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) 2021

BIOLOGY

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133 BIOLOGY

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FOREWORD

The National Examinations Council of Tanzania (NECTA) is pleased to issue this Candidates' Item Response Analysis Report (CIRA) on the Biology for the Advanced Certificate of Secondary Education Examination (ACSEE), 2021. This report aims to provide feedback to teachers, prospective candidates, policy makers, educational administrators and other stakeholders in education on the achievement of teaching and learning objectives in the classroom through the candidates' performance. This is because, principally, the candidates' performance is a measure of the effectiveness of the educational system in general and educational delivery in particular.

Generally, the report shows that the candidates' performance in the ACSEE Biology subject was good because 96.81 per cent passed the examination. The candidates performed well in the topics of Transportation, Comparative Studies of Natural Groups of Organisms, Evolution, Principles of Classification, Regulation/Homeostasis, Cytology and Reproduction. The factors for the good performance include the candidates' good mastery of the competencies stipulated in the syllabus, good drawing skills and ability to interpret the demands of the questions and to apply principles of the subject.

Besides, the report shows that a few candidates (3.19%) demonstrated weak performance on the topics of Genetics, Growth and Development, Nutrition, Gaseous Exchange and Respiration, Ecology and Coordination. The factors for their weak performance include the lack of competences in biological concepts, poor drawing skills and inability to interpret the demands of the questions.

NECTA expects that the stakeholders in education will use feedback provided in this report to continue strengthening the teaching and learning of the Biology subject in secondary schools. This will eventually enhance students' competencies as stipulated in the Biology subject syllabus for better performance in future examinations by NECTA.

Finally, NECTA wishes to express its sincere appreciation to all examination officers and others who participated in preparing this report.

Dr Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

The Biology subject examination had three papers namely, 133/1 Biology 1, 133/2 Biology 2 and 133/ Biology 3. Biology 1 and 2 were theory papers, while 133/3 Biology 3 was a practical paper. The 133/3 Biology 3 paper was categorised into paper 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology C. These papers were set based on the Biology Subject Examination Format of 2019 and conducted in May 2021.

The 133/1 Biology 1 examination paper had Sections A and B with a total of 10 questions. Section A had seven (7) short answer questions. The candidates were required to respond to all questions. Each question carried ten (10) marks. Section B had three structured/essay-type questions. The candidates were required to answer two (2) questions. Each question carried 15 marks. As for the 133/2 Biology 2 examination paper it had six (6) structured/essay-type questions. The candidates were required to respond to five 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 twenty (20) marks and the other two questions carried fifteen (15) marks each. The candidates were required to sit for only one of the practical papers and answer all questions.

A total of 27,970 school candidates sat for the Examination in which 96.81 per cent passed but 3.19 per cent failed. The performance in 2021 has decreased by 0.18 per cent when compared to the performance in 2020, whereby 96.99 per cent passed.

The next part analyses the performance of the candidates on each question in 133/1 Biology 1, 133/2 Biology 2 and 133/3 Biology 3 in the 2021 ACSEE.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH QUESTION

The candidates' performance on each question in each Biology Subject paper is analysed by indicating the competencies tested and the requirement of each question. In addition, the analysis indicates the percentage of the candidates who attempted the question and of those who had good, average or weak performance, based on their responses. The performance on a question is considered to be *good* if the percentage of the candidates who correctly responded to it is from 60 to 100, *average* if the percentage is from 35 to 59 and *weak* if the percentage is from 0 to 34. Furthermore, green, yellow and red colours are used in graphs/charts/tables to indicate good, average and weak performance levels respectively.

2.1 133/1 - BIOLOGY 1

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

2.1.1 Question 1: Reproduction

The question measured the candidates' competence in the concept of Oestrous Cycle. They were required to describe the stages of the oestrous cycle in part (a). In part (b), they were required to justify the need for the oestrous cycle in female animals.

Data reveal that 100 per cent of the candidates responded to the question. The analysis of their performance is shown in Figure 1.

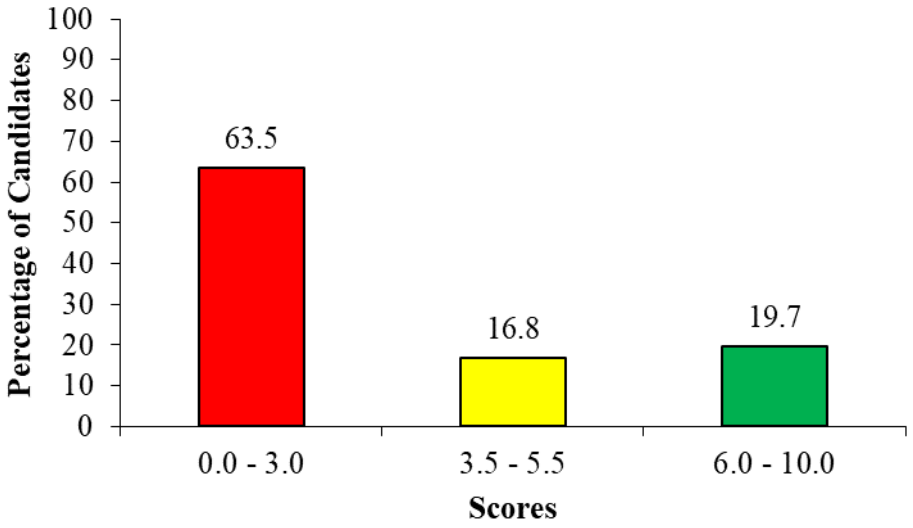


Figure 1: *Distribution of Candidates' Scores on Question 1*

Figure 1 shows that 36.5 per cent of the candidates scored from 3.5 to 10.0 marks, while 63.5 scored from 0.0 to 3.0 marks.

The candidates who scored high marks (19.7%) demonstrated good competence in the concept of the oestrus cycle and its importance. They were aware that the oestrus cycle takes place in most mammalian females except primates such as human beings and monkeys. The cycle has four stages which are influenced by hormones, and it is important for preparing female mammals for sexual receptivity

to copulation. Extract 1.1 is a sample response from a candidate who scored high marks.

1 (a) Stages of oestrus cycle are:

(i) Dioestrus stage.

→ In this stage, there are no any signs of oestrus in an animal, female animal.

(ii) Pro-oestrus stage

→ In this stage, there is development of follicles, also known as follicular phase in female animals.

(iii) Oestrus stage.

→ In this stage, the follicle is released from the ovary (ovulation) and also, it is characterized by signs of 'heat' whereby the female animal shows all the signs of accepting a mate.

(iv) Post-oestrus stage.

→ In this stage, the female animal becomes pregnant if fertilization occured and if fertilization didn't occur, it is the period of pseudo-pregnancy.

(b) Oestrus cycle is important in female animal because;

→ It enhances maximum accuracy in the process of fertilization due to the fact that at heat period the female animal releases a follicle which has a high probability of meeting a sperm.

→ It ensures efficient copulation between a male and a female animal since it is the time when a female accepts a mate, especially 'heat period' or oestrus.

Extract 1.1: A sample of the candidates' correct responses to Question 1

In Extract 1.1, the candidate correctly described dioestrus, pro-oestrus, oestrus and post-oestrus/metestrus as the stages of the oestrus cycle and pointed out efficient copulation as one of the needs for the oestrus cycle in a female mammal.

The candidates who scored from 3.5 to 5.5 marks, lost most of the marks in part (a) of the question. This was caused by candidates' partial competence in the concept of oestrous. Some of the candidates outlined the stages of the oestrus cycle correctly, but they failed to describe the stages of the oestrus cycle. Other candidates outlined the stages correctly but gave incorrect description in part (a). However, in part (b), they gave the correct needs for the oestrus cycle in female mammals.

Most of the candidates who scored from 1.0 to 3.0 marks mixed up some stages of the oestrus cycle with uterine and menstrual cycles. However, they gave the correct response to part (b). The candidates who scored a zero described the circles or processes which do not relate to the oestrus cycle. For example, one candidate described the urea cycle in part (a). Another candidate described the birth process instead of oestrus cycle in part (a). Consequently, some of these candidates gave the importance of the respective cycle/process, which is the formation of urine and the formation of placenta/regeneration of the uterus instead of the importance of the oestrus cycle in female animals in part (b). Some of these candidates pointed out the secretion of Luteinizing hormone and Follicle stimulating hormone as the importance of the oestrus cycle in female animals in part (b). Extract 1.2 is an example of an incorrect response from one of the candidates.

1:

Oestrus cycle is the period where the mother need to produce the foetus outside the uterus throug the cervic. Oestrus pass through three stages that are

labour stage this is the stage that mother get the pain that caused by the stimulation of the hormone that lead to the openen in the female part and the breage of the uterus wall.

Birth stage this is where the baby are removed out of the womb of the mother ready for the start the life that do not depent the placent and this stage the placent has been cutted

Baby start to cri this help the baby its lungs to operate when the baby cri the lung function and its the site for gastone exchnge start

(b) There need of oestrus cycle in the female animal is to make the uterus to be regenerated and the placent to stop the work that has been perfer at the different part of the body of babre to be function

Extract 1.2: A sample of the candidates' incorrect responses to Question 1

In Extract 1.2, the candidate regarded the oestrus as a birth process. Therefore, he/she described the stages of birth instead of the oestrus cycle.

2.1.2 Question 2: Gaseous Exchange and Respiration

On one hand, part (a) of the question measured the candidates' competence in the concept of aerobic respiration using glucose as a substrate. Specifically, the question required the candidates to find the Respiratory Quotient (RQ) for a complete respiration of glucose. On the other hand, part (b) measured the candidates' knowledge about the importance of fermentation by requiring them to justify the needs for fermentation process to animals.

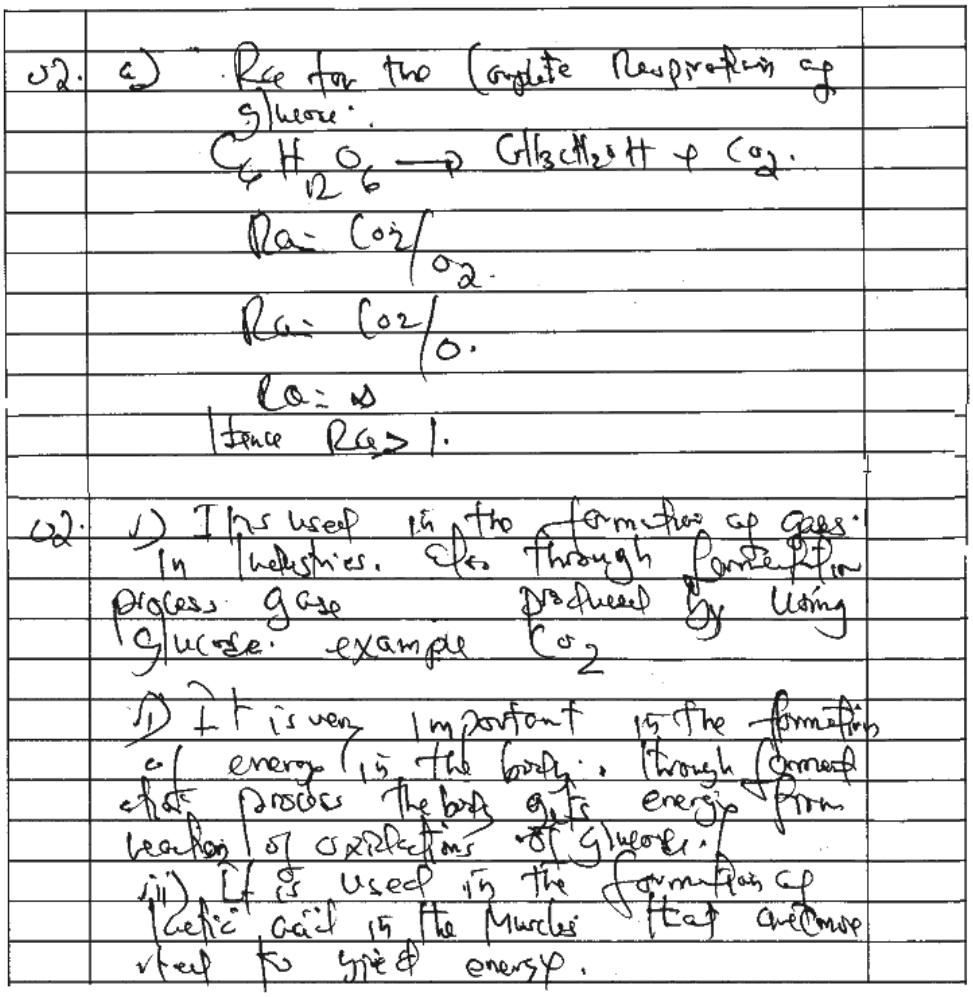
The analysis of candidates' performance reveals that most of the candidates (96.6%) scored low marks (0.0 to 3.0), while a few (3.4%) scored above 3.0 marks. Table 1 is illustrative.

Table 1: **Distribution of Candidates' Scores on Question 2**

Scores	Description	Per centage of Candidates
0.0 – 3.0	Weak	96.6
3.5 – 5.0	Average	3.2
6.0 – 10	Good	0.2

The analysis of the candidates' responses reveals that those who scored low marks in part (a) and (b) wrote an incorrect equation, either an unbalanced one or an anaerobic respiration equation of glucose instead of aerobic. Consequently, did not get the value of RQ. This is because the RQ is the ratio of carbon dioxide evolved and oxygen used in the respiration equation. The ratios are obtained from a correct balanced equation or respiration.

In part (b), some of the candidates did not score full marks because they wrote only a few advantages of fermentation to animals such as production of carbon dioxide for bread making and alcohol, such as beer for human consumption. Other candidates gave incomplete responses such as production of carbon dioxide, but they did not show the usefulness of carbon dioxide to animals. Extract 2.1 shows part of an incorrect response from one of the candidates.



Extract 2.1: Part of a candidate's incorrect responses to Question 2

Extract 2.1 shows that in part (a), the candidate wrote an equation which shows glucose as the only raw material for respiration instead of glucose and oxygen. The candidate also showed alcohol and carbon dioxide as the only products instead of carbon dioxide, water and energy. In part (b), the candidate did not describe the usefulness of carbon dioxide to animals.

Despite the weak performance of most candidates on this question, 3.4 per cent of the candidates scored from 3.5 to 10.0 marks. On the other hand, those who scored from 3.5 to 5.0 marks obtained full marks in part (b). However, they scored zero in part (a) because the they wrote an incorrect equation for respiration of glucose.

On the other hand, those who scored high marks (6.0 to 10.0) got most of the marks in part (b) and few or all the marks in part (a). Some of these candidates scored full marks in parts (a) and (b). Extract 2.2 shows a response by a candidate who scored high marks.

2. (a.) Respiration is the catabolic process which involves breaking down of substrates like glucose to release energy.

Glucose is the major respiratory substrate in human beings.

The equation of complete respiration of glucose.

$$C_6H_{12}O_6(s) + 6O_2(g) \longrightarrow 6CO_2(g) + 6H_2O(l) + 38\ ATP$$

Respiratory Quotient = Volume of CO_2 produced / Volume of O_2 consumed

$$RQ = \frac{6}{6}$$

$$RQ = 1.$$

∴ The respiratory Quotient of complete respiration of glucose is 1

(b.) The importance of fermentation process.

(i.) Helps in baking of bread by yeast.
- Yeast respire anaerobically thereby producing Carbon dioxide gases that helps the dough to rise hence essential in bread making.

2. (b.) (ii.) Helps in the making ... alcohol (useful in brewing industries)
- Yeast respire anaerobically by fermentation process to produce alcohol which is a drink Consumed by human.

(iii.) Helps in production of biogas
- Fermentation process involves respiration in the absence of oxygen which serves a great deal in formation of fuel (biogas) by anaerobic bacteria.

(iv.) Helps in the production of Vinegar
- Some bacteria like acetic acid bacteria may respire anaerobically thus help in forming Vinegar which acts a preservatives of cucumbers and other fruits.

(v.) Fermentation helps in Souring of milk
- Anaerobic respiration is carried out by bacteria in milking processing to produce sour milk for human consumption.

(vi.) Helps in making cheese as a food product for human consumption.

Extract 2.2: A sample of the candidates' correct responses to Question 2

Extract 2.2 shows that, in part (a), the candidate followed the necessary steps to establish the RQ, namely writing a balanced respiratory equation, writing the formula for calculating RQ and plugging the data to the formula. In part (b), the candidate justified the need for the fermentation process to animals by considering the products of fermentation and their usefulness to animals.

2.1.3 Question 3: Principles of Classification

The question measured the candidates' knowledge about the disadvantages and advantages of the Natural System of Classification. The question required the candidates to support the statement that *The Natural system of classification has never been achieved in the fullest sense* in part (a). In part (b), it required them to

support the statement that *Scientists prefer to use the natural system of classification.*

Data show that the question was responded to by all candidates. The candidates' performance is shown in Figure 2.

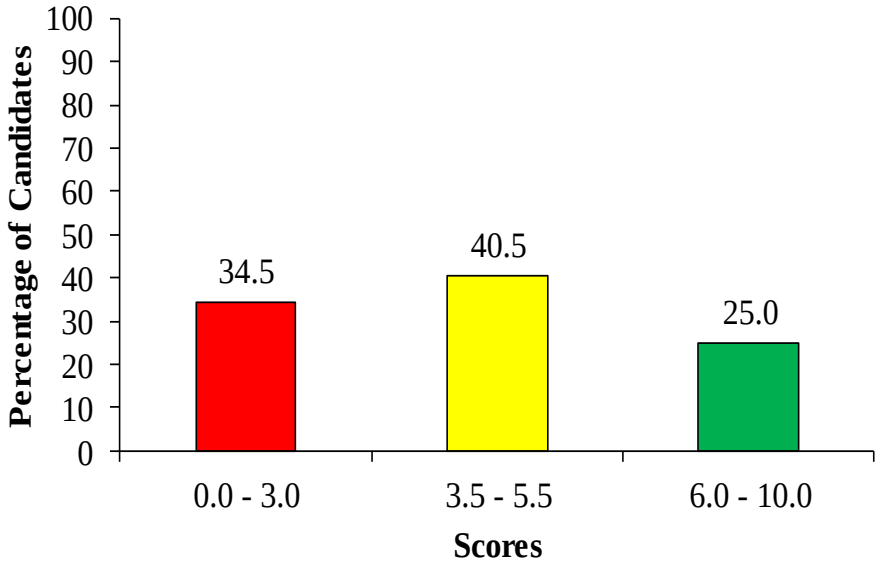
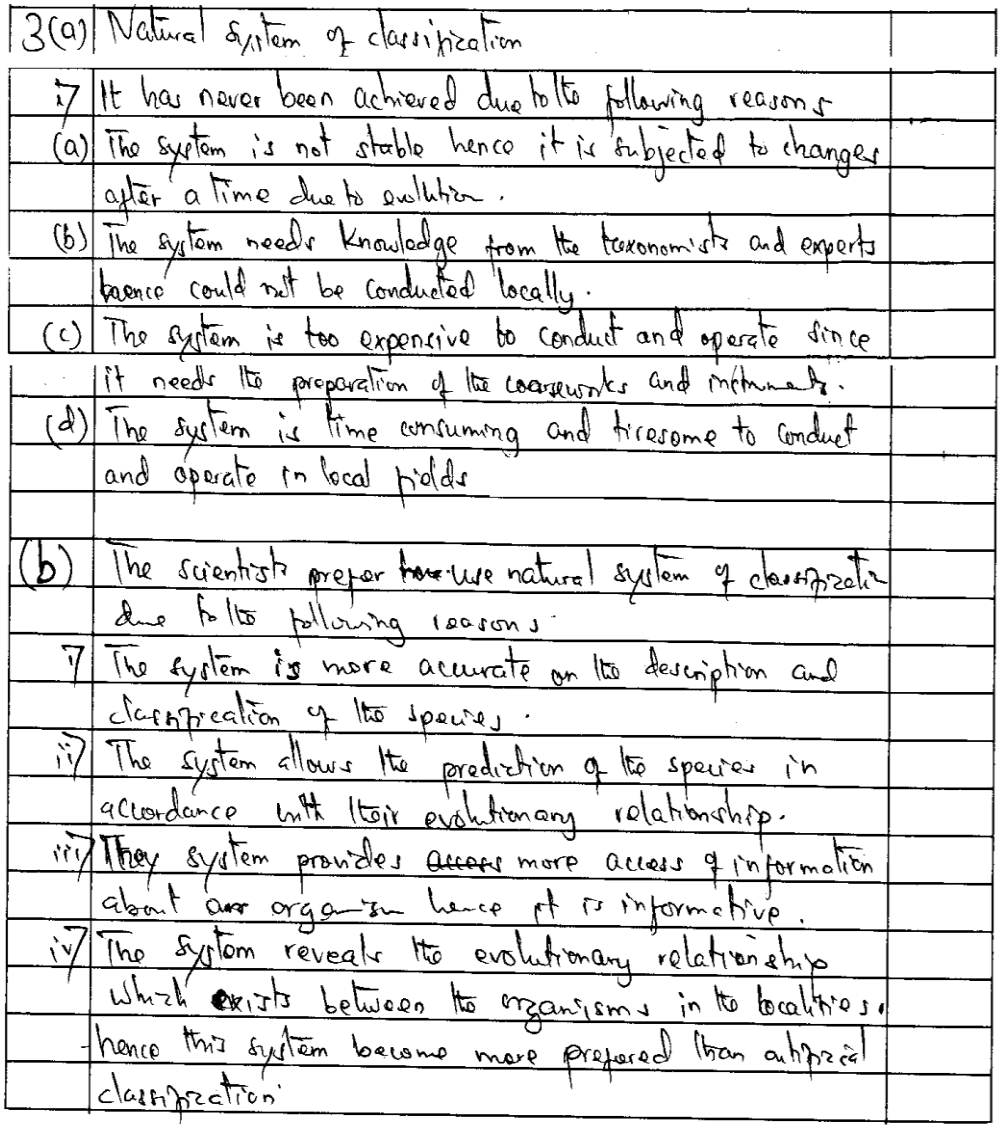


Figure 2: *Distribution of Candidates' Scores on Question 3*

Figure 2 indicates a good performance since 65.5 per cent of the candidates scored from 3.5 to 10.0 marks.

The 25.0 per cent of the candidates who scored high marks (6.0 to 10.0) were aware that the natural system of classification is based on the observation of both external and internal features of an organism. In this case, it has never been achieved in its fullest sense because it is expensive, less stable and time consuming. However, scientists prefer it because it carries more information that can be used for prediction. Therefore, the candidates gave all or most of the correct points to parts (a) and (b) of the question. Extract 3.1 shows a response of a candidate who scored high marks.


3(a) Natural system of classification

i) It has never been achieved due to the following reasons

(a) The system is not stable hence it is subjected to changes after a time due to evolution.

(b) The system needs knowledge from the taxonomists and experts hence could not be conducted locally.

(c) The system is too expensive to conduct and operate since it needs the preparation of the courseworks and instruments.

(d) The system is time consuming and tiresome to conduct and operate in local fields

(b) The scientists prefer ~~have~~ use natural system of classification due to the following reasons

i) The system is more accurate on the description and classification of the species.

ii) The system allows the prediction of the species in accordance with their evolutionary relationship.

iii) They system provides ~~access~~ more access of information about an organism hence it is informative.

iv) The system reveals the evolutionary relationship which exists between the organisms in the localities, hence this system become more preferred than artificial classification.

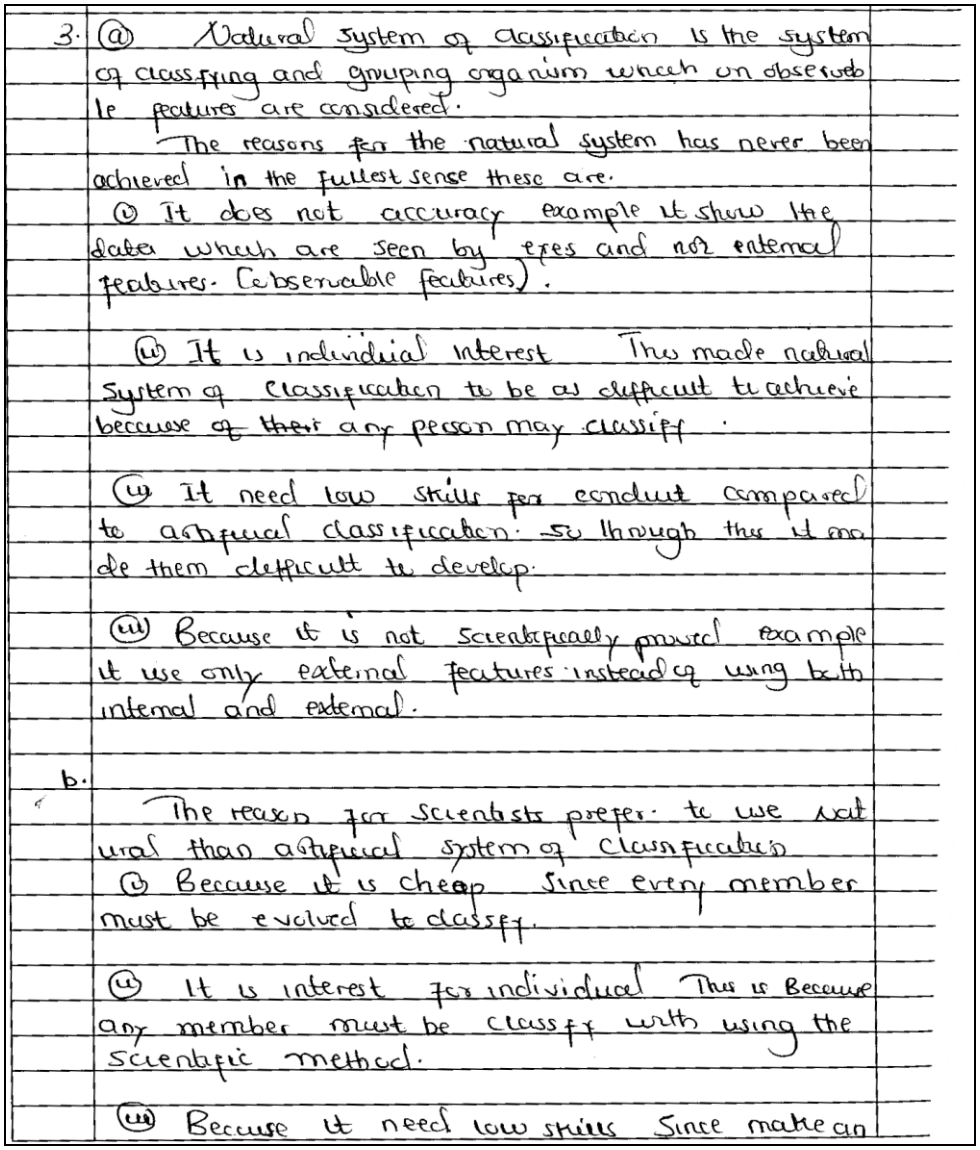
Extract 3.1: A sample of the candidates' correct responses to Question 3

In Extract 3.1, the candidate demonstrated high level of competence in Principles of Classification by pointing out cost and need of experts as factors hindering natural system from classification for not being achieved full. In addition, the candidate pointed out accuracy and reveal of evolutionary relationships among organisms as among the factors for the scientists to prefer using the natural system of classification.

On the one hand, the candidates who scored from 3.5 to 5.5 marks, missed some points in either part (a) or part (b) of the question. In part (a), the candidate based

their responses on the artificial system of classification instead of the natural system of classification. For example, one candidate wrote: *Natural system of classification is very stable, the system is not time consuming; that's why it is not achieved in its fullest sense.* These are the advantages of the artificial system of classification. Likewise, the candidates who missed some marks in part (b) based their responses on the advantages of the artificial system of classification instead of the natural system of classification. For example, one candidate wrote: *It is not time consuming so minimises time for research to be conducted and not expensive.*

On the other hand, some candidates with weak performance gave incorrect responses to both parts (a) and (b). However, others gave incorrect responses to part (a) and a few correct responses to part (b) of the question. The major reason for their weak performance was lack of knowledge about the natural system of classification. Extract 3.2 is a sample of weak responses from one of the candidates.


3. (a) Natural system of classification is the system of classifying and grouping organism which on observable features are considered.

The reasons for the natural system has never been achieved in the fullest sense these are.

(i) It does not accuracy example it show the data which are seen by eyes and not external features. (observable features).

(ii) It is individual interest This made natural system of classification to be as difficult to achieve because of ~~their~~ any person may classify.

(iii) It need low skills for conduct compared to artificial classification. So through this it made them difficult to develop.

(iv) Because it is not scientifically proved example it use only external features instead of using both internal and external.

b.

The reason for scientists prefer to use natural than artificial system of classifications

(i) Because it is cheap Since every member must be evolved to classify.

(ii) It is interest for individual This is Because any member must be classify with using the scientific method.

(iii) Because it need low skills Since make an

Extract 3.2: A sample of the candidates' weak responses to Question 3

Extract 3.2 shows that, in both parts (a) and (b), the candidate wrote the advantages of the artificial system of classification such as *it is cheap, it needs low skills* and *it does not consume time* instead of the disadvantages and advantages of the natural system of classification.

2.1.4 Question 4: Cytology

The question measured the candidates' competence in the adaptations of various organelles and the mechanism of enzymes' action. Specifically, in part (a), the candidates were required to explain how the following structures enable the respective organelles to perform their roles: (i) Tonoplast in vacuole, (ii) Glycocalyx in plasma membrane, (iii) DNA in nucleus and (iv) Cristae in mitochondria. In part (b), they were required to describe the *Lock and Key* model of enzyme action.

The question was attempted by all candidates. Figure 3 illustrates the candidates' performance.

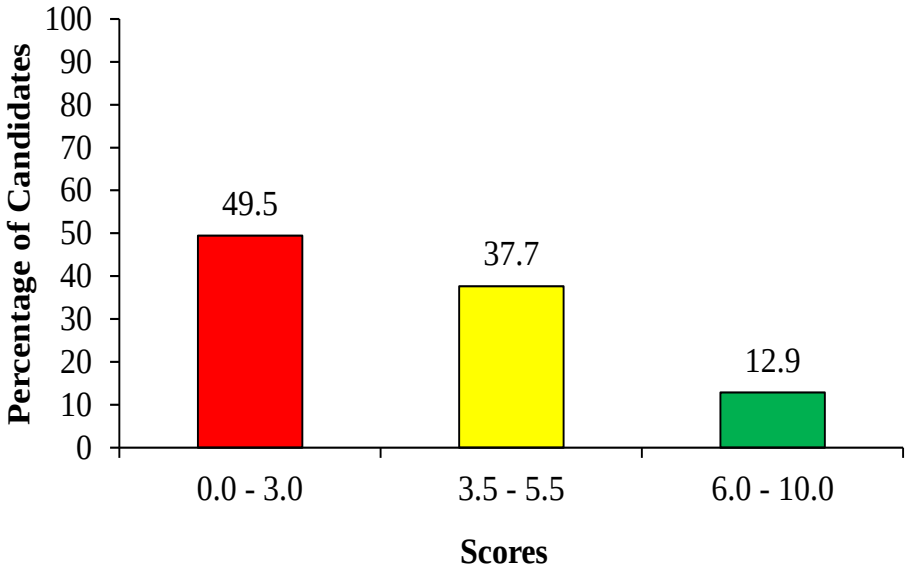
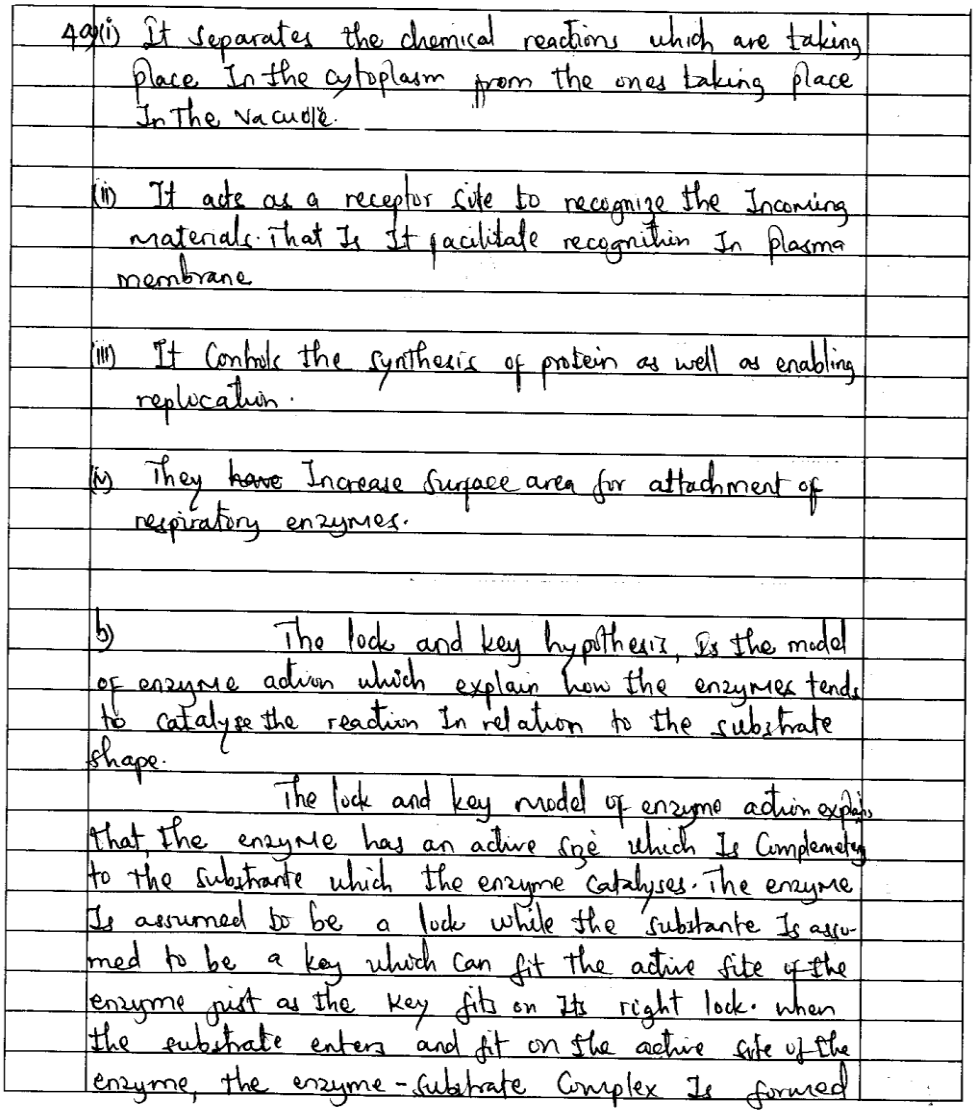


Figure 3: *Distribution of Candidates' Scores on Question 4*

Figure 3 shows average performance of the candidates where about half of the candidates (50.6%) scored from 3.5 to 10.0 marks.

The candidates who scored above 5.5 marks were knowledgeable about the subcellular structures and their adaptations in part (a). In part (b), they were aware that enzymes have active sites in which substrates complement to be catalysed into products. The complimentary pattern between enzymes and substrates relates to the action of the Key on the Lock whereby, the enzymes represent the Lock and the substrate represents the Key. Extract 4.1 is a sample response from one of the competent candidates in the tested concepts.


4a(i) It separates the chemical reactions which are taking place In the cytoplasm from the ones taking place In The vacuole.

(ii) It acts as a receptor site to recognize the Incoming materials. That Is It facilitate recognition In plasma membrane

(iii) It Controls the synthesis of protein as well as enabling replocation.

(iv) They have Increase Surface area for attachment of respiratory enzymes.

b) The lock and key hypothesis, Is the model of enzyme action which explain how the enzymes tends to catalyse the reaction In relation to the substrate shape.

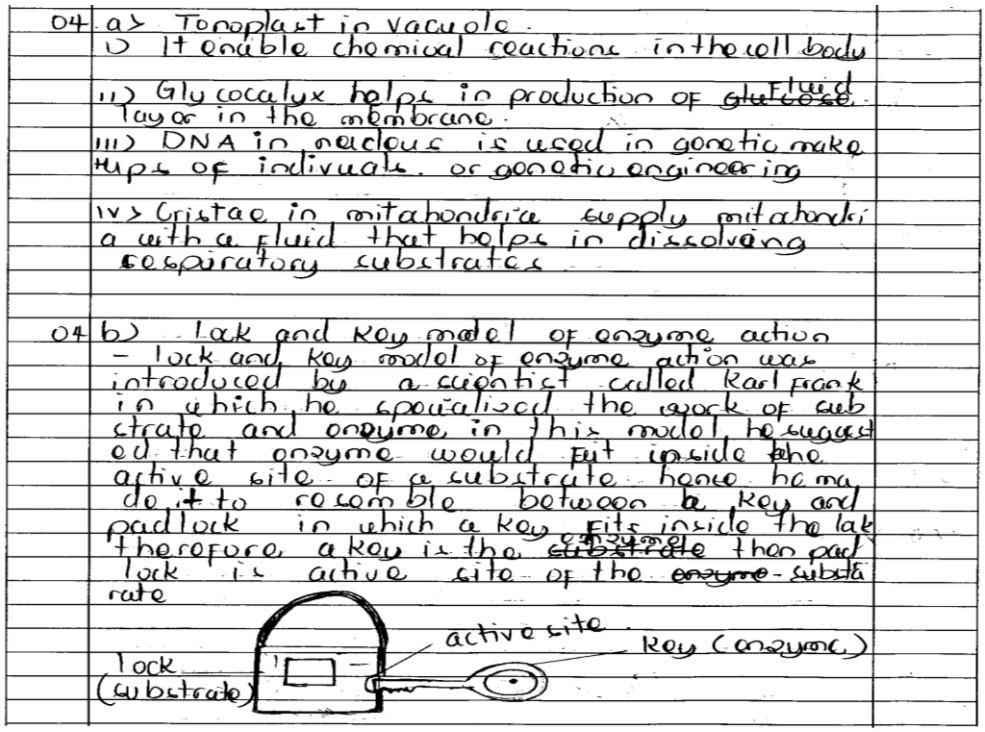
The lock and key model of enzyme action explains that, the enzyme has an active site which Is Complementary to the Substrate which the enzyme Catalyses. The enzyme Is assumed to be a lock while the substrate Is assumed to be a key which can fit the active site of the enzyme just as the key fits on Its right lock. when the substrate enters and fit on the active site of the enzyme, the enzyme-substrate Complex Is formed

Extract 4.1: A sample of the candidates' correct responses to Question 4

In Extract 4.1, the candidate correctly stated how each of the listed structures enables its respective organelle to perform its roles such as glycocalyx, which act as a receptor site for recognition of materials coming into the cell in part (a). In part (b), the candidate correctly matched the action of the enzyme and substrate with that of Lock and Key.

Despite the average performance on Question 4, a further analysis indicates that 49.5 per cent of the candidates scored below 3.5 marks. These candidates demonstrated low competence in the topic of Cytology

specifically, on the organelles and mechanism of enzymes' action. For example, one candidate wrote: *The function of tonoplast is for supporting the trapping of sunlight since vacuole is for trapping sunlight* in part (a). The response indicates that, the candidate was not aware that chloroplast is the one which is responsible for trapping light and not the vacuole. Another candidate wrote: *Glycocalyx in plasma membrane is there to support the process of glycolysis*. The candidate was not aware that the glycocalyx is a structure made up of glycoprotein and glycolipid in a plasma membrane which helps in cell to cell recognition. Similarly, in part (b), the candidates lacked awareness that, in the Lock and Key model of enzyme action, the enzyme is related to the Lock due to the presence of an active site which complements with the substrate. In contrarily, the substrate is related to the Key, which fits to the Lock. Extract 4.2 is a incorrect response from one of the candidates.



Extract 4.2: A sample of the candidates' incorrect response to Question 4

In Extract 4.2 the candidate incorrectly likened the enzyme with the Key instead of the Lock, and the Lock with substrate instead of the Key.

2.1.5 Question 5: Nutrition

The question assessed the candidates' competencies in the digestive juices, their contents, the role of each content and the optimum pH for proper functioning of the contents. The candidates were required to state the digestive roles which will be impaired if the pancreas is severely damaged in part (a). In part (b), they were required to describe what would happen to duodenal enzymes if the pH in the duodenum was 2.

Data indicate that the question was attempted all candidates. The analysis of the candidates' performance is illustrated in Figure 4.

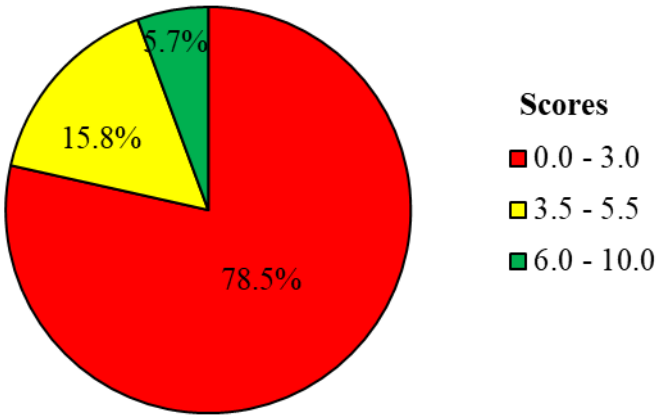


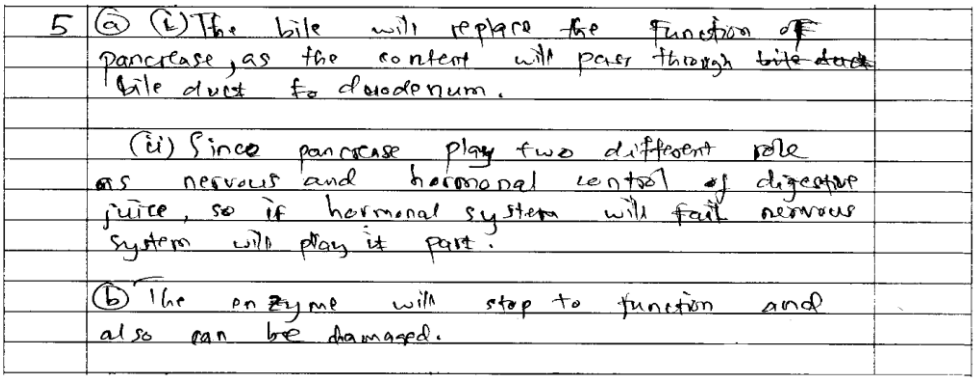
Figure 4: *Distribution of Candidates' Scores on Question 5*

Figure 4 indicates that the performance on the question was weak as more than three quarters of the candidates (78.5%) scored below 3.5 marks and only 21.5 per cent scored from 3.5 to 10.0 marks.

The candidates who scored zero were incompetent in the tested concept while those who scored from 1.0 to 3.0 marks demonstrated lack of knowledge about the digestive juices. In part (a), some of the candidates did not adhere to the question demand as they stated the non-digestive processes that would be affected if the pancreas is severely damaged instead of the digestive processes. For example, one candidate wrote: *The production of insulin will cease hence no regulation of blood sugar level, there will be no production of hormones and if hormonal system fail the nervous system will not play its part*. Other candidates who were aware of the roles of the pancreas. For example, one candidate wrote: *If the pancreas is severely damaged emulsification of lipids would be impaired*. The candidate was not aware that bile is produced from the gall bladder and not from the pancreas.

Another candidate wrote: *If the pancreas is severely damaged, there will be no production of aldosterone hormone which increase water reabsorption in the gut during water shortage*. Another candidate wrote: *If the pancreas is severely damaged, the hormones will be denatured*. The candidate was not aware that, although the pancreas produces insulin and glucagon hormones, the hormones are involved in the regulation of sugar and not digestion of food. Furthermore, other candidates gave unclear responses. For example, one candidate wrote: *The bile will replace the function of pancreas as the content will pass through bile duct to duodenum, since pancreas play two different roles as nervous and hormonal control of digestive juice.*

In part (b), some of the candidates gave incorrect response. For example, one candidate wrote: *if the pH of duodenal enzymes remained at 2 there will be corrosion of the wall of the duodenum.* Other candidates gave partial correct responses, which did not deserve full marks. For example, one candidate wrote: *if the pH of duodenal enzymes remained at 2 the digestion in the duodenum will stop*. The candidate did not give any description as per the question's demand.


5 (a) (i) The bile will replace the function of pancrease, as the content will pass through ~~bile duct~~ bile duct to duodenum.

(ii) Since pancrease play two different role as nervous and hormonal control of digestive juice, so if hormonal system will fail nervous system will play it part.

(b) The enzyme will stop to function and also can be damaged.

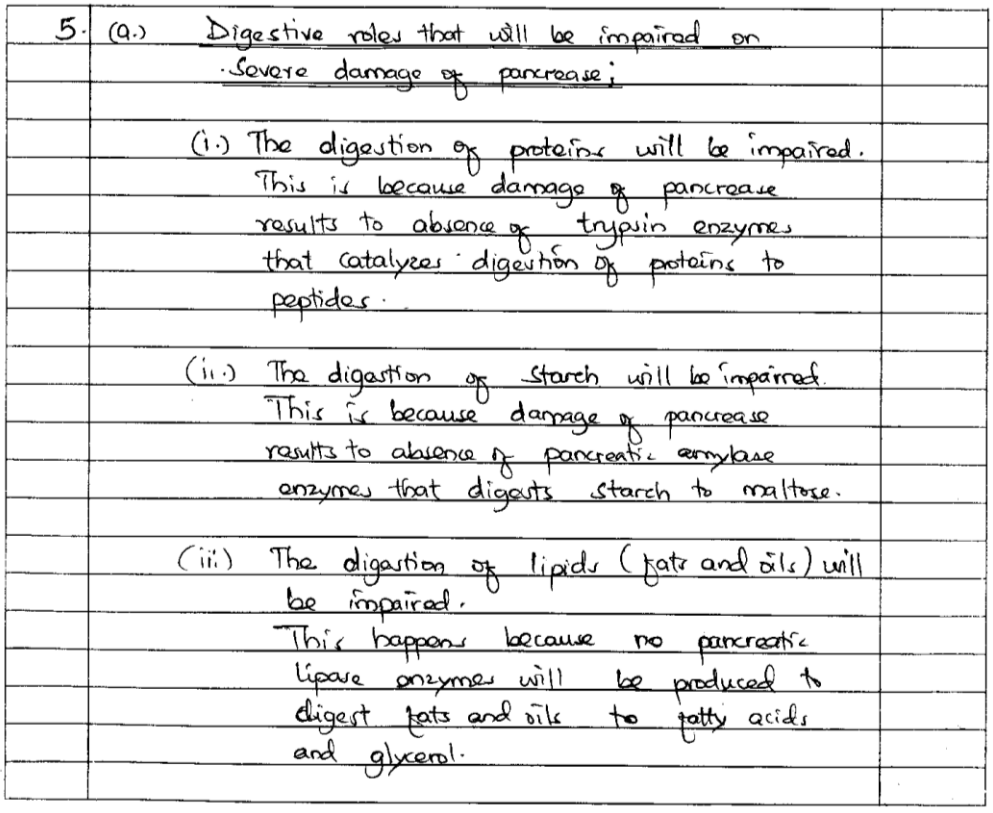
Extract 5.1: A sample of the candidates' incorrect responses to Question 5

In extract 5.1 the candidate incorrectly showed that pancreas and bile work together such that, if the pancreas is severely damaged then bile can work on behalf.

Although most of the candidates (78.5%) scored low marks, a few candidates scored from 3.5 to 5.5 marks. These candidates scored low marks in part (a) because they gave partial responses. For example, one candidate wrote: *If the pancreas is severely damaged the digestion of starch, protein and lipid will not take place*.

Conversely, 6.7 per cent of the candidates scored high marks (6.0 to 10.0). They demonstrated a good mastery of the competencies in the topic of Nutrition, particularly the subtopic of Digestion in mammals. The candidates were aware that the pancreas secretes pancreatic juice which contains various enzymes that digest starch, proteins and lipids in the duodenum. The juice also contains sodium bicarbonate, which neutralises acidic chyme and provides the best alkaline medium for effective functioning of the enzyme.

In part (b), the candidates were aware that enzymes are specific to the pH in which they work and that they work best under optimum pH. Therefore, alteration of the concentration of hydrogen ions will cause alteration of the active site of an enzyme, making it lose the ability to bind substrates and convert them into products. Extract 5.2 is a sample of the correct responses from one of the candidates.


5. (a.) Digestive roles that will be impaired on severe damage of pancrease;

(i.) The digestion of proteins will be impaired. This is because damage of pancrease results to absence of trypsin enzymes that catalyzes digestion of proteins to peptides.

(ii.) The digestion of starch will be impaired. This is because damage of pancrease results to absence of pancreatic amylase enzymes that digests starch to maltose.

(iii.) The digestion of lipids (fats and oils) will be impaired. This happens because no pancreatic lipase enzymes will be produced to digest fats and oils to fatty acids and glycerol.

(iv.) Digestion of food substances in the small instestine will be impaired due to failure to secrete hydrogen carbonate salt of sodium which provide basic medium for efficient working of duodenal and ileum enzymes.
- Thus enzymes will be denatured due to acidic medium because sodium hydrogen carbonate is not produced.

(b.) The duodenal enzymes will be less efficient due to denaturation or inactivation in acidic medium.

The reason for the denaturation is that duodenal enzymes work in basic medium to act on fats and oils, starch, proteins.

Extract 5.2: A sample of the candidates' correct responses to Question 5

In Extract 5.2, the candidate stated the digestive roles that would be affected based on the contents of pancreatic juice which will not be produced if the pancreas is severely damaged in part (a). In part (b), the candidate pointed out that enzymes are specific to the pH. Hence, alteration in pH will either hinder their function or lower their efficiency.

2.1.6 Question 6: Cytology

The question measured the candidates' competence in the cell structure. In part (a) required the candidates to explain why most of the reactions of the cell take place in the cytoplasm. Part (b) required them to explain why cytoplasm is an important part of the cell.

Data show that all candidates responded to the question. The analysis of their performance is shown in Figure 5.

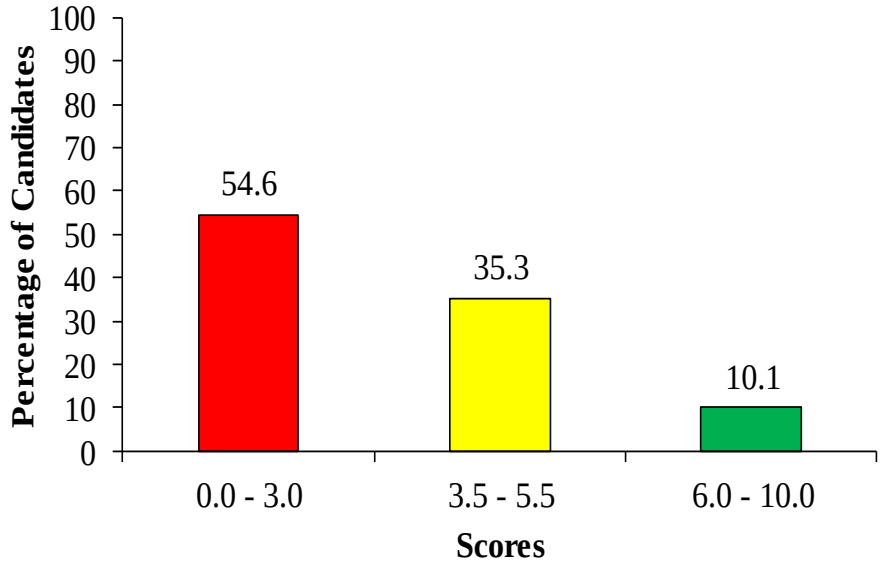


Figure 5: *Distribution of Candidates' Scores on Question 6*

Figure 5 indicates that, 45.4 per cent of the candidates scored from 3.5 to 10.0 marks while 54.6 per cent scored from 0.0 to 3.0 marks.

The analysis of the candidates' responses reveals that those who scored from 6.0 to 10.0 marks were competent in the tested concept. Therefore, in part (a) of the question, they were aware that the cytoplasm contains enzymes, organelles, ions and soluble organic compounds needed for the various reactions of the cell to take place. In part (b), they were knowledgeable about the roles played by the cytoplasm such as storing energy in the form of ADP and ATP, transporting organelle and processing some chemicals. Extract 6.1 is a sample of the correct responses from one of the candidates.

06 a) The following are the reasons as to why most of cell reaction occur or takes place in cytoplasma.

i) Most of cell organelles are suspended in cytoplasma and thus they are responsible for their activities or processes example free ribosome which are highly suspended in the cytoplasma perform protein synthesis.

ii) Some of enzymes for some reaction are suspended in the cytoplasma example the enzymes responsible for process of glycosis are in cytoplasma example hexokinase, aldolase, enolase enzymes.

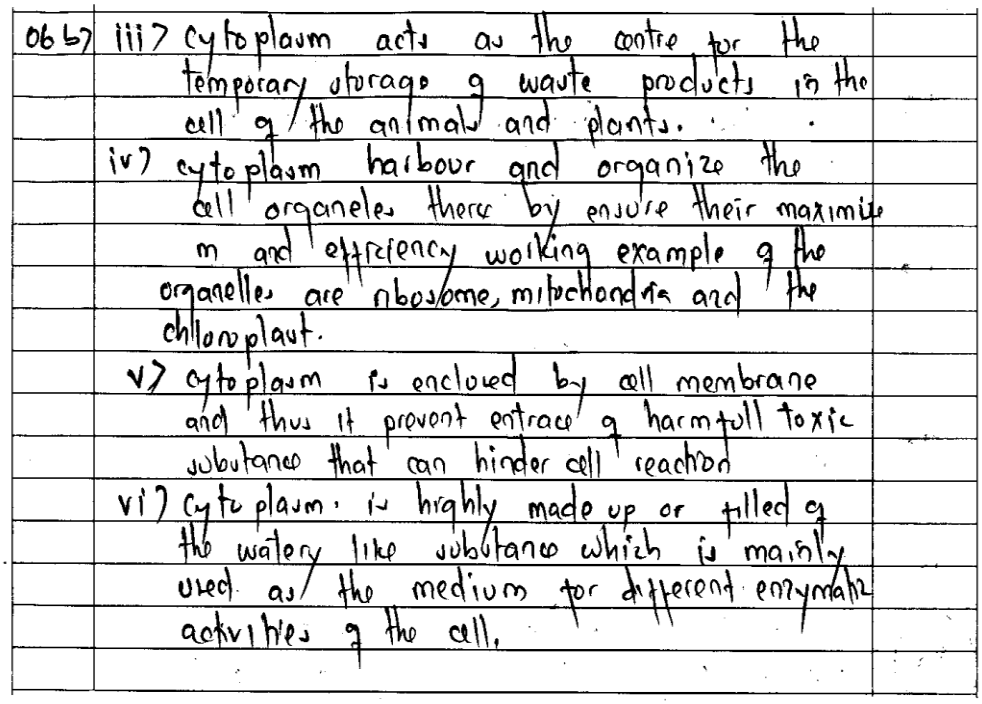
iii) Presence of some molecules of ATP in the cytoplasm acts as the activator for the cellular reactions example ATP provide energy for activation of process of glycolysis by mainly photophosphorylation of sugar thus make it more succesible to enzymes.

iv) cytoplasma of some species possesed the food storage parts like lipid granules and starch granules which store food oxidized to provide energy for many different cell reactions.

06 b) Functions played by cytoplasma.

i) cytoplasm acts as a centre of many cellular reaction such as glycolysis and protein synthesis.

ii) cytoplasm help in storage of usefull materials and food in cell such as lipid droplet and starch granules.



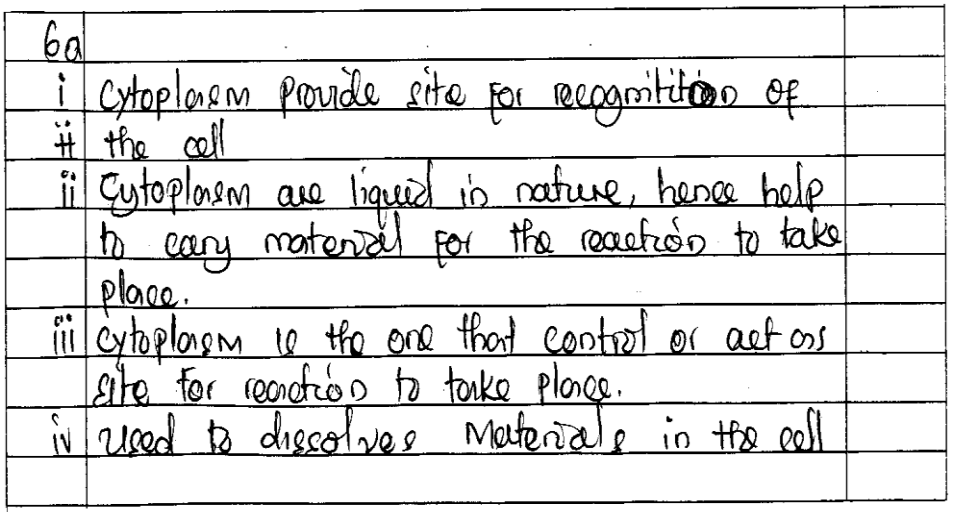
Extract 6.1: A sample of the candidates' correct responses to Question 6

In Extract 6.1, the candidate was knowledgeable about the features of cytoplasm that make it a suitable site for most reactions in part (a). In part (b), the candidate demonstrated knowledge of the features that makes cytoplasm an important part of the cell.

The candidates who scored from 3.5 to 5.5 marks, did not get any marks in part (b) because they wrote the contents of the cytoplasm instead of its functions. For example, one candidate wrote: *Cytoplasm is an important part of the cell because it is fluid in nature*.

Likewise, the candidates who had weak performance, scored zero in part (b). In part (a), did not score full marks because they had not given entirely correct responses. For example, one candidate wrote: *Most reactions of the cell take place in the cytoplasm because cytoplasm provides site for recognition of the cell*. The candidates were not aware that, cell-cell recognition is done by the cell membrane. The membrane has glycocalyx made up of glycoproteins and glycolipids which are sensitive; hence, they help in cell-cell recognition. The candidates who scored zero did not adhere to the demand of the question. For example, most of these candidates wrote the functions of cytoplasm instead of adaptations of the cytoplasm for various reactions in part (a). In part (b), they wrote features of

cytoplasm instead of the functions. Extract 6.2 is a sample of candidates' incorrect responses.


6a
i Cytoplasm provide site for recognition of
ii the cell
ii Cytoplasm are liquid in nature, hence help
to carry material for the reaction to take
place.
iii cytoplasm is the one that control or act as
site for reaction to take place.
iv used to dissolves Materials in the cell

Extract 6.2: A sample of the candidates' incorrect responses to Question 6(a)

In Extract 6.2, the candidate provided functions of the cytoplasm instead of features which make it a suitable site for most of the reactions of the cell in part (a).

2.1.7 Question 7: Coordination

The question measured the candidates' competence in the formation and conduction of a nerve impulse. The question required the candidates to describe with the help of diagrams the conduction of the nerve impulse along an unmyelinated neurone.

Data show that all candidates responded to the question. The analysis of their performance is shown in Figure 6.

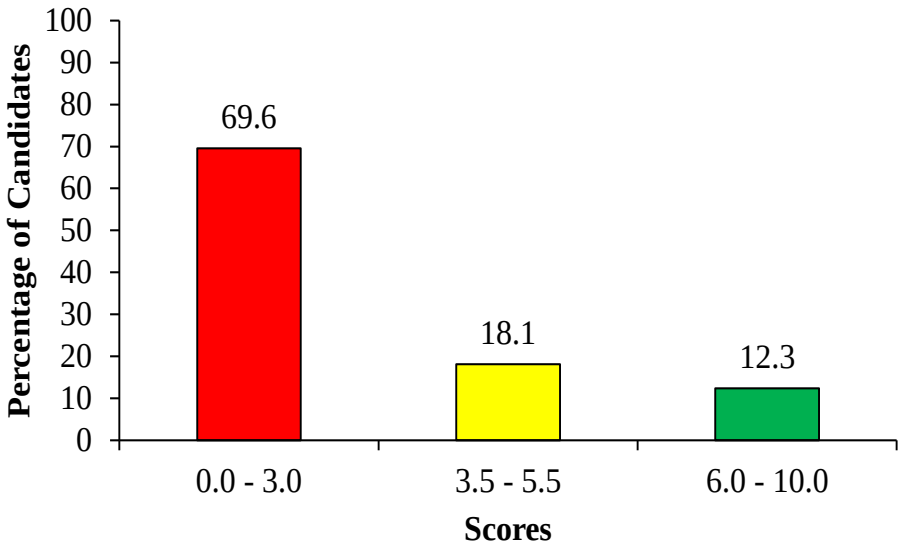


Figure 6: *Distribution of Candidates' Scores on Question 7*

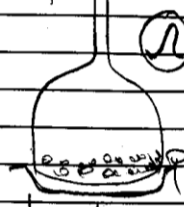
Figure 6 shows that, more than half of the candidates (69.6%) scored from 0.0 to 3.0 marks while 30.4 per cent scored from 3.5 to 10 marks.

The candidates with weak performance (69.6%) either lacked competence in the tested concept or did not adhere to the requirement of the question. For example, some of the candidates assumed that, the neuron is depolarised when at rest. Thus, they considered the concentration of sodium ions to be high inside the membrane when the membrane is at rest. Therefore, they failed to show how local electrical circuits are formed and involved in the transmission of the impulse.

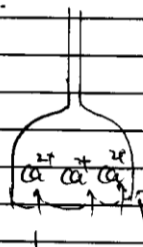
In contrast, some of these candidates drew the diagrams of motor, sensory or relay neurone, and explained the roles of their parts. Other candidates described and drew diagrams showing the transmission of impulse across the synapse, instead of the transmission of the impulse along the unmyelinated neuron. These candidates demonstrated low competence. Some of them described one to three of the first stages of transmission of impulse in a neurone without using any diagram or with incorrect diagrams. Some of their incorrect diagrams indicated that the membrane of the neurone is negatively charged outside when at resting potential instead of positively charged. Extract 7.1 is a sample of the incorrect responses from one of the candidates.

07 i) Depolarisation

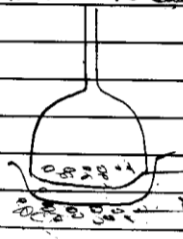
i) The arrival of nerve impulse at the synaptic knob depolarises the pre-synaptic membrane



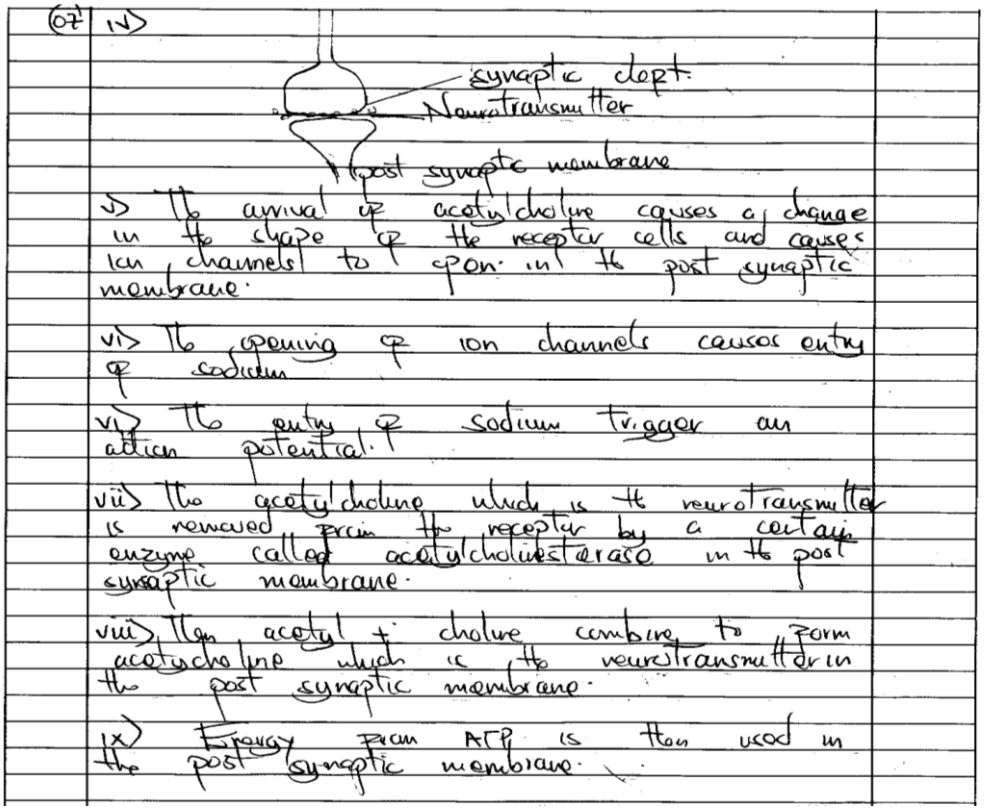
ii) Depolarisation of pre-synaptic membrane causes calcium ion to open and increase to Ca^{2+}.



iii) As calcium ruch into the presynaptic membrane synaptic vesicle fusses with pre-synaptic membr ane and release a neurotransmitter.



iv) The neurotransmitter diffuse across the synaptic cleft and attaches to a particular receptor in the post synaptic membrane.

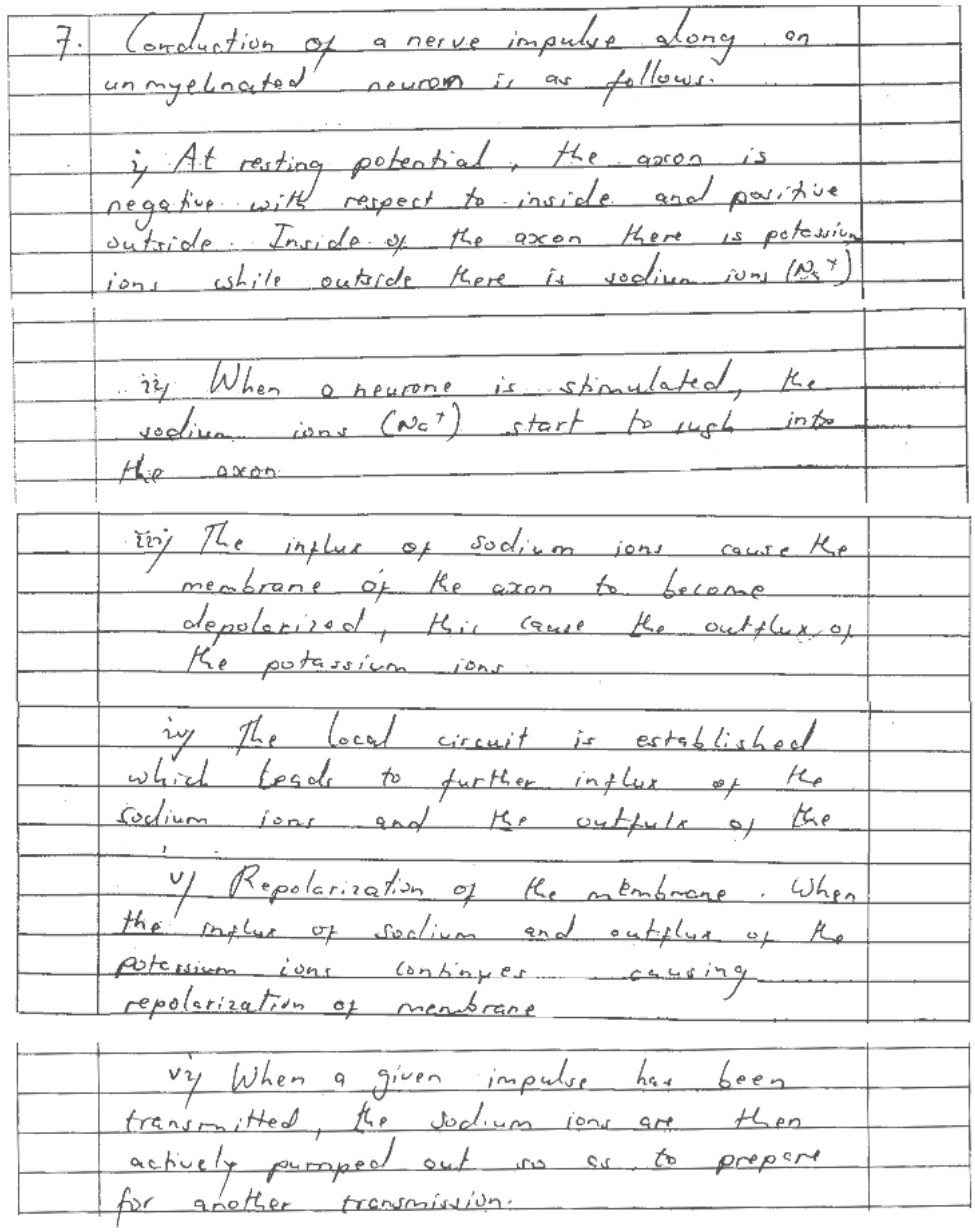


Extract 7.1: A sample of the candidates' incorrect responses to Question 7

In Extract 7.1, the candidate used diagrams of synapse to describe the transmission of the nerve impulse across the synapse instead of transmission along the unmyelinated neurone.

A further analysis of the candidates' responses reveals that, the candidates who scored from 3.5 to 5.5 marks, could not get full marks since they described incorrectly some of the stages of the transmission of impulse or by presenting incorrect diagrams. This was caused by the candidates' inadequate knowledge of the polarization, depolarisation and repolarization of neurone membrane when at rest, during and after transmission, respectively.

The candidates with high performance were aware that a neurone is polarised at resting potential and depolarised when stimulated where a local circuit is created, which propagates the transmission of the nerve impulse along the axon. Extract 7.2 is a sample of the correct responses from one of the candidates.


7. Conduction of a nerve impulse along an unmyelinated neuron is as follows:

i) At resting potential, the axon is negative with respect to inside and positive outside. Inside of the axon there is potassium ions while outside there is sodium ions (Na^+)

ii) When a neurone is stimulated, the sodium ions (Na^+) start to rush into the axon

iii) The influx of sodium ions cause the membrane of the axon to become depolarized, this cause the outflux of the potassium ions

iv) The local circuit is established which leads to further influx of the sodium ions and the outflux of the

v) Repolarization of the membrane. When the influx of sodium and outflux of the potassium ions combines causing repolarization of membrane

vi) When a given impulse has been transmitted, the sodium ions are then actively pumped out so as to prepare for another transmission.

Extract 7.2: A sample of the candidates' correct responses to Question 7

In Extract 7.2, the candidate correctly described the conduction of impulse along an unmyelinated neurone by showing the alteration of influx and out flux of sodium and potassium across the axon membrane. However, the candidate did not draw diagrams.

2.1.8 Question 8: Gaseous Exchange and Respiration

The question required the candidates to describe the adaptations to oxygen uptake shown by the mammalian foetus, mountain dwellers and divers.

The question was attempted by 92.8 per cent of the candidates. It was the most attempted ones among the optional questions. Figure 7 illustrates the candidates' performance.

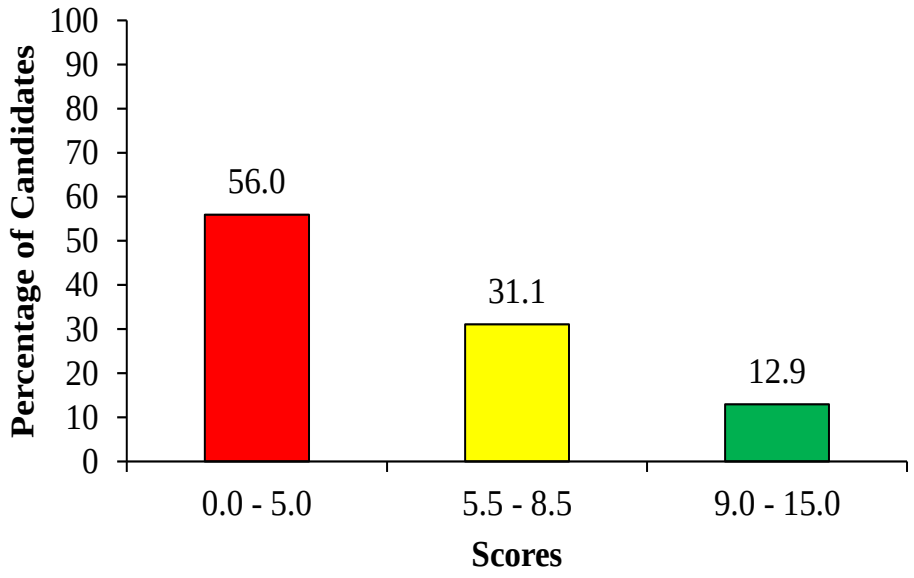


Figure 7: *Distribution of Candidates' Scores on Question 8*

Figure 7 shows that the candidates' performance on Question 7 was average since 44.0 per cent scored from average and above.

The candidates (12.9%) who scored from 9.0 to 15.0 marks demonstrated good competence in the topic of Gaseous Exchange and Respiration, particularly Gaseous exchange in mammals. These candidates were aware that, the mammalian foetus, mountain dwellers and divers live in the environment where they need to have special features such as a high concentration of haemoglobin in the red blood cell for efficient uptake of oxygen for their survival. Extract 8.1 is a sample of the correct responses to the question.

8. Mountain dwellers.

Mountain dwellers are those who dwell in high altitude. Mountain dwelle experience a problem of Low partial pressure of oxygen at high altitude that some can suffe from mounta in sickeness. To avoid such proble m mountain dwellers are adapted for uptake of oxygen as follows

i. They have Large lung. Moont ain dweller posses Large lung whi ch increase the tidal volume for the maximum and efficient upta ke of oxygen

ii. Their bone marrow produce more red blood all that incre ase the chance of transportation of oxygen

iii. Their tissue are tolerant to Low oxygen content that are capable of undergoing an aerobic respiration at high altitude

iv. They tend to have slow breath and slow heartbeat rate for efficient up take of oxygen

8 v. They tend to redirect blood to the vital organs like brain

vi. They have haemoglobin and myoglobin which have greater affinity for oxygen that enhance more taking up of oxygen

vii. Mountain dwellers also decrease their metabolic rate to minimize the consumption of oxygen

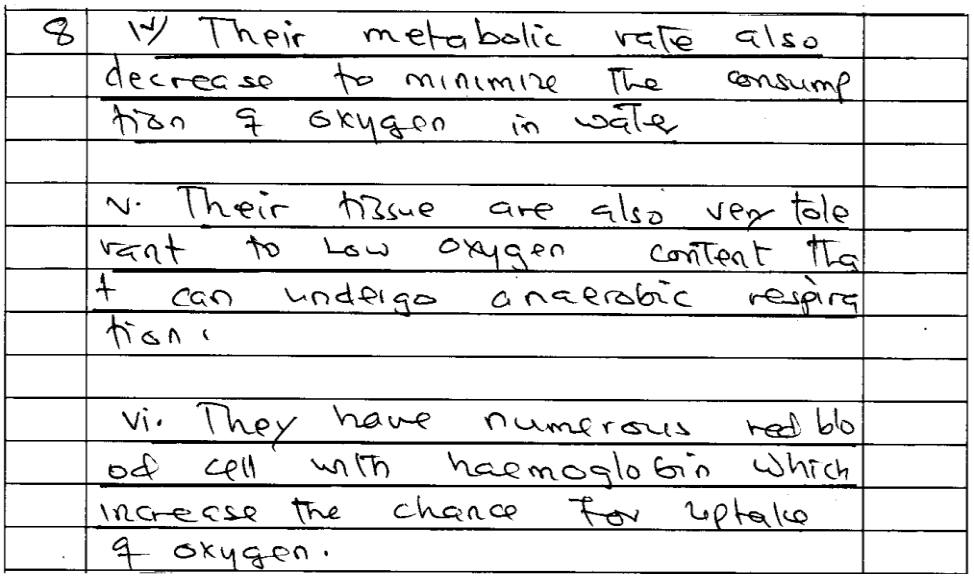
DIVER.

Diver are adapted for taking up oxygen as follows

i) They breath slow and even stop for a moment and their heart rate are very slow for effective taking up of oxygen

ii) They have numerous myoglobin which have greate affinity of oxygen

iii. They redirect blood to the vital organs like heart and brain for making them active in work.

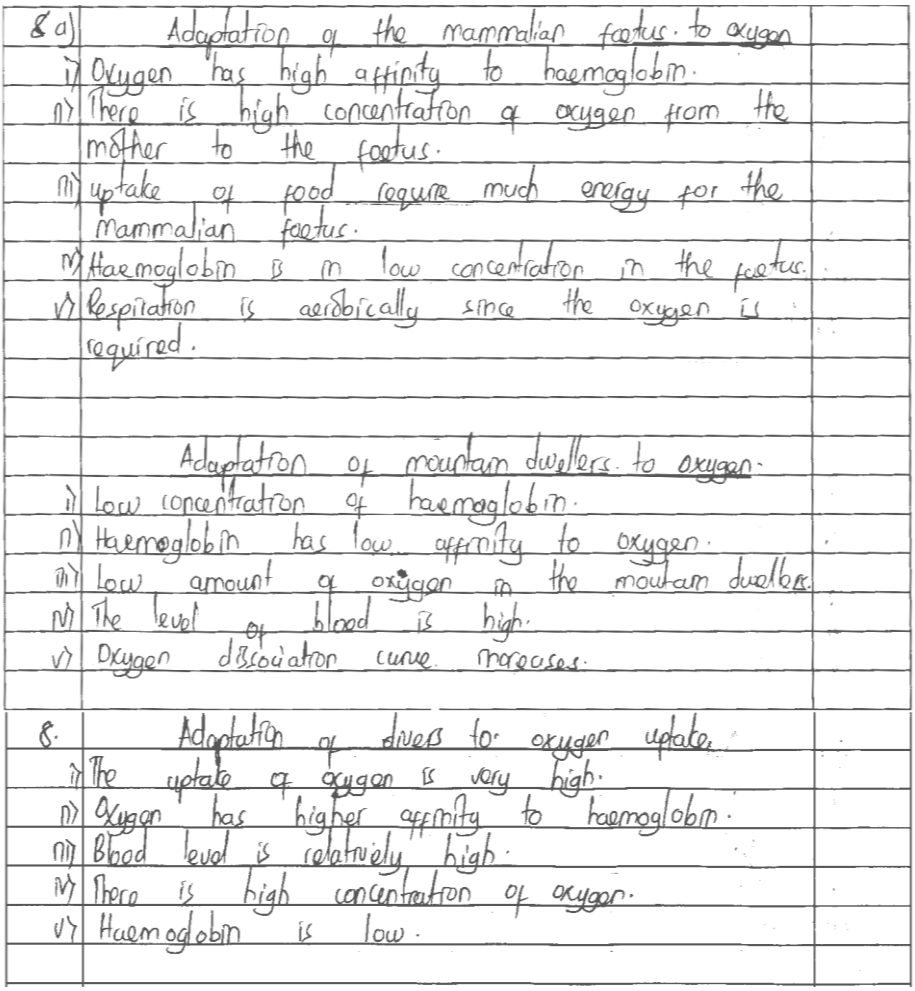


Extract 8.1: A sample of the candidates' correct responses to Question 8

In Extract 8.1, the candidate correctly described the adaptive features of the mammalian foetus, mountain dwellers and divers in relation to oxygen uptake in their respective environments.

Thirty-one per cent (31.1%) of the candidates with average performance, did not score full marks on the adaptations of the mammalian foetus, diver and mountain dweller.

The candidates with low performance lacked competence in the tested concepts. This was revealed in their responses whereby they stated the features of the respective organisms without showing how the features help such organisms in the uptake of oxygen. For example, one candidate wrote: *Mammalian foetus has haemoglobin and high concentration of red blood.* Another candidate wrote*: In mammalian foetus, oxygen has high affinity to haemoglobin*. Another candidate wrote: *One of the adaptations in divers is formation of extra alveoli*. Yet another candidate wrote: *Mountain dwellers are adapted by having high blood pressure which assist to absorb oxygen from low oxygen partial pressure altitudes*. Besides, some candidates drew oxygen dissociation curves for the mammalian foetus, mountain dwellers and divers. This was contrary to the requirement of the question. Extract 8.2 is a sample of the incorrect responses to this question.


8 a) Adaptation of the mammalian foetus to oxygen
i) Oxygen has high affinity to haemoglobin.
ii) There is high concentration of oxygen from the mother to the foetus.
iii) uptake of food require much energy for the mammalian foetus.
iv) Haemoglobin is in low concentration in the foetus.
v) Respiration is aerobically since the oxygen is required.

Adaptation of mountain dwellers to oxygen.
i) Low concentration of haemoglobin.
ii) Haemoglobin has low affinity to oxygen.
iii) Low amount of oxygen in the mountain dwellers.
iv) The level of blood is high.
v) Oxygen dissociation curve increases.

8. Adaptation of divers to oxygen uptake.
i) The uptake of oxygen is very high.
ii) Oxygen has higher affinity to haemoglobin.
iii) Blood level is relatively high.
iv) There is high concentration of oxygen.
v) Haemoglobin is low.

Extract 8.2: A sample of the candidates' incorrect responses to Question 8

In Extract 8.2, the candidate wrote incorrect responses such as haemoglobin is in low concentration in foetus and some features of mountain dwellers such as a high level of blood.

2.1.9 Question 9: Reproduction

The candidates were provided with Figure 1, which shows the interaction of reproduction hormones.

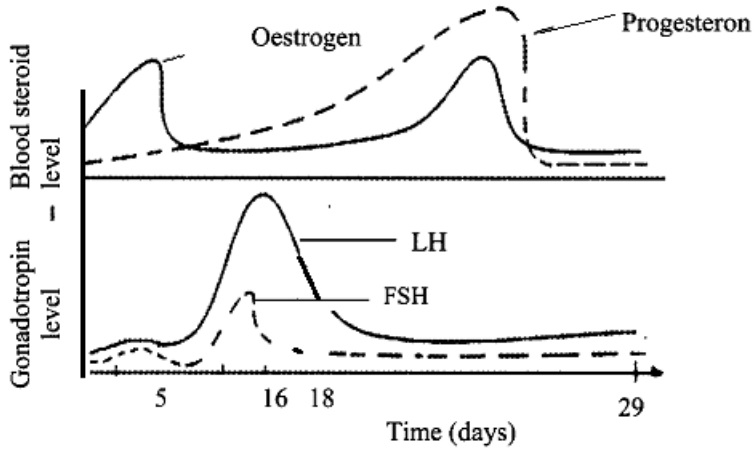


Figure 1

They were required to study the figure and (a) explain the importance of hormones shown in the figure and (b), predict hormonal changes which would have occurred if pregnancy had occurred on the 18th day of the menstrual cycle.

This question was chosen by less than a quarter of the candidates (21.9%). It was the least chosen question among the optional ones. The performance of the candidates is summarised in Figure 8.

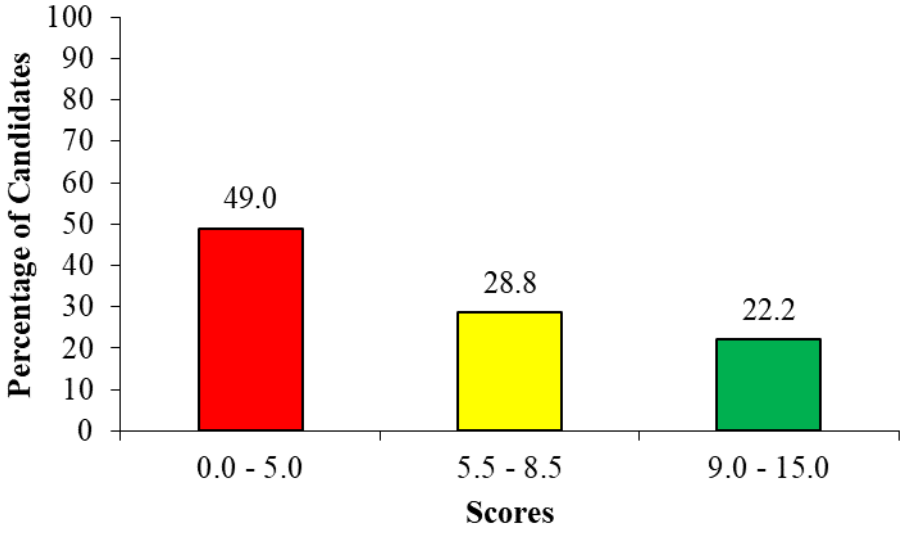
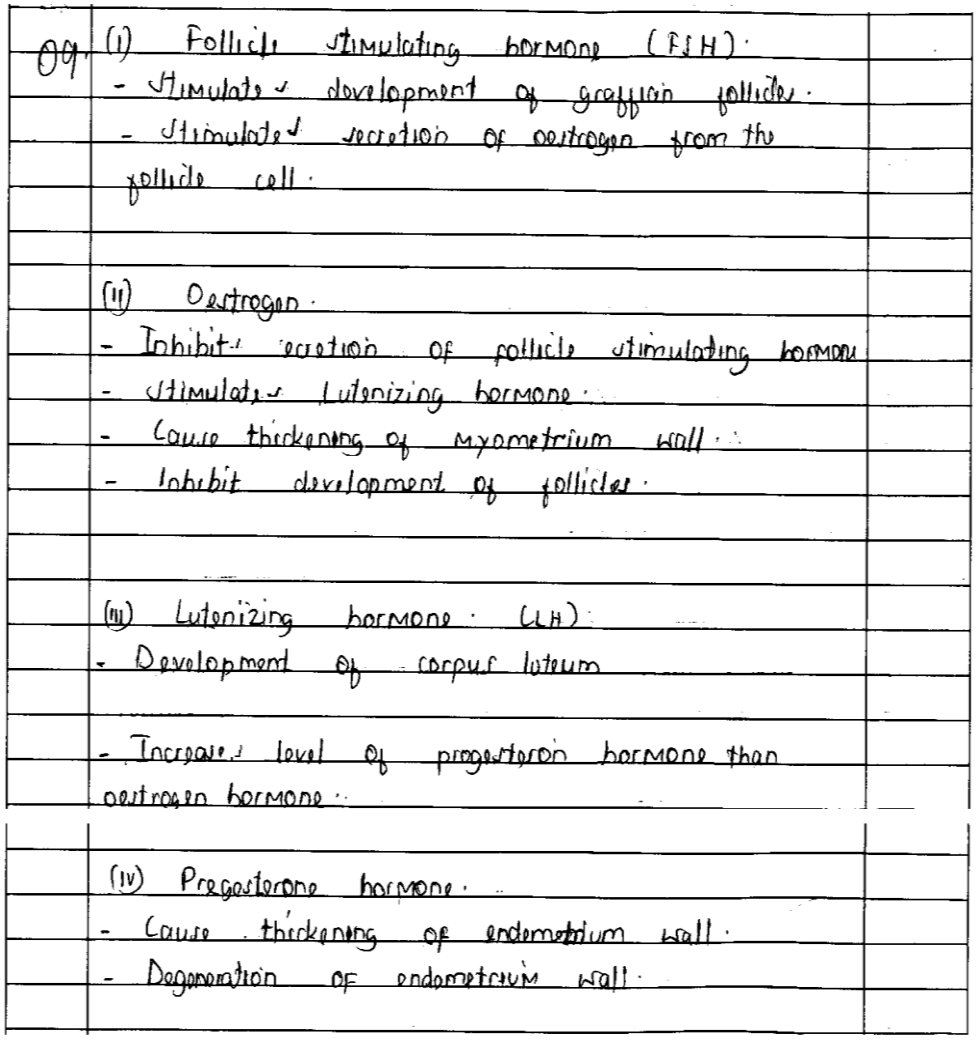
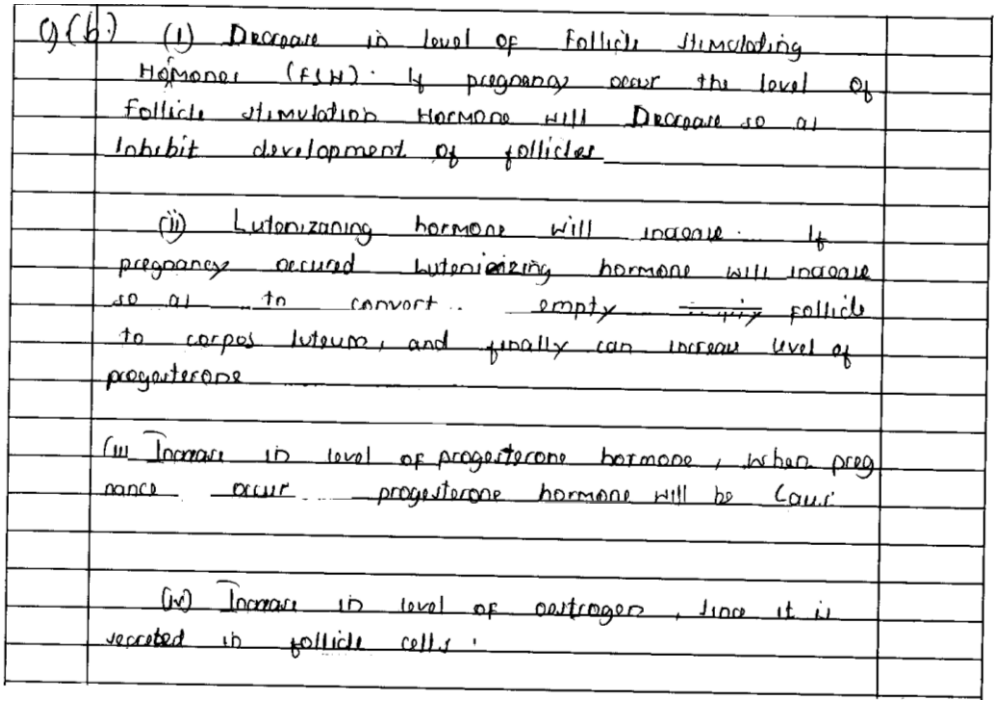


Figure 8: *Distribution of Candidates' Scores on Question 9*

Figure 8 shows that about half of the candidates (51.0%) passed the question by scoring from 5.5 to 15.0 marks. This indicates average performance.

The candidates (22.2%) who scored high marks (from 9.0 to 15.0) were aware of the reproductive hormones and their changes when pregnancy occurs. These candidates explained correctly all or most of the required roles of oestrogen, progesterone, LH and FSH in part (a). In part (b), they correctly explained the interaction of that hormones before and during pregnancy. Extract 9.1 is a sample of the correct responses from one of the candidates.




9(b) (i) Decrease in level of follicle stimulating Hormone (FSH). If pregnancy occur the level of follicle stimulation Hormone will Decrease so as Inhibit development of follicles

(ii) Luteinizing hormone will increase. If pregnancy occured Luteinizing hormone will increase so as to convert empty ~~follicle~~ follicle to corpos luteum, and finally can increase level of progesterone

(iii) Increase in level of progesterone hormone, when pregnance occur progesterone hormone will be Coun

(iv) Increase in level of oestrogen, since it is secreted in follicle cells.

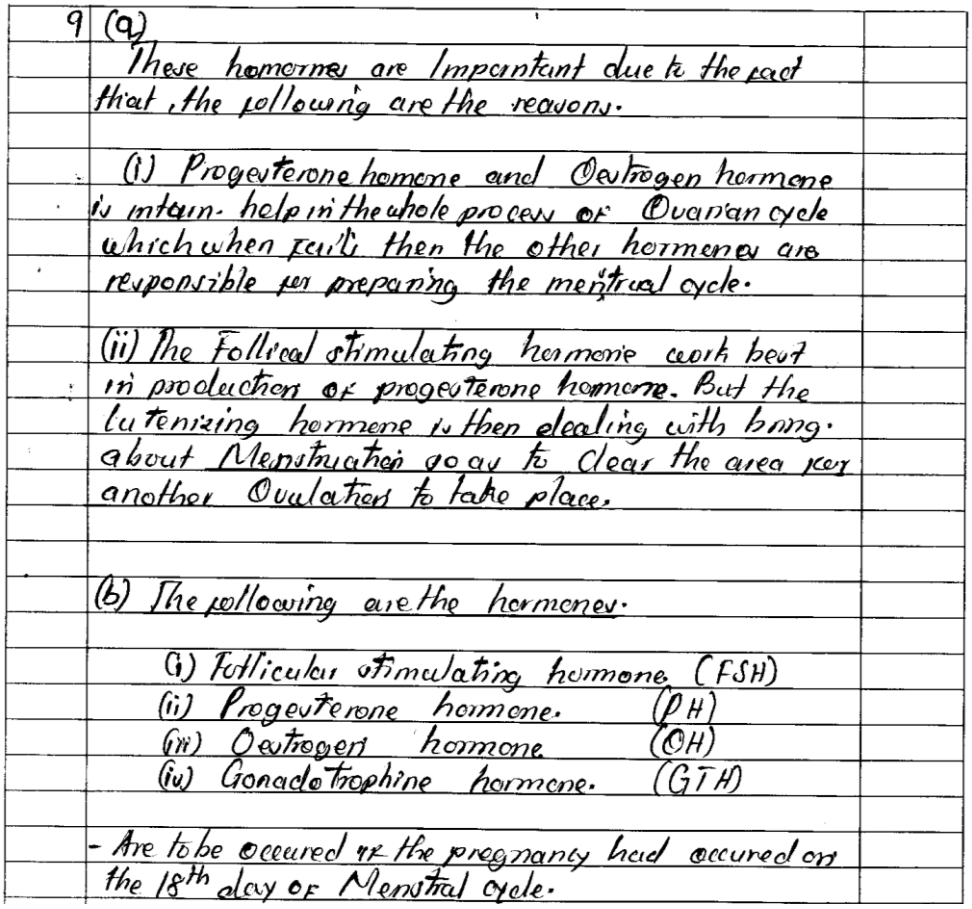
Extract 9.1: A sample of the candidates' correct responses to Question 9

In Extract 9.1, the candidate demonstrated adequate knowledge of the roles of the hormones and their changes during pregnancy in part (a). In part (b), the candidate showed that the level of some hormones is high before pregnancy and low during pregnancy such as FSH.

The candidates who scored average marks (5.5 to 8.0) were knowledgeable about the roles performed by each reproductive hormone shown in Figure 1. However, they did not know the changes which occur in those hormones during pregnancy.

The candidates who scored zero, completely lacked knowledge about the hormones controlling menstrual and oestrus cycles. Therefore, they stated incorrect functions of these hormones. For example, one candidate wrote: *The changes which occur if pregnancy occurs in day 28 are increase in the production of FSH and ovulation*. This candidate was not aware that FSH is responsible for the formation of follicles, a process which cannot take place if pregnancy occurs. This is because during pregnancy there is no need for the formation of follicles until after delivery. Therefore, if pregnancy occurs, the level of FSH decreases. In the same way, ovulation cannot take place during this time. This is because ovulation is the release of ovum from a matured follicle, and since during pregnancy the level of FSH is low, there is no development/maturation of the follicles, hence there will be no ovulation. In addition, some candidates outlined

the signs of pregnancy as the hormonal changes that will occur in a female if pregnancy occurs in day 28. One of these candidates wrote: *the woman will start to vomit, bleeding will stop, the woman will feel tired and the human chorionic gonadotrophic hormone will appear in female urine*. Extract 9.2 is a sample of the incorrect responses to the question.



9 (a)
These homornes are Impcantant due to the fact that the following are the reasons.

(i) Progesterone homone and Oestrogen hormone is intain. help in the whole procesu of Ovarian cycle which when fail then the other hormenes are responsible for preparing the menstrual cycle.

(ii) The Follical stimulating hormone work best in production of progesterone hormone. But the lutenizing hormene is then dealing with bring about Menstruation go on to clear the area for another Ovulation to take place.

(b) The following are the hormones.

(i) Follicular stimulating hormone (FSH)
(ii) Progesterone hormone. (PH)
(iii) Oestrogen hormone (OH)
(iv) Gonadotrophine hormone. (GTH)

- Are to be occured if the pregnancy had occured on the 18th day of Menstral cycle.

Extract 9.2: A sample of the candidates' incorrect responses to Question 9

In Extract 9.2 the candidate incorrectly wrote that the FSH produces progesterone and LH, bringing about menstruation.

2.1.10 Question 10: Transport

In part (a), the candidates were required to explain the adaptation of xylem for water transport and in part (b), they were required to explain how the capillarity force governs the upward movement of water and mineral salts.

This was the second most opted question since it was attempted by 84.3 per cent of the candidates. The analysis of the candidates' performance is shown in Figure 9.

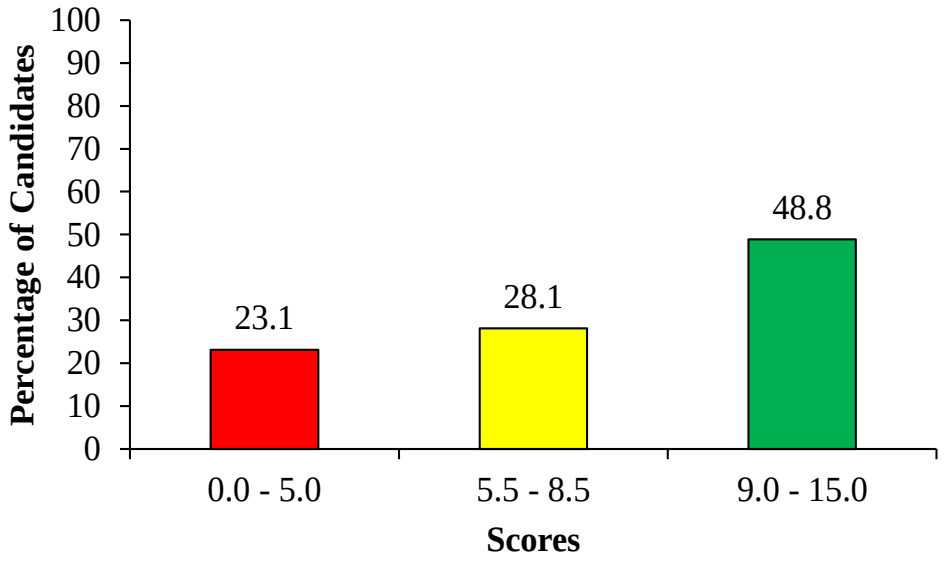


Figure 9: *Distribution of Candidates' Scores on Question 9*

Figure 9 illustrates good performance where, more than three quarters (76.9%) scored from 5.5 to 15 marks.

The candidates who scored high marks (from 9.0 to 15.0) demonstrated competence in the topic of Transport, particularly in the subtopic of Upward Movement of Water and Mineral Salts. The candidates knew that xylem is a plant tissue concerned with the transport of water and mineral salts. The tissue is also concerned with support. Therefore, it has features which help it to accomplish those roles. Moreover, they were aware that the capillarity force is created by the narrowness of the xylem tube, and it works in conjunction with cohesion and adhesion forces. The cohesion force is caused by the attraction of water molecules, whereas the adhesion force is caused by the attraction of water molecules and the wall of the xylem. Extract 10.1 is a sample of the correct responses from one of the candidates.

10 (a) Xylem is the vascular tissue which deals with translocation of water and mineral salt from roots to all parts of the plant body

Adaptations of Xylem

They have narrow lumen, This make water and mineral ions to move upward by capilary action

They have lateral pits, for lateral or sideway movement of water and mineral ions

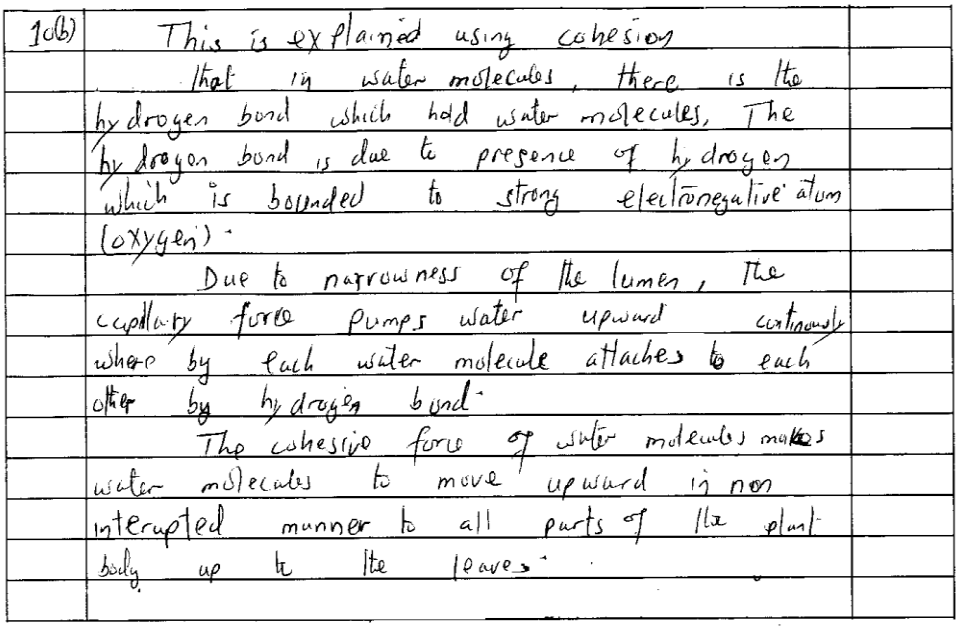
The tracheid and Xylem vessel lack cell organelles such as nucleus and mitochondria, in order to increase surface area for upward movement of water and mineral ions

The cells; tracheid and xylem vessels join one another to form a continious tube, thus water move continously in the tube

They have lignified cell wall which enables it to with stand high pressure during the translocation without breaking

Lignified cell wall increase adhesive force between wall of xylem vessels and water molecules

(b) Capillary force is the force which forces water molecules and mineral ions from the soil to the upper part of the plant due to the narrowness of the lumen of the xylem



Extract 10.1: A sample of the candidates' correct responses to Question 10

Extract 10.1 shows that the candidate was knowledgeable about the adaptations of xylem for water transport and support. He/she was also aware on the how capillarity operates to bring about the upward movement of water and mineral salts.

Twenty-eight per cent of the candidates who had average performance failed to explain how the capillarity force operates in part (b). In part (a), they stated the features of xylem without explaining how they help to accomplish its roles. For example, one candidate wrote: *Xylem has tracheid* and *lateral pits.* In part (b), some candidates wrote the pathways for water and mineral salts in the roots. For example, one candidate wrote: *Apoplast, vacuolar and symplast pathways.*

The candidates who scored zero lacked competence on the concept tested in both parts (a) and (b). Extract 10.2 is a sample of the incorrect responses from one of the candidates.

10 b) UPWARD MOVEMENT OF WATER AND MINERAL SALTS

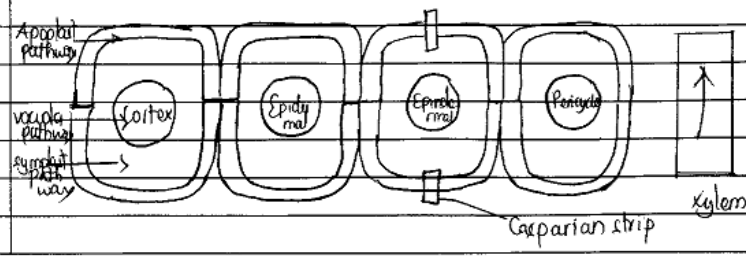
The upward movement of water and mineral salts is where the passing of water in different areas to the xylem. Water is passed in Cytoplasm, Cell wall and also in vacuole. It involve three main pathway which are known as Cymplast, Vacuda and Apoplast.

Apoplast pathway, this involves the movement of water in the cell wall and high amount of water is passing through apoplast. In the cell wall there is the suberin that will form a wax like in the Epindermal that known as Casparian strip, Casparian strip has the role of limit large volume of water to pass, also limit all toxic materials to pass also prevent the cell from bursting.

Symplast pathway, this is the way where water is passing in the cytoplasm without interconnected any where up to the xylem.

Vacuola pathway, this involves the movement of water to pass in the vacuole it start from the cortex, to the Epidermal, to the Epindermal and finally to the Pericycle and then direct to the Xylem.

The capilarity forces is very important because it help the movement of water to success by the force of gravity



Extract 10.2: A sample of the candidates' incorrect responses to Question 10

In Extract 10.2 the candidate described the pathways of water and mineral salts across the root, which are apoplast, symplast and vacuolar pathways. In addition, the candidate regarded the capillary force as the one which supports the pathways.

2.2 133/2 BIOLOGY 2

This paper consisted of six questions set from six topics. The topics were Comparative Studies of Natural Groups of Organisms, Regulation (Homeostasis), Growth and Development, Genetics, Evolution and Ecology. Each question carried 20 marks and the pass mark for each question was from 7.0 to 20.0 marks.

2.2.1 Question 1: Comparative Studies of Natural Groups of Organisms

In part (a), the candidates were required to justify the fact that viruses are considered to be non-living entities. In part (b), they were required to describe the economic importance of Protoctists and give example for each case.

The question was attempted by 96.3 per cent of the candidates. Data show that 58.0 per cent of the candidates passed the question by scoring from 7.0 to 20.0 marks. The performance is further illustrated in Figure10.

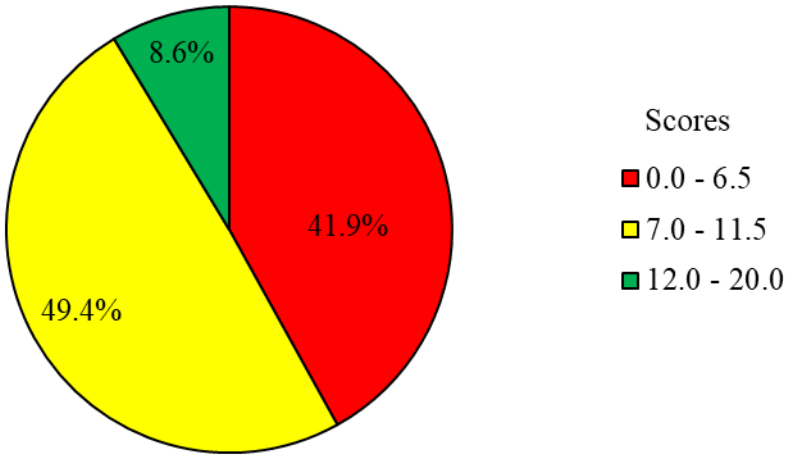


Figure 10: *Distribution of Candidates' Scores on Question 1*

Figure 10 shows that, more than a half of the candidates (58%) attempted the question well. Therefore, their overall performance was average.

Those who scored high marks (12.0 to 20.0) were aware that viruses, as non-living things, possess either DNA or RNA but not both. The viruses also lack cell structure/they are akaryotes and have the ability to crystallise. In addition, the candidates were knowledgeable about the various organisms which belong to the Kingdom Protoctista and their economic importance. However, some of these

candidates could not score full marks in part (b) of the question because they gave some incorrect examples of the organisms which belong to the Kingdom Protoctista. Besides, Extract 11.1 is a sample of the correct responses to the question.

1 a) viruses are the smallest organism which possess both living and non living characters, example of viruses are bacteriophage, HIV and others.

They are considered to be non living because of the following

» viruses crystallize outside the living host; most of viruses when they are outside the host they crystalline by not showing any characteristic, they act as dead.

» viruses do not grow neither reproduce outside the living host; when outside the host they loose their ability to grow and produce.

» viruses are accelular; all living organisms are made up of cells according to theory of cells hence viruses have no cellular structure that is cell hence they are non living

» viruses do not show any sensitivity outside the host; all living organisms show sensitivity but outside the host viruses do not show sensitivity and hence they are non livins organisms.

1b) Economic importances of protoctists.

i) Protoctists are source of nutrients in the soil and can be used as fertilizer due to high Nitrogen content they posses. Example; green algae

ii) Protoctists can cause Eutrophication. excess algae in water bodies cause eutrofication which is the source of blue babies and causing harm to the water, Example; euglena.

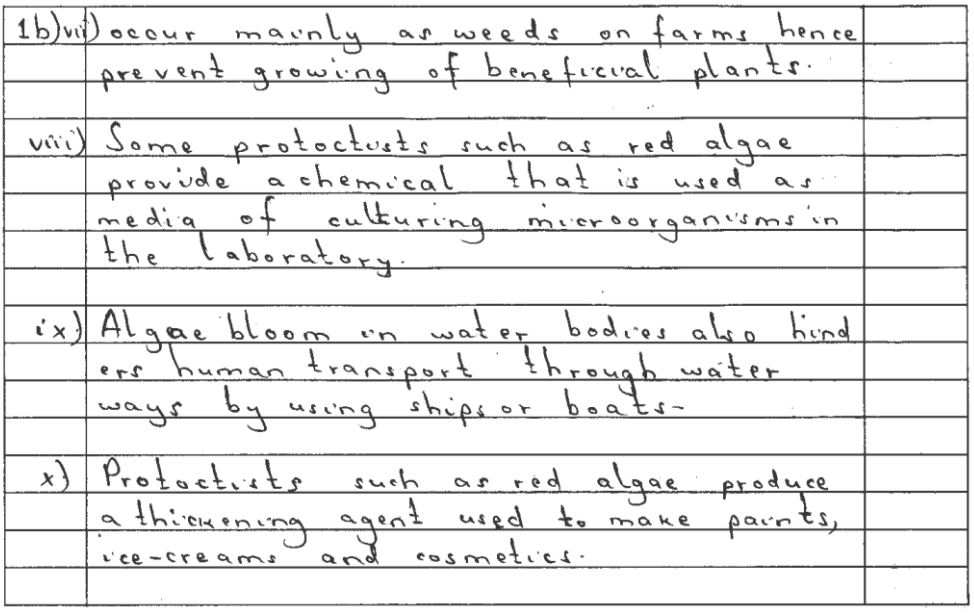
iii) Protoctists are source of oxygen, especially photosynthetic protoctists such as Euglena.

iv) Protoctists cause diseases to human beings and animals. Example malaria by plasmodium, amoeba dysentry by amoeba.

v) Algal bloom in water bodies hinders the aquatic organisms from getting enough oxygen and hence cause death of fishes and other aquatic creatures.

vi) Some protoctists are used as foods by both human beings and other aquatic organisms. Example; phytoplanktons and euglena and green algae.

vii) Some protoctists, such as green algae



Extract 11.1: A sample of the candidates' correct responses to Question 1

In Extract 11.1, the candidate provided correct justifications for the viruses to be considered as non-living entities in part (a) such as their inability to reproduce outside the host. In part (b), he/she used real examples to describe the economic importance of protoctists such as source of nutrients in the soil.

The candidates who scored average marks (from 7.0 to 11.5), in part (b) had given either fewer than the required points or incorrect economic importance of protoctists. Other candidates also gave incorrect example of organisms in the Kingdom Protoctista such as bacteria and viruses.

Likewise, the candidates who scored low marks (1.0 to 6.5), in part (b) had described the economic importance of fungi and bacteria instead of protoctists. Consequently, they provided examples of fungi and bacteria in each description instead of protoctists. In part (a), the candidates gave fewer than the required non-living features of viruses.

In contrast, the candidates who scored zero provided incorrect nonliving features of viruses such as their inability to attach to other organisms in part (a). In part (b), they described the economic importance of either the Kingdom Monera or Fungi instead of the Kingdom Protoctista. Likewise, they gave examples based on the Kingdom they described. Extract 11.2 presents a sample of the candidates' incorrect responses.

1. a) Viruses thus are organisms that are found in the environment. This virus has both living and non living organisms characters in the environment. It act as living when are inside the body of organism and non living when outside the cell of the body of organism

It can not cause disease, since they are found out of the cell of an organism are unable to cause any disease when outside of living organism cause it cause disease to the body of organism and not outside.

It can not degenerate, the viruses always degenerate to form their body by removing their protein coat while attaching organism but its difficult to degenerate outside the body of organism since their degenerate depends on the site where they are found in the body of organism so that they can attach other species especially their host by removing their protein coat.

They not attached to other species, this is the characteristics of virus as non living things simply because the virus are non living things when are found outside their cell it does not attach to any organism so it depend to their own which lead to the death of organisms in some or most cases. thus how virus entities as non living things.

Therefore, the viruses are mostly found in the body of organisms for for mostly of the time to catalyse certain function they only mostly are considered as living things than non living things in the entities.

1 b) protoctists, these are organisms that are found in kingdom protoctista. these organisms includes virus bacteria and amoeba. the following are the economic importance of protoctists

Used in biological studies, this protists are used in biological studies to determine their feature and their characteristics which help them to place into this kingdom and not other kingdom. Example Bacteria.

Used in biological control, this is the economic importance of protoctists simply because most of organism in the kingdom protoctist are used to control the food chain and food web in their cycles especially bacteria.

Used as decomposed, this is the economic importance of kingdom protoctist since they used to decompose dead organic matters in most of the environment. Example saprophytic bacteria

Used as a source of food, most of organisms in the kingdom protoctist are source of food in both human being and their other organism in the environment. Forexample bacteria used as source of food to other organism.

Used as a source of medicine, most of the organism that are found in the kingdom protoctista are used as people cure for different diseases forexample bacteria.

Used as source of income, this is the economic importance of of organism found in kingdom protoctist simply because most of organism are selled by people in most places in order to earn income in their family and country

1 b) at large forexample Amoeba are selled by people for experimental purposes.

Soure of foreign current, those organism are not found in all over the world but in few countries so its important to those countries which there is those organism since they earn foreign currency. forexample Enteroebs a found in few countries.

Soure of tourist attraction, this is the importance of organism of kingdom protoctist simply because due to the scarcity of those organisms the people from different countries visit other countries with those specie forexample most of foreign people visit African countries due to the presence of the organisms like Amoeba

Soure of employment this protoctist are used as soure of employment to those people who study fourts like carrory of organism which they use those organisms to earn their salary since those organisms needs great care in term of structure there forexample carrory of Enteroebs and Amoebas.

used in nitrogen fixation, most of organisms are used in nitrogen fixation in the environment to convert soil into nitrogen gas in the atmosphere of the ecosystem. Forexample bacteria are mostly protoctist used in the environment to convert nitrogen gas.

Therfore the protists also contain their effect to the environment like to cause diseases since most of diseases in the environment are caused by those protists.

Extract 11.2: A sample of the candidates' incorrect responses to Question 1

In Extract 11.2, the candidate incorrectly justified that viruses are considered to be non-living entities because they cannot cause diseases in part (a). In part (b), she/he incorrectly considered bacteria to be examples of protoctists.

2.2.2 Question 2: Regulation (Homeostasis)

The question tested the candidates' competence in the mechanism of temperature regulation in endotherms. Specifically, the question required the candidates to explain the role of the major components of the homeostatic system in part (a). In part (b), it required them to describe how hypothalamus controls temperature in the human body.

The question was chosen by 93.1 per cent of the candidates. The performance of the candidates is illustrated in Figure 11.

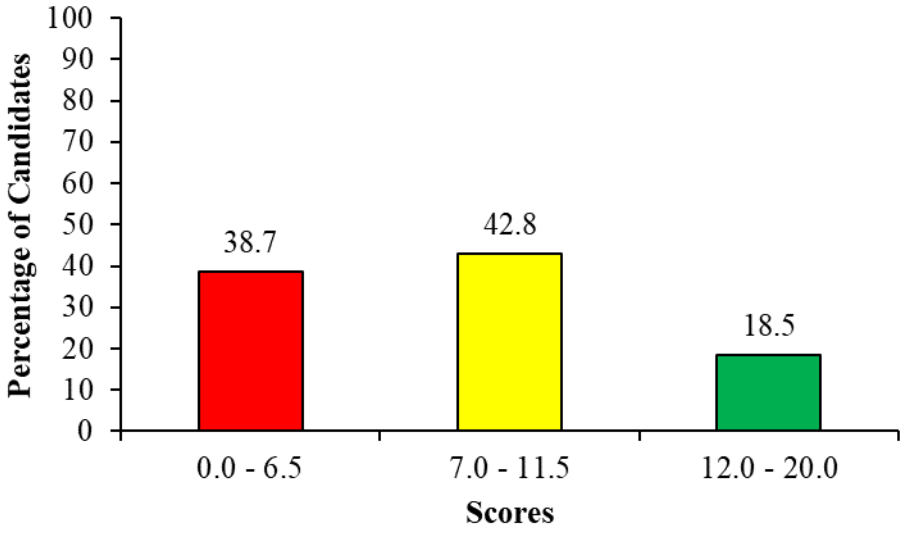


Figure 11: *Distribution of Candidates' Scores on Question 2*

Figure 11 shows good performance of the candidates on this question, where more than a half (61.3%) scored from 7.0 to 20.0 marks.

The candidates who scored from 12.0 to 20.0 marks demonstrated good competence in the topic of Regulation (Homeostasis). These candidates had adequate knowledge of the major components of the homeostatic system and their roles in part (a). For example, one of the components is effector, which brings the necessary change needed to return the system to the reference point. Likewise, in part (b), the candidates were aware that the hypothalamus controls the body temperature by lowering it during overheating and raising it during overcooling. Therefore, these candidates correctly described the mechanism of hypothalamus in controlling temperature in the human body. Extract 12.1 is a sample of the correct responses from one of the candidates.

2 (a) Homeostatic system is a system which regulates and controls the deviations from a set point (equilibrium point) by either positive feed back mechanisms or negative - feedback mechanisms. The major homeiostatic components - include: Stimulus, detector, coordinator/regulator, effector and response which have the following roles

If: Stimulus: Is an internal or external change which requires and appropriate response. Example:
decrease or rise of the body temperature,

If: Detector: It is the part of an organism which detects the deviation of level from the set point due to stimulus. The detector tend to compose of receptor cells which detect and transduce the stimulus detected.
Example: Osmoreceptors and thermoreceptors present as hypothalamus part of the brain tend to detects change in osmotic pressure of body fluid, and temperature of the body respectively

If: Coordinator: The coordinator tend to receive nerve impulse from detector and interpreter interpets the stimulus stimulus and sending nerve impulse to the effector inorder to correct the effect by restoring the level of the

2 (b) Hypothalamus is a major thermoregulatory center in human body and all mammals. The hypothalamus tend to control and maintain relative amount of temperature of the body together with the skin. The hypothalamus tend to perform control of the body via the following ways:

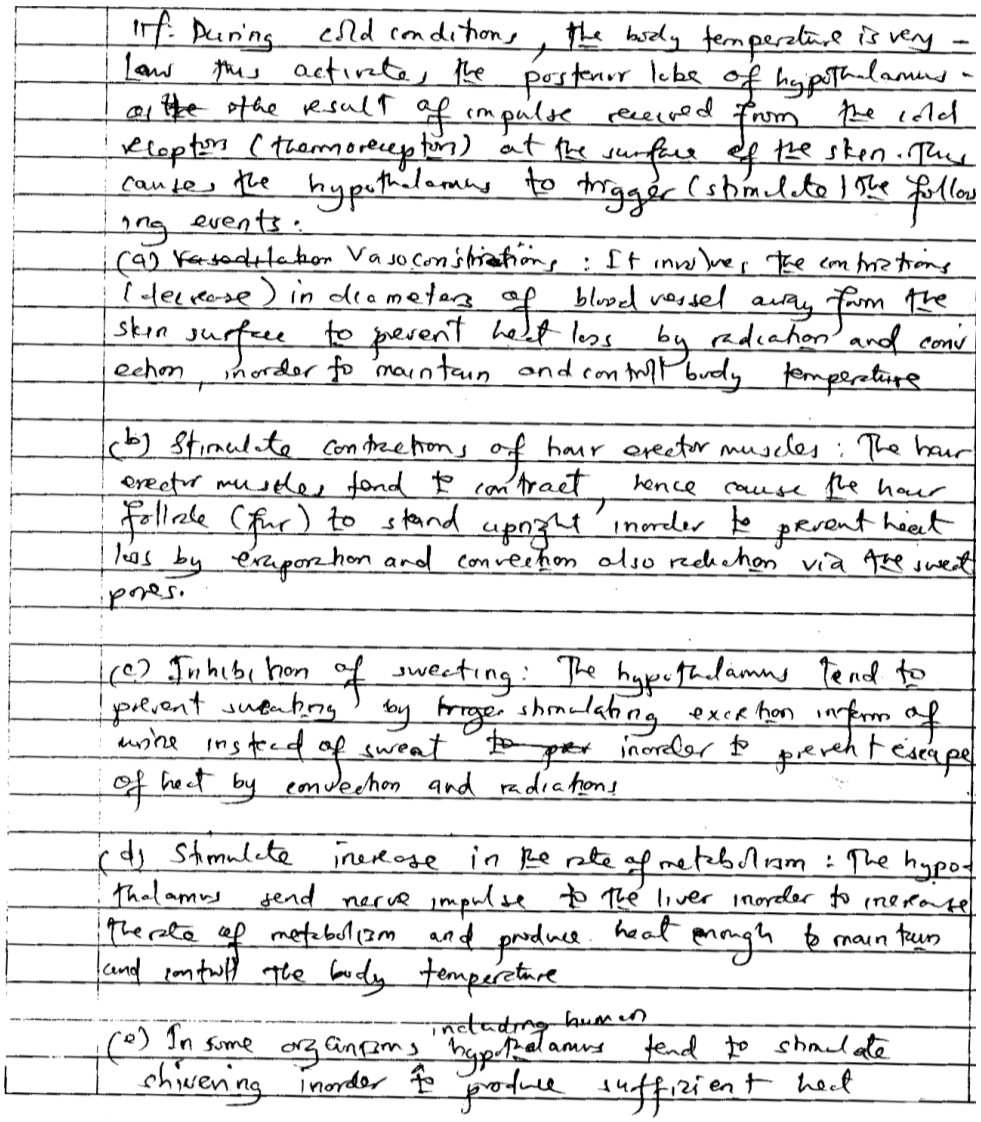
i. During hot conditions, the anterior lobe of hypothalamus tend to be activated as result of impulse received from thermoreceptors present at the surface of the skin. The activation of anterior lobe of hypothalamus tend to stimulate processes including:

(a) Vasolidation: Is the process involving increase of diameters of arterioles and venules (blood vessel) at close of the skin surface in order to allow heat loss by radiation convection and evaporation, Thereby decrease of body temperature, hence maintaining body temperature

(b) Relaxation of hair ~~erect~~ erector muscles: The hair ~~effect~~ or muscles tend to ~~left~~ relax thereby allowing flatination of the fur/hairs at surface of the skin which allow escape of heat in form of radiation, convection Increase of rate of

(c) Sweating: Is the condition involving removal of the sweat and heat on the body. The rate of sweating tend to increase to allow heat loss in order to maintain body temperature

(d) Decline of metabolism and metabolic activities; The hypothalamus stimulate (by triggers) the liver and inhibit the rate of metabolism in order to avoid production of heat during hot conditions.


If: During cold conditions, the body temperature is very - low thus activate, the posterior lobe of hypothalamus - as the result of impulse received from the cold receptors (thermoreceptors) at the surface of the skin. This cause, the hypothalamus to trigger (stimulate) the follow ing events.

(a) ~~Vasodilation~~ Vasoconstriction: It involves the contractions (decrease) in diameters of blood vessel away from the skin surface to prevent heat loss by radiation and convection, inorder to maintain and control body temperature

(b) Stimulate contractions of hair erector muscles: The hair erector muscles, tend to contract, hence cause the hair follicle (fur) to stand upright, inorder to prevent heat loss by evaporation and convection also reduction via the sweat pores.

(c) Inhibition of sweating: The hypothalamus tend to prevent sweating by trigger stimulating excretion in form of urine instead of sweat to per inorder to prevent escape of heat by convection and radiations

(d) Stimulate increase in the rate of metabolism: The hypo- thalamus send nerve impulse to the liver inorder to increase the rate of metabolism and produce heat enough to maintain and control the body temperature

(e) In some organisms including humans hypothalamus tend to stimulate shivering inorder to produce sufficient heat

Extract 12.1: A sample of the candidates' correct responses to Question 2

In Extract 12.1 the candidate correctly explained the role of the major components of the homeostatic system and described the mechanism of the hypothalamus in controlling temperature in the human body.

The candidates who scored from 7.0 to 11.5 marks obtained most of the marks in part (a). However, in part (b), they scored few marks because they did not have adequate knowledge about the mechanism for temperature regulation by the hypothalamus. In part (b), they confused between thermoregulation, which is regulation of temperature and osmoregulation, which is the regulation of water in the body. Therefore, they described the mechanism for the regulation of water and

salts in the human body instead of temperature. Other candidates explained the role of pituitary gland instead of the role of hypothalamus in thermoregulation. For example, one candidate wrote: *The role of pituitary gland is to produce antidiuretic hormone (ADH).*

The candidates who had weak performance on this question gave responses which were contrary to the demand of the question. For example, in part (a), one candidate gave the role of excretory organs such as the liver and kidney instead of the component of the homeostatic system. Another candidate wrote: *The following are the components of homeostatic system; temperature regulation, water regulation, salt regulation, excretion and osmoregulation*. Extract 12.2 is a sample of the incorrect responses.

2 a) Homeostasis is the maintanance of the internal condition of an organism. The components of homeostatic system

i) The kidney
Its major role is to regulate amount of water in the body, control blood pH, regulate ions such as sodium (Na^+) chlorine (Cl^-), potacium (K^+). Also to excrete nitrogenous waite such as urea, ammonia and uric acid.

ii) Hormones and glands
The hormones include angiotensin, adrenaline which controls the amount of water, salt and bring back the heart beats into normal conditions Together with pituitary gland

iii) Liver
It converts ammonia to urea in human beings for excretion

iv) Pancreas
Secretes insulin and glucagon hormones which maintains blood sugar regulation in the body

2 b) Hypothalamus is used to control body temperature in human body as follows. ~~When there is~~

When there is low temperature in the surrounding then the hypothalamus stimulate the pituitary gland to secrete adrenal cortico hormone which initiates adaptations and behavioural mechanisms to gain temperature in the body. The mechanisms include shivering, vasoconstriction, erection of the hair cells, increased metabolic activities and wearing of heavy clothes

In high temperature the hypothalamus stimulate pituitary gland to secrete angiotensin hormone to the brain sensing more heat and initiates vasodilation of the muscles, relaxing of the hair cell, putting on light clothes, reduced metabolic rate

Hypothalus is very useful to control the body's temperature as enzymes works best in optimum temperature. On very high or low temperature enzymes denature or becomes inactive

Extract 12.2: A sample of candidates' incorrect responses to Question 2

In Extract 12.2, the candidate incorrectly explained the roles of some organs, such as the pancreas, as the major components of the homeostatic system in part (a). In part (b), they based the responses on osmoregulation instead of thermoregulation.

2.2.3 Question 3: Growth and Development

The question tested the candidates' competence in primary and secondary growth in angiosperms. It required the candidates to describe the process of primary growth in plants in part (a). In part (b), it required them to explain how lateral branches and roots are formed.

The question was attempted by 64.6 per cent of the candidates. Their performance was generally weak because 89.4 per cent scored below 7. 0 marks on the question. Table 2 is illustrative.

Table 2: **Distribution of Candidates' Scores on Question 3**

Scores	Description	Per centage of Candidates
0.0 – 6.5	Weak	89.4
7.0 – 11.5	Average	10.2
12.0 – 20.0	Good	0.4

Table 2 shows that the majority of the candidates (89.4%) scored from 0.0 to 6.5 marks while 10.6 scored from 7.0 to 20.0 marks.

Some of the candidates zero described the factors that affect growth while others described the growth patterns of annual or perennial plants. Some of these candidates described some growth theories while others described the conditions necessary for seed germination, instead of the process of primary growth in part (a). In part (b), they confused primary growth with secondary growth. For example, one candidate wrote: *The lateral branches and roots are formed from secondary growth.*

The candidates who scored from 1.0 to 6.5 marks, in part (b) did not realise that lateral branches and roots are the primary growth characters. However, in part (a), they partially described primary growth; hence, they did score full marks. Extract 13.1 is an example of the incorrect responses.

3(a) The following is the process of primary growth in plants:

(i) Germination phase:

- This is the first stage of primary growth whereby the seeds germinate, giving rise to plumule and radicles.
- In this stage there is a decrease in dry mass of a seed since the stored food is used through respiration to provide necessary energy for growth of plumule and radicle since the seed can not photosynthesize.

(ii) Growth phase.

- In this stage, the rate of root and shoot growth becomes high. Also, there is high rate of photosynthesis but there is low rate of respiration due to a seedling being small.
- It involves high rate of growth of meristematic parts such as the apices of shoots and roots.

(iii) Stationary phase:

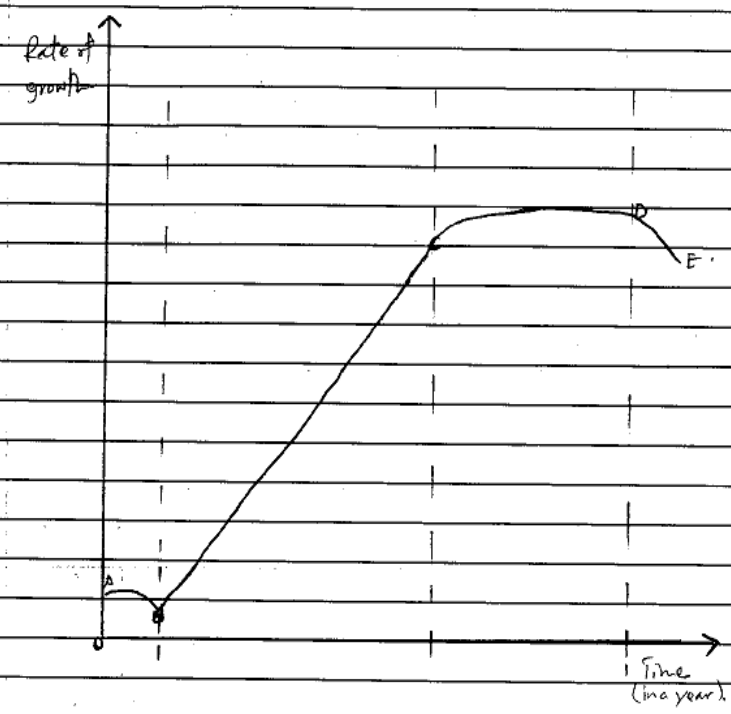
- In this stage, the rate of photosynthesis becomes equal to the rate of respiration of a plant.
- At this stage the plant is mature enough and hence it can produce fruits and leaves and seeds.

(iv) Decelerating phase:

- In this stage there is a decrease in dry mass of the plant.
- This is due to falling of leaves and fruits and seed dispersal.
- The plants can undergo annual growth, biennial growth or perennial growth.
- The following is a graph for description.

3 (a) A GRAPH OF PROCESS OF GROWTH IN PLANTS.

(PRIMARY GROWTH)



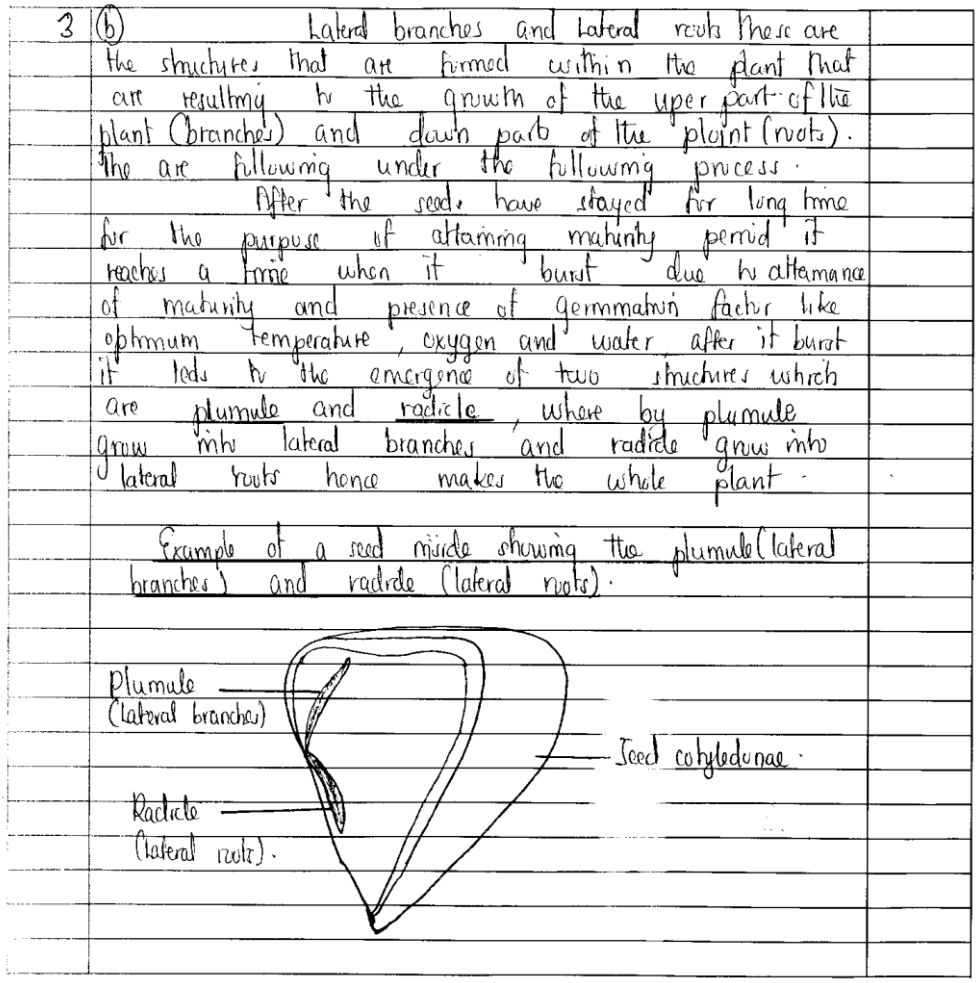
Whereby;

AB portion is a Germination phase

BC portion is a Growth phase

CD portion is a Stationary phase.

DE is the Dereliction phase.



Extract 13.1: A sample of candidates' incorrect responses to Question 3

Extract 13.1 shows a response of a candidate who incorrectly described the phases of the growth curve of annual plants in part (a) instead of the process of the primary growth in plants. Likewise, in part (b), the candidate incorrectly illustrated the process of germination where plumule and the radical are formed.

Almost all candidates (99.6%) who scored high marks (7.0 to 20.0) on this question had knowledge about the roles of apical meristematic tissues in primary growth in part (a). They explained that the primary growth in roots and shoots is brought about by apical meristematic cells that undergo cell division, enlargement and differentiation. In part (b), they had adequate knowledge of the origin of lateral branches and roots. They explained lateral branches and roots originate

from apical meristem. Extract 13.2 is a sample of the correct responses from one of the candidates.

3. a) Primary growth is the growth which occurs as a result of the activity of apical meristems in the tips of shoots and roots that bring about development of a primary plant body due to increased length of the plant.

The process of primary growth in plants can be well understood through the regions at the tips of the shoots and roots.
That is i) Zone of cell division,
ii) Zone of cell elongation.
iii) Zone of cell enlargement.

i) Zone of cell division.
- This is where meristematic cells divide to produce daughter cells which possess features like thin and extensible cell walls, large number of mitochondria and small numerous vacuoles or no vacuoles at all.
This occurs in both shoots and roots.
- But in roots, the division of meristematic cells occurs both towards the inside and outside.
- The cell division towards the outside result to the formation of root cap which has functions
i) to protect the apical meristems.
ii) secrete mucus like substance that lubricate the tender root tips as they grow towards the soil. and also a quiscent zone behind root cap.

In both shoots and roots, as a result of division of meristematic cells, the daughter cells form three layers of meristematic tissues.

3. a, that is - Protoderm, that may give rise to the epidermis

- Procambium, which may give rise to primary xylem, primary phloem as well as Vascular cambium

- Ground meristem, which may give rise to parenchyma tissues that may form pith and cortex in dicot plants.

ii, Zone of cell elongation.

- In this region, the daughter cells which now contain primary thin extensible walls expand by absorption of water.

- As they absorb water, the hydrostatic pressure pushes the extensible cecell walls such that the cellulose myofibrils in the primary walls determine the final structure that is attained by the cells.

- The expansion is also brought by when the small numerous vacuoles absorb water and then fuse together to form a larger vacuole giving the cell an increased size.

This occurs in both shoots and roots such that increase in length of the plants is normally accounted for by the elongation and enlargement of the cells.

3. a) All the processes in the three regions at the tips of shoots and roots result to an increased length of the plant hence primary growth in plants.

b) Lateral branches and lateral roots are also formed as a result of activity of apical meristems but without causing an increase in length of the plant

Lateral branches

These are formed due to activity of apical meristems, present below the leaf blades in between it and the stem.

The activity result to formation of a swelling that gives rise to apical bud whose function is to protect the apical meristems.

Increased activity of the apical meristems causes the swelling to become bigger and larger which may then bud off and give rise to the lateral branches.

Lateral roots

These are formed during the division of apical meristems towards the outside such that, along side the root cap, a quiscent zone is formed just behind it.

- the quiscent zone contains cells that are to replace the damaged apical meristems.

3. b) - differentiation of the cells in the quiscent zone may give rise to structures which grow on the lateral sides of the root now called lateral roots.

- Hence lateral roots are formed.

Extract 13.2: A sample of candidates' correct responses to Question 3

In Extract 13.2, the candidate correctly responded that primary growth and the formation of lateral branches and roots are controlled by apical meristematic cells.

2.2.4 Question 4: Genetics

The question measured the candidates' competence in the concept of gene interaction, which is the epistasis. The candidates were informed that a cross between pure black haired male and white haired female goats gave all the F_1 black haired. When the F_1 were selfed gave F_2 with the following phenotypes: 418 – Black haired goats, 106 – Grey haired goats and 36 – White haired goats. The candidates were then required to use the Punnet square to show the formation of F_1 and F_2.

The question was attempted by 71.4 per cent of the candidates. The analysis of their performance is shown in Table 3.

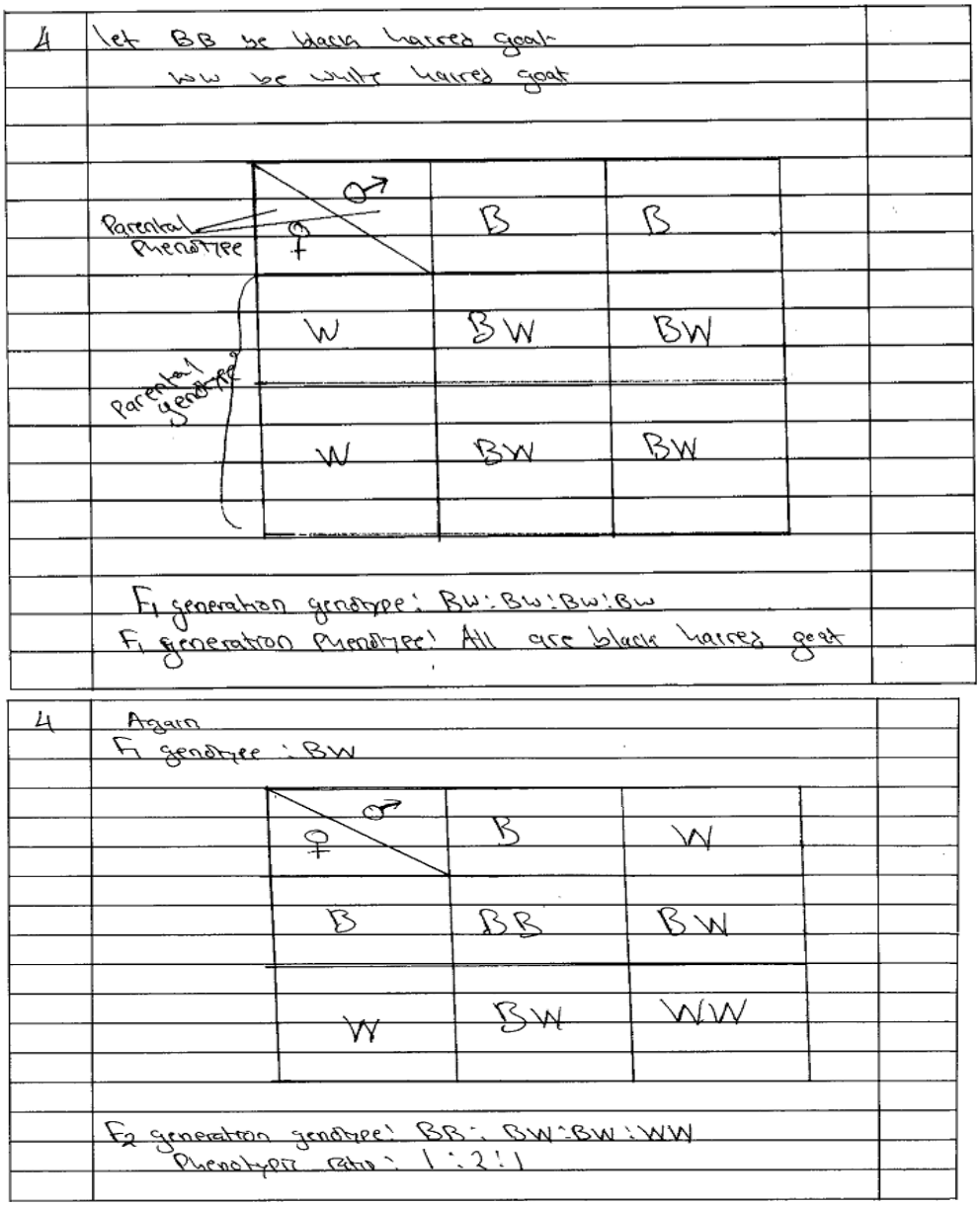
Table 3: **Distribution of Candidates' Scores on Question 4**

Scores	Description	Per centage of Candidates
0.0 – 6.5	Weak	98.5
7.0 – 11.5	Average	0.3
12.0 – 20.0	Good	1.2

Table 3 indicates that the performance of the candidates in the question was generally weak since most of them (98.5%) scored from 0.0 to 6.5 marks.

A further analysis of the candidates' performance reveals that, among the 98.5 per cent of the candidates who scored from 0.0 to 6.5 marks, 22.5 percent scored zero. These candidates lacked competence in the interaction of genes in genetic crosses. They were not aware that, in responding to the question, one was supposed to convert the numbers of F_2 individuals into ratios. The ratios obtained from the question was 12 - Black: 3 - Grey: 1-White, which represents the Non-Mendelian inheritance (epistasis) that does not obey Mendelian ratios. In fact, the candidates failed to carry out correct crosses to show the formation of F_1 and F_2. Other candidates were not aware that, epistasis is a Non-Mendelian inheritance. Therefore, they based their responses on the Mendelian inheritance instead of the Non-Mendelian inheritance. Besides, some candidates were not aware that unrelated genes are located at different loci on the chromosome. For example, one candidate indicated dominant (BBbb) and recessive (WWww) genes on the same locus instead of different loci (BBWW and bbww).

Some of the candidates who scored from 1.0 to 6.5 marks had correctly manipulated the data and found the genetic ratio, but they had failed to choose the correct letters to represent the genes. Furthermore, some of the candidates interpreted the ratio and choose the letters correctly but they used genetic crosses instead of the Punnet square method to show the formation of F_1 and F_2. Extract 14.1 is a sample of the incorrect responses from one of the candidates.



Extract 14.1: A sample of the candidates' incorrect responses to Question 4

In Extract 14.1 the candidate chose the incorrect letter to show the formation F_1 and F_2 in the Punnet square. Consequently, the candidate got incorrect F_2 with the phenotypic ratio of 1:2:1 instead of 12:3:1.

A further analysis of candidates' responses shows that 1.2 per cent of the candidates with high scores had adequate knowledge of interaction of genes. They interpreted the given data into genetic ratio which is 12:3:1 indicating a dihybrid phenotypic ratio for epistatic gene interaction since it deviates from dihybrid phenotypic ratio (9:3:3:1) in Mendelian inheritance. In epistatic gene interaction, one gene called epistasis masks the expression of the other gene called hypostatic gene. In this case, the epistatic gene had two alleles, one for colour suppression (dominant) and another for colour production (recessive). The hypostatic gene also had two alleles, one for grey colour (dominant) and another for white colour (recessive). The existence of the dominant epistatic allele did not allow either grey or white colours to be expressed; only black colour was expressed. The absence of epistatic dominant allele and occurrence of the epistatic recessive allele allowed the expression of grey colour in the presence of the dominant hypostatic allele. The presence of both recessive hypostatic and epistatic alleles expressed white colour. Extract 14.2 is the sample of a correct responses from one of the candidates.

4.

given: the Ration of the F_2

Black haired	Grey haired	White haired
418	106	36

Ratio = $\frac{418}{36} : \frac{106}{36} : \frac{36}{36}$

$\simeq 12 : \simeq 3 : \simeq 1$

12 : 3 : 1

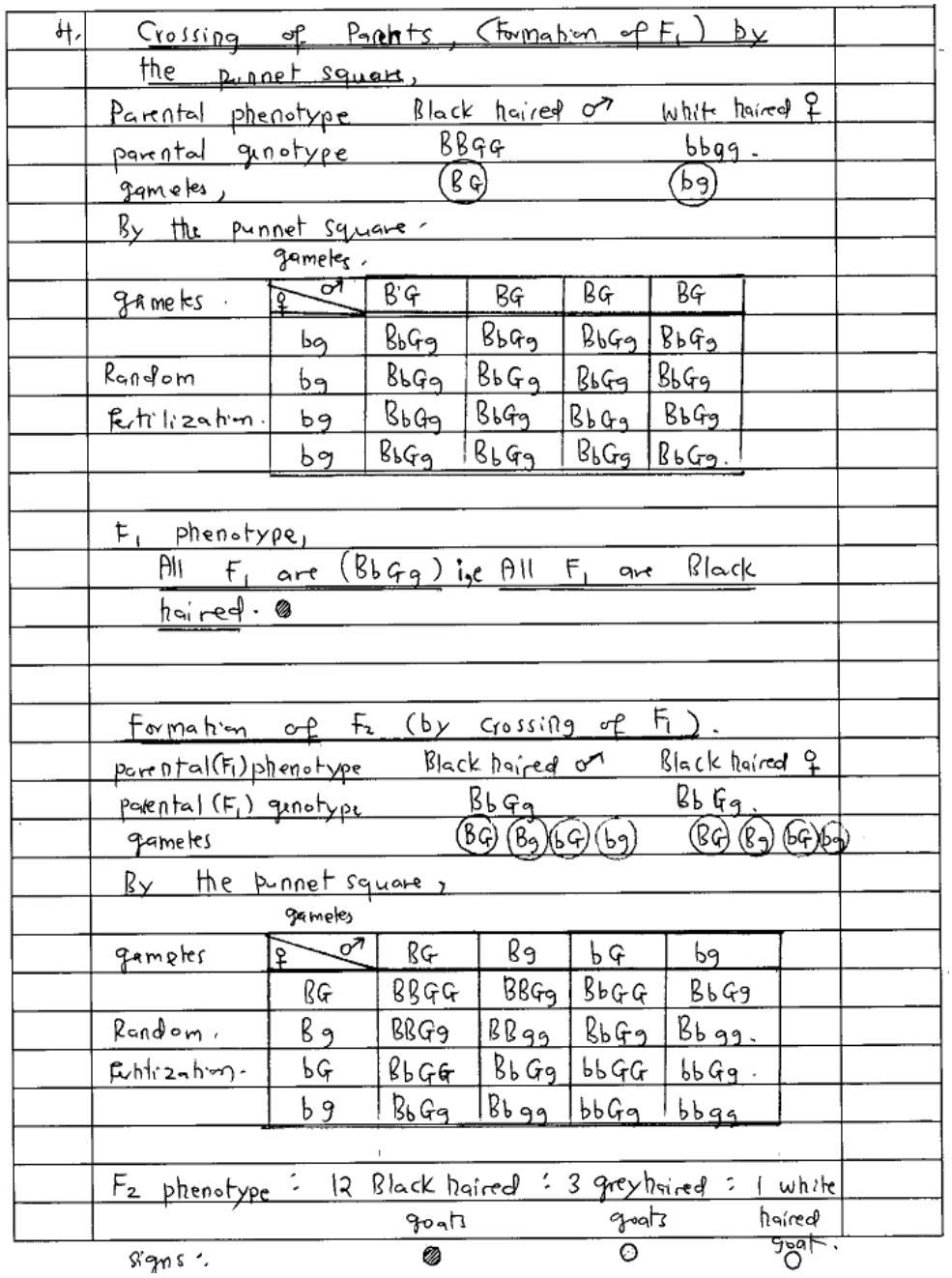
The Ratio of the F_2 shows that the traits consists of Epistatic genes.

Then

Let B be an allele for Black (absena of colour)
b be an allele for colour formation.
G be an allele for grey colour
g be an allele for white colour.

- B is dominant over b, also B is the EPISTATIC allele, since the number of black haired are many. B tends to mask the expression of G and g

And the genotypes of the Pure breeding parents are BBGG and bbgg.



4. Crossing of Parents, (Formation of F_1) by the punnet square,

Parental phenotype: Black haired ♂ × White haired ♀

parental genotype: BBGG × bbgg.

gametes: (BG) × (bg)

By the punnet square:

gametes ♀ \ ♂	BG	BG	BG	BG
bg	BbGg	BbGg	BbGg	BbGg
bg	BbGg	BbGg	BbGg	BbGg
bg	BbGg	BbGg	BbGg	BbGg
bg	BbGg	BbGg	BbGg	BbGg.

Random fertilization.

F_1 phenotype,

All F_1 are (BbGg) i.e All F_1 are Black haired. ●

Formation of F_2 (by crossing of F_1).

parental(F_1) phenotype: Black haired ♂ × Black haired ♀

parental (F_1) genotype: BbGg × BbGg.

gametes: (BG) (Bg) (bG) (bg) × (BG) (Bg) (bG) (bg)

By the punnet square,

gametes ♀ \ ♂	BG	Bg	bG	bg
BG	BBGG	BBGg	BbGG	BbGg
Bg	BBGg	BBgg	BbGg	Bbgg.
bG	BbGG	BbGg	bbGG	bbGg.
bg	BbGg	Bbgg	bbGg	bbgg

F_2 phenotype : 12 Black haired goats : 3 grey haired goats : 1 white haired goat.

Signs: ● ○ ○

Extract 14.2: A sample of candidates' correct response to Question 4

In Extract 14.2, the candidate correctly interpreted the ratio 12:3:1 as epistatic. The candidate chose and used appropriate letters in the Punnet square to show the formation of F_1 and F_2.

2.2.5 Question 5: Evolution

The question measured the candidates' knowledgeable about the evidence of evolution. The candidates were required to use examples and explain how each of the following piece of evidence supports organic evolution: (a) Palaeontology (b) Comparative morphology and anatomy (c) Comparative biochemistry and (d) Comparative embryology.

The question was attempted by 96.8 per cent of the candidates. The analysis of their performance is illustrated in Figure 12.

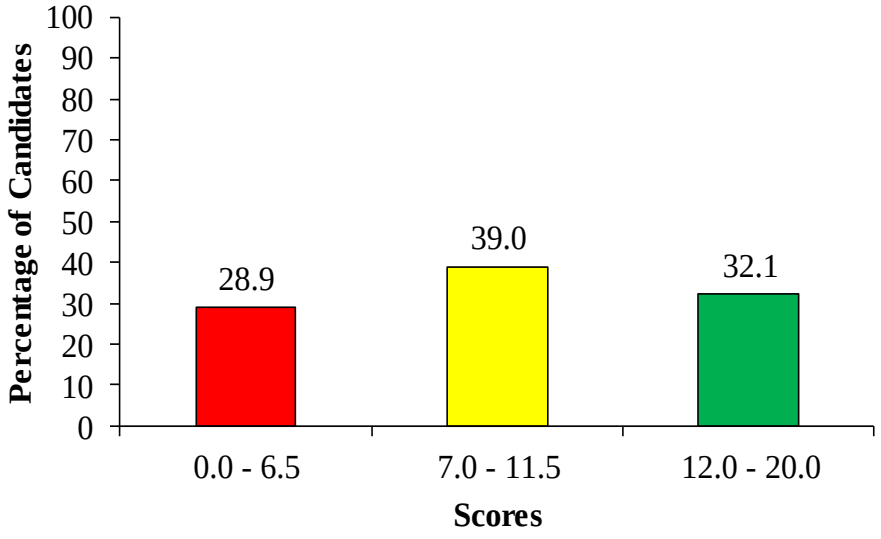


Figure 12: *Distribution of Candidates' Scores on Question 5*

Figure 12 shows that, 71.1 per cent attempted the question well since they scored from 7.0 to 12.0 marks.

The candidates (32.1%) who scored high marks (12.0 to 20.0) were knowledgeable about existence of organic evolution that occurs among organisms due to environmental changes. Such changes enable organisms to adapt well in their environment. The candidates had also adequate knowledge about the changes can be traced back through the study of fossils, comparative study of morphology and anatomy, biochemistry and embryology. Extract 15.1 is a sample of the correct responses from one of the candidates.

05. Organic evolution is the gradual change of an organism from simpler form to the complex form.
The following are the evidences support the organic evolution

a. Palaeontology
⇒ This is the study of fossils present on the earth.
⇒ There various types of fossils such as moulds, carbonized and petrified fossils.
⇒ Various forms of fossils structure present in sedimentary rocks shows evolution.
⇒ The fossils in the upper layers of sedimentary rocks have similar form to the present organisms.
⇒ The fossils from the lower layers of the sedimentary rocks differ in forms and structures with present organisms.
⇒ For example fossils of bone of limb of a horse removed from lower layers of rocks is quite differ to the present limb bone of a horse.
⇒ This shows that organisms are gradually changing from primitive form to complex form.
⇒ Therefore this support organic evolution.

05 b. ii. Comparative morphology and anatomy

⇒ This is the study of body structures and forms of different organisms.

⇒ The similarity of various forms and structures of different organisms suggest that organisms come from the same ancestor.

⇒ The structures are categorized in the following

i. Basic structure

- These are structures which present in all organisms for example all angiosperms contain flowers

ii. Homologous structure

- These are structures of different organisms with different functions but the same form
- For example pentadactyl limbs to all vertebrates has the same form but different functions.
- This shows that vertebrates come from the same ancestor.

iii. Analogous structure

- These are structures with the same function but different form for example wings of birds
- This shows convergent evolution

iv. Vestigial structure

- These are structures which have the same form but some of them become functionaless

05 - This shows organisms have adapted differently but comes from the same ancestor. For example appendix of human to that of cow.

⇒ Due to similarity above the organisms seem to be evolved from the same ancestor.

c. Comparative biochemistry

⇒ This is the study of the cellular components and their functions of different organisms.

⇒ Similarity of various cellular components and physiology suggests that organisms ~~come~~ evolve from the same ancestor.

⇒ The study is based on :-

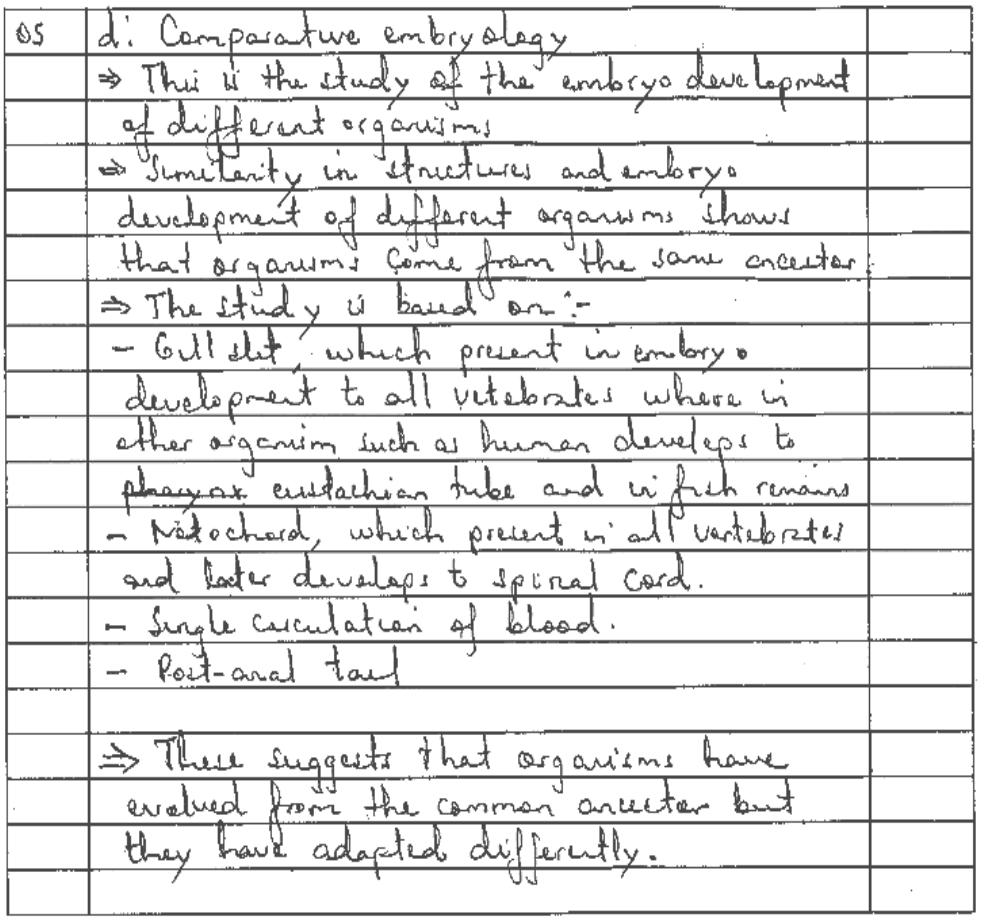
i. Cellular components

- These are components which found in each organism. For example cytochrome present in every organism which respire. Also presence of DNA.
- This shows organisms come from the same ancestor.

ii. Physiology

- This is the study of body functions of different organisms which shows that organisms has the same physiology. For example action of prolactin hormone in animals and insulin hormone.

⇒ Due to similarity in cellular components suggests that organisms come from the same ancestor.



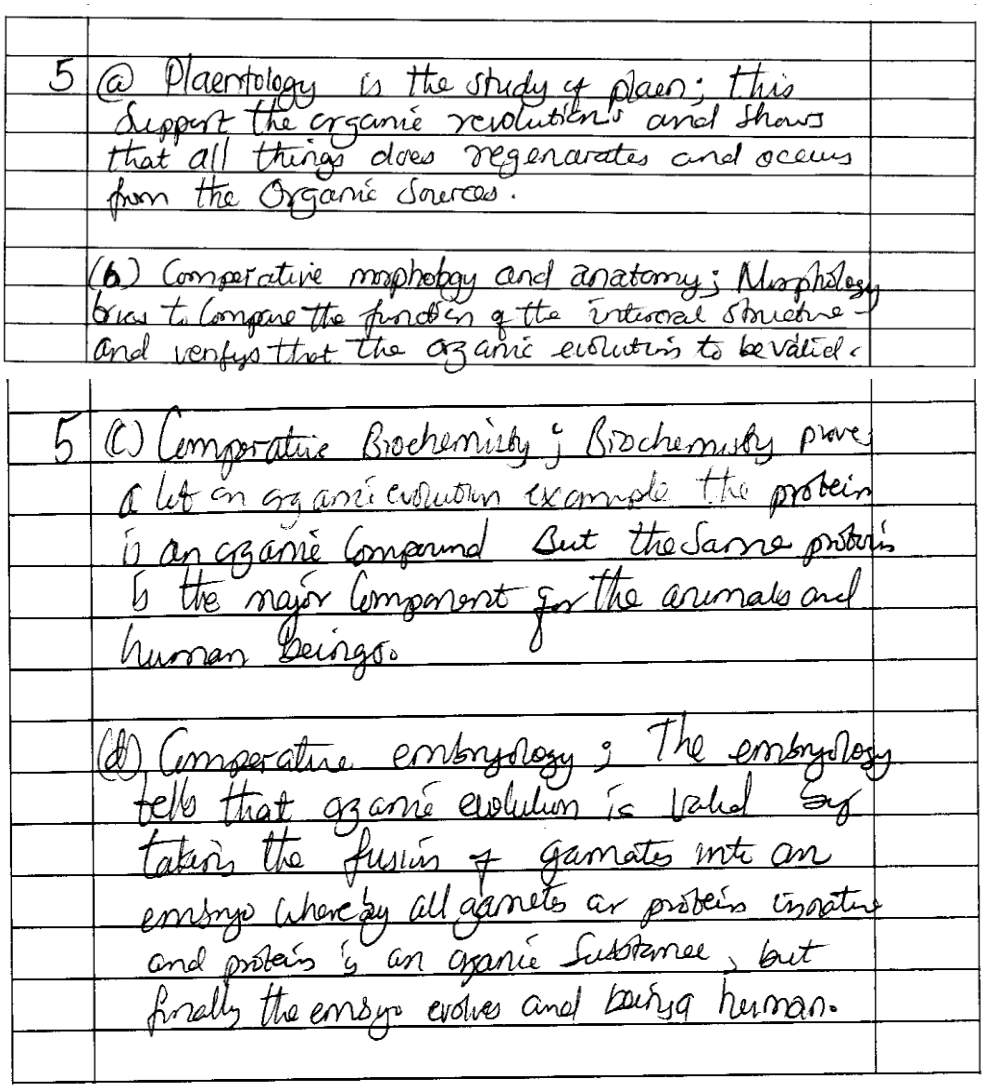
Extract 15.1: A sample candidates' correct responses to Question 5

In Extract 15.1, the candidate explained how the study of fossils, development of embryos, the chemical composition of cells and general body patterns support organic evolution.

Despite the good performance of the candidates on this question, 28.9 per cent of the candidates scored from scored 7.0 to 11.5 marks. The candidates partially described how palaeontology, morphology and anatomy, biochemistry and embryology support evolution. The descriptions thus did not deserve full marks. Other candidates' descriptions were not supported with examples or were supported with incorrect examples.

The candidates who scored below seven marks either gave incorrect descriptions to all or most pieces of the evidence. Specifically, most of the candidates score zero for their description of comparative morphology and anatomy and

comparative embryology. Besides, candidates described these concepts but did not provide examples. Extract 15.2 is a sample of candidates' incorrect responses.



Extract 15.2: A sample of candidates' incorrect responses to Question 5

In Extract 15.2, the candidate incorrectly regarded palaeontology as the study of plan and gave unclear descriptions of how comparative morphology and anatomy, biochemistry and comparative embryology support organic evolution.

2.2.6 Question 6: Ecology

The question tested the candidates' competence in the concept of ecological succession. The candidates were required to describe how primary and secondary ecological successions are brought about in the ecosystem.

The question was attempted by 74.0 per cent of the candidates. Their performance is illustrated in Figure 13.

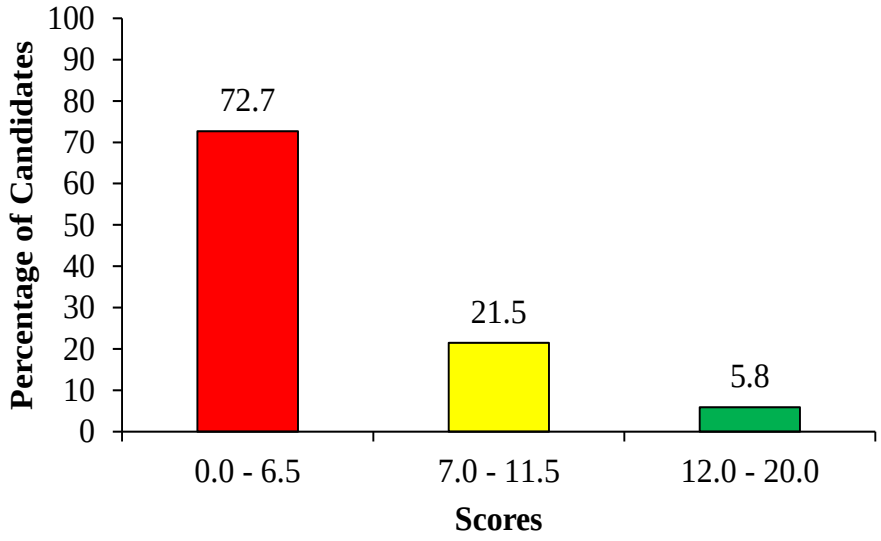


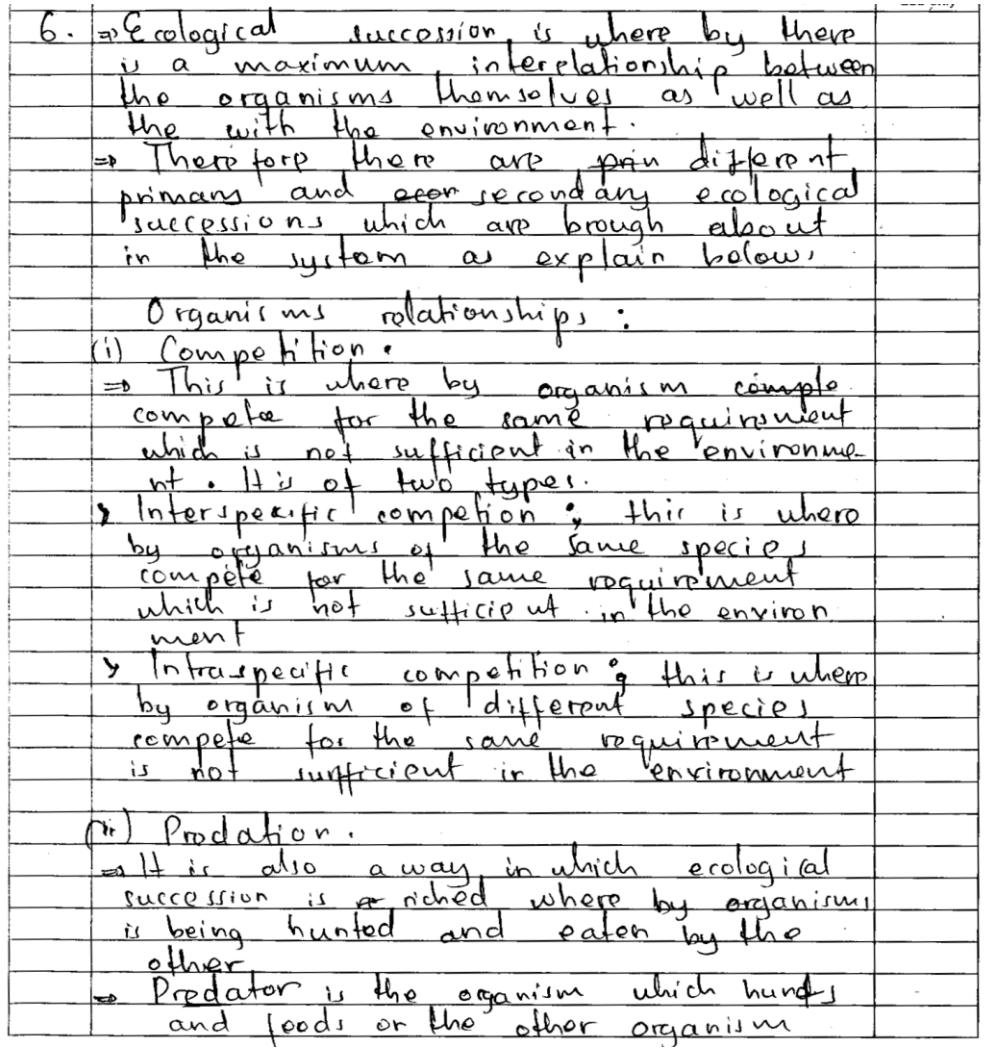
Figure 13: *Distribution of Candidates' Scores on Question 6*

Figure 13 shows that 72.7 per cent of the candidates scored from 0.0 to 6.5 marks. Only 27.3% scored from 7.0 to 20.0, indicating weak performance.

The candidates who scored from 1.0 to 6.5 marks described secondary ecological succession and obtained marks for describing primary succession. Some of these candidates either ended up defining the primary and secondary ecological successions in the introductory part or skipped some of the important stages of primary ecological succession.

Some of the candidates who scored zero described the ecological succession as the flow of energy from producers down to the quaternary consumers. Other candidates described the organisms under each trophic level in the ecosystem instead of primary and secondary ecological successions. For example, one of the candidates wrote: *in order for an ecosystem to be maintained, there should be many primary producers to provide food to the consumers all the time*. Another candidate regarded primary and secondary ecological successions as the first and

last stages of the ecological succession. The candidate wrote: *Primary succession is the early stage of the formation of community and secondary succession is the final stage of the community formation*. Extract 16.1 is a sample of the incorrect responses to the question.

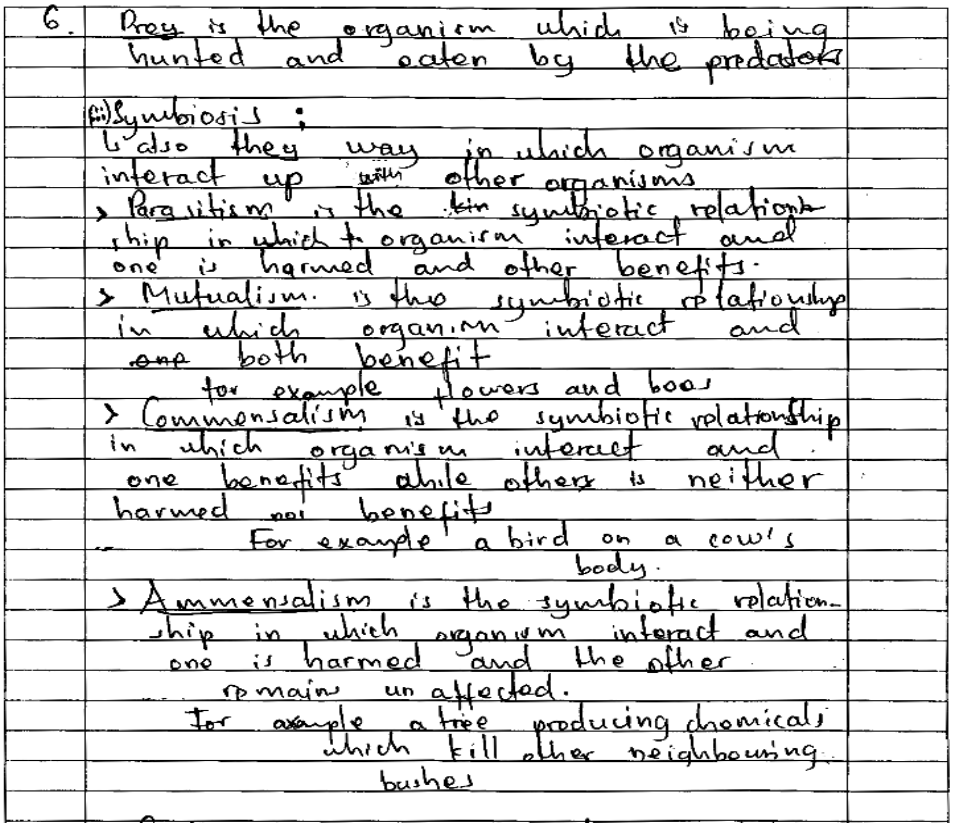


6. ⇒ Ecological succession is where by there is a maximum interrelationship between the organisms themselves as well as the with the environment.
⇒ Therefore there are ~~pri~~ different primary and ~~sec~~ secondary ecological successions which are brough about in the system as explain below;

Organisms relationships:

(i) Competition.
⇒ This is where by organism compete compete for the same requirement which is not sufficient in the environment. It is of two types.
› Interspecific competion; this is where by organisms of the same species compete for the same requirement which is not sufficient in the environment
› Intraspecific competition; this is where by organism of different species compete for the same requirement is not sufficient in the environment

(ii) Predation.
⇒ It is also a way in which ecological succession is ~~a~~ riched where by organism is being hunted and eaten by the other
⇒ Predator is the organism which hunts and feeds on the other organism


6. Prey is the organism which is being hunted and eaten by the predators

(ii) Symbiosis :
Is also they way in which organism interact up with other organisms
> Parasitism is the kin symbiotic relationship in which t organism interact and one is harmed and other benefits.
> Mutualism is the symbiotic relationship in which organism interact and both benefit
for example flowers and bees
> Commensalism is the symbiotic relationship in which organism interact and one benefits while others is neither harmed nor benefits
For example a bird on a cow's body.
> Ammensalism is the symbiotic relationship in which organism interact and one is harmed and the other remain un affected.
For example a tree producing chemicals which kill other neighbouring bushes

Extract 16.1: A sample of candidates' incorrect responses to Question 6

In Extract 16.1, the candidate described the interaction of the biotic components of the ecosystem, such as competition and predation, instead of describing how primary and secondary ecological successions are brought about in the ecosystem.

A further analysis of the candidates' responses reveals that the candidates who scored from 7.0 to 20.0 marks were knowledgeable about the primary ecological succession. They knew that this succession starts in hostile conditions such as on barren areas like sandy beaches, bare rocks and sand dunes. They also knew that the primary succession goes though colonisation, early succession, mid succession to late succession. In contrast, the secondary ecological succession take place in an environment which was formally inhabited by vegetation but later disturbed significantly by either fire outbreak or catastrophic events such as volcanic eruption, glacier retreat and a land slide. The secondary succession goes though growing of grasses, shrubs, small trees, tall trees and finally mature trees with dense canopy. This knowledge made the candidates to respond correctly to the question. Extract 16.2 is a sample of the correct responses from one of the candidates.

6. Ecological Succession is the Orderly displacement of living organisms from a less stable community to a relatively stable community. This involves creation of new life but also replacement of past life that was destroyed.

Primary Succession involves orderly displacement of living Organisms to an environment to where no past forms of life are/where exhibited. Primary Succession comes into life at a new environment like Sand Bianhes and Sand dunes.

Primary Succession begins with early life involving organisms like Colonizers. These colonizers are the first life forms on a bare land, they include lichens, moss and fern plants. These life forms grow on rocks, sediments hence more. The beginning of weathering through rocks disintegration and this leads to formation of Primary Soil. as these plants die, they decompose and form humus in the soil and hence the soil begins to receive nutrients from dead decaying matter.

As the environment gets better there arises a second stage in Primary Succession which involves Organisms known as Generalist These plants are quite adaptive to new environmental Conditions -example short and tall grasses and some Simple leguminous plants which can fix nitrogen. These also accelerate rock disintegration and humus forms a fair thick layer of soil with Vast amount of nutrients. The generalists are also Called opportunities or Primary Intabitters. as they also die and decay they form more humus and improve Soil Structure and aeration. at this stage the Succession

6. also called Primary Succession we can say that it has reached at middle stage.

Primary Succession accomplishes with arrival of dominant species like tall trees, as seen in tropical forests. These arrive after the generalists and become dominant due to extensive and intensive adaptations to the environment and due to improved soil structure, reaction, air, water and thereby begins increased competition for the available resources hence we can say that Primary Succession has reached at a climax stage at which a stable community is seen.

Secondary Succession this involves orderly displacement of living Organisms to an environment where past forms of life were destroyed in one way or another. This form of succession takes into account areas of study like rain tropical forests being burnt and destroyed by rampant fires.

The rampant fires destroy the past forms of life and hence leaving the land bare into ashes. but this doesn't mark the end of life, Since the soil had already nutrients locked inside the soil, the process of Succession begins again with land plowed the weeds and short grasses which emerge few months/years after destruction.

In secondary succession the process is somehow fast reliable and faster in occupancy compared to Primary Succession as environmental factors become more favourable trees (short) will emerge but not that fast and later on shrubs are seen to emerge and eventually forests hence

6. accomplishing the Secondary succession process with a climax stage where a stable community has been re-established again.

Extract 16.2: A sample of candidates' correct responses to Question 6

In Extract 16.2, the candidate described how the primary ecological succession is brought about from bare rock to a climax community. On the other hand, she/he

described the development of the secondary ecological succession from an area that has been destroyed by fire to a stable community.

2.3 133/3 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. The candidate had to do only one of these papers. Each paper comprised three (3) questions. Question 1 of each paper was set from the topic of Comparative Studies of Natural Groups of Organisms and Question 2 from Cytology. However, Question 3 was set from the topics 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 6 to 15 marks each.

The analysis of the candidates' performance on each question in Biology 3 starts with question 1 of all the alternative papers 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology 3C followed by question 2 and 3.

2.3.1 Question 1: Comparative Studies of Natural Groups of Organism

In general, the question measured the candidates' competence in conducting scientific experiments by dissecting a selected animal and displaying various systems. In Biology 3A, the candidates were instructed to dissect the specimen **K** (toad/frog) to fully display the viscera general. Then, they were required to:

(a) Draw a large and well labelled diagram of the dissected specimen **K**.
(b) (i) Identify two structures in the specimen which form the small intestine.
(ii) Explain how the structures identified in 1(b) (i) are adapted to their function by giving three points for each.

Likewise, in Biology 3B, the candidates were instructed to dissect the specimen **S** (mouse/guinea pig/rat) and display the digestive system. Then they were required to:

(a) Draw a large and well labelled diagram of the dissected specimen **S**.
(b) Mention two glands in the specimen which carry out the digestive role.
(c) Briefly explain what would happen in the digestive system of the specimen, if the glands mentioned in (b) were completely damaged.
(d) Explain how the specimen is adapted to its mode of life by giving two points.
(e) State two disadvantages of the specimen to the Tanzania economy.

Similarly, in Biology 3C, the candidates were instructed to dissect specimen $\mathbf{R_1}$ (fresh cockroach) to fully display the excretory structures associated with the digestive system and deflect the digestive system to their right hand side. Then they were required to:

(a) Draw a large diagram of the dissection and label the digestive system with the attached excretory structures.
(b) State three economic importance of the specimen.
(c) Explain how the specimen is adapted to its mode of life by giving four points.

The question was attempted by all candidates. Data show that 99.3 percent of the candidates scored from 6.5 to 20.0 marks. A further analysis of the candidates' performance is shown in Table 4.

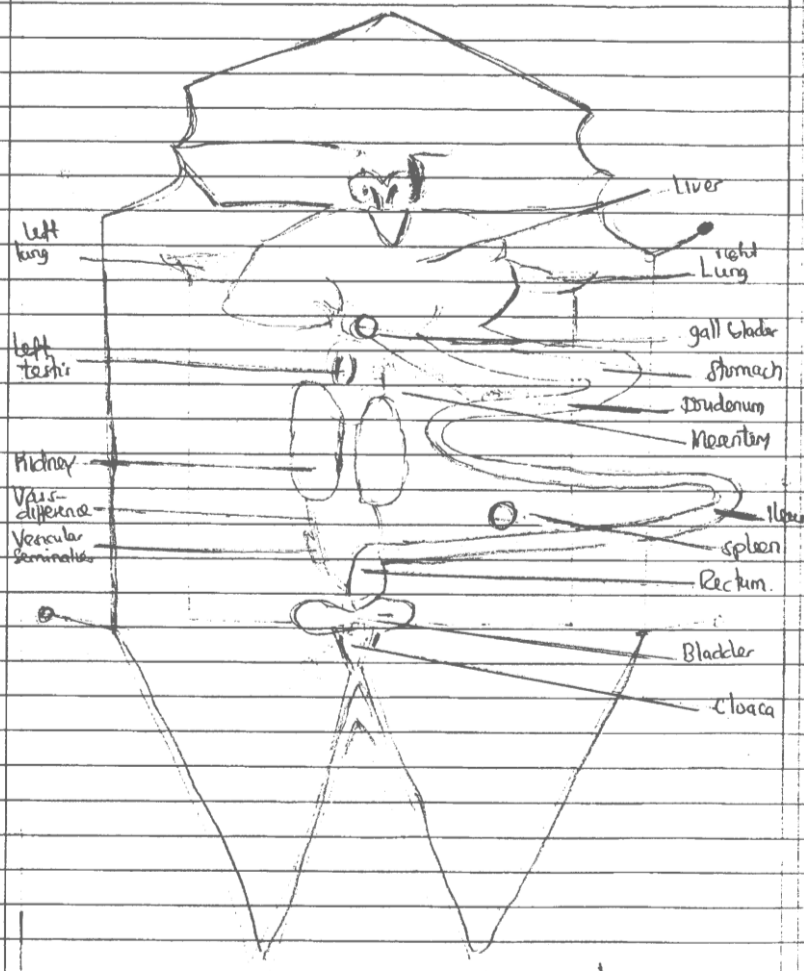
Table 4: **Distribution of Candidates' Scores on Question 1 (3A, 3B and 3C)**

Scores	Description	Per centage of Candidates
0.0 – 6.5	Weak	0.9
7.0 – 11.5	Average	10.5
12.0 – 20.0	Good	88.6

Table 4 shows that the performance of the candidates on Question 1 was good because 99.1 per cent of the candidates scored from 7.0 to 20.0 marks.

The candidates (88.6%) who scored high marks (12.0 to 20.0) in Biology 3A demonstrated not only good competence in dissection but also good drawing skills. These candidates followed the principles of biological drawing. The principles include: Use of pencil, large diagram, drawing in sharp lines, neatness, non-arrowed labelling lines, parallel/non crossing labelling lines, freehand drawing, magnification and title/caption. Therefore, the candidates drew the correct diagrams of the dissected toad/frog in part (a). In addition, they were aware of the parts which form the small intestine and their adaptations to the function they perform. Extract 17.1(a) shows the correct responses from one of the candidates.

1 (a) THE DIAGRAM OF VISCERAL GENERAL OF FROG



1. (b) i) The structures which form small intestine are
→ Duodenum
→ Ileum

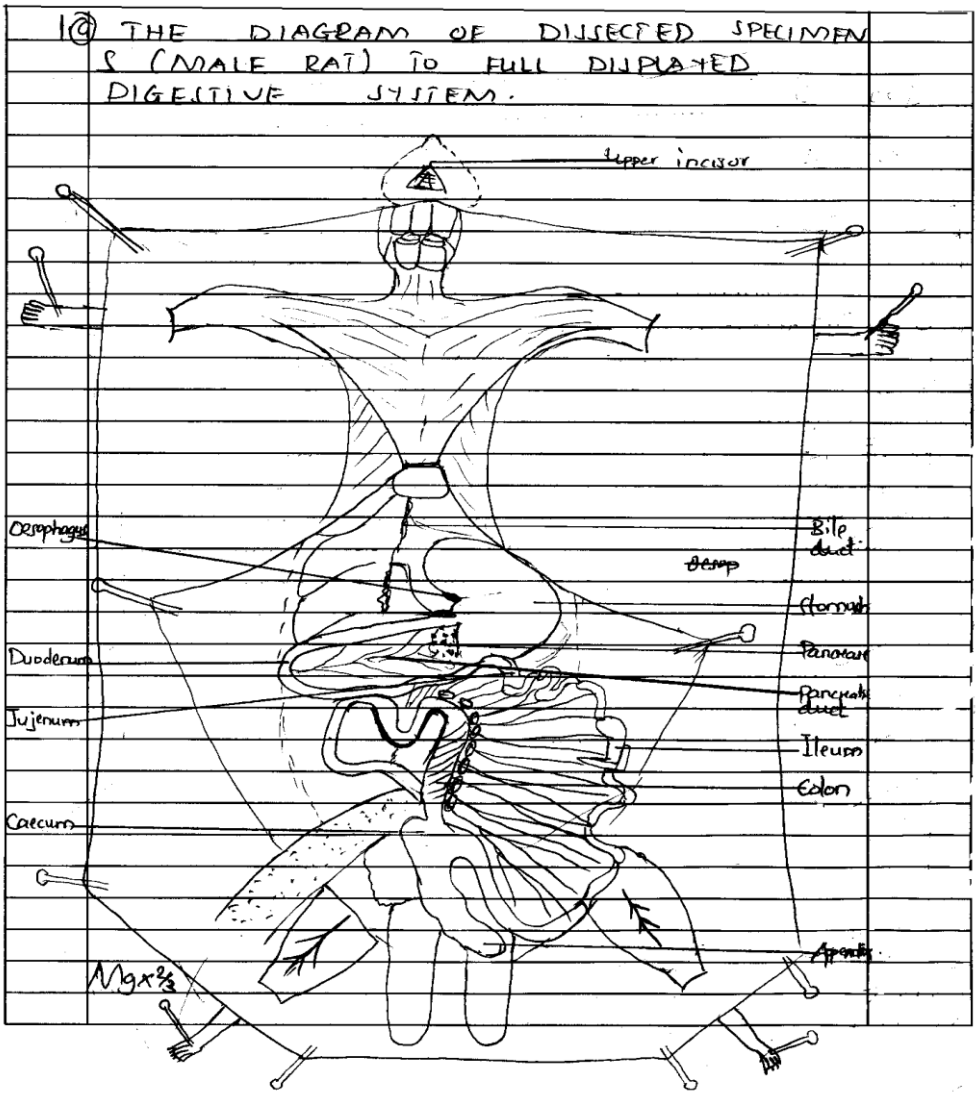
ii) Adaptive features of duodenum
→ It has connection to pancreas to ensure – supplies of pancreatic juices for digestion of food
→ It is supplied with bile duct to ensure the provision of biles for neutralizing acidic – chyme from stomach
→ Its wall is made up with cuboidal epitheli um which secrete mucus

Adaptive features of Ileum
→ It is very coiled so as to increase the – surface area and time for complete – absorption of food
→ It has lining made up of Villi and Microvilli for increase the surface area for absorption of food
→ It is well supplied with blood capillaries for transporting absorbed food nutrients to all parts of the body.

Extract: 17.1(a): A candidate's correct responses to Question 1 in Biology 3A

In Extract 17.1(a), the candidate observed the principles of biological drawings such as the use of caption and magnification in drawing the diagram of the dissected frog/mouse in part (a). In part (b), she/he considered secretion of some juices and the large surface area as the adaptations of the small intestine to its functions.

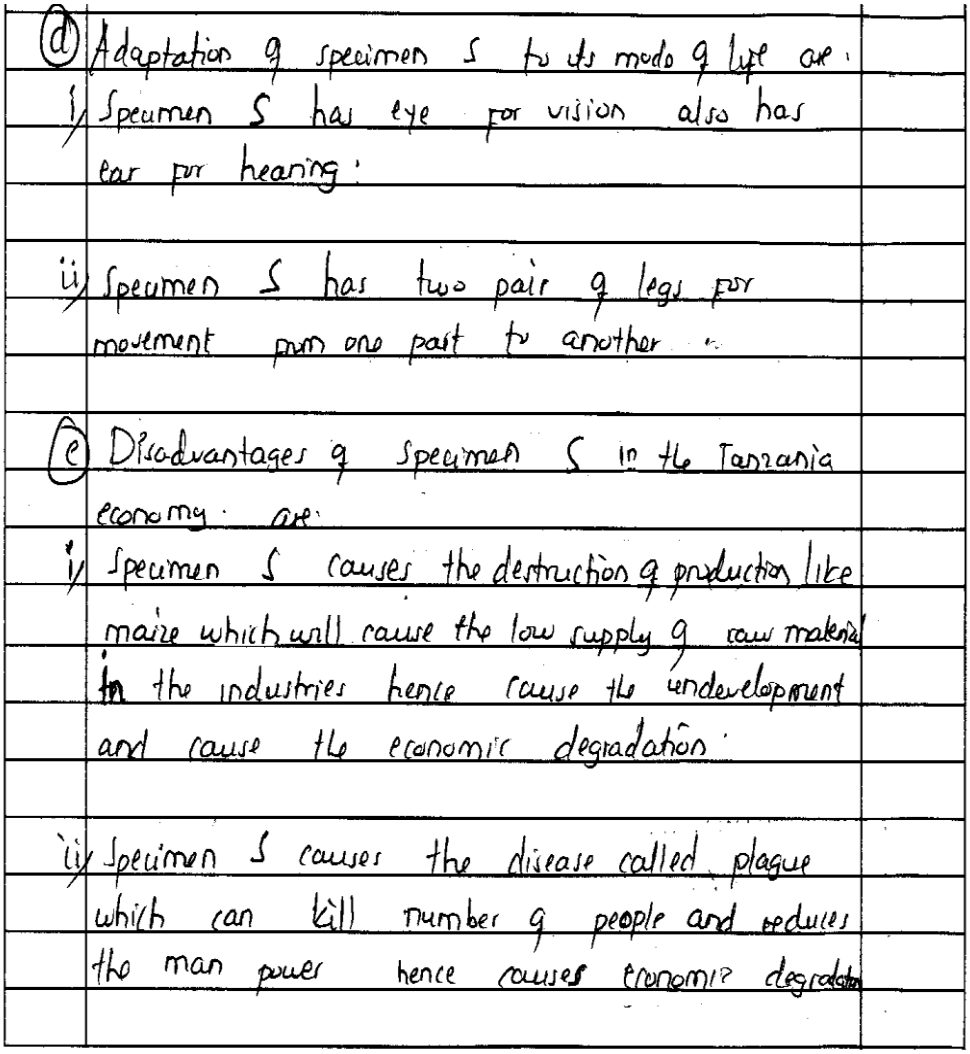
Similarly, the candidates who scored from 12.0 to 22.0 marks in Biology 3B, demonstrated good drawing skills by drawing correct diagrams of the dissected mouse/rat/guinea pig. In addition, they were aware of the glands that are found in the specimen and the digestive roles they perform. Moreover, they knew the adaptions of the specimen and its disadvantages to the Tanzania economy. Extract 17.1(b) shows one of the correct responses to the question.



1 (b) The two glands in specimen which play good digestive role are.
i) Gastric gland.
ii) Pancreatic gland.

(c) (i) If the gastric gland will be completely damaged, the gastric juice will not be produced which will cause the absence of pepsin, rennin and Hydrochloric acid which plays the role of converting protein to peptide, coagulation of milk, and activation of pepsinogen and prorennin respectively.
- Means that role of
- Pepsin - to convert protein to peptide.
- Rennin - to convert soluble milk to insoluble milk.
- Hydrochloric acid - to convert pepsinogen and prorennin to their active form which are pepsin and rennin respectively.

(ii) If Pancreatic gland will be completed damaged the pancreatic juice will not be produced then
- $NaHCO_3$ will not be produced to neutralize the acidic chyme from the stomach which would destroy the intestinal wall
- Also the enzymes in the intestinal wall will not function well so they will be denatured due to the acidic of the chyme from the stomach
- Also Pancreatic amylase enzyme will not be produced so starch will not be converted to maltose

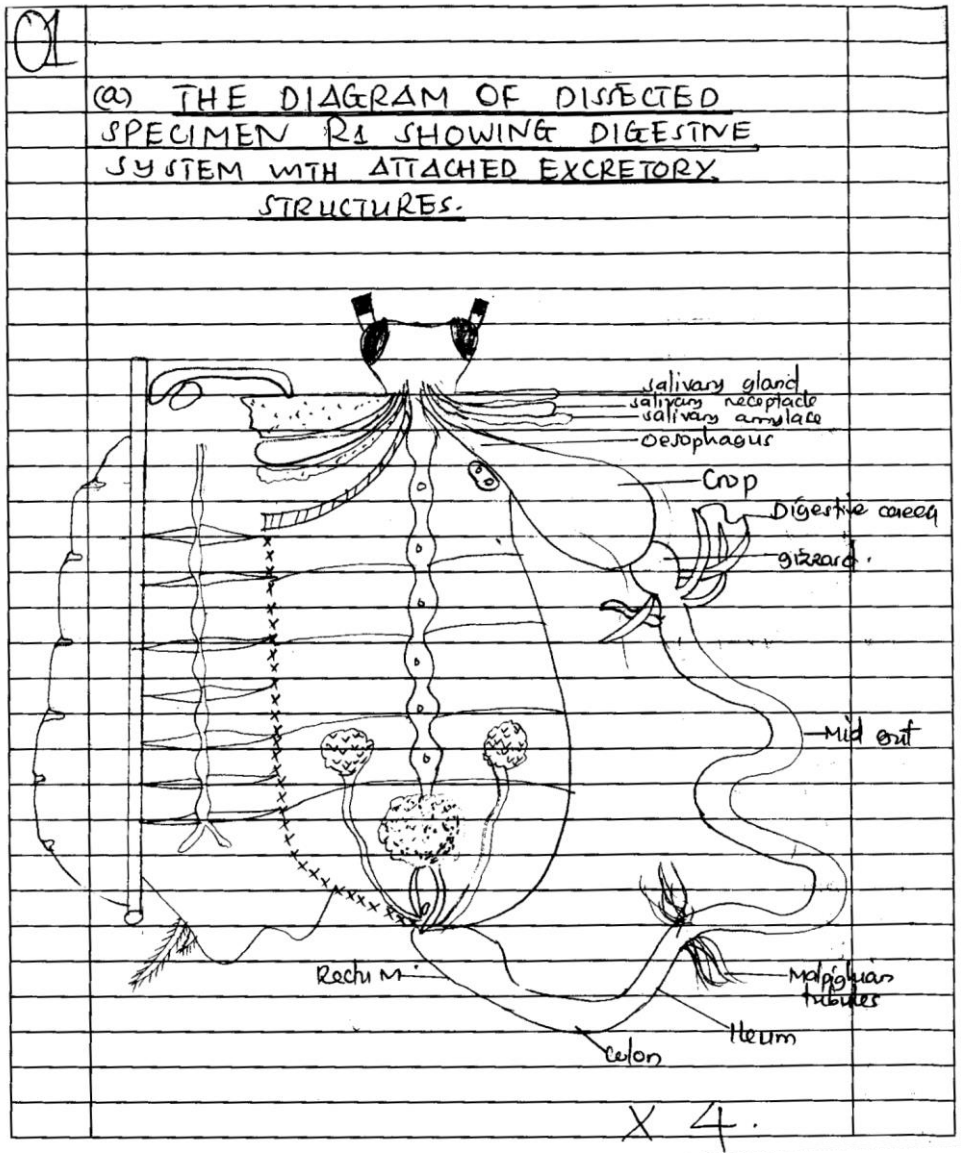


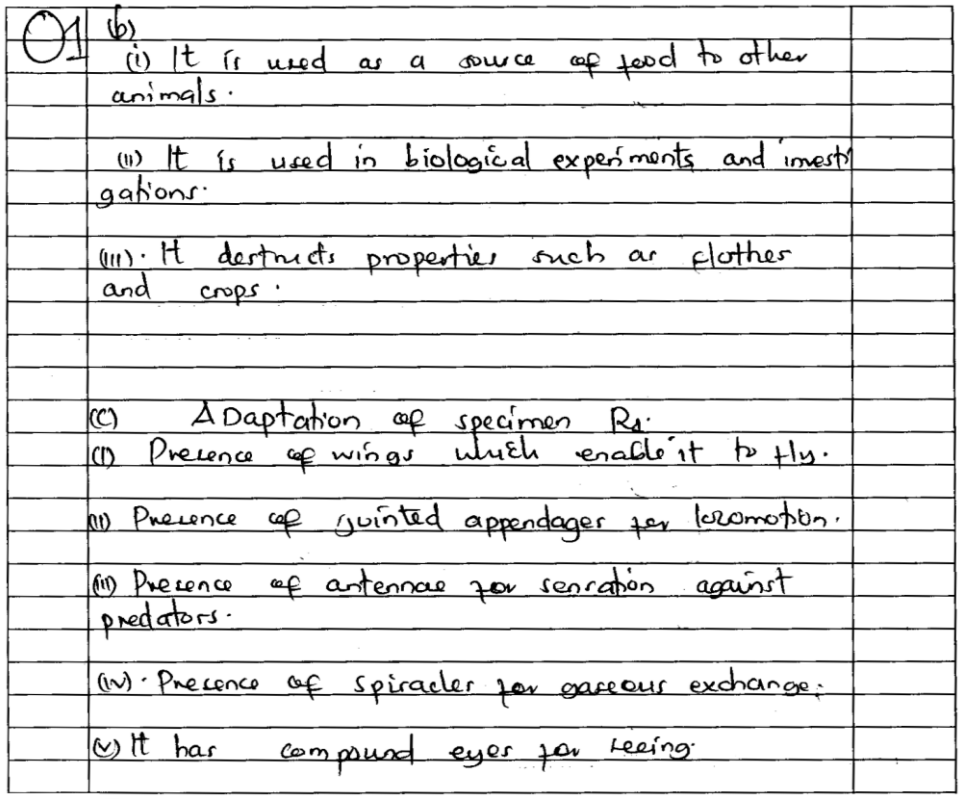
Extract 17.1(b): A candidate's correct responses to Question 1 in Biology 3B

In Extract 17.1(b), the candidate followed the principles of drawing biological diagrams to draw the diagram of the dissected rat. The candidate was knowledgeable about roles of the glands and their digestive juices such as pepsin from gastric gland for converting protein to peptides. Furthermore, the candidate described the adaptation and disadvantages of the rat.

Likewise, the candidates who scored from 12.0 to 22.0 marks in Biology 3C, demonstrated good drawing skills by drawing correct diagrams of the dissected cockroach. In addition, they knowledgeable about glands which are found in the cockroach and the digestive roles that they perform. They had adequate knowledge about economic importance of cockroaches such as food to other organisms and its adaptation such as the possession of the exoskeleton for support

and prevention of desiccation. Extract 17.1(c) shows sample of the correct responses from one of the candidates.





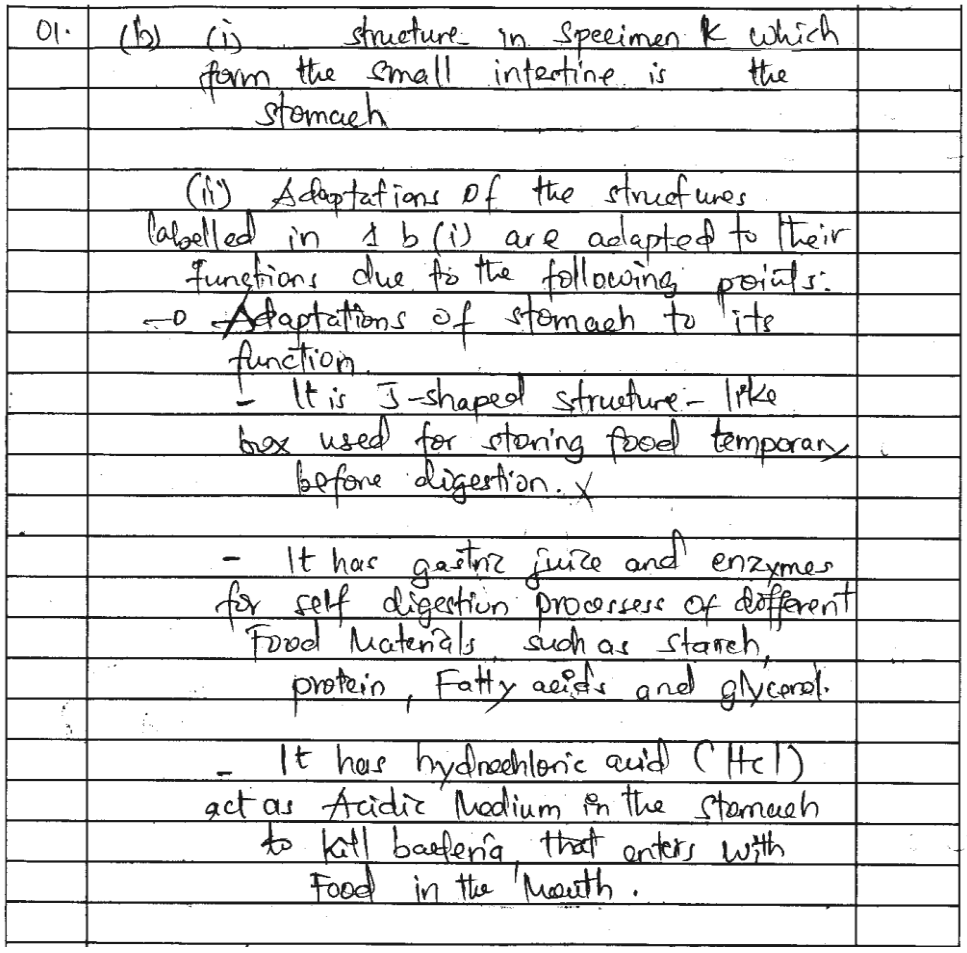
Extract 17.1(c): A candidate's correct response to Question 1 in Biology 3C

In Extract 17.1(c), the candidate correctly drew a diagram of the cockroach and showed the digestive and excretory systems. She/he also explained the economic importance of the cockroach and its adaptations to its mode of life.

Despite the good performance of the candidates on Question 1, a few candidates (10.5%) scored average marks (7.0 to 11.5). In Biology 3A, these candidates drew correct diagrams of dissection in part (a). However, they incorrectly wrote the caption. Some of the diagrams had no magnification. The candidates who scored from 1.0 to 6.5 marks, incorrectly labelled some parts in (a). In addition, they violated some principles of drawing biological diagrams such as indicating magnification and caption. In part (b), although they correctly identified the structures which make the small intestine, they failed to explain their adaptation.

Some of the candidates scored zero, some drew diagrams of the frog showing the nervous system instead of visceral general in part (a). In part (b), they incorrectly stated parts of the small intestine, such as the stomach, and gave their adaptations. Other candidates mentioned the microvilli and villi as parts of the small intestine. However, these are finger-like structures found in the ileum to increase the surface

area for efficient absorption of nutrients. Extract 17.2(a) is part of the incorrect responses by one of the candidates in Biology 3A.


01. (b) (i) structure in Specimen K which form the small intestine is the stomach

(ii) Adaptations of the structures labelled in 1 b (i) are adapted to their functions due to the following points:

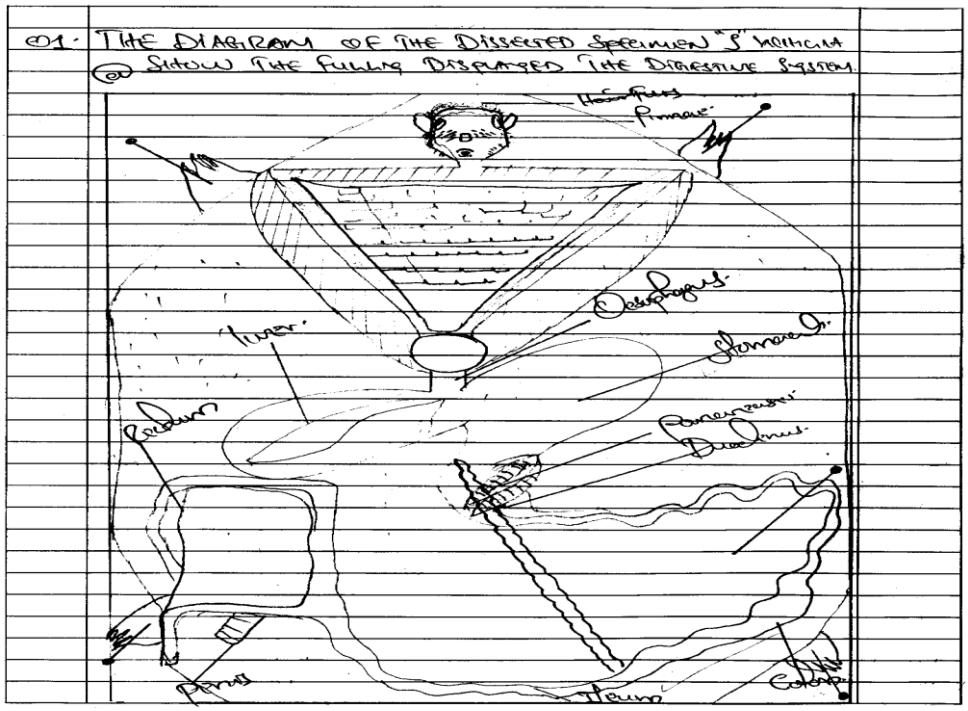
- Adaptations of stomach to its function.
  - It is J-shaped structure - like box used for storing food temporary before digestion.
  - It has gastric juice and enzymes for self digestion processes of different Food Materials such as starch, protein, Fatty acids and glycerol.
  - It has hydrochloric acid (HCl) act as Acidic Medium in the stomach to kill bacteria that enters with Food in the Mouth.

Extract 17.2 (a): Part of the candidate's incorrect responses to Question 1(b) in Biology 3A

In Extract 17.2, the candidate incorrectly mentioned the stomach as one of the parts of the small intestine and stated its adaptation.

Similarly, the candidates who scored from 7.0 to 11.5 in Biology 3B either gave some incorrect labels or drew diagrams without showing the caption and magnification in part (a). The candidates also lacked knowledge about the roles of the glands, adaptations and economic importance of the rat/mouse/guinea pig in parts (b) (c), (d) and (e). Therefore, they either gave incorrect points or fewer than the required ones.

Likewise, the candidates who scored from 1.0 to 6.5 marks in part (a) lacked drawing skills. For example, one candidate drew a diagram which did not reflect the rat/mouse/guinea pig. Another candidate drew a diagram of the human digestive system. These candidates could not score full marks in parts (b) (c), (d) and (e) due to their inadequate knowledge about the respective specimen. For example, one candidate wrote: *When the salivary gland is impairment its enzymes remain resistant* in part (c). Extract 17.2(b) is a sample of the incorrect responses to the question.



Extract 17.2(b): Part of the candidate's incorrect responses to Question 1 in Biology 3B

In extract 17.2(b), the candidate drew a diagram with a head like that of human being. Also, the digestive system displayed appears like that of a human instead of that of a mouse/guinea pig/rat.

Likewise, the candidates who scored from 7.0 to 11.5 marks in Biology 3C violated a few biological drawings principles in part (a). For example, some of the candidates drew diagrams without captions. Other candidates include incorrect captions. For example, one candidate wrote: *The diagram of a dissected cockroach.* Another candidate wrote*: A diagram of a male cockroach.* Besides, some of the candidates drew diagrams without magnification. This was similar to

those candidates who scored from 1.0 to 6.5 marks, except that they had many incorrect labels in part (a). Moreover, these candidates wrote the features of the cockroach instead of adaptations in part (c). For example, one candidate wrote: *the cockroach has wings, antennae and legs.*

2.3.2 Question 2: Cytology

In Biology 3A, the candidates were instructed to carry out an experiment using the following procedures:

(i) Take 2 test tubes and label them as test tube 1 and 2 respectively.
(ii) Rinse your mouth with pure drinking water; then, collect your saliva by spiting 2 ml into test tube 1.
(iii) Put 2 ml of water into test tube 2.
(iv) Add 2 ml of starch suspension to each of the test tubes. Shake the test tubes.
(v) Put the test tubes in a beaker of water at 40^0C and leave them for 10 minutes.
(vi) Put 2 drops of solution from each test tube into separate dimples of white tile and add a drop of iodine solution. Note the results.
(vii) Add 3 ml of Benedict`s solution to each test tube, then boil the test tubes for a minute. Note the results.

Then, they were required to answer the following questions:

(a) Based on the observations in procedures (vi) and (vii), write what happened to the iodine and Benedict`s tests, respectively. Record your experimental results as shown in Table 1.

Table 1

Test tube	Result of iodine test	Result of Benedict`s test
1		
2		

(b) Why was water in test tube 2 was needed in place of the saliva?
(c) Which test tube contained starch at the end of experiment? Give a reason to support your answer.
(d) What is the effect of the saliva on starch?
(e) Why was warmth in procedure (v) of the experiment important to our bodies?
(f) What is the importance of the food substance contained in test tube 1 at the end of experiment?

(g) In what ways is the knowledge used in the experiment useful in your daily life?

Similarly, in Biology 3B, the candidates were provided with solutions **X_1** (Sucrose solution) and **Z_1** (Starch solution). Then, they were required to:

(a) Use the provided chemicals to identify the food substance(s) present in each of the solutions X_1 and Z_1 and record the experimental work as shown in Table 1.

Table 1

Food tested	Procedure	Observation	Inference

(b) State two properties of the food substance(s) identified in each of the solutions X_1 and Z_1.
(c) Give the importance of warmth in some procedures of the experiment.
(d) State a way in which the food substance(s) identified in the solutions X_1 and Z_1 is important in the human body.
(e) Briefly explain how the knowledge applied in the experiment is useful in their daily life.

Likewise, in Biology 3C, the candidates were provided with solution **A_1** which contained protein and glucose. Then, they were required to:

(a) Use the chemicals and reagents provided only to identify the food substances present in solution A1 and record their experimental work as shown in Table 1

Table 1

Food tested	Procedure	Observation	Inference

(b) (i) Mention a disease which develops when the diet provided to a child lacks one of the food identified in 2(a).
(ii) State four symptoms of the disease mentioned in 2 (b)(i).

The question was attempted by 100 per cent of the candidates. Their performance is illustrated in Figure 14.

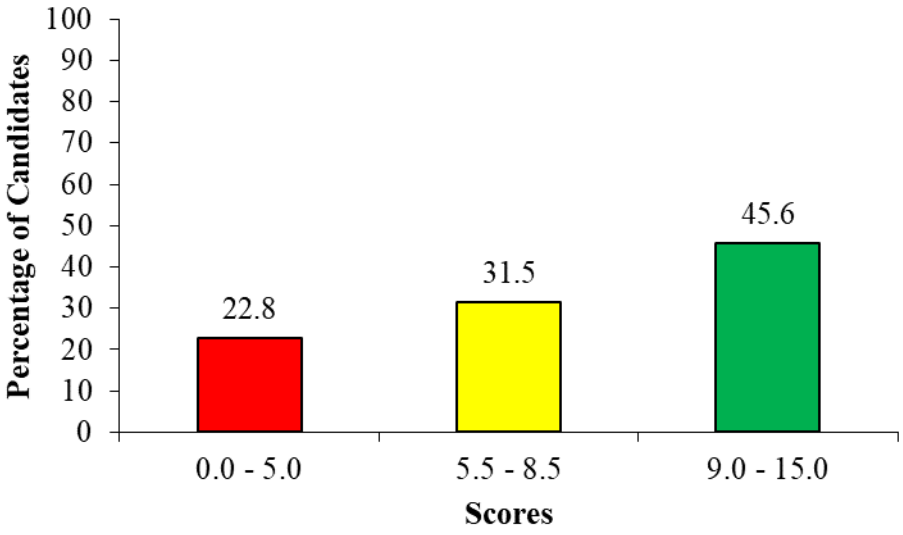


Figure 14: *Distribution of Candidates' Scores on Question 2*

Figure 14 shows that the candidates performance on the question was good since more than three quarters (77.2 %) of the candidates scored from 5.5 to 15 marks.

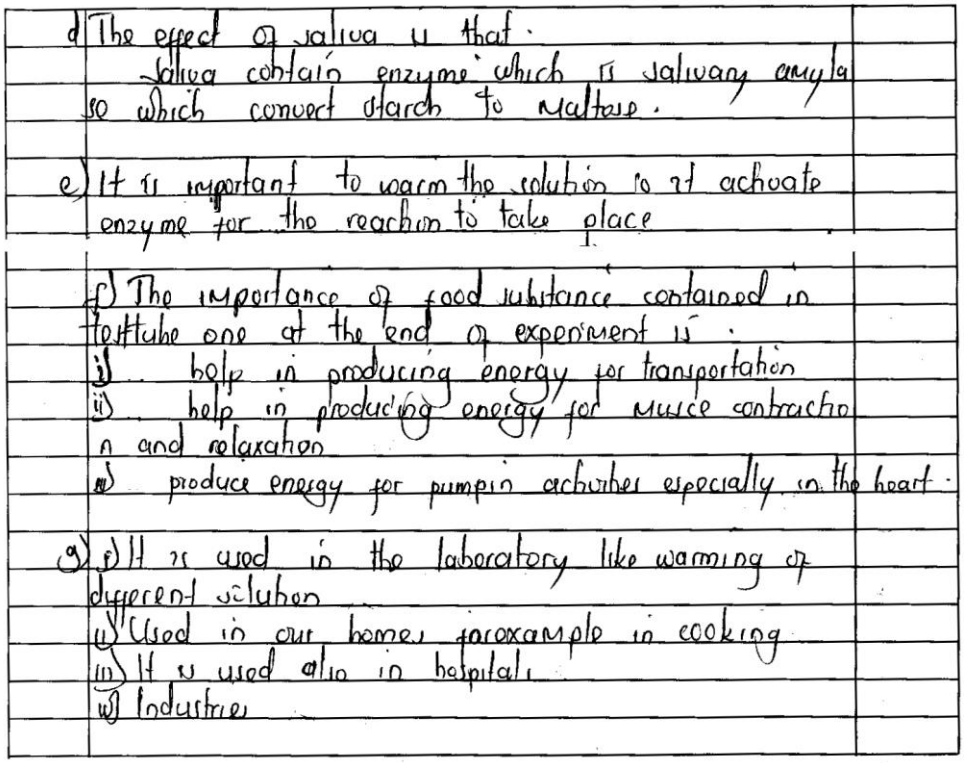
The analysis of the candidates' responses in Biology 3A reveals that the candidates (45.6%) who scored high marks (9.0 to 15.0) were competent in the use of apparatuses and measurements. Therefore, they correctly carried out the given procedure to obtain the correct results in parts (a) and (b). In addition, they correctly interpreted the results. In part (c), they were aware of the effects of enzymes on the food substances. Therefore, they correctly identified a test tube which contained starch at the end of the experiment when saliva and water were added to two separate test tubes containing starch solution. Moreover, the candidates were aware of the importance of warmth in the human body, the importance of food substance contained in test tube 1 at the end of the experiment and the importance of the knowledge of experiments in our daily life. Extract 18.1(a) is a sample of the correct responses from one of the candidates.

2. TABLE OF RESULT.

Test tube	Result of Iodine test	Result of Benedicts test
1	On addition of 2 drops of iodine solution the brown colour of iodine solution was retained	On addition of 3 mls of Benedicts solution the colour of a solution turned from blue green yellow and finally to brick red
2.	On addition of 2 drops of iodine solution the solution turned to blue black colour.	On addition of 3 mls of Benedicts solution the blue colour of Benedicts solution was retained

b) Water was needed in testtube 2 because- First it is neutral and has no any contamination like an enzyme. So was needed in a testtube 2 so as to compare the results of those two testtubes.

c) Testtube 2 contained starch because on addition of iodine solution it turned into blue black colour which show that starch is present.
Solution contained in testtube two (2) form a polyiodide complex on addition of few drops (2) of iodine solution

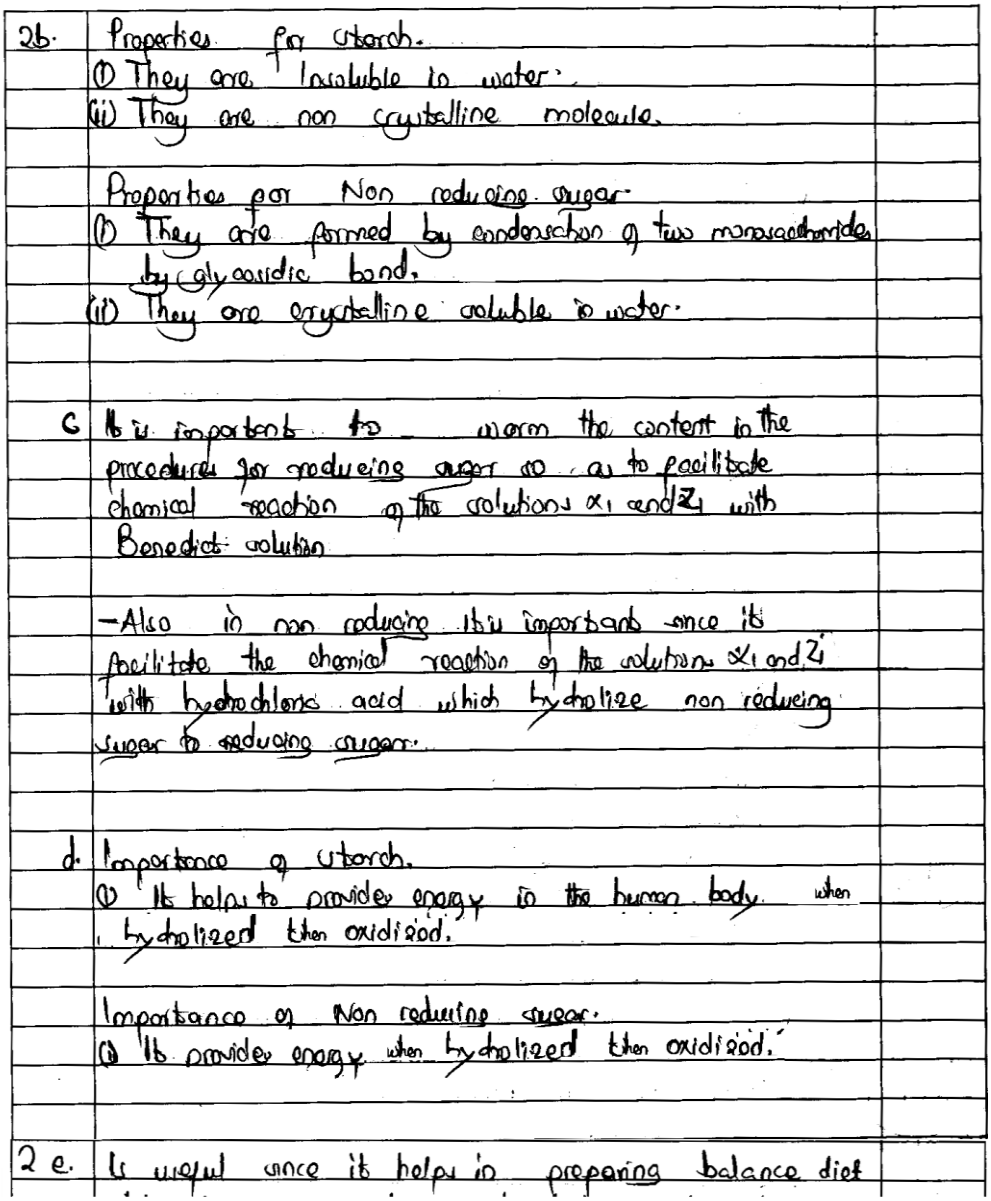


Extract 18.1(a): A sample of the candidates' correct responses to Question 2 in Biology 3A

In Extract 18.1(a), the candidate correctly used laboratory equipment and apparatus to carry out the experiment. Consequently, he/she made the correct observation and interpretation of the results. In addition, she/he was knowledgeable about salivary amylase converts starch to maltose and warmth speeds up the rate of chemical reactions.

Likewise, the candidates (45.6%) who scored high marks (12.0 to 20.0) on Question 2 of Biology 3B, were competence in the conducting experiments, recording and interpreting results. They were aware of the different types of food substances, their properties and their importance in the human body. Extract 18.1(b) is a sample of the correct responses to the question.

29.	Food Tested	Procedure	Observation	Inference
	STARCH	To 2cm³ of solutions X_1 and Z_1 into separate test tubes. 2 drops of Iodine solution were added separately and shaken.	The colour of solution Z_1 changed to blue black	Starch was Present
			Solution X_1 retained the brown colour of Iodine solution	Starch was absent
	Reducing Sugar	To 2cm³ of solutions X_1 and Z_1 into different test tubes 2cm³ of Benedicts solution was added separately and boiled.	Solution Z_1 retained the blue colour of Benedict solution.	Reducing sugar was absent
			Solution X_1 retained the blue colour of Benedict solution	Reducing sugar was absent.
	Non Reducing Sugar	To 2cm³ of solutions X_1 and Z_1 into different test tubes 1cm³ of dilute hydrochloric acid was added separately and heated and then cooled with cold water followed by addition of 1 cm³ of sodium hydroxide and shaken. Then 2 cm³ of Benedict solution was added separately and boiled.	Solution Z_1 retained the blue colour of Benedict solution	Non Reducing Sugar was absent
			Solution X_1 changed Colour from blue, green, yellow, orange and finally brick red precipitate.	Non Reducing sugar was present.

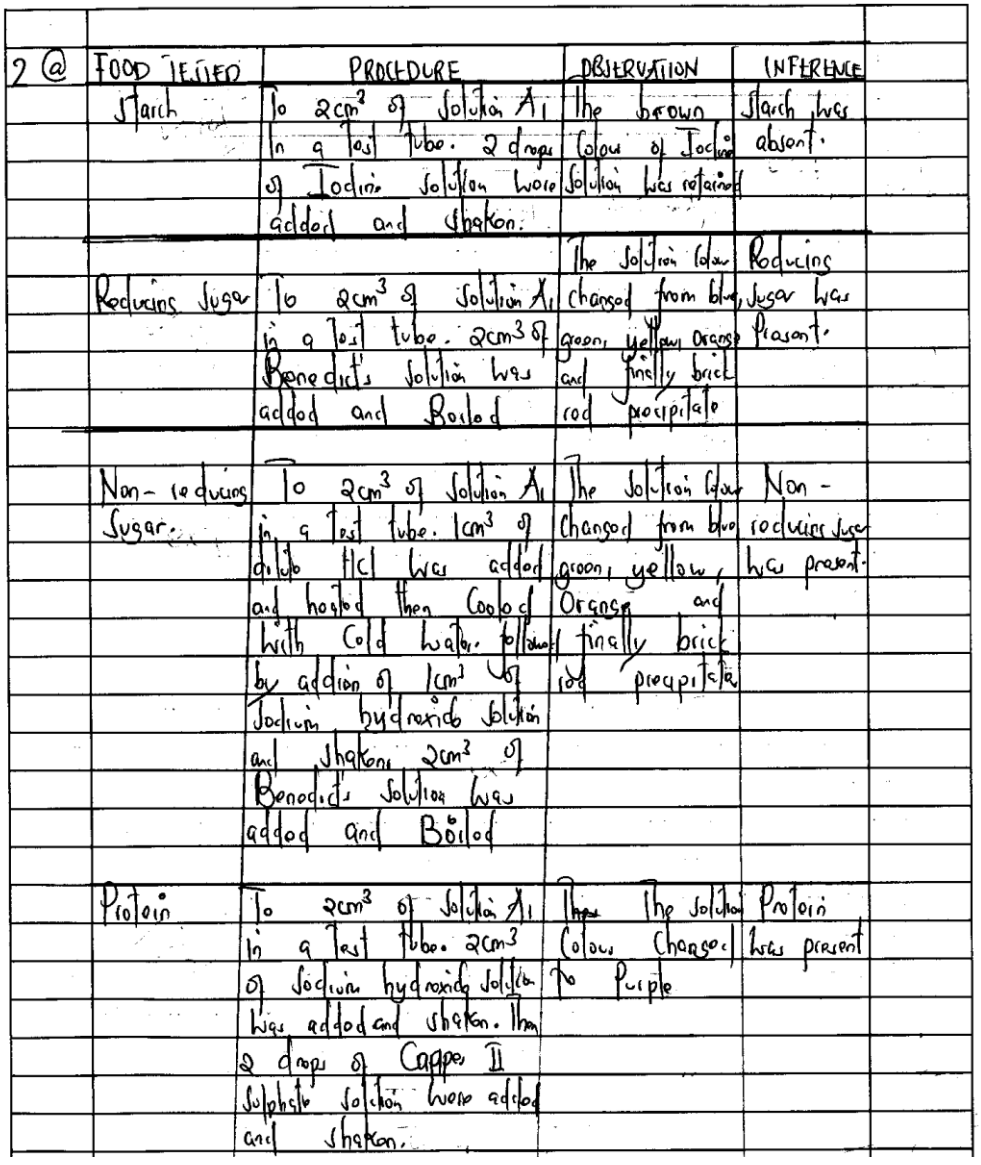


Extract 18.1(b): A sample of the candidates' correct responses to Question 2 in Biology 3B

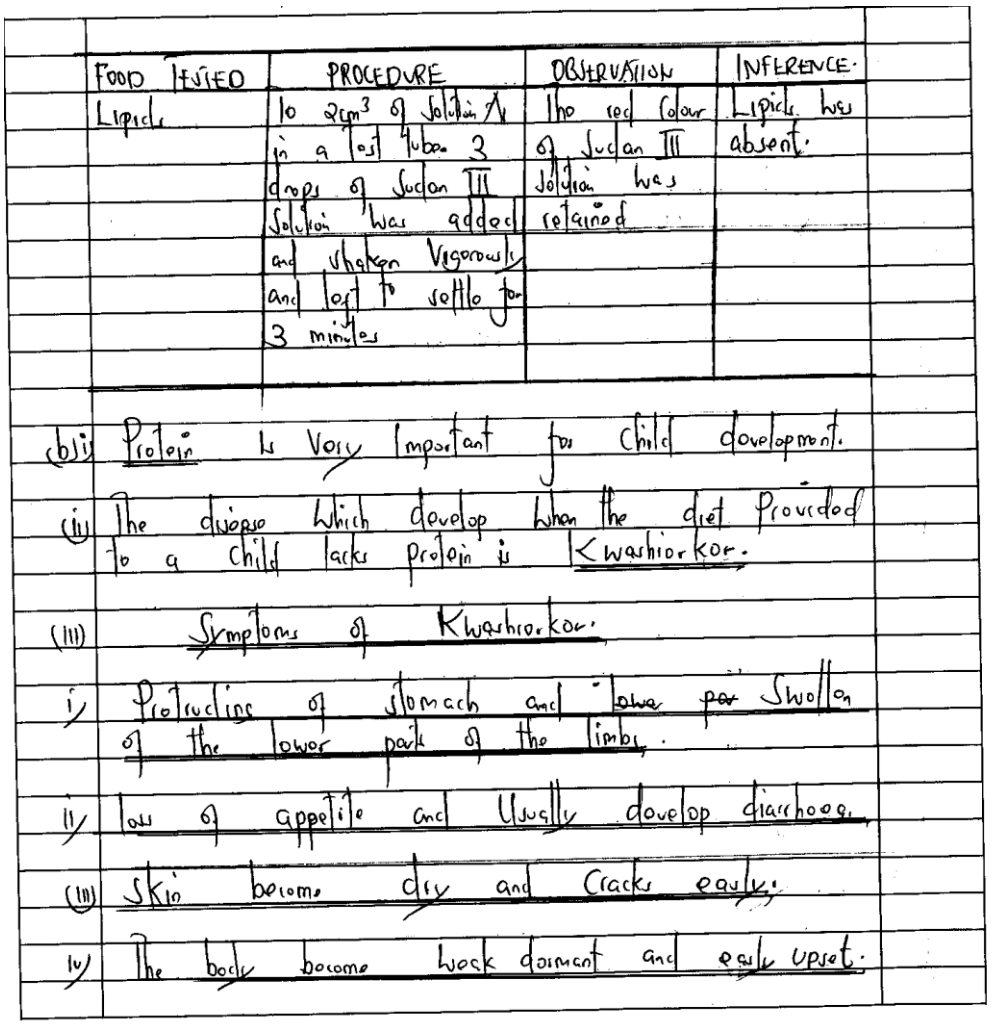
In Extract 18.1(b) the candidate demonstrated competence in conducting scientific the experiment and reporting the results. In addition, she/he was aware of the importance of the food identified in the solutions and the application of knowledge of the experiment in the daily life.

In the same way, the candidates who scored high marks (12.0 to 20.0) on question 2 of Biology 3C demonstrated competence in conducting the scientific experiment

to obtain correct results and to report them. Moreover, they knowledgeable about the disease and problems which result in the body of a child due to protein deficiency. They were aware that lack of protein leads to a child nutritional deficiency disease, called kwashiorkor. The disease is associated with symptoms like loss of appetite. Extract 18.1(c) is a sample of the correct responses.



2 @	FOOD TESTED	PROCEDURE	OBSERVATION	INFERENCE
	Starch	To 2cm³ of solution A, in a test tube. 2 drops of Iodine solution were added and shaken.	The brown colour of Iodine solution was retained	Starch was absent.
	Reducing Sugar	To 2cm³ of solution A, in a test tube. 2cm³ of Benedict's solution was added and Boiled	The solution colour changed from blue, green, yellow, orange and finally brick red precipitate	Reducing Sugar was present.
	Non-reducing Sugar.	To 2cm³ of solution A, in a test tube. 1cm³ of dilute HCl was added and heated then Cooled with Cold water. followed by addition of 1cm³ of Sodium hydroxide solution and shaken, 2cm³ of Benedict's solution was added and Boiled	The solution colour changed from blue, green, yellow, Orange and finally brick red precipitate	Non-reducing Sugar was present.
	Protein	To 2cm³ of solution A, in a test tube. 2cm³ of Sodium hydroxide solution was added and shaken. Then 2 drops of Copper II Sulphate solution were added and shaken.	Then the solution colour changed To Purple	Protein was present



FOOD TESTED	PROCEDURE	OBSERVATION	INFERENCE
Lipids	To $2cm^3$ of solution N in a test tube 3 drops of Sudan III solution was added and shaken vigorously and left to settle for 3 minutes	The red colour of Sudan III solution was retained	Lipids was absent.

(b)(ii) Protein is very important for child development.

(iii) The disease which develop when the diet provided to a child lacks protein is Kwashiorkor.

(iii) Symptoms of Kwashiorkor.

i/ Protruding of stomach and lower par swollen of the lower part of the limbs.

ii/ Low of appetite and usually develop diarrhoea.

(iii) Skin become dry and cracks easily.

iv/ The body become weak dormant and easily upset.

Extract 18.2(c): A sample of the candidates' correct responses to Question 2 in Biology 3C

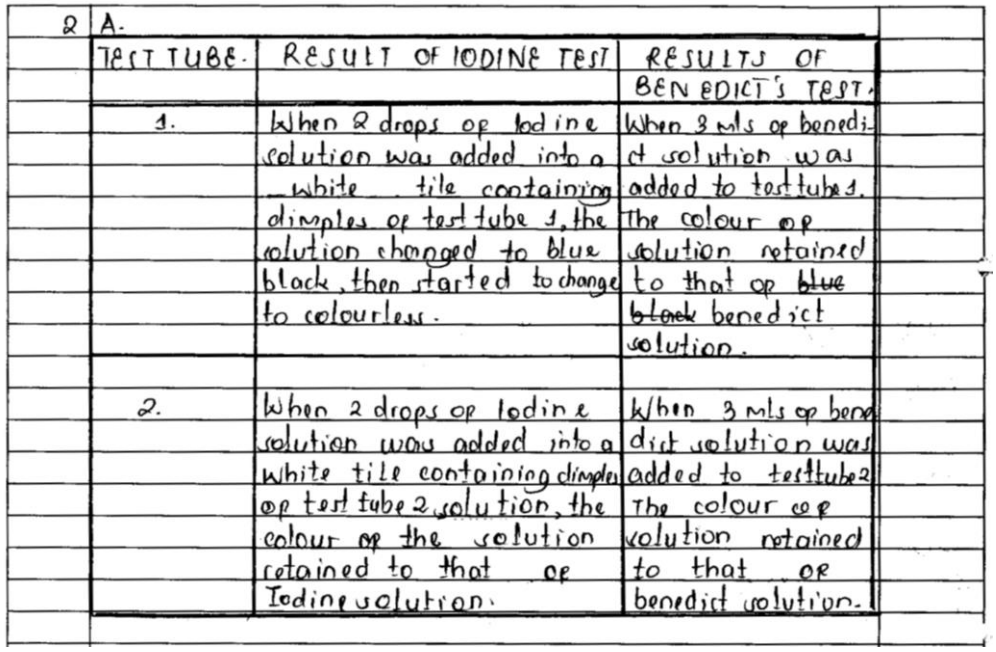
In Extract 18.2(c), the candidate demonstrated good skills in conducting the biochemical test and reporting the results. Besides, she/he wrote the correct malnutrition disorder caused by protein deficiency in children, which is kwashiorkor, and its symptoms, such as having a protruded stomach.

Despite the candidates' good performance on Question 2 of Biology 3A, 3B and 3C, 31.5 per cent scored average marks (5.5 to 8.5) while 22.8 per cent scored low marks (0.0 to 5.0). The candidates who scored average marks (5.5 to 8.5) in Biology 3A, failed to interpret the results in test tube 1 in which starch was converted to maltose (reducing sugar) by the salivary amylase contained in the saliva in par (a). Some of them scored zero in part (g) because they were not

knowledgeable about the importance food test in their daily life. For example, one candidate wrote: *The importance of the knowledge of this experiment in daily life is for cooking food.*

The candidates who scored low (1.0 to 5.0) marks on the question scored zero in parts (a). They failed to make correct observation and interpretation of the results. For example, a few candidates reported positive results with Iodine test to a test tube containing starch and saliva boiled to 40^{o}C. This indicates that, they boiled the solution to a high temperature (above 40^{o}C) which denatured the salivary amylase, making it incapable of converting starch to maltose. The candidates were not aware that enzymes are specific to temperature. In addition, they could not score marks in part (g) because they were not aware of the application of the knowledge of the experiment to their daily life.

The candidates who scored zero made incorrect observation of the experimental results and consequently had incorrect interpretation. Extract 18.2(a) is part of an incorrect response from one of the candidates.



2 A.

TEST TUBE.	RESULT OF IODINE TEST	RESULTS OF BENEDICT'S TEST.
1.	When 2 drops of Iodine solution was added into a white tile containing dimples of test tube 1, the solution changed to blue black, then started to change to colourless.	When 3 mls of benedict solution was added to test tube 1. The colour of solution retained to that of ~~blue black~~ benedict solution.
2.	When 2 drops of Iodine solution was added into a white tile containing dimples of test tube 2 solution, the colour of the solution retained to that of Iodine solution.	When 3 mls of benedict solution was added to test tube 2 The colour of solution retained to that of benedict solution.

B.

- Water in test tube 2 was needed in place of saliva in order to identify the food substance present in the solutions and identify the effect of ~~to~~ saliva in starch suspension.

C

- Test tube 1 contained starch at the end ~~point~~ of experiment this is because starch present in the solution is identified by Iodine solution therefore after addition of Iodine solution the colour change to blue black and this shows starch present.

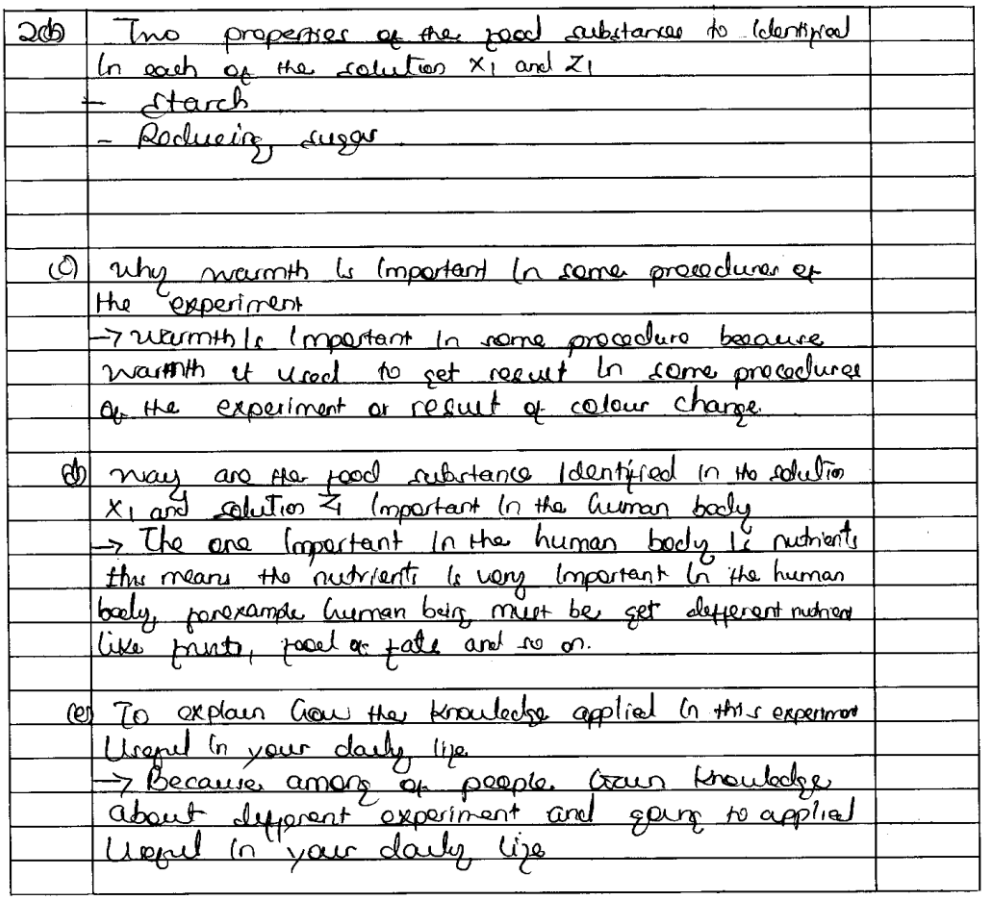
Extract 18.2(a): Part of the candidate's incorrect responses to Question 2 in Biology 3A

In Extract 18.2(a), the candidate lacked skills in conducting and interpreting experimental results. Consequently, he/she identified test tube 1 as the one which contained starch at the end of the experiment instead of test tube 2.

The candidates who scored average marks (5.5 to 8.5) in Biology 3B could not score marks in part (a), but they scored a few marks in part (b). In part (a), they either made incorrect observations or inferences. In part (b), they not knowledgeable about properties of various food substances in the human body such as starch and non-reducing sugar.

In contrast, the candidates who scored low marks (1.0 to 5.0) stated an incorrect procedure for testing non-reducing sugar in part (a). The candidates did not consider boiling as an important procedure. Others failed to identify the food substances contained in the given solutions in part (a). Consequently, they could not score full marks in parts (b), (c), (d) and (e). They incorrectly stated properties and the importance of the food identified. Besides, they gave incorrect applications of the knowledge of the experiment in their daily life.

The candidates who scored zero, used incorrect an experimental procedure which gave incorrect results; consequently, they made incorrect observations and inferences. Finally, they gave incorrect responses to parts (b), (c), (d) and (e). Extract 18.2(b) is a sample of the incorrect responses from one of the candidates.


2(b) Two properties of the food substances to identified In each of the solution X_1 and Z_1
+ Starch
- Reducing sugar

(c) Why warmth is important in some procedures of the experiment
→ warmth is important in some procedure because warmth it used to get result in some procedures of the experiment or result of colour change.

(d) way are the food substance identified in the solution X_1 and solution Z_1 important in the human body
→ The one important in the human body is nutrients this means the nutrients is very important in the human body, forexample human being must be get different nutrient like fruits, food or fats and so on.

(e) To explain how the knowledge applied in this experiment Useful in your daily life.
→ Because among of people. Learn knowledge about different experiment and going to applied Useful in your daily life

Extract 18.2(b): Part of the candidate's incorrect response to Question 2 in Biology 3B

In Extract 21.2, the candidate wrote starch and reducing sugar as the properties of the food identified in part (b). In part (d), he/she gave the general importance of the food identified such as provision of nutrients to the human body.

The candidates who scored average marks (5.5 to 8.5) in Biology 3C, scored few marks in parts (a) and full or most marks in part (b). However, in part (a) they failed to make inferences. In part (b), they were not aware of the disease and symptoms of kwashiorkor which is caused by deficiency of protein in children.

Similarly, the candidates who scored low marks (1.0 to 6.5) in part (a) stated the wrong procedure for testing lipids, proteins and reducing sugar. These candidates did not consider leaving the solution to settle (for lipid), adding dilute NaOH (for protein) and boiling (for reducing sugar) to be important procedures for testing the respective food substances. Others scored few marks in part (a) and could not score full the marks in part (b). This was because, in part (b), they were not aware

of the deficiency disorder caused by lack of protein in children and their symptoms, such as oedema.

The candidates who scored zero used an incorrect experimental procedure which resulted to incorrect results, observation and inferences in part (a). Consequently, they provided incorrect responses in part (b). For example, one candidate wrote: *The disease is marasmus and the symptoms include general body weakness.* In a real senses marasmus is a nutritional deficiency disease caused by lack of carbohydrates.

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

In Biology 3A, the candidates were provided with specimens **L** (mushroom), **T** (spider)**, W** (tilapia), **X** (lizard), **Y** (termite) and **Z** (beetle). Then, they were required to:

(a) Give three distinctive features used to place each of the specimens L and Y in its respective Kingdom.
(b) State one advantage and disadvantage of each of the specimens L and Y.
(c) Construct a bracketed key for identification of the specimens T, W, X, Y and Z by considering the following features: (i) Nature of the skeleton (ii) Wings (iii) Scales and (iv) Body parts.

Similarly, in Biology 3B, the candidates were provided with specimens **A** (lizard), **B** (frog/toad), **C** (tilapia fish**), D** (earthworm)**, E** (ascaris)**, F** (matured moss plant) and **G** (matured fern plant). Then, they were required to:

(a) Explain how each of the specimens F and G is adapted to its mode of life. Give three points for each.
(b) (i) Identify the Division/Phylum, Class and the Genus of each of the specimens F and G.
(i) Use binomial nomenclature rules to correctly write the specific names of each specimen if the specimens F and G belong to hygrometrica and filix-mas species respectively.
(c) Construct a bracketed key for identification of the specimens A, B, C, D and E using the following features: (i) Backbone (ii) Body shape (iii) Fins (iv) Limb size.

Likewise, in Biology 3C, the candidates were provided with specimens $\mathbf{R_2}$ (cockroach), $\mathbf{B_1}$ (millipede), $\mathbf{B_2}$ (earthworm), $\mathbf{B_3}$ (centipede) and $\mathbf{B_4}$ (ascaris). Then, they were required to:

(a) Classify each of the specimen B_1 and B_2 to Class level.
(b) State three ways in which specimen B_2 is important to the environment.
(c) State the habitat of each of the specimens B_1 and B_2.
(d) Construct an indented key for identification of the specimens R_2, B_1, B_2, B_3 and B_4 using the following features: (i) Nature of the skeleton (ii) Body segments (iii) Wings and (iv) Legs.

This question was attempted by all candidates and the performance is shown in Figure 15.

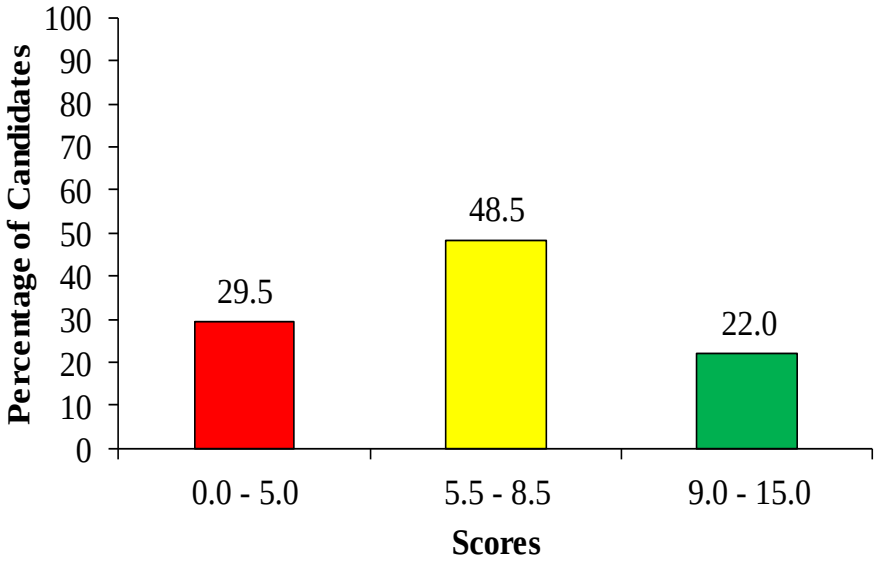
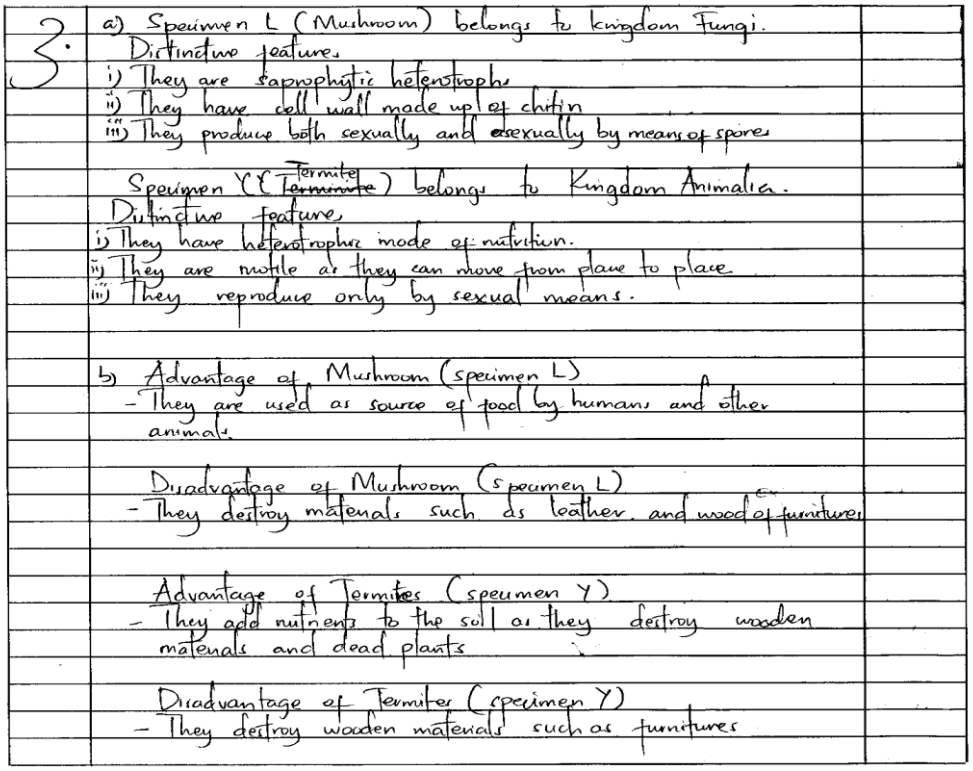


Figure 15: *Distribution of Candidates' Scores on Question 3*

Figure 15 shows that more than a half of the candidates (70.5%) scored from 5.5 to 15 marks. This shows that their performance was good.

Those who scored from 9.0 to 15.0 marks in Biology 3A had adequate knowledge of the distinctive features of the Kingdoms Fungi and Animalia. Therefore, they correctly classified the mushroom and termite as members of the Kingdoms Fungi and Animalia, respectively. In addition, they had knowledge about the positive and negative effects of mushrooms and termites. For example, one candidate wrote: *Mushroom is important because it is a source of food to other organisms such as human being. But some species of mushroom have negative effects as they poisonous and may cause death to human being*. Moreover, they were knowledgeable about the construction of a bracketed key. They correctly formulated contrasting statements/leads from the given features and constructed the bracketed key. Extract 19.1(a) is a sample of the correct responses by one of the candidates.


3. a) Specimen L (Mushroom) belongs to kingdom Fungi.
Distinctive feature.
i) They are saprophytic heterotroph.
ii) They have cell wall made up of chitin
iii) They produce both sexually and asexually by means of spores

Specimen Y (Termite) belongs to Kingdom Animalia.
Distinctive feature.
i) They have heterotrophic mode of nutrition.
ii) They are motile as they can move from place to place.
iii) They reproduce only by sexual means.

b) Advantage of Mushroom (specimen L)
- They are used as source of food by humans and other animals.

Disadvantage of Mushroom (specimen L)
- They destroy materials such as leather and wood of furniture.

Advantage of Termites (specimen Y)
- They add nutrients to the soil as they destroy wooden materials and dead plants

Disadvantage of Termite (specimen Y)
- They destroy wooden materials such as furnitures

Extract 19.1(a): Part of the candidate's correct responses to Question 3 in Biology 3A

In Extract 19.1(a), the candidates correctly classified the mushroom and termite as members of Kingdoms Fungi and Animalia, respectively. She/he also pointed out destruction of wooden material as one of the disadvantages of the mushroom and termite.

Likewise, the candidates who scored from 9.0 to 15.0 marks in Biology 3B classified matured moss and fern plants as the members of the Kingdom Plantae. They proceeded to the respective Divisions of moss and fern plants which are Bryophyta and Filicinophyta/Pteridophyta respectively. They also described all or most of their required adaptations. Moreover, they used the given feature and the correct procedure for constructing bracketed key. Extract 19.1 is a sample of the correct responses from one of the candidates.

3 a) Adaptations of specimen F.

i) It has rhizoids for anchorage to the soil providing water and mineral salts from the soil.

ii) Produces light spores and its seta is raised for easier dispersal of spores by wind.

iii) Grows short hence water uptake is by capillary action.

Adaptations of specimen G.

i) Has wide leaves called fronds with chlorophyll hence produce its own food by photosynthesis process.

ii) Possess adventitious roots for giving support on land and absorption of water and mineral salts from the soil.

iii) Its leaves have cuticle which prevents water loss by transpiration.

b) i)

Specimen	Division	Class	Genus
F	Bryophyta	Musci	Funaria
G	Filicinophyta		Dryopteris

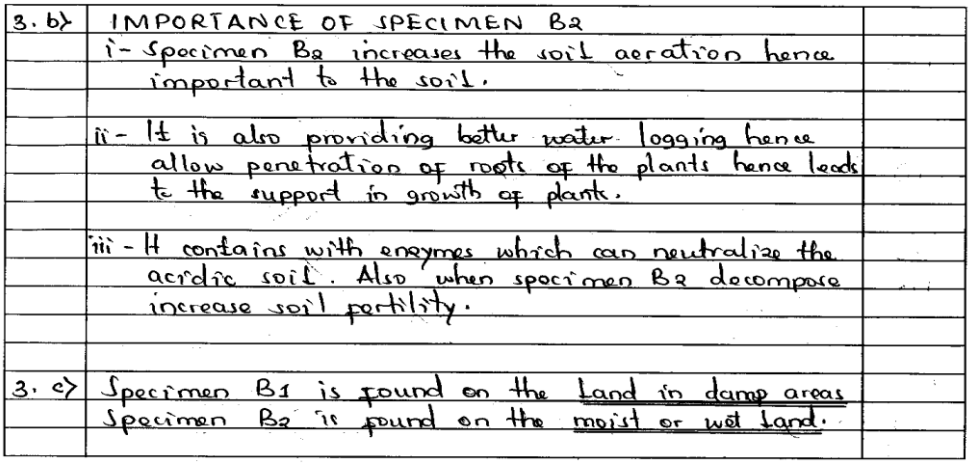
3b ii)

Specimen	Specific name
F	Funaria hygrometrica
G	Dryopteris filix-mas.

Extract 19.2(b): A part of the candidate's correct responses to Question 3 in Biology 3B

In Extract 19.2(b), the candidate correctly described the adaptations of moss and fern plants, such as the presence of rhizoids in moss and adventitious roots in fern for anchorage.

The candidates who scored from 9.0 to 15.0 marks in Biology 3C classified the specimens B_1 (millipede) and B_2 (earthworm) to class level. In addition, they gave the habitats of the specimens B_1 and B_2, and the importance of the specimen B_2. Moreover, they demonstrated good skills in constructing the indented key for the given organisms. Extract 19.1(c) is part of the correct response by one of the candidates.


3. b) IMPORTANCE OF SPECIMEN B2

i- Specimen B2 increases the soil aeration hence important to the soil.

ii- It is also providing better water logging hence allow penetration of roots of the plants hence leads to the support in growth of plants.

iii - It contains with enzymes which can neutralize the acidic soil. Also when specimen B2 decompose increase soil fertility.

3. c) Specimen B1 is found on the Land in damp areas
Specimen B2 is found on the moist or wet land.

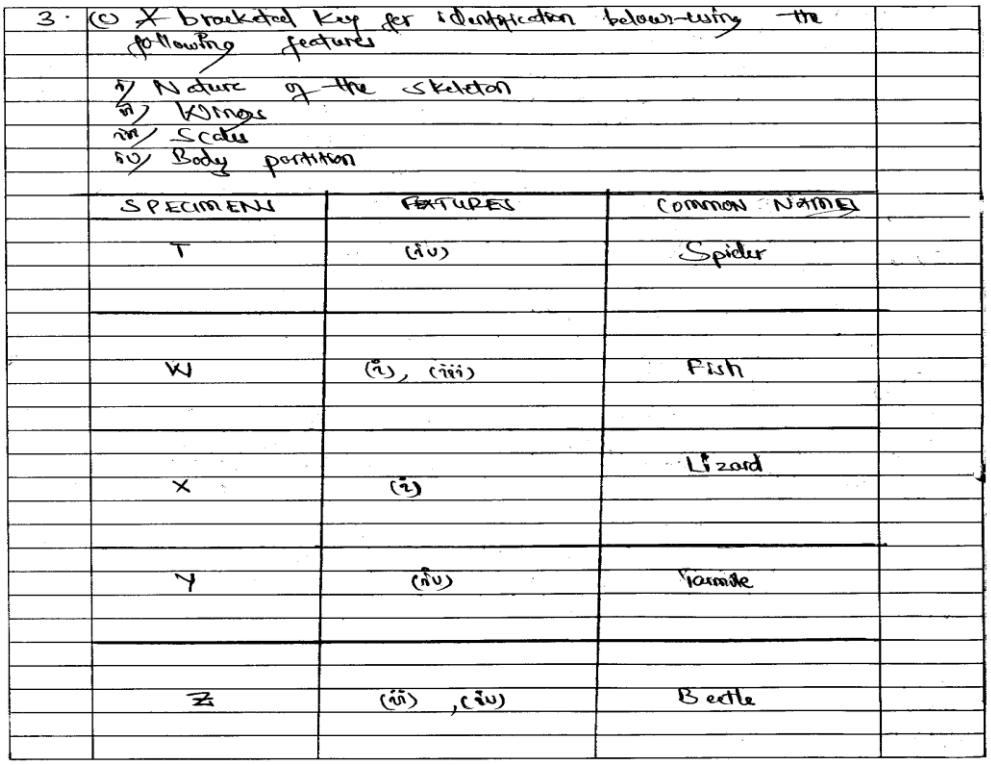
Extract 19.1(c): Part of the candidate's correct responses to Question 3 in Biology 3C

In Extract 19.1(c), the candidate gave the importance of earthworms such as improvement of soil aeration. He/she gave the habitats of the given organisms, which is terrestrial/land, specifically in damp areas for millipedes and wet/moist land for earthworms.

Despite the good performance of the candidates on Question 3, a further analysis of candidates' responses in Biology 3A, 3B and 3C reveals that the candidates who scored from 5.5 to 8.5 marks in Biology 3A, did not score full marks on the construction of bracketed keys. This was caused by their inadequate skills in the construction of keys. For example, one of the candidates constructed an indented key instead of the bracketed key. Another candidate used three statements in one lead instead of two contrasting statements.

Likewise, the candidates who scored from 1.0 to 5.0 marks, could not score marks for constructing key and scored some marks for distinctive features of the Kingdoms Fungi (Mushroom) and Animalia (termite). Some of these candidates wrote distinctive features of the Phyla or Class of the respective organisms instead of their Kingdoms while others wrote the features of the provided organisms such as the presence of three body parts in a termite.

On the other hand, a few candidates who a score zero, demonstrated lack of competence on the construction of keys and classification of organisms. Extract 19.2(a) is part of an incorrect response from one of the candidates.



3. (c) A bracketed Key for identification below using the following features

(i) Nature of the skeleton
(ii) Wings
(iii) Scales
(iv) Body partition

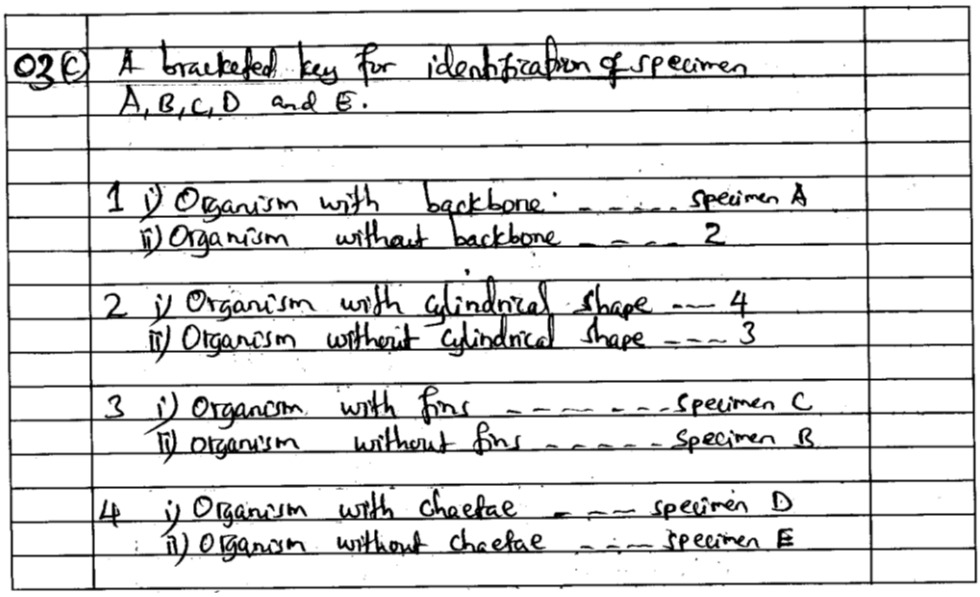
SPECIMEN	FEATURES	COMMON NAMES
T	(iv)	Spider
W	(i), (iii)	Fish
X	(i)	Lizard
Y	(iv)	Termite
Z	(iii), (iv)	Beetle

Extract 19.2 (a): Part of the candidate's incorrect responses to Question 3 in Biology 3A

In Extract 19.2(a), the candidate incorrectly considered the given features to be the leads for constructing a bracketed key.

Similarly, the candidates who scored from 5.5 to 8.5 marks in Biology 3B could not score marks in part (b) (i) but scored some marks in parts (a) and (c). In part (b) (i), they failed to place matured moss and fern plants into their respective Divisions and Genera and write their scientific names. Most of these candidates mixed up between moss and fern plants. For example, one candidate wrote: *Moss plant belongs to the division Pteridophyta while fern belongs the division Bryophyta*.

Some of candidates who scored from 0.0 to 5.0 marks did not score marks in parts (a), (b) or (c). In part (c), they failed to follow the procedure for constructing the bracketed key. For example, one candidate formulated three contradicting leads instead of two. Extract 19.2(a) is a sample of the incorrect responses by one of the candidates.

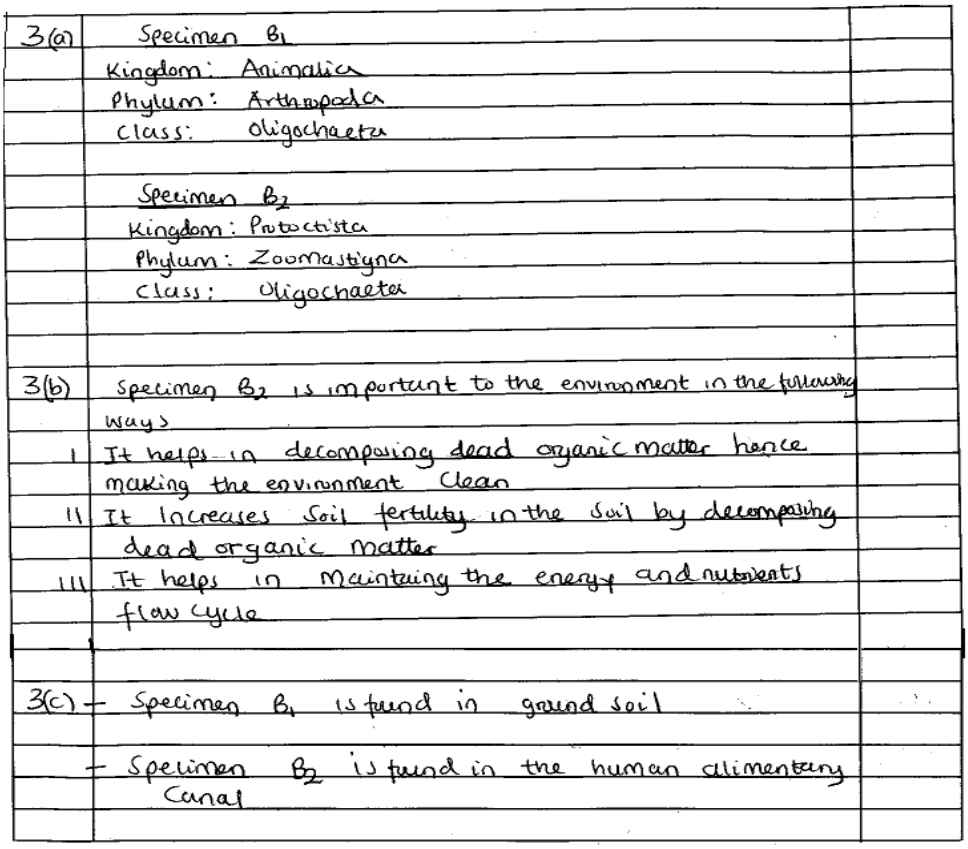


Extract 19.2 (b): Part of the candidate's incorrect responses to Question 3 in Biology 3B

In Extract 19.2(b), the candidate incorrectly used chaeta, the features that were not provided in the question to construct the bracketed key.

Likewise, the candidates who scored from 5.5 to 8.5 marks in Biology 3C in part (d) constructed a bracket key instead of an indented key. This was also similar to those who scored from 1.0 to 5.0 marks. However, in part (a), the candidates exchanged the classification of specimen B_1 (millipede) and B_2 (earthworm). Some candidates in part (b) regarded earthworms as decomposers. These candidates were not aware that the role of decomposition is done by bacteria and fungi.

The candidates who scored zero in parts (a) and (b) did not understand the demand of the question and lacked knowledge of the tested concepts. Extract 19.2(c) is a sample of the incorrect responses by one of the candidates.



Extract 19.2(c): Part of the candidate's incorrect responses to Question 3 in Biology 3C

In Extract 19.2(c), the candidate gave incorrect responses except for the Kingdom and Phylum of the specimen B_1 (millipede).

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH TOPIC

A total of 13 topics were tested in the Biology Subject Examination where seven topics were tested in the133/1 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 is a practical paper.

The candidates' general performance in Biology shows that the candidates had good performance on six topics, average performance on one topic and weak performance on six topics. The performance is as follows:

In the 133/1 Biology 1 paper, the candidates showed highest performance on the topic of *Transportation* (76.9%) showed the highest performance followed by

Principles of Classification (65.5%), *Cytology* (47.9%), *Coordination* (30.4%), *Gaseous Exchange and Respiration* (23.7%), *Reproduction* (43.7%) and *Nutrition* (21.5%). In the 133/2 Biology 2 paper, the topic of *Evolution* (71.1%) ranked first followed by *Regulation/Homeostasis* (61.3%), *Comparative Studies of Natural Groups of Organisms* (58.0%), *Ecology* (27.3%), *Growth and Development* (10.6%) and *Genetics* (1.5%). In the 133/3 Biology 3 paper, the topics of *Comparative Studies of Natural Groups of Organisms/ Principles of Classification* and *Cytology* were performed at 84.6 per cent and 77.2 per cent, respectively. The performance on each topic is summarised in Appendix A.

The comparison of the candidates' performance on each topic in Biology ACSEE 2020 and ACSEE 2021 reveals similar or slightly difference as follows: The topics which have similarly demonstrated good performance are *Comparative studies of Natural Groups of Living Organisms, Principles of Classification* and *Cytology* while the topic of *Reproduction* has maintained an average performance. Similarly, the *Ecology* and *Nutrition* topics demonstrated weak performance as it was reflected in 2020. Contrarily, the performance on the topics of *Transportation* and *Evolution* has improved from weak to good while that of *Regulation/Homeostasis* has improved from average to good. However, the performance on the topics of *Gaseous Exchange and Respiration* and *Growth and development* has decreased from average to weak while that of *Coordination* and *Genetics* has changed from good to weak. The comparison is summarised in Appendix B.

4.0 CONCLUSION

The general performance of the candidates in Biology in the ACSEE 2021 was good since 96.81 per cent of them scored 35 marks or above. This performance indicates that there is more effort in enhancing the teaching and learning process, which has enriched the candidates with knowledge, skills and competencies in the tested concepts. Moreover, it has strengthened the candidates' ability to identify the tasks of the questions, to explain, describe or justify the biological concepts/facts, dissect animals such as the cockroach, frog and rat and draw their diagrams.

Despite the good knowledge, skills and competencies that most of the candidates demonstrated, a further analysis of the candidates' performance shows that 3.19 per cent of the candidates had weak performance. These candidates lacked enough knowledge, skills and competencies in the tested concepts. The candidates either provided responses which were contrary to the requirement of the questions or gave responses which lacked details for them to obtain full marks. Others provided

inadequate responses compared to the requirement of the question. The following factors which might have contributed to the weak performance:

(a) Candidates' incompetence in the tested concepts. This might have been caused by the lack of students' internalisation of the biological concepts.

(b) Candidates' confusion of related biological concepts/facts or organisms. This might have been caused by either failure of the candidates to read the questions carefully and understand their demands before attempting them or carelessness when responding to the questions.

(c) Candidates' inability to adhere to the principles of drawing biological diagrams. This might have been caused by their lack of drawing skills.

5.0 RECOMMENDATIONS

The candidates' good performance is the result of the teaching and learning process which involves teachers on one side and learners on the other side. Accordingly, the following recommendations are put forward to improve performance of prospective candidates:

(a) Teachers should ensure that they use the following teaching/learning resources:

(i) Charts/illustrations or diagrams in teaching the concept of epistasis on the topics of Genetics which demonstrated the lowest performance.

(ii) Real plants/specimens of meristematic tissue/diagram or charts in teaching the concept of the formation of lateral branches and root on the topic of Growth and Development, whose performance has dropped from average to weak.

(iii) Charts/diagrams/models or pictures in teaching the Nutrition topic which maintained the weak performance for four consecutive years.

(iv) Charts/diagrams or video showing the process of respiration of various respiratory substrates on the topic of Gaseous Exchange and Respiration, which their performance has dropped from average to weak.

(v) Field visit in teaching the topic of Ecology which has maintained the weak performance for two consecutive years.

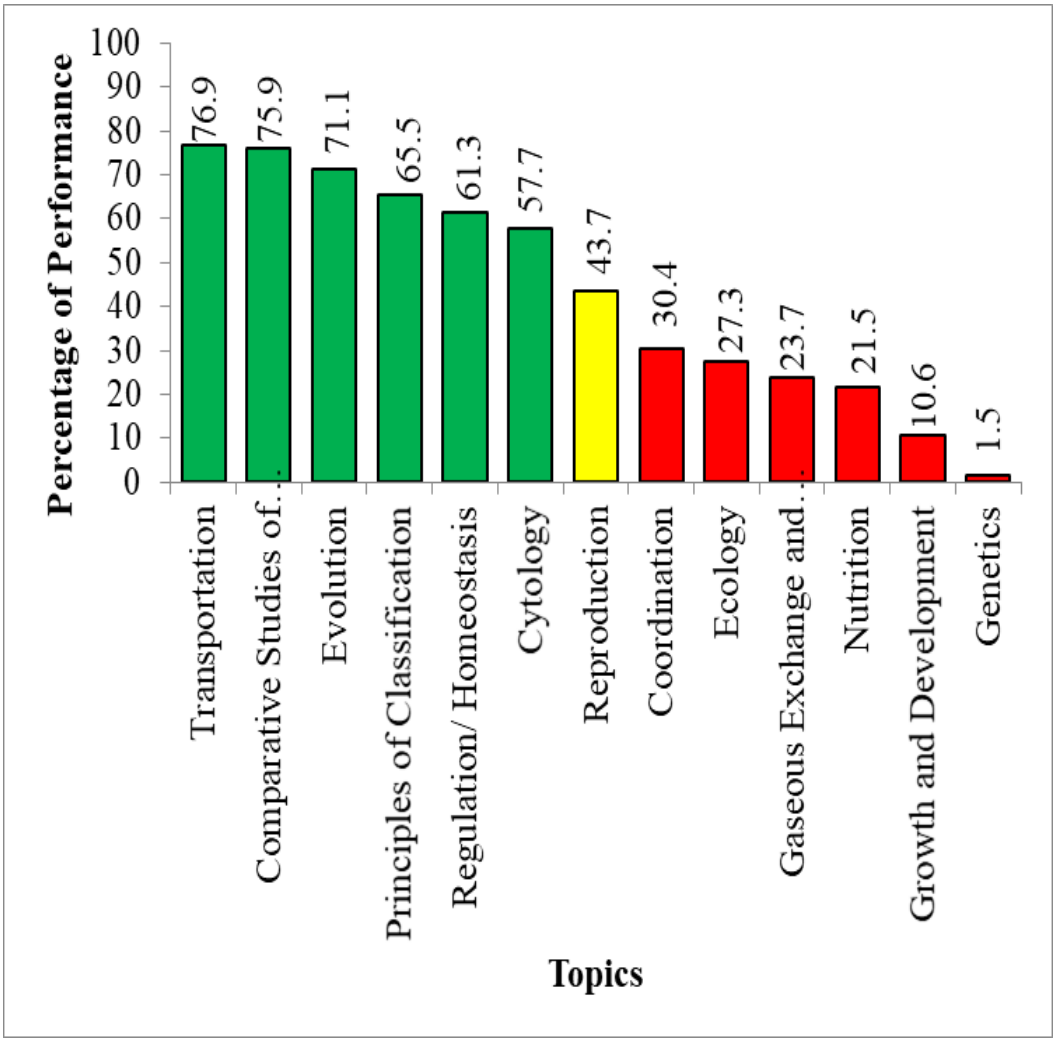
(vi) Photographs/diagrams/pictures or illustrations to teach the topic of *Coordination* whose performance has dropped from good to weak.

(b) Students should do more practice to solve various questions in the Biology subject. The practice will help them to internalise the concepts taught under each topic.

(c) Students should read each question carefully to ensure that they clearly understand its requirement before attempting it.

(d) Students should practice drawing biological diagrams in accordance with the principles of drawing such diagrams in Biology.

Appendix A: The Candidates' Performance on Each Topics in 2021 ACSEE



Appendix B: Comparison of the Candidates' Performance on 133 Biology ACSEE between 2020 and 2021 by topic

S/N	Topic	2020			2021		
		No of Question(s)	Per centage of Candidates who Scored an Average of 35 Per cent or Above	Remarks	No of Question	Per centage of Candidates who Scored an Average of 35 Per cent or Above	Remarks
1.	Transportation	1	30.4	Weak	1	76.9	Good
2.	Comparative Studies of Natural Groups of Organisms	2	59.5	Good	3	75.9	Good
3.	Evolution	1	16.8	Weak	1	71.1	Good
4.	Principles of Classification	1	83.4	Good	1	65.5	Good
5.	Regulation/ Homeostasis	1	55.7	Average	1	61.3	Good
6.	Cytology	2	79.2	Good	3	57.7	Good
7.	Reproduction	2	37.9	Average	2	43.7	Average
8.	Coordination	1	67.9	Good	1	30.4	Weak
9.	Ecology	1	12.8	Weak	1	27.3	Weak
10.	Gaseous Exchange and Respiration	2	46.9	Average	2	23.7	Weak
11.	Nutrition	1	24.2	Weak	1	21.5	Weak
12.	Growth and Development	1	59.7	Average	1	10.6	Weak
13.	Genetic	1	81.7	Good	1	1.5	Weak