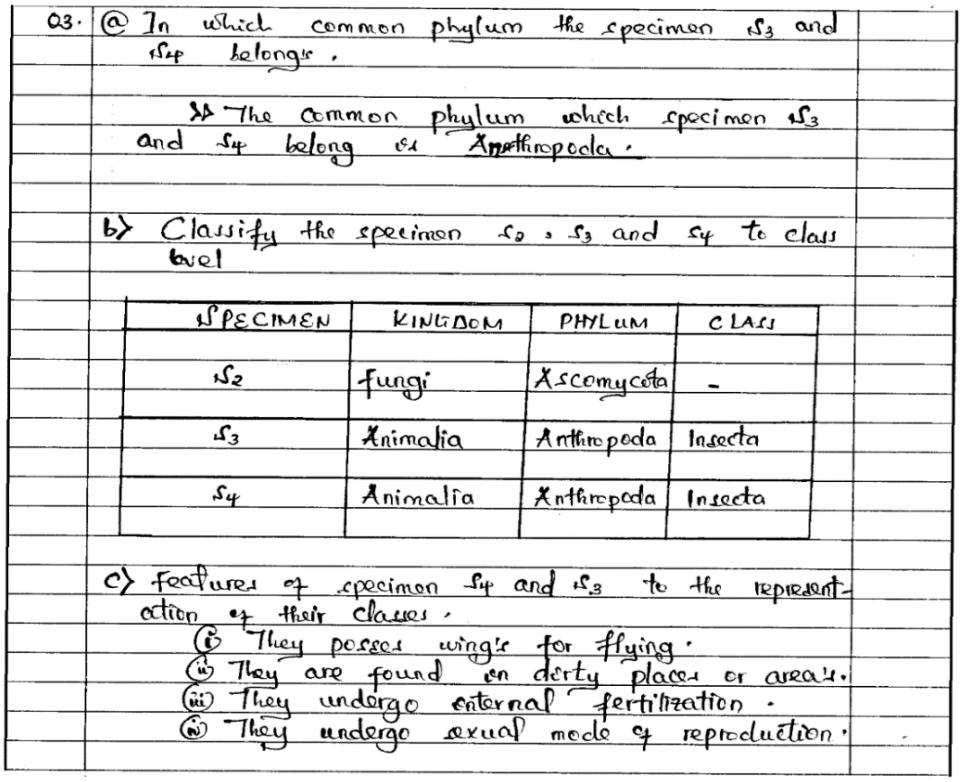
Extract 19.2 (a): A sample of incorrect responses to question 3 in Biology 3A.

In Extract 19.2 (a), the candidate wrote incorrect responses to all part of the question. He/she copied the sentences of the Key and drew poor diagram of a crab.

Similarly, in Biology 3B, the candidates who scored low marks (0 to 5.5) demonstrated inadequate knowledge of the concept of classification. Some failed to explain the observable features that make houseflies and beetles to be placed in the same phylum, i.e Phylum Arthropoda. They gave incorrect internal features such as *houseflies has mulphigian tube, beetle it has a horn used for protection and for sensitivity.* Also, they were unable to correctly identify the kingdom, phylum and the class to which houseflies, beetles and yeast belongs in part (b). Some of them either wrote the taxon interchangeably or misspelt the scientific words. For example, the

misspelled words were such as *athropoda, anthropoda and arthropods* instead Arthropoda. Others wrote phylum *Ascomicota* and *ascomacota* instead of Ascomycota while others wrote class as *Insect* instead of Insecta. These misspelt words may not be understood by the community of scientist. In addition, the candidates failed to state the observable features which justify the placement of both houseflies and beetles into Class Insecta. Instead, they wrote features of other classes. For example, one candidate wrote; b*oth have three pairs of jointed leg per segment.* Another candidate wrote *both have two pairs of jointed leg per segment* to mention a few. The latter is the typical feature of the Class Diplopoda. Some of the candidates wrote features of other Classes such as Arachnida, Chilopoda instead of the Class Insecta.

Moreover, some candidates lost marks because they failed to give the natural habitat of specimen of housefly**.** They wrote speculated habitat such as *in the house and in air* instead of dirty places. For example, pit toilets, municipal dumps and dustbins. Furthermore, they incorrectly explained the usefulness of yeast in economic development. These candidates were not aware that yeast has been used for long time in production of alcoholic drinks, rise dough in bakeries, as a source of vitamins B, and for medicinal purposes. Lastly, they failed to precisely describe the adaptations of the beetle to its environment. Extract 19.2(b) is a sample of the candidates' incorrect responses to the question.



Q3. (a) In which common phylum the specimen S_3 and S_4 belongs.

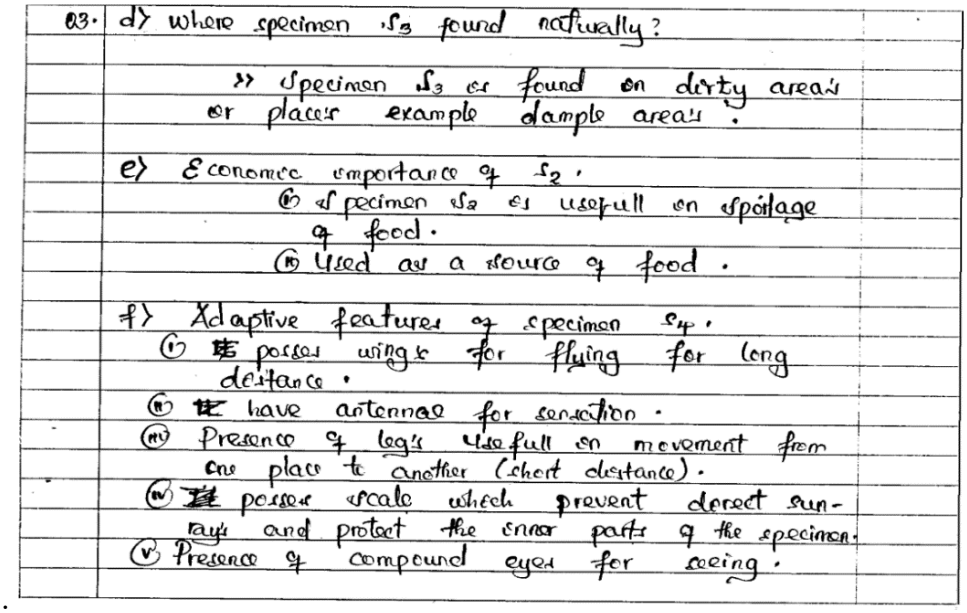
» The common phylum which specimen S_3 and S_4 belong is Arthropoda.

b) Classify the specimen S_2, S_3 and S_4 to class level

SPECIMEN	KINGDOM	PHYLUM	CLASS
S_2	Fungi	Ascomycota	-
S_3	Animalia	Arthropoda	Insecta
S_4	Animalia	Arthropoda	Insecta

c) Features of specimen S_4 and S_3 to the representation of their classes.

(i) They posses wings for flying.
(ii) They are found on derty places or areas.
(iii) They undergo external fertilization.
(iv) They undergo sexual mode of reproduction.



Q3. d) where specimen S_3 found naturally?

» Specimen S_3 is found on dirty areas or places example dample areas.

e) Economic importance of S_2.

(i) Specimen S_2 is usefull on spoilage of food.
(ii) Used as a source of food.

f) Adaptive features of specimen S_4.

(i) posses wings for flying for long distance.
(ii) have antennae for sensation.
(iii) Presence of legs usefull on movement from one place to another (short distance).
(iv) posses scale which prevent direct sun-rays and protect the inner parts of the specimen.
(v) Presence of compound eyes for seeing.

Extract 19.2(b): A sample of incorrect responses to question 3 in Biology 3B.

In Extract 19.2 (b), the candidate had insufficient knowledge of classification of living organism. She/he misspelt scientific words such as

phylum anthropoda. Also, wrote a feature of the representative member of class Insecta as *they are found in dirty place area,* and the economic important of yeast as *used for food*.

Likewise, in Biology 3C, the candidates who scored low marks (0 to 5.5) demonstrated a lack of knowledge about classification of living organisms. Most of them were not aware of the reasons which make scientists not prefer the use of common names in the identification of living organisms. Consequently, they wrote incorrect responses such as *because in common name natural and artificial classification system is not used*, *common name has only home name while scientific name has two parts.* These candidates lacked understanding that common names originate from vernacular languages and not suitable to be used in communication since may cause confusion among scientists. Moreover, the candidates misplaced grasshoppers, crabs and cockroaches to respective Kingdom, Phylum and Classes. Most of them failed to identify the class to which crabs belongs as they categorized it as Class Insecta and Class Arachnida instead of Class Crustacea. Moreover, they failed to give differentiating features of the Class Insecta and Class Crustacea. They either wrote the features in those classes interchangeably or they wrote the features of other classes. On the other hand, they failed to identify the taxon in which crabs and grasshoppers share the common features. i.e the Phylum Arthropoda. Some of the incorrect responses they provided were *both have legs, both have eyes, both have mouth.* Extract 19.2(c) is part of a sample of the candidates' incorrect responses to the question.

3 a) ① Because.

ii) Habitant

Z4 ⇒

Z5 ⇒

Z6 ⇒

b) Z4 → Grasshopper

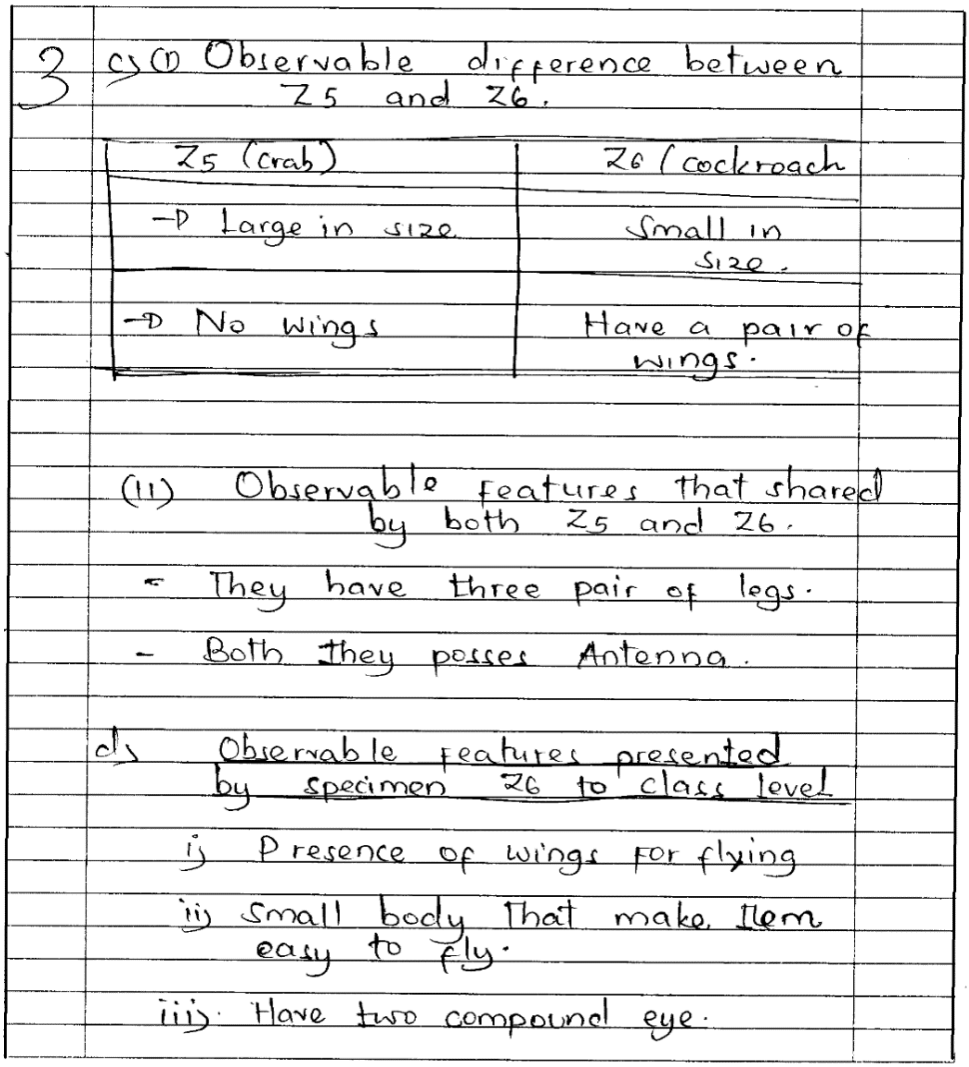
Kingdom : Animalia.
Division : Chordata.
Class : Insecta

Z5 → Crab.

Kingdom → Animalia.
Division → Crustacea
Class → Crustae.

Z6 → Cockroach

Kingdom : Animalia
Division : Chordata
Class : Insecta.


3 c) (i) Observable difference between Z5 and Z6.

Z5 (crab)	Z6 (cockroach
→ Large in size.	Small in size.
→ No wings	Have a pair of wings.

(ii) Observable features that shared by both Z5 and Z6.

- They have three pair of legs.
- Both they posses Antenna.

d) Observable features presented by specimen Z6 to class level

i) Presence of wings for flying

ii) Small body that make them easy to fly.

iii) Have two compound eye.

Extract 19.2(c): A sample of incorrect responses to question 3 in Biology 3C.

In Extract 19.2 (c), the candidate had insufficient knowledge of classification of living organisms. For Example, she/he placed grasshopper in the Phylum Chordata instead of Arthropoda. In addition, she/he wrote the wrong differences between members of Class Insecta and Crustacea. For example, grasshopper has small size while crab has larger size.

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH TOPIC

The Biology examination covered 13 topics. Seven topics were tested in 133/1 Biology 1 paper and six topics in the133/2 Biology 2 paper. Three topics, (two from paper 1 and one from paper 2) were also, tested in 133/3 Biology 3, which was a practical paper.

The analysis of the candidates' performance shows that the candidates had good performance on five topics, average performance on six topics and weak performance on two topics. The performance is as follows:

The candidates showed good performance on the topics of *Growth and Development (82.60%), Cytology* (71.60%), *Coordination* (67.20%), *Comparative Studies of Natural Groups of Organisms* (64.50%), Principles *of Classification (*60.65%) and *Evolution* (60.10%). The averagely performed topics were *Nutrition* (57.95%), *Reproduction* (53.35%)*, Transportation* (48.50%), *Genetics* (46.00%) followed by *Gaseous Exchange and Respiration* (40.25%). However, the candidate demonstrated weak performance on the topics of Reg*ulation*/ *Homeostasis* and *Ecology* with the percentage of 30.70 and 15.80 respectively. The performance on each topic is summarised in Appendix A.

The comparison of the candidates' performance on each topic in Biology ACSEE between 2022 and ACSEE 2023 shows that the topics of *Growth and Development, Comparative Studies of Natural Groups of Living Things* and *Evolution* have maintained a good performance while *Nutrition*, *Reproduction, Transportation*, *Genetics* and *Gaseous Exchange and Respiration* have maintained an average performance. On the other hand, the performance on the topics of *Cytology* and *Coordination* have improved from average to good while that on the topics of Reg*ulation*/ *Homeostasis* has dropped from average to weak performance and that on *Ecology* from good to weak performance. The comparison is summarised in Appendix B.

4.0 CONCLUSION

The candidates' performance in the ACSEE 2023 in Biology was good since 98.94 per cent passed the examination. This performance is a result of efforts made by education stakeholders in improving teaching and learning. However, a few (1.06%) of the candidates demonstrated weak performance which have been attributed to:

(a) provision of incorrect responses contrary to question demand: This is a result of either failure of the candidates to read the questions carefully and understand their demands before attempting them or carelessness when responding to the questions.

(b) candidates' lack of sufficient knowledge on the tested concepts: This is a result of students' lack of mastery of the biological skills and concepts stipulated in the syllabus.

(c) candidates' incompetence in drawing skills on microscopic and small organisms: This might have been caused by students' inadequate practice of using proper formulae to calculate magnification and using principles of drawing skilful biological diagrams.

(d) candidates' incompetence in using taxonomic keys. This might have been caused by students' inadequate practice of using key to identify organisms.

5.0 RECOMMENDATIONS

The candidates' good performance is a product of collective effort of teachers and learners. Based on this fact, the following are recommendations for teachers and learners to improve the performance of prospective candidates:

(a) Teachers have to continue using locally available materials (improvisation) and include the following teaching/learning resources:

(i) the table of specification (ToS) that indicated the number and percentage weight of items in relevant cognitive levels. This ensure that the competences and skills gained at each instructional objective are examined extensively.

(ii) charts, simple constructed keys, published key for plants and animals and variety of organisms to teach the topic of *Principles of Classification,* which although it has improved its performance in 2023 from weak to good, its performance in paper 1 was average.

(iii) charts, diagrams, models, microscope, microscope slides or pictures of substrates of digestive juice in teaching the topic

Nutrition especially on the identification of types of glands and their secretions.

(iv) video films, microscope slides, charts, diagrams, models and pictures in teaching the topic *Reproduction* specifically on the events which compromise the fertilization mechanism in plants and animals.

(v) diagrams, charts and illustrations in teaching the concept of *inheritance* on the topic of *Genetics* especially on different types of mutations.

(vi) charts, models, illustrations, diagrams and photographs in teaching and learning of general features of animals living in cold and hot environments in the topic *Regulation/ Homeostasis* whose performance has dropped from average in 2022 to weak in 2023.

(vii) videos, charts, diagrams of various ecosystems in teaching and learning of the concept of food chain and trophic levels in the topic of *Ecology* whose performance has dropped from good to the weak performance.

(b) Students are advised to:

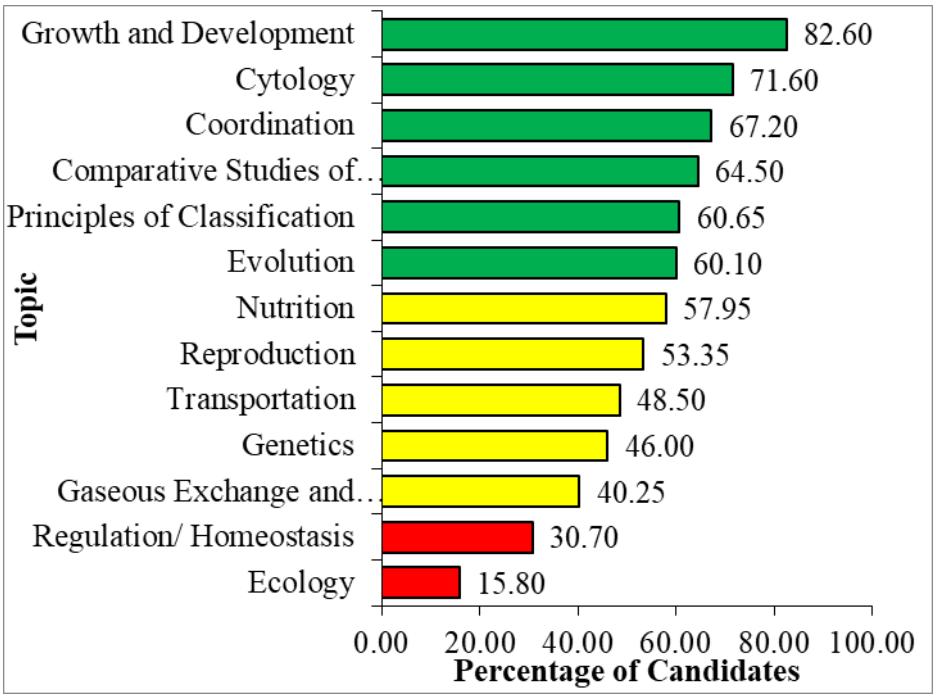
(i) Read intensively to ensure that they manage to internalize the biological concepts taught under each topic.

(ii) Reading the question carefully to clearly understand them before attempting them.

(iii) Practice drawing various biological diagrams using principles and using formula to calculate the magnification to sharpen their drawing skills.

(iv) Practice identification of organisms in various groups using simple key and construct the keys to sharpen their skills.

Appendix A: The Candidates' Performance on Each Topic in 2023 ACSEE



Appendix B: Comparison of the Candidates' Performance on 133 Biology ACSEE by Topic between 2022 and 2023

S/N	Topic	2023			2022		
		Number of questions	Candidates who Scored an Average of 35 Per cent or Above	Remarks	Number of questions	Candidates who Scored an Average of 35 Per cent	Remarks
1.	*Growth and Development*	1	82.60	Good	1	79.96	Good
2.	*Cytology*	2	71.60	Good	2	49.80	Average
3.	*Coordination*	1	67.20	Good	1	38.94	Average
4.	*Comparative Studies of Natural Groups of Organisms*	2	64.50	Good	3	68.68	Good
5.	*Principles of Classification*	2	60.65	Good	1	17.90	Weak
6.	*Evolution*	1	60.10	Good	1	96.91	Good
7.	*Nutrition*	2	57.95	Average	2	53.15	Average
8.	*Reproduction*	2	53.35	Average	2	40.17	Average
9.	*Transportation*	1	48.50	Average	1	49.70	Average
10.	*Genetics*	1	46.00	Average	1	34.30	Average
11.	*Gaseous Exchange and Respiration*	2	40.25	Average	2	52.05	Average
12.	*Regulation/ Homeostasis*	1	30.70	Weak	1	54.39	Average
13.	*Ecology*	1	15.80	Weak	1	69.01	Good