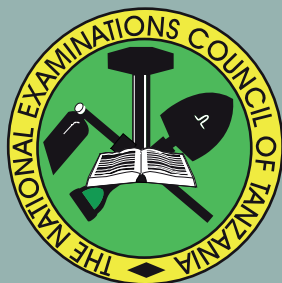


THE NATIONAL EXAMINATIONS COUNCIL OF TANZANIA



**CANDIDATES' ITEMS RESPONSE ANALYSIS REPORT
FOR THE ADVANCED CERTIFICATE OF SECONDARY
EDUCATION EXAMINATION (ACSEE) 2017**

133 BIOLOGY

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FOREWORD

The Report on Analysis of Candidates' Items Response in Biology subject in the Advanced Certificate of Secondary Education Examination (ACSEE) 2017 has been prepared and issued in order to provide a feedback to the candidates, teachers, parents, policy makers and the public in general, on the performance of the candidates.

The Advanced Certificate of Secondary Education Examination marks the end of two years of the advanced level of secondary education. It is a summative evaluation, which among other things shows the effectiveness of the education system in general and the educational delivery system in particular. Principally, the candidates' response to the examination questions is a strong indicator of what the educational system was able or unable to offer to the candidates in their two years of advanced secondary education.

The analysis presented in this report entails an understanding of some of the reasons behind the performance of the candidates in Biology subject. The report pinpoints some of the factors that made most of the candidates to score high marks in the questions. Such factors include adequate Biology content knowledge, good understanding of question demand and good drawing skills. The report also highlights the factors which made a few of the candidates to score low marks. These include inadequate Biology content knowledge, failure to comprehend requirement of the question, unclear explanation and description and poor drawing skills. It is expected that the feedback issued herein will enable the education administrators, school managers, teachers and candidates to identify appropriate measures to be taken in order to continue to improve the candidates' performance in future examinations administered by the Council.

The National Examinations Council of Tanzania welcomes and highly appreciates constructive and genuine comments and suggestions from teachers, candidates and the public in general, which can be used for improving future reports.

Finally, the Council would like to express sincere appreciation to Biology subject Examination Officers, Examiners and all who participated in the preparation of this report.



Dr. Charles E. Msonde
EXECUTIVE SECRETARY

1.0 INTRODUCTION

The analysis in this report is focused on Biology Advanced Certificate of Secondary Education Examination (ACSEE), 2017 which was done by 24,053 school candidates.

The analysis is based on two papers namely 133/1 Biology 1 and 133/2 Biology 2. The questions in all papers intended to measure candidates' theoretical competences on the contents stipulated in the 2009 Biology syllabus and were set as per 2015 examination format.

Paper 1 contained ten (10) questions classified into section A and section B. Section A had seven (7) compulsory short answer questions, each carrying 10 marks. On the other hand, section B consisted of three (3) essay type questions, each carrying 15 marks and the candidates were required to attempt only two (2) questions.

Paper 2 had eight (8) essay type questions presented into four sections, namely A, B, C and D. The candidates were required to answer five (5) questions in this paper by choosing at least one (1) question from each section. Each question carried 20 marks. The analysis of the examination results shows that the general performance in Biology was good as out of 24,055 candidates who sat for the examination, 95.06 percent passed. This result shows an increase of 1.65 percent when compared to ACSEE 2016.

Analysis of the candidates' performance in each question is shown in the next section of the report. The performance in each question is ranked as weak, average or good if the percentage of the candidates who scored 35 percent or more of the marks allocated to the question lies in the range 0 – 34, 35 – 59 or 60 – 100, respectively. The section also determines some possible reasons for observed performance of the candidates in each question. In addition, some candidates' responses have been extracted and used to express the candidates' good and weak responses in each question. It is expected that this report will offer a valuable feedback to all educational stakeholders through highlighting the areas where the candidates experienced learning difficulties so that they can rectify the situation for more success in the teaching-learning process, hence achieving best candidates' performance in the subject.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE PER QUESTION

2.1 133/1-BIOLOGY 1

2.1.1 Question 1: Cytology

In part (a), the candidates were required to study figure 1 below:

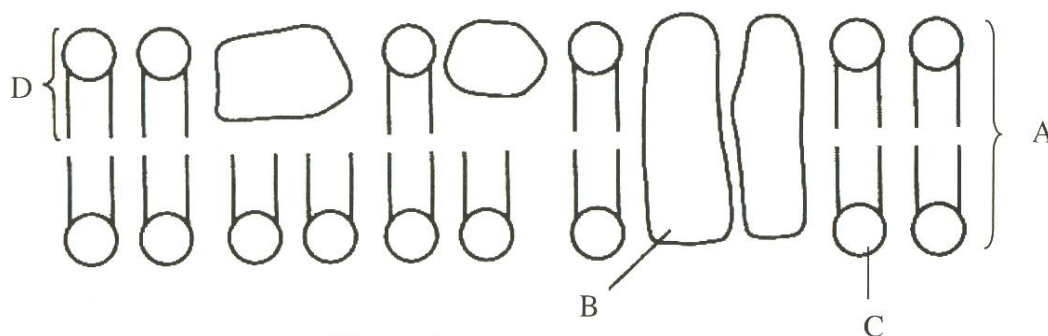


Figure 1

Then, they were asked to (i) state what does the figure represent, (ii) identify the parts labeled A, B, C and D, and (iii) state four functions of the structure labeled by letter B. In part (b), they were required to describe three functions of microtubules.

Analysis of the candidates' performance shows that out of 24,053 candidates who attempted this question, 24.8 percent scored from 6 - 10 and 35.6 percent scored from 3.5 - 5.5 marks out of 10 marks allocated to this question. However, 39.6 percent scored from 0 - 3 marks as depicted in Figure 1.

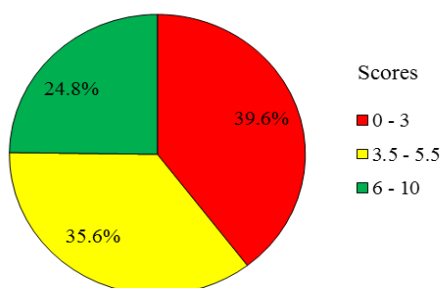


Figure 1: summarises candidates' performance in question 1.

From the data presented in figure 1, it can be deduced that the candidates' general performance in this question was good as 60.4 percent passed the question. The candidates who scored high marks accurately stated what figure 1 represents and correctly identified the parts labeled A, B, C and D. They also correctly stated the functions of the structure labeled B. This indicates that the candidates had enough knowledge about the structure of cell membrane. Moreover, in part (b), the

candidates correctly described the functions of microtubules. Extract 1.1 shows a sample of good responses from one of the candidates.

Extract 1.1

1 (a)	The fluid mosaic model of the cell membrane.	
ii	A - Phospholipid bilayer	
	B - Protein molecule	
	C - Polar head of Phospholipid	
	D - Phospholipid layer	
iii	- It acts as a channel through which non polar molecules are able to pass in and out of the cell.	
	- In some cells they serve as enzymes such as in epithelial cells of the microvilli in the small intestine	
	- They act as receptor sites for attachment of specific molecules	
	- They combine with glucose Carbohydrate molecules to form glycoproteins that are essential in cell to cell recognition for tissue formation.	
(b)	Functions of microtubules	
	- They are useful in spindle formation during cell division in animals	
	- They give mechanical strength and support to the cell and give the cell its structure.	
	They are useful in formation of flagella for movement in some cells such as sperms	

Extract 1.1 shows a sample of good responses from the candidate who correctly identified all the labelled parts in figure 1 and managed to state the functions of structure B. Furthermore, the candidate well described the functions of microtubules.

On the other hand, the candidates who scored 3.5 - 5.5 marks either stated less than the required four functions of the structure labeled B or described less than three functions of microtubules which led them to get less marks than expected.

Although the general performance in this question was good, further analysis reveals that 39.6 percent of the candidates had poor performance. The candidates either failed to give correct answers to some or all parts of the question. For

example in part (a), some of the candidates incorrectly identified figure 1 as; *mosaic fluid analysis, Daniel – Davson model and fluid mosaic theory*. Likewise, the labelled part A was incorrectly named as *protein channel, lipid bilayer and bimolecular layer of lipids* instead of phospholipid bilayer; B as *cell membrane, carbohydrates and lipid* instead of protein molecule; C as *lipid droplet node, protein and lipid* instead of polar head of phospholipid whereas D was labelled as *single layer of membrane, lipid molecular layer and protein* instead of phospholipid layer.

In addition, some candidates wrongly stated the functions of the structure labelled B as *it prevent cell from bursting, it shows that the membrane is not static but dynamic, it protects the cell membrane, it helps to repair the body of living organisms and it helps to build up the body of living organisms*. These responses indicate that the candidates had inadequate knowledge in Cytology, particularly the structure of the cell membrane.

In part (b), some of the candidates not only had inadequate knowledge on the topic of Cytology but also failed to comprehend the meaning of microtubules. This was signified by incorrect responses they provided for the functions of microtubules. For example some wrote; *acts as a storage organs, help in the excretion of waste products in the cell, detoxification of the harmful substances and synthesis of protein*. Extract 1.2 illustrates a sample of the candidates' weak responses.

Extract 1.2

Q1.	(a) i/ In figure one (1), The structure that is presented	
	is PHOSPHOLIPID BILAYER.	
	ii/ Identification of Labelled Parts	
	A - phospholipid bilayer	
	B - Separating layer	
	C - A head or Hydrophobic (water loving)	
	D - A single phospholipid contain a head	
	and a tail	

Extract 1.2 continue

	iii/ Function of structure labelled B.	
	- Helps in the arrangement of phospholipids in the cell concern	
	- Acts as a Permeable Membrane to the bilayer phospholipids.	
	- Since the phospholipid bilayer contains lipids and proteins hence structure labelled B is not continuous	
	(b) Function of Microtubules	
	- They are small in size that helps in diffusion of Materials. Microtubule has got small size that enable it to diffuse easily Materials.	
	- They are narrow for easy transportation of the Materials. Microtubule are narrow that their size and shape determine the narrowness of it. Then helps in transportation of Materials within Microtubules	
	- Have smaller number of electron that helps to occupy a larger surface area	

Extract 1.2 shows a sample of weak responses from a candidate who had inadequate knowledge in Cytology. He/she incorrectly identified figure 1 as *phospholipid bilayer* and gave incorrect names for the parts labelled B, C and D. He/she wrote incorrect functions of protein molecule and that of microtubules.

2.1.2 Question 2: Cytology

In part (a), the candidates were required to analyse the differences between cyanobacteria and yeast cells based on the following criteria: (i) cell division, (ii) respiration, (iii) photosynthesis and (iv) protein synthesis. In part (b), they were required to enumerate five similarities between mitochondria and chloroplast.

The analysis shows that 24,053 (100%) candidates attempted this question, out of which 34.9 percent scored from 6 - 10 marks, 39.8 percent scored from 3.5 - 5.5 marks, whereas 25.3 percent scored from 0 - 3 marks out of the 10 marks allocated to this question. The performance is summarized in Figure 2.

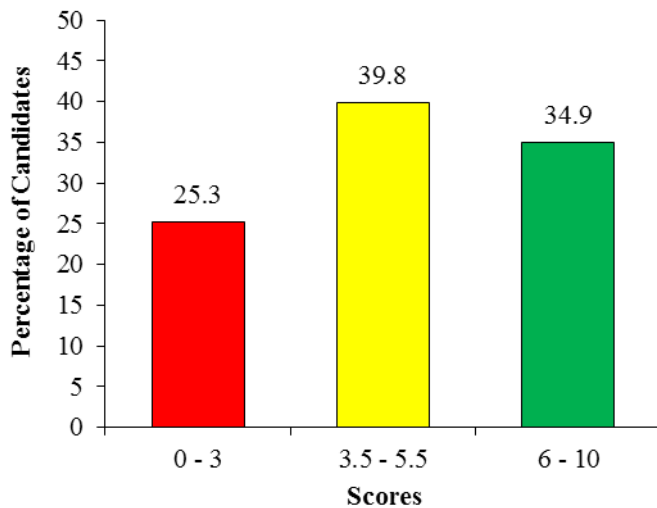


Figure 2: The summary of the candidates' performance in question 2.

Figure 2 indicates that the general performance of the candidates in this question was good as three quarters (74.7%) scored 35 percent and above of the marks allotted to this question. The candidates who performed well were able to correctly analyse the differences between cyanobacteria and yeast cell, and state the similarities between mitochondria and chloroplast. This implies that the candidates had adequate knowledge on the topic of Cytology. Extract 2.1 shows a sample of the candidates' good responses.

Extract 2.1

2a ii)	Differences according to respiration	
	- Respiration in cyanobacteria occurs in mesosomes and other respiratory membranes while respiration in yeast occurs in mitochondria.	
	- Yeast can undergo anaerobic respiration to produce alcoholic fermentation while cyanobacteria rarely undergo anaerobic respiration.	
iii)	Difference according to photosynthesis	
	- Cyanobacteria undergo photosynthesis through photosynthetic membranes that contain photosynthetic pigments while Yeast does not undergo photosynthesis since it has no photosynthetic mem. pigments.	
iv)	Differences according to protein synthesis	
	- Cyanobacteria undergo protein synthesis using smaller 70s ribosomes while Yeast possess 80s ribosome	
	- Yeast have ribosome bounded to endoplasmic reticulum to form Rough endoplasmic reticulum while the ribosomes in cyanobacteria are bounded, non bounded.	
2b)	Similarities of mitochondria and chloroplast	
	i) Both are bounded by a double membrane forming an envelope	
	ii) Both contain smaller 70s ribosomes for protein synthesis	
	iii) Both contain a small piece of circular DNA in their structure	
2biv)	Both contain internal medium compartmentalized from the external cytoplasm i.e stroma for chloroplast and mitochondria contains matrix.	
v)	Both divide independently of other organelles hence act as cells within the cell.	

Extract 2.1 shows that the candidate was able to give the correct differences between cyanobacteria and yeast cells according to the given criteria. He/she also managed to correctly state the similarities between mitochondria and chloroplast.

Most of the candidates who scored 3.5 to 5.5 marks, were able to analyse few differences between cyanobacteria and yeast. They also managed to enumerate two or three similarities between mitochondria and chloroplast.

Conversely, the candidates who showed weak performance (0-3 marks) failed to correctly answer all or most of the parts of the question. For example in part (a), some of the candidates wrote, *yeast undergoes budding as the type of cell division and respiration in cyanobacteria occur in cell wall, cyanobacteria use oxygen for breathing while yeast cell use Carbon dioxide and cyanobacteria are heterotrophs while yeast cell are autotrophs, respiration in cyanobacteria is aerobic respiration while in yeast is anaerobic respiration* as the differences between cyanobacteria and yeast. Others interchanged the differences between cyanobacteria and yeast. These responses imply that those candidates lacked enough knowledge in Cytology, specifically on Cyanobacteria and Yeast.

Likewise, the similarities between mitochondria and chloroplast were incorrectly stated. Some of the incorrect responses observed on candidates' scripts include: *both have cytoplasm for protein, both make plant to manufacture its own food*. Extract 2.2 shows a sample of one of the candidates' weak responses.

Extract 2.2

2.	(a) The differences between cyanobacteria and yeast cell.	
	Cyanobacteria	Yeast Cell
	(i) - Cell division by Binary fusion	(i) - cell division by Mitosis
	(ii) Respiration Buck, lung system	(ii) Respiration Lungs system
	(iii) Photosynthesis plusimid organ	(iii) Photosynthesis have no photo synthesis organ
	(iv) Protein synthesis plusimid	(iv) Protein synthesis cell vacuole
	(b) The Similarities between mitochondria and chloroplast are.	
	- All are organelle in the cell	
	- Both are the site of Respiration process	
	- Both are used as food storage in the body	
	- Both are the source of energy in the body	
	- Both are used in the body as the site of production	

Extract 2.2 shows a sample of responses from a candidate who gave incorrect responses in both parts (a) and (b). For example in part (a) (i), the candidate confused binary fission (division) with binary fusion (union).

2.1.3 Question 3: Cytology

In part (a), the question required the candidates to (i) briefly explain how to test for the protein in a given solution using Biuret test, and (ii) explain the basis of protein test.

In part (b), the candidates were required to explain how the following factors cause protein denaturation: (i) heat, (ii) acid, (iii) alkalis and (iv) mechanical force.

The general performance in this question was poor as out of 24,053 candidates who attempted this question, the majority (74.4%) scored a zero mark and 20.2 percent scored from 1 - 3 out of 10 marks. The candidates who scored from 3.5 - 5.5 marks were 4.7 percent and a few (0.7%) scored from 6 - 10 marks out of the 10 marks. The performance of candidates in this question is displayed in Figure 3.

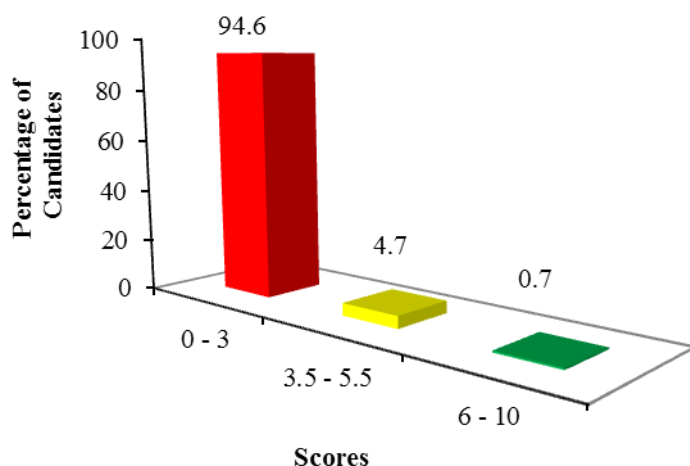


Figure 3: Illustrates the candidates' performance in question 3.

The data from Figure 3 show that the majority (94.6%) of the candidates failed to correctly respond to the question and obtained lower (0-3) marks. Most of the candidates in this category failed to recall the term Biuret test. Some of the candidates regarded Biuret test as one of the reagent used to test protein instead of the method. For example, one of the candidates wrote, *2cm³ of solution sample is taken into a clean and dry test tube followed by addition of few drops of Biuret solution and then boiled.* Equally, this implies that the candidates lacked knowledge on the procedure of testing protein in the food sample. For example some candidates wrote, *2mls of solution was put in a test tube, 1ml of sodium hydroxide was added in test tube followed by drop wise addition of copper (II) sulphate and the mixture was shaken well. Equal amount of sudan III were added in a test tube contain a sample solution.* These responses indicate that the candidates failed to recognise that Biuret test makes use of sodium hydroxide solution and copper II sulphate solution.

The candidates failed also to comprehend the reaction which takes place during protein test in the presence of copper II sulphate, consequently they wrote an

incorrect responses which suggest guess work. For example, some of the incorrect responses observed in candidates script were such as: *the basis of protein test is appearance of violet/purple colouration, the basis of protein test is copper sulphate and NaOH, the basis of protein is amino acids, the purple color formed is due to the reduction of copper (II) ions into copper (I) ions.*

Similarly in part (b), the candidates faced difficulties to explain how heat, acid, alkalis and mechanical force cause protein denaturation. For example, some of the candidates wrote: *mechanical force means the higher the mechanical force can cause the protein to lose their three dimensions so it can be the cause of protein denatured, acid increase pH which is greater than 7 (neutral) and protein bond are affected by pH change since acid withdraw the H^+ ions from the protein and denature its structure.* These responses show that the candidates were not familiar with the procedures of testing protein using Biuret test, indicating students' less skills for doing practicals. Extract 3.1 is a sample of weak responses from one of the candidates.

Extract 3.1

3	a) i) 2cm ³ of a solution was taken into a test tube followed by equal amount of Sudan III then the mixture was boiled.	
	ii) To obtain Violet colour which could be detected from food solution.	
	b) i) Heat Protein molecules needs optimum heat in order to avoid denaturation but when protein is denatured it is due excess amount of heat has provided which will lead to a protein to be denatured.	
	ii) Acid When acid is in excess in the protein molecule will be denatured because the excess amount of acid cause the protein to be denatured so protein needs optimum acid to be not denatured.	
	iii) Alkali When alkalis are more in the protein molecule it will lead to a protein to be denatured therefore for a protein to be not denatured optimum amount of alkalis is required.	
3	b) iv) Mechanical forces When mechanical forces are applied to a protein molecules then the protein molecule will be denatured, so mechanical forces like radiation should not applied to the protein in order to maintain its nature.	

Extract 3.1 shows a sample of weak responses from a candidate who failed to provide correct responses in both parts of the question. In part (a), the candidate wrote wrong procedures in testing for protein as well as the basis for protein test. In part (b), he/she provided incorrect explanation on how protein is denatured by heat, acids, alkali and mechanical force.

On the other hand, most of the candidates who scored average marks (3 - 5), most of them failed to give correct responses in part (a). However, they were able to explain how heat, acid, alkalis and mechanical force cause denaturation of protein. The candidates who scored above 6 marks had adequate knowledge in the topic of Cytology, particularly in biochemistry. They provided correct explanation on how to test for the protein in a given solution using Biuret test and explained well the basis of protein test. They also managed to explain how heat, acids, alkalis and mechanical force cause protein denaturation. Extract 3.2 illustrates this case.

Extract 3.2

3(b).	The Factors for protein denaturation are described as follows:-	
i	Heat, heat denature protein due to the fact that atoms of molecule in protein get energy which make hydrogen bonds to break and leads the protein to be denatured.	
ii	Acid, presence of acid adds H^+ ions which combine with COO^- group to form $COOH$ which are now broken, hence leads to protein denaturation.	
iii	Alkalis, the addition of alkali reduced the NH_3^+ since alkali react with NH_3^+ result to the formation of NH_2 and result to the broken of the bond in protein	
iv.	Mechanical Force, the movement of protein example keratin found in hair lead to protein denaturation since if hair is stretched it reach the extent that the keratin break. hence lead to denaturation of protein	
3(a).i.	To test for protein, first $2cm^3$ of a sample solution was placed in a clean test tube. Add $2cm^3$ of sodium hydroxide, followed by two drops of 1% copper (II) sulphate solution and then the mixture was shaken gently. The presence of protein is indicated when the solution becomes purple in colour but if is not present the solution retain the pale blue colour of copper sulphate solution.	

Extract 3.2 shows the responses of a candidate who was able to correctly explain how to test for protein in a given solution using Biuret test. The candidate was also able to explain the effect of heat, acid, alkalis and mechanical force on denaturation of protein.

2.1.4 Question 4: Coordination

In part (a), the candidates were provided with a Figure 2 below showing a certain stage of synaptic transmission and asked to (i) identify each of the parts labelled T, U, V, W and Z, (ii) name the state of the region shown by letter Y, and (iii) state the role played by structures labeled U and W, respectively.

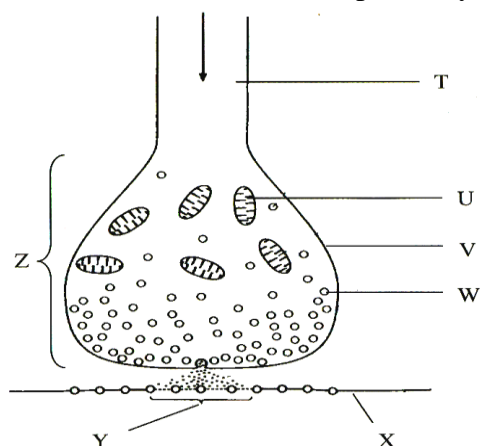


Figure 2

In part (b), the candidates were asked to explain why some impulses arriving at the pre-synaptic membrane fail to produce an action potential in the post synaptic neuron, whereas several impulses arriving in succession can do so.

Statistics indicate that a total of 24,053 candidates attempted this question, of whom 42.5 percent scored from 6 - 10 marks, 39.7 percent scored from 3.5 - 5.5 marks and 17.8 percent scored from 0 - 3 out of the 10 allocated marks. These data are illustrated in Figure 4 below:

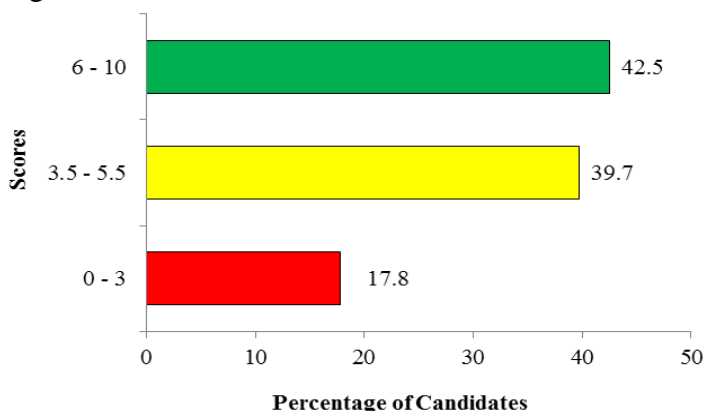


Figure 4 illustration of the candidates' performance in question 4.

The data from Figure 4 show that 42.5 percent of the candidates had good performance in this question. These candidates were able to identify the parts

labelled T, U, V, W, X and Z. They accurately named the state of the region shown by letter Y and the role played by the structure labelled U and W. They were also capable to explain why some impulses arriving at the pre-synaptic membrane fail to produce an action potential in the post synaptic neuron, whereas several impulses arriving in succession can do so. Extract 4.1 shows a sample of good responses from a candidate.

Extract 4.1

4a.	i	T - Axon	
		U - Mitochondrion	
		V - Pre-synaptic membrane.	
		W - synaptic vesicles	
		X - Post-synaptic membrane.	
		Z - synaptic knob	
	ii	State of the region Y is Depolarisation.	

Extract 4.1 continue

	III, Role played by part U.	
	- Provide energy required by the synaptic vesicles during recombination of acetyl and choline from the transmitter substance Acetylcholine.	
	$\text{Acetyl} + \text{Choline} \xrightarrow{\text{ATP}} \text{Acetylcholine}.$	
	Role played by part W.	
	- They contain neurotransmitter substance which is responsible in transfer of impulse. Example of neurotransmitter substance is Acetylcholine (ACh).	
4b.	Several impulse arriving in succession produce an action potential as a result of additive or cumulative effect brought about by each. This is <u>SUMMATION</u> .	
	Summation involves adding up the effect of individual weak impulse to produce an action potential. Weak impulses fail to produce an action potential by being below the threshold frequency. Simultaneous arrival of stimulus impulse is then added to increase strength of the impulse and hence produce an action potential.	

Extract 4.1 is a sample of a good response from a candidate who correctly identified the labelled parts and named the state of the region labelled Y. He/she also stated the roles of parts labelled U and W. He/she gave the correct reason as to why some impulses arriving at the pre-synaptic membrane fail to produce an action potential in the post synaptic neuron.

On the other hand, 39.7 percent of the candidates who scored average marks were able to correctly identify the labelled parts in the Figure 2 and partially managed to state the roles played by structures labelled U and W. However, in part (b) the majority could not give the correct answer.

Further analysis indicates that 17.8 percent of the candidates who had weak performance provided a variety of incorrect labels of the parts in Figure 2. Such responses include, 'T' is the direction of nerve impulse, 'U' is synaptic knob, 'W' is cytoplasm instead of synaptic vesicles, 'X' is synaptic cleft and Z is presynaptic

membrane. In addition, some of the candidates were unable to distinguish presynaptic from post synaptic membrane, consequently they gave incorrect responses in part (b) of the question while others skipped to label some of the parts.

In part (a) (ii), some of the candidates incorrectly mentioned the state of the region labelled by letter Y, as *repolarization state* and *action potential* instead of depolarized state. In part (b), some of the candidates wrote, *because those impulses haven't reach the threshold level enough to propagate the membrane and create an action potential on the post synaptic membrane, because the presynaptic membrane is depolarised and net potential difference is zero*. All these responses indicate that the candidates lacked enough knowledge on the concept of transmission of nerve impulses. Extract 4.2 shows a sample of candidates' poor responses.

Extract 4.2

Q4. (a)	i) T - Incoming impulses (synaptic nerve)	
	U - Synaptic knob	
	V - pre-synaptic membrane	
	W -	
	X - post-synaptic neurone	

04	(a) (i) Z - Synapse.	
	ii) The state of the region shown by letter Y is region where chemical are produced or releasing for transmitting of an impulses.	
	iii) U (Synaptic knob)	
	- They are used for carrying an impulse which are enter in the synapse and produce action potential.	
	W - Synaptic cleft	
	- They are used for producing and releasing of chemical which are used for transmitting of an impulse.	
	(b) This is because - when an impulse arriving at the pre-synaptic membrane it be activated by synaptic knob which produce action potential for an impulse to pass and when it arrive to post-synaptic neurone it fail because there is no yet releasing of action potential and chemical which aid for transmitting impulses within the synapse.	

Extract 4.2 shows the candidate who failed to identify the labelled parts in Figure 2 and wrongly stated the roles of U and W. Also in part (b), the candidate gave wrong reasons as to why some impulses arriving at the pre-synaptic membrane fail to produce an action potential in the post synaptic neuron.

2.1.5 Question 5: Nutrition

Part (a) of the question required the candidates to briefly explain the roles of (i) NADP, (ii) Ribulose diphosphate, and (iii) Photosystem I and II (PSI and PSII) in photosynthesis. In part (b), the candidates were required to explain by giving reasons, the effect of lowering oxygen concentrations on (i) C3 photosynthesis, and (ii) C4 photosynthesis. In part (c), the candidates were asked to explain why the rate of photosynthesis decreases at high temperatures.

Statistics indicate that a total of 24,053 candidates attempted this question, out of which 44.9 percent scored from 6 - 10 marks, 28.1 percent scored from 3.5 - 5.5 marks and 27 percent scored from 0 - 3 marks out of the 10 marks allocated to this question, as summarized in the Figure 5 below.

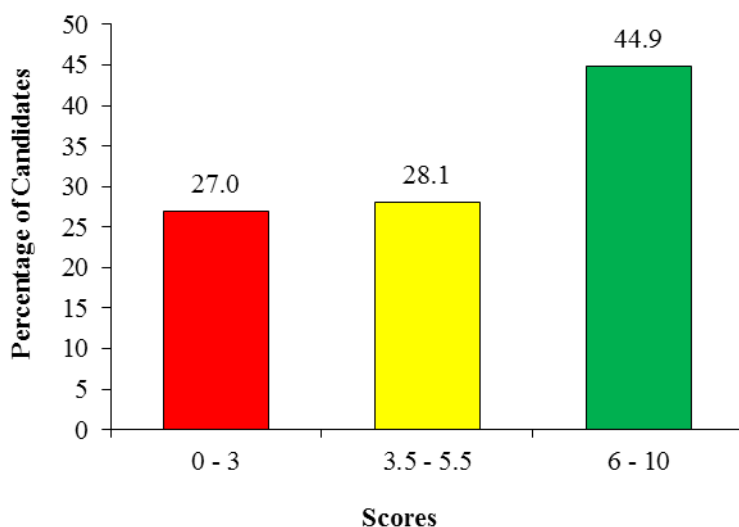


Figure 5: The summary of the candidates' performance in question 5.

Figure 5 shows that a total of 73 percent of the candidates passed this question by scoring from 3.5 and above marks suggesting that the general performance was good. The candidates who performed well were able to correctly explain the roles of NADP, Ribulose diphosphate and Photosystems I and II in photosynthesis. They also gave correct reasons in explaining the effect of lowering oxygen concentration on C3 and C4 photosynthesis. In addition, the candidates provided correct explanation as to why the rate of photosynthesis decreases at high temperature. On the other hand, the candidates who scored average marks managed to explain the roles of NADP, Ribulose diphosphate and Photosystems I and II in photosynthesis. However, their responses, especially on the effects of lowering oxygen to C3 and C4 photosynthesis lacked clarity which made them to lose some marks. Extract 5.1 shows a sample of good responses.

Extract 5.1

5. (i) NADP is an electron acceptor hence hydrogen acceptor, it combine with electron and hydrogen to form NADPH and this NADPH is used as a hydrogen carrier which is used in the dark reaction in photosynthesis for making sugar carbohydrate. Hence NADP is reduced to NADPH for carrying of hydrogen hence electron and hydrogen carrier.

(ii) Ribulose diphosphate act as a carbon dioxide gas acceptor in dark reaction during photosynthesis reaction hence leading to the production of four molecules which are locked in chemical bond as a phosphoglycerate molecule which is a 3C-compound. Therefore, Ribulose diphosphate accept/combine with carbon dioxide hence leading to the resulting of phosphoglyceric acid as the primary intermediate food.

(iii) Both photosystems I and photosystem II (P₇₀₀ and P₆₈₀) help much in the release of electron which act as the means of e^- in photosynthesis process which combine with NADP and hydrogen to form NADPH.

— Also these photosystems act as they absorb sunlight from the sun thus leading to the excitation of electrons to high energy which ~~on~~^{as a} result they involve in energy synthesis when they tend to come to the lower energy level.

<p>(b)(ii) Lowering oxygen concentration on C_4 photosynthesis does not affect C_4 photosynthesis since in C_4 plants there are two cells involved in the fixation of carbon dioxide. It is mesophyll bundle sheath cell and mesophyll cell also there is an enzyme called phosphoenolpyruvate carboxylase (PEPase) which has high affinity to carbon dioxide as the result there will be normal photosynthesis as usual and no effect with oxygen to C_4 photosynthesis will affect.</p>	
<p>(iii) Lowering oxygen concentration on C_3 photosynthesis favours photosynthesis in C_3 plant since in C_3 plant there in their chloroplast there is an enzyme which is Ribulose biphosphate carboxylase (RuBisCo) which has high affinity to oxygen than carbon dioxide as the result when oxygen is lowered in C_3 plant then photosynthesis normal and high yield of photosynthesis will attain since Ribulose biphosphate carboxylase (RuBisCo) will fix carbon dioxide normal and at high rate.</p>	
<p>(c) The rate of photosynthesis decreases at high temperature since at high temperature enzyme which are involved in photosynthesis are denatured by being destroyed their active site for the substrate to bind hence lowering in photosynthesis rate for example Ribulose biphosphate carboxylase and phosphoenolpyruvate carboxylase (PEPase) will be denatured hence carbon dioxide fixation will fail hence lowering in photosynthesis rate.</p>	

Extract 5.1 shows the candidate who correctly explained the roles of NADP, Ribulose diphosphate and Photosystem I and II. He/she managed to explain the effect of lowering Oxygen concentrations on C_3 and C_4 photosynthesis and gave correct reasons to support the decrease of the rate of photosynthesis at high temperatures.

Despite the good performance in this question, some of the candidates scored lower marks (0 - 3) as they gave incorrect responses in almost all of the parts of the question. For example in part (a), such incorrect responses on the role of NADP, Ribulose Diphosphate include; *NADP is involved in carbohydrate formation,*

NADP is used in the photosynthesis during CO₂ in order organism to manufacture their own food, Ribulose biphosphate is used during the carbohydrate. on the role of Photosystem I and II (PSI and PSII) candidates wrote; PSI and PSII is used during nitrogen fixation because the PSI have short wavelength it is same applied to PSII, PSI and PSII are electron carrier during cyclic and non-cyclic photophosphorylation. These responses indicate that the candidates had insufficient knowledge in photosynthesis.

However in part (b), some of the candidates gave incorrect explanation about the effect of lowering oxygen concentration on C3 and C4 photosynthesis. Some of the incorrect explanation observed in candidates' scripts were; *in C3 photosynthesis is more efficient to the oxygen concentration while C4 photosynthesis are less efficient to the oxygen concentration, lowering of oxygen concentration has no effect in C3 photosynthesis because C3 react with PEP which have high efficient to CO₂ than O₂ and lowering of oxygen concentration increase photosynthesis in C4 plant because RuBP carboxylase O₂ and CO₂ compete with it active site which O₂ act as inhibitor.* These responses indicate that the candidates had misconception between C3 and C4 photosynthesis. They were unable to comprehend that C4 photosynthesis is not affected by the concentration of oxygen as C3 does.

Likewise in part (c), some candidates were unable to explain why the rate of photosynthesis decreases at high temperatures, instead they wrote responses like, *because at high temperature the plant can't manufactured their own food there's no evaporation that takes place so due to high temperature it causes the photosynthesis rate to be low.* These incorrect responses generally indicate that the candidates lacked knowledge on photosynthesis. Extract 5.2 shows a sample of weak responses.

Extract 5.2

S	a	
	i/ NADP	
	-	
	ii/ Ribulose diphosphate.	
	- To ensure there is availability of energy, simply because one ribulose diphosphate reacts with phosphate group it produce A.T.P energy so due to that ensure the availability of energy during photosynthesis.	
	iii/ Photosystem I and photosystem II	
	photosynthesis takes place in the light areas so the presence of photosystem I and photosystem II result provision of light to a particular plant's. So the absence of photosystem I and photosystem II result poor photosynthesis or no photosynthesis at all.	
	b	
	ii/ There is no any effect of lowering oxygen concentration in C_3 photosynthesis simply because it has no ability for them to survive in drought areas.	
	iii/ The effect of lowering Oxygen concentration in C_4 photosynthesis it affect all system at all simply because material within C_4 plants are not well manufactured	
S	c	
	The rate of photosynthesis decreases at high-temperature because there are some plants which during high temperature tends to loss more water than to manufacturing of food. So during high temperature the rate of transpiration exceed the rate of photosynthesis hence result materials or food to be manufactured to be low also.	

Extract 5.2 shows a sample of candidates' weak responses. The candidate failed to correctly answer parts (a) and (b) of the question. This indicates that he/she had insufficient knowledge on the topic of Nutrition.

2.1.6 Question 6: Cytology

In part (a), the candidates were required to draw the structure of an animal cell as seen under electron microscope. In part (b), they were required to (i) name a double membrane organelle found in plant cells only and (ii) explain how the organelle is adapted to its role.

A total of 24,053 candidates attempted this question. The candidates' general performance was good since more than half (67.9%) of them scored 6 - 10 marks and 23.0 percent scored 3.5 - 5.5. In addition 9.1 percent scored 0 - 3 out of the 10 marks allocated to this question. Figure 6 below summarizes the candidates' performance in this question.

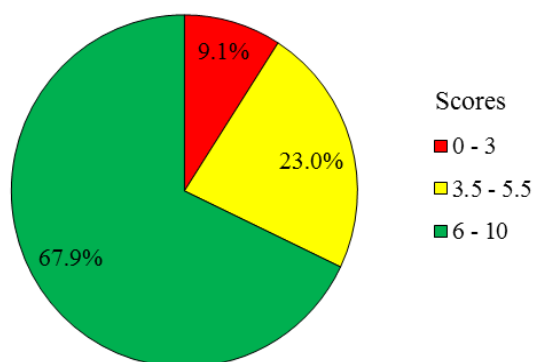
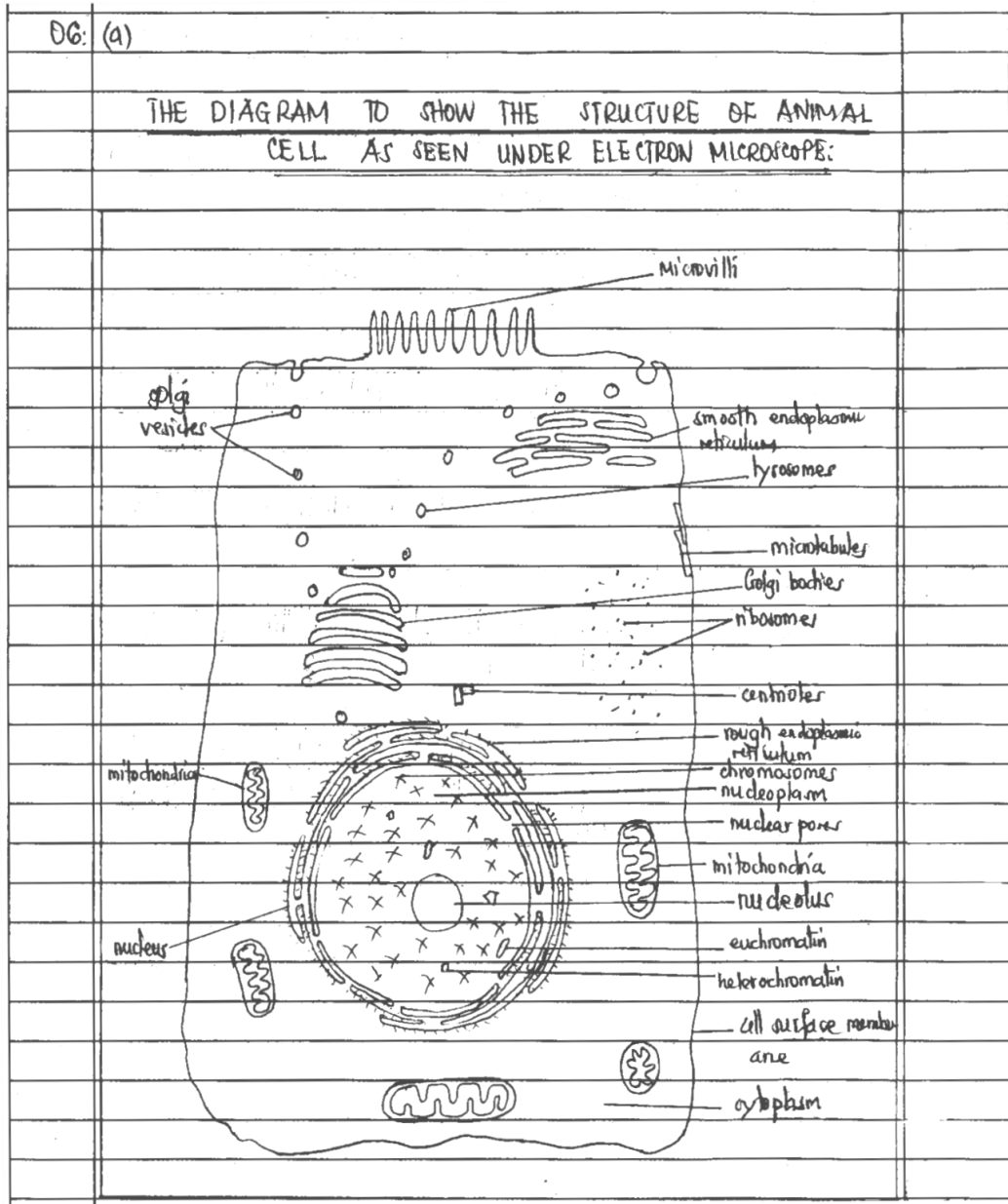


Figure 6: The summary of candidates' performance in question 6.

The candidates who scored high marks had sufficient knowledge on the concept of cell organelles. In part (a), they correctly drew the structure of an animal cell as seen under electron microscope. In part (b), the candidates were able to name the double membrane organelle found in plant cells only and explained how it is adapted to its role. Extract 6.1 shows a sample of good responses from one of the candidates.

Extract 6.1



Extract 6.1 continues

OG:	(b)(i) Double membrane organelle found in plant cells only is the chloroplast.	
	(ii) Its role is photosynthesis	
	The organelle is adapted to its function/role as follows:	
	1: It has a double membrane system which separate its reaction from those of the cytoplasm.	
	2: It has enzymes to facilitate the photosynthesis process. Example RUBISCO.	
	3: It has a stroma which acts as a site of all the chemical reactions of chloroplast.	
	4: It has structures called thylakoid to facilitate absorption of light from the sun.	
	5: It has chlorophyll which is essential requirement for photosynthesis to occur.	
	6: It has starch grains and lipid droplets for the food reserve.	
	7: It has its own DNA molecule which makes it able to self-replication.	
	8: It has ribosomes in its stroma for the synthesis of proteins and enzymes.	
	9: It has carbon dioxide acceptors, the Ribulose biphosphate and Phosphoenol pyruvate to enable the succession of photosynthetic reactions.	

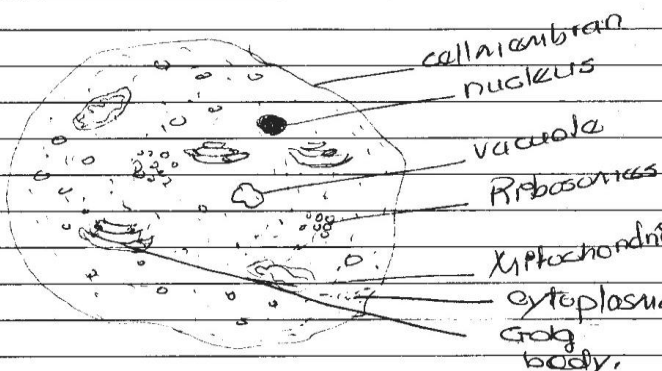
Extract 6.1 shows the candidate who correctly drew the structure of animal cell and named the double membrane organelle found in plant cells only. He/she also explained how the organelle is adapted to its role.

Some of the candidates with an average performance were able to draw the structure of animal cell and labelled some parts. However, they failed to state some of the adaptations of the double membrane organelle found in plant cell only. In addition, some candidates could not write a caption on the diagram of the animal cell.

The data analysis reveal that there were 9.1 percent of the candidates who demonstrated weak performance in this question. It was observed that in part (a) some of these candidates drew poor structures of animal cell while others drew plant cell instead of animal cell. Moreover some of them and others had spelling mistakes for some technical terms, especially in labelling the structures of animal cell. Some of the incorrectly spelt labels include; *endothermic reticulum* instead of endoplasmic reticulum, *geoge vesicles* instead of Golgi vesicles and *gold apparatus* instead of Golgi vesicles. In part (b) (i), some of the candidates failed to identify the double membrane organelle which is found in plant cell only as they wrote mitochondria. Consequently in part (b), (ii) they gave the adaptation of the mitochondria instead of the chloroplast. Some of the adaptations written by these candidates include; *have finger-like projections that is folded to increase its surface area, have matrix which offer best medium for oxidative phosphorylation to occur and have double membrane for the passage of materials in and out of the cell.*

Moreover, some of the candidates did not understand the demand of the question as in part b (i). Instead of explaining the adaptations of the Chloroplast they wrote the roles of chloroplast. They gave responses such as; *chloroplast is responsible in the Oxygen supply, Carbon dioxide utilization and starch synthesis.* These responses indicate that the candidates did not read the question carefully before attempting it. Extract 6.2 illustrates a sample of poor responses from one of the candidates.

Extract 6.2

Q. a)	ANIMAL CELL STRUCTURE	
		
b) (i)	Double membrane organelles	
	<ul style="list-style-type: none"> - Mitochondria - Ribosomes - Golgi body - Chloroplast - Microtubule 	
(ii)	Adaptation of mitochondria	
	<ul style="list-style-type: none"> - Have ribosomes that helps to perform protein production process - The inner membrane is folded to form cristae so as to increase their surface area 	

Extract 6.2 continues

Q b)	- Have matrix work as cytoplasm that helps to a chemical reaction to take place.	
	- Have DNA that helps to control all activity within it.	
	- Have cell wall that have protects the inner part of cell.	
	Adaptation of Golgi body.	
	- Have thin inner so as cell membranes so as to allow easy transportation of material.	
	- Have large surface area for food storage.	
	Adaptation of ribosomes.	
	- Have cell membrane that protects the inner part.	

Extract 6.2 shows the candidate who drew a poor structure of animal cell and misspelt some labels like *golgi body* and *cell membran*. He/she also stated adaptations of several organelles apart from chloroplast.

2.1.7 Question 7: Principles of Classification

In part (a), the question required the candidates to explain the meaning of natural system of classification and in part (b), they were asked to explain why it is difficult to achieve a complete natural system of classification.

A total of 24,052 candidates attempted this question, of which 65.9 percent scored from 6 - 10 marks, 16.5 percent scored from 3.5 - 5.5 marks and 17.6 percent scored from 0 - 3 marks out of the 10 allocated marks. The summary of the candidates' performance in this question is depicted in Figure 7.

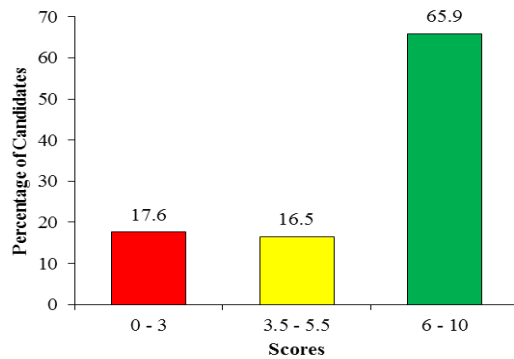


Figure 7: The candidates' performance in question 7.

The data from the figure reveal that the candidates' performance in this question was good as majority (82.4%) scored higher marks. The candidates who scored all 10 marks had enough knowledge in the topic of Principles of Classification, predominantly the concept of natural system of classification. This was revealed by their ability to correctly explain the meaning of natural system of classification and explained why it is difficult to achieve a complete natural system of classification. Extract 7.1 shows a sample of one of the candidates' good responses.

Extract 7.1

Q7:	(a) Natural system of classification is the system of classification in which organisms are classified basing on their true evolutionary relationship, it never use few observable features.	
	(b) It is difficult to achieve complete natural system of classification because;	
	1: Natural system of classification is time consuming process.	
	2: It needs skilled personnel, and biases the unskilled ones.	
	3: It is expensive in terms of cost and equipments.	
	4: It uses true evolutionary relationship which can not be observed externally.	
	5: It is not flexible to allow discovery of new organisms.	
	6: For those unknown organisms, it does not allow their classification easily.	
	7: It requires the history of an organism to trace the ancestral origin of features.	

Extract 7.1 shows the candidate who correctly explained the meaning of natural system of classification and explained why it is difficult to achieve a complete natural system of classification.

Most of the candidates who scored average marks managed to give a correct explanation on the meaning of natural classification in part (a). However in part (b), most of them were able to give not more than three reasons as to why it is difficult to achieve the complete natural system of classification.

Conversely, 17.6 percent of candidates who performed poorly in this question were unable to comprehend the knowledge of Principles of Classification. For example in part (a), some of the candidates failed to explain the meaning of natural system of classification as they wrote incorrect responses, such as; *natural system classification is the type of classification which used to classify organism according to the observable features and it was used by people who are illiterate and it is the system of classification which considers non-observable features only.*

Likewise in part (b), some candidates failed to give reasons as to why it is difficult to achieve a complete natural system of classification. Some of the incorrect responses given by the candidates include; *the system is not common to all organisms, It is challenged by climatic conditions, organisms change their features as time goes due to mutation which is caused by different things in the present world, they classify organism not related genetically, ecologically and evolutionary, they collect few data on the basis of their external features.* These responses prove that the candidates were lacking sufficient knowledge in natural system of classification. Extract 7.2 shows a sample of candidates' poor responses.

Extract 7.2

7	(a) Natural system of classification is the sorting and grouping living organisms due to their observable features.	
	(b) - It is difficult to archive a complete natural system since we at it considers on matter of observable features, Environmental changes tend to affect the living organisms. because, they have to develop or miss some	
7	(b) features and structures in order to adapt with the environment for their survival. These gradual changes cause living organisms to th change their observable features continuously. Therefore some of organisms in the same kingdom or phylum or whatever is might deviate the features made them to be grouped at that taxonomic rank. - It doesn't care on comparative biochemistry of organisms like blood composition of organisms. For instance the horse shoe crab seemed to be in the same group with the normal crab, but their blood composition is different. - It doesn't observe or check on how group of organism due to the phenotypical features are genotypically related. Thus, it is always unrealistic system of classifying organisms.	

In extract 7.2 the candidate had insufficient knowledge on the topic of Principles of Classification. He/she considered mostly the observable features as the main characteristics to consider when classifying organisms under natural system of classification.

2.1.8 Question 8: Transportation

In this question, the candidates were asked to elaborate the main adjustments that occur to the heart rate and circulatory system just before, during and after a 100m race.

The analysis indicates that the question was opted by 11,128 (46.3%) of the candidates out of which, the majority (81.4 %) scored from 0 - 5 marks, 14.9 percent scored from 6 - 8 and 3.7 percent scored from 9 - 15 out of 15 marks allocated to this question. The trend of the performance is depicted in Figure 8.

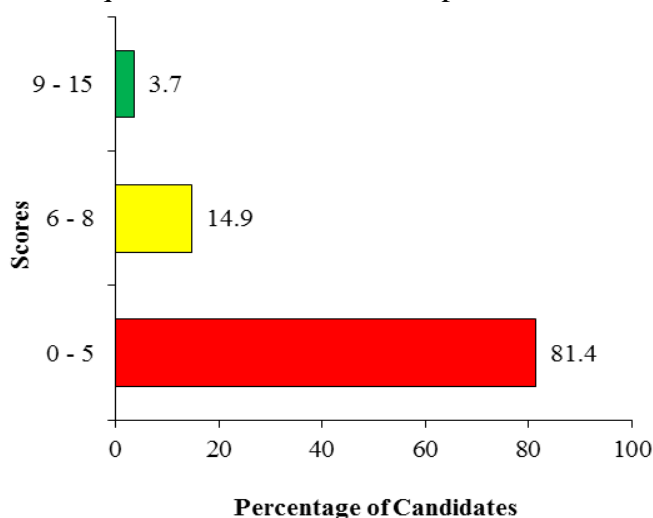


Figure 8: The candidates' performance in question 8.

The data from Figure 8 indicate that the general performance of the candidates was weak in this question as the majority (81.4%) scored lower marks. Most of them were not able to think critically and transfer the knowledge obtained from other topics on the body mechanisms that lead to changes of the heart rate and the circulatory system especially, when the animal is involved in vigorous cardiac activities. Consequently, the responses provided by the most of the candidates lacked clear meaning on the adjustment occurring in the heart rate and the circulatory system before, during and after someone is involved in the 100m race. Examples of such responses given by the candidates were; before the race *the heart rate is in low motion, circulatory system is low due to the resting body does not need more oxygen, slow rate of breathing, the rate of heart pumping of blood to the body is slowly due presence of enough oxygen to the body, the haemoglobin of a person become less affinity to the oxygen gas for different functions.* During the race; *the heart beat will be lowered due to muscles cramp, the cardiac muscles of the heart will contract to allow supply of oxygen to the body.* While after the

race, heart rate increase in motion since an organism need more oxygen, circulatory system also increases the rate of transportation, increase the volume of the lung so that allow oxygen obtained to be stored and used in the blood. These responses imply that candidates' ability to transfer knowledge when responding to questions which need critical thinking is weak.

There were also some candidates who failed to identify the question demand as they wrote the mechanism of breathing, such as, *intercostal muscles relax and contract, change of shape of diaphragm as well as upward and downward movement of ribs*. Other candidates wrote the differences between open and closed blood circulatory system instead of elaborating the adjustments that occur in the heart and circulatory system. Extract 8.1 shows an example of weak responses.

Extract 8.1

8	Closed blood circulation	Open blood circulation
	- More efficient in transporting the blood.	- Less efficient in transport of blood.
	- Blood is pumped twice in the heart	- Blood is pumped once in the heart
	- It is under high pressure	- It is under low pressure
	- Blood is contained into blood vessels	- Blood donot contained into blood vessicle.
	- Blood doesnot come direct into contact with body tissues	- Blood come Direct contact with the body tissues

Extract 8.1 shows a candidate who wrote the differences between closed and open blood circulations instead of elaborating the adjustments that occur in the heart and blood circulatory system during a 100 m race. This candidate did not understand the demand of the question.

Despite the weak performance, there were some candidates who scored average marks. However, their responses on the adjustments occurring in the heart rate and circulatory system before, during and after involving someone in the 100m race lacked clarity which made them to lose some marks. Some of the candidates (3.7%) performed well in this question as they demonstrated their ability to transfer knowledge from other topics and correctly explained the biological mechanisms that lead to adjustments occurring in the heart rate and circulatory

system before, during and after involving someone in the 100m race. Extract 8.2 shows one of the candidates' good responses.

Extract 8.2

2.	Adjustment to the heart rate and circulatory system just before, during and after a 100m race	
	Before the race.	
	Anticipation to the race consequently causes production of adrenaline hormone. Adrenaline hormone cause vasoconstriction of almost all vital organs, due to vasoconstriction of these organs blood pressure consequently increases and there is overall increase in heart rate and the rate of metabolism is increased too.	
	During the race.	
	Due to the increase in rate of metabolism there is a general increase in concentration of (CO_2) this causes vasodilation.	
	However the chemoreceptors found in the aorta triggers the vasomotor to promote vasoconstriction thus generally there is an increase in vasoconstriction and almost complete emptying of the heart vesicles occurs.	
	During the end of the race a man respires anaerobically and consequently there is an increase in lactic acid in the body.	
2.	After the race.	
	After the race oxygen debt is paid off, so as to restore normal level of oxygen receiver in the body, body is returning to normal breathing and heart rate.	

Extract 8.2 shows a candidate who correctly elaborated the main adjustments that occur to the heart rate and circulatory system just before, during and after a 100m race. The candidate's responses show a good mastery of the content knowledge in the topic of Transportation.

2.1.9 Question 9: Reproduction

In part (a), the candidates were required to (i) briefly explain the concept of capacitation as it is related to reproduction, and in (ii) outline two protective roles of mammalian placenta to the foetus. In part (b), the candidates were given the information that “the chromosomes number in a radicle of a certain species of a flowering plant is 16”. They were then required to calculate, by giving reasons, the number of chromosome in (i) pollen tube nucleus, (ii) antipodal cell, (iii) endosperm, (iv) pollen mother cell and, (v) integument cell.

This question was opted by 14,269 (59.3%) of the candidates of whom, more than three quarters (76.3%) scored from 0 to 5 marks, 18.6 percent scored from 5.5 to 8.5 marks and 5.1 percent scored from 9 to 15 marks out of the 15 marks allocated to this question. Figure 9 summarizes the general performance of the candidates in this question.

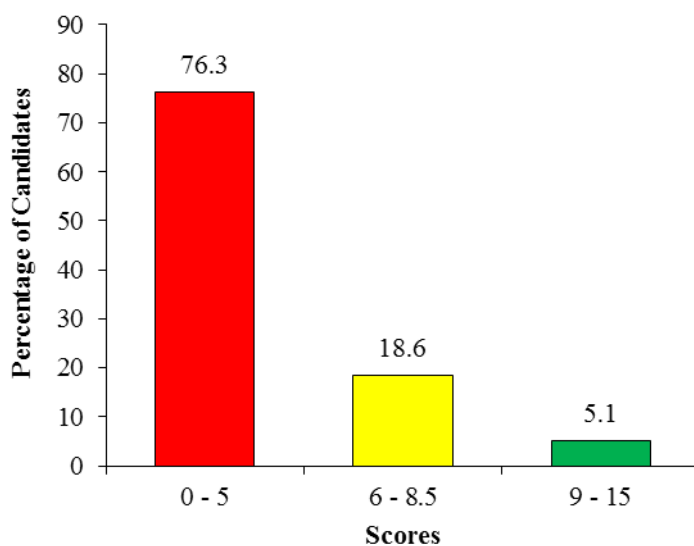


Figure 9: The candidates' general performance in question 9.

The data from Figure 9 reveal that the performance of the candidates was poor as majority (76.3%) scored low marks. The candidates who performed poorly in this question had inadequate knowledge on the topic of Reproduction. Most of them wrote incorrect explanations on the concept of capacitation. For example they wrote, *capacitation is the ability of a sperm release enzymes so as to digest corona radiata, is the maturation of the sperm before released on the reproductive organ of the female, is the male infertility caused by breakage of vas deferentia and immature sperms produced.* Other candidates considered

capacitation as the period in which the sperm gains mechanical energy before it is matured.

Similarly in part (ii); some of the candidates were not able to outline the protective role of placenta as the responses provided signified their poor comprehension of the roles of the placenta. For example the candidates wrote; *placenta has umbilical cord which help the transportation of heat to the foetus, mammalian placenta protect the foetus from internal and external stress, it separates the mother from foetus to allow physiological reliance, placenta used for gaseous exchange which contain microvilli for transport of oxygen gas.* These responses indicate that the candidates were not able to identify the protective roles of the placenta.

In part (b), the responses provided by the candidates indicate that most of them lacked knowledge on gametogenesis in flowering plants and double fertilization as they failed to identify whether a given cell is haploid, diploid or triploid in nature so as to calculate the number of chromosomes in the given cells and give reason. For example, some of the incorrect responses given on the number of chromosomes were; *pollen tube nucleus = 16 chromosomes antipodal cell = 32 chromosomes, endosperm = 48 chromosomes, pollen mother cell (two chromosomes) and integument cell (four chromosomes).* In addition, some of them did not give reasons to support their calculations on the number of chromosomes. This may have been attributed by lack of comprehensive continuous assessment accompanied with timely feedback and remedial practices to enable students to identify their weakness before the commencement of the National Examination. Extract 9.1 shows weak responses.

Extract 9.1

9	(a)(i) Capacitation \neq Refers to the activation time of the sperm before fusing itself with female egg to fertilize	
	(ii) - It contains amniotic fluid that acts as a shock absorber - It possess Umbilical Cord which helps in transportation of heat to the foetus.	
	(b)(i) Pollen tube nucleus - It has only one chromosome. This is because a pollen tube nucleus doesn't fuse itself to any other chromosome, it only reaches the ovule and pass the two other nucleus for double fertilization	
	(ii) Antipodal cell (Six chromosomes) - There are cells found on the embryo sac, they are six in number, they live on the upper part of the embryo	

Extract 9.1 shows a sample of responses from a candidate who failed to explain the concept of capacitation and to give the protective roles of mammalian placenta to the foetus.

On the other hand, the candidates with average performance scored 5.5 - 10 marks. These candidates were able to explain the concept of capacitation as it is related to reproduction and correctly outlined the protective role of mammalian placenta to the foetus. However some of the candidates did not manage to calculate the number of chromosomes mostly in pollen tube nucleus, antipodal cell and endosperm. On the other hand, candidates who managed to calculate the number of chromosomes in the given cells failed to give the reasons to support their calculations which made them to lose some marks.

The analysis indicates that few candidates who scored higher marks managed to provide correct explanations on the concept of capacitation as it is related to reproduction and correctly outlined the protective role of placenta in mammalian foetus. In addition, they managed to calculate the number of chromosome in the required cells. Extract 9.2 shows a sample of good responses.

Extract 9.2

9.	(a) i/ Capacitation is the process by which the sperm cell become-activated prior to fertilisation. The process involves the removal of a glycoprotein layer and the increase in permeability of calcium ions (Ca^{2+} ions) which serve dual characters of increasing the beating action of the tail and propagation. The sperm spends an almost-seven hours in capacitation. - It also serves to activate lytic-enzymes found in the acrosome.
9.	(a) ii/ 1. Passage of Antibodies from-maternal to foetus. - The placenta is involved in the process of passive immunity where-antibodies from maternal pass-to the foetal circulation, offering-resistance to infection. such as Immunoglobulin A (IgA) which is passed from maternal to foetal circulation. 2. Prevents direct contact of - fetal and maternal blood circulation - Also the placenta prevents direct contact of maternal and foetal-circulation which is important as it prevents the mixing of incompatible blood groups of maternal and foetal, and also maternal blood may be flowing at a high speed-pressure which may rupture foetal-blood vessels.
	(b) i/ number of chromosomes = $16\frac{1}{2} = 8$ reason : The pollen tube nucleus is formed by the process of meiosis-during sporulation.
	ii/ Antipodal cell, number of chromosomes = $16\frac{1}{2} = 8$ reason : It is formed by meiotic-division of the Pollen mother cell.

Extract 9.2

9.	ib) iii/ Endosperm.	
	number of chromosomes = $3n = 3 \times 8 = 24$	
	reason ÷ It is formed by the fusion of a diploid nucleus and one male-gamete nucleus.	
	iv/ Pollen mother cell.	
	number of chromosomes = $2n = 2 \times 8 = 16$	
	reason ÷ It is formed by mitotic division of the carpel therefore diploid.	
	v/ Integument cell.	
	number of chromosomes = $2n = 2 \times 8 = 16$.	
	reason ÷ It is formed by mitotic division.	

Extract 9.2 shows a sample of good responses from a candidate who was able to explain the concept of capacitation. He/she managed to explain the protective roles of mammalian placenta to the foetus. Moreover, the candidate accurately calculated the number of chromosome in given cells.

2.1.10 Question 10: Transportation

This was an optional question where the candidates were required to identify the vascular tissues in plants and explain how they are adapted to their roles.

The analysis reveals that the candidates' performance in this question was good as out of 22,713 candidates who attempted this question, 63.5 percent passed and out of these 32.1 percent scored 6 - 8.5 marks and 31.4 percent scored 9 - 15 marks. On the other hand, 36.5 percent scored 0 - 5 out of the 15 marks allocated to this question. Figure 10 displays the performance of the candidates in this question.

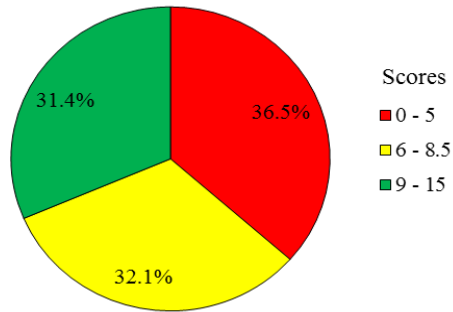


Figure 10: The candidates' performance in question 10.

The data from Figure 10 indicate that, one third (31.4%) of the candidates scored between 9 - 15 marks. There were only 21 candidates who got all marks (15) allocated to this question. These candidates demonstrated good knowledge in the topic of Transportation because they were able to identify the vascular tissues in plants and correctly explained the adaptations of the tissues to their roles. Extract 10.1 shows a sample of good responses from one of the candidates.

Extract 10.1

10.	Varacular tissues are plant tissues that aid in transportation and translocation of materials in the plants etc. According to the type of the material transported through the tissues, they are classified into two main groups:-	
	(i) Xylem tissue.	
	Xylem is the plant tissue that is responsible for the transportation of water and mineral salts from the roots upwards up to the upper plant parts (leaves and branches).	
	Xylem is made up of several components as follows.	
	Xylem vessels. These are plant tissues that are found in xylem. Xylem vessels are adapted to perform their functions as follows.	
	Xylem vessels are long and tubular. These vessels are long and tubular to provide enough space for the transportation of water and	

Extract 10.1 continues

10	(*) - mineral salts from the soil to the leaves of the plant. Xylem	
	Xylem vessels contain the strengthening materials upon its walls. This helps the vessels not to collapse during transportation of water and mineral salts.	
	Xylem vessels have lateral pits or pores. These pits aid in lateral movement of water and mineral salts to the lateral parts of the plant.	
	Xylem vessels lack nucleus when mature. The absence of nucleus provides the space for the transportation of water and mineral salts.	
	The other component of Xylem is Tracheids. Tracheids are similar to Xylem vessels but they differ in the following parameters:	
	Tracheids are short and thick. Tracheids are short when compared to Xylem vessels, they are not for long conduction of water and mineral salts.	
	They have lateral pits. Tracheids have lateral pits for lateral transportation of water and mineral salts.	
	The other component of Xylem is Xylem Parenchyma. This is the tissue that aid in strengthening and providing the support to Xylem vessels. It is also involved in the transportation of water and mineral salts.	

Extract 10.1 continues

10	(5)	Sieve plates have pits or pores. These pores aid in the movement of materials. They act as the control centre. The materials are usually loaded at the source and unloaded at the sink region.	
		Sieve plates have	
		Sieve tubes are made thin in diameter in order to allow maximum capillarity and cohesion to increase the movement of materials	
		Phloem tissues are also made up of phloem parenchyma. This tissue helps in supporting the other tissues. It is usually made up of strengthened material such as lignin and tubulin.	
		Plant tissues are so important in the sense that if one is removed the plant may die, however when the Xylem is Phloem is removed the plant may survive, but if all tissues are removed the plant wilts.	

Extract 10.1 shows a response of one candidate who was able to identify the vascular tissues in plants and correctly explained how they are adapted to their roles.

The candidates who had an average performance managed to state the type of vascular tissues in plants but missed some points because they explained few or wrong adaptive features of one of the vascular tissues in plants.

Nevertheless, the majority of the candidates who revealed weak performance, managed to identify the vascular tissues and explained that they are found in plant but were unable to explain how the tissues are adapted to their roles. Some of the incorrect responses given by these candidates on adaptive features of xylem to their roles were; xylem has fibres which aid the maintenance of osmotic condition to the plant, has xylem parenchyma helping in provision of energy required for active transportation of water, have sieve tube with perforation which prevent the backflow of water in xylem vessels and presence of mucus like materials attached

to the walls where mineral salts pass through sliding and this eases the transportation of these materials to the required places.

On the other hand the candidates gave incorrect adaptive features of phloem, such as; they have perforation so as to ensure the upward movement of food, contain sieve tube element with membrane perforation and pits for vertical translocation of water, possess the vessel member that allow lateral movement of manufactured food and has casparian strip which help prevent the movement of water in the phloem. These responses indicate that the candidates had insufficient knowledge in the topic of Transportation in plants. Extract 10.2 shows a sample of weak responses from one of the candidates.

Extract 10.2

10.	The Vascular tissue in plants are :	
	(I) Xylem tissue .	
	(II) Phloem tissue .	
	The Vascular tissues in plants can adopted to their roles in various ways through the xylem tissue and phloem tissue . The plants need tissue in order to survive well . The following are the reasons on how they adopted to their roles .	
	Releasing ^{Using} of Oxygen and Carbondioxide . This is the process of the plant to adapt through gaining or taking place of oxygen and Carbondioxide due to the Vascular tissue . The Vascular tissue help the plant to adapt in order the process of using the oxygen and Carbondioxide to occur . so the process of using oxygen and Carbondioxide to the plant it help the Vascular to to Continue to survive and it is very good role to the plant .	

Extract 10.2 Continues

10.	Occuring of photosynthesis. The Vascular tissue is the source of light to penetrate in order the plant to adapt well. Photosynthesis is very important roler to the Vascular tissue to the plant on how the sun light penetrating when occuring of light.	
	Using of stomata pores. This is the good roler when the plant can adapt well through Vascular tissue such as xylem and phloem tissue. Using of stomata pores is the good proccet of Vascular tissue in plants in order to provide nutrients through stomata pores. This roler is very important the plant in order to adapt.	
	Absorbing of mineral salts. This is the proccet of roots in order to absorb the nutrients such as water in order the Vascular tissue like xylem and phloem to the plant to adapt well. So this is the good roler of the Vascular tissue in plants on how take place on how absorbing of mineral nutrient.	
	Transport of materials. The Vascular tissue in plants it help for transport of materials in order the plant to growth well. The xylem tissue and phloem tissue occur in plants in order provide the good transport of materials to be well. So the Vascular tissue take place in plant due to the proccet of transportation of material.	
	In conclusion this is the Vascular	

Extract 10.2 shows poor responses from one of the candidates. Although the candidate was able to identify the vascular tissues in plants (xylem and phloem), she/he failed to explain the correct adaptive features of the tissues to their roles. The candidate did not understand well the task of the question as He/she included the roles of the xylem and phloem in his/her responses.

2.2 133/2-BIOLOGY 2

2.2.1 Question 1: Comparative Studies of Natural Groups of Organisms

In part (a), the candidates were required to classify the following organisms to class level (i) bean, (ii) crab, (iii) elephant grass and (iv) mouse. In part (b), they were asked to give six reasons to justify (i) the phylum to which mouse belongs, and (ii) class to which bean plant belongs, while in part (c), the candidates were required to briefly explain why liverworts and mosses have sometimes been described as the amphibians of the plant world.

A total of 19,088 (79.4%) candidates attempted this question of whom 52.8 percent scored from 7 - 11.5 marks, 21.4 percent scored from 12 - 20 marks, and 25.8 percent scored from 0 - 6.5 marks out of 20 marks allocated to this question. These data are summarized in Figure 11.

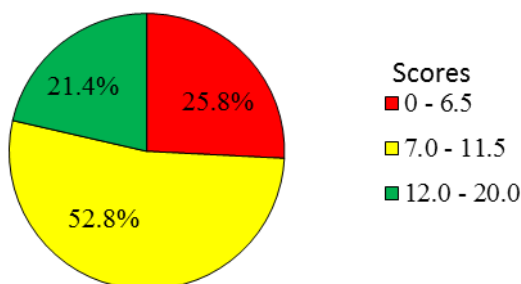


Figure 11: The candidates' performance in question 1.

Figure 11 indicates that the candidates' general performance was good as 74.2 percent correctly answered the question. The candidates who scored average (7 - 11.5) marks either gave less than six correct reasons to justify the phylum to which mouse belongs and class to which bean plant belongs, or incorrectly explained why liverworts and mosses have sometimes been described as the amphibians of the plant world. However, most of the candidates who performed well (21.4%) had adequate knowledge in the topic of Comparative Studies of Natural Groups of Organisms particularly classification of organisms. In part (a), some of them managed to classify bean, crab, elephant grass and mouse to their class level. In part (b), the candidates correctly gave six reasons to justify the phylum to which mouse belongs, and class to which bean plant belongs. In part (c), they also accurately and briefly explained why liverworts and mosses have sometimes been

described as the amphibians of the plant world. Extract 1.1 shows a sample of good responses from one of the candidates.

Extract 1.1

1(a)	(i) Bean	
	KINGDOM - Plantae	
	DIVISION - Angiospermophyta.	
	CLASS - Dicotyledonae.	
	(ii) Crab	
	KINGDOM - Animalia	
	PHYLUM - Arthropoda.	
	CLASS - Crustacea.	

1(a)	(iii) Elephant grass	
	KINGDOM - Plantae.	
	DIVISION - Angiospermophyta.	
	CLASS - Monocotyledonae.	
	(iv) Mouse	
	KINGDOM - Animalia.	
	PHYLUM - Chordata.	
	CLASS - Mammalia.	
(b)(i)	Six reasons to justify the phylum to which mouse belongs are:	
	(i) They have a notochord in atleast one stage of their life history.	
	(ii) They have a post-anal tail.	
	(iii) They have a visceral clefts	
	(iv) They have a dorsal-ventrally hypognath.	
	(v) Limbs are formed from more than one body segment.	
	(vi) They possess endoskeleton.	

Extract 1.1 continues

4(b)(ii)	six reasons to justify the class to which bean plant belongs	
	(i) They have two cotyledons.	
	(ii) They have net-like venation leaves.	
	(iii) They have a tap root.	
	(iv) They have a ring shape vascular bundle in stem.	
	(v) They have a star-shaped vascular bundle in roots.	
	(vi) They have three four/five or their multiples floral parts.	

1.	c) Liverworts and mosses are organism found in kingdom plantae, phylum/division bryophyta.	
	Amphibians are organism that are capable to live in both terrestrial and aquatic environment.	
	Liverworts and mosses have sometimes been described as the amphibians of the plant world because	
	i) Their habitats are on moist land and shady, dampy places. similar to amphibian need water and the terrestrial habitats	
	ii) Their fertilization needs water though they live on land. This is because they possess motile male gametes with flagella. so water help fertilization to take place that is the reason as to why liverworts and mosses are described as amphibians	
	iii) They have no true roots and no xylem and phloem tissues responsible for transporting water so they have to stay near water source for ensuring constant water supply.	

Extract 1.1 shows the candidate who correctly classified the given organisms to appropriate class level and gave correct justifications as to why mouse belongs to

phylum Chordata and bean plant belong to the class Dicotyledonae. They also correctly explained why liverworts and mosses are described as amphibians of the plant world.

Although, the majority of the candidates managed to score average marks (7 – 11.5), there were 25.8 percent who exhibited weak performance as they lacked knowledge in classification of organisms particularly, the Kingdoms Plantae and Animalia. In part (a), most of the candidates incorrectly classified bean, crab, elephant grass and mouse as; *Crab belongs to phylum Arachnida, mouse belongs to Phylum Mammalia*. Some of the candidates misspelt hierarchical names, such as; *Phylum Anthropoda, Phylum Angiospermophyte, Class Crustaceans and Class Dicotyledon*. Other misinterpreted the elephant grass as an animal, hence they classified it into *Kingdom Animalia, Phylum Chordata and Class Mammalia*.

Additionally in part (b) (i), some of the candidates failed to justify by reasons the phylum to which mouse belongs. This was revealed by incorrect responses such that some of the responses were adaptations of mouse to live in cold environment. For example some candidates wrote; *the body of mouse is covered by hairs this help it to live in the colder areas thus the hairs play role in maintenance of temperature, it has the pentadactyl (five fingers) in its limbs, it has sensory cells which are used in detecting those internal and external changes of the body, it has closed blood circulation in which blood passes through the blood vessels, its body parts connected to system of nerves, every chordate like mouse bears only a single sex and they have heterotrophic mode of nutrition*. Further analysis revealed that in part (b) (ii), some of the candidates did not understand the demand of the question as they wrote some parts of the plant as reasons to justify the class to which bean plant belongs. For example, they wrote; *it has root, stem and leaves, it has flowers, it has seed and it has chlorophyll*.

Also in part (c), the candidates were unable to give correct reasons as to why liverworts and mosses are described as the amphibians of the plant world. Some of the incorrect responses which were noted from the candidates scripts were; *liverworts and mosses live and grow inside water, they respire by using gills during gaseous exchange, they have no true roots, stem and shoot, therefore they cannot manufacture their own food, they have no specified habitat, they have adapted parts as amphibians, possess stomata opening on the upper epidermis, they reproduce rapidly by the means of sporulation and leaves are lateral and wide*. These responses imply that, the candidates had difficulties in comprehending the knowledge in Kingdom Animalia and Plantae. The candidates failed to transfer the knowledge obtained from classification of animals class particularly,

amphibian to study the characteristics of liverworts and moss. Extract 1.2 shows a sample of candidates' weak responses.

Extract 1.2

Qn.	Organism	Kingdom	phylum	Class.
i)	Beans	Plantae	Platyhelminthes	Monocotyledoneae
ii)	Crab	Animalia	Arthropods	Crustaceas
iii)	Elephant grass	Plantae	Platyhelminthes	Monocotyle doneae
iv)	mouses	Animalia	Bryophyta	Cestoda
14)	i) The reason which make the mouses belongs to that phylum:			
	Mause belong to phylum <u>Bryophyta</u> .			
	Reason:			
	<ul style="list-style-type: none"> - They growth in Shady and damp area - They do not have a true root. - They growth on the moisture/area contain water. - They born structure like Curve. - They have large Stem. 			
	ii) The reason which make the beans plant to belong to class <u>Monocotyledoneae</u> :			
	Reason:			
	<ul style="list-style-type: none"> - They have shallow root system. - They are leaf are in morphology (are rough). - The vein in leaf are not arranged well. - They have stem which support the leaf. - The vein are arranged horizontally. - They are autotrophic modes 			

15)	The reason why the liver worts and mosses are called amphibian of the plant:			
	Reason:			
	<ul style="list-style-type: none"> • Both liver worts and mosses plant they have the characters which are same with Amphibian which make difficult to differentiate in the simple ways. 			

Extract 1.2 shows a sample of responses from a candidate who failed to give the correct Phylum of mouse and class of bean plant, hence failed to

justify why mouse belongs to Phylum Chordata and bean belongs to Class Dicotyledonae. Furthermore, the candidate failed to explain why liverworts and mosses are described as the amphibians of the plant world.

2.2.2 Question 2: Comparative Studies of Natural Groups of Organisms

The question required the candidates to study Figure 1, and then, to answer the questions that follow:

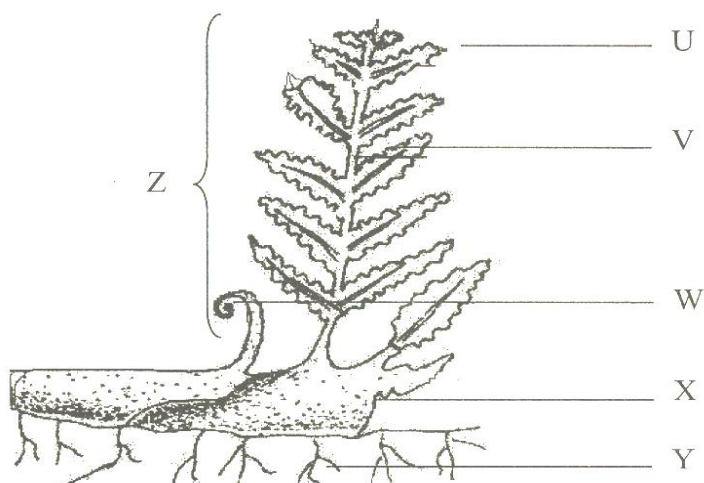


Figure 1

In part (a), the candidates were required to (i) name the organism, (ii) classify the organism to division level, and (iii) explain four general and three distinctive features of the kingdom to which the organism belongs. In part (b), the candidates were required to (i) identify the parts labeled U, V, W, X, Y and Z, (ii) state three roles played by the part labeled Y, and (iii) give five ways in which the organism structurally adapts to its mode of life.

The analysis shows that the question was chosen by 12,967 (53.9%) candidates, of whom more than half (55.2%) scored from 7 - 11.5 marks. The candidates who scored from 0 - 6.5 marks were 26.3 percent and 18.5 percent scored from 12 - 18.5 marks. However, none of the candidates scored all the 20 marks allocated to this question. The data are summarized in Figure 12.

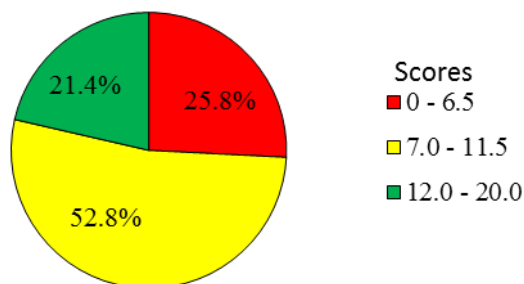


Figure 12: The candidates' performance in question 2.

Figure 12 depicts that more than half (73.7%) of the candidates who attempted this question scored above 7 marks of the allotted marks. This implies that the general performance of the candidates was good. The candidates who scored higher marks demonstrated their competences in classification of the Kingdom Plantae, particularly in Division Filicinophyta. Therefore in part (a), they managed to correctly name and classify fern plant to division level. They also correctly explained the general and distinctive features of the Kingdom Plantae in which the fern plant belongs. Moreover in part (b), they correctly identified the parts labeled U, V, W, X, Y and Z as pinna, pinnule, curled young leaf, Rhizome, adventitious root and frond, respectively and correctly stated the roles played by adventitious root. However, most of the candidates managed to give few structural adaptation of fern plant to its mode of life which led them to lose some marks. Extract 2.1 shows a sample of good responses from one of the candidates.

Extract 2.1

Q(a)(i)	fern plant	
(P)	Kingdom - plantae Division - Bryophyta	
(iii)	General features	
(i)	They are autotrophs	
(ii)	Store food in form of starch	
(iii)	Reproduce both sexually and asexually	
(iv)	They do not locomote	
	Distinctive features	
(i)	Their cell wall made up of cellulose	
(ii)	Store food in form of starch	
(iii)	They show a alternation of generation in which the gametophyte generation alternate with the sporophyte generation.	
(b)(P)	U - Pinna V - Branch W - Young leaf X - Underground rhizome Y - Adventitious root Z - frond	
(ii)	(i) Absorption of water and dissolved mineral salts (ii) Anchorage (iii) provides mechanical support	
Q(b)(iii)	(i) They have green pigments called chlorophyll to trap sunlight for photosynthesis (ii) They have adventitious roots for anchorage. (iii) The adventitious roots enable the organism to absorb water and mineral salts required by the plant. (iv) They possess sori found behind the pinnae for protection of spores (v) They have brown hairs covering the young leaf for protection.	

Extract 2.1 shows a candidate who was able to name and classify the organism in Figure 1 to division level and explain general and distinctive features of kingdom of the organisms. He/she also identified the labeled parts in the given figure and correctly stated the roles played by part Y.

On the other hand, most of the candidates who performed poorly, failed to provide the correct answers in almost all parts of the question. There were candidates who

failed to recognize the organism which was a fern plant. Some of them incorrectly named the organism as moss plant while others named it as conifers plant. Most of the candidates also failed to classify the fern plant to class level as they just mentioned the Class only. Other candidates totally failed to give the taxon in which fern plant is formally designated. For example, a candidate named Division Bryophyta instead of Filicinophyta. In addition, the candidates gave incorrect general and distinctive features of the Kingdom to which fern plant belong. This was attributed to the fact that the general and distinctive features were interchanged by most of the candidates' script and others gave incorrect responses. Example of such incorrect responses were; *the general features of the kingdom Plantae are undergoes transpiration, undertake guttation, have root for penetration, have anaerobic respiration, have rhizoids which absorbs water and mineral salts*. In case of the distinctive features of Kingdom Plantae, some candidates wrote *they have adventitious roots, they have sori, they have hyphae, they have rhizoids, this is for attachment of water and mineral salts, they have fronds which grow and later develop to become stem which provide strength of the tree*.

Moreover, a good number of candidates in this category failed to identify and label the parts of a fern plant as the structures were either wrongly labelled or interchanged. Furthermore, the roles played by adventitious root labelled by letter Y were incorrectly stated. Example of incorrect responses comprise; *Y is a place where reproduction of plant is taking place, photosynthesis taking place, translocation of food taking place in that region, growth of plants (apical meristems) and provides cooling effect to the plant*.

On the other hand, the candidate in this category were unable to give the correct structural adaptations of fern plant to its mode of life. Example of such candidates' incorrect responses include; *"it has small and many rhizoids which prevent the loss of minerals from soil and it has sporophyte generation which is dominant than gametophyte generation, hence adapted to survive, mode of nutrition either autotrophic or heterotrophic and mode of respiration either anaerobic or anaerobic"*. However, a few of the candidates skipped some parts of the question implying that they had insufficient knowledge in Kingdom Plantae. Extract 2.2 shows a sample of the candidates' weak responses.

Extract 2.2

2	① Moss plant	
	② Kingdom — Plantae	
	Class — Phlecinophyta	
	Phylum —	
III	The following are general and distinctive feature of the Kingdom belongs.	
	The general feature.	
	1. During this kingdom the photosynthesis process occur. also many plant it do this process, also this is common to all plants.	
	2. Also plant are produce food. also some plant it produce food to the living organism.	
	3. Also some plant are source of medicine. There fore plant are source of medicine example "mushroom, avocardo etc.	
	4. Also this kingdom, in some plant they have three parts, Apex, stem, and root.	
	There fore the following are some & distinctive feature	
	1. Many plant it have three party Apex, stem and Roots	
	2. It has phloem for food and xylem for water	
	3. Photosynt	

Extract 2.2 continues

⑤	①	
	U —	APEX
	V —	STEM
	W —	
	X —	
	Y —	ROOTS
	Z —	
⑤	②	The following are role played by part labelled Y.
		13. It help to transport movement of salt and ions. Also roots are help to transport minerals and to the system.
		14 Roots it have air tubes which used during photosynthesis process.

Extract 2.2 shows a sample of weak responses from one candidate who gave incorrect name of the organism and gave wrong general and distinctive features of the kingdom Plantae. In addition, the candidate failed to give the roles played by adventitious root labeled by letter Y.

2.2.3 Question 3: Growth and Development

In part (a), the candidates were required to describe the location, role and effects of apical, lateral and intercalary meristems by tabulating their answers using the following table.

Type of meristem	Location	Role	Effect

In part (b), they were required to explain the results shown by endosperm, embryo and total mass curves in Figure 2, which shows relative changes in dry mass of endosperm and embryo during germination of barley.

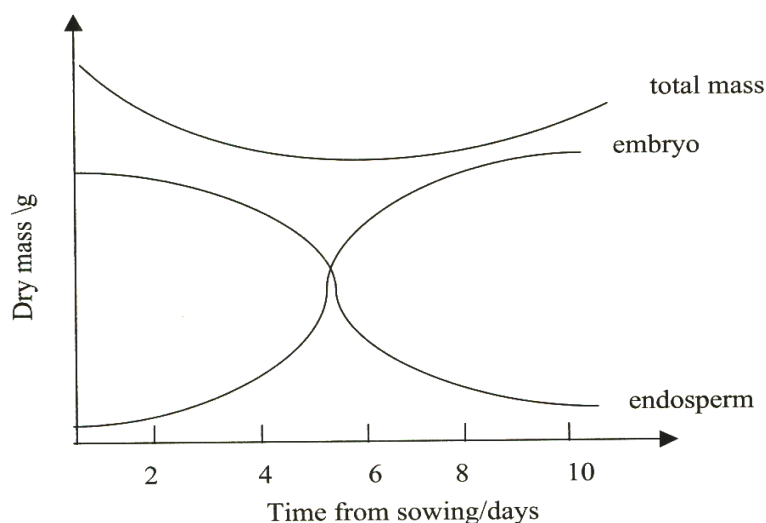


Figure 2

The analysis shows that a total of 17,288 (71.9%) candidates opted for this question of which 44.6 percent scored from 6.5 - 11 marks and 34.0 percent scored from 11.5 - 20 marks out of 20 marks allocated to this question. The candidates who scored from 0 - 6 marks were 21.4 percent. The Figure 13 portrays a representation of the data.

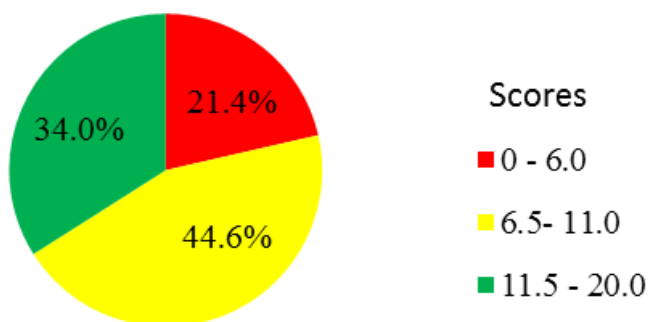


Figure 13: The candidates' performance in question 3.

The data from Figure 13 show that the general candidates' performance was good as a total of 78.6 correctly answered this question. The candidates who scored full marks in this question had enough content knowledge of Growth and Development in plants. They understood the task of the question as they correctly described the location, role and effect of apical, lateral and intercalary meristems. They also correctly explained the results shown by endosperm, embryo and total mass curves

in Figure 2. Extract 3.1 shows the model of a good responses from one of the candidates who attempted this question.

Extract 3.1

3. (a) Type of meristem, location and role.				
Type of meristem	Location	role	effect.	
i Apical meristem	Located in - Root apical - shoot apex	Primary growth of plants (undergo repeated mitotic division and absorb water and expand)	increase in length of the plant.	
ii lateral meristem	Located in lateral parts or side of the plant/shoot	It lead to secondary growth of plants (it produce cork and vascular cambium) for secondary tissues like xylem and phloem, corks and fibres	increase in thickness of plant	
iii intercalary meristem	located at the plant nodes	> Growth at the nodes > bud development of plants as it contain meristematic cells	increase in length of plants	

Extract 3.1 continues

3	germination, this is due to that the embryo is using only food from the endosperm	
	Immediately about fifth day of germination the mass of the embryo increase rapidly this is due to opening of the first leaf which marks the beginning of photosynthesis hence more food is supplied leading to increased mass rapidly which then from eighth day the growth goes normal.	
	(iii) The total mass of the plant/seed and endosperm as well as embryo	
	The total mass decrease from the first day to the 5th day, this is because of negative growth as catabolism reaction only was taking place.	
	Catabolism involved hydrolysis of food present in the endosperm to be used for germination and no any anabolism was taking place	
	The ^{total} mass of started to increase on the sixth day as the result of synthesis of food by photosynthesis as plumule has opened up above/outside the seed.	
	Hence the overall effect of using food from endosperm were and those synthesized becomes positive, increasing the total mass	

Extract 3.1 shows a candidate who correctly described the location, role and effect of apical, lateral and intercalary meristems. Moreover, he/she was able to give correct explanation of the results shown by endosperm, embryo and total mass curves.

Candidates who scored average marks, accurately described the location, role and effects of apical, lateral and intercalary meristems. However, they failed to score full marks because they gave few undetailed explanation on the results shown by endosperm, embryo and total mass curves. Others were able to explain the results

shown by endosperm, embryo and total mass curves on Figure 2 but failed to describe either the location, role or effect of some meristems hence lost some marks.

The candidates with weak performance demonstrated lack of sufficient knowledge of Growth and Development in plants. In part (a), the candidates gave several incorrect responses including the following:

Type of meristem	Location	Role	Effect
Apical meristem	Node of the plant	Increase in width of the plant	Primary growth of the plant
	Stem, root and leaf of the plant	Facilitate the growth of the tree	Promote the growth of the tree
Lateral meristem	Shoots and roots	Increase the length of the plant	Primary growth of the plant
	Stem and roots	Distribute mineral salts and chemicals	Increase the weight of the tree
Intercalary meristem	All places in the part of the plant	Fused part of the plant	Secondary growth of the plant
	Leaf and roots	Distribute the mineral salts	Develop different shapes of the leaf

In part (b), some of the candidates wrote unclear explanation on the results shown by endosperm, embryo and total mass curves in Figure 2. For example, the following statements were observed in the candidates' scripts; in embryo seed; "when the sunlight is introduced to seed tend to dry and loss its water content that enable to stay for a long time without germination, the total mass; the endosperm burst and allow the radicle and plumule to emerge in the ground due to enough matured seed to that has been developed through endosperm stored food and embryo". Other candidates wrote clear but incorrect responses while explaining on the results shown by endosperm, embryo and total mass curves in Figure 2. For example, some of responses noted were, on total mass curve; "after sowing, the mass of the endosperm was increasing rapidly while that of embryo was decreasing slowly, this led to the decrease in overall total mass in the first week". On embryo curve; "at the first week the embryo is not yet well adapted to the environment as it is faced with several diseases before adapting to the environment. After a time, there is a rapid increase of the embryo because it is well adapted to the environment. Therefore increase in dry mass". Other candidates

were unable to distinguish between the role and effect of the meristems, hence they interchanged them as shown in extract 3.2. These responses signify that the candidates with weak performance had insufficient knowledge in Growth and Development in Plants, particularly in the concepts of meristems and seed germination. Extract 3.2 shows a sample of weak responses from one of the candidates.

Extract 3.2

3a	Type of Meristems	Location	Role	Effect
	Apical	roots and nodes	It increase the length of the plant	It affect the primary growth of the plant
	Lateral	Stem	It increase the width of the plant	- It help the secondary growth to occur
	Intercalary	root and node	It increase the width & length of the plant	- It affect the primary growth of the plant
(b) Endosperm - is oxidized after the storage of food which the endosperm store it as energy used for the seed to grow before it grow				
embryo formation occur when the energy which produced from the endosperm used to the seed to grow from it embryo.				
total mass curves - is summation of the energy of the endosperm embryo which produced the total mass curves show the amount of energy used by.				

Extract 3.2 displays a sample of responses from a candidate who gave incorrect descriptions on the location, role and effect of apical, lateral and intercalary meristems. He/she also failed to give correct explanation of the results shown by endosperm, embryo and total mass curves.

2.2.4 Question 4: Regulation (Homeostasis)

In part (a), the candidates were required to (i) state two main roles of the kidney, and (ii) complete the Table that summarizes the relationship between excretory product and the habitat of the representative animal group.

Table 2

Animal	Excretory product	Habitat
Protozoan		
Terrestrial insect		
Fresh water bony fish		
Marine bony fish		
Bird		
Mammal		

In part (b), the candidates were required to enumerate three symptoms of each of the following disorders of urinary system in human; (i) bladder infection, (ii) kidney stone, (iii) kidney gout and (iv) kidney failure.

The data indicate that the question was opted by 12,644 (52.6%) candidates, of whom 66.9 percent scored from 7 - 11.5 marks. The candidates who scored from 0 - 6.5 were 26.8 percent and 6.3 percent scored from 12 - 18 marks. However, none of the candidate scored full marks allotted to this question. The performance is shown in Figure 14.

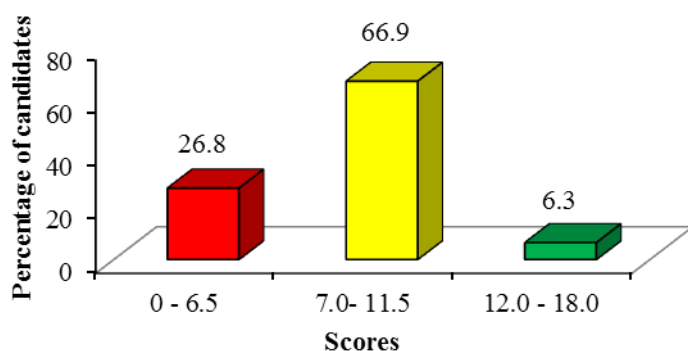


Figure 14: The candidates' performance in question 4.

Although none of the candidates managed to score all 20 marks, Figure 14 shows that the candidates' performance was generally good as about three quarters (73.2%) of the candidates scored from 7 and above marks of the allotted marks. The candidates who performed well in this question had sufficient knowledge on the topic of Regulation, particularly in the aspect of excretory system and

disorders of urinary system. They demonstrated their understanding of the contents by correctly stating the roles of the kidney and completing the table that summarizes the relationship between excretory product and the habitat of the representative animal in each group. In part (b), most of the candidates correctly gave the symptoms of the disorders of urinary system in human. However, some of the candidates gave either few or mixed the disorders of urinary disorders, thus they lost some marks. Extract 4.1 shows a sample of a candidates' good responses.

Extract 4.1

4. (i) • Kidney regulates water content in the body and salt concentration in the body "Osmoregulation"

• Controls the removal or excretion of waste of metabolism
For example urea.

ii.

Animal	Excretory product	Habitat
Protozoan	Ammonia	Aquatic.
Terrestrial insect	Uric acid	Terrestrial
Freshwater bony fish	Ammonia	Aquatic
Marine bony fish	Urea, trimethylamine oxide	Aquatic
Bird	Uric acid	Terrestrial
Mammal	Urea	Terrestrial

(b)

Disorder	Symptoms
(i) Bladder infection	<ul style="list-style-type: none"> • Frequent urination • Urine may be contaminated with blood • Lower abdominal pain
ii) Kidney stones	<ul style="list-style-type: none"> - Abdominal pain - urination in spurts - scanty urine
Kidney gland	<ul style="list-style-type: none"> • Joint pains • Kidney impairment • Legs may swell.

Disorder	Symptoms
iv/ Kidney failure	<ul style="list-style-type: none"> • Little Urine • Bone pain • Frequent headaches

Extract 4.1 shows a sample of good candidates' responses. In part (a), the candidate precisely stated the main role of the kidney and correctly completed the table by indicating the excretory product and the habitat of the respective group

of animal. He/she was able to correctly enumerate the symptoms of each of the given urinary disorders.

On the other hand, some of the candidates who scored lower marks (0 - 6.5) failed to enumerate the roles played by the kidney. Some of the incorrect responses observed in the candidates' scripts include; *secretion of useful materials and removal nitrogenous bases like urea which when allowed to accumulate in body may cause residual effect*. In part (a) (ii), some of the candidates incorrectly completed Table 2 by either giving wrong excretory product and habitat or interchange of details in the columns between excretory product and habitat.

In part (b), the candidates provided incorrect responses when enumerating the symptoms of bladder infection, kidney stone, kidney gout and kidney failure. Some of the incorrect symptoms were; bladder infection; *swelling of the bladder, pain in leg due to accumulation of water, vomiting, loose appetite of food, pain stomach, there is burning sensation*, symptoms of kidney stone; *little urine, severe pain, body weakness, there is thirsty occurring, sometimes small stones may be observed in the urine passed out, passing out urine which contain the blood stains, coloured urine, fever*; symptoms of kidney gout; *frequent urination, vomiting, feel pain when urination, illness, decrease in the formation of urine* and symptoms of kidney failure; *feeling much pain when urinating, there is loss of appetite, urinate more concentrated urine and low blood pressure*. Moreover, some of the candidates skipped some parts of the question. These responses imply that the candidates had insufficient knowledge in the topic of Regulation in Animals principally on the concepts of Excretory systems in Animals. Extract 4.2 shows a sample of the candidates' weak responses in this question.

Extract 4.2

4 (a)	Two role played by the kidney	
	① Balance of the body temperature	
	② To store the To control the poison harmful within the body.	
	Animal	Excretory product
	Protozoan	on land.
	Terrestrial insect	Damp area
	Freshwater bone fish	in water
	Marine bone fish	in water
	Bird	Urea Uric
	Mammal	CO ₂
		on land
⑥	Bladder infection symptoms	
	Bladder infection is the process of the bladder to failure their function within the body	
	Bladder infection there are symptoms when failure to function. There are,	
	pain under the stomach, when bladder infection the stomach, under the stomach it will be with more pain	
	Urea will it contain the colour blood, if the symptoms which can know the bladder	
(i)	Kidney stone.	
	Symptoms of the Kidney Stone.	
	- Loss of weight body body weight	
	- Loss of	
(ii)	Kidney gut	
	Symptoms of the kidney gut	
	-	
(iii)	Kidney failure	
	The following are the symptoms of the kidney failure there are,	
	①. To remove urea without information	
	②. Loss of body weight	
	③.	

Extract 4.2 shows responses of a candidate who gave incorrect responses in both parts (a) and (b). He/she failed to state the main roles played by the kidney.

The candidate also demonstrated poor command of English Language. In addition, he/she left some parts of the questions unfilled.

2.2.5 Question 5: Genetics

In part (a), the candidates were required to state three features of DNA which enable it to: (i) serve as a store of genetic information, (ii) transmit genetic information accurately. Part (b)(i) of the question required the candidates to carry out genetic crosses to show the percentage phenotype of blood group of children whose parents are both heterozygous, the father being blood group A and the mother AB using appropriate genetic symbols and (ii) state the probability that the parents will have a child with blood group O.

The analysis indicates that a total of 17,675 (73.5%) candidates opted for this question and their performance was average as 41.1 percent scored from 0 to 6.5 marks, 41.8 percent scored from 7 to 11.5 marks and 17.1 percent scored from 12 to 19 of 20 marks allocated to this question. There was no candidate who scored all 20 marks. These data are summarized in figure 15.

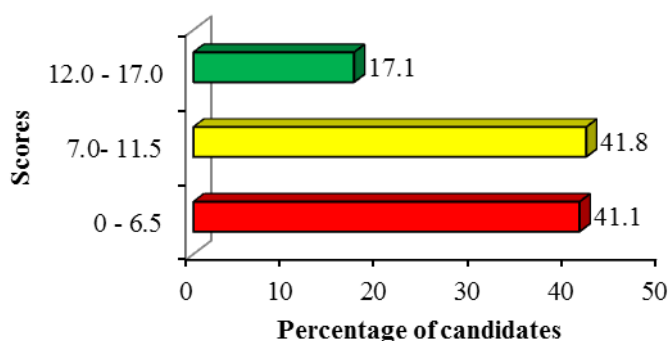


Figure 15: The candidates' performance in question 5.

Figure 15 shows that, the candidates' general performance was average as more than half (58.9%) of the candidates scored average marks. Some of these candidates were able to carry out genetic crosses to show the percentage phenotype of blood group of children, whose parents are both, heterozygous, the father being blood group A and the mother AB. Also they were able to state the possibility that the parents will have a child with blood group O. However, some of them either failed completely to respond to part (a) of the question or stated few features which enable DNA to serve as a store of genetic information and accurately transmit of genetic information.

On the other hand, the candidates who scored high marks were knowledgeable enough to state the features of DNA which enable it to serve as a store of genetic information and transmit genetic information. They were also able to correctly carry out genetic crosses to show the percentage phenotype of blood group of children, whose parents are both heterozygous. They correctly stated the probability that the parents will have a child with blood group O. Extract 5.1 shows a typical good response from one of the candidates who attempted this question.

Extract 5.1

5a	i. features of the DNA serves as the store of Genetic Information are :-	
	i. The base-pairing of the DNA molecules store the information coded form.	
	ii. Metabolically stable : The DNA is metabolically stable and inert this it enable the stored information in base pairing ratio unchanged	
	iii. Its length : The DNA being longer and helically coiled this it enable the information being stored in linear array.	
5a	ii. features of the DNA serves to transmit the Information accurately. are :-	
	i. self replication : DNA is able to replicate so that each progeny cell may have the same information as the parent cell containing the DNA.	
	ii. The base-pairing : The information can be transmitted by the DNA in base pairing.	
	iii. DNA can unwind and act as a template	

Extract 5.1 continues

5b	P. Let. I - Gene for the blood group. I ^O - Allele for the blood group O. I ^A - Allele for the blood group A. I ^B - Allele for the blood group B.	
	parental phenotype : Blood Group A x Blood Group AB.	
	parental Genotype : I ^A I ^O x I ^A I ^B .	
	meiosis :	
	Gamete :	
	Random fertilization	
	children Genotypes I ^A I ^A I ^A I ^B I ^A I ^O I ^B I ^O .	
	percentage phenotype of the children blood group is-	
	25% of blood Group B.	
	50% of blood Group A	
	25% of blood Group AB.	
5b	ii: the probability that the parent will have a child with blood Group O is zero	

Extract 5.1 shows typical good responses from a candidate who managed to state the features of DNA. The candidate also correctly carried out genetic crosses to show the percentage phenotype of blood group of children, whose parents are both, heterozygous. Furthermore, he/she correctly stated the probability that the parents will have a child with blood group O.

On the other hand, the candidates who scored below 7 marks had insufficient knowledge in the concepts of DNA and blood groups. In part (a) (i) for example one of the candidates wrote; *DNA are made up of five carbon sugar and phosphate group, have enzymes which help to join the complimentary component of DNA, possess the nucleotide which store information* and in (ii), some candidates stated that; *pentose as a source of energy for movement, DNA is free to move within the body, it is situated in chromosomes which take part in meiosis and passed to new cells*. In part (b) (i), some of the candidates wrote incorrect

genotypes for the heterozygous parent. Some of the incorrect genotypes written were; $I^A I^{AB}$, $I^A I^A$, $I^O I^{AB}$, AO and AB for blood groups A and AB. These candidates failed to realize that inheritance of blood groups is determined by gene I, which has alleles A, B and O and any two of the alleles can occur at a single locus at any one time. The incorrect written genotypes of the heterozygous parents led to wrong genotypes of offspring after the crosses and eventually wrong percentage of phenotypes for the expected blood groups. For examples in part (b) (ii), some incorrect offspring probability for a child with group O genotypes observed in candidates' scripts include; 25% 50% and $\frac{3}{4}$. Extract 5.2 shows a sample of weak responses from one of the candidates.

Extract 5.2

05.	(a) DNA	
	i/ Store of genetic information is enabled by	
	• Presence of the locus which is the centre for storage of genes	
	• Strong bond between the nucleic bases, Guanine(G), Cytosine(C), Thymine(T) and Adenine(A) enables strong storage of genetic information.	
	ii/ Transmission of genetic information accurately is due to the fact that,	
	• informations of a particular character are not mixed or confused with other information.	
	• It is not easy to break the bond between the nucleic bases and thus	

Extract 5.2 continues

(b) 2/ Consider the Cross between parents
Father and Mother.

Let

A = Gene for Blood group A

Ia = Gene for blood group B

O = Gene for blood group O

Thus, Aa = Blood group AB, AO = AA = blood group A

Parents
Genotype
Meiosis
Genes

Father

Mother

AO

Aa

A

O

A

a

Fertilisation

F_2 generation:

AA

Aa

AO

ao

Phenotypes:

• Blood group A = 3 (AA, Aa, AO)

• Blood group B = 1 (ao)

Genotypes:

AA, Aa, AO, ao

Percentage phenotype of Blood group
(%Ph) = ?

Extract 5.2 continues

05	(b) 2/ From	
	• Percentage phenotype of Blood group A ($\%P_A$) = ?	
	From, $\%P_A = \frac{3}{4} \times 100$	
	$= 75\%$	
	\therefore The percentage phenotype of blood group A	
	$= 75\%$	
	• Percentage phenotype of Blood group B ($\%P_B$) = ?	
	From, $\%P_B = \frac{1}{4} \times 100$	
	$= 25\%$	
	\therefore The percentage phenotype of blood group B	
	$= 25\%$	
	ii / Probability with blood group O.	
	$P(O) = ?$	
	$\%P_O$	
	From $\frac{P(O)}{4} = \frac{0}{4} = 0$	
	\therefore Probability of children with blood group O	
	$= 0$	

Extract 5.2 shows a sample of weak responses from a candidate who failed to state the features of DNA. Also the candidate performed incorrect genetic crosses to show the percentage phenotype of blood group of children whose parents are both heterozygous, which led to incorrect probability of the parents to have a child with blood group O.

2.2.6 Question 6: Genetics

Part (a) of the question required the candidates to explain how the formation of messenger ribonucleic acid takes place during protein synthesis while in part (b), the candidates were asked to (i) identify three types of ribonucleic acids and (ii) describe the structure and location of the identified types of ribonucleic acids.

The data indicate that the question was opted by 11,004 (45.7%) of the candidates, of whom 52.2 percent scored from 6.5 - 11.0 marks. The candidates who scored from 0 - 6.0 were 38.6 percent and 9.2 percent scored from 11.5 - 17 marks. Nevertheless, none of the candidates scored all the 20 marks. The statistics for this question is summarized in Figure 16.

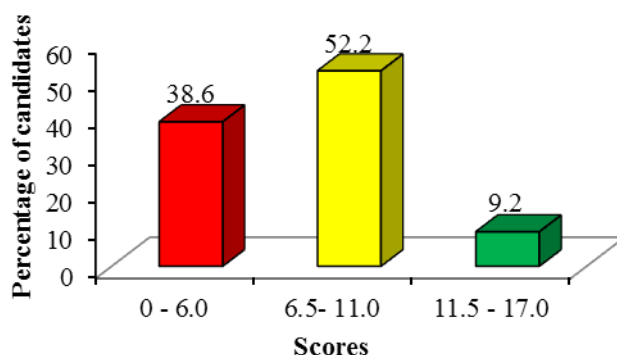


Figure 16: The candidates' performance in question 6.

As Figure 16 indicates, more than half (61.4%) of the candidates passed the question by scoring from 6.5 and above of the allocated marks. This trend suggests that the general performance of the candidates was good. Most of the candidates demonstrated partial understanding of the content knowledge taught under the topic of Genetics, particularly protein synthesis. The candidates were able to identify and describe the structure and location of the types of ribonucleic acids in part (b). However in part (a), some of them failed to explain how the formation of messenger ribonucleic acid takes place during protein synthesis. A few of the candidates managed to give correct answers in almost both parts of the question. Extract 6.1 shows a sample of good responses from one of the candidates.

Extract 6.1

6@	<p>Transcription process; that is Formation of Messenger RNA; The process takes place Under the following Sub-stages:</p>	
	<p>Unwinding of the DNA double Helix by the enzyme RNA Helicase; In the transcription process the DNA molecule is Unzipped or Unwinded by the enzyme RNA Helicase thus exposing the polynucleotide chains free for the process of transcription to begin.</p>	
■	<p>→ Selection of the template DNA Strand; After Exposing the two DNA strands one of the strands acts as the Template for the formation of mRNA-</p>	
■	<p>→ Joining of free nucleotides to form mRNA by the enzyme RNA polymerase following base pairing rule; The strand of mRNA is formed from the template DNA strand under the influence of an enzyme RNA polymerase which joins up free nucleotides following base-pairing rule corresponding to base sequence of the DNA molecule, in which Adenine pairs with Uracil, Thymine pairs with Adenine, Cytosine pairs with Guanine and Guanine with Cytosine</p>	
	<p>→ The pairing of Bases is achieved by formation of Hydrogen bonds between bases in which between Adenine and Uracil exist two hydrogen bonds and between Cytosine and Guanine exist three hydrogen bonds.</p>	

Extract 6.1 continues

6. (a) by the enzyme RNA e ligase;.
- The RNA ligase fills the gaps left in the mRNA if the replication is discontinuous as the RNA polymerase does not able to replicate from the 3' to 5' of the newly formed strand.

(iv) Proof reading by the enzyme RNA Polymerase.

- The RNA polymerase proof-read the formed mRNA by removing incorrect base pairs and thus giving the required mRNA.

(v) Winding up (zipping up) of the DNA Molecules.

- After the mRNA has been formed the DNA double strand zips up again and the mRNA leaves the nucleus via nuclear pore to the cytoplasm where it meets with Ribosomes, amino acids and tRNA for protein synthesis.

6. (b) (i). Types of Ribonucleic acids-

① Ribosomal Ribonucleic acid (rRNA).

② Messenger Ribonucleic acid (mRNA).

③ Transfer Ribonucleic acid (tRNA).

Extract 6.1 continues

6.	(b). (ii). <u>Messenger Ribonucleic acid (mRNA).</u>	
	→ The messenger Ribonucleic acid (mRNA) is a single straight chain of nucleotides.	
	→ In humans and other organisms are made only during protein synthesis and are found in cytoplasm of the cell during the process of protein synthesis. But in prokaryotes the RNA acts as the control of inheritance.	
	<u>Ribosomal Ribonucleic acid (rRNA)</u>	
	Location; rRNA are found freely in the cytoplasm of the cell.	
	<u>Transfer Ribonucleic acid (tRNA).</u>	
	It is clove shaped; and has the anticodons.	
	The tRNA has single strand.	
	At one end it ends with the CCA (base sequence).	
	Location; tRNA are mainly found in the cytoplasm of the cell, where it complexes with the amino acids during the process of protein synthesis.	

Extract 6.1 shows a candidate who was able to explain how the formation of messenger ribonucleic acid takes place during protein synthesis. In part (b), he/she identified the types of ribonucleic acids and described the structure and location of the mRNA and tRNA.

On the other hand, the candidates who scored lower marks were not able to explain how the formation of messenger ribonucleic acid takes place during protein

synthesis. Incorrect responses observed in candidates' scripts were such as; *"messenger RNA takes place during the transfer of information to the all body parts of an organism, messenger RNA have formed from nucleus of an organisms and the transfer of information due to the formation carry, messenger RNA takes place when polymerase enzyme attaches to one end of DNA molecule, it causes weaking of hydrogen bond more weaking of hydrogen bond, it causes DNA molecule to produce another strand which is messenger ribonucleic acid"*. These responses signify that the candidates lacked knowledge on protein synthesis.

In addition, the candidates in this category failed to identify the correct types of ribonucleic acids and describe their structure and location. For instance, some candidates wrote; *ribosomal ribonucleic acids has small subunits and large subunit and are found in the ribosome, messenger ribonucleic acid has small unit and found in the nucleus, transfer ribonucleic acid has large subunit and small subunit and found in the cytoplasm*. These responses indicate that the candidates had misconception between ribosome and ribosomal ribonucleic acid. However, some candidates interchanged the location of messenger RNA and ribosomal RNA. For example they wrote; *messenger RNA is found in the cytoplasm and transfer RNA is found in the nucleus*. Extract 6.2 shows a sample of weak responses from one of the candidates.

Extract 6.2

6(a)	Protein synthesis takes place between two stages (i) translation (ii) transduction	
	mRNA (messenger RNA) is formed on the first step of protein synthesis. The following are the stages under which mRNA is formed from protein synthesis	
	1. breaking of the DNA double stranded molecule, the double helix stranded molecule is breaking the strand of DNA.	
	2. Unwinding of the DNA double strand, the enzyme ligase is used to unwinding the double strand of DNA into two single strand.	
	3. Addition of nucleotides to the unwinded double strand molecule.	
(b)	(i) - messenger RNA (mRNA) Initiates the protein synthesis process, and the information to the DNA for which kind of protein is to be synthesized	
	- transfer RNA (tRNA) transfer RNA transform information from mRNA to the DNA on how the protein is to be synthesized.	
	- Ribosomal RNA (rRNA) this type of ribonucleic acid is used to convert protein into its respective amino groups and it receives information from tRNA.	

Extract 6.2 shows weak responses of a candidate who failed to explain how the formation of messenger ribonucleic acid takes place during protein synthesis. In part (b), he/she incorrectly described the structure and location of the types of ribonucleic acids. The candidate described the role of ribonucleic acids instead of structure.

2.2.7 Question 7: Evolution

In part (a), the candidates were required to (i) name three theories of origin of life, and (ii) explain the origin of life based on the theories named in 7(a)(i). In part (b), they were required to explain the mechanism of organic evolution according to Lamarck theory and state strengths and weakness of the theory.

The analysis indicates that, the question was attempted by 22,299 (92.7%) candidates. The candidates' performance was good as 63.8 percent scored from 11.5 - 20 marks and 29 percent scored from 7 - 11.0 marks. However, 7.2 percent score 0 - 6 marks out of the 20 marks allocated to this question. Figure 17 summarizes the performance of the candidates in this question.

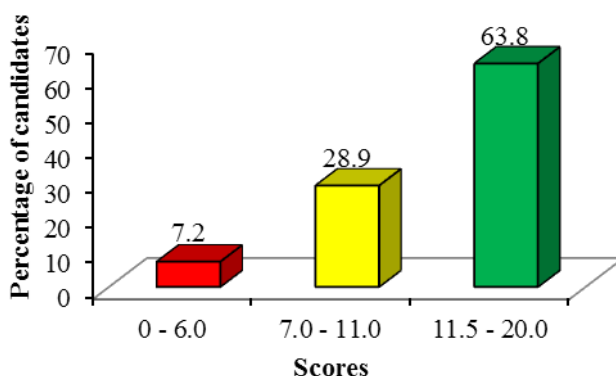


Figure 17: The candidates' performance in question 7.

Figure 17 shows that the candidates' performance was good as a total of 92.8 percent passed by scoring from 7 - 20 marks. The candidates who scored high marks in this question had good mastery of the content knowledge in the topic of Evolution, particularly in the concept of Theories of Evolution. They were able to name the theories of origin of life and correctly explained the origin of life based on the theories. In part (b), the candidates were able to explain the mechanism of organic evolution according to Lamarck theory and clearly stated the strengths and weakness of the theory. Extract 7.1 shows a sample of good responses from one of the candidates.

Extract 7.1

7.	(a).	
	(i). The three theories of origin of life are:-	
	(i). Special creation theory.	
	(ii). Cosmozoan theory.	
	(iii). Spontaneous generation theory. (Chabogenesis theory).	
	(ii). Origin of life based on the theories named:-	
	(i). <u>Special creation theory.</u>	
	-The theory suggest that "All living and non-living things were created by the God, Supernatural power in one time and ever since the world has created, no change has took place to the organisms".	
	-The theory is derived from the Holy scriptures like Quran and bibles and it is supported by believers in the religions and natural being.	
	-The theory can not be proved to be true by scientific methodologies.	

Extract 7.1 continues

7.	<p>(ii). <u>Cosmozoan theory</u></p> <p>The theory suggest that, the life in this planet were derived from somewhere else in the universe. Means the origin of life on earth is somewhere else out of this world. The theory is supported by observations made and encountered mysteries in space like Unidentified Flying Objects (UFO) and rocket drawings. Also the explorations made by scientists on the nature of meteorites particles and ability of some planets to have little support of life.</p> <p>- But the theory fails to tell us how life was derived and what is the origin where it originated.</p>
	<p>(iii). <u>Spontaneous generation theory (Theory of Abiogenesis).</u></p> <p>The theory suggest that life originate from non-life materials or living organisms originate from non-living organisms by means. The theory was supported by Ancient Greek philosophers of Athens.</p> <p>- The ancients believed that, if supportive environments are made, the living organisms could evolve from non-living organisms.</p> <p>- Example, if a piece of dirt cloth and darkness are set, mice could evolve from them.</p> <p>- The theory does not give the exact mechanisms.</p>

Extract 7.1 continues

7. (b). Lamarck's theory of organic evolution.

Organic evolution is the process where by organisms originate from pre-existing organisms under course of time.

Lamarck put forward his theory of organic evolution by considering three important things, which can be traced as the mechanisms.

The following are the mechanisms by which organisms evolve from pre-existing ones under Lamarckism.

- Environmental changes creates a need and cause the organisms to be subjected to changes. These can be man made changes or natural changes such as hunger, drought, fire outbreak or floods as well.

Under Lamarck, all organisms initially are of one type and there is no varieties among them. As the environments change, then the organisms start to create the means to survive.

- Constant use and disuse of body parts. In the course to survive in the changed environments, Lamarck suggested that organisms will be using their body parts more than the others. Those who fail to efficiently use their body parts will die and those who will be using more their body parts will cause the strength of those body to increase and hence new characteristics being acquired. In this case, they will survive in the new changed environment.

Extract 7.1 continues

7.	<p>• Inheritance of acquired characteristics, Lamarck believed that, the acquired characteristics by organisms during the constant use will be passed on to their offsprings in the course of reproduction. And hence the new characteristics will be maintained and modified by the next generation.</p>	
	<u>Strengths of Lamarck's theory of organic evolution.</u>	
	(i). The theory give the way for scientist to explore more on the organic evolution, like Darwin did.	
	(ii). The theory appreciates on the role of environment on organic evolution.	
	(iii). The theory suggest that characters are passed on to offsprings, on reproduction	
	(iv). The theory appreciates that changes occurs in environment and organisms do change.	
	(v). The theory gives the origin of Vestigial organs.	
	<u>Weakness of the theory.</u>	
	(i). It is not true that acquired characteristics are inherited.	
	(ii). No more explanation on how acquired characteristics are passed on to offsprings.	
	(iii). It is not true that if a body part is unused deteriorates.	

Extract 7.1 shows a candidate who correctly named the theories of origin of life and explained the origin of life based on the theories. He/she also explained the mechanism of organic evolution according to Lamarck theory and accurately stated the strengths and weakness of the theory.

On the other hand, most of the candidates who scored average (7 - 11) marks, explained the mechanism of organic evolution according to Lamarck theory and stated some strengths and weaknesses of the theory. However, some of them were able to name the theories of origin of life but failed to explain the origin of life based on the theories.

Furthermore, some of the candidates who scored from 0 - 6 marks demonstrated weak mastery of content knowledge in Evolution. Some of the candidates incorrectly explained the origin of life based on the theories. They incorrectly wrote; *steady state theory states that life on earth created or spontaneous supported, cosmozoan theory state that life on earth came from the world, special creation theory state that life on earth supported by the magicians existed*. Others wrote; *creation theory state that life on planet earth is the same but the life is supported by the earth, steady state theory states life on earth cannot support to origin of human life but life can arise on the planet like earth*. These responses show that the candidates had inadequate knowledge on the topic of Evolution.

In part (b), some of the candidates failed to explain the mechanism of organic evolution according to Lamarck theory and incorrectly stated the strengths and weakness of the theory. Some of the incorrect responses about the mechanism of organic evolution given were; *the better adapted organisms in the environment will survive while those have less adapted character will be eliminated by the environment thus the weak organisms will outcompeted by the well adapted organisms*. This indicates that the candidates had a misconception between the idea of Darwin and Lamarck. On the strengths of Lamarck theory, incorrect responses provided include; *it explains of the origin of the parts of body present to different organisms such as giraffe and ducks*, he explains about how organisms compete from each other for resources. Extract 7.2 shows one of the candidate's weak responses.

Extract 7.2

	<u>SECTION D</u>	
7	1) Darwin theory	
	- Lamarck theory	
	- Mendel theory.	
	11) Lamarck theory. I - environment	
	- states "that the characters of an organism depends on the type of the environment the organism belongs."	
	In this theory Lamarck discovered that for an organism to survive or fit on the environment the characters and organism must fit the environment	
	From these Lamarckism theory he showed the relation between environment and organism in such a way that an organism depends massively on the environment in relation to the characteristic and structure the organism posses. For instance the long neck of the giraffe it was an acquired traits and it passed from generation to generation	

Extract 7.2 continues

	<u>Darwin theory.</u>	
	This theory also relate the existence of organism to their environment	
	<u>Postlet 1: Like Produce Like.</u>	
	In this theory Darwin explained that a certain organism will produce organism of the same character, anatomy and biochemical equivalent.	
	<u>Postlet 2: Struggle for existence.</u>	
	Darwin explained that organism tend to struggle to exist by competing for the available resources that can make them survive.	
	<u>Postlet 3: Struggle for the fittest.</u>	
	Darwin state that the organism tend to struggle to fit on their environment and those who fail to fit will die and their specie extinct but those who will fit to their environment will live on and pass in different generation.	
	<u>Postlet 4: Over production.</u>	
	The organism in this postulet are termed that they produce more than the number to replace them; This means that organism produce large number of offsprings than that number of the parent organism	

Extract 7.2 continues

Posttel 5: Over population

This Postlet says that the population of different species tends to increase and not vice versa as this is due to availability of resources to the environment.

Conclusion; These theories are 85% true since they based on characteristic nature of organisms and their the best theories despite their critic.

Sm :

Mendel theory:

Mendel explain on inheritance and passage of traits.

Postlet 1: The character of an organism
is represented by the factor of genes occurring
in pair; on this Postlet it is seen that
all the characteristics are due to combinati
on of genes to form a pair of genes.

Postnet 2: Only one factors (one gene from the pair of genes gives its traits out will the other gene become recessive; on this theory - the genes combination brings about dominant gene and recessive genes. The dominant genes are the ruler genes and are the factors that shows trait of organism -

In sum ~~app~~ Mendel theory explained the evolution of ~~var~~ character variation and factors for variation

Extract 7.2 shows a candidate who incorrectly named the theories of origin of life and failed to explain the origin of life based on the theories. He/she also incorrectly explained the mechanism of organic evolution according to Lamarck theory and failed to state the strengths and weakness of the theory.

2.2.8 Question 8: Ecology

In this question, part (a) required the candidates to (i) define the term population explosion and explain three causes of it, and (ii) state five negative consequences of population explosion. In part (b), the candidates were required to (i) give the meaning of capture recapture method, and (ii) outline nine procedures used to estimate population under capture recapture method.

The analysis indicates that the question was mostly skipped as 7300 (30.35%) candidates attempted it. However, majority (93.7%) scored from 0 - 6 marks and 5.8 percent scored from 6.5 - 11 marks. Only a few (0.5%) candidates scored from 12 - 17 marks. Figure 18 summarizes the performance of the candidates in this question.

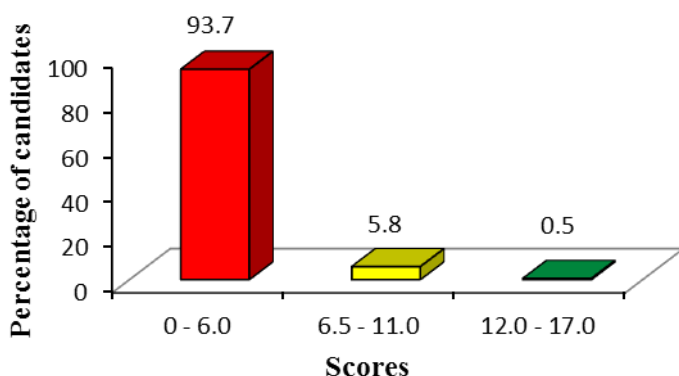


Figure18: The candidates' performance in question 8.

The data from Figure 18 shows that a total of 93.7 percent of the candidates scored lower marks. Most of these candidates failed to comprehend the meaning of the term population explosion, as a result their responses on the definition, causes and its negative consequences were almost incorrect. Examples of incorrect definition provided on the term population explosion are; *Population explosion refers to the increase of the total number of people in a certain community; is a collection of living individuals in an area.* The candidates also wrote incorrect causes of population explosion. For example, some of the candidates wrote; *struggle for existence, dangerous organism like pathogen that kills bacteria, diseases and pests, climate and relief.* Some of the incorrect negative consequences of population explosion include; *increase of the government burden thus the government should increase more money, increase in street children, and eruption of AIDS/HIV.*

Similarly in part (b), most of the candidates failed to understand the meaning of capture recapture method as they were not able to give the correct meaning and explain the procedure used to estimate the population by using this method. Some of the incorrect definitions of the term capture recapture method, were such as; *refer to the biological species to capture the pests and diseases, for example use of predators and refers to the method used to scientist by introducing other organism to feed on them so as to reduce the disturbances on crops*. However, some candidates wrongly outlined the procedures used to estimate population under the capture-recapture method and others confused the procedures of capture recapture method with procedures of scientific investigations. For example, the the candidates wrote; *identify the problem to know the source of the problem, passing through different project book for solution, hypothesis formulation must formulate different ideas, collection of data to different area on how they say, data analysis and compare the areas and ideas of yours and majority*.

Similarly, there were candidates who wrote procedures for constructing pyramid of numbers instead of the procedures of capture recapture methods. For example the candidates wrote; *look the number of primary consumers, look the number of tertiary consumers, look the number of quaternary consumers, look the number of decomposers*. These responses imply that the candidates lacked knowledge in the ecological methods of estimating population size using capture recapture method. Extract 8.1 shows a sample of the candidates' weak response.

Extract 8.1

8.① Population explosion is the rapid merge or growth of population in a given area. this means is the faster growth of population in a given area. it can be human population or other living organisms. population explosion can be caused by different factors. can be biological factors or physical factors. The following are the reasons ^{or causes} for the population explosion :-

Eudaphic factors (soil) > that means population explode in areas where there is good and fertile soil, thus will lead to explosion of population.

2① compared to other places with no fertile soil the population is very low and slow because no favourable condition for organism to stay.

Climate that means is the average condition of a place, when there is good climate that is cool climate with no high temperature or very cold area population explosion will occur on that place compared to the other place with no good climatic condition hence the population will be low example in desert no population explosion and will not happen due to bad climate in the desert.

Biological factors this are the factors like diseases and other biological factors. In other places which have frequent diseases people will tend to shift from that place and tend to go on the area with no diseases and free from pest that resulted to the population explosion in the area where there is no diseases.

8 ② Negative consequences of population explosion.

① Shortage of resources available like water, land etc.

② Emergence of diseases like cholera, TB and other diseases.

③ Increase in crimes due to high population.

④ Destruction of environment like cutting down of trees and emission can take place.

⑤ Emergence of conflicts and competition on the resources < shortage of resources >.

Extract 8.1 continues

85	ii	Procedure used to estimate population under capture recapture method.	
		→ Identify the organisms present on that population. eg. zebra, lion, gazeller.	
		→ choose the type of organism which you want to estimate the population. eg. Only zebra.	
		→ Mark few organism on that place	
		→ other organisms remained unmarked	
		→ Count the total number of all individual on that population and record the Number.	
		→ Count unmarked individuals and record the number	
		g) count marked individual and record the Number	
		h) Take the total number of marked organisms times total number of unmarked organism	
		i) The total number obtained from the marked times unmarked divide by total population before marked the individuals. Hence the population estimation will be done.	
86	i	Capture recapture method	
		Is the method used to estimate population on by using or by taking few sample of captured individuals and marked with recaptured individuals marked with those unmarked over the total population.	
		OR	
		Is the method used to estimate population.	

Extract 8.1 shows a candidate who failed to define the term population explosion and incorrectly explained its causes. He/she wrongly stated the negative consequences of population explosion. Moreover, the candidate failed to explain the meaning of capture recapture method and incorrectly outlined the procedures used to estimate population under capture recapture method.

Despite the poor performance, the candidates who performed well in this question precisely defined the term population explosion and explained its causes. They also stated negative consequences of population explosion. In part (b), the candidates correctly outlined some of the procedures used to estimate population under capture recapture method. However, majority of the candidates incorrectly

gave the meaning of capture recapture method which made them to lose some marks. Extract 8.2 shows a sample of good responses from one of the candidates.

Extract 8.2

8(a)(i)	Population explosion - This is the rapid and fast increase in number of organisms in a given area. Population explosion occur in a given time but the rate of increase in population is so rapidly.	.
	<u>Causes of population explosion.</u>	
(i)	Increase in birth rate. This can cause population explosion in the rate of birth is rapidly and higher.	
(ii)	Immigration. Incoming of organisms in a given area. When the rate of immigration is higher than the rate of emigration this can result population explosion.	.
(iii)	Availability of given resources and low mortality or death rate. Death rate also can determine the population of a given area to grow fast or not. Also the availability of a given resource which lead to competition of such resource and cause population explosion.	
8(a)(ii)	Five negative effects of population explosion. • Deforestation and soil erosion. Cutting down trees in order to establish settlement in a given area. This also can be the outcome of population explosion, which finally cause soil erosion.	

Extract 8.2 continues

8(a)(i)	<ul style="list-style-type: none"> Population explosion cause air pollution. This is because number of organism is higher than the normal. Can cause water pollution. Water bodies will be polluted as the result of waste from different human activities like domestic activities. Rapid eruption and transmission of diseases. Loss of biodiversity. <p>Some of the species will be lost due to population explosion example plant species.</p>	
8(b)(i)	<p><u>Capture-recapture method</u> - This is the method used to estimate population size or number of an organism in an area. This method involve capturing of group of organism and mark them and then release and allowed to distribute then an organisms are captured again and check how many are already marked in the initial sample. It is given as.</p>	
	$\text{Number of organism} = \frac{\text{Number of Initial sample} \times \text{Number of Second sample}}{\text{Number of Recaptured organisms}}$	

Extract 8.2 continues

8(b)	(ii) Nine procedures to estimate population under capture recapture method.	
	<u>First procedure.</u>	
	• Select or choose a given geographical area where population have to be estimated, the area selected must have defined boundaries.	
	<u>Second procedure.</u>	
	• Count the number of ^{captured/taken} organism of a given species that are needed to estimate population.	
	<u>Third procedure.</u>	
	• After Count the number of organism whose population needed mark the organism. When marking avoid use of paint/colour that will subject the organism to predators.	
	<u>Fourth stage/procedure.</u>	
	• After marking all organism; organism can ^{allowed} must be released and allowed to distribute all over the area.	
	<u>Fifth procedure.</u>	
	• Leave the organism for two or three weeks so as to ensure good dispersal of organism in that area.	
	<u>Sixth procedure.</u>	
	• The organism in that area are captured again and this will be named as second sample.	•

Extract 8.2 continues

8(b)(i) <u>seventh procedure</u>	
• Captured organism are counted. And in the second sample there may be appearance of organism which are already captured in the first sample.	
<u>Eighth procedure.</u>	
Then after taking the second sample the number of marked organisms from the first sample is recorded.	
<u>Ninth procedure.</u>	
In this stage the number of organism/population can be determined by taking:	
$\frac{\text{Number of organism in first sample} \times \text{Number of organism in second sample}}{\text{Number of recaptured organism.}}$	
Hence population in a given area already estimated.	

Extract 8.2 shows a candidate who correctly stated the negative consequences of population explosion. In part (b), the candidate managed to outline the procedures used to estimate population under capture recapture method.

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE IN EACH TOPIC

The analysis of the performance in different topics indicate that 7 out of 12 topics which were tested in Biology paper one and paper two had good performance, 3 topics had average performance and 2 topics had poor performance. The topics that had good performance are; *Evolution, Principles of Classification, Coordination, Growth and Development, Comparative Studies of Natural Groups of Organisms, Regulation/Homeostasis and Nutrition*. However, the topics of *Genetics, Cytology and Transportation* had an average performance. On the other hand, the topics of

Reproduction and *Ecology* had poor performance. **Appendix 1** summarizes the candidates' performance in different topics in the ACSEE 2017 while appendix 2 compares the performance in the years 2017 and 2016. In the appendices, the performance in each topic has been regarded as weak (red coloured), average (yellow coloured) or good (green coloured), if the percentage of the candidates who scored from 35 percent or above of the marks allocated to the respective question lies in the interval from 0 - 34, 35 -59 or 60 – 100, respectively.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The general performance of the candidates in Biology subject was good in ACSEE 2017 as 95.06 percent passed the examination. The analysis of performance in each individual question indicated that good performance was attributed to such factors like candidates' adequate content knowledge, good understanding of question demand and good drawing skills and good command of English Language.

Although the general performance in Biology is good, further analysis of performance in each question revealed a wide range of marks with only a few candidates scoring all the marks allotted to the given questions. Most of the candidates managed to give some correct information in almost all of the questions. However, most of the responses provide by majority of the candidates did not meet the quality of a good response as they missed sufficient details to be awarded full marks.

Several factors led the candidates fail to score all the marks. Some of these include:

- (a) Candidates' insufficient knowledge on the tested topic which led them to give incorrect answers. This might have been contributed by:
 - (i) Failure of the candidates to read books, use internet, online studies, journals and magazines so as to increase their knowledge.
 - (ii) Lack of ample time to make through revision on all the topics and make self-evaluation before they sit for the national examination.
 - (iii) Lack of enough classroom assessment accompanied by motivation and feedback from both teachers and parents to promote candidates' intrinsic and extrinsic motivation.
 - (iv) Lack of enough laboratory work and field projects.
- (b) Failure to identify the demand of the question which caused the candidates to give wrong answers. Generally, this may have been contributed by:

- (i) Lack of enough preparatory exercises including home works, assignments, tests and examinations accompanied by immediate feedback from the teachers so as to promote critical thinking of the students.
 - (ii) Failure of the candidates to read the questions carefully in order to identify the question demand before attempting them.
- (c) Failure to transfer knowledge obtained in one topic in solving challenging questions from other topics.
- (d) Failure to express themselves using English Language.

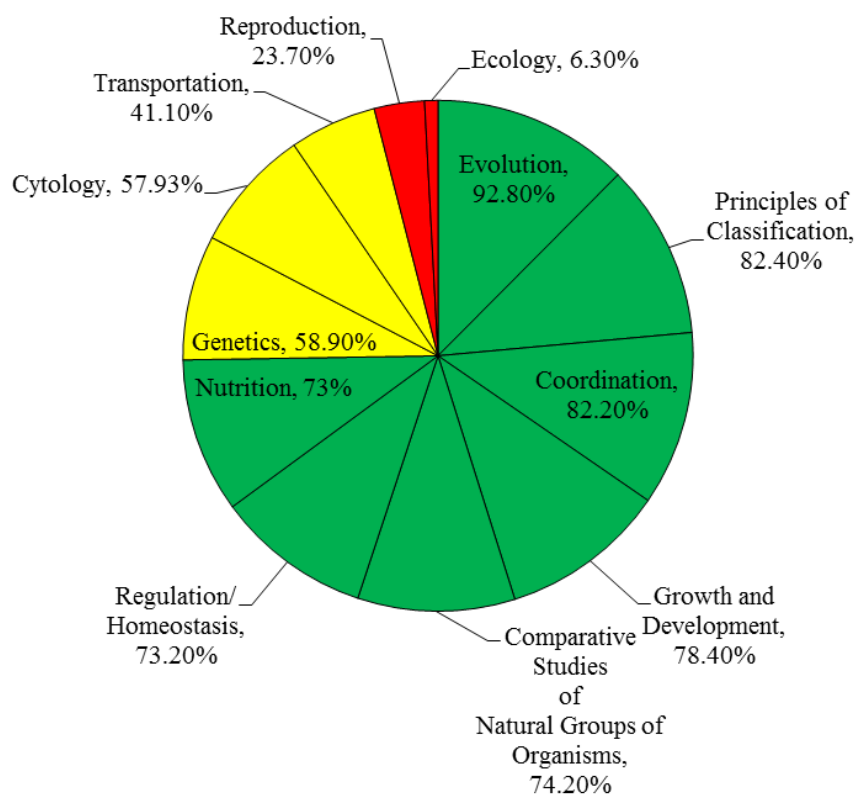
4.2 Recommendations

Basing on the analysis of the candidates' responses which revealed that some of the candidates had insufficient knowledge in the tested topics, failed to identify the demand of the question and failed to apply the knowledge obtained in one topic to solve questions from other topics, it is therefore recommended that:

- (a) For the students to acquire enough content knowledge of the taught topics the following should be done:
 - (i) Enough time should be given for self-study and making revision on what they have been taught so that they recognize their weaknesses and take corrective measures before they sit for the examination.
 - (ii) Students should be encouraged to read several books, journals and use internet to supplement what is not well covered in class or are not well elaborated in the textbooks.
 - (iii) Class based assessment should be strengthened to make sure that teachers provide candidates with enough continuous assessment such as practical work, assignments and tests accompanied with feedback in order to reinforce the candidates' mastery of the content knowledge and skills in each topic. For example the topic of Reproduction which had low performance.
 - (iv) Biology subject teachers should employ a variety of teaching-learning strategies, such as integrating theory with practical so as to motivate the students to learn Biology. For example question 3 in paper 1 from the topic of Cytology had poor performance because most of the candidates failed to explain how to test for protein in a given solution using biuret test.
 - (v) Teachers should use appropriate teaching and learning methods and cover the syllabus on time so as to ensure students get enough knowledge for answering examination questions.

- (b) In order to resolve the problem resulting from the candidates' inability to identify the demand of the question, students should be:
 - (i) urged to read the questions carefully before attempting it.
 - (ii) provided with exercises, assignments, tests and examinations accompanied with immediate teachers' feedback to enable the candidates build up confidence, skills and experience needed for identifying the demand of the question.
- (c) In order to help students improve in English Language, teachers should encourage students to:
 - (i) develop the habit of reading various books, articles and different journals written in English Language.
 - (ii) use English in their subject discussion groups.
 - (iii) participate in different discussion and essay writing which are conducted in English Language.

The Candidates' Performance Topic-wise in ACSEE 2017



Appendix 2

Comparison of the Candidates' Performance Topic-wise in ACSEE 2016 and 2017

S/N.	Topic	2016		2017		Remark
		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	
1.	<i>Evolution</i>			1	92.8	Good
2.	<i>Principles of Classification</i>	1	88.30	1	82.4	Good
3.	<i>Coordination</i>			1	82.2	Good
4.	<i>Growth and Development</i>	1	89.50	1	78.4	Good
5.	<i>Comparative Studies of Natural Groups of Organisms</i>	2	77.30	2	74.0	Good
6.	<i>Regulation/Ho meostasis</i>	2	71.00	1	73.2	Good
7.	<i>Nutrition</i>			1	73	Good
8.	<i>Genetics</i>	1	74.40	2	72.2	Good
9.	<i>Cytology</i>	5	77.74	4	57.93	Average
10.	<i>Transportation</i>	3	56.20	2	41.1	Average
11.	<i>Reproduction</i>	1	71.10	1	23.7	Poor
12.	<i>Ecology</i>	2	48.25	1	6.3	Poor

