THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR THE ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (ACSEE) 2019

133 BIOLOGY

THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

CANDIDATES' ITEM RESPONSE ANALYSIS REPORT FOR THE ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (ACSEE) 2019

133 BIOLOGY

Published by

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

TABLE OF CONTENTS

FOREWORD

The National Examinations Council of Tanzania is pleased to issue this report on Candidates' Item Response Analysis (CIRA) for the Advanced Certificate of Secondary Education Examination (ACSEE) in Biology subject which was conducted in May, 2019. The ACSEE marks the end of two years of the advanced level of secondary education. The results of the ACSEE are used as a basis for the selection of candidates who join colleges and universities for professional education.

The report provides feedback to candidates, teachers, parents, policy makers and the public in general on the performance of the candidates and how effective the teaching and learning process was. It highlights factors which contributed to the achievements of the candidates as well as the challenges which the candidates faced in answering questions correctly. The analysis shows that the candidates who scored high marks had ability to identify the tasks of the questions, sufficient competence on expressing biological ideas clearly, enough drawing skills and English Language proficiency for responding to different questions. However, the candidates with low scores had low competence in those areas.

It is expected that, the feedback provided in this report will enable teachers and other stakeholders to take appropriate measures in order to improve the teaching and learning of Biology in advanced level secondary schools in Tanzania. In addition, the Council hopes that the skills which teachers and candidates will acquire from this analysis will improve performance in future NECTA examinations.

Finally, the National Examinations Council of Tanzania is grateful to all stakeholders who provided valuable assistance in the preparation of this report in various capacities.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

The 2019 Biology Advanced Certificate of Secondary Education Examination was held in May. There was a total of 28,023 school candidates registered for 2019 ACSEE out of which 27,823 sat for the examination and 26637 (96.12%) passed the examination. This performance is lower by 0.86 per cent when compared to the performance of 2018 where 96.98% passed. The analysis of the candidates' performance in 2019 in each grade and gender is summarized in Table 1.

Table 1: Candidates' Performance by Grades and Gender in the 2019 ACSEE

Gender	Grades and marks range							
	A (80-100)	B (70-79)	C (60-69)	D (50-59)	E (40-49)	S (35-39)	F (0-34)	Total
Male	6	487	3,254	6,369	4,713	963	638	16,430
Female	6	297	1,900	4,278	3,545	819	437	11,282
Total	12	784	5,154	1,0647	8,258	1,782	1,075	27,712

Table 1 shows that, majority of the candidates passed at E grade (8,258) followed by C grade (5,154). The least performed grade is A in which only 12 candidates got it.

This report is the analysis of Candidates' Item Response in Biology ACSEE, 2019 which was set according to 2015 examination format. It is the report of two papers namely, 133/1 Biology 1 and 133/2 Biology 2 which aimed at measuring theoretical competences gained by candidates after completing two years of Advanced level Secondary Education.

The 133/1 Biology 1 examination paper contained ten (10) questions grouped into sections A and B. Section A had seven (7) short answer questions each carrying ten (10) marks while section B consisted of three (3) structured essay/essay type questions each carrying fifteen marks. Candidates were required to attempt all questions in section A and only two (2) questions in section B. On the other hand, paper 2 had eight (8) structured essay/essay type questions presented into four sections namely, A, B, C and D. The candidates were required to answer five (5) questions by choosing at least one (1) question from each section. Each question carried 20 marks.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH QUESTION

This section examines the candidates' performance in each question by giving a brief overview of demand of the question, candidate's response and the possible reasons for that kind of response. In addition, extracts from candidates' answer sheets have been used as samples of the best and poor responses respectively. The candidates' average performance per topic has been grouped into three categories based on the percentage attained as follows: From 60 to 100 percent is considered good performance; from 35 to 59 percent average performance and from 0 to 34 percent weak performance. For easy presentation, three colours namely green, yellow and red have been used in figures and appendix to represent good, average and weak performance respectively.

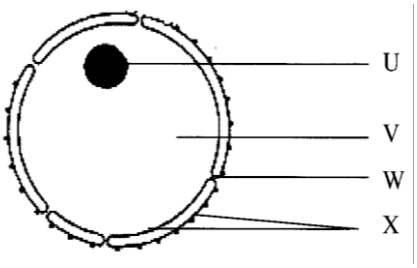
It is hoped that the analysis presented in this report will give a true reflection of the success and challenges faced by the candidates, hence help teachers to take appropriate measures to solve them in order to improve the teaching and learning of Biology.

2.1 133/1 - BIOLOGY 1

This paper assessed 5 topics which are Cytology, Principles of Classification, Coordination and Nutrition. The first 3 topics were assessed in section A while the last 2 were assessed in section B. The analysis of each question is as follows:

2.1.1 Question 1: Cytology

In this question the candidates were given a diagram of nucleus and were required to study it and answer the questions that followed.



In part (a) (i) the candidates were required to name the structure represented by the figure, (ii) to identify the labeled parts and (iii) to state

the role of each part. In part (b), they were required to enumerate four roles played by the structure.

The question was attempted by 27,822 (99.1%) candidates. The performance in this question is summarised in Figure 1.

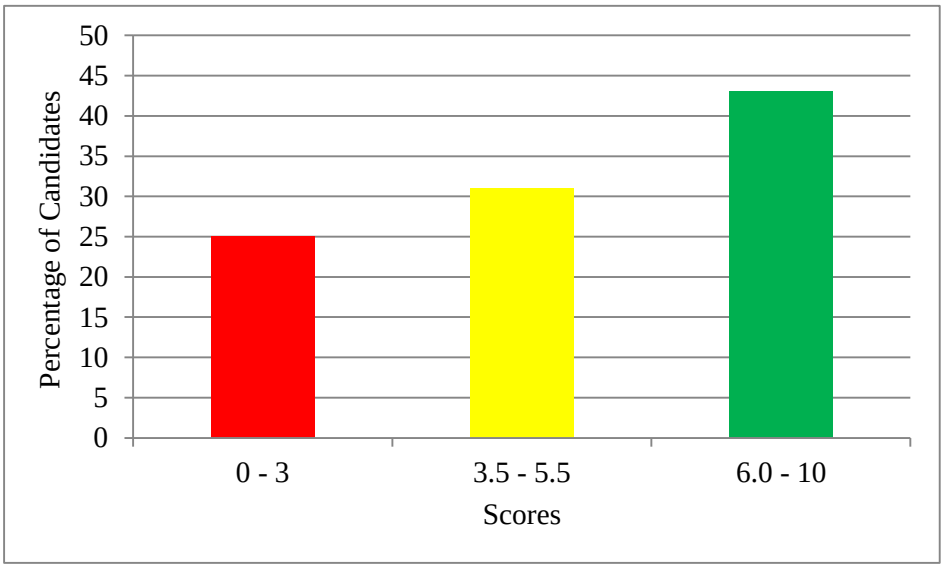


Figure 1: *Distribution of candidates' scores in question 1*

As shown in Figure 1, 74.3 percent of the candidates scored marks ranging from 3.5 to 10 while 25.7 percent scored marks ranging from 0 to 3 out of 10 allocated marks. This indicates that the performance in the question was good.

The candidates who scored more than 3.5 marks in this question, correctly named the given structure, identified the labeled parts and stated the role of all or most of the parts in part (a). Similarly, in part (b), they were able to enumerate all or most of the roles played by the labeled parts of the nucleus. This performance signifies that candidates had enough competence in the topic of Cytology, especially on the subtopic of organelles and their roles. Extract 1.1 is a sample of correct responses from one of the candidates.

1. (a)

(i) The structure is nucleus.

(ii) U – nucleolus
V – nucleoplasm
W – nuclear pore
X – nuclear envelope (two membranes).

iii).

U- NUCLEOLUS:

- This contains DNA which are used during protein synthesis to make messenger RNA.
- It synthesises ribosomal RNA in a region called nucleolar organiser in the nucleolus.

V- NUCLEOPLASM

- This contains chromatin molecules which carry genetic information
- It is the site for nucleus activities, such as nuclear division processes.

W- NUCLEAR PORE

- This helps the movement of materials between the cytoplasm and the nucleoplasm.
- It provides the path for messenger RNA (mRNA) from the DNA to the cytoplasm after transcription in the process of making protein.
- Also, food materials, such as amino acids are passed from the cytoplasm to nucleus through nuclear pore.

X- Nuclear envelope.

- this separates the metabolic activities of the nucleus to those in the cytoplasm of a cell.
- It is associated with ribosomes which help in protein synthesis.

b). Roles played by the nucleus:

i) It stores genetic information from both parents after fertilisation process.
ii). It controls all activities of the cell, such as respiration
iii). It helps in protein synthesis, where DNA produces ribonucleic acid, messenger RNA.
iv). Nucleus helps to control cell division, and distribution of organelles.

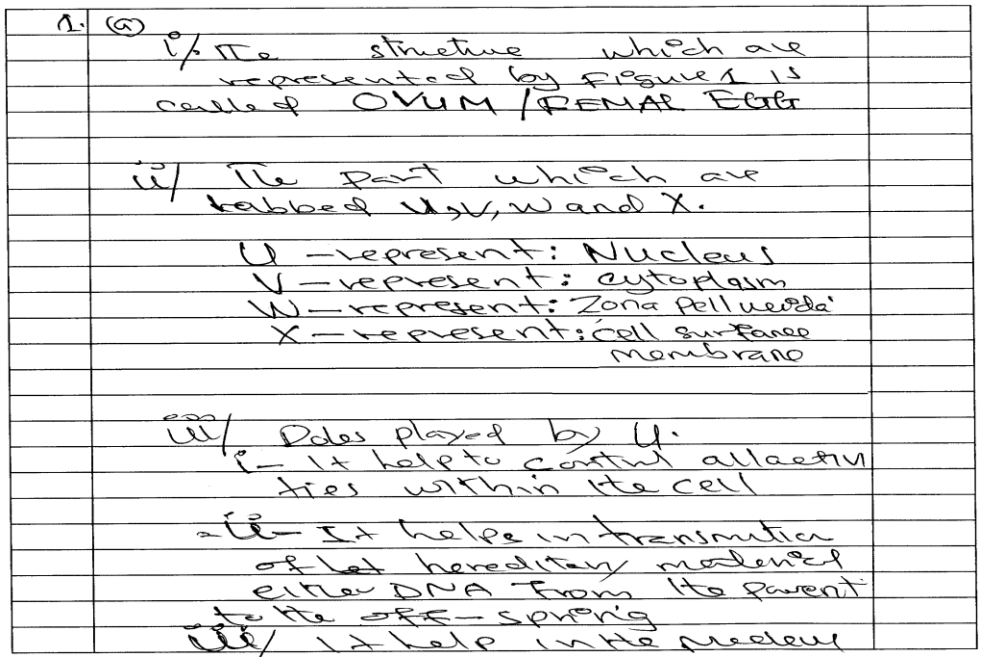
Extract 1.1: A sample of the candidate's good responses in question 1

In Extract 1.1 the candidate gave a correct name of the nucleus, labeled the given parts and stated the role of each part. The candidate also managed to enumerate the roles played by the nucleus.

Despite the good performance achieved by most of the candidates in this question, further analysis revealed that 31.1 percent of the candidates failed. Some of the candidates were not able to provide correct answers to most or all parts of the question due to lack of knowledge or misconception. Their failure can be summarised as follows:

In part (a), some of them failed to correctly name the given structure, hence they missed the second and third parts of the question due to misconception. For example, one of the candidates named the structure in item (i) as *pollen grain.* Thus, in item (ii), U was identified as *generative nucleus*, V as *cytoplasm,* W as *pit*, X as *intine and exine cell,* all of which are the parts of pollen grain. Likewise, in item (iii) the candidate wrote the roles of U as *to fertilize ovum, V - to nourish the gamete nuclei,* W - *to enable the passage of oxygen and nutrients, X - to confer protection to the cell.* In part (b), she wrote the roles played by the structure as ……..*to enables fertilization to take place hence results into maintenance of diploid condition of the cell; it enables formation of endosperm;..... it develops the pollen tube necessary for transmission of gametes towards ovule,* all of which being the roles of the pollen grain.

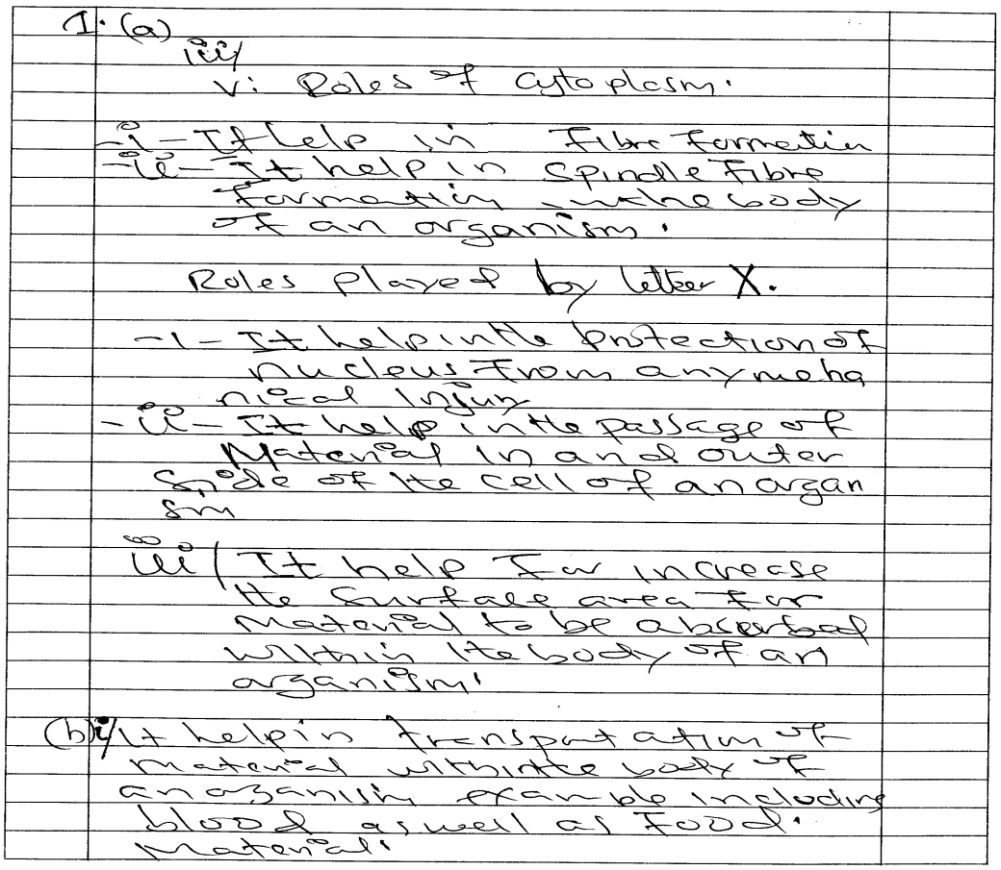
Another candidate misinterpreted the given structure as *ovum,* hence the names of the labeled parts and their roles relied on the *ovum.* These kinds of responses indicated that the candidates lacked enough knowledge on the concept of cell organelles. Extract 1.2 provides similar example of incorrect response from a candidate.



1. (a)
i/ The structure which are represented by figure 1 is called OVUM / FEMALE EGG

ii/ The part which are labbed U, V, W and X.
U - represent: Nucleus
V - represent: cytoplasm
W - represent: Zona pellucida
X - represent: cell surface membrane

iii/ Roles played by U.
i - It help to control allactivities within the cell
ii - It help in transmution of hereditary material either DNA from the parent to the off-spring
iii/ It help in the nucleus



I. (a)
iii/
v: Roles of cytoplasm.
i - It help in Fibre formation
ii - It help in Spindle Fibre formation in the body of an organism.

Roles played by letter X.
- i - It help in the protection of nucleus from any mechanical injury
- ii - It help in the passage of Material in and outer side of the cell of an organism

iii/ It help for increase the surface area for material to be absorbed within the body of an organism.

(b) i/ It help in transportation of material within the body of an organism example including blood as well as food material.

Extract 1.2: A sample of the candidate's poor responses in question 1

The responses in Extract 1.2 reveal that the candidate lacked knowledge required in this question. He/she identified the structure as female egg instead of nucleus and stated the roles of blood vessels like transport of blood instead of stating the roles of nucleus.

2.1.2 Question 2: Cytology

Part (a) required the candidates to explain the procedure for testing non-reducing sugar in a given solution, while part (b) required the candidates to analyse the chemical composition of (i) lipids and (ii) proteins.

Analysis of data shows that 27,823 (99.1%) of the candidates attempted this question, whereby 44.7 percent scored from 3.5 to 5.5 marks, 44.0 percent scored from 0 to 3 while 11.3 percent scored marks ranging from 6 to 9.5 out of 10 marks. None of the candidates scored full marks. A summary of candidates' performance is given in Figure 2.

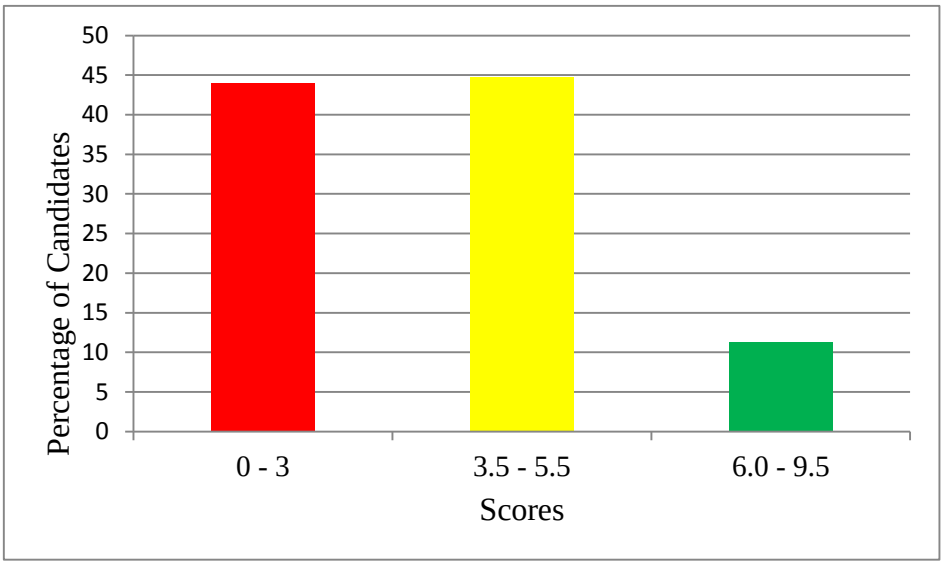
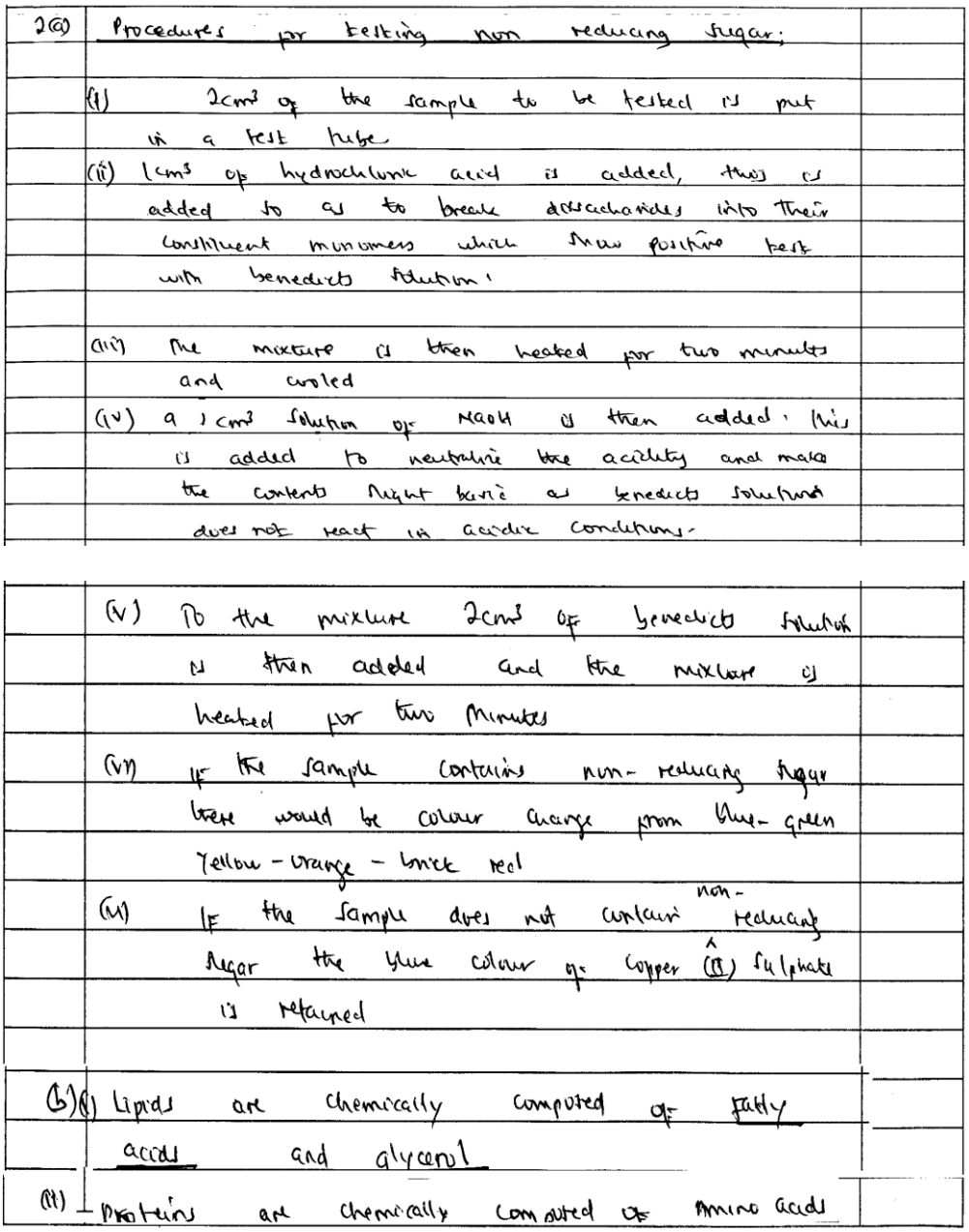


Figure 2: *Distribution of candidates' scores in question 2*

Figure 2 indicates that the candidates' performance was good since 56 percent passed the question by scoring 3.5 and above.

Analysis of candidates' responses revealed that most of the candidates who scored from 3.5 to 9.5 marks, showed mastery of correct procedure for testing non-reducing sugar in part (a), but they failed to analyse the chemical composition of lipids and proteins in part (b). Some of the incorrect responses given in part (b) were acids for lipid and amines for protein. This

is an indicator that, they had partial knowledge on biochemical tests of the Organic Constituents of Cells, which is a subtopic in Cytology. On the other hand, there were some candidates who did not understand the demand of the question in part (b); hence, they stated the properties of lipids such as its solubility in water and release of ATP energy when oxidized; in protein they stated its amphoteric nature and its ability to act as a buffer. Extract 2.1 is a sample of a candidate's correct response.



Extract 2.1: A sample of the candidate's good responses in question 2

The responses in Extract 2.1 indicate that, the candidate was able to explain the procedure for testing non-reducing sugar. The candidate also analysed properly the chemical composition of lipids and proteins.

Even though the performance of some candidates in the question was good, further analysis indicates that 44.0 percent failed by scoring less than 3.5 marks. The candidates who scored zero could not explain the procedure for testing non-reducing sugar in part (a) nor provided correct chemical composition of lipids and proteins in part (b). The failure of such candidates was mostly caused by lack of knowledge and skills on the procedure of biochemical tests of the non-reducing sugar. For example in part (a), some candidates wrote the first step as addition of Benedict's solution to the sample solution instead of dilute hydrochloric acid. This made the whole procedure to be incorrect. In part (b), they wrote responses like the roles of proteins and lipids instead of their chemical composition.

The candidates who scored 3.5 - 5.5 marks some did not explain the purpose of adding dilute hydrochloric acid solution and sodium hydroxide solution. In some cases, addition of sodium hydroxide solution to the sample solution preceded the addition of dilute hydrochloric acid. Others did not explain the reason for adding dilute Hydrochloric acid and boil the mixture. Additionally, others stated incorrect volumes of solutions and reagents. For example one candidate wrote *to 3 cm^3 of the sample solution 1 cm^3 of Benedict's solution is added* whereas the procedure requires the volume of the original solution and that of the Benedict's solution to be equal. There were also some candidates who did not state the actual volumes of solutions and reagents to be used for testing non-reducing sugar, instead they used relative terms such as *small volumes/little amount of solutions or excess amount of reagents.* Moreover, other candidates wrote wrong reagent for testing non reducing sugar by writing Sudan III instead of Benedict's solution, a phenomenon which indicate that the candidate had no understanding that Sudan III tests lipids.

In part (b), some candidates stated the chemical compositions of lipids as *carboxylic acid* and Sudan III while *Sodium hydroxide solution* and *carboxyl groups* were stated as composition of proteins. These incorrect responses indicate that the candidates lacked knowledge on the chemical composition of lipids and proteins. Extract 2.2 is a sample of incorrect response.

2 a) Procedures for testing non-reducing sugar in a solution

i) A small amount of non-reducing sugar sample is put into a test tube. (about 2 to 3 drops / $2cm^2$ of sample solution).

ii) Then addition of 2 to three drops of benedict's solution followed by the addition of Sodium hydroxide, then mix the mixture by shaking gently

iii) Heat mixture onto a bunsen flame for two to three minutes whereby there will be colour change observations

iv) Then the mixture is left to cool so as to proceed on observing the colour change in the mixture.

b) Chemical composition of the following food substances

i) Lipids

This refers to a food molecule that is formed when one saturated atom combines with another unsaturated atom to form Lipids

ii) Protein

This is formed when two amino group combine to form a protein molecule.

Extract 2.2: A sample of the candidate's poor responses in question 2

As shown in Extract 2.2, the candidate failed to recognize that in testing non reducing sugar the addition of dilute hydrochloric acid should precede Benedict's solution in part (a). In part (b), the candidate wrote that a lipid is the product of saturated and unsaturated atoms while amino groups are products of protein.

2.1.3 Question 3: Principles of Classification

In part (a) (i) the candidates were required to identify the lowest taxon and (ii) to illustrate taxonomic hierarchy of human being. In part (b) (i), they were required to give three points on why classification of organisms is needed and (ii) analyse three differences between natural and artificial systems of classification.

A total of 27,823 (99.1%) candidates responded to the question and the distribution of their performance is illustrated in Figure 3.

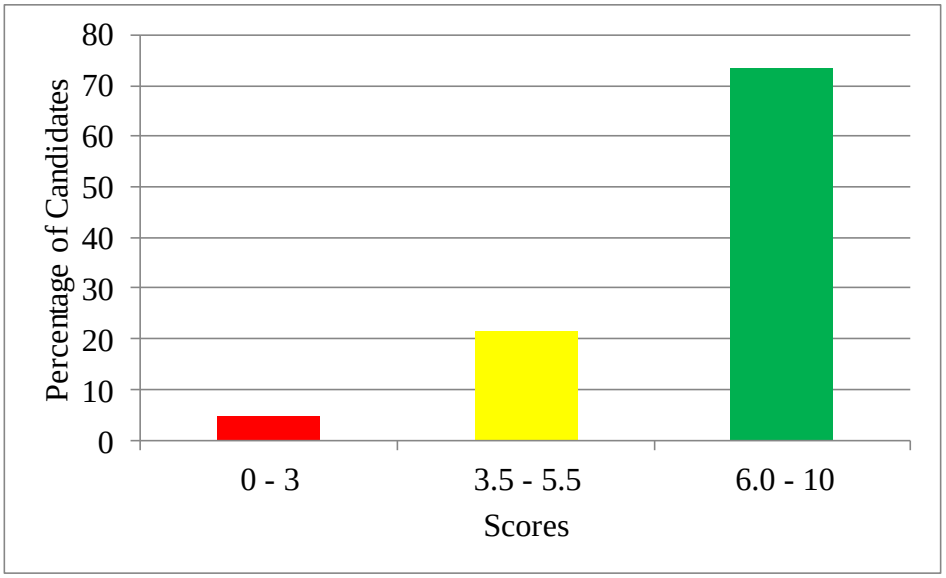


Figure 3: *Distribution of candidates' scores in question 3*

In Figure 3 one can see that the performance in this question was good, since 95.1 percent scored marks ranging from 3.5 to 10 while 4.9 percent scored below 3.5 marks.

Most of the candidates who performed well were able to identify the lowest taxon in taxonomic hierarchy and correctly spelt all taxa of human being from Kingdom to Species in part (a). In part (b), they stated clearly the need for classifying living organisms and correctly differentiated between natural and artificial systems of classification. This performance is an indicator that candidates met the demand of the question and they had enough understanding of the concepts tested, Extract 3.1 shows a good response from one of the candidates.

3a) i) The lowest taxon is Species

ii) Taxonomic hierarchy of human being

Kingdom : Animalia
Phylum : Chordata
Class : Mammalia
Order : Primates
Family : Hominidae
Genus : Homo
Species : Sapiens

b) i) Why classification of organisms is needed.

Classification of organisms is needed because classification has some advantages such as;

> Provides an organized system into which newly discovered organism can be placed in the future.

∴ Through classification, newly discovered organisms in the future can be easily studied and placed in its appropriate group by studying its characteristics and comparing with the characteristics of a particular group of organisms.

3b i) - to come up with conclusion about the characteristics of the studied organism.

> Simplifies communication among biologists throughout the world.

Classification involves assigning of scientific names to an organism. These scientific names are universal unlike common names hence biologists can be able to understand each other well

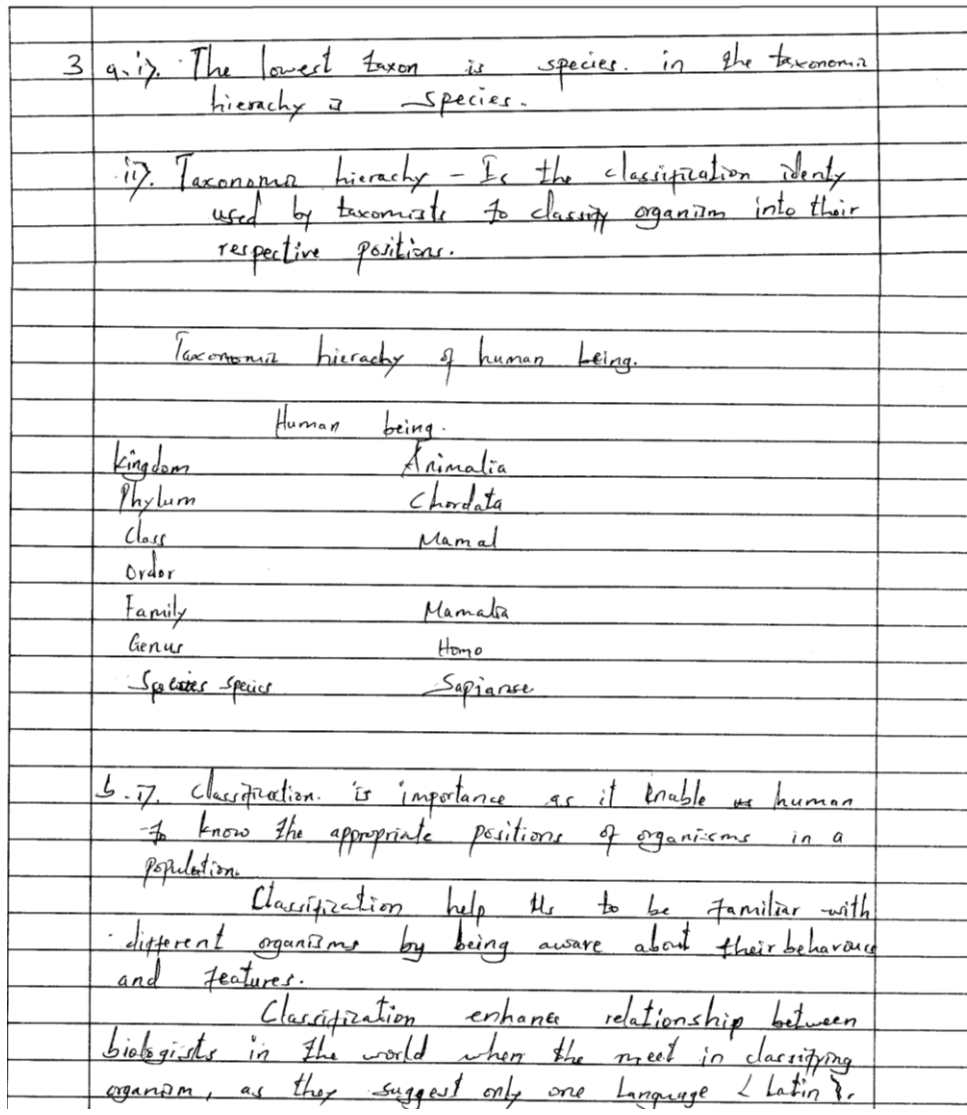
ii) Differences between natural and artificial systems of classification.

	Natural system of classification	Artificial system of classification
i	Is the type of classification in which organisms are placed into their natural groups based on many characteristics they have in common, both internal and external	Is the type of classification in which organisms are placed into their ~~natural~~ groups based on few observable external features.
ii	It considers evolutionary relationship of organisms.	Does not consider evolutionary relationship of organisms
iii	It is expensive, time consuming and requires ~~x~~ much knowledge	It is cheap, fast and requires minimal knowledge

Extract 3.1: A sample of the candidate's good responses in question 3.

In Extract 3.1 the candidate demonstrated mastery of knowledge of Classification Systems and Categories of Classification by specifying the issues of taxonomy and systems of classification.

Candidates who scored below 3.5 marks had inadequate knowledge of Principles of Classification. In part (a) for instance, most of them did not consider the hierarchy from Kingdom to Species, as some started from Kingdom to Phylum to Order then to Class implying that they were not aware that in taxonomic hierarchy Class precedes the Order. On the other hand some of the candidates wrote the hierarchy correctly but misspelt some taxa. For example, the Order Primates was incorrectly written as *Primate*, Phylum Chordata as *Chodata* and Class Mammalia as *mamal*. In part (b), some of the candidates interchanged the differences by placing Natural system of classification in place of Artificial system of classification. Extract 3.2 is a sample of poor response from one of the candidates.



3 a. i). The lowest taxon is species. in the taxonomic hierachy is Species.

ii). Taxonomic hierachy - Is the classification identy used by taxonomists to classify organism into their respective positions.

Taxonomic hierachy of human being.

Human being.

Kingdom	Animalia
Phylum	Chordata
Class	Mamal
Order	
Family	Mamalia
Genus	Homo
Species species	Sapiense

b. i). classification is importance as it enable us human to know the appropriate positions of organisms in a population.

Classification help us to be familiar with different organisms by being aware about their behavaure and features.

Classification enhance relationship between biologists in the world when the meet in classifying organism, as they suggest only one Language (Latin).

	ii> Difference between.	
	Natural classification	Artificial classification.
	i> It is based on natural observable features	i> Based on artificial features or characteristics.
	ii> It does not require more skills to perform	ii> It requires more skills to complete it.
	iii> It does is less costfull or not expensive.	iii> It is more costfull that is more expensive.

Extract 3.2: A sample of the candidate's poor responses in question 3

As represented in Extract 3.2, the candidate misspelt a Class and Species of human being as *mamal* and *sapianse* instead of Mammalia and sapiens respectively. The candidate also interchanged the differences between natural and artificial systems of classification.

2.1.4 Question 4: Coordination

In part (a), the candidates were asked to identify four main types of receptors and state the role of each while in part (b), they were asked to describe the effects of (i) axon diameter and (ii) myelin sheath in transmission of nerve impulse.

Statistical data show that 27,822 (99.1%) candidates responded to the question and the performance is as shown in Figure 4.

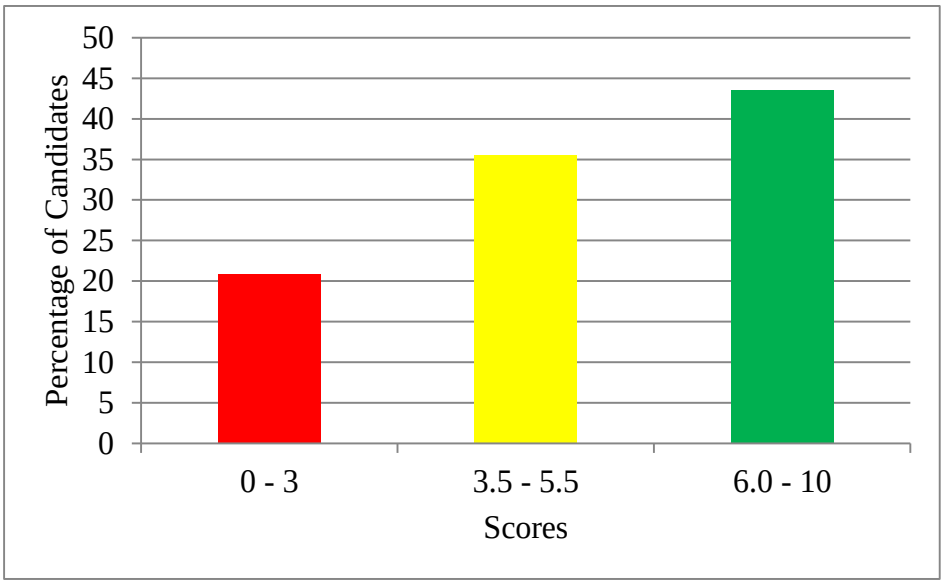


Figure 4: *Distribution of candidates' scores in question 4*

Figure 4 indicates that 43.5 percent scored marks ranging from 6 to 10, 35.6 percent scored from 3.5 to 5.5 marks while 20.9 percent scored below 3.5 marks.

Most of the candidates with good performance (6 – 10 marks) correctly identified the main types of receptors and stated the roles of each receptor. Moreover, they correctly described the effects of either axon diameter or myelin sheath or both in transmission of nerve impulses. This is a good indicator for candidates' good mastery of the contents, especially on nervous tissue. Extract 4.1 is the sample of correct response from one of the candidates.

4 iii) PHOTORECEPTORS.
- These are receptors which play a role of detecting light stimuli.

iv) MECHANO RECEPTORS.
- These are receptors which play a role of detecting mechanical stimuli such as touch.

b) i) AXON DIAMETER.
- Axon diameter affects the transmission of nerve impulse in the following way :-
- Axon with greater diameter usually speeds up the transmission of nerve impulses this is because in larger axons having great diameter the resistance offered by the axoplasm is usually less and due to this nerve impulses tend to travel at a faster rate.
- Also to the axon with smaller diameter the rate of nerve impulse transmission is usually too low this is because there will be greater resistance offered by the axoplasm which will tend to slower the speed of the nerve impulse.

ii) MYELIN SHEATH.
- To the axon with myelin sheath usually the nerve impulses are propagated at a faster rate compared to the non-myelinated axon.
- Between one myelin sheath to the other there is a space known as node of Ranvier. Myelin sheath dont conduct the nerve impulse but instead the impulses will be moving / jumping from one node of ranvier to another and this movement is known as saltatory movement. This movement is actually the reason to the faster speed of nerve impulses along the axon.

Extract 4.1: A sample of the candidate's good responses in question 4

As indicated in Extract 4.1 the candidate identify four main types of receptors and correctly stated their roles and the effects of axon diameter and myelin sheath were well clarified in transmission of nerve impulse.

Despite the good performance in the question, further analyses indicate that the candidates who scored below 3.5 marks some interchanged the roles of the particular receptors while some outlined path taken by a stimulus such as receptor and effector in part (a). Likewise in part (b), they reversed the effect of axon diameter on the rate of transmission of nerve impulse. For example in part (b) one of the candidates wrote the following in his/her explanation;

> *When there is a smaller diameter the nerve impulse travels at high rate and when there is a large diameter of the axon there is high resistance leading to a low rate of transmission of nerve impulse. Thus the larger the diameter the slower the transmission of nerve impulse and the smaller the diameter the faster the transmission of impulse.*

The response reveals that the candidate did not understand that the speed of transmission of action potential depends on the resistance offered by axoplasm which is related to the axon diameter, that means the broader the axon the higher the speed of transmission of nerve and vice versa. Extract 4.2 is a poor response from one of the candidates.

Q4. a) Types of receptor

(i) light receptor
(ii) electric receptor
(iii) mechanic receptor
(iv)

- light receptor used for sight, from one to another meaning that to visual something
- Electric receptor – Use of electric to detect something
- Mechanic receptor – using hearing

(b)(i) Axon diameter:
At the increase of axon diameter it also the decrease of of transmision of of impluse of or information simply because the diameter will increase so the information will be slowly to take place at respective place.

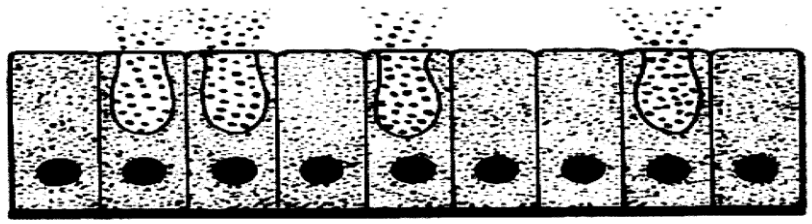
(ii) Myelin sheath
Also the myelin sheath bring an effect when the not myelin sheat during information transimision it make the impulse to be slowly and failed to transmit to the brain or other placed.

Extract 4.2: A sample of the candidate's poor responses in question 4

The candidate's responses in Extract 4.2 shows that, the candidate described the effect of large axon diameter as to lower transmission speed and myelin sheath to hinder nerve impulse transmission which are incorrect rsponses.

2.1.5 Question 5: Nutrition

In this question the candidates were given a diagram of a part of glandular tissue. They were required to study it and answer the subsequent questions.



In part (a) (i), the candidates were instructed to identify the type of tissue given. In part (ii), they were asked to examine the digestive role played by the tissue. Lastly, in part (iii) they were supposed to elaborate how the

structure of the tissue relates to its function. In part (b) (i) they were instructed to examine three features of ileum which increase its surface area and in (ii) to give two reasons on why it is an advantage for the ileum to have large surface area.

The question was attempted by 27,823 (99.1%) candidates. Analysis of data indicates that the performance in the question was average since 54.8 percent scored above 3 marks. The percentage of candidates who scored from 0 to 3 marks out of 10 marks allocated to the question was 45.2. The performance in this question is summarised in Figure 5.

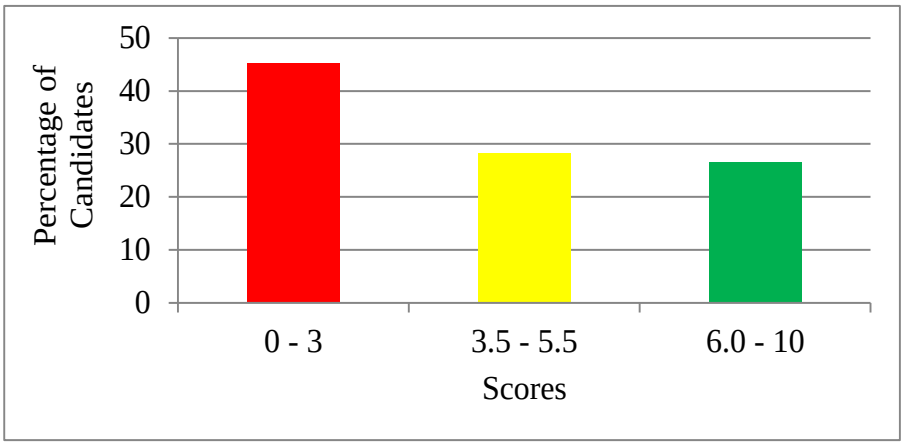
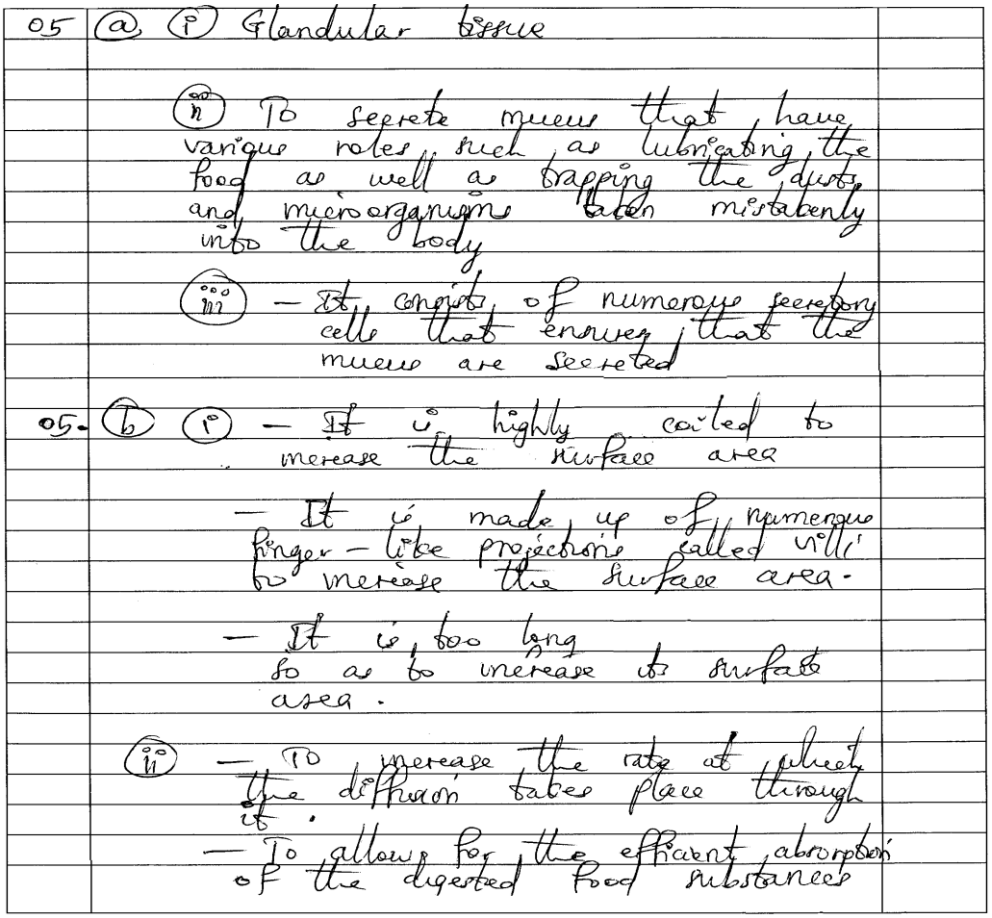


Figure 5: *Distribution of candidates' scores in question 5*

Figure 5 shows that 45.2 percent scored marks ranging from 0 to 3 marks, 28.2 percent scored 3.5 to 5.5, whereas 26.6 percent scored 6 to 10 marks.

Most of the candidates who scored above 3 marks demonstrated good understanding of the topic of *Nutrition*, particularly on digestion in mammals. These candidates correctly identified the type of tissue represented by the diagram and examined the digestive role played by the tissue. They also well elaborated all or most of its adaptations in part (a) (iii). In part (b), the majority managed to examine the features of ileum which increase its surface area. However, few were able to give reasons on why it is an advantage for the ileum to have large surface area. Extract 5.1 illustrates the correct response from a candidate.

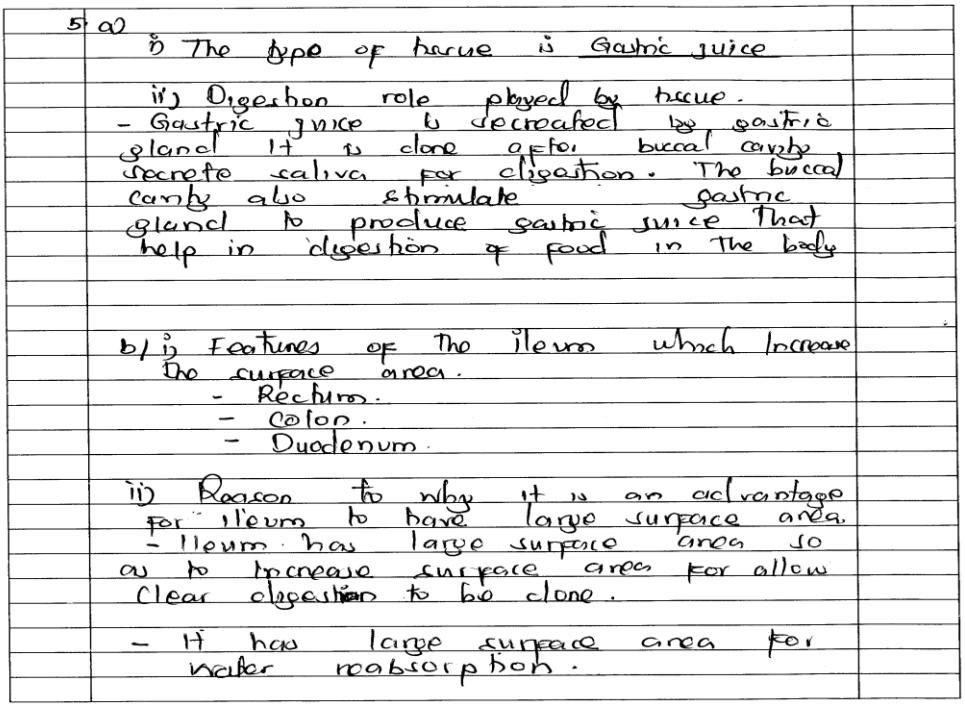


Extract 5.1: A sample of the candidate's good responses in question 5

As represented in Extract 5.1 the candidate had adequate knowledge of the topic *Nutrition*, specifically on digestive role of the ileum and its adaptations. She/he correctly elaborated how the structure of the required tissue relates to its function and stated the features of ileum that increase its surface area.

Despites this general good performance in the question, some of the candidates scored marks ranging from 0 to 3 because they gave incorrect responses in most parts of the question. In part (a) for example, some of the candidates failed to recognize the secretory nature shown by the tissue represented by the diagram and incorrectly identified it as *gastric juice*, *epithelial tissue*, *collumner epithelium* instead of glandular epithelial tissue. Furthermore, in part (b) (i), one of the candidates mentioned some parts of the alimentary canal like *rectum, colon and duodenum* while another candidate wrote *presence of blood capillaries* as features which increase the surface area of ileum. The candidate did not understand that the

presence of blood capillaries in illeum does not increase its surface area, but brings efficiency in absorption of food nutrients. In part (b) (ii), one of the candidates explained that *the illeum has large surface area for absorption of water*. This candidate failed to understand that absorption of water takes place in the colon and not in the ileum. Generally these responses indicate that the candidates lacked enough knowledge of role and adaptations of ileum. Extract 5.2 is a sample of incorrect response.


5. a)
b) The type of tissue is Gastric juice
ii) Digestion role played by tissue.
- Gastric juice is secreated by gastric gland it is done after buccal cavity secrete saliva for digestion. The buccal cavity also stimulate gastric gland to produce gastric juice that help in digestion of food in the body
b) i) Features of the ileum which increase the surface area.
- Rectum.
- Colon.
- Duodenum.
ii) Reason to why it is an advantage for ileum to have large surface area.
- Ileum has large surface area so as to increase surface area for allow clear digestion to be done.
- It has large surface area for water reabsorption.

Extract 5.2: A sample of the candidate's poor responses in question 5

As depicted in Extract 5.2 the candidate in item (b) (i) named some parts of the alimentary canal instead of stating features of ileum that increase its surface area. These responses imply that the candidate failed to identify the demand of the question.

2.1.6 Question 6: Coordination

In part (a) candidates were required to state the functions of (i) motor neuron (ii) sensory neuron and (iii) relay neuron. In part (b) (i), the candidates were required to explain how receptors of nervous system communicate with effectors and (ii) to describe how the structure of synapse ensures passage of signals in only one direction.

A total of 27,822 candidates corresponding to 99.1 percent attempted the question. The performance is summarised in Figure 6.

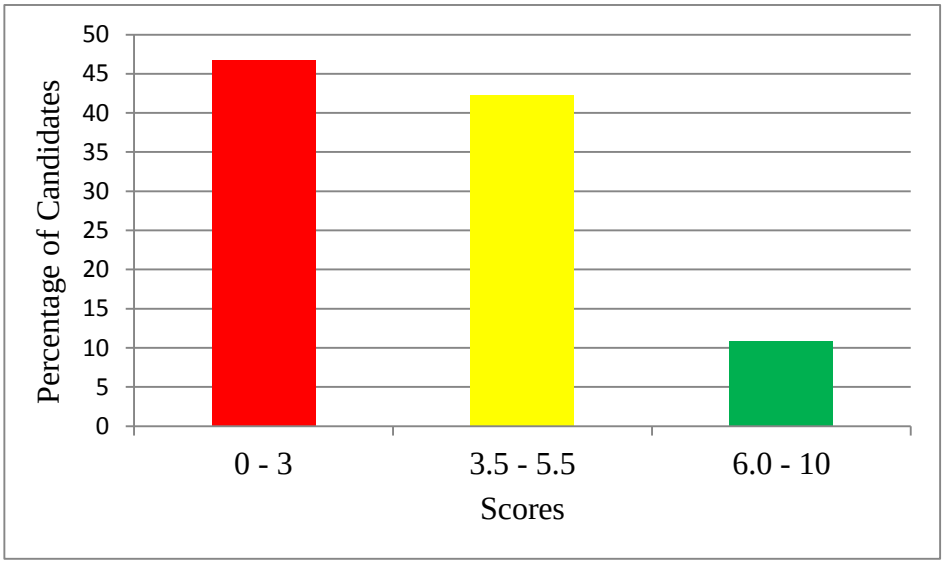


Figure 6: *Distribution of candidates' scores in question 6*

Figure 6 indicates that the candidates who scored marks ranging from 0 to 3, 3.5 to 5.5 and 6 to 10 were 46.8, 42.3 and 10.9 percent respectively. The overall performance in this question was average.

Candidates who scored high marks (6 – 10) correctly responded to most or all of the items. This is an indicator that the candidates had adequate knowledge of the tested areas in the topic of *Coordination* especially on the concept of nerve. Extract 6.1 is a sample of correct response from one of the candidates.

6.a(i) Motor Neurone.

This links the central nervous system and the effector where the response is to be initiated. Dendrites carry information towards the cell body that directs it to the axon and towards the synapse.

(ii) Sensory Neurone.

This links the outside environment and the Central nervous system. This detect the stimuli. They are mainly found in the receptors

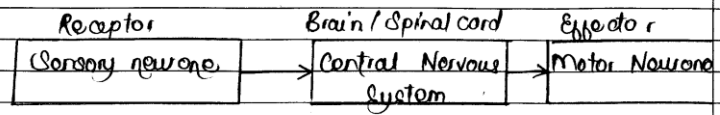
(iii) Relay neurone.

This act as an intermediate, it links the motor neurone and sensory neurone.

b.(i) The receptors of the nervous system have the sensory neurone which detect the stimuli from the environment. The stimuli is detected and the impulse is generated which is sent to the Central nervous System.

The central Nervous system is composed of the Brain and the Spinal cord. This interpret the required stimuli and gives off the appropiate response through the motor Neurone of the specific effector

The dendrites of the motor neurone will conduct the impulse towards the cell body and directed to the axon that is towards the synapse and the response is then achieved. The relay neurone act as an intermediate between motor neurone and sensory neurone.



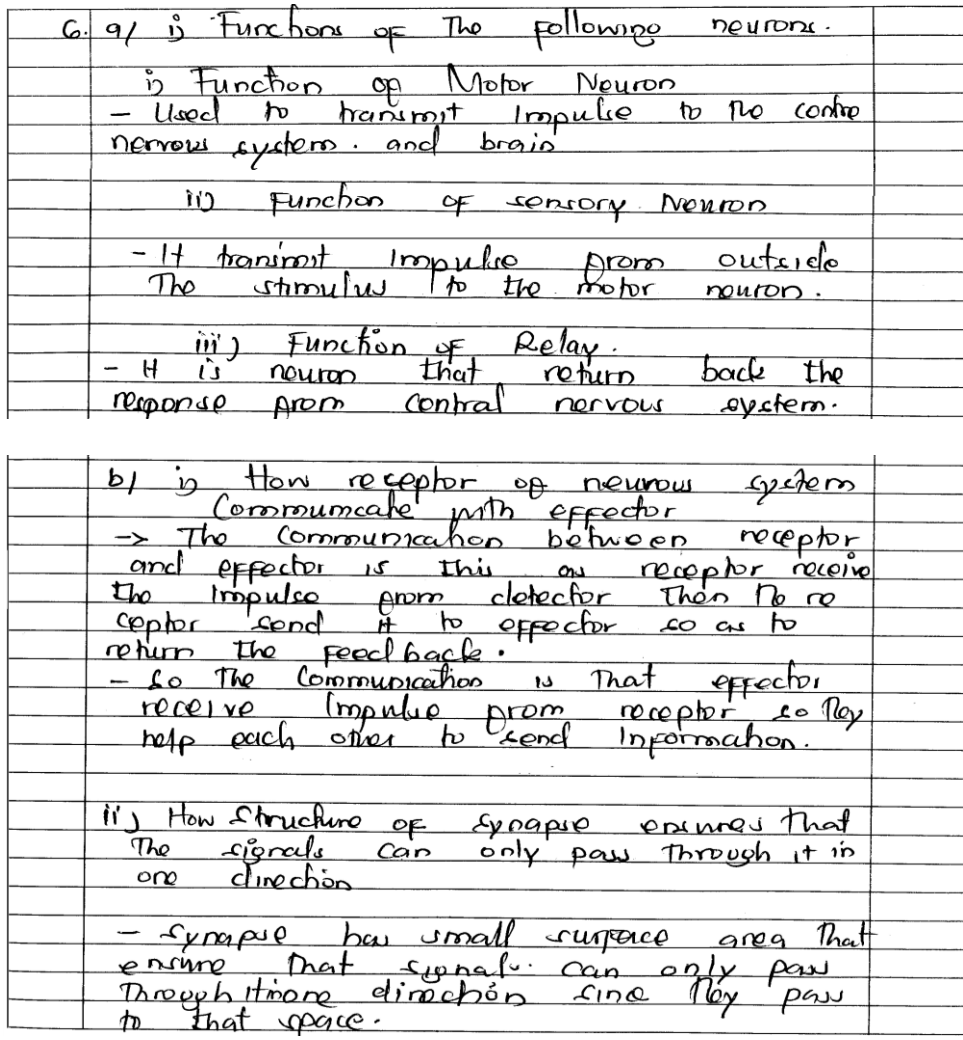
(ii) • Presence of receptors on the post-synaptic membrane that will only detect impulse from the before neurone that are on the cleft.

• Presence of presynatic membranous vesicle that will release neurotransmitter on the cleft and not other wise.

Extract 6.1: A sample of the candidate's good responses in question 6

Extract 6.1 indicates that the candidate was able to state the function of nerve and explain well how communication occurs in the nervous system.

Further analysis of candidates' responses reveals that most of the candidates in the category of weak performance did not understand the demand of the question. As a result, they drew the structures of motor, sensory and relay neurons instead of stating their roles in part (a). In part (b) (i), most of the candidates explained the mechanism for transmission of nerve impulse across the synapse instead of explaining how receptors of nervous system communicate with effectors. In item (ii) some of the candidates responded by sketching different diagrams such as synapse instead of describing how the structure of synapse ensures passage of signals in only one direction. In addition, some candidates lacked enough knowledge as they gave incorrect information although related to the nerve and synaptic conduction of impulses. Extract 6.2 shows the weak response from a candidate.


6. a/ i) Functions of the following neurons.

i) Function of Motor Neuron
- Used to transmit Impulse to the centre nervous system. and brain

ii) Function of sensory Neuron

- It transmit Impulse from outside the stimulus to the motor neuron.

iii) Function of Relay.
- It is neuron that return back the response from central nervous system.

b/ i) How receptor of neurous system Communicate with effector
-> The communication between receptor and effector is this as receptor receive the Impulse from detector then the receptor send it to effector so as to return the feedback.
- So the Communication is that effector receive Impulse from receptor so they help each other to send Information.

ii) How Structure of synapse ensures that the signals can only pass through it in one direction

- synapse has small surface area that ensure that signals can only pass through it one direction since they pass to that space.

Extract 6.2: A sample of the candidate's poor responses in question 6

Extract 6.2 shows that the candidate in this question gave responses with incorrect functions of neurons, ways of communication between receptors and effectors and incorrect description on the adaptive features of the synapse which enable it to pass nerve impulse in one direction.

2.1.7 Question 7: Nutrition

In this question candidates were required to evaluate the importance of light and dark reaction processes of photosynthesis to life.

A total of 27,821 candidates corresponding to 99.1 percent attempted the question and the performance is summarised in Figure 7.

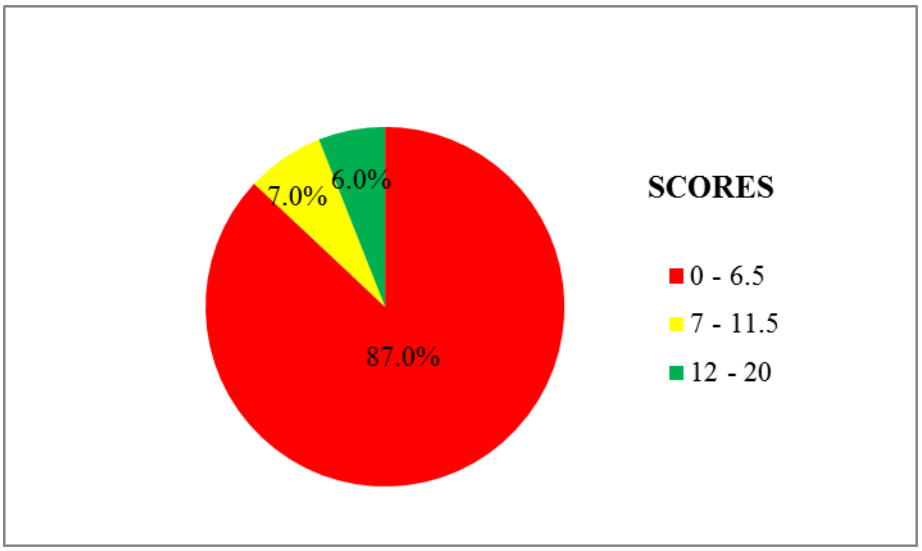


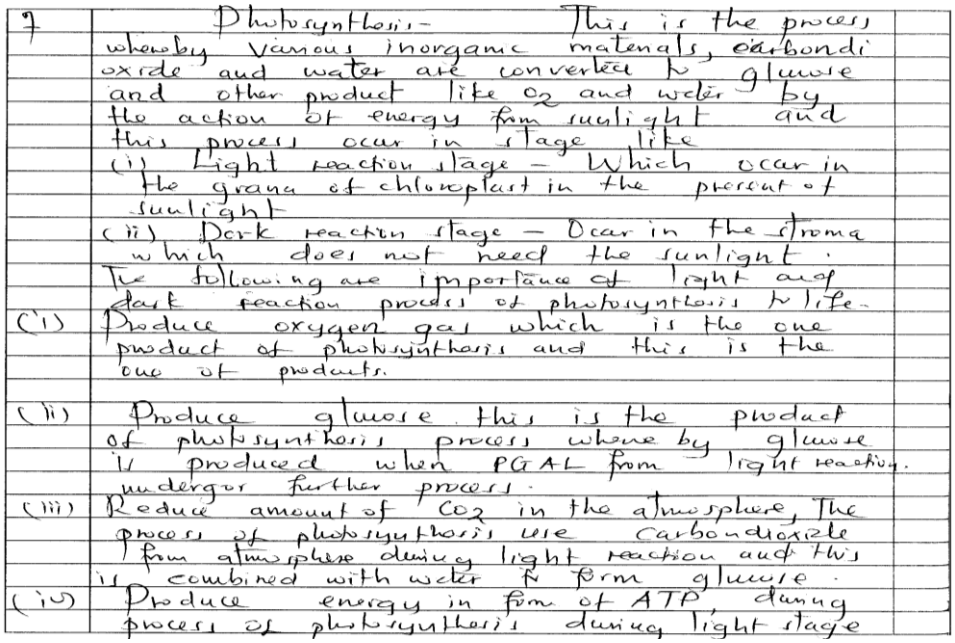
Figure 7: *Distribution of candidates' scores in question 7*

Figure 7 shows that the candidates' performance in the question was poor since more than three quarters of the attempters scored below pass mark (0 - 3). Most of the candidates lacked the knowledge of the importance of dark and light reaction processes of photosynthesis to life as they wrote incorrect responses. Others did not meet the demand of the question as they wrote the products of photosynthesis such as carbohydrates, oxygen and water without explaining their importance to life. For example one of the candidates wrote;

> *Photosynthesis increases the amount of oxygen gas in the atmosphere. As the light reaction involves photolysis of water during non – cyclic pathway to produce pair of electrons hydrogen*

atom and oxygen gas in which oxygen gas is biproduct hence released out from the plant.

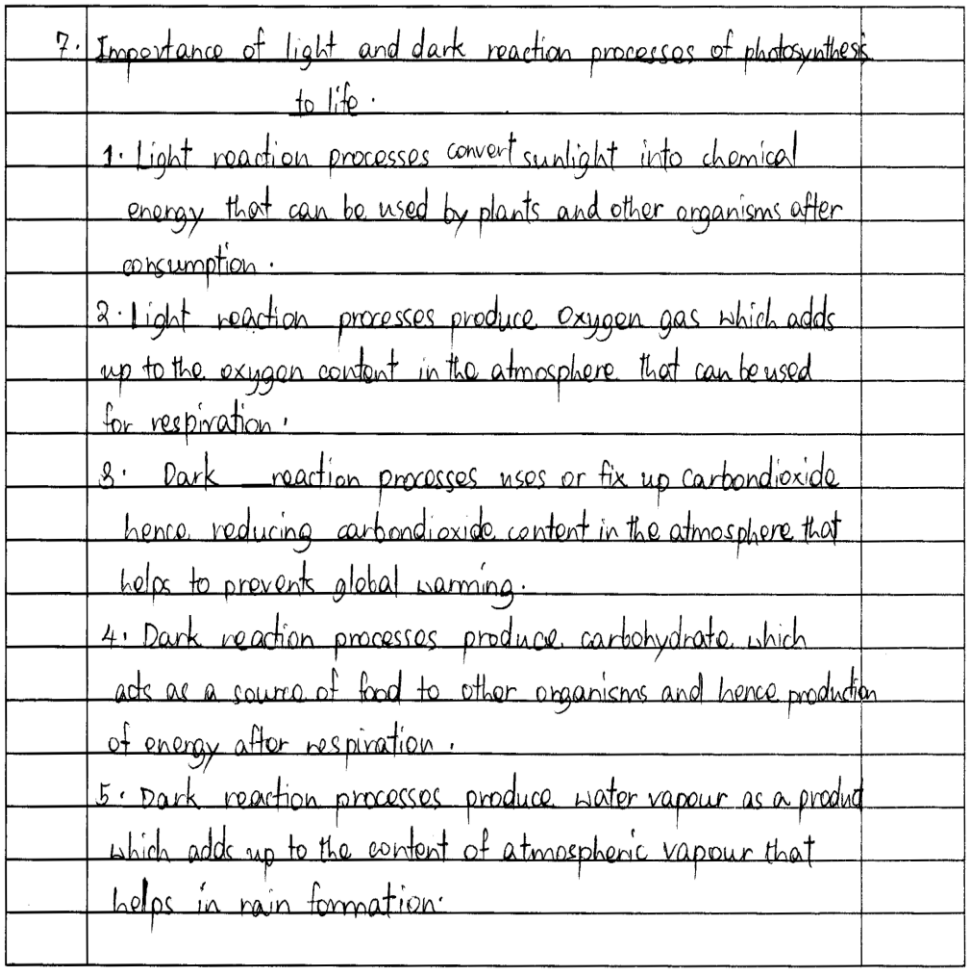
Such a response does not explain the importance of oxygen to life indicating that the candidates had inadequate knowledge of the importance of light and dark reaction in life. The candidate was expected to give answers like; oxygen is used by aerobes for respiration in order to release energy which is useful for physiological processes such as movement, digestion and reproduction. More incorrect response is given in Extract 7.1.


7 Photosynthesis- This is the process whereby various inorganic materials, carbondi oxide and water are converted to glucose and other product like O_2 and water by the action of energy from sunlight and this process occur in stage like
(i) Light reaction stage – Which occur in the grana of chloroplast in the present of sunlight
(ii) Dark reaction stage – Occur in the stroma which does not need the sunlight.
The following are importance of light and dark reaction process of photosynthesis to life.
(i) Produce oxygen gas which is the one product of photosynthesis and this is the one of products.
(ii) Produce glucose this is the product of photosynthesis process whose by glucose is produced when PGAL from light reaction undergo further process.
(iii) Reduce amount of CO_2 in the atmosphere, The process of photosynthesis use carbondioxide from atmosphere during light reaction and this is combined with water to form glucose.
(iv) Produce energy in form of ATP during process of photosynthesis during light stage

Extract 7.1: A sample of the candidate's poor responses in question 7

Extract 7.1 indicates that the candidate gave general products of photosynthesis without stating their importance to life which are incorrect responses.

Further analysis of the candidates' response reveals that of the candidates who scored high mark (3.5 to 10), majority of them stated two to five correct importance of light and dark reaction of photosynthesis to life. This reveals that they had knowledge of the topic of *Nutrition*, specifically on light and photosynthesis. Extract 7.2 is a sample of correct response from one of the candidates.


7. Importance of light and dark reaction processes of photosynthesis to life.

1. Light reaction processes convert sunlight into chemical energy that can be used by plants and other organisms after consumption.

2. Light reaction processes produce oxygen gas which adds up to the oxygen content in the atmosphere that can be used for respiration.

3. Dark reaction processes uses or fix up carbondioxide hence reducing carbondioxide content in the atmosphere that helps to prevents global warming.

4. Dark reaction processes produce carbohydrate which acts as a source of food to other organisms and hence production of energy after respiration.

5. Dark reaction processes produce water vapour as a product which adds up to the content of atmospheric vapour that helps in rain formation.

Extract 7.2: A sample of the candidate's good responses in question 7

In Extract 7.2 the candidate correctly stated the importance of light reaction and dark reaction to life as result merited to score high marks allotted to this question.

2.1.8 Question 8: Reproduction

In part (a) candidates were required to state three roles of Oestrogen hormones in reproduction. In part (b), they were required to identify and describe three stages of birth.

A total of 20,205 candidates, equivalent to 72 percent opted for this question. It was the most attempted question among the optional questions.

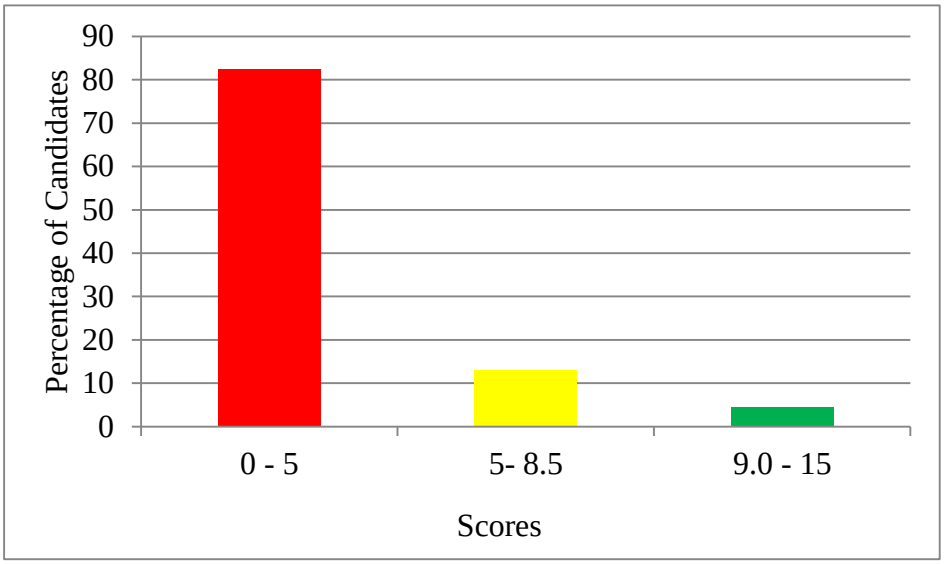
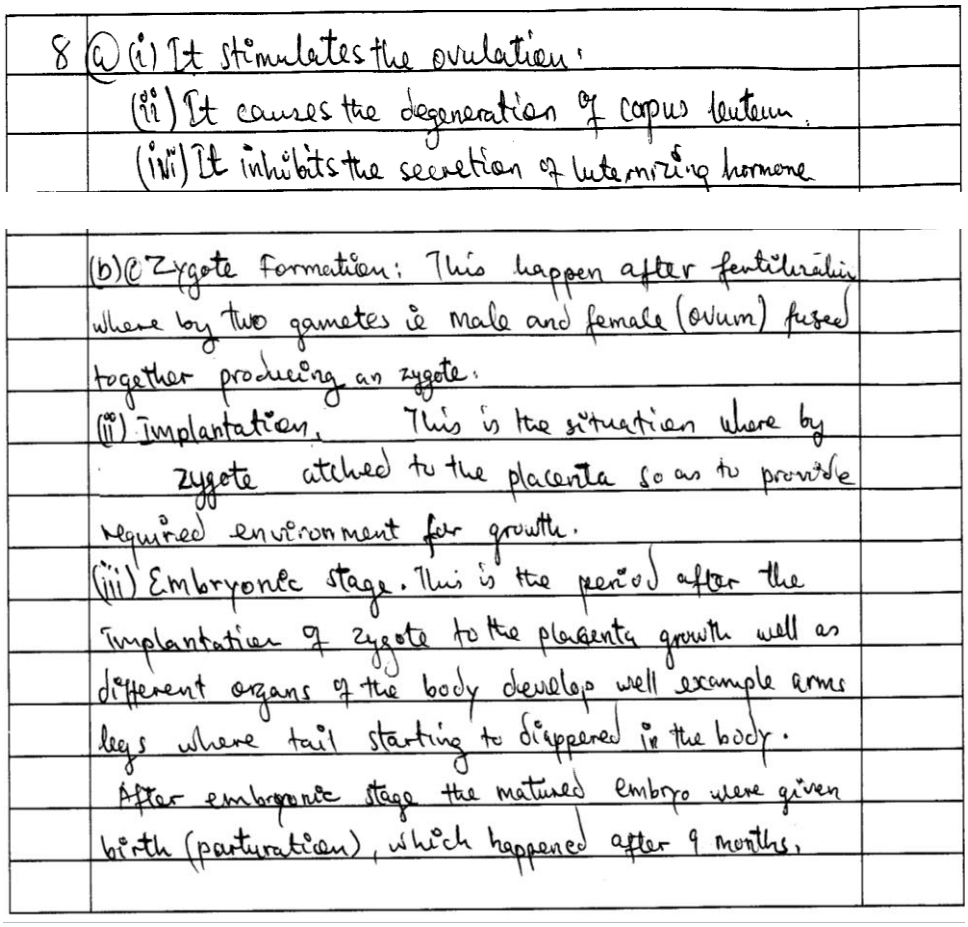


Figure 8: *Distribution of candidates' scores in question 8*

Generally, Figure 8 indicates that the candidates' performance in the question was poor since more than three quarters (82.4%) of the candidates failed while 17.6 percent passed. Those who failed lacked knowledge of reproductive hormones since they were unable to state the required roles of Oestrogen hormone in reproduction and identified and described the stages of birth in part (a). Some of the incorrect roles of Oestrogen hormone, such as *enhancing development of secondary characteristics and stimulation of release of follicle stimulating hormone (FSH),* contrary to the primary role of Oestrogen hormone which is to prepare the uterus wall for implantation during pregnancy. In part (b) one of such candidates identified and described developmental stages of embryo such as *cleavage, blastulation* and *gastrulation* instead of writing the stages of birth which are opening of cervix, birth of baby and birth of placenta. Others mentioned the stages of birth without making any description. Extract 8.1 is from a candidate who gave incorrect responses.


8 (a) (i) It stimulates the ovulation.
(ii) It causes the degeneration of corpus luteum.
(iii) It inhibits the secretion of luteinizing hormone

(b) (i) Zygote Formation: This happen after fertilization where by two gametes ie male and female (ovum) fused together producing an zygote.
(ii) Implantation. This is the situation where by zygote atched to the placenta so as to provide required environment for growth.
(iii) Embryonic stage. This is the period after the Implantation of zygote to the placenta growth well as different organs of the body develop well example arms legs where tail starting to disppered in the body.
After embryonic stage the matured embryo were given birth (parturation), which happened after 9 months.

Extract 8.1: A sample of the candidate's poor responses in question 8

Extract 8.1 indicates that the candidate gave incorrect responses by outlining the stages of birth as zygote formation, implantation and embryonic stage and described them.

Further analysis of the candidates' responses reveals that, most of the candidates who scored average mark (5.5 - 8.5), managed to state three roles of Oestrogen hormone in reproduction in part (a) and in part (b) they were able to identify the three stages of birth but gave partial explanation. Further, candidates who scored above 8.5 marks managed to state the roles of Oestrogen hormone and described the stages of birth which are dilation of cervix, birth of the baby and birth of placenta. This is an indicator that the candidates had acquired enough knowledge of reproduction especially stages of birth. Extract 8. 2 is a sample of good responses in this question.

8. a). Roles of oestrogen hormones

i). Causes contraction of myometrium

ii). Causes thickening of uterus walls.

iii). Inhibit release of FSH (Follicle Stimulating Hormone).

8. b). Stages of birth.

There 3 stages ; i). First stage / Cervix dilation
ii). Birth / delivery of the baby
iii). After birth

i). First stage / Cervix dilation.

- Starts when the baby's / foetus hypothalamus releases ACTRH (Adrenal Corticotrophic Releasing Hormone) which stimulate the anterior pituitary part to release ACTH (Adrenal Corticotrophic Hormone).
- This stimulate adrenal cortex of the foetus to release corticosteroid hormones that enters mother's blood circulatory system via placenta.
- Presence of corticosteroid stimulate mother's hypothalamus to release oxytocin hormone which increases labour pain.
- Also level of oestrogen increase which causes

8 b. further contraction of myometrium and their is a release of prostaglandins that causes further contraction and labour pain increases.

- Increase in contraction causes the amnion to rupture and amniotic fluid is released.
- Further contraction makes the cervix to dilate and the foetus is pushed further down to the cervix.
- This stage ends when the diameter of the cervix is equal to the diameter of the head of the foetus.

ii/. Second stage / Birth stage

- This is the actual stage in which the baby is expelled out of the mother's placenta.
- Umblical cord connecting the two is clamped at two points and a cut is made between the clamps.
- The baby is finally independent from mothers physiological processes.

iii/. Third stage / After birth

- This stage involve birth or removal of all extra embryonic membranes and placenta.
- This is done soon or 10 minutes after delivery were extra embryonic membrane are removed and the stage is not painful.

Extract 8.2: A sample of the candidate's good responses in question 8

In Extract 8.2 the candidate correctly stated the roles of Oestrogen hormone, identified and described the stages of birth which are dilation of cervix, birth of the baby and birth of placenta.

2.1.9 Question 9: Transportation

In this question candidates were required to describe the structure of stomata with the help of a diagram. A total of 20,033 candidates, equivalent to 71.4 percent attempted this question.

Statistics indicate that 74.5 percent scored marks ranging from 0 to 5, 23 percent scored 5 to 8.5 and 2.5 percent scored 9 to 15 out of 15 allocated marks. The performance trend is presented in Figure 9.

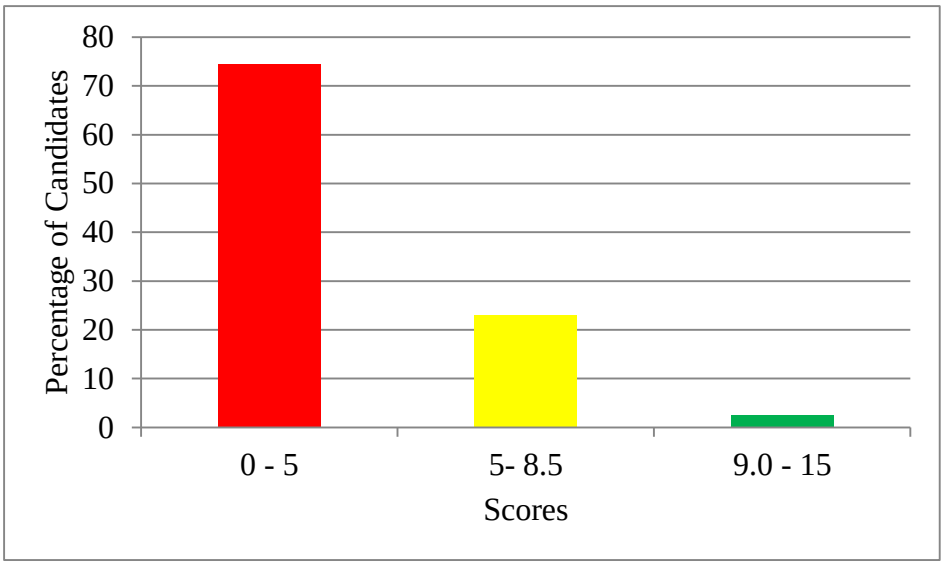


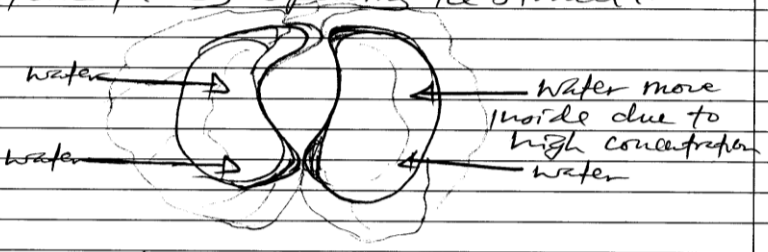
Figure 9: *Distribution of candidates' scores in question 9*

Figure 9 shows that the candidates' performance in the question was poor since about three quarters that is 74.5% scored below the pass marks. Further analysis of candidates' responses indicated that majority of the candidates who scored below 3 marks lacked skills on drawing biological diagrams hence they drew poor diagrams of stomata. Others were able to draw the diagram but failed to label it correctly. On the other hand, some candidates did not understand the demand of the question as they described the mechanism of stomata opening and closing instead of drawing the structure of stomata. For example, one of the candidates described the mechanism of opening and closing of the stomata such based on *starch – sugar theory I* and *starch –sugar theory II.* Another candidate explained how the stomata are adapted to the process of opening and closing. The candidate also described the wall of the guard cell in terms of cell membranes of the guard cells. Extract 9.1 is a sample of the incorrect responses.

9. STARCH SUGAR THEORY I

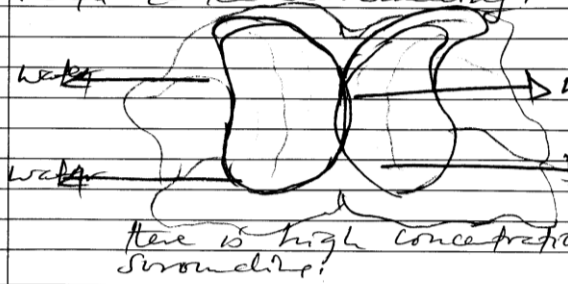
OPENING OF THE STOMATA

During a day there is low concentration of Carbon dioxide and hence there is high concentration of glucose inside the of the stomata which lead water to move from the sorrounding inside the stomata by opening the stomata.



CLOSING OF THE STOMATA.

During a night concentration of Carbon dioxide is greater and more concentration of glucose will be created outside while inside there is high water potential water will flow from the inside the stomata to the sorrounding.



there is high concentration to the sorrounding.

STARCH SUGAR THEORY II

Opening of the stomata.

During a day there is low concentration of Carbon dioxide and hence low Carbonic acid which tend to rize the pH value due to this fact low starch will be converted into glucose hence high concentration will be created inside and then water will move from the sorrounding inside the cell.

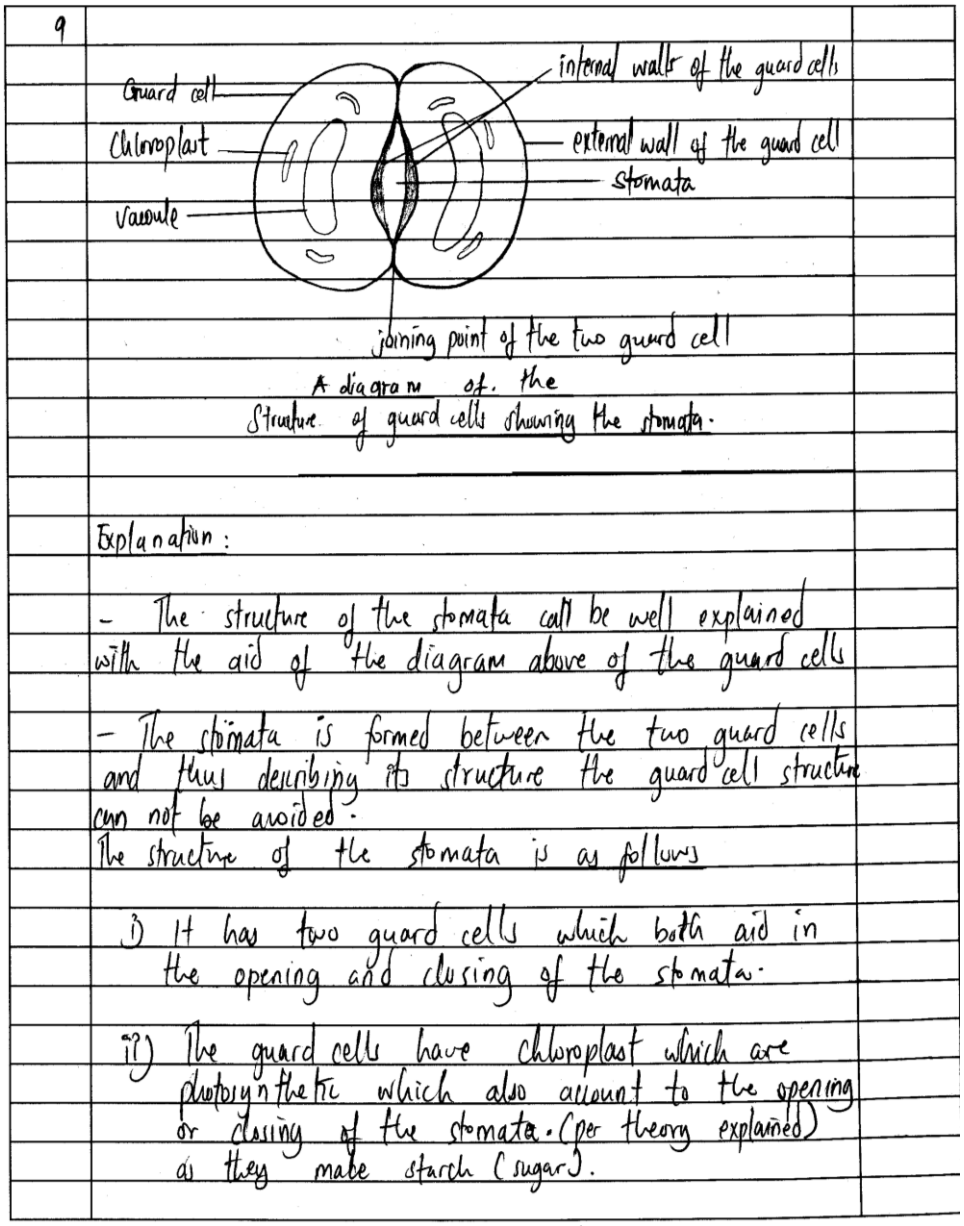
Closing of the stomata

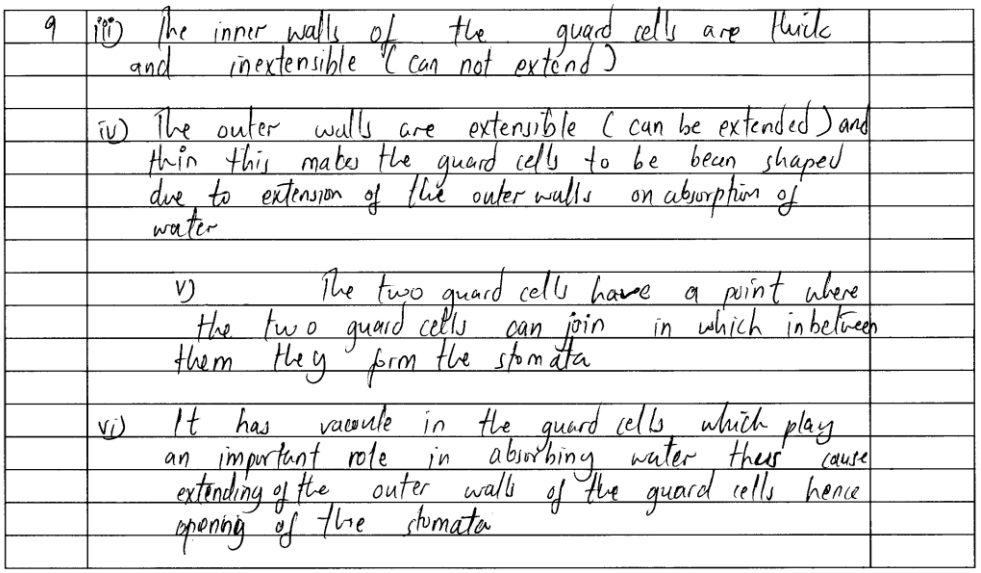
During night there is high concentration of Carbondioxide and hence low Carbonic acid which tend to lower the pH value due to this fact glucose will be converted into starch hence water will move from the cell to the sorrounding where high concentration is created.

Extract 9.1: A sample of the candidate's poor responses in question 9

Extract 9.1 shows that the candidate drew the poor structure of stomata and gave incorrect description of mechanism of closing and opening instead of describing the structure of stomata.

The candidates who scored high marks (5.5 - 15) showed good mastery of the topic of *Transportation*, particularly, the structure of stomata. Most of them correctly drew the structure of stomata. However, there were some of them who labeled some parts of diagram. They also made clear description of the structure of stomata. Extract 9.2 is a sample of correct responses.





Extract 9.2: A sample of the candidate's good responses in question 9

The candidate's response in Extract 9.2 shows that, the candidate correctly drew the structure of stomata and described it well.

2.1.10 Question 10: Reproduction

In part (a), candidates were required to draw a longitudinal section of a matured carpel at its fertilization stage and indicate the parts which carry out each of the following roles:

(i) receiving pollen grain
(ii) transferring pollen grain to the ovule
(iii) fusing with male gamete to form zygote
(iv) attaches ovule to the ovary
(v) protecting egg cell
(vi) controlling growth of pollen tube
(vii) fusing with male nucleus to form endosperm.

In part (b), the candidates were required to describe the events leading to double fertilization in plants.

A total of 15,414 corresponding to 54.9 percent of the candidates attempted the question. Data analysis shows that the candidates' performance in the question was average since 43.2 percent passed by scoring from 5.5 to 15 out of 15 marks. Figure 10 displays the performance of candidates in the question.

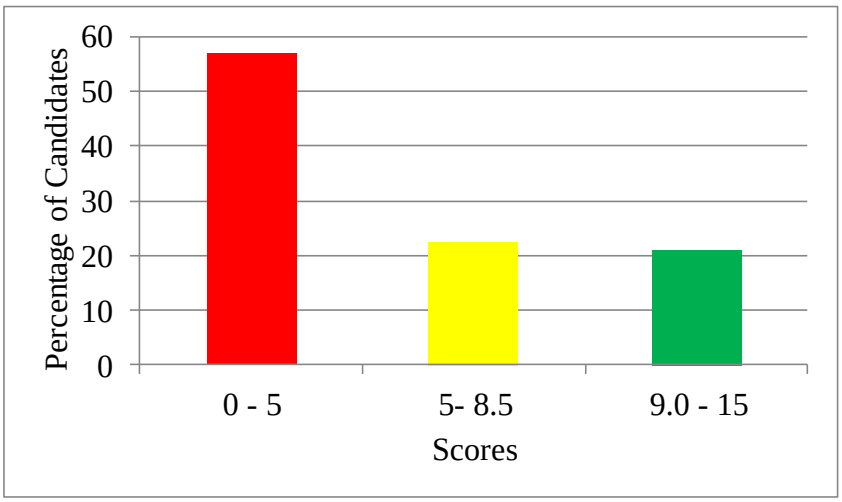
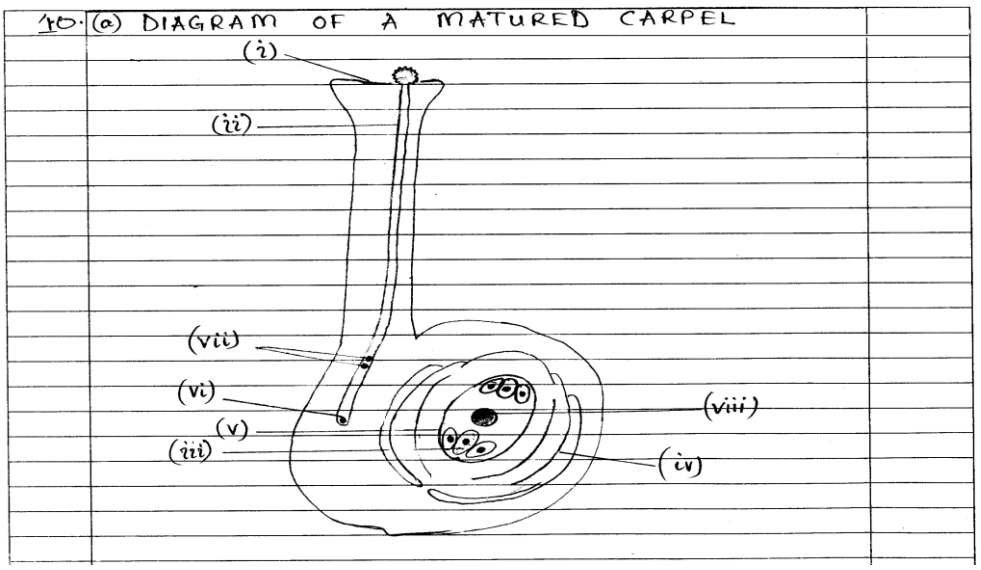
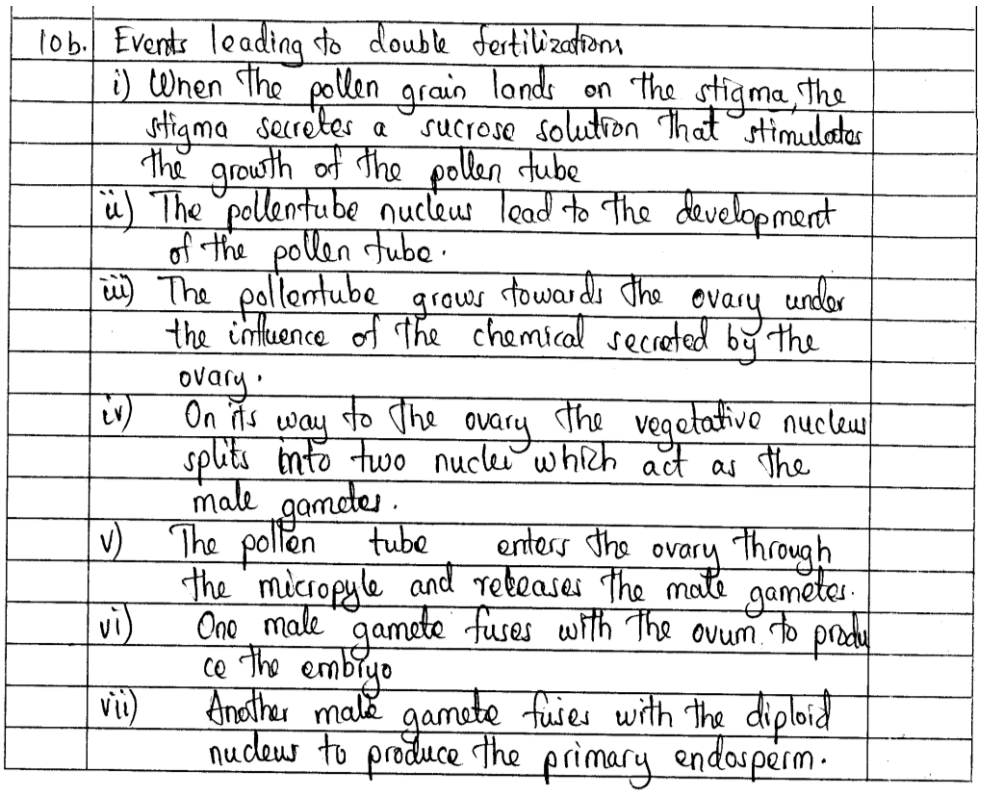


Figure 10: *Distribution of candidates' scores in question 10.*

Figure 10 shows that, 56.8 percent scored from 0 to 5 marks; 22.3 percent scored from 5 to 8.5 and 20.9 from 9 to 15 marks. The candidates who scored high marks had good competence of the topic *Reproduction*, particularly on the subtopic *double fertilization in plants*. In addition, they had good drawing skill such that in part (a), most of them were able to draw the diagram of the matured carpel at fertilization stage and correctly labeled all or most of the asked parts. In part (b), they clearly described the events leading to double fertilization in plants. Extract 9.1 is a sample of correct responses from one of the candidates.



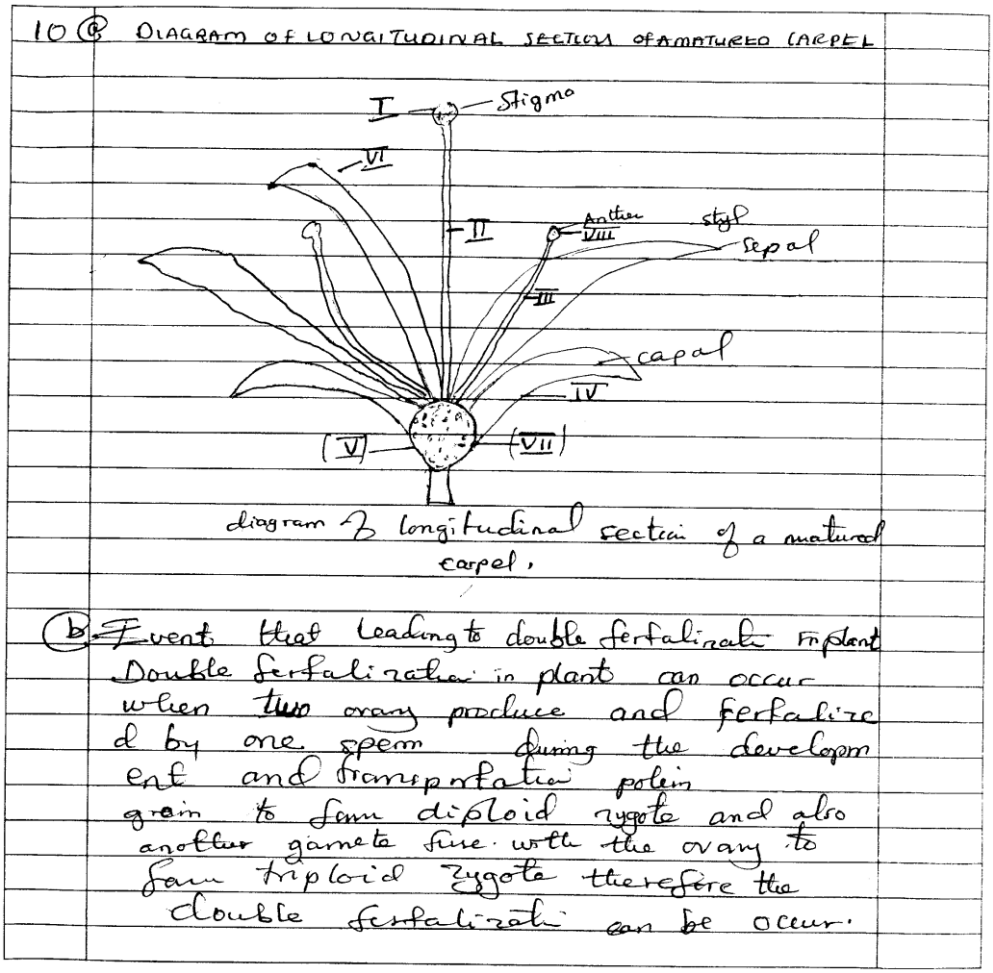


Extract 10.1: A sample of the candidate's good responses in question 10

In Extract 10.1 the candidate drew a diagram of a longitudinal section of a matured carpel and labeled it as per demand of the question in part (a). In part (b), the candidate made correct description of the events leading to double fertilization in plants.

Analysis of the candidates' responses reveals that, of the candidates who scored 0 to 5 marks in part (a), some of them drew a diagram of a longitudinal section of a matured carpel at fertilization stage but did not labeled all the parts. In part (b), they gave partial description of the events leading to double fertilization in plants. Candidates who scored zero mark in part (a) drew different diagrams from what was required. For example, one of the candidates drew a longitudinal section of hibiscus flower and labeled parts such as anther, petals, and sepal. Others drew embryo sac instead of carpel at fertilization stage. Furthermore, there were some candidates who drew the correct diagram but made wrong labelling. Such as egg/ovum, pollen tube and male nuclei instead of using roman numbers to indicate the required parts. In part (b), some of the candidates explained the process of forming twins in animals instead of describing the events

leading to double fertilization in plants. Extract 10.2 is from a candidate who gave incorrect response.



Extract 10.2: A sample of the candidate's poor responses in question 10

Extract 10.2 shows that the candidate drew the cross section of a flower instead of the structure of a matured carpel at fertilization stage.

2.2 131/2 BIOLOGY 2

This paper contained eight (8) questions set from six topics. The topics are Comparative Studies of Natural Groups of Organisms, Regulation (Homeostasis), Growth and Development, Genetics, Ecology and Evolution. The paper had four sections; A, B, C and D whereby each section contained two (2) questions carrying 20 marks each and the pass mark for each question was 7 and above.

2.2.1 Question 1: Comparative Studies of Natural Groups of Organisms

In this question candidates were required to use examples when explaining five advantages and disadvantages of Kingdom Fungi.

The question was attempted by 23,696 (84.4%) candidates. Data analysis reveals that 57.6 percent of the candidates scored marks ranging from 7 to 11.5, 39.4 percent scored from 7.5 to 11.5; and only 3 percent scored from 0 to 7 marks out of 20. These data are summarised in Figure 11.

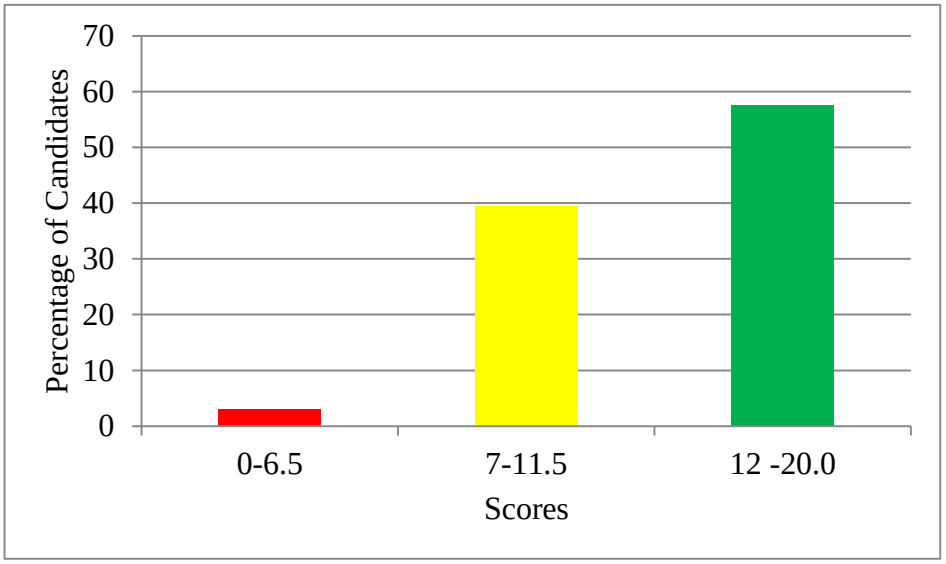


Figure 11: *Distribution of candidates' scores in question 11*

Figure 11 shows that the general performance of the candidates in this question was good as 97.0 percent of the candidates scored marks from 7 to 20.

The candidates who scored high marks managed to correctly explain with relevant examples, five advantages and disadvantages of Kingdom Fungi. The correct responses given by candidates signify that, they understood the content and had enough competence in the topic Comparative Studies of Natural Groups of Organisms. Extract 11.1 shows the sample of correct responses.

1. Advantages of kingdom fungi to human beings.

a) Source of food to man.

⇒ Some fungi are eaten by man and hence source of protein in the body. Example the Agaricus compestris.

Helps in

b) Manufacturing of Medicines.

⇒ Some fungi help in manufacturing of medicines that treat bacterial diseases. For example Penicillium leads to the manufacture of Penicilin that treat bacterial diseases.

c) They are used for biological Studies or Research. For example the Neurospora.

d) They lead to bakery and alcohol production.

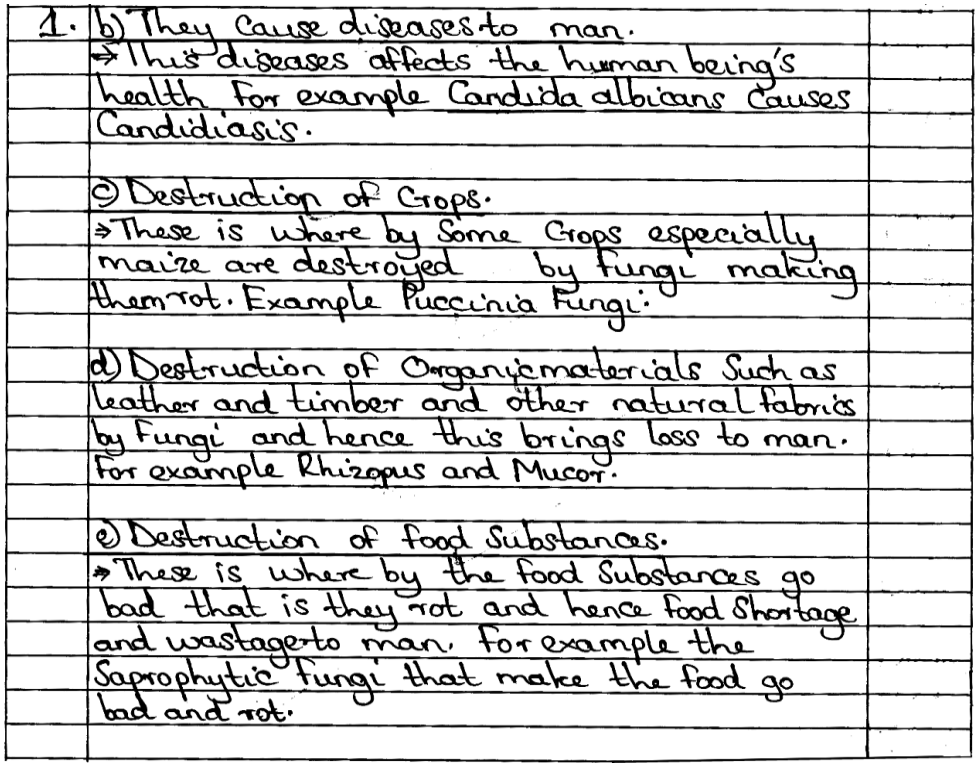
⇒ Fungi assist in fermentation process where breads and alcohols are made. Example yeast helps in bakery and Saprophytic fungi in alcohol production.

e) They Improve the Soil fertility.

⇒ Fungi decompose Organic matter hence leading to humus formation which adds nutrients to the soil making the soil fertile. For example the Saprophytic fungi.

Disadvantages of kingdom fungi to human beings

a) They Cause death, Some fungi are poisonous when eaten and hence when eaten they Cause death. For example Amanita Species of Mushroom.

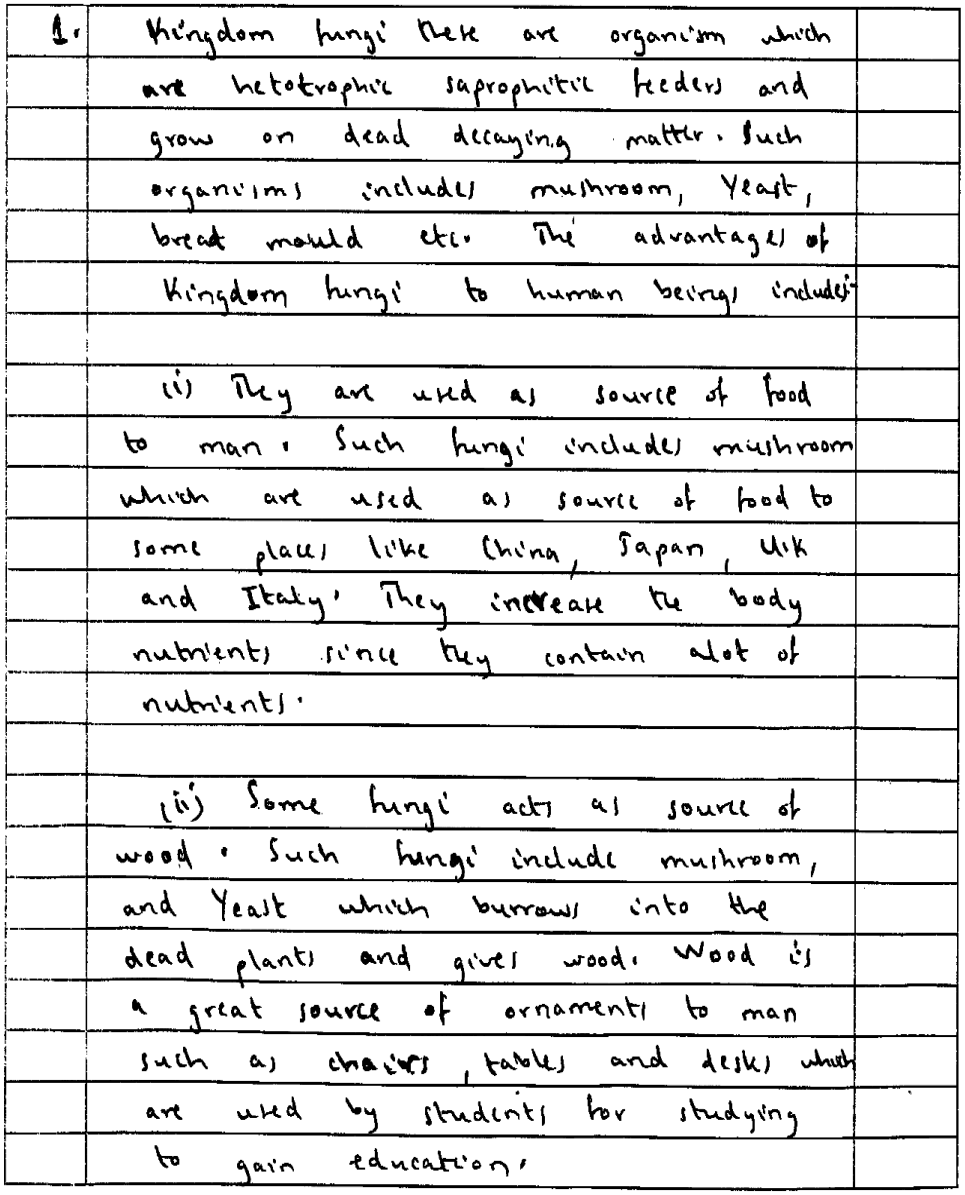


Extract 11.1: A sample of the candidate's good responses in question 1

In Extract 11.1 the candidate used correct examples to explain the advantages of the Kingdom Fungi such as the source of food to man and disadvantages such as the cause of diseases.

Further analysis of candidates' response reveals that, of the candidates with weak performance in the question, most of them had insufficient knowledge of the subtopic *Fungi*. As a result they failed to give correct responses on advantages and disadvantages of the organism. It was observed that some of these candidates responded by giving the advantages and disadvantages of bacteria instead of fungi. Examples of the responses given include: *some fungi are used to provide nitrogen fixation, lactic bacteria such as saprophytic are used in food making, some fungi are used in production of insulin and they are used for decoration.* Some candidates failed to recognize proper disadvantages of fungi, hence they wrote the incorrect disadvantages like *some fungi destroy the environment since they grow in damp; they are hard to handle them since they are very small; they lead to decreasing of oxygen during gaseous exchange; fungi decrease soil nutrients in the farm as they absorb them, hence decrease in farm products.* Other incorrect disadvantages given were that *they cause*

underdevelopment to people who take science, cause negative life expectancy of the students, cause families quarrels due to fermentation process who make people to be alcoholism, cause coast full to human being in treatment. All these responses are indicators of students' inadequate knowledge about advantage and disadvantages of fungi. Equally, the responses imply that, these candidates were incompetent in constructing sentences which are grammatically correct. Extract 11.2 indicates a sample of incorrect responses.


1. Kingdom fungi there are organism which are hetotrophic saprophitic feeders and grow on dead decaying matter. Such organisms includes mushroom, Yeast, bread mould etc. The advantages of Kingdom fungi to human beings includes

(i) They are used as source of food to man. Such fungi includes mushroom which are used as source of food to some places like China, Japan, Uk and Italy. They increase the body nutrients since they contain alot of nutrients.

(ii) Some fungi acts as source of wood. Such fungi include mushroom, and Yeast which burrows into the dead plants and gives wood. Wood is a great source of ornaments to man such as chairs, tables and desks which are used by students for studying to gain education.

1. (iii) Some fungi prevents soil erosion to occur. Such fungi include mushroom. It increases the soil nutrients and ability to hold it's particles so as not to move away.

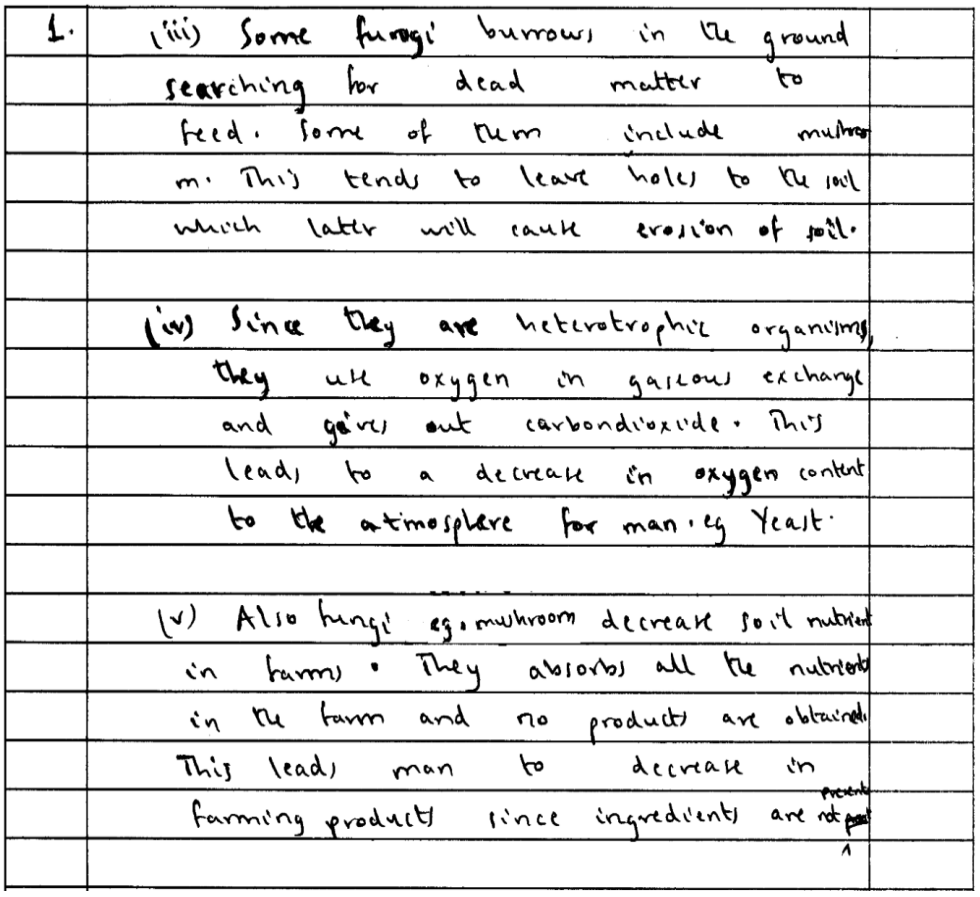
(iv) Some fungi are used in bakeries such as bread mould. This provides products such as breads and cakes. Also some of fungi such as Yeast are used in breweries for production of beers.

(v) Some fungi such as mushroom and Yeast are used in pharmaceuties for the production of medicine. Such medicine prevents the body of the organism from diseases.

- Also some fungi are disadvantageous to human beings. Such of them include

(i) Some fungi such as mushroom are poisonous to man. They contain a poison which may affect the man's liver and death may result.

(ii) Fungi destroy the environment since they grow in damp and wet places. This results to the destruction of the altitute of human being, for example mushroom.



Extract 11.2: A sample of the candidate's poor responses in question 1

Extract 11.2 shows that the candidate had inadequate knowledge to respond to the question. He/she stated some incorrect advantages of fungi such as source of wood and disadvantages such as cause of soil erosion.

2.2.2 Question 2: Comparative Studies of Natural Groups of Organisms

In part (a) the candidates were required to draw a diagram of a bacteriophage and label six parts. In part (b) the candidates were required to justify the fact that viruses are living and non-living organisms by giving four living and three non-living characteristics.

The question was attempted by 17,776 candidates corresponding to 63.3 percent. The analysis of data reveals that 60.4 percent of the candidates scored marks ranging from 12 to 20, 29.6 percent scored from 7 to 11.5 and 10 percent scored from 0 to 6.5 marks out of 20. These data are summarised by Figure 12.

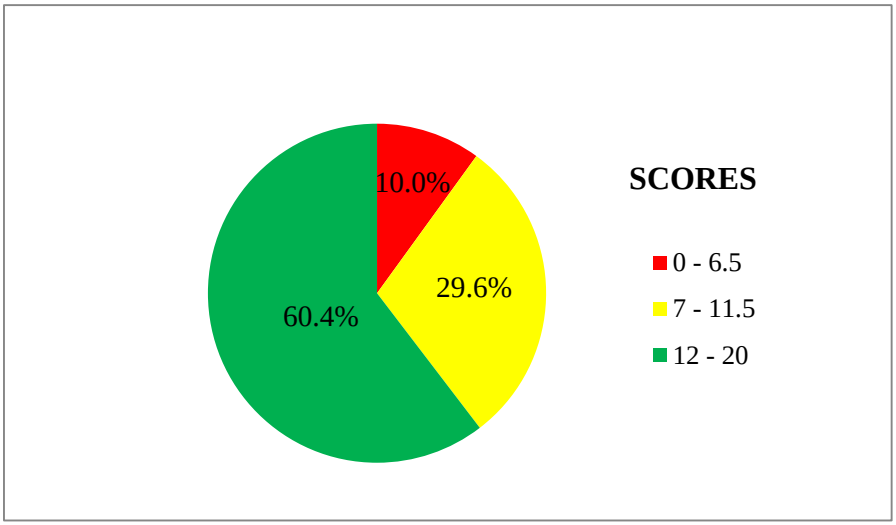
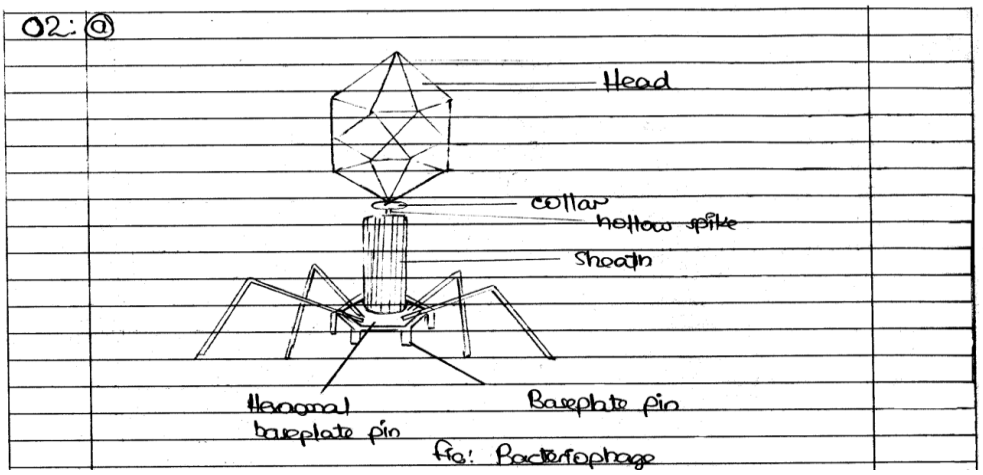
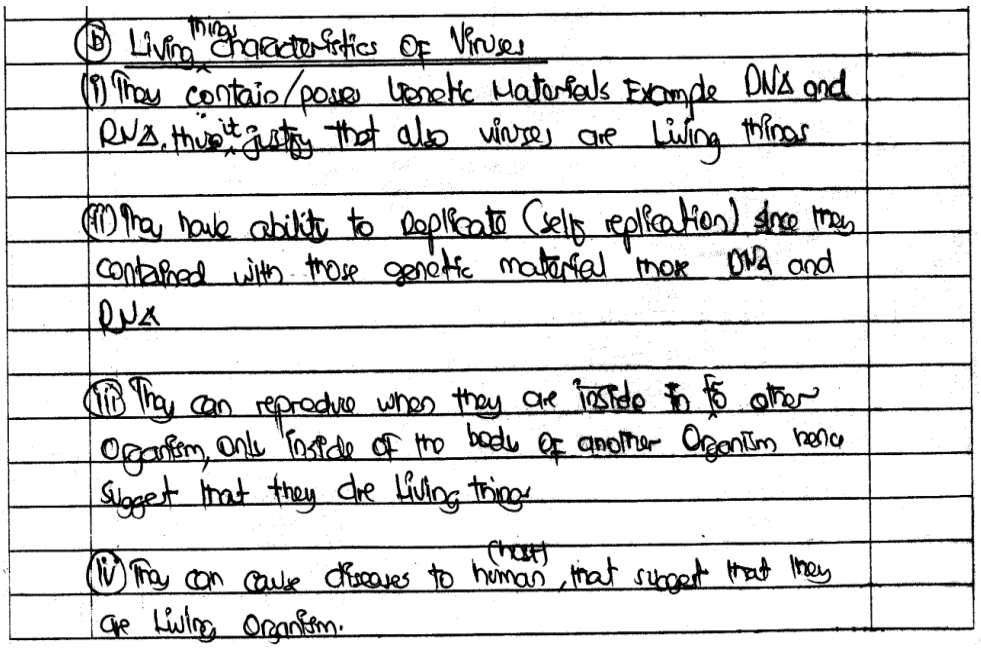


Figure 12: *Distribution of candidates' scores in question 2*

Figure 12 indicates that the general performance of the candidates in the question was good as 90 percent of the candidates scored marks from 7 to 20.

According to the analysed responses of the scripts, the candidates who scored good marks managed to draw correct diagrams of bacteriophage and labelled all or most of the parts correctly. They stated correctly the living and non-living characteristics of the viruses. The correct responses given by candidates suggest that they acquired enough knowledge of the topic *Comparative Studies of Natural Groups of Organisms*.





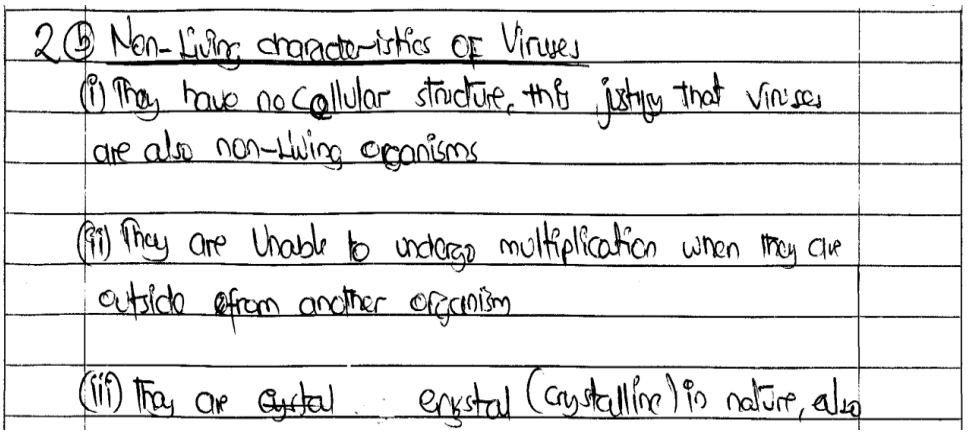
(b) Living things characteristics of Viruses

(i) They contain/posses Genetic Materials Example DNA and RNA. thus it justify that also viruses are Living things

(ii) They have ability to Replicate (self replication) since they contained with those genetic material that DNA and RNA

(iii) They can reproduce when they are inside in to other Organism, only inside of the body of another Organism hence suggest that they are Living things

(iv) They can cause diseases to human (host), that suggest that they are Living Organism.



2 (b) Non-Living character-istics of Viruses

(i) They have no Cellular structure, this justify that viruses are also non-Living organisms

(ii) They are Unable to undergo multiplication when they are outside from another organism

(iii) They are Crystal crystal (crystalline) in nature, also

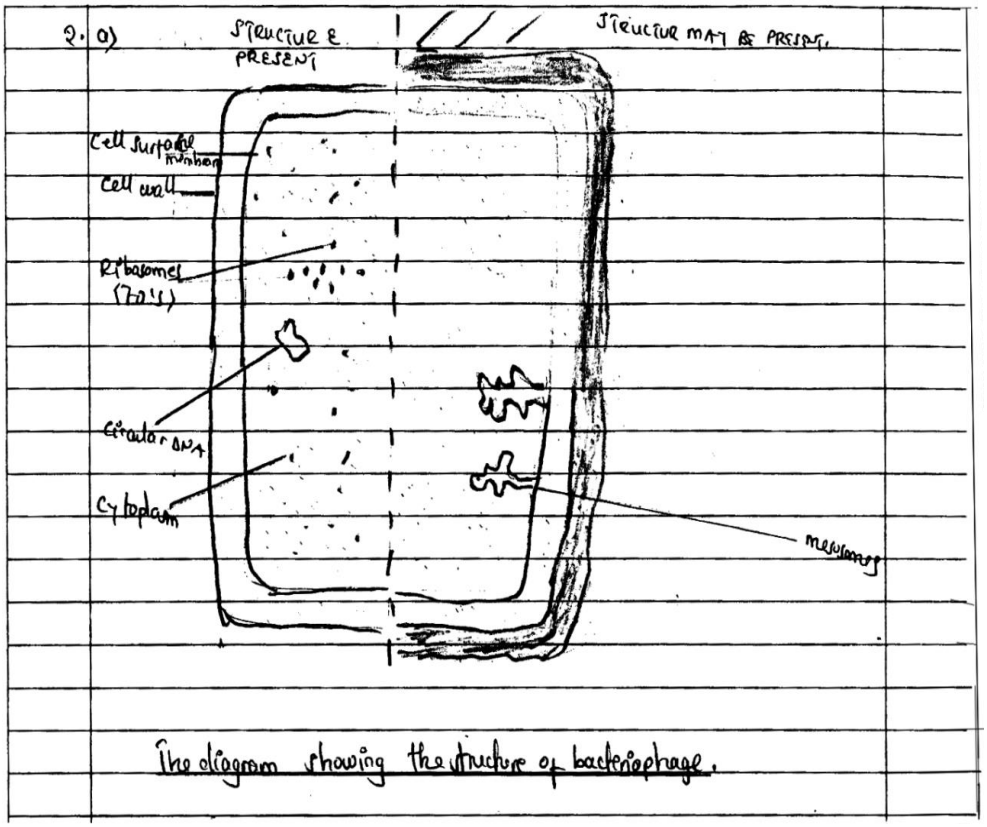
Extract 12.1: A sample of the candidate's good responses in question 2

Extract 12.1 shows that, the candidate managed to draw and label a diagram of bacteriophage and correctly stated living and non-living characteristics of the viruses.

However, some candidates who scored average marks 7 to 11 managed to draw a diagram of a bacteriophage and labelled six parts of it. However, they failed to justify the characteristics of virus as living and non-living.

Moreover, some of the candidates who scored below 7 marks had insufficient knowledge of the subtopic *Viruses* as some of them drew a good diagram of bacteriophage but failed to label some of the parts correctly. For example, one candidate wrongly labeled tail fibre as *leg*;

sheath as *neck* and base plate pin as *pits*. Further observation in the analysed scripts showed that there were candidates who failed even to draw a diagram in part (a) and some of them failed to recognise the characteristics of viruses and justify why viruses are either non-living or living things. For example for living characteristics some candidates responded that; *viruses are motile, undergo growth, are cellular respiration, are heterotrophs* and *viruses are replication*. While for non-living characteristics of viruses they wrote that; *they cannot move, they lack sensitivity, they have necked DNA, they are not harmful*. Further analysis revealed that, some candidates confused bacteriophage with bacteria, thus they drew a diagram of bacteria instead bacteriophage (a virus). Extract 12.2 is one of the responses from a candidate who responded incorrect to the question.



2 b) The characteristics of living and non-living viruses.

Viruses these can be defined as the smallest organisms which posses both the living and non-living characteristics

The following are the characteristics of living viruses.

As other living organisms viruses can replicate to produces identicals of their own copy. The viruses posses this character which resembles like other living organism; therefore it is difficult to group such viruses.

They posses the RNA and DNA materials as other living organisms. These are the materials which which are posses by living organisms so it is difficult to classify or identify viruses which posses such characters.

They the live in the host cell of oth

They can infect and effect the other living organism so they posses the resembling character of infecting and effecting the host cell.

They can not produce their own food as other living organism since they are not autotrophic organisms therefore it is difficult for them to be identified as living viruses.

The following are the characteristics of non-living viruses.

They can crystallize. The viruses can crystallize to form very small particles in the host. As other non-living organism.

They can not produce their own food since they are not autotrophic organism. ii

They live in the host cell since they can not stay by their own until they live in the host cell.

They can invade the host cell for their respiration. Since they are living in the host cell as non-living organism they can not respire by their own.

Therefore the viruses pose problem in identifying as they possess characteristics of both living and non-living things.

Extract 12.2: A sample of the candidate's poor responses in question 2

Extract 12.2 reveals that, the candidate failed to recognise the question demand. He/she drew a diagram of a bacterium instead of a bacteriophage

(virus) and stated some incorrect living characteristics of the viruses such as possession of DNA and RNA.

2.2.3 Question 3: Regulation (Homeostasis)

This question had parts (a) and (b). In part (a) the candidates were required to describe with the help of a diagram the formation and removal of urea in mammalian liver. In part (b), they were required to (i) identify the major excretory products in vertebrates (ii) state the nature of each excretory product and give example of an organism which excretes each of the excretory products.

The question was attempted by 18,624 candidates which corresponds to 66.3 percent. The analysis of data reveals that 62.4 percent of the candidates scored marks ranging from 12 to 20; 29.1 percent scored from 7 to 11.5 and 8.5 percent scored from 0 to 6.5 marks out of 20 marks. The data are summarised in Figure 13.

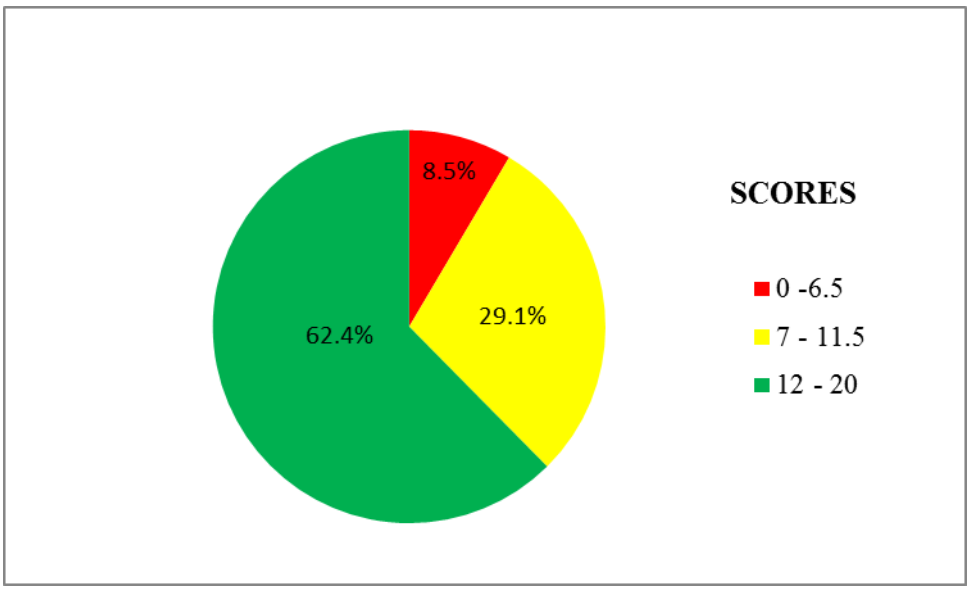


Figure 13: *Distribution of candidates' scores in question 3*

Figure 13 indicates that, the general performance of candidates in this question was good as 91.5 percent of the candidates scored marks ranging from 7 to 20.

The candidates who had good performance correctly described the process of formation and removal of urea in mammalian liver. They also drew a well labelled diagram of ornithine cycle to support their explanations.

Moreover, the candidates gave the major excretory products in vertebrates and correctly stated the nature of each excretory product supported with correct examples of the organisms concerned. The correct responses given by candidates implied that, they had enough knowledge of the topic *Regulation* especially on the subtopic *Excretion*. Extract 13.1 illustrate a sample of good responses.

3. (a) FORMATION AND REMOVAL OF UREA.

- Urea is formed in mammalian liver by aid of two process namely, (i) Deamination of Amino acids and (ii) Detoxrification

(i) Deamination of Amino acids.

- The process involves removal of amino group from amino acids through oxidizing aminoacids.

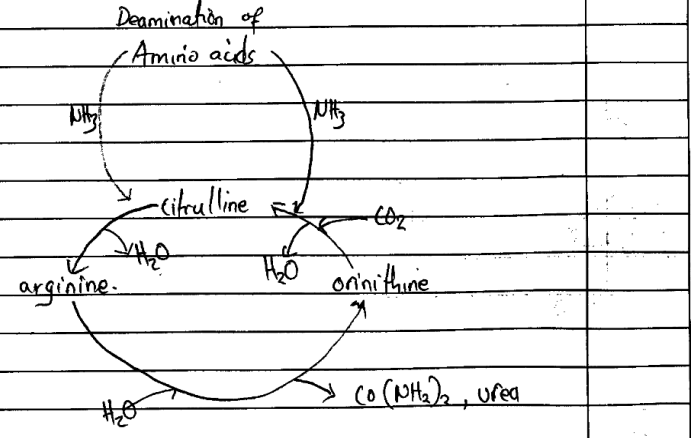
$$NH_2 - \underset{H}{\overset{R}{C}} - COOH + O_2 \longrightarrow 2NH_3 + \underset{R}{\overset{O}{\overset{\|}{C}}} - COOH.$$

(ii) Detoxification.

- Due to formation of ammonia which is a harmful product, detoxification takes place it converts harmful product to harmless product. Ammonia reacts with carbondioxide produced from respiration and leads to formation of urea.

$$2NH_3 + CO_2(g) \longrightarrow \underset{\text{Urea.}}{CO(NH_2)_2}$$

ORNITHINE CYCLE.



3. (a) Urea is transported to kidney and excreted away, therefore the following are pathway of urea from liver to kidney so that it can be removed.

Liver → hepatic vein → Posterior Vena cava → right autrium of heart → right ventricle of heart → Pulmonary artery → Lungs → Pulmonary vein → left autrium of heart → left ventricle of heart → dorsal aorta → Renal artery → Kidney.

(b) (i) The major excretory products in the vertebrates are,

(i) Uric acid

(ii) Urea.

(iii) Ammonia

(ii)

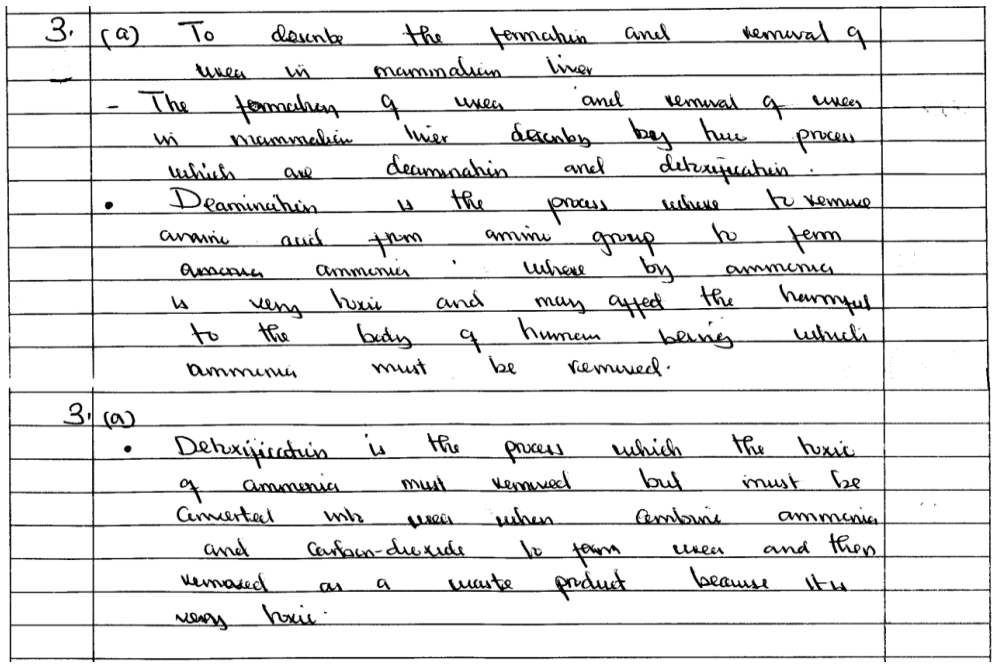
Excretory product	Nature	Example of organism
Ammonia	- It is very toxic - Requires alot of water for its excretion.	Fish.
Urea	- It is less toxic compared to ammonca - Less water is required for its excretion - It is soluble molecule, can be easily filtered with kidney	Human being
Uric Acid	- It is non-toxic - Less water or no water is required for its excretion	Reptiles example Lizard.

Extract 13.1: A sample of the candidate's good responses in question 3

In Extract 13.1, the candidate managed to describe the process of formation and removal of urea in mammalian liver. These responses imply that the candidate had adequate knowledge to respond the demand of the question.

Further analysis of candidates' response reveals that, of those who scored low marks, some of them lacked knowledge of the topic as they left this item unresponded. Similarly, some had inadequate knowledge of the process of urea formation as they drew the structure of nephron instead of ornithine circle. Others drew the structure of the urinary system. Some drew the ornithine cycle, but failed to use the arrows correctly to indicate input and output of the cycle. For example, one of the candidates used arrow to indicate that ammonia and carbon dioxide are the outputs of the cycle instead of input. Another one indicated wrongly that urea is an input instead of output. In addition, the majority of the candidates failed to recognise that the compound ornithine combines with carbondioxide and ammonia to release water.

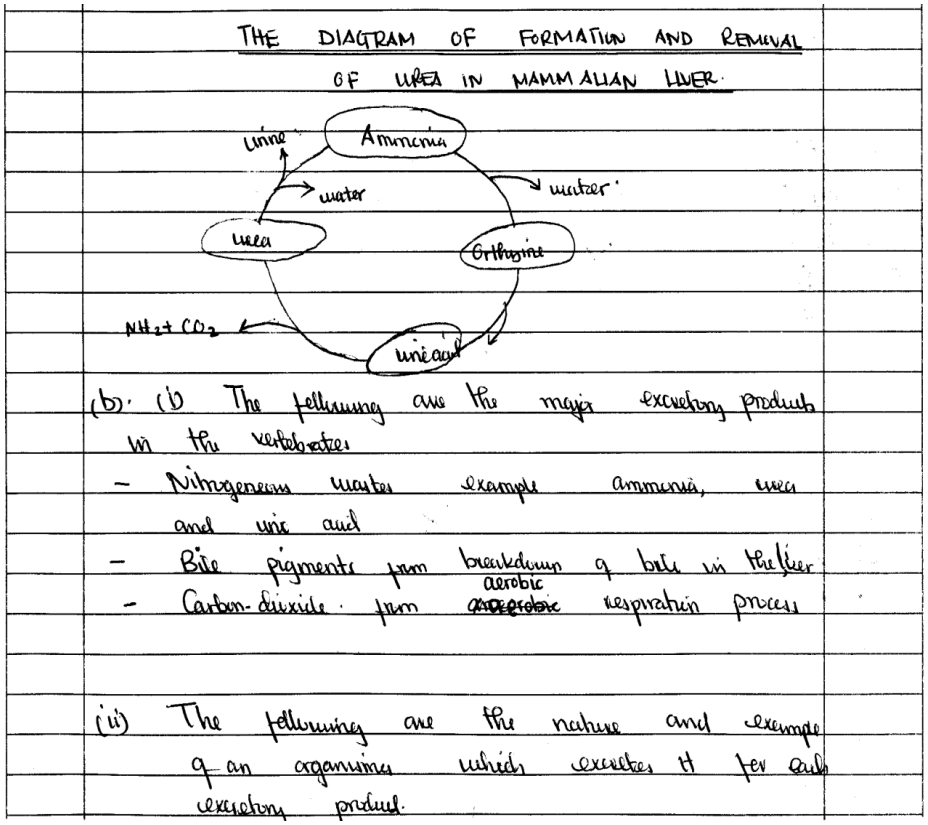
Moreover, some of the candidates were unable to identify the major excretory products of each vertebrate. An example of this is drawn from the candidate who wrote the excretory products as *urine, nitrogenous waste, salts, carbondioxide and bile.* Others failed to state the nature of each excretory product and gave incorrect example of an organism which excretes such products. An example of this is when the candidate wrote that the vertebrates which excrete ammonia are; *insects, grasshopper* and *spider;* and *protozoa* and *amoeba* excrete urea and uric acid respectively. These responses showed that, the candidates had inadequate knowledge of the topic *Regulation (Homeostasis)*, specifically on Excretion. Extract 13.2 is an example of incorrect responses.


3. (a) To describe the formation and removal of urea in mammalian liver

- The formation of urea and removal of urea in mammalian liver describe by two process which are deamination and detoxification.
- Deamination is the process where to remove amino acid from amino group to form ammonia. where by ammonia is very toxic and may affect the harmful to the body of human being which ammonia must be removed.

3. (a)

- Detoxification is the process which the toxic of ammonia must removed but must be converted into urea when combine ammonia and carbon-dioxide to form urea and then removed as a waste product because it is very toxic.



Extract 13.2: A sample of the candidate's poor responses in question 3

Extract 13.2 shows a response from a candidate who indicated urea and ammonia as outputs in ornithine cycle. He/she was unable to state the excretory products, their nature and organisms which excrete each excretory product.

2.2.4 Question 4: Growth and Development

In part (a) the candidates were required to describe, with the help of a diagram, the growth curve pattern of a pea plant. In part (b) the candidates were required to outline causes of seed dormancy.

The question was attempted by 18,294 candidates, the number which corresponds to 65.2 percent. The analysis of data reveals that 36.4 percent of the candidates scored marks from 7 to 11.5, 32.4 percent scored from 12 to 20 and 31.4 percent scored from 0 to 6.5 marks out of 20 marks. The data are summarised in Figure 14.

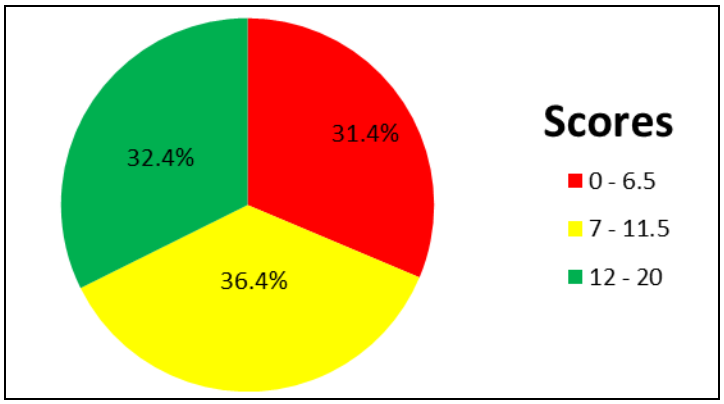
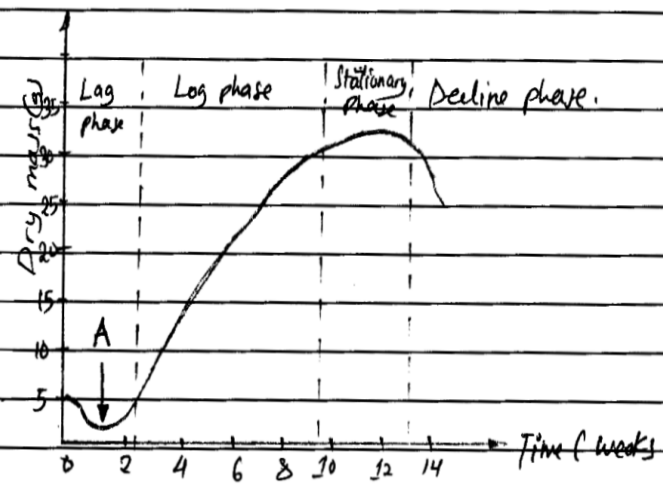


Figure 14: *Distribution of candidates' scores in question 4.*

Figure 14 indicates that the general performance of the candidates in the question was good as 68.6 percent of the candidates scored from 11 to 20 marks.

The analysis of the candidates' responses shows that, the candidates with good performance used a well labelled diagram to describe the growth curve pattern of a pea plant and outlined causes of seed dormancy. The correct responses given by the candidates implied that they acquired adequate knowledge on the topic *Growth and Development*. Extract 14.1 is a sample of good response in question 4.

4(a) Growth curve of a pea plant.



Pea plants are one of the annular plants which can be grown one per year. It is a dicot seed possessing plant. They have periods of germination, growth and maturation periods where the produce peas. Their growth pattern is expressed as below.

Lag phase: This is ~~the period~~ immediately after planting the seed. In the curve, A - represent decrease of drymass of the seed. This is due to the process of utilizing the food in the cotyledones. The process of respiration of the food substance in the cotyledoners.
- The rate of catabolism in this stage is higher than anabolism.
- There is a decline in dry mass.
- The emerging of plumule and radical occurs.
- Development of leaves for photosynthesis begin.

4(a) The log phase.

This is the stage after the development of the pea seedling where it develops leaves whereby photosynthesis is initiated. The following activities occur in this phase.

- The rate of growth and increase in dry mass increases due to initiation of the process of photosynthesis whereby food substances are manufactured whereby some are utilized and others are stored in form of starch which increases the dry mass of the seedling.
- The rate of anabolism increases compared to anabolism.
- Growth activities increase to maximum due to development of new structures. Eg. New leaves and roots.
- Development of the plant complexibility occurs Eg developing of efficient vascular bundles ie Phloem and Xylem.

The stationary phase.

This is the phase whereby growth activities are reduced to minimum and become constant. During this phase the rate of anabolism is contant whereby the rate of photosynthesis of the rate of ~~string~~ respiration is equal. This is the period for increasing the complexibity of the plant and the development of structures for preparation of production of yield or product.

4(c) The decline phase

Is the phase whereby the pea plant produces peas. The mass of the pea plant declines due to the ~~mass~~ process of pea formation. The following events occur at this state.

- The rate of anabolism becomes lower than catabolism
- The overall mass decrease due to higher rate of consumption ~~of~~ the food materials stored in the plant.
- The rate of photo synthesis declines accompanied by cellular division and differentiation
- Finally the pea plant dies after harvesting the peas from the plant.

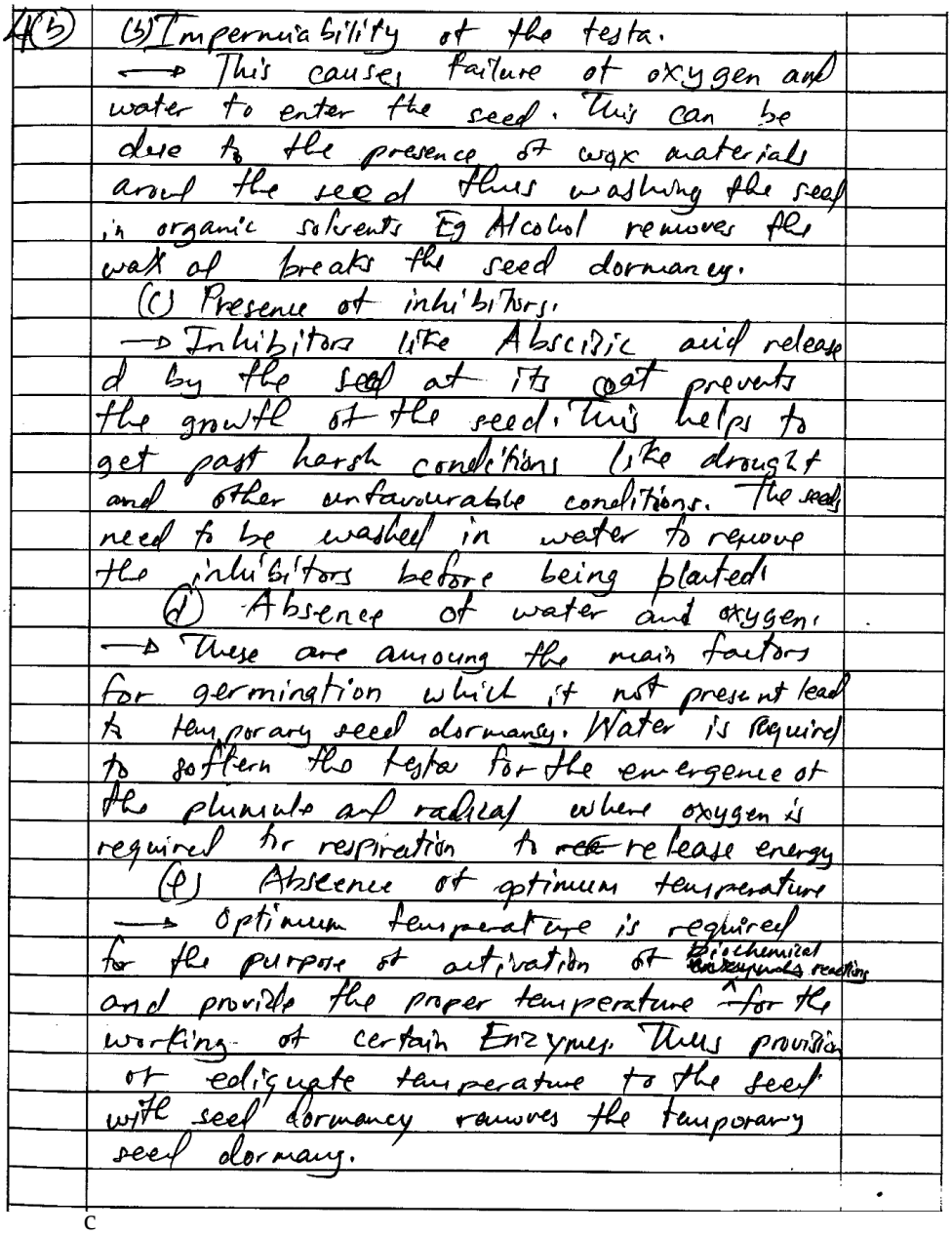
(b) Causes of seed dormancy.

Seed dormancy is the process or situation whereby a seed fails to germinate. It can be caused by both many factors which can make the seed have permanent or temporary seed dormancy

The following are the causes of seed dormancy.

(a) Immaturity of the embryo

→ The embryos of annular plants mature avaragely after one year. The imature embro does not have enough food reserves for germination al hence when the seed is planted it does not germinate.

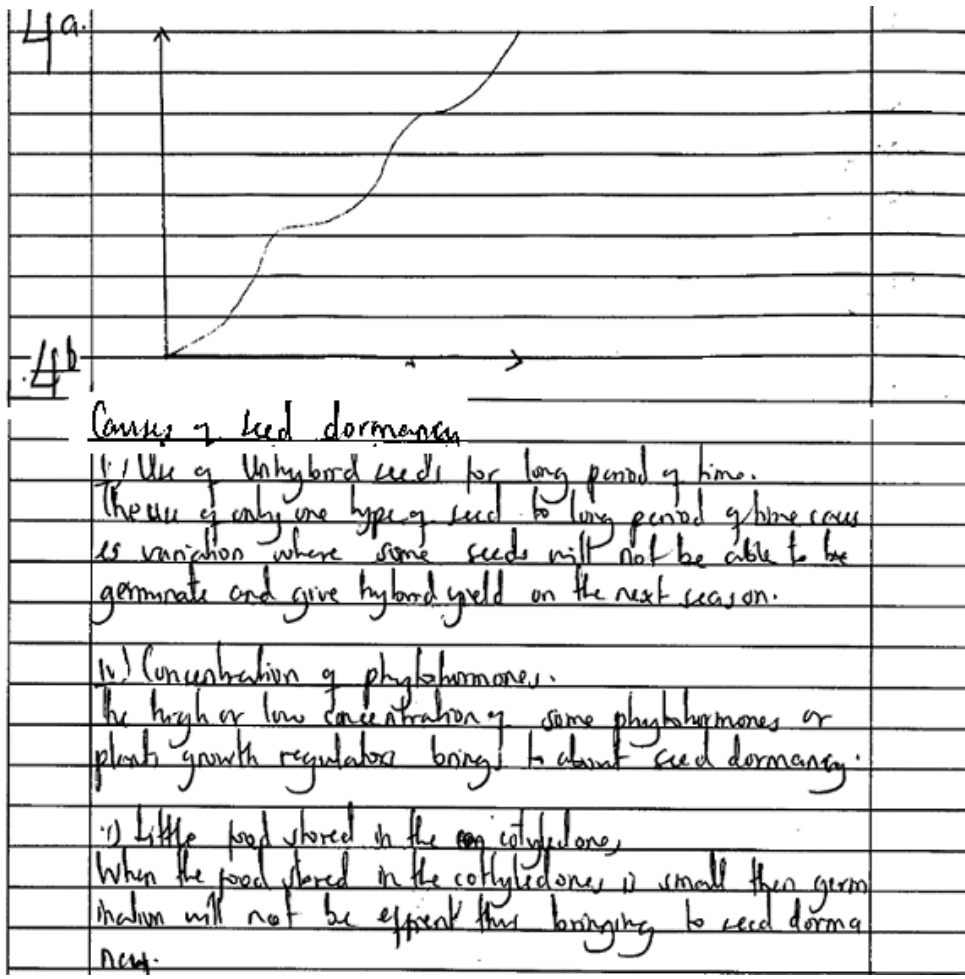

4(b) (b) Impermiability of the testa.
→ This causes failure of oxygen and water to enter the seed. This can be due to the presence of wax materials around the seed thus washing the seed in organic solvents Eg Alcohol removes the wax of breaks the seed dormancy.
(c) Presence of inhibitors.
→ Inhibitors like Abscisic acid released by the seed at its coat prevents the growth of the seed. This helps to get past harsh conditions like drought and other unfavourable conditions. The seeds need to be washed in water to remove the inhibitors before being planted.
(d) Absence of water and oxygen.
→ These are among the main factors for germination which if not present lead to temporary seed dormancy. Water is required to soften the testa for the emergence of the plumule and radical where oxygen is required for respiration to ~~rele~~ release energy
(e) Absence of optimum temperature
→ Optimum temperature is required for the purpose of activation of biochemical enzymes reactions and provide the proper temperature for the working of certain Enzymes. Thus providing of adiquate temperature to the seed with seed dormancy removes the temporary seed dormancy.
C

Extract 14.1: A sample of the candidate's good responses in question 4

Extract 14.1 shows that, the candidate managed to describe the growth curve pattern of a pea plant and outlined the causes of seed dormancy.

Further analysis of candidates' response reveals that some of the candidates who got weak performance lacked knowledge of the topic *Growth and Development* in plants as they failed to draw the growth curve. Others failed to understand the demand of the question as they drew incorrect

diagrams. Some of such candidates responded by drawing a graph showing a series of sigmoid curves for perennial plants instead of annual plants (pea plant). Further analysis revealed that some candidates were unable to explain the growth stages of the curve and the causes of seed dormancy. For example, some candidates wrote human growth stages such as *embryonic stage* and *Adolescence stage* instead of Lag phase and Log phase. On the other hand, the candidates provided some factors affecting yield such as *use of unhybrid seed for long period of time* and *fertile* soils instead of the causes of seed dormancy. Extract 14.2 is additional example of incorrect response.



Extract 14.2: A sample of the candidate's poor responses in question 4

In Extract 14.2, the candidate drew incorrect growth pattern which does not reflect that of pea plant. Likewise, he/she stated incorrect cause of seed dormancy such as use of hybrid seeds.

2.2.5 Question 5: Genetics

Part (a) (i) of the question required the candidates to explain two roles of deoxyribonucleic acid. In part (ii) the candidates were to describe chemical composition of deoxyribonucleic acid whereas in part (b), the candidates were required to describe four properties of genetic material.

Statistics indicate that a total of 23,688 candidates (84.4%) opted for the question where, 43 percent scored marks from 7 to 11.5; 37.5 percent scored 12 to 20; and 19.5 percent scored from 0 to 6.5 marks out of the 20. Figure 15 summarizes the results.

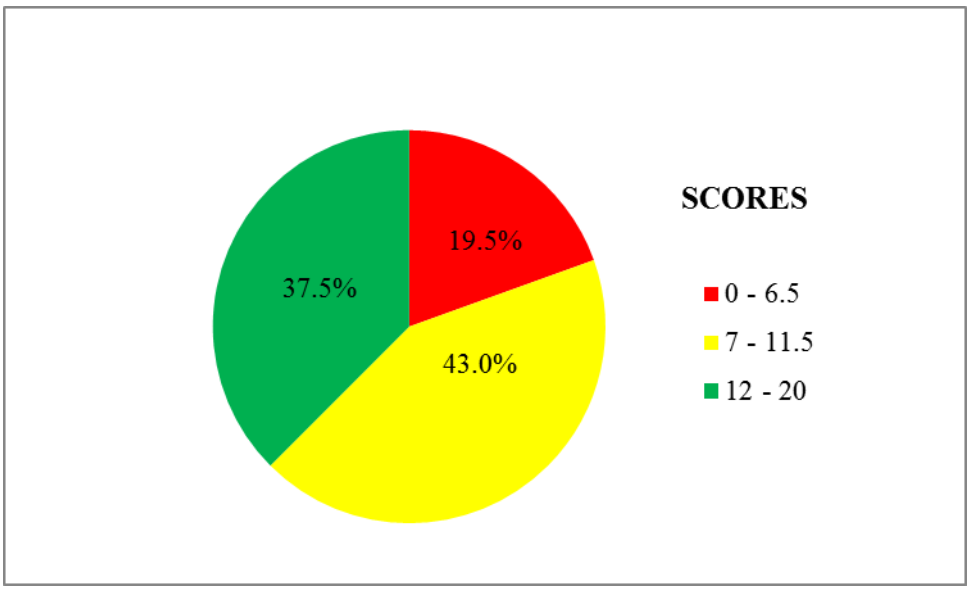


Figure 15: *Distribution of candidates' scores in question 5.*

Figure 15 shows that, the candidates' performance was good as 80.5 percent of the candidates passed the question by scoring marks from 7 to 20 out of 20 marks.

The analysis indicated that candidates who scored from 7 to 20 marks were able to explain the roles of deoxyribonucleic acid and describe clearly the chemical composition of deoxyribonucleic acid in part (a). In part (b), they were able to describe some or all the four properties of genetic material. Good performance of these candidates was attributed by understanding the demand of the question and enough competence on the topic of *Genetics*. Extract 15.1 is a sample of good response.

5. (a) (i) Roles of Deoxyribonucleic acid.

(I) To carry all genetic information of an organism

Deoxyribonucleic acid contains all genetic informations of an organism where by each organism can be differentiated from another through deoxyribonucleic acid.

(II) To carry out transcription process to produce ribonucleic acid which facilitate the process of protein synthesis in an organism. So the process of protein synthesis can be considered that it's facilitated by deoxyribonucleic acid.

(II) Chemical composition of deoxyribonucleic acid.

The deoxyribonucleic acid is composed of the followings

(I) Pentose sugar

This is the 5-carbon sugar which is deoxyribose which found in chain that form deoxyribonucleic acid.

(II) Nitrogenous bases.

These are bases which are bonded together to form a deoxyribonucleic acid these includes-

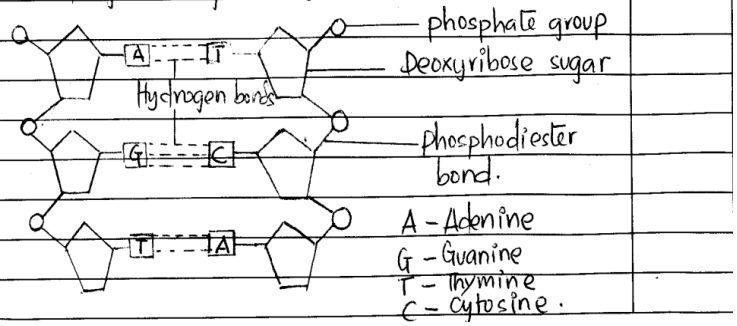
5(a) (II) Purines (Adenine and Guanine), and Pyrimidines (Thymine and Cytosine).
During pairing of nucleotides Adenine(A) allwalys pair with Thymine (T) while Guanine(G) pair with cyctosine (C)

(III) Phosphate group
Deoxyribonucleic acid is made up of phosphate group that is derived from phosphoric acid. This part of deoxyribonucleic acid is the one which give it an acidic nature.

(IV) Chemical bonds
i. Hydrogen bond; this occur at the base complementary pairing. For instance Adenine (A) is bonded to Thymine (T) by two hydrogen bonds.
While Guanine (G) is bonded to cytosine(C) by three hydrogen bonds.

ii. Phosphodiester bond.
This is the bond which join the phosphate group of one deoxyribose sugar to another deoxyribose sugar.

Consider the diagram of deoxyribonucleic acid.



Extract 15.1: A sample of the candidate's good responses in question 5

Extract 15.1 reveals that, the candidate had adequate knowledge in this question. He/she correctly described the role and chemical composition of DNA.

Although this question showed a general good performance, some candidates performed poorly as they lacked sufficient knowledge of the topic *Genetics*. For example, in part (a) some candidates gave incorrect

responses by writing general role of the cell instead of DNA. One of these candidates wrote the roles of deoxyribonucleic acid as *to enable organism to survive.* Similarly, on the components of deoxyribonucleic acid one candidate named the chemical components such as *Phosphorus, Oxygen, Carbon and Hydrogen* without giving any description. On the other hand, other candidates' responses showed that, they failed to understand the demand of the question as they wrote characteristics of genetic codes instead of the role of DNA. Others drew the structure of DNA instead of describing its chemical composition. Extract 15.2 shows a sample of poor candidates' responses.

Genetic code: Genetic code This is the triplate base which is related to a specific ammino acid. The following are the general propertries of genetic code

Genetic code is triplate Base: This properties means that an asociation of Three base code for one amino acid Three base are asociated to code one amino acid in living organism during the the proces of DNA – synthesis when taking place

Genetic code is puntuated: Genetic code is also puntuated This proces means that one ammino acid may be coded by more than one codon in living cell of organism like human being this proces ocure specialy during DNA replication and synth

Genetic code is degeneracte: in This propertie as one of the propertries of genetic code Some of the codon act as starting codon but other act as stop codon during the process of traslation

Genetic code is none overlaping Genetic code is none overlaping this is because each genetic code read separately during traslating of material in DNA replicati when it take place

Extract 15.2: A sample of the candidate's poor responses in question 5

Extract 15.2 shows a part of response from a candidate who described genetic code instead of roles of DNA. These responses imply that the candidate failed to recognise the demand of the question.

2.2.6 Question 6: Genetics

In this question, the candidates were provided with information that the gene controlling the coat colour is carried on X chromosome and are codominant. The parents who were black-coat female mated with a ginger-coat male, the offsprings produced were black-colour male and tortoiseshell colour female kittens. Then, they were required to carry out genetic cross in order to find out the expected F2 phenotypic ratio and explain the results.

The question was attempted by 7,913 candidates, equivalent to 28.2 percent. Data analysis reveals that 50.3 percent of the candidates scored marks ranging from 12 to 20, 30.4 percent scored from 0 to 6.5 and 19.3 percent scored from 7 to 11.5 marks out of 20 marks allocated to this question. The data are summarised in Figure 16.

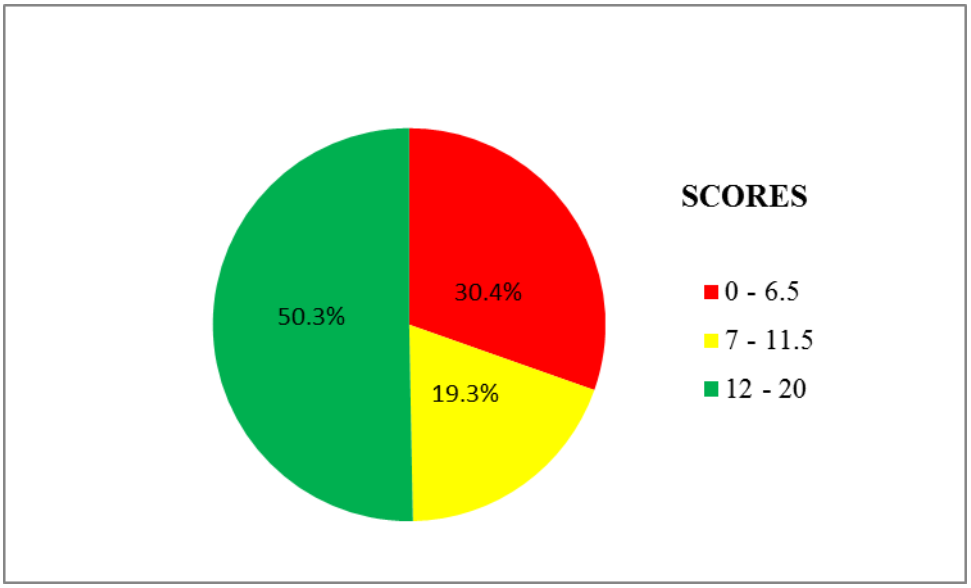
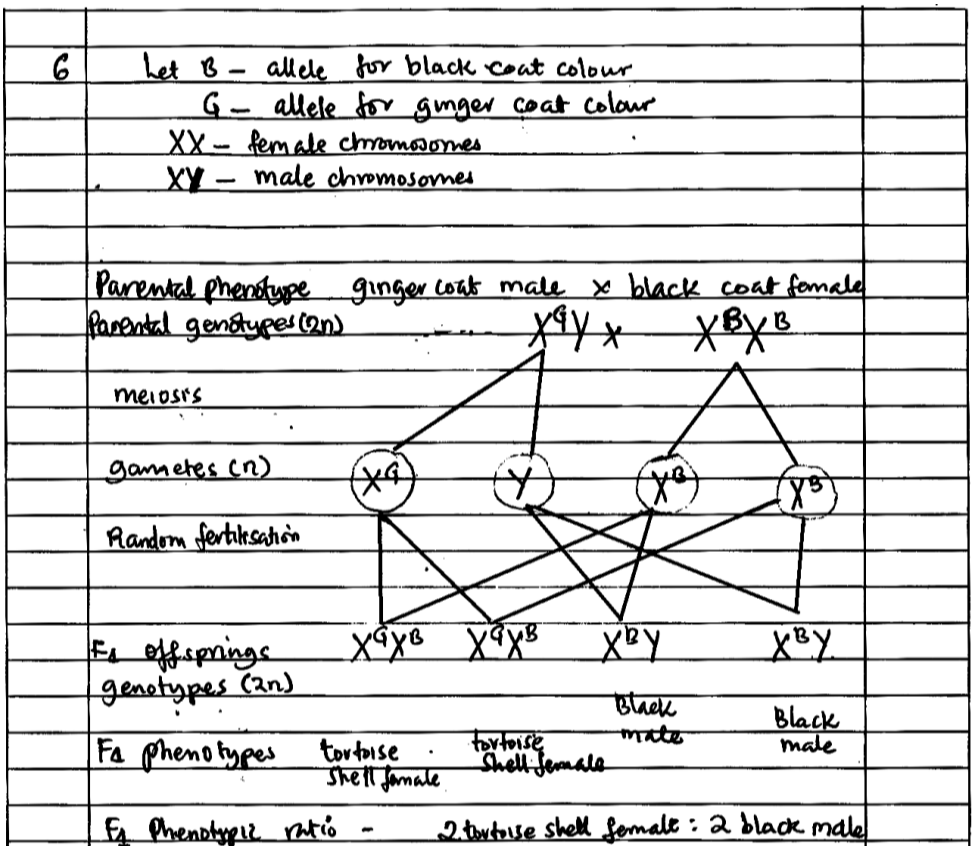


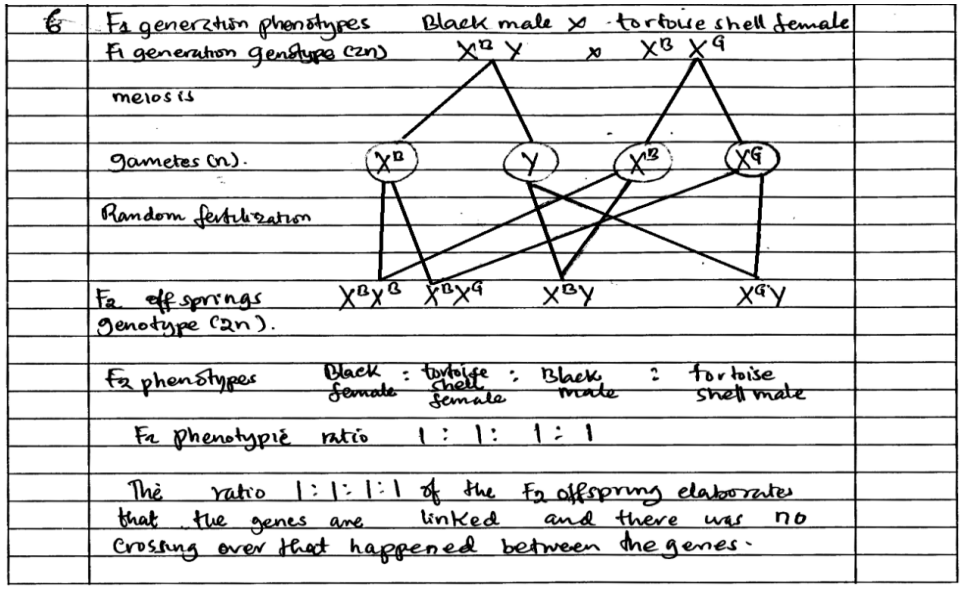
Figure 16: *Distribution of candidates' scores 6.*

Figure 16 indicates that the general performance of the candidates in the question was good as 69.6 percent scored marks ranging from 7 to 20.

The analysis of responses from candidates scripts shows that, those who performed better were able to use the concept of codominant to carry out the required genetic cross and considered the sex chromosome to show the expected phenotypic ratio and explained the results obtained. The correct responses given by these candidates implied that they had enough

knowledge of the topic *Genetics*, especially the concept of Non-Mendelian inheritance. Extract 16.1 is a sample of candidates' good responses.

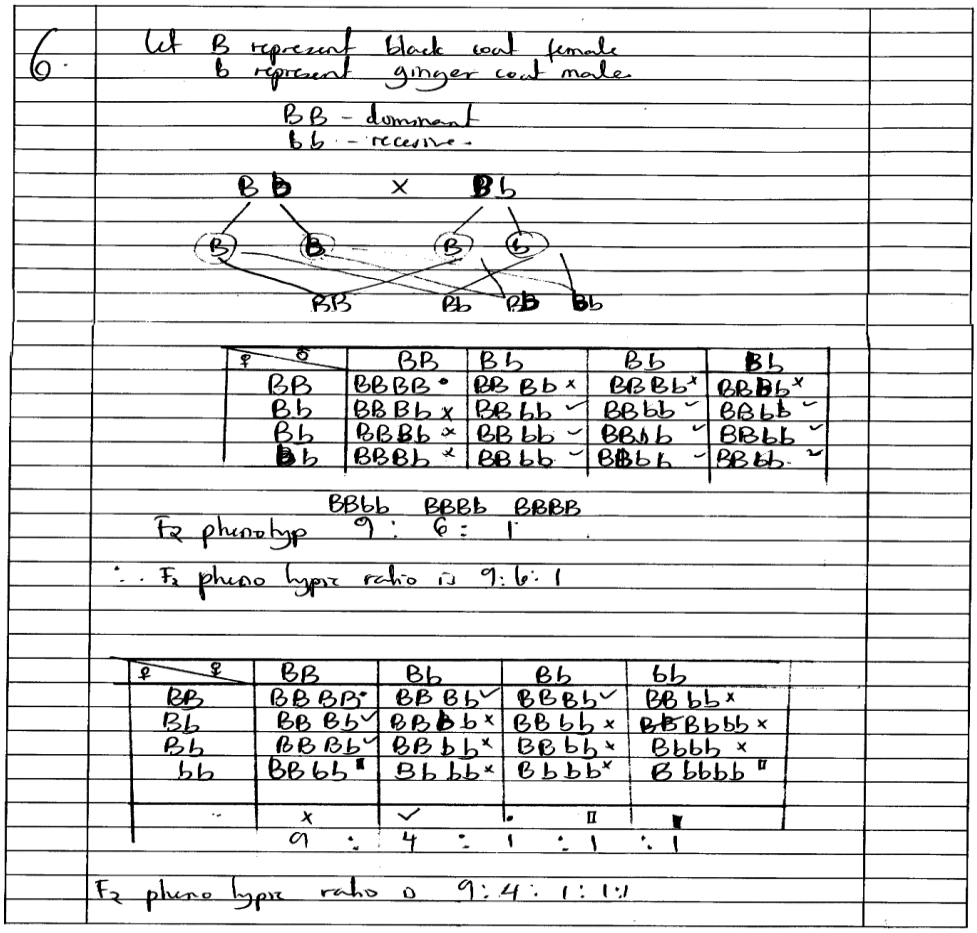




Extract 16.1: A sample of the candidate's good responses in question 6

In Extract 16.1 the candidate managed to use codominant concept and sex chromosome to make correct crossing to show the results of phenotypic ratio and explain them.

On the other side, analysis of candidates' responses revealed that candidates with weak performance in this question showed to have inadequate knowledge of Non-Mendelian inheritance. This is proved by their responses which were based on the concept of recessive and dominance (Mendelian inheritance) instead of codominant (Non-Mendelian inheritance). Most of them made crosses which gave incorrect results, and hence they failed to explain those results. For example, some candidates made a cross which consider recessive and dominant only without considering sex chromosome. Such a cross presented as *B* x *b* (*B = black and b = ginger*) instead of X^B x X^G (B = black and G = ginger, while X is sex chromosome). Extract 16.2 indicates sample from a candidate who gave incorrect response.



Extract 16.2: A sample of the candidate's poor responses in question 6

In Extract 16.2 the candidate failed to make a required genetic cross using sex chromosome and a concept of codominant. Hence unable to show the correct results.

2.2.7 Question 7: Ecology

The question had parts (a) and (b). In part (a) the candidates were required to explain briefly how poaching and deforestation affect the flow of energy in the ecosystem. In part (b) the candidates were required to describe seven biotic factors which affect population distribution.

Statistics indicate that a total of 15,037 candidates (53.6%) opted for the question where 45.9 percent of those candidates scored marks ranging from 0 to 6.5; 39.4 percent scored from 7 to 11.5; and 14.7 percent scored from 12 to 20 marks. Figure 17 illustrates the results.

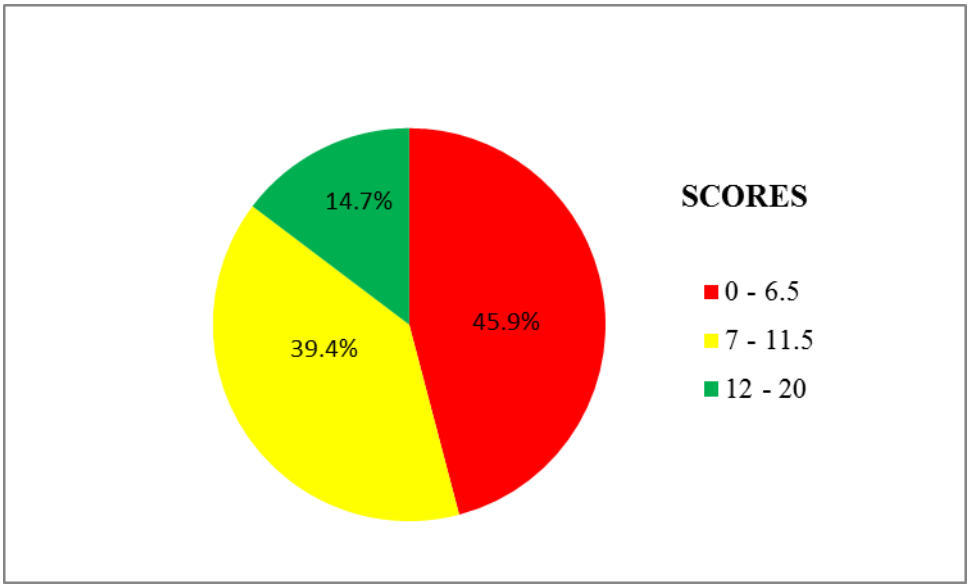


Figure 17: *Distribution of candidates' scores in question 7.*

Figure 17 shows that the candidates' performance was average as 57.1 percent performed the question well by scoring marks ranging from 7 to 20 out of 20 marks.

Analysis of the candidate' responses show that, the ones who performed well managed to explain the effects of poaching and deforestation on the flow of energy in the ecosystem and describe biotic factors which affect population distribution. The correct responses given by these candidates

suggest that they had enough knowledge of the topic *Ecology*. A sample of a good response is given in Extract 16.1.

7. (a) i) Poaching

Poaching involves hunting and killing of the animals in a given ecosystem by different purposes like food and business illegally. During the process many animals are killed.

-Killing of these animals prevents the flow of energy among the consumers as a result an unbalanced ecosystem emmerges which leads to it's collapse.

For example if is pp primary pr consumers are extensively killed the amount of energy flowing from producers to the secondary consumers up to decomposers will decrease hence most of them will die due to absence of food, the thing which will lead into death of producers too due to lack of nutrients, CO_2 and manure.

7. (a) ii) Deforestation

All of the energy we use in this earth is derived from the sun. Plants which are primary producers use it to Converts it into Chemical energy which can be accessed by other ~~or~~ organisms too. Hence without plants there is no energy to make life

7. (a) possible on earth.

Deforestation involves cutting down trees and destruction of plants. In a given ecosystem this will hinder flow of energy from the sun to other organisms hence some will migrate which most of them will die.

7. (b) Population distribution is the dispersal of the members of a certain specie over a given area. Population distribution is not uniform, thus there are factors which describes the pattern of population distribution.

The following are the basic factors which affect population distribution:

Predation. This being a biological relation among organisms were whereby some organism hunt and eat others (preys). This relation affect population distribution because areas with high predation levels will be less populated while those with low predation levels will be highly populated.

Competition over natural resources. When resources are limited in a given area there emmerge competition among organisms of the same specie or different specie during the competition weak competitors will be selected out living the strong ones. Hence areas with stiff competition will be less populated while areas with apparent competition will be more populated.

Parasitism. This is the close association between organisms where one organism benefits from the relation and another one is harmed. Parasites makes their hosts suffer and may

7. (b) even lead to the death of their hosts. As a result places with alot of parasites will be sparsely populated while places without parasites will be highly populated.

Mutualism. This is the feeding relationship whereby two organisms benefits from the relationship, for example lichens which is the association between algae and fungi. Mutualism creates a stable ecosystem and reduces competition in a given area hence mutualism increases population in a given area.

Migration. This is the movement of organisms from one place to the other. Migration causes uneven distribution of the population since most organisms move/migrate to areas which are favourable ... from those which are unfavourable. However migration process is dynamic. Usually organisms keep on migrating inspite of dwelling on the same place.

Availability of primary producers (photosynthetic plants). Primary produces converts non-usable light energy into usable chemical energy which can be accessed by other living organisms. Therefore places with many plants are evenly populated than places which lacks primary producess like deserts.

Extract 17.1: A sample of the candidate's good responses in question 7

Extract 17.1 indicates a part of a response from a candidate who explained correctly the effect of poaching and deforestation to the flow of energy in the ecosystem and described correctly the biotic factors which affect population distribution such as predation.

Despite the good performance in this question, some candidates showed insufficiency of knowledge of the topic *Ecology* as they failed to give the meaning of the terms poaching and deforestation. For example, one candidate defined poaching as *the process of keeping bees for earning honey, when you keep bee you can get energy from the honey*; *is the process of conserving the environment by planting trees and lot of grasses.*

As a result the candidate failed to explain the contribution of poaching to the flow of energy in the ecosystem. In part (b) some candidates failed to understand the demand of the question as they described the factors affecting abiotic instead of the factors affecting population distribution such as; *wind, soil, temperature, water, humidity, air, relief, rainfall, oxygen, death* and *light.* Others described some social factors such as *sufficient food materials in the area, presence of good security, presence of social services, spread of diseases, presence of vegetation, presence of micro-organism, death of people* and *lack of employment.* Extract 17.2 shows a sample of incorrect response.

7 a) i Poaching
This is the process of catching the organism, This help the human being to obtain the energy ~~by~~ eating them this is because the energy from the sun is converted to chemic al substance in the plant by the proces of the photosynthesis and this energy ~~transfed~~ transfered to harbevores when obtain nutrients from the plant leaves then the energy flow to the human when eat the harbevores but ~~to~~ not the constant amount of energy is transported from the sun to human being but there is certain factors which the some of energy to be losted from one organism to another, examples of that factors are:
- some energy used to excrete the waste product from the organism.
- some of it are used in metabolic activities.

ii) Deforestation: This cause the production low amount of energy from The sun to the human beings. due to destroying the enviroter of converting the light energy into the Chemical energy that can be

7a)	used by the herbivore and human being	
7b)	The seven biotic factors which affect population distribution are as follows	
	• Competition : Due to the availability of the resource when is low the organism in the same or diffrent species tend to compete to obtain food.	
	• Reproduction : This lead the organism to migrate one community to another for the aim of mating to produce off spring and lead increase in the number of population.	
	• Immigration : This cause the increase in the population when certain organism migrate from one community to another	
	• Death rate : Due to certain organism to die tend to affect the population distribution and the decrease on population size.	
	• Birth rate : This lead numbers of organism in certain species to increase	
	• Emmigration : This cause the certain population community to decrease when numbers of species emigrate to another community	

Extract 17.2: A sample of the candidate's poor responses in question 7

In Extract 17.2 the candidate gave incorrect responses. He/she described the factors that affect population size such as reproduction; instead of biotic factors affecting population distribution like predation.

2.2.8 Question 8: Evolution

The question had two parts (a) and (b). In part (a), the candidates were required to enumerate six essential features of natural selection as put forward by Charles Darwin. In part (b) they were required to describe how geographical, reproductive and genetic isolations bring about speciation.

The data indicate that a total of 14,052 candidates, equivalent to 50.1 percent, chose the question. Out of these; 56.8 percent scored marks ranging from 7 to 12; 30 percent scored from 0 to 6.5; and 13.2 percent scored from 11.5 to 20 marks. The data are summarized in Figure 18.

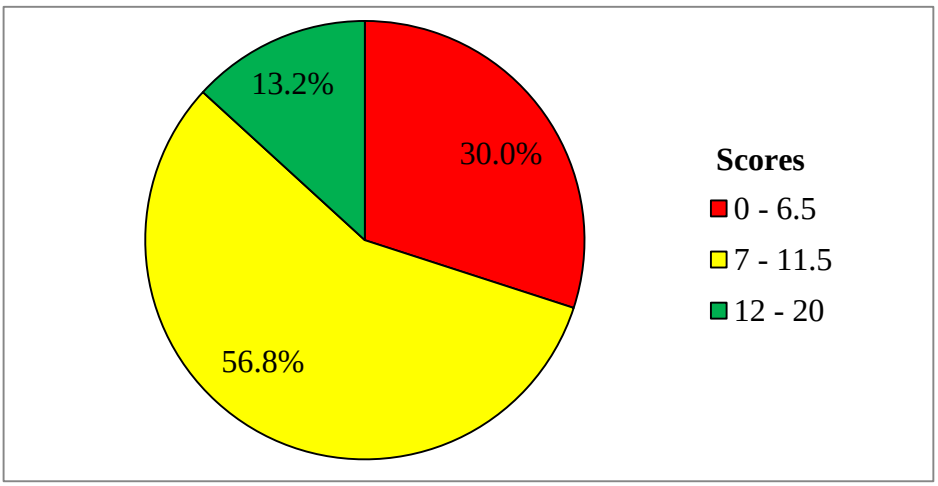


Figure 18: *Distribution of candidates' scores in question* 8

The analysis of responses from candidates' scripts indicated that some of candidates who scored above the average (11 to 20) marks were able to enumerate correctly the features of natural selection as put forward by Charles Darwin in part (a). In part (b) the candidates were able to describe how geographical, reproduction and genetic isolations lead to the formation of species. The high performance of these candidates was attributed by enough knowledge of the topic *Evolution* and clear understanding of the demand of the question. Extract 18.1 shows the sample of this response.

8(a) Charles Darwin was a scientist who travelled from south America to various parts of the world to make research and through his research he ended up making the following features and observation about natural selection. Charles Darwin postulated that

There is Overproduction. Charles Darwin states that there is overproduction of offsprings within members of ~~am~~ the population. He postulated that individuals tend to reproduce more offsprings than the environment can support or than those required to replace them

Constancy within a population. Darwin stated that although there is overproduction the population size still remains constant.

Struggle for existence - Darwin presumed that what caused constancy of a population despite the overproduction was struggle or competition among members of the population. Competition can be of food, shelter, place or mating and so those who are best adapted survive while those who are less adapted (weak) perish thats why there is a constant population size.

Universal occurance of variation

8(a) Darwin presumed that in every population there is variation and variation is brought about when the organisms try to adapt to their their enviroments

Survival of the fittest. Darwin then presumed that when there is limited resources in the population those which posses more strong adaptation survive while those with weak adaptations will be selected out of the population so these strongly adapted organisms tend to grow to maturity and reproduce new offsprings which also posses the strong or desired adaptations.

Natural selection. Darwin stated that the environment itself tend to choose those which are best fit to live in it and selects out those who are weak to survive in it hence evolution of species which are well adapted to survive in that environment.

Hence the above points are the features of natural selection according to Charles Darwin

8(b) Speciation is the process whereby new species arise from pre existing ones. Speciation can be parapatric, Allopatric or Sympatric.

Geographical Isolation This is the type of isolation whereby organisms are separated by physical barriers such as lakes rivers or mountains and hence resulting to two populations of the same species found in different geographical locations. Those species which are found in one geographical location tend to adapt to the new environment hence formation of the new features which may lead to evolution of new species and hence speciation

Reproductive Isolation - This is the condition whereby species may be found on the same geographical location but develop features which make them fail to mate and reproduce new offsprings. This can be due to change in the sex organs or gametes making them unable to interbreed and produce new fertile offsprings. These organisms will then undergo evolution separately and lead to the formation of new species within a course of time and hence speciation.

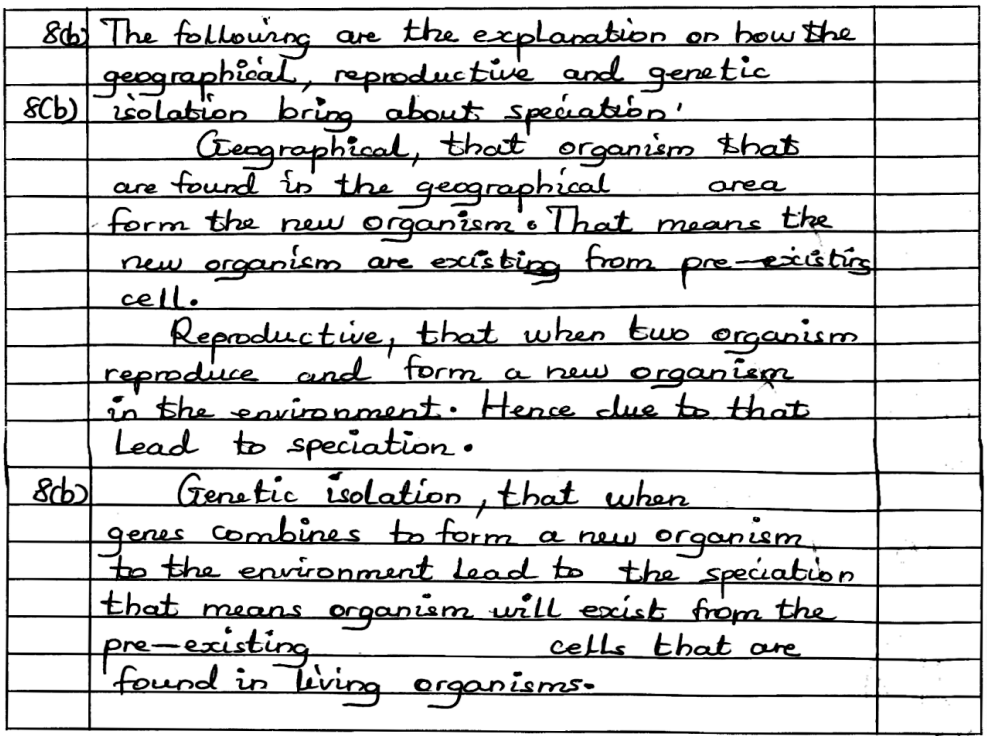
Genetic Isolation - This is the isolation due to the change in genetic make up of individuals in a population resulting into them being unable to mate and produce fertile offsprings hence leading to these organisms to change and evolute each one on its own and hence leading to the formation of new species hence speciation

8(b)

Extract 18.1: A sample of the candidate's good responses in question 8

In Extract 18.1 the candidate correctly wrote the features of natural selection as put forward by Charles Darwin. Likewise, he/she correctly described the contribution of geographical, reproduction and genetic isolations on the formation of species.

On the other side, the analysis of candidates' responses showed that, other candidates failed to adhere to the demand of the question, hence they responded on essential features of Darwin theory by writing concepts of the Lamark's theory. For example one candidate wrote features such as *long neck and legs of giraffe, webbed leg of the duck, flat and slim body of fish, lack of fly to flightless birds, slim body of the snake* and *variation,* all of which base on Lamarck's theory of evolution. Similarly, they failed to describe how geographical isolation, reproductive isolation and genetic isolation contributed to the formation of species. One of such candidates wrote, *geographical isolation contribute by seasonal isolation, ecological isolation and behavioural isolation; organism that are found in the geographical area* all of which are factors leading to speciation. The other wrote *reproductive isolation contribute by hybrid breakdown and genetic isolation.* Extract 18.2 shows the sample of incorrect response.


8(b) The following are the explanation on how the geographical, reproductive and genetic
8(b) isolation bring about speciation:
Geographical, that organism that are found in the geographical area form the new organism. That means the new organism are existing from pre-existing cell.
Reproductive, that when two organism reproduce and form a new organism in the environment. Hence due to that Lead to speciation.
8(b) Genetic isolation, that when genes combines to form a new organism to the environment lead to the speciation that means organism will exist from the pre-existing cells that are found in living organisms.

Extract 18.2: A sample of the candidate's poor responses in question 8

Extract 18.2 shows a part of response from a candidate who gave the meaning of geographical, reproductive and genetic isolations but did not explain how the isolations lead to the formation of species. These responses imply that the candidate had inadequate knowledge on this question.

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH TOPIC

The analysis of the candidates' performance in different topics indicates that 8 out of 12 topics, which were tested in Biology paper one and two, had good performance. 1 topic had average performance while 3 had weak performance. The topics that had good performances are: *Principles of Classification* (95.1%), *Comparative Studies of Natural Groups of Organisms* (93.5%), *Regulation/Homeostasis* (91.5%), *Genetics* (75.05%), *Evolution* (70%), *Growth and Development* (68.6%), *Coordination* (66.15%), *Cytology (65.15%).* The topic that had an average performance was *Ecology* (57.1%) whereas *Nutrition*, *Reproduction* and *Transportation* had weak performances of 33.9, 30.4 and 25.5 percent, respectively.

Appendix 1 summarizes the candidates' performance in different topics in the 2019. Appendix 2 compares the performances between the year 2018 and 2019.

4.0 CONCLUSION

The analysis of the statistics in this report shows that the performance of the candidates in Biology ACSEE 2019 was generally good, as 96.12 percent passed the examination. The analysis of candidates' response also showed that the good performance was caused by factors such as the candidates' good competence in most topics, good drawing skills and mastery of English language which helped them to express their responses clearly.

Despite the good performance observed, the analysis shows that 3.88 percent of the candidates scored below the pass mark. The majority of the candidates provided fewer responses than the required and others their responses lacked details that could have attracted full marks.

Factors thought to have contributed to the candidates' weak performance include:

(a) candidates' scanty or lack of competencies in some Biology topics (especially the topics Nutrition, Reproduction and Transportation) in the ACSEE syllabus, making them to write fewer points than expected, undetailed information or incorrect responses. This might be due to:

(i) failure of some teachers to use charts, diagrams and models in teaching the topic of *Nutrition*, *Reproduction* and *Transportation* which show low performance in order to enhance students' understanding.

(ii) poor concentration while revising; leading to the failure to internalise the subject matter;

(iii) lack of self-evaluation through quizzes, tests and examinations to enable them to do self-rectification in areas which they have learning weaknesses;

(iv) the tendency of students' to cram, instead of comprehending the content matter of the subject.

(b) failure of the candidates to read questions carefully and understand their demand before attempting them;

(c) little drawing skills caused by the lack of drawing practices;

(d) poor English language proficiency causing some candidates to write sentences which are grammatically incorrect. Thus, distorting the intended meaning of some sentences.

5.0 RECOMMENDATIONS

According to the information from this analysis of the candidates' performance, the following recommendations are put forward in order to ensure that candidates acquire enough competencies to pass the examination.

(a) Teachers should ensure that they use charts, diagrams and models in teaching the topics of *Nutrition*, *Reproduction* and *Transportation* which show low performance in order to enhance students' understanding.

(b) Candidates need to do a good number of peer study/review, quizzes, and homework and school examinations in order to master the subject contents.

(c) Candidates need to devote more time to their studies to be able to internalize the subject content.

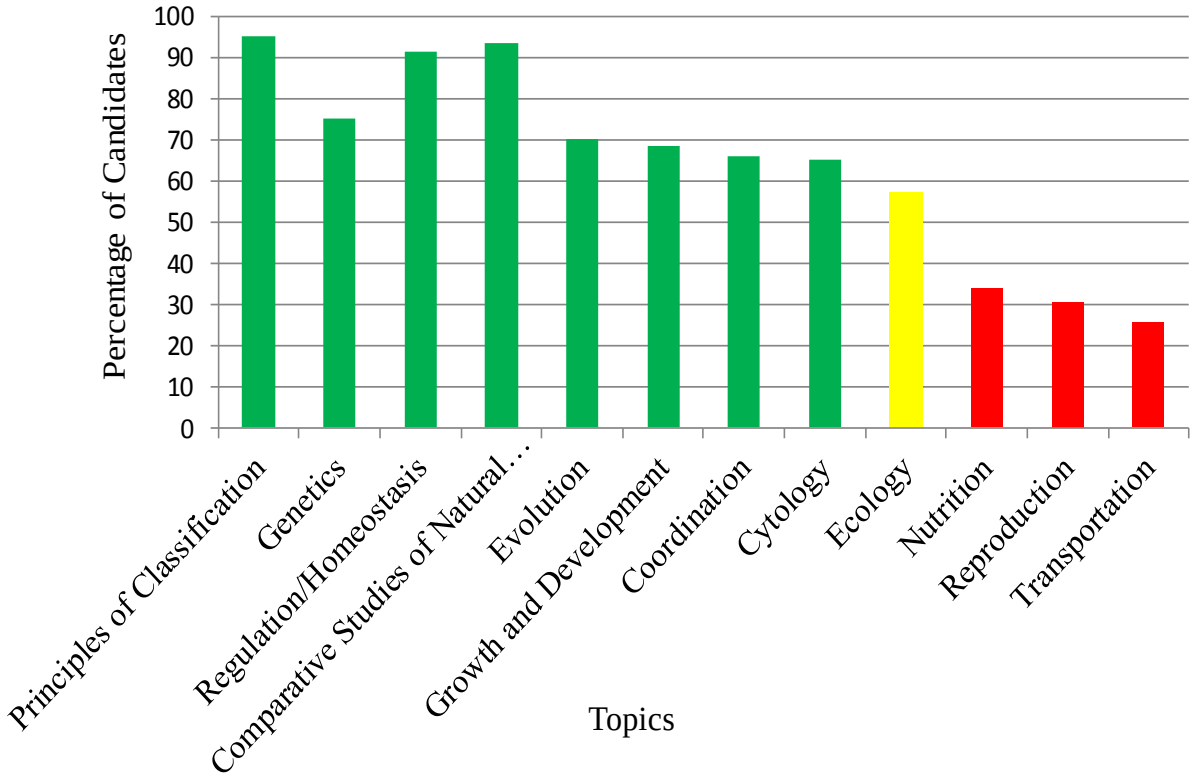
(d) Candidates need to read questions between the lines, to ensure that they clearly comprehend the requirement of each question before attempting them.

(e) Candidates need to exercise writing words which seem to be difficult in order to gain expertise in spelling.

(f) Candidates need to practice drawing diagrams in order to develop their drawing ability.

Appendix A

The Candidates' Performance in 2019 ACSEE by Topic



Appendix B

Comparison of the Candidates' Performance in 133 Biology ACSEE between 2018 and 2019 by topic

S/N	Topic	2018		2019		
		No of Question	Percentage of Candidates who Scored an Average of 35 Percent or Above	No of Question	Percentage of Candidates who Scored an Average of 35 Percent or Above	Remarks
1.	Principles of Classification	1	95.2	1	95.1	Good
2.	Regulation/Homeostasis	1	87.5	1	91.5	Good
3.	Comparative Studies of Natural Groups of Organisms	2	81.9	2	93.5	Good
4.	Genetics	2	88.7	2	75.1	Good
5.	Evolution	1	78.4	1	70	Good
6.	Growth and Development	1	77.3	1	68.6	Good
7.	Coordination	1	72.1	2	66.2	Good
8.	Cytology	3	68.5	2	65.2	Good
9.	Ecology	1	8.1	1	57.1	Average
10.	Nutrition	1	65.4	2	33.9	Poor
11.	Reproduction	1	41.9	2	30.4	Poor
12.	Transportation	1	23.8	1	25.5	Poor