

THE UNITED REPUBLIC OF TANZANIA NISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY ATIONAL EXAMINATIONS COUNCIL OF TANZANIA



CANDIDATES' I TEM RESPONSE ANALYSIS REPORT ON THE ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION (ACSEE) 2022

BIOLOGY



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133 BIOLOGY

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TABLE OF CONTENTS

FOREWORD	iv
1.0 INTRODUCTION	.1
2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH	. 2
QUESTION	. 2
2.1 133/1 - Biology 1	. 2
2.1.1 Question 1: Cytology	. 2
2.1.2 Question 2: Principles of Classification	. 5
2.1.3 Question 3: Coordination	.7
2.1.4 Question 4: Nutrition	11
2.1.5 Question 5: Gaseous Exchange and Respiration	14
2.1.6 Question 6: Cytology	18
2.1.7 Question 7: Reproduction	20
2.1.8 Question 8: Gaseous Exchange and Respiration	23
2.1.9 Question 9: Reproduction	26
2.1.10 Question 10: Transport	29
2.2 133/2 Biology 2	33
2.2.1 Question 1: Comparative Studies of Natural Groups of Organisms	34
2.2.2 Question 2: Regulation (Homeostasis)	39
2.2.3 Question 3: Growth and Development	42
2.2.4 Question 4: Genetics	46
2.2.5 Question 5: Evolution	51
2.2.6 Question 6: Ecology	57
2.3 133/3 BIOLOGY 3	62
2.3.1 Question 1: Comparative Studies of Natural Groups of Organisms	62
2.3.2 Question 2: Nutrition	77
2.3.3 Question 3: Comparative Studies of Natural Groups of Organisms and	1
Principles of Classification1	00
3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH TOPIC	•
	14
4.0 CONCLUSION	15
5.0 RECOMMENDATIONS1	16
Appendix A: The Candidates' Performance on Each Topics in 2021 ACSEE 1	19
Appendix B: Comparison of the Candidates' Performance on 133 Biology ACSE	E
between 2021 and 2022 by Topic 1	20

FOREWORD

The National Examinations Council of Tanzania (NECTA) is pleased to issue this Candidates' Item Response Analysis Report (CIRA) on the Biology for the Advanced Certificate of Secondary Education Examination (ACSEE), 2022. The purpose of this report is to provide feedback to all education stake holders and students on the achievement of the implementation of advanced level Biology syllabus in the classroom through the candidates' performance. This is because, primarily, the candidates' performance isan indicator of the effectiveness of classroom teaching and learning.

The report reveals the candidates' good performance on the ACSEE Biology subject since 99.26 per cent of the candidate passed the examination. The candidates' good performance was a result of their good mastery of the fundamental concepts, principles and skills of biological science as specified in the syllabus.

The topics which were well performed are: Evolution, Transportation, Growth and Development, Ecology, Comparative Studies of Natural Groups of Organisms, Gaseous Exchange and Respiration, Regulation/Homeostasis, Nutrition, Cytology, Reproduction, Coordination and Genetics. However, the topic Principles of Classification had weak performance.

NECTA expects that this feedback will help the prospective candidates to identify the strengths and weaknesses demonstrated by ex-candidates and work on them in the course of learning before sitting for the ACSEE. The feedback will also help teachers to identify areas where students have learning problems and take appropriate measures during the teaching and learning for improvement. Moreover, it is the NECTA's belief that education stakeholders will continue to take necessary measures for strengthening the teaching and learning of the Biology subject especially, those areas identified as challenging to candidates. This will ultimately enhance students' competenciens stipulated in the Biology subject syllabus for better performance in future examinations by NECTA.

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

Athumani S. Amasi EXECUTIVE SECRETARY

1.0 INTRODUCTION

This report presents the analysis of the candidates' performance in ACSEE Biology subject conducted on May 2022. The examination was set based on the 2019 Biology Subject Examination Format. It had three papers namely; 133/1 Biology 1, 133/2 Biology 2 and 133/ Biology 3. Biology 1 and 2 were theory papers, while 133/3 Biology 3 was a practical paper. The 133/3 Biology 3 practical paper was categorised into paper 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology C. The candidate was to sit for only one category. The 133/1 Biology 1 and 133/2 Biology 2, carried a total of 100 per cent each while the 133/3 Biology 3 weighed 50 per cent.

The 133/1 Biology 1 examination paper had 10 questions divided into sections A and B. Section A had seven (7) short answer questions. The candidates were required to respond to all questions. Each question carried ten (10) marks. Section B had three (3) structured/essay-type questions. The candidates were required to answer two (2) questions and each question carried 15 marks. As for the 133/2 Biology 2 examination paper six (6) structured/essay-type questions were contained therein and the candidates were required to respond to five (5) questions. Each question carried 20 marks. The 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology C papers had three (3) questions each. Question one (1) carried twenty (20) marks and the other two questions carried fifteen (15) marks each. The candidates were required to answer all the questions in whichever selected category.

A total of 27,534 school candidates sat for the examination where 99.26 per cent passed. Further analysis showing pass grades based on sex is presented in Table 1.

Sex	Grades					
	Α	В	C	D	Е	S
Male	18	636	4,158	6,963	2,910	237
Female	23	378	2,392	5,942	3,232	334
Total	41	1,014	6,550	12,905	6,142	571

Table 1: The candidates' Performance in Biology ACSEE 2022

Table 1 shows that most of the candidates (12,905) obtained D grade while few (41) of them obtained A grade, of which females were the majority (23).

The comparison of the candidates' performance between 2021 and 2022 reveals that the performance in 2022 has increased by 2.45 per cent.

The next part shows the analysis of the candidates' performance on each question in 133/1 Biology 1, 133/2 Biology 2 and 133/3 Biology 3 in the 2022 ACSEE.

2.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH QUESTION

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

2.1 133/1 - Biology 1

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

2.1.1 Question 1: Cytology

Part (a) of the question measured the candidates' competence pertaining to the effect of temperature to enzymes' action. The candidates were given a scenario that; A scientist placed $2cm^3$ of starch solution in a test tube followed by $2cm^3$ of saliva which was boiled to 75 ^{0}C . He then carried out starch test and observed a positive result.

The candidates were then required to briefly explain the observation. Part (b) measured the candidates' competence pertaining to the cell structure and function by requiring them to explain the advantages of the organelles to be bounded with the membranes.

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



Figure 1: Distribution of Candidates' Scores on Question 1

Figure 1 reveals the candidates' poor performance in question 1 since only 28.35 per cent scored from 4 to 10 marks out of the 10 marks allotted to this question.

The candidates who scored low marks (0 - 3) had inadequate knowledge of the effect of above optimal temperature on salivary amylase. They were also not aware that the structure of an enzyme is maintained by bonds which tend to break under above optimum temperature and cause distortion of their three dimensional shape. For example, one of the candidates wrote that *salivary amylase has strong ionic bonds that cannot be broken by* $75^{\circ}C$ *therefore starch is hydrolysed to maltose*. This candidate was not aware of the weak hydrogen bond present in enzyme molecule which can easily be broken by above optimal temperature. There were some candidates who did not understand the demand of the question as they tabulated the food test report in part (a). In part (b), most of the candidates wrote the functions of cell wall/cell membrane instead of the advantages of binding the organelles with the membrane. For example, one of the candidates wrote such an incorrect response as *cell membrane maintains the shape of the cell*. Another candidate wrote *cell membrane controls what enters or leaves the cell*. Extract 1.1 is a part of an incorrect response from one of the candidates.

01.	©				
	iost jor	Procedure	Observation	Interence	
	t'	2003 01 Starch			
	Stard	solution was added	The starch colution will	No starch	
		in a left tube	netrin the brown colour	was prosent	
		followed by rens	of lodine solution.	ų	
		on falive while	Because on additing		
		way boiled to	salive there is reachen		
		75°G.	that took place in the		
		And the Relippe	precence of Saliva anylaso		
		ap lodino selution	where stard was		
		none added to	converted to Maltose		
		the togettube			

Extract 1.1: A sample of the candidates' incorrect responses to question 1(a)

In Extract 1.1, the candidate responded to the question by tabulating the food test report in part (a) instead of explaining a positive starch test observed after adding saliva boiled to 75° C.

On the other hand, the candidates who scored average marks (4 - 5) obtained most of the marks in part (b) as they gave from one to two correct explanation on the advantages of the organelles to be bounded with the membranes. However, in part (a) they were aware that above optimal temperature causes denaturation/change of shape of the enzyme molecule but they lost some marks because they gave partial explanation on how denaturation is brought about.

The candidates who scored high marks (6 - 10) were knowledgeable about the effect of above optimal temperature $(75^{0}C)$ in salivary amylase. They were aware that when salivary amylase contained in the saliva is heated to the above optimal temperature, it becomes denatured. This is due to the increase of the kinetic energy which causes vibration of molecules of salivary amylase and breaks the weak hydrogen bond. This in turn, makes the enzyme unable to convert starch into maltose. Hence a positive result on starch tests. In part (b), the candidates demonstrated clear understanding of the advantages of the organelles to be bounded with the membranes.

1	Advantage of groanelles to be bough	
46	Membrane	
(1)	It helps to separate le matabalia	
$\square \leftrightarrow$	activities taking dage in the	
	Organolly from Po the all la	
	environment Example Initia	
	membrane in allow to all soone	
	photosupplases proposed and reparates	
<u> </u>	Secondary King in and mitechandrig	
	transford fulling cycle and dearon	
	Stansporr system,	
60	It much clark	
	In provide selective absorption of	
	alerals in the Organeties. Materials	
	entering the organities are selectively	
	absorption to ensure raw materials	
	ervers the organetic and end products	
	leave the Organelle.	
(393)		
(10)	at helps to separate the hydrolytic	
	enzyme present in Organelles such as	
	ysosome from the cell environment.	
	Lt offers protection by preventing	
	the hydrolytic enzymes contained	
	in the organelles such as hisosome	
	and vacuate which can eause	
	autolysis	

Extract 1. 2 is a sample of responses from the candidate who scored high marks.

Extract 1.2: A sample of the candidates' correct responses to question 1(b)

In Extract 1.2, the candidate correctly described the effect of temperature on salivary amylase and clearly explained the advantages of binding the organelles with membrane(s).

2.1.2 Question 2: Principles of Classification

The question measured the candidates' competence concerning with taxonomic keys where in part (a) they were required to give reasons as to why biologists needed a biological key. In part (b), they were required to

describe the procedures of constructing a dichotomous key and explain how it is used.

The question was attempted by 100 per cent of the candidates. The analysis of the candidates' performance is presented in Table 1.

Scores	Description	Per centage of Candidates
0 - 3	Weak	82.10
4 - 5	Average	16.72
6 - 9	Good	1.18

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

Table 1 reveals that the candidates' general performance in this question was weak because only 17.90 per cent of the candidates scored from 4 to 9 marks. This question was the poorest performed one.

The candidates who scored low marks (0 - 3) demonstrated lack or partial knowledge of the tested concepts. These candidates either constructed the dichotomous key instead of describing its construction and use, or described the procedures for using dichotomous key instead of how to construct it. For example, one of the candidates wrote: *In constructing the key the organisms with most distinctive features will first be grouped; keep on subdividing until the last individuals are distinguished*. Another candidate wrote: *Take one organism and observe its external features (ii) Matching organisms' features to the contrasting feature in the key (iii) Choose statement which match to the features of the organism in the couplet (iv) Follow the instruction stipulated in the matched statement until the name of the organism is obtained*. Extract 2.1 shows a sample of incorrect responses from one of the candidates.

2 @ That because the biological key gives more information about the organism	
2 D (1) + Analyse the features of each organisms.	
+Identity the common teature on the organisms.	
+ Compare the organisms by using the common features.	
-+ Construct the Dichotomous Key while following the order of common to less common feature.	

Extract 2.1: A sample of the candidates' incorrect responses to question 2

Extract 2.1 shows that in part (a), the candidate stated the advantage of a natural system of classification instead of the significance of a biological key. In part (b)(i), the candidate mixed up the procedures for constructing a key and the one for using the constructed key to classify organisms.

The candidates who scored average marks (4 - 5) lost some marks in part (b) (i) because they gave incomplete procedures for constructing a dichotomous key.

The candidates who scored high marks (6 - 10) had adequate knowledge pertaining to the importance of biological keys. In addition, they were aware of the ways for constructing and using the dichotomous key. Therefore, in part (b)(i), they pointed out important procedures for constructing dichotomous key such as; collection of data by laying out the organism to be keyed in front of you, recording of data on note card by listing the species to be key along one side and the character to study along the other side. The procedure continues by grouping organisms with the most distinctive features by starting with features that separate the living things to be keyed into two groups of similar number, using two statements of 'present' vs 'absent' to make couplets usually starting with a noun, and then continue to subdivide the organisms until the last individuals are distinguished.

In part (b)(ii), the candidates explained how to use a dichotomous key in identifying the organisms by taking one organism and observe its external features. The procedure continues by matching the features of the organisms to the first contrasting features in the key, choosing the statements which resemble to the features of the organism in the couplet/key number one and following the instruction stipulated in the matched statement until the name/group of the organism is obtained.

2.1.3 Question 3: Coordination

The question measured the candidates' competence in the nervous coordination in mammals. Part (a) required the candidates to explain what would happen to organisms if their nervous system is severely damaged. In part (b) the candidates were provided with Figure 1



Figure 1

Then the candidates were required to identify with reason the type of neuron represented by the figure. In addition, they were required to explain what would happen if each of the parts labelled A and B would be severely damaged.

The question was attempted by all the candidates (100%). The candidates' performance is shown in Table 2.

Scores	Description	Per centage of Candidates
0 - 3	Weak	61.06
4 - 5	Average	33.07
6 - 9	Good	5.87

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

Table 2 indicates an average performance in question 3 since 38.94 per cent of the candidates scored from 3.0 to 9.0 marks.

The candidates who scored high marks (6 - 9) had sufficient knowledge concerning with the functions of the nervous system. Therefore, in part (a), they correctly stated the effects that organism will face if the nervous system is severely damaged. For instance, they stated such effects as failure of the neurone in detecting the stimuli, transduction and transmission of the impulse. In part (b), they demonstrated clear understanding of the structures of all types of neurons and their features such that they correctly identified the type of neuron presented by Figure 1, as sensory/afferent because the nuclear is at the middle/not at the end of the neuron. Moreover, they were aware of the role of Nissl's granule in the neuron that is the production of proteins and enzymes. They were also aware of the myelin sheath that provides insulation and speeds up the transmission of impulse along the

nerve. Therefore, they correctly explained the effect that an organism will face if the given parts (A: Nissl's granule and B: myelin sheath) will be severely damaged. Extract 3.1 shows responses of a candidate who scored high marks in this question.

20	In the parine action to several damage of	
305	There will be no detable on name limited term tiller	
	is more all the no clearter of arrow imposes from the	
	informal or external (re body.	
	-> This is just because the assence of sensory requirements	
	which are found on the teniory organi	
	(in there will be no transduction up herve imposes into herve	
	<u>Signals</u>	
	-b The nerve celle du play part in transducing the inerve	
	Impulses Into nerve signals before propagation to the central	
	norveus system, so is there will be no neurones also, this	
	handuction will not occur.	
	din There will be no propagation of nerve signals to the	
L	central nervous system (brain and spinal cord).	
L	-p. This is because op the absence of relay and remony neurone	
	thur, there is no conduction up impulses	
	rivo. There will be no reponse from the central nervous system	
	to the expectors with respect to the impulse triggered.	
	-D The motor nones do bring back the response, from	
	Ite central nervous system to the exectors (muscles and	
	glands), so ip no motion neurones there he no	
	reno onse	

Extract 3.1: A sample of the candidates' correct responses to question 3(a)

In Extract 3.1, the candidate demonstrated good competence related to nervous system in mammals by pointing out the effects of damaging the organism's nervous system.

The candidates who scored the average marks (4 - 5) had insufficient knowledge of the functions of the nervous system. Therefore, in part (a), they correctly stated the effects that an organism will face if its nervous system is severely damaged. Likewise, in part (b)(i), they gave correct identification of the neuron. However, in part (ii), they were not aware of the functions of the parts labelled A (Nissl's granule) and B (myelin sheath)

hence they gave incorrect explanation on what would happen to the neuron if that parts were severely damaged.

On the other hand, some candidates who scored low (0 - 3) marks had inadequate knowledge concerned with the functions of the nervous system. Therefore, they either scored no marks in any part of the question or scored few marks in one part. Most of the candidates regarded neuron as sense organs and gave responses such as: if the nervous system is severely damaged an organism would not be able to see; an organism would not be able to hear and an organism would not be able to sense or touch. In part (b), they identified the type of neuron as *myelin neuron* which was not correct because myelin is not a neuron but a protective sheath that surrounds the neuron. Another candidate incorrectly identified part A as nucleus instead of Nissl's granule and wrote; if it is severely damaged the neuron will die. There was also a candidate who identified part A as mitochondria and wrote: if it is severely damaged energy production will not occur. On the other hand, one of the candidates incorrectly identified part B as axon instead of myelin sheath and wrote: *if it is severely damaged* there will be low rate of metabolism. Extract 3.2 is a sample of weak responses from one of the candidates.

3 67	
iii) if part A is damaged.	
01: Low energy production.	
· The production of energy decliner when the part is	
damaged since it is the part where the mituchondia	
(energy synthesizing organelles) are found	
02 loss of control of the all	
nucleus which is exclusively found in part A hence	
! It's damage means damage to the nucleur.	

Extract 3.2: A sample of the candidates' incorrect responses to question 3(b)(iii)

Extract 3.2 shows that, in part (b)(iii), the candidate incorrectly identified part A as nucleus instead of Nissl's granules. Hence he/she wrote; *if part A is damaged, low energy production will occur*. The candidate was not

aware of mitochondria as the ones concerned with energy production and not the nucleus.

2.1.4 Question 4: Nutrition

The question assessed the candidates' competences pertaining to food manufacturing in plants (photosynthesis). In part (a), the candidates were required to explain how light energy from the sun is trapped and collected to the photosystems. In part (b), they were supposed to explain how electron transport takes place in photosystem I (PSI) and II (PSII).

The question was responded by all the candidates (100%). The candidates' performance was weak as shown in Figure 2.



Figure 2: Distribution of Candidates' Scores on Question 4

Figure 2 shows that the performance of the candidates was weak because more than half of the candidates (69.81%) scored from 0.0 to 3 marks.

The candidates who scored low marks (0 - 3) either gave incorrect response to all parts of the question or gave some correct responses in part (a). The candidates who scored zero, were not conversant with the trapping of solar energy which is done by green pigment called chlorophyll. The pigments act as funnel by collecting photons of light as they are arranged in association with proteins and lipid molecules in the thylakoids membrane/grana of the chloroplast. Then, the pigments transfer the energy into special molecules of chlorophyll in a reaction centre that is photosystem I abbreviated as PSI (P700) and Photosystem II abbreviated as PSII (P680). Therefore, in part (a), these candidates failed to explain how energy is trapped from the sun. Some of the incorrect responses given by candidates the were: solar trapped through energy is

photophosphorylation. These candidates were not aware that photophosphorylation is the formation of energy in form of ATP using energy from the sun.

In part (b), these candidates failed to understand that when light is absorbed by a chlorophyll molecule in the reaction centre PSI, an electron is displaced and transferred to a protein called electron acceptor. The electron acceptor passes the electron downhill to Nicotinamide Adenine Dinucleotide Phosphate (NADP) which is reduced to NADPH. The energy released is used to form ATP. Some electrons go back to photosystem I to fill the left gap. On the other hand, when PSII absorbs light, an electron is displaced from it and passes to the electron acceptor. The electron is then passed along a chain of electron carriers including cytochrome and pay back the electron that was displaced from PSI. The electron deficit created in photosystem II is payed back by electrons from photolysis of water.

In part (b), most of the candidates mixed up the transfer of electron in PSI and PS II. For example, one of the candidates wrote; *the gap left by electron excited from photosystem I will be replaced by electron from photolysis of water*. This is incorrect because the electron from photolysis of water pays back the deficit of electron in photosystem II. There were also some candidates who listed some components of the photosystems I and II instead of explaining how electron transport takes place in the photosystems I (PSI) and II (PSII). Extract 4.1 is a sample of an incorrect response from one of the candidates.

4a.	The Process of Photosynthesis involves trapping of sun Light	
	anarroy and collection It to photosyllim, the process takes	
	Dlace Through PHOTOPHORPHORYLATION:	
	Photo phaphory lation -	
	Involves the additional of Inormanic phaphate to ADP	
	In order to form ATP by Living anavoy from the sun.	
	- Photophaphary lation involves two types which are.	
	(Velic and pon- cyclic photophosphory lation,	
	(V diz photophory lation:	
	Involver (valic Leavement of election when	
	Its Goo Light Strike Photosyltem I (PII).	
	- Cyclic Dhate pharpharylation include the Following,	
	electron acceptor (Cytechnome), ATP and RUBISLO	
	nazvmo:	
<u> </u>	Non-Cyclic phataphosphorylation,	
	- Involver MoveMent or eladion botween two photosystem	
<u> </u>	and to the electron acceptor,	
	and to me there each	
4 h.	Flation transport to kee place in photosystem ICATI	
4-1-1-	and PST by the Following Way.	
	- ID Photovitem T TPSET.	
<u> </u>	In photographic (PIT) election trampart takes	
	Diaro by involving alortrop acceptor, I (15 (humo),	
	ATP and PURISCO Enzyme.	
	7.11 and purples - //	
	In Photosyctem TI.	
	- To photo wdem Ti electron trambort takes place	
	by Involving election acceptors, NADHO, photosyste	
	MI T and enzyme.	

Extract 4.1: A sample of the candidates' incorrect responses to question 4

In Extract 4.1, the candidate explained cyclic and non-cyclic photophosphorylation in part (a) instead of the process for capturing and collecting energy from the sun. In part (b), he/she identified some components of photosystems instead of explaining how electrons moves in the photosystems.

The candidates who scored average marks (4 - 5), most of them obtained the marks in part (b) by explaining three to four points on how light energy from the sun energy is trapped and collected. However, in part (a) they did not score any marks.

The candidates who scored high marks (6 -10) had enough knowledge of photosynthetic pigments which trap light energy from the sun. Therefore, in part (a), they correctly explained how light energy from the sun energy is trapped and collected. Moreover, they were aware that the electron from PSI takes cyclic pathway while the one from PSII I takes non-cyclic pathway. Therefore, they correctly explained how electron transport takes place in the photosystems. Extract 4.2 is a sample of correct responses from one of the candidates who scored high marks.



Extract 4.2: A sample of the candidates' correct responses to Question 4(b)

In Extract 4.2, the candidate correctly explained how electron transport in photosystem I takes place. He/she was aware that electron in PSI takes a cyclic pathway.

2.1.5 Question 5: Gaseous exchange and respiration

Part (a) of the question measured the candidates' competence related to gaseous exchange in mammals where they were required to justify the need for respiratory surface to have; large surface area to volume ratio, thin membrane, moist surface and permeable membrane. In part (b), the question measured the candidates' competence concerned with the fate of pyruvic acid under anaerobic respiration. Specifically, the candidates were required to explain how pyruvic acid is converted to ethanol.

The candidates who attempted this question were 100 per cent where 72.10 per cent passed. Further analysis of the performance is shown in figure 3.



Figure 3: Distribution of Candidates' Scores on Question 5

Figure 3 indicates that the performance on the question was good owing to the fact that about three quarters of the candidates (72.10%) scored from 3.5 to 10 marks.

The candidates who scored high mark (6 - 10) have correctly justified the need for the respiratory surface to have features such as large surface area to volume ratio, thin membrane, moist surface and permeable membrane. Moreover, they were aware of the ways through which pyruvic acid is converted to ethanol. Extract 5.1 is a sample of the correct responses from one of the candidates.

.5 alig Large surface and to volume ration enables	
effective exchange of respiratory gates in a	
given repiratory surface	
in Moist surface is errential for a respiratory surface	
so as to ensure that the respiratory gases diffuse	
in jolution form and hence priviling quick exchange	
0 0020	
is This membrane is essential as it reduces distance to	
which diffusion takes place as a result it enables	
tait ratate of diffuscion of respiratory gards across	
a given respiratory surface.	
9	
iv Poincable meriliane enables easy passage of the	
respiratory pases across the respiratory surrage and	
Heretore helps in easy dispusition of open.	
5 Punivate is converted # to ethanol as tollows.	
- is Puruvate is writ converted to ethanal in the	
dellace of decurtexulate ensure.	
Puruvate decarborulage enzymy Ethanal	
0.1	
is The formed Ethanal 11 reduced to form Sthand	
during anaeropic respiration in plants.	
NADHTH' NAD	
Ethanal > Ethanol	

Extract 5.1: A sample of the candidates' correct responses to question 5

In extract 5.1, the candidate correctly explained the reason for the respiratory surface to have features such as thin membrane which increases the speed to which the gas to passes through. Also he/she was aware that in the absence of oxygen pyruvate is decarboxylated then reduced to ethanol.

The candidates who scored average marks (3.5 - 5.5) lost some marks in part (b) because they were not aware of the ways through which pyruvic acid is converted to ethanol. Some mixed the coenzymes NAD used in fermentation with NADP that is used in photosynthesis. There were also some candidates

who wrote hydrogenation as the first stage of conversion of pyruvate to ethanal instead of decarboxylation.

The candidates who scored low marks (0 - 3) either wrote incorrect responses in all or most of the parts. Some of the incorrect responses written in part (a) were; *permeable membrane facilitates the reabsorption of water content in the plant increases, respiratory surface needed to be moist in order to neutralize the concentration of gases so as it can be in a form that can be used in respiration* and *thin membrane allows large amount of air to pass through.* In part (b), one of the candidates wrote; *pyruvic acid can be converted to ethanol by removing oxygen from the pyruvic acid.* All these responses indicate the candidates' partial knowledge of the tested concepts. Extract 5.2 is a sample of the incorrect responses from one of the candidates.

5.	(a) Q Large surface area to volume ratio	
	Respiratory usurgade have large surgace area to	
	Volume ratio this is because, the respiratory	
	surrace they transport materials in the body.	
	to release every such as Oxygen gas in the body	
	Moirt rurrace	
	The body of living organisms it is moust surface	
	to release energy to the respiratary surface	
	take place and "occur faster ()	
	(II) This membrase	
	Reprindenty it is this so forge small organisms	
	can penetrate into the body scompared its large	
	omicro bacteria	
	(W) Permeable membrane.	
	The air or Oxygen gas is very penetrale faster	
	and other respiratory surrace materials in	
	the body because lit is permeable membra	
	ne	

Extract 5.2: A sample of the candidates' incorrect responses to question 5(a)

In extract 5.2, the candidate incorrectly described adaptive features of the respiratory surfaces. This candidate lacked the understanding of adaptation features of the respiratory surface.

2.1.6 Question 6: Cytology

Part (a) measured the candidates' competence regarding the importance of features of the cell membrane. Specifically, the candidates were required to explain what will happen if the cell membrane lacks antigens. Part (b) measured the candidates' competence pertaining to the constituents of the cell (water) where they were required to explain the importance of water to plants.

The data show that all candidates (100%) responded to the question. The analysis of their performance is shown in Figure 4.



Figure 4: Distribution of the Candidates' Scores on Question 6

Figure 4 indicates that 71.25 per cent of the candidates scored from 3.5 to 10 marks while 28.75 per cent scored from 0 to 3 marks.

The candidates who scored high marks (6 - 10) were aware of the roles of antigens in the membrane of the cell which are; identification markers, cells recognition and metabolic activities. Thus, in part (a), they correctly explained what will happen if the cell membrane lacks antigens. Moreover, they were aware of the importance of water for physical and chemical processes of the plant such as germination, photosynthesis, fertilization (in lower plants), opening and closing of stomata, cooling and transportation of solutes in the phloem. Extract 6.1 is a sample of the part of the correct responses from one of the candidates.

()		
6	b. Mays at which water & Important to plants	
	> Helps to cod the plants	
	in Helps In the transportation of mineral salts within	
	the plants 2	
	in Helps To metabolic process of the plant like photomorphism	· · · · · · · · · · · · · · · · · · ·
1	and respiration.	
	in there in the movement of all nutrients from the	
	source to the sink in the plant by man flow	
	with the phluen tiber.	

Extract 6.1: A sample of the candidates' correct responses to question 6(b)

In Extract 6.1, the candidate gave correct importance of water to the plants such as cooling, transport and metabolism.

The candidates who scored average marks (3.5 - 5) obtained most of the marks in part (b) as they explained two to three importance of water to plants. However, in part (a), they lost all the marks because they were not aware of the roles of antigens in the membrane of the cell.

On the other hand, the candidates who scored low marks (0 - 3) either gave incorrect responses in all parts of the question or obtained one to two points in part (b) but not in part (a). In part (a), some of the candidates incorrectly regarded antigen as a protective cover of the cell as they wrote: *if cell lack antigen it will die because it will not have a protective cover, it will be damaged.* In part (b), Extract 6.2 is a sample of incorrect responses from one of the candidates.

L		
6.	a) A cell : Is the basic fundamental unit of life	
	of the organisms, as it is known that all I Ming -	
	orsanisms are compared of a cell, then one of the-	
	parts of a cell is cell membrane. then the cell	
	membrane will lack antigens the following will	
	happen.	
	the cell will be damaged since one of the	
	biggest role of the cell membrane is to protects the	
	cell from being damased.	
	the cell will die thus it will not work since -	
	the protective layer of the cell has damased.	
	. Therefore inorder for the coll to work its -	
	membrane should be active thus it should contains all	
	the important need including antigens.	
6.	b) Water is a chamical substance made up of indeuly	1
	of hydrogen and molecules of oxusen. Water is very	
	important to plantis due to the following versions.	
	1+ abb as a PH in plants.	

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

In Extract 6.2, the candidate responses focused on the role of the cell membrane instead of the antigen. Also the candidate stated the chemical composition of water which are hydrogen and oxygen instead of explaining the importance of water to plants.

2.1.7 Question 7: Reproduction

Part (a) of the question required the candidates to trace the correct order of the parts of the ovary through which pollen tube must grow in order to reach the embryo sac and to identify a part which performs similar function as umbilical cord in human being. In part (b), the candidates were required to identify parts of the seed which will develop from each of the parts B, D, G and F, and the fate of parts A and I after fertilization.



The data show that all candidates responded to the question. The analysis of their performance is shown in Table 3.

Scores	Description	Per centage of Candidates
0 - 3	Weak	81.94
3.5 - 5	Average	12.87
6 - 10	Good	5.20

Table 3 indicates a weak performance in question 7 since more than three quarters of the candidates (81.94%) scored below the pass marks (0 - 3) and none of them scored all the 10 marks.

The candidates who scored low marks (0 - 3) either gave incorrect responses in all parts or gave one correct point in part (a)(ii) and/or (b) (i). In part (a) (i), most of the candidates were not aware of the roles performed by each part of the flower. Therefore, they failed to trace the correct pathway taken by a pollen tube towards the embryo sac. For instance, one of the candidates wrote such incorrect responses as; A: *style*, B: ovary wall, C: nucellus and D: integuments instead of A, B and I. Likewise in parts (b)(i), one of the candidates incorrectly wrote; part B will develop into fruit while G will develop into seed instead of B will develop into pericarp and part G into endosperm. Extract 7.1 is a sample of the incorrect responses from one of the candidates.



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

In Extract 7.1, the candidate gave incorrect order through which the pollen tube must grow in order to reach the embryo sac, that is C; Chalaza, D: Integument and I: Micropyle. He/she also gave incorrect changes which occur to the flower after fertilization such as development of G into fruit instead of endosperm.

The candidates who scored average marks (4 - 5) scored most of the marks in part (a) but not in part (b). On the other hand, those candidates who scored high marks (6 - 10) had enough knowledge of the functions of different parts of a flower as they correctly listed the order in which pollen tube must grow to reach the embryo sac. They were also aware that funicle (E) has the same function as the umbilical cord in human being. Moreover, they had clear understanding of the changes which occur in the flower after fertilization. Extract 7.2 is a sample of the correct responses from one of the candidates.

7.	a) i) The pollowing in the order which the
	pollen lube will more in wany until it reach
	the endoys lac.
	- A
	- B
	- [
	ά) E
	b) B will develop to Reviscourp.
	D will develop to Seed coat
	G will develop to endorperm
	F will disintegrates
7.	b) 11) A will disintegrates
	I will Scar on the fruit.

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

In Extract 7.2, the candidate demonstrated good mastery of the concept of changes which occur in a flower after fertilisation. He/she wrote correctly the order through which the pollen tube must grow in order to reach the embryo sac and also the changes which occur in the flower after fertilization.

2.1.8 Question 8: Gaseous Exchange and Respiration

The question measured the candidates' competence with regards to respiration, specifically in identifying the essential features in glycolysis, Krebs' cycle and electron transport chain and explains how electron transport chain occurs in aerobic respiration.

The question was attempted by 38.00 per cent of the candidates. It was the least attempted question among the optional questions. Figure 5 illustrates the candidates' performance in question 8.



Figure 5: Distribution of the Candidates' Scores on Question 8

Figure 5 shows that the candidates' performance on Question 8 was poor because more than half of them (68.01%) scored below average marks (0 - 5).

Most of the candidates who scored low marks (0 - 5) either lacked/had inadequate knowledge of essential features of glycolysis, Krebs' cycle and electron transport chain. Those who scored from 1 to 5 marks gave two to three correct features of glycolysis and Kreb's cycle. However, they were not familiar with the way electron transport chain in aerobic respiration takes place. Thus they lost most of the marks in this part. There were also some of the candidates who gave incorrect features of glycolysis, Kreb's cycle or Electron transport chain. For example, some candidates drew the diagram showing Kreb's cycle instead of analysing its essential features. Another candidate wrote the features of electron transport chain as; *electron chain takes place in the cytoplasm and its hydrogen emits ATP*. This candidate was not aware that electron transport chain takes place in the cristae and it is characterised by oxidation and reduction. Extract 8.1 is a sample of incorrect responses from one of the candidates.

8 Features on the stages of glycolysis, krebs cycle	
and electron transport chain Includes the following.	
A In Glycolysis.	
is the process occurs in the Cutoplasm	
is the process of aucolysis Tavolves series	
of steps to form pyruvic, acid.	
B In kreb's cycle	
is the process occurs in the mitochondria.	
is the Involves convetion of pyruvic acid to	
acetul co A so as it can proceed with the	
stages Iseries.	
<i>C</i>	
C In Electron transport chain.	
is its occurs in the cartochondria.	
is its involves formation of energy from	
electrons and	

Extract 8.1: A sample of a part of the candidates' incorrect responses to question 8

In Extract 8.1, the candidate wrote site of occurrence of glycolysis, Kreb's cycle and electron transport chain instead of their essential features. He/she also gave the end products in each process of which, some are not correct. For example, the acetyl CoA is not the product of Krebs cycle but the product formed in a transition stage that is the stage between glycolysis and Kreb's cycle.

The candidates who scored average marks (5.5 - 8.5) correctly explained some essential features of glycolysis, Krebs' cycle and electron transport chain. However, they gave partial explanation pertaining to the way electron transport chain takes place as a result they scored from 1 to 2 marks in this part.

The candidates who scored high marks (9 - 15) demonstrated good understanding of the features of glycolysis which are phosphorylation of the sugar, lysis of the phosphorylated sugar and oxidation by dehydrogenation. They also pointed out the features of Krebs' cycle which

are decarboxylation and oxidation by dehydrogenation. As for electron transport chain, they pointed out oxidation and reduction. Moreover, they outlined correct events of electron transport chain by pointing out the transportation of electron and hydrogen proton from one complex to another while releasing energy which is harnessed for the combination of ADP and Pi to form ATP. Extract 8.2 is a sample of a part of the correct responses from one of the candidates.

8 Glucose molecules releasing energy which passes
in three stages such glycolyne, Kreb cycle and electron
transport chain. The following are escential penburg
of each stages were follows as
Glycolysis
phosphorylation of sugar molecules, which involves
the we of ATP molecules
Lyces of sugar and exidation by dehydrogenase
This involves the splitting of the glucose molecule

Extract 8.2: A part of the candidates' correct responses to question 8

In Extract 8.2, the candidate gave correct essential features of glycolysis such as phosphorylation of sugar, lysis of sugar and oxidation by dehydrogenation.

2.1.9 Question 9: Reproduction

The question measured candidates' competence concerning the fertilization and zygote development in mammals where they were required to explain why should mammalian placenta be formed immediately after implantation.

This question was chosen by 86.83 per cent of the candidates. It was the most chosen question among the optional ones. The performance of the candidates in this question is summarised in Figure 6.



Figure 6: Distribution of the Candidates' Scores on Question 9

Figure 6 shows that about half of the candidates (62.28%) passed the question by scoring from 5.5 to 15 marks. This indicates a good performance.

The candidates who scored high marks (9 -15) were aware that foetus development depends on the mother for nutrition, excretion, gaseous exchange and protection against pathogens. They were also aware that the placenta produces hormones such as progesterone and oestrogen which are important for maintaining the uterus wall. Thus, they gave correct responses. Extract 9.1 is a sample of the correct responses to the question.

<u> </u>		
9	Placente; This refer to the part that join the.	
	poetus to the Mother through umbilical cord	
	when fetus II implated placenta of formed 10 as to	
	serve sevatat function;	
	Transport of putrient : such as amino and,	
	lafty and, glucose are transported from miller	
	to the fecture via umbilicat cord to as to ensure	
	growth of fefus.	
	Transport, of waste materials: The placente.	
	through umbilical cord remove the waytes making	
	from the feture to maker and matter remore within	
	through excretion 1	
	Exchange of respiratory gases. Placenter public	
	He transport of axygen Tiem miller to the feeling	
9	This because the feetus has high affinity to exygen	
	than mother But als removed of carbondiexide gas	
	from foefus .	
	projective barrier; ne placonta' act to	
	protect the embry o from any discose and infection	
	hence placenter prevent toxic material from entering	
	the pombry of se as to possive furviva of emby o'	
	Passage of notifiedies: The placenter through	
	umbilical intel encure payage of antibodies from	
	million to deplice we as to improve the between immunity	
	ease to be recipront to infortion and disease 1:	
	Production of homenousta Provide it	
	incoming the for an full of the second that soles to	
	referinged for production of homenes had enter to	
	The block your to enture growin of the foreful.	
	tience, the placenta strutter is formed immediately	
<u> </u>	after embryo embedded to uterine wall seas to	
	ensure survival and development of the embryo	

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

In Extract 9.1, the candidate demonstrated good understanding of what placenta is and the roles it plays in an embryo such as nutrition, gaseous exchange and protection.

The candidates who scored average marks (5.5 - 8.5) had insufficient knowledge about the dependence of the foetus depend on the mother when in the womb as they wrote proper explanation about placenta in introductory part and explained correctly not in more than three to four points regarding the importance of placenta being formed immediately after implantation.

However, some candidates scored low marks (0 - 5). Those who scored zero were not aware of the roles of the placenta to embryo. Those who scored from 1 to 5 marks gave incorrect responses mixed with the correct ones. For example, one of the candidates considered placenta as a respiratory organ as he/she wrote; it has moist surface and gas diffuse easily through it. Another candidate wrote; placenta is important as it produces antibodies that prevent the foetus from infection. This candidate failed to understand that antibodies are not produced by placenta but pass from the mother to the foetus. There were also candidates who wrote; immediate formation of the placenta helps in exchange nutrients. These candidates were not aware that placenta exchange gases but not nutrients, waste products or anything else. There were some candidates who regarded placenta as a bag which contains the baby. These candidates wrote; the placenta being a sac acts as a shock absorber, it protects the foetus from mechanical damage. They seem to have confused the placenta with embryonic membranes such as amnion and chorion.

2.1.10 Question 10: Transport

The question measured candidates' competence pertaining to the concept of transport in vertebrates by requiring them to explain how oxygen is transported in the human body.

This was the second most opted question since it was attempted by 75.16 per cent of the candidates. The analysis of the candidates' performance in this question is shown in Figure 7.



Figure 7: Distribution of the Candidates' Scores on Question 10

Figure 7 illustrates an average performance where about half of the candidates (49.70%) scored from 5.5 to 15 marks.

The candidates who scored high marks (9 - 15) had adequate knowledge about how oxygen is transported in mammalian body. They were aware that high concentration of oxygen gas in the lungs creates concentration gradient between lungs and blood thereby causing oxygen to diffuse into the blood. They also realized that, in the blood stream, oxygen combines with the respiratory pigment called haemoglobin to form a complex compound called oxyhaemoglobin. They further realized that, when oxyhaemoglobin reaches the area where there is low concentration of oxygen it dissociates to release oxygen. Similarly, they were aware that large amount of oxygen (97 - 98%) is transported in human body in form of oxyhaemoglobin, and that the remaining per cent of oxygen (2 - 3%) dissolves in blood plasma and it is transported in the body. Extract 10.1 is a sample of the candidates' correct responses.

L		
10	Oxygen yas is very important you to the	
	life of living things like animate, including animal	
	Since when unimals like human being lack oxyge	
	1 yes, the human being would dip.	
	The full wing are the way through	
	which uxyyen wild be transported in human hody	
	and this ways are ?	
	As solution form . Oxygen yas in	
	human body can be transported a solution form since	
	It dissolves into the blood plasma and is could	
	be transported to a solution form, Note the per	
	centage in which oxygen can be then sported in	
	It is form 1 about 2%. It is unly live perce	
	ntage but of 100% can be transported in this	
	form.	
	As Oxyhaemuglubin; Also Iti	
	another way is which axinger in he transported	
	in the Lody of an organism, according to this	
	way oxygen is transported from region that	
	with high participre usure of	L
	oxygen that is called Lungs to the resion	
	with low partial pressure of oxygen that is	
	celled Budy Hillie, It is unly 9'8% of	
	uxyyen that is transported in this way	L
		L <u></u>

Extract 10.1: A sample of a part of the candidates' correct responses to question 10

In Extract 10.1 the candidate demonstrated good understanding of the concept of transport of oxygen in human. He/she was aware that oxygen being an important gas for aerobic organisms it has to be transported from the lungs to the body tissues for respiration. He/she knew that large amount of oxygen is transported in the form of oxyhaemoglobin.

The candidates who scored average marks (5.5 - 8.5) gave a correct introduction and described one or two ways through which oxygen is transported in the mammalian body.
On the other hand, the candidates who scored low marks (1 - 5) obtained most of the marks from the introduction and conclusion parts. In addition, they partially described one way by which oxygen is transported in human body. Some candidates mixed up some points. For example, one candidate wrote; when oxygen enters in the haemoglobin it is then taken to the lungs instead of oxygen combines with haemoglobin to form oxyhaemoglobin which is later transported to the body tissues. Another candidate wrote; small amount of oxygen is transported via white blood cells instead of small amount of oxygen dissolves in blood plasma.

The candidates who scored zero mixed up transportation of oxygen and carbon dioxide such that some of them explained how carbon dioxide is transported instead of oxygen. Others explained about the factors which determine the unloading of oxygen such as carbon dioxide concentration, and pH. Extract 10.2 is a sample of the candidate's incorrect responses to question 10.

10	Orwarn in transported to all parts of the body, through	
	several parton that enable the unbading of oxygenin	
	the body ;	
	i) cultondioxi de concentration	
	loading or withondrowdr gas in the hormoglobin bund	
	rauses the release of caugin in the human body, also,	
	the increase of epideodioaide concentration in the lungs	
	needs to be loaded and then transported,	
	Due to this effect, both effect, oxygen is released in human	
	bedy so that as bondioxide can be loaded and also	
	transported.	
	U l'emperature	
	Oxygen forms a bond with harmoglobin, called oxyharm	
	oglobin, this bond can easily be broken when temperature	
	increases due to increase in imetabolic activities	
	The bond is thus broken and oxygen is released in the human	
	body through that, axygen can be equily reaching to	
	oll nurts or the body,	
	(iii) Icu pri	
	when the pill is low, it means that it is audic medium.	
	which causes the readily release of oxygen, because	
	the bond with harmoglobin is strong in high pt than in	
	low pit, hence oxygen will be release and the harmog-	
	lobin would occupy the hydrogen ions to replace the	
	oxygen released. Hence this enable oxygen to reach	
	all parts or the hedge	

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

In Extract 10.2 the candidate incorrectly pointed out some factors responsible for oxygen unloading such as temperature, carbon dioxide concentration and pH instead of ways through which oxygen is transported in human.

2.2 133/2 Biology 2

This paper was composed of six topics, namely; Comparative Studies of Natural Groups of Organisms, Regulation (Homeostasis), Growth and Development, Genetics, Evolution and Ecology. Each topic contributed one question carrying 20

marks. The candidate was required to attempt only five questions. The pass mark for each question was from 7.0 to 20.0 marks.

2.2.1 Question 1: Comparative Studies of Natural Groups of Organisms

The question had parts (a) and (b). Part (a) required the candidates to describe structural similarities and differences between the bodies of birds and mammals while in part (b) they were required to explain how amphibians adapt to their environments.

The question was opted by 90.09 per cent of the candidates of whom 23.75 per cent passed. Further analysis of the candidates' performance is shown in table 4.

Scores	Description	Per centage of Candidates
0 - 6.5	Weak	76.25
7 - 11.5	Average	21.90
12 -18	Good	1.85

Table 4: Distribution of the Candidates' Scores on Question 1

Table 4 indicates a weak performance in question 1 since more than three quarters of the candidates scored below average marks (0 - 6.5). There were no candidates who scored above 18 marks.

The candidates who scored low marks (1 - 6.5) had partial knowledge about the characteristics of birds and mammals. They obtained some marks by giving one to three similarities and/or differences between birds and mammals. In part (a), some candidates wrote differences such as; *birds have two limbs and mammals have four limbs*. The candidate was not aware that birds and mammals have four limbs however, in birds the fore limbs are modified for flying while those in human being are used for holding things. Another candidate wrote; *birds move by flying and mammals by walking*. The candidate was not aware that birds also do walk and run by using hind limbs. There was also one candidate who wrote; *birds have small body size compared to mammals*. This candidate did not know that the size of both birds and mammals vary from small to large.

In part (b), the candidates provided incorrect adaptive features of amphibians such as, *amphibians have strong limbs*. These candidates were not aware that the hind limbs are the ones which are strong for jumping or leaping. Another response was, *all amphibians have tails for swimming*. This candidate was not aware that it is webbed hind feet that are important for swimming and not the tail. Another candidate wrote: *have hard and tough skin which aid about temperature regulation*. This is incorrect because amphibian have smooth and moist skin which is sometimes used for gaseous exchange but not for temperature regulation. There was also a candidate who wrote; *amphibians release eggs in different form*, instead of amphibian lay large number of eggs in water in order to increase the chance of external fertilization.

The candidates who scored zero lacked knowledge pertaining to the characteristics of classes to which birds and mammals belong, which could help them to provide correct responses. In addition, they lacked knowledge of adaptive features of amphibians. They were also not aware that the eggs are covered with jelly like material for protection. Extract 11.1 is a sample of response from a candidate who scored low marks.

in at the ball the second second	+
Lia Structural similarities between the bodies of birds	
and mammab.	
- Both they contains hairs which covers their bodies	
For insulation	
- Both they posses experientian which makes the	
shapo of their bedies.	
- Both they contain mammal alands especially	
to bat resemble with mammaly	
- Both they containe leas FOT more most but amon	<u> </u>
one place to another:	
- Both they contains portals for the runner of	
respiration process	
Differences between light and manual	
Rippi	
it they motion wings it they within the task	
Tor - him kings y may contain do not contain	i
Lit The and winge	
lives are cold in they are warm	
blooded. blooded.	
they contain they contains teels for	
leeth for diacition mativation	
mastication	
- 19 hey contain one 107 They contains movement	
pair of leas in in the torrestrial.	
The JKy.	

Extract 11.1: A sample of the candidates' incorrect responses to question 1(a)

In Extract 11.1, the candidate mixed up incorrect and correct responses in part (a) and (b). For example, in part (a), he/she gave structural similarities of the bodies of birds and mammals such as possession of hair, mammary gland and exoskeleton. The candidate was not aware that hair and mammary gland are features of mammals and not birds. Similarly, exoskeleton is neither found in mammals nor in birds but in arthropods. In part (b), the candidate failed to realize that both birds and mammals are also warm blooded because

he/she considered birds to be cold blooded while mammals are warm blooded.

The candidates who scored average marks (7 - 11.5) obtained most of the marks in part (b) but not in (a). In part (b), they gave some correct adaptations of amphibian while in part (a) they gave one or two correct responses on the similarities or differences of mammals and birds.

The candidates who scored high marks (12 - 18) demonstrated good competence in grouping organisms according to their respective taxonomic hierarchy. They were aware of the structure of the bodies of birds and mammals such that in part (a) of the question they correctly described their similarities and differences. Similarly, the candidates had good understanding of the adaptive features of amphibians which help them to live in their environments. This knowledge helped the candidates to correctly explain how amphibians are adapted to their environments. Extract 11.2 is a sample of the correct responses to the question.

	Birds are organisms that belong
1 Birds an to class Ave quails Mammals beings, camels beings, camels bodies of bi Bolh ventrally positive beings beings, camels bodies of bi bodies of bi bi bi bi bi bi bi bi bi bi	to class tres they include then, parrot
	Mamon b on the other hand include human
	beings, camelo, apes
	The following are the similarities between
	bodies of birds and mammab.
	Both trive a dorsal thellow nerve
	and that is used in coordination
	Both brids and mammals have an
	endeskeleton that is made up of Bones
	re Minerals couch as coloum.
	Both birds and mammals have a
	ventrally positioned heart that is used
	to pump blood in their circulatory systems:
	Both birds and marninols have
	pentadacty/ Limbs which involve 5
	projango
	Both birds and mammals have the
	vertebral coloumn that is used for support

a princh production barrow and	
They power digeron ces which are	
The bodies of birds are coverred	
in reathers that is used or insulation and	
protection while the bodies of man nots	
are covered in fur or hair	
ha at the state that a the	
Inammais have eublachian type inor	
Bused to equalize preserve in the model	
hibe.	
Mammals have mammany glands that	
to the female mammals which are used for	
<u>lactation of young ones while Birds do not</u>	
have mammary glands	
Mannal has pipps that applies	
The mummors have puring that enables	
Bridge do not have pinne in their bodies	
Birds have their mouth modified into	
beaks while mammals have their mouth	
as normal	
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Ine hind imous of a bird bre modified	
The game while hand time at a monord	
and modified for amount walking.	

Extract 11.2: A sample of the correct responses to question 1(a).

In Extract 11.2, the candidate provided correct descriptions of the structural similarities and differences between the bodies of birds and mammals such as possession of vertebral column, dorsal nerve cord and ventral heart.

2.2.2 Question 2: Regulation (Homeostasis)

This question required the candidates to describe the process of osmoregulation by Anti Diuretic Hormone in human body.

The question was opted by 67.90 per cent of the candidates of which 54.38 per cent passed. Further analysis of the candidates' performance shows that they scored from 0.5 to 19 marks. There was no candidate who scored full 20 marks allotted to this question. The candidates' performance in this question is shown in Figure 8.



Figure 8: Distribution of the Candidates' Scores on Question 2

The data in Figure 8 shows an average performance in this question since about half of the candidates (54.39%) scored from 7 - 19 marks.

The candidates who scored high marks (12 - 19) were equipped with the knowledge of how dilute and concentrated urine are formed in human. Hence they correctly described the process of osmoregulation by Anti Diuretic Hormone in human. Extract 12.1 is a sample of the correct responses from one of the candidates.

Qnz	Anti divietic hormone (ADH) sometimes is called	
	Vagopressin this hormone is being made in hypothala mu	
	and temporary stored in the posterior pituitury.	
	The hormone is responsible for maintaining constant	L
	water and mineral zell within the body. If control	
	as follows:	
	I When there is small amount of water in the	
	body compared to that of salt	
	- When the water in the body decreases which	
	can be caused also hi excessive sweating or	
	intake of large amount of salt the como	
	receptor present in the body detect and	
	send information to piturtary hypothalanus	L
	- Hypothalamus induces secretion of Anheliurchic	r
	hormone (APPI) from posterior pituitary.	
	This hormone is transported through blood	L
	Stream to Kidney	1
	- Ithe Kidney Antidiuretie hormone (ADTUis	
	munsported to the membrane of distal	
	convuluted hube and collecting duct.	
	- At dutal convuluted tube ADH increases	ļ
	permedbility of the membrane to water to	
	Increase by increasing the water channel	L
	on the membrane. These ch. water channels	
	are being manufuctured in the cytoplasm	
	At a cult and stored in the golgi veride	
	- The effect is made possible by ADH Through	h
	inducing Fusion of veside with the	
L	membrane et distal convuluted tubes	
	Hence large amount of water will be	
	reabsorbed back to the body turne kentil	
	The water and salt level balances	

Extract 12.1: A part of the correct responses to question 2

In Extract 12.1, the candidate correctly described the process of osmoregulation by Anti Diuretic Hormone in human body specifically when there is little amount of water in the body.

The candidates who scored average marks (7 - 11.5) demonstrated partial understanding of osmoregulation process by Anti Diuretic Hormone. They gave partial description on how the ADH is involved in osmoregulation. Their descriptions included incorrect responses which made them lose some marks.

The candidates who scored low marks (1 - 6.5) had inadequate knowledge about the mechanism of osmoregulation. Hence provided one to four correct points on osmoregulation by ADH. These candidates lost some marks for introduction and conclusion.

On the other hand, some of the candidates scored zero. Some of these candidates confused osmoregulation with thermoregulation. Therefore, they gave such incorrect responses as; *osmoregulation is involved in maintenance of body temperature, it is controlled by Anti Diuretic Hormone which stimulate sweating, panting and vasodilation*. There were some candidates who wrote about other hormones such as aldosterone instead of ADH. For example, one candidate wrote; *Aldosterone hormone increase absorption of water*. Extract 12.2 is a sample of incorrect responses from one of the candidates.

02: Osmoregulation - This is a process that	
tuke place in human body that can	
dear with the maintainance of emenny	
of wester in the human body	
- Ant Diweter Hormone - This is an	
hormone that produced in human	
bidy by advenced grand that indute	
there is maintainance of water in	
human body	
First process - Three or production of	
Add + Diviett? Hormony in human body	
Inorder to ensure maintai the water	
In the human body	
Secondly process - After production of	
Ant Diurenz Hormone in the human	
body in the nephon there is	
utraporation at unite	
Thirdly process - Due to Due ollurance	
1)+ Charter Current multiplu autom in	
he mu	
	1

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

In Extract 12.2, the candidate wrote that ADH is produced by adrenal gland instead of pituitary gland. He/she also wrote that there is ultrafiltration in the nephron without specifying the part of the nephron where ultrafiltration occurs. This shows that he/she was not aware of the gland responsible for the production of ADH and the way it works in the nephron to effect osmoregulation.

2.2.3 Question 3: Growth and Development

Part (a) required the candidates to explain the internal and external factors that affect seed germination. Part (b) required the candidates to explain with the aid of diagram the events which occur during telophase stage of mitosis.

The question was opted by 97.20 per cent of the candidates of which 76.96 per cent passed. Further analysis of the candidates' performance is shown in Figure 9.



Figure 9: Distribution of the Candidates' Scores on Question 3

Figure 9 shows that most of the candidates (42.91%) scored from 7 to 11.5 marks while 37.04 per cent scored from 12 to 20 marks.

The candidates who scored high marks (12 - 20) were competent in the biological concepts of germination, seed dormancy and mitosis cell division. Thus in part (a) the candidates correctly explained internal factors that affect seed germination such as the presence of enzymes, inhibitors and

immaturity of the seed.; and external factors such as temperature, water and oxygen. Similarly, in part (b) the candidates correctly described events which occur in telophase stage. In addition, they had good drawing skills which helped them to present the events diagrammatically. Extract 13.1 is an example of the correct responses.

3(1 b)	
Telophase is the mitohic stage which occur	
aster anaphape. The collection are expects a	1
telophane stage:	+
- Ofganogarange and optically three	+
Attar anappediate of spinore 101005,	
diamondate the militic chindle yores	<u> </u>
aucappears	
- Centroles replication	
The centricles replicate to each claughter cell	
- Nucleolus and nuclear membrane reporms	
- The nucleolus and nuclear methoraned which	
disappeared reports at this stage.	
- Arrival a chromatics at the apprette man	
At this stage the chromoticle have arrived at the	
opposite poles and two chuchter cells rooms with	†
Course number a champion as that a paral	<u> </u>
- O'chibeting a cubalance and an ut	
amone the two downtars wills	
Carrold the new deeping and	<u> </u>
OUCOUND OF AUTOMA STAR	
DIAGRAM OF MILUSIS STAGE	
Nuclear montrare Contrideo	
- / ···································	
Chromatin gibios	
Chromatin libros	
(entrices	

Extract 13.1: A sample of the candidates' correct responses to question 3(b)

Extract 13.1 shows a correct response from a candidate who explained correctly internal and external factors that affect seed germination such as temperature and maturity of the seed in part (a). Likewise, in part (b), the

candidate correctly described events which occur during telophase stage of mitosis and support the explanation with a diagram.

The candidates who scored average marks (7 - 11.5) obtained most of the marks from part (a) but not (b). They demonstrated partial knowledge of telophase stage of mitosis and failed to explain correct events which occur in telophase stage of mitosis. Therefore, they lost most of the marks allotted in that part.

The candidates who scored low marks (1 - 6.5) in part (a) explained from one to three factors that affect seed germination, hence scored few marks in this part. On the contrary, most of the candidates scored no marks in part (b). while in part (b) most of them scored no marks. The responses given by these candidates lacked clarity which could attract full marks.

On the other hand, the candidates who scored zero (0.0) demonstrated lack of knowledge about the tested concept. For example, some of the factors for germination written in part (a) were; *concentration of waste in the seed*, *freezing of the seed*, *genes of the seed*, *absence of nutrient supply* and *parasitism*. There was also a candidate who wrote; *if the temperature is not favourable to the seed*, *it will denature the seed and cause seed dormancy*.

In part (b), most of candidates failed to distinguish the events which occur in different stages of mitosis. Thus, they stated events which occur in other stages of mitosis apart from telophase. For example, some candidates wrote events which occur during interphase such as; *formation of DNA*, *DNA replication, centromere divides, spindle fibres become visible, formation of nucleus in each side*. On the other hand, some candidates described specific events which occur in prophase stage of mitosis such as; *formation of the spindle fibres, chromosome becoming visible and short, formation of centromere*. Other candidates wrote general phases of cell cycle such as; *growth phase I, growth phase II, synthesis and cytokinesis* instead of events which take place in telophase stage of mitosis. There was also a candidate who wrote events that occur in metaphase stage of mitosis such as *migration of the chromosomes into the centre*. Extract 13.2 is a sample of the correct responses from one of the candidates.

3 b) relaphage stage is the last stage	
of mitusis where by two diploid	
doughter cell we formed, and it	
trube pridde in this senies of the.	
echlowing event which is devided	
as fellal :-	
Thickening A the cell from the	
middle part preparing in division.	
2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
Thick wind yestically.	
I huck-drang varies o	
(28, 26, 26) **	
- in this stage DNA reputation	
process is completed for the	
new daughter cell which will be	
formed.	
- Centro mar are pormied' at the end.	-
at the pole of the dividing cell	·
antrometer cantrometer	

Extract 13.2: A sample of the candidates' incorrect responses to question 3(b)

Extract 13.2 indicates that, in part (b), the candidate gave incorrect description of events which occur during telophase stage of mitosis. For example, the candidate wrote DNA replication which occurs during interphase.

2.2.4 Question 4: Genetics

The question measured the candidates' competence in the concept of gene interaction, that is the epistasis. The candidates were informed that:

A cross between pure yellow testa and green testa bean seeds gave all the F_1 yellow. When the F_1 were selfed gave F_2 with the following phenotypes: 836 – yellow testa, 212 – red testa and 72-green testa.

The candidates were then required to carry out the genetic crosses to show the phenotype and genotype of F_1 and F_2 .

The question was attempted by 65.30 per cent of the candidate out of whom 34.30 per cent passed. Description of the performance is further shown in Table 5.

Table 5: Distribution of the Candidates' Scores on Question 4

Scores	Description	Percentage of Candidates
0 - 6.5	Weak	65.70
7 - 11.5	Average	4.06
12 - 20	Good	30.24

Table 5 indicates a weak performance in question 4 since more than half of the candidates (65.70%) scored from 0 to 6.5 marks.

The candidates with high scores (12 - 20) demonstrated good mastery of genetic crosses including gene interactions which is Non-Mendelian inheritance. They analysed the given data into genetic ratio of 12:3:1 which indicates a dihybrid phenotypic ratio for epistatic gene interaction since it deviates from normal dihybrid phenotypic ratio (9:3:3:1) in Mendelian inheritance. They were aware that in epistatic gene interaction, one gene called epistatic masks the expression of the other gene called hypostatic at different locus. In this case, the epistatic gene had two alleles, one for

colour suppression (dominant) and the other one for colour production (recessive). The hypostatic gene also had two alleles, one for red testa (dominant) and another for green testa (recessive). The existence of the dominant epistatic allele did not allow either red or green colours to be expressed; only yellow colour was expressed. The absence of epistatic dominant allele allowed the expression of red colour in the presence of the dominant hypostatic allele. The presence of both recessive hypostatic and epistatic alleles expressed green colour. Extract 14.1 is the sample of a correct responses from one of the candidates.

4: From the number of ofborning given in question)
Yellin testa => 836	
Red teste =0 212.	
Urrean testa => 72.	
phonotypic ratio is	
896 yellow: 212 Red: 72 Green	
Dividing by 72 gives the opproximite ratio of 12:3.1	
- This ratio indicates that Yellow is epistatic to the	
alleler of Red and seen and Red is dominent	over
Green:	
let	
Y- reprosent a dominant allele for yellow te.	sta
y-represents an allele for other colours.	oftete
R-represent on allele for Red tests	
r- represent an ollele Br green tests	
porental phynostypes Yellow testa Urean tes	ta
e anontal sonstypes YYRR × byrr.	
Meiais	
sameles (YR) (YR) (Ur) (Ur)
	\bigcirc
Rondom Partilization	
Fi senstypes Yurr Yurr Yurr Yu	Rr.
Fi phonotypes All yellow testa reech.	

6.			· · · · ·			-	
4 .	e orgatal etienature.	<u> </u>	ally test	>	Vella	1 late	
	porental aprotype		Yulka	×	Yu	Rr Rr	
	Meiosis	/			$\overline{\Lambda}$		
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				\sim _ (A star	
		9	(C)	$\langle \sigma \rangle$	\bigcirc		
		00	(R)	Cr	(UR)	(yr)	
	Random Pertilization,	50	YYRR	YYRr	YURR	YyRr	··
	F2 genotypes and	U	Yellow	Yellow	Yellow	Yellow	
	phonotypes	\mathbb{R}	YYRr	YYOF	Yyer	Yurr	
		Ur	Yellow	Yellow	Yellow	Yellow	
		(mR)	YURR	YyRr	UURR	USRr	
		Jen	Xellow	Yellow	Red	Red	
		(yr)	YyRr	Yurr	UNRT	yyrr	. (
		9.0	Yellow	Yallow	Red	green	
	Them the above	evinnet.	Janore				
	F2 phonotypes a	ive:	•			16	
		Yel	Iow tests	1	2		
		Re	d testa		3		
		£1	een tes	tc	1		
	The phenotypic	tatio 5	f F2 3	Hopping	ь 12:2	3:1	
	= This ratio corrie	upondu 1	with the	t which	L SIV	•n in	
	the question						

Extract 14.1: A sample of the candidates' correct responses to question 4

In Extract 14.1, the candidate correctly interpreted the ratio 12:3:1 as the one resulting from epistatic. He/she then chose and used appropriate letters in the Punnet square to show the formation of F_1 and F_2 .

The candidates who scored average marks (7 - 11.5) correctly manipulated the data and found the genetic ratio (12.3.1). Then they showed the formation of F1 generation. However, they lost some marks because they did not show the formation of F₂.

The candidates who scored low marks (1 - 6.5) had partial knowledge of the epistatic genes. Most of them showed the first few steps for the cross. They were not aware that, in responding to the question, they were

supposed to convert the given numbers of F_2 individuals into ratio. The ratio obtained from the question was 12 - yellow: 3 - red: 1-green, which represents the Non-Mendelian inheritance (epistasis) that does not obey normal Mendelian ratio.

The candidates who scored zero were not aware of the type of gene interaction shown in the question that is epistasis (Non-Mendelian inheritance). Therefore, they based their responses on the normal Mendelian inheritance. For example, one of the candidates crossed yellow testa with green testa using letter YY and yy which led to incorrect response. Besides, some candidates were not aware that unrelated genes are located at different loci on the chromosome. For example, one candidate used dominant YYyy and recessive (RRrr) instead of YYRR and yyrr. There were also some candidates who considered the cross to be monohybrid. Extract 14.2 is the sample of an incorrect responses from one of the candidates.



Extract 14.2: A sample of incorrect responses to question 4 from one of the candidates

In Extract 14.2 the candidate considered the cross to be normal dominant-recessive monohybrid Mendelian cross. Therefore, the F_2 were in the ratio of 3:1 instead of 12:3:1.

2.2.5 Question 5: Evolution

The question had parts (a) and (b). Part (a) demanded the candidate to describe theories of origin of life while part (b) required them to outline the strengths and weaknesses of each theory.

This question was the most opted as 98.80 per cent of the candidates attempted it. Likewise, it was the most well performed question as 96.91 per cent of the candidates passed. Further analysis of the candidates' performance is shown in Table 6.

 Table 6: Distribution of the Candidates' Scores on Question 5

Scores	Description	Per centage of Candidates
0.0 - 6.5	Weak	3.09
7.0 - 11.5	Average	17.58
12 - 20	Good	79.33

Table 6 indicates the candidates' good performance in question 5 where 96.91 per cent scored from 7 to 20 marks and only 3.09 percent scored marks below average (0 - 6.5).

The candidates who scored high marks (12 - 20) demonstrated clear understanding of the theories of origin of life, and the strengths and weaknesses of each. They were aware of the origin of different organisms originated and supported on earth. They used the knowledge available to them to describe correctly the theories of origin of life and asses their strengths and weaknesses. Extract 15.1 is a sample of the correct responses from one of the candidates.

5.	@ The theories of airgin of life were put Farward	
	when scientists began to think of the driving	
	Faule of life.	
	One of the scientist to state the theory is	
	charles Darwin.	
	The theories of Chigin of life includes the	
	tellewing	
	(1) Special Creation theory	
	The theory states that	
	"All living auganoms and all matter	
	were created by One Supernatural being called GOD"	
	This theory is written in holy books including	
	Bibles and Quian.	
	The theory suggests the existance of	
	a Supernatural being that created everying on	
	earth a long time ago.	
	(ii) Steady-state theory	
	the theory siggests that, life has no angin,	
	it was found before and it continued to be	
	supported on earth.	
	Hence life is a continual process mainly	
L	Found on earth and supported.	
L	(iii) Cosmozoan theory.	
	The theory suggests that life was not	
	anginate on earth, rather it O'ngrinated else	
	where in the space or universe and brought	
	here on earth.	
	thus, the Orgin of life is pot on earth	
	but commune in the space	

11		
5 0	U IV- Spontaneous theory.	
	this theory was put Fainand by Dr. charles	
Î	Darwin. he suggested that life anafoated	· · · · · · · · · · · · · · · · · · ·
	from the non-living matteril decomposed a	
	long time ano	
	The theory luggets that three is go	
a	the fairle in the matter which brought about	
1.	(Fe . i	
	He performed an experiment about string ment	
ur	nder light Conditions which he left it decound	
	ind after a period of time he tound long I their	
Ô	regarisms and unermy, which be concluded there is	
d	chiqin of life from the non-living matteri	
(b) The Inenath, and weaknesses of the theory	
	described includes the fellowing	
	(i) Special creation theory	
	Inepaths	
	> Of Opened up the minds of iccentralis to	
ά	rave about the apain of life.	
	> It is believed and trusted by the believers	
0	the presence of the almighty GOD.	
	wakpeses (
	> The theory can not be proved experimentally	
<u> </u>	nie it occurred only Obie and of long time ago.	
	J	
	The theory do not recognize the trientypic work	
a	nd is against the scientic theories of life.	

Extract 15.1: Part of a sample of the candidates' correct responses to question 5

In Extract 15.1, the candidate described correctly four theories of origin of life in part (a) and correctly outlined strengths and weaknesses of some of the theories in part (b).

The candidates who scored average marks (7 - 11) obtained most of marks from part (a) but not part (b). They demonstrated good understanding of the theories of origin of life hence, gave correct explanation on the theories in part (a). However, in part (b), they failed to outline the strengths and weaknesses of the theories.

Some of the candidates scored low marks (1.0 - 6.0) because they had inadequate knowledge about the theories of origin of life as well as their strengths and weaknesses. Certain candidates either mentioned the theories without giving any description or describing one to two theories. Others described all the four theories with some incorrect points. However, most of them gave incorrect strength and weaknesses of the theories.

The candidates who scored zero lacked knowledge pertaining to the theories of life and their strength and weaknesses in such a way that they gave incorrect responses. Other candidates did not understand the demand of the question, hence they listed and described Darwin and Lamarck theories of life instead of theories of origin of life which are spontaneous theory, special creation theory, cosmozoic theory, naturalist theory and steady state theory. Extract 15.2 is a sample of the candidates' incorrect responses.

Sa	Evolution is twation where by an organis	
	are develop one stage of lije to another	
	stages of life. During the evolution life	
	there to many life ongin that organism	4
	pass through it. This origin are as	
	the following.	
	Use and disuse: The supertist are describe	
	the origin of life by essing the factors	
	of use and dis-use. In this stage of	
	origin of life they deal due to using	
	organ and dis-use of the organ.	
	when the organ is used always	
	developed while when the organ is	
	dis-use always is discappear.	
	Grow for engansing by developed. In	
	this stage good example of this stage	
	is giverage when they do want to	
	eat, they need is small but by	
	grow when they eat it new good and	
	beame larger compare to the other	
	organizen. This is the stage where by	
	the scientist describe and prio grigg	
	as the good example in this andituris.	
	Human being are originated form	
	the wompy Also the saintest describe	
	the origin of brun an being and	
	they they said thank the origin	
	of the huwan being is markey	-
	as well as. But also the manker	
	develop and at the end do beare	
	the lungan at was is.	

They said that the origin of	
the life is to generation. Not only	
that there are some shartist say that	
these are organism are organized from	
ove generation to another generation.	
Organism always broth and other	
one birth at the and the generation	
is you up. In this andition the	
situation where by organism gette forme	
ene generation to another generation	
is described by the organism in the	
evolution. Up to Know the generation	
is steal generate from one generation	
to another generation.	
Dyganism are digiwated from the	
back or ook of the plant and the	
they amundale up the organized start	
to move by sliper side way and the	
beame the full lomplete ongainer.	
Organspu are originated for the	
fils also the organism are originated	
from the fish and that move to	
the seas for life and at the and	
be people or another organisin,	
56 Due to theory various theories of	
the origin of the life, these are so	
many sitremaths as well as the	
weaknes of this theories as the following.	
Strangth of the theones.	
It true that the organism use	
infinated from one generation to	

another generation, this is due to	
by a proved by increasing the	
number of people in the world.	
It the that there are some organism	
that are orginated from the day	
of sand and now organism ampleted.	
Frank of them is plants.	
It tone that when the sogaw is	
not used they do not use efficiently	
as the scrubst sand.	
aleaning of the engin of the life	
It is not true that the organism are	
privingeted from the cook of the tree	
and then	
It is not that when the vypusin are	
not use some organ they dissappear	
islead wit disapped and their remain	
but della ancy function.	
to that these and sme organsm	
prain of life in Jude away the	
manner awording to Scientist pers	
Howah which one of the following	
(Detation) of file	
wight of the	

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

In Extract 15.2, the candidate described Lamarck's theory instead of describing theories of origin of life in part (a) and outlining strengths and weaknesses of the theory in part (b).

2.2.6 Question 6: Ecology

The question had parts (a) and (b). Part (a) required the candidate to describe with example the interdependence of groups of organisms in the ecosystem such as detritivores and decomposers, producers and consumers, food chain and food web. Part (b) required them to explain how energy flows within an ecosystem.

This question was opted by 79.90 per cent of the candidates where 69.01 per cent passed. Further analysis of the candidates' performance is shown in Figure 10.



Figure 10: Distribution of the Candidates' Scores on Question 6

Figure 10 indicates the candidates' good performance in question 6 where 69.01 per cent scored from 7 to 20 marks.

The candidates who scored high marks (12 - 20) demonstrated appropriate use of biological knowledge, concepts, principles and skills in relation to ecology. They were competent in the components of ecosystem. This knowledge helped them to describe the interdependence of groups of organisms in the ecosystem and explained correctly the way energy flows within an ecosystem. Extract 16.1 is a sample of the candidate's correct responses to the question.

060°. When The primary consumers peeds on	
the producers, the initially stored energy	
is passed to the primary consumers.	
Example: of primary consumers are The	
goats rebies among other herbivorous	
an in and.	
. The primary consumer possess This energy	
until when is eaten by the secondary	
Consumers '	
Here the energy is then passed to	
the secondary consumers,	
Example of the secondary consumed aro	
the lions Leopardi anong other carnivoous	
animals,	
. Eventually, the secondary answer are then	
eater by the tertiany convuner and in	
That case, the enersy is passed on	
again to the tertiary consumed :	
Example of tertian consumed are the	
vultures.	
. The decomposed then take up	
the energy when a tertian conviners	
dies	
However this amount of energy is very	
mall thus the next trophic level	
cant be sustained.	
This is because some patts are not	
edible, some assimilation is not 100%	
efficient.	

Extract 16.1: A sample of the candidates' correct responses to question 6(b)

In Extract 16.1, the candidate described correctly the interdependence of groups of organisms in the ecosystem in part (a) which are detritivores and decomposer, producers and consumers, food chain and food web. In part (b), he/she explained correctly how energy flows within an ecosystem.

The candidates who scored average marks (7 - 11) obtained most of the marks from part (a). In part (b), most of these candidates gave one or two points which were correct.

The candidates who scored low marks (1 - 6) lost most of the marks in part (b) and few marks in part (a). These candidates lacked knowledge about the dependence of organisms in the ecosystem. For example, in part (a) one of the candidates wrote; *the dependence of and decomposer is that detritivores are living organisms which does not possess teeth hence depend on decomposers*. Some candidates failed to understand the demand of the question as they described the habitats of the organisms instead of describing their interdependence. For example, one of the candidates wrote; *detritivores are organisms live on the land and decomposers are organism live in the soil, food chain is a series of feeding relationship of organism and food web is the mesh of food chain.*

On the other hand, the candidates who scored zero marks either lacked knowledge of ecosystem or failed to understand the demand of the question. For example, in part (b) one of the candidates discussed the factors which affect flow of energy in the ecology such as poaching, explosion/outbreak of fire and grazing instead of explaining the way energy flows within the ecosystem. Another candidate explained some cycles such as water /hydrological cycle and nitrogen cycle. There were also some candidates who explained the interaction of biotic components of the ecosystem such as predator-prey, parasitism and herbivory. Extract 16.2 is a sample of the candidate's incorrect responses to the question.

6 D Ecosystem is the community of	
living things interacting each other and	
with non living thing e. Ecosystem involve	e
both terrestrial and acquatic habitate	
The pollowing are the ways which sho	0
how energy Flow in an ecosystem.	
Water cycle, the water is formed throw	16
various processes then it show how even	ν N
Flows since it involves transpiration in	
plante, avaparation From water bodies a	b
call which form vapacit, when vapaur	
ascende to the atmosphere it cools an	d
Form clouds thus when clouds move thro	uah
air currents to area of high tomperature	2
it malts and fall as drops of rain.	
Nitregen cycle, Nitregen present in the	ie l
atmosphere combine with rais t and discol	ve
in the soil where in the nodules of	
leguminous plants are those are pitrog	on
Fixing bactoria thus cause increases in	
eail partility also amount of nitrogen in	
the atmosphere.	
tredator-prey relationship, the predat	tors
Food on prey then there is energy	
Flow botween predator and prey that	
l'é predator gain energy which was	
interlocked in the bedy of prey althou	26
pot 100% of orargy is absorbed by predate	
due to presence of banes which are not	-
consumable.	

Extract 16.2: A sample of the candidates' incorrect responses to question 6(b)

In Extract 16.2, the candidate described some ecological cycles such as water cycle and nitrogen cycle instead of explaining how energy flows within an ecosystem. This candidate was not aware that cycles help the circulation of nutrients and not the flow of energy. He/she also gave explanation of the interaction between biotic components of the ecosystem such as predator - prey relationship.

2.3 133/3 BIOLOGY 3

133/3 Biology 3 was a practical examination with three alternative papers, namely 133/3A Biology 3A, 133/3B Biology 3B and 133/3C Biology 3C. The candidate had to do only one of these alternatives. Each paper comprised three (3) questions. Question 1 and 3 of each paper was set from the topic of Comparative Studies of Natural Groups of Organisms while question 2 from Nutrition. Question 1 carried twenty (20) marks while questions 2 and 3 carried fifteen (15) marks each. The pass mark for question 1 was from 7.0 to 20.0 marks, while for questions 2 and 3 it was from 6 to 15 marks each.

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

2.3.1 Question 1: Comparative Studies of Natural Groups of Organisms

In all the three alternatives 3A, 3B and 3C, the questions measured the candidates' competence in dissecting the selected animal and displaying various systems. In Biology 3A, the candidates were provided with specimen S_1 which was a mouse/guinea pig/rat. Then, they were instructed to dissect it to fully display the *viscera in situ*. Then, they were required to:

- (a) Draw a neat diagram of the dissected specimen S_1 and label ten (10) parts.
- (b) (i) Identify the associate organs of the digestive system present in the specimen.
 - (ii) Explain the digestive role played by each of the associate organs identified in 1(b)(i).
 - (iii) Describe how each of the associate organs identified in 1(b)(i) is adapted to perform its digestive role in the specimen.
 - (iv) Explain how each associated organ identified in 1(b)(i) is adapted to regulate sugar in the body of the specimen.

Similarly, in Biology 3B, the candidates were provided with specimen N_1 which was a fresh cockroach and were instructed to dissect it and display the reproductive and digestive systems. The candidates also were instructed

to make sure that the digestive system is pined to the right hand side. Then they were required to:

- (a) Draw a neat diagram of the dissected specimen N_1 and label twelve (12) parts.
- (b) Explain the roles played by the labelled parts of the system in the digestion process by giving six points.

In the same vein, for Biology 3C the candidates were provided with the specimen S which was a toad/frog and instructed to dissect it to fully display the viscera general. Then they were required to:

- (a) Draw a neat diagram of the dissection and label twelve (12) parts.
- (b) (i) State the natural habitat of the specimen S.
 (ii) Give five observable features which enable the specimen S to adapt its natural environment.

The analysis of the candidates' performance indicated that the question was attempted by all 27529 (100%) candidates, out of whom 11.36 per cent scored from 0.5 to 6.5 marks which is the weak performance. The candidates who scored averagely from 7.0 to 11.5 marks were 45.77 per cent and 42.87 scored from 12 to 20 marks which is good performance. Figure 11 summarizes the candidates' performance in this question.



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

Figure 11 reveals that the candidates' performance in question 1 was good because 86.64 per cent of candidates scored from 7 to 20 marks.

Further analysis show that the candidates who scored high marks (12- 20) had sufficient knowledge about the dissection of small animals, arthropods and frog. Therefore, in Biology 3A, these candidates demonstrated adequate competence in dissecting the rat/mouse/guinea pig specimen as well displaying the *viscera in-situ* hence, scored the full 5 marks allocated for on - sport assessment. In part (a), the candidates drew a skilful large, neat, labelled diagram of their dissection with non-crossing labelling lines. In addition, the caption and magnification were appropriate to the diagram. Also, they correctly identified the associate organs of the digestive system present in the specimen and explained the digestive role played by each of the identified associate organs. Moreover, they correctly described how each of the identified associate organs adapt to perform its digestive roles and regulation of sugar in the body of the specimen. Extract 17.1(a) shows the correct responses from one of the candidates.



1. (L) (1) Associate organs of the digestive system	
in love Specimen arp	
- Liver	
- Pancreas	
(ii) * Digestive roles of liver	
- Secrete bile which is important	
for Lipid digestion	
- Sevete bile satts which an punide	
Lasic medium for puper functioning	
of energines in the duodenum	
-	
* Digestime role of paneties	
- Ef respete pancrectic juice for with	
ensures such as parcreatic tipage for	
direction of fip'd	
(iii) Adaptation of the liver for	
ets digestive role.	
- Liver cell can secrete bile and shore it	
to the gall Hadder	
Adaptation of paneness for	
its discustive vole.	
- The cells are able to secrete has	
have large number of endoplasmic reticulum	
and golgi budies helping to make the	
thaymes for digertion	

- If has paracreatic duct prossing praymes.

1. (3) (iv) Adaptation of pancreas to regulation	
01 Sugar in the body of the	
Tspeainy n Si	
- Itheraphy cells of Langerhans which	
secrete glucagon that convert	
glycogen to glucose when there is	
Low mear level in the blood of	
the Spearing SI	
- If has been cell of langerbans	
Which secrete insufin that convert	
glucose to slycosen when there is	
high sugar level is the yord of	
In specimen SI	

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

In Extract 17.1(a), the candidate had good drawing skills and was knowledgeable on dissecting the rat/mouse/guinea pig to display the *viscera in-situ* in part (a). The caption and magnification were relevant to the diagram. In part (b), the candidate identified the associate organs of the digestive system and the roles played by each organ. Also, the adaptation of the associate organs to digestion and sugar regulation were correct.

In Biology 3B, the candidates demonstrated good understanding about dissection of the cockroach provided to display the reproductive and digestive systems. They also correctly deflected the digestive system to their right hand side. Thus, they deserved the 5 marks allocated for on-sport assessment. In part (a), the candidates correctly drew the diagram of their dissection with correct labels and the required systems. The caption and magnification were correct and relevant to the diagram. In addition, they provided correct digestive roles played by the labelled parts. Extract 17.1(b) shows the good responses from one of the candidates.


1	da		
	Part of the protein	Polad	
	il Jalivar gland	- It is used to secrect digestive	
	y - 11- 7 51	ensypes. Example JeliVary amylese	
	and the second		·····
	i Oesopheque	- It is used to pass the insested	
	7	ford purficles into the Corp.	
	and the second		
	iii/ Crup	- It is used to stoke eaten food	
	7	particles temporarily	
		- It is the site for both chancel	
		and prechanical digestions.	
	in Gizzard	- It contains articular like Feelt	
	/	which hop to over of the found	
		particles into smaller particles.	
		- It Contains Sand which goe	
		mixed with find particles.	
	V Digestive Carca	- It contains digestive enzypes	
	¢	which are pussed into the	
L		Grop for disesting found.	
		- It contains bectore that	
		puduos the enzypes.	
	Vý Colon	- It is we do, have used p	
		absorb instr Contents from the	
		undisented food particles.	
		- It would's into Formation of dy	
		fore cap.	
		- It helps to put's featos to la	
		require for starge storage.	

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

Extract 17.1(b) shows the response of the candidate who demonstrated good drawing skills. The candidate correctly gave the caption and magnification. Also, she/he was aware of the roles performed by each part of the reproductive and digestive system of the cockroach.

Likewise, in Biology 3C, the candidates who scored from 12.0 to 20.0 marks demonstrated adequate competence pertaining to the dissection of the frog/toad provided to display the viscera general, hence deserved the 5 marks allocated for on-sport assessment. In part (a), the candidates drew a skilful neat diagram of their dissection with correct labels. They also

provided relevant caption and magnification for the dissected specimen. In addition, they correctly identified the natural habitat of frog/toad and the observable features which enable the specimen to adapt its natural environment. Extract 17.1(c) shows sample of the correct responses from one of the candidates.



1 \$ 3) The nuteral nubitate of precimen Sis aqualic or	
ing water.	
i) The observable factore which enable preeman	
S to adapt to its environment.	
I It have webs that help in during	
when in the verter	
if it have unscalar lingtimes which halp it for	
the movement and jumping when in the	
nearly and in land.	
i) It have long fangue that evalue it	
to actuly prey especially inject.	
iv) It have gointed boily that thelpit	
to reduce resistance of water daring	
swimming in the weder.	
v) societimen I have eyes this adeel	
for the Vibion and englie it to fight four	
and fighthy of its precleter.	

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

Extract 17.1(c) depicts the responses from the candidate who had good drawing skill. The caption and magnification provided were relevant to the diagram. He/she also managed to identify the natural habitat of the frog/toad and correctly explained the observable features which enable it to adapt its natural environment.

Despite the good performance of the candidates in question 1, a few (11.36%) of the candidates scored from 0.5 to 6.5 marks due to lack of competence required in in performing the dissection experiments. In Biology 3A, most of the candidates demonstrated poor competence in dissecting the rat/mouse/guinea pig to display *viscera in-situ*. Consequently, some of them drew incorrect diagrams with features found in frog and cockroach in part (a). Examples of such incorrect features are: *gizzard, malpighian tube* and *crop*. Others drew incorrect diagrams with

internal organs which are not part of the viscera in-situ such as kidney, renal artery and renal vein. These responses signify that the candidates lacked knowledge about the viscera insitu, hence the system displayed in the dissection were wrong. They also provided irrelevant caption and magnification for the dissected specimen. The incorrect caption was a diagram of a dissected specimen S_1 . These candidates did not indicate the system required to be displayed in the question. However, the some of the candidates provide incorrect labels of the required parts of the viscera instu.

In part (b) (i), the majority of the candidates were not able to correctly identify the associate organs of the digestive system instead they mentioned other parts of the digestive system such as stomach, ileum, gall bladder and explained their digestive roles in part (b)(ii). For example, some candidates wrote the roles of the stomach as *it acts as food storage*, another one wrote; *it removes all harmful substances, ileum tends to produce bile pigment that may somehow control the amount of sugar in an organism, crop it is used to store food substance, gizzard used to break food and gall bladder used to produce bile the.*

Also, some candidates in this category provided incorrect adaptations of the associate organ as they based on the incorrect organs identified in part (b)(i). Some of them were not aware of the term adaptation as they wrote the function of the liver and the pancreas instead of the present features which enables the organs to perform the respective functions. Such features include among others the presence of cells producing bile in the liver and presence of bile duct pouring the bile to the duodenum. Others include the presence of acinar cells that produce pancreatic juice and presence of pancreatic duct pouring the pancreatic juice into the duodenum.

On the other hand, the candidates were unable to explain correctly how the liver and pancreas are adapted to regulate sugar as the majority of them wrote the mechanism of sugar regulation. These candidates were not aware that liver has cells that enable it to convert excess glucose into lipids and that the pancreas has cells, the islets of Langerhans with α - cells which produce glucagon for stimulating the conversion of glycogen into glucose. They also failed to understand that, the pancreas has β = cells which produce insulin from the islets of Langerhans for stimulating the conversion of excess sugar in the blood to glycogen for storage. Extract

17.2(a) is part of the incorrect responses by one of the candidates in Biology 3A.



1	(bu)a	Crop .		
	6) Theum		
	(a	B Reetun		
		Gizzard	ρ	
		<u> </u>		
	Gið	agans	Function	
		@ Crop	10mporny storage of 7000	
		6) ILeum	Absorption of aligested Toool	
	L			
		(c) Raetum	Removal of un digested	
	-		Jood materials.	
		a Circuit		
		d Gizzard	Mechanical digestion of Food	
<u> </u>			Subrance.	
<u> </u>	100			
\vdash	4110	0		
<u> </u>	1 1	Crop	wether of whether all	
<u> </u>	- 1ma P	er have sn	ell intestino al Large intestine way	-
	- Je	v accumia	here it food and here the	
	61			
	n.s	aum.	- 1 A Contata to increase alteration	
<u> </u>	1000	dime to d	about Buch the merel	
<u> </u>	1 4 .	11993 20 10	stands a per stone.	
	6 D	- D		
	ne i re	alera no	Al well which is hypertonic the	
	rem	viel al me	strastal matienal	
		and of the		
	60 0	1122ard.		
	They	have third	well which is energies the power of	
	en	traction.		

E	(Gliv)	
	@ Pancheaso.	
	The panenase. is used to source insulin	
	and Culy cayon harmone which negulate	
	the sugar in The body of specime of.	
	(b) Ileum.	
	In the Hemme Iters end product of standy which is	
	Oluciose when olucise land rise cause	
	insulis hormone to be seeneted and convert	
	into glycogen.	

Extract 17.2 (a): Part of a sample of the candidates' incorrect responses to question 1 in Biology 3A

In Extract 17.2 (a), the candidate demonstrated lack of knowledge about the *visceral insitu*. He/she drew a diagram with other parts such as gizzard and

kidney which are not part of the *viscera insitu*. In addition, the candidate provided incorrect associate organs of the digestive system and incorrect adaptation to digestive roles and sugar regulation.

Similarly, most of the candidates among those who scored from 0.5 to 6.5 marks in Biology 3B lacked competence pertaining to the dissection of cockroach. Consequently, they drew incorrect diagram in part (a). There were some candidates who drew the diagram with incorrect deflection, as the digestive system was deflected to the left instead of the right hand side of the candidate. In addition, some of the candidates drew diagrams with irrelevant caption and others neither wrote the caption nor the magnification used. However, the majority of them failed to label correctly some of the parts of the systems as the result, they provided incorrect responses about the roles played by the labelled parts in the digestion process. Example of the candidates' incorrect responses are: *the colon is site for lipid synthesis, ileum is a place where nutrients digestion takes place*. Extract 17.2(b) is a sample of the candidates' incorrect responses to the question.



Extract 17.2(b): Part of a sample of the candidates' incorrect responses to question 1 in Biology 3B

In extract 17.2(b), the candidate incorrectly wrote the caption which did not match with the diagram and the demand of the question. Similarly, the diagram drawn was incorrect and wrongly labelled.

In Biology 3C, the candidates who scored 0.5 to 6.5 marks demonstrated inadequate competence in dissecting the frog/toad to display the viscera general. Some of them cut and removed out the digestive systems instead of displaying it to their right hand side. Consequently, they drew incorrect diagram in part (a). In addition, some of the candidates drew diagrams with irrelevant caption and others neither wrote the caption nor the magnification used. Examples of irrelevant captions are; *The diagram of a dissected frog* and *The diagram of dissection of male frog*. These candidates were not aware that the caption should indicate the required system. For example, the diagram of a dissected frog to display the viscera general.

In part (b), some of the candidates wrote incorrect habitat and observable features which enable the frog/toad to survive in their habitat. Some of the given incorrect features are; *have compound eye* and *lung book for respiration*. These candidates were not aware that these features are found in the arthropods. Extract 17.2(c) is a sample of the candidates' incorrect responses to the question.



Extract 17.2(c): A part of a sample of the candidates' incorrect responses to question 1 in Biology 3C

In extract 17.2(c), the candidate incorrectly drew partial diagram of the viscera general without the required parts, caption and magnification.

2.3.2 Question 2: Nutrition

The questions in all alternatives namely 3A, 3B and 3C, measured the candidates' competence in conducting food test experiments. In Biology 3A, the candidates were provided with 5 cm^3 of fresh liver, water and solution X which was hydrogen peroxide. The candidates were also provided with the chemical reagents which were iodine, Benedict's solution, copper II sulphate, sodium hydroxide, dilute hydrochloric acid and Sudan III solution. Then they were instructed to perform the following:

- (i) Cut the 3 cm³ of the liver into small pieces and crush it to paste by using a mortar and pestle provided. Add a little amount of water into the paste, mix well and label it as liver solution.
- Put the remaining 2 cm³ of a liver into a test tube, add 3 drops of solution X in the test tube and observe the results.

The candidates also required to:

(a) Carry out a biochemical test to identify the food substances present in the liver solution and tabulate their results as shown in the following table below:

Food tested	Procedures	Observation	Inference

- (b) Name the solution **X**.
- (c) Use a chemical formula to illustrate the reaction which led to the observation made in (ii).
- (d) Explain how can one set a control experiment for the reaction presented in (c).

Similarly, in Biology 3B the candidates were provided with solution. Then, they were required to:

(a) Identify the food substances present in the solution S_2 and tabulate their work as shown in the table below:

Food tested	Procedures	Observation	Inference

- (b) State two properties of the food substance(s) identified in solutions S_2 .
- (c) State the food substances missing in solution S_2 to make it a balanced diet.

In Biology 3C, the candidates were provided with solutions C_1 and C_2 which contained unknown food substances (Mixture of egg albumen and starch in solutions C_1 ; and Glucose in solution C_2). Then, they were required to:

(a) Use the chemicals and reagents provided only to identify the food substances present in solutions C_1 and C_2 , and tabulate their experimental work as shown in the table below.

Food tested	Procedures	Observation	Inference

- (b) Explain the importance of the following in the experiments
 - (i) Neutralization process
 - (ii) Cooling process.
- (c) State the factors affecting enzyme activities when digesting the food substances identified in 2(a).

The question was attempted by all 27529 (100%) candidates of which 23.90 per cent scored from 0 to 5 marks. The candidates who scored averagely, that is from 5.5 to 8.5 marks, were 48.58 per cent and 27.52 per

cent of the candidates scored from 9 to 15 marks which was good performance. The candidates' performance on this question is illustrated in Figure 14.



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

Figure 14 shows that the candidates' performance in question 2 was good since about three quarters (76.10 %) of the candidates scored from average and above (5.5 to 15) marks.

The analysis of the candidates' responses in Biology 3A reveals that the candidates (27.52%) who scored highly (from 9 to 15 marks) were competent in carrying out the food test experiments. These candidates demonstrated good mastery of the principles governing the carrying out of the food test experiments. They were also able to make correct observation and inferences of the result in part (a). In addition, they correctly named solution \mathbf{X} as hydrogen peroxide in part (b). The candidates also gave the correct chemical formula for the reaction observed when a piece of liver was dropped into hydrogen peroxide and the peroxide bubbled vigorously due to decomposition into water and oxygen gas. Moreover, they were able to recognise the use of boiled liver tissue as a control experiment instead of using unboiled fresh liver provided. They realized that, in the boiled liver, the hydrogen peroxide will be denatured by the heat. Extract 18.1(a) is a sample of the correct responses from one of the candidates.

(2)	FOOD IG TED	PROCEDURE	OBSERVATION	IN Perma
		2 cm ³ of liver solu	Liver soly	
	Starch	tion was taken	tion reta	Starch
		in a test tube,	ined brun	was
4		2 drups of loaling	colour of	absent
		solution were added	lodine soluti	
			ún	
		Runs of user educt		era we
	Protein	ion was taken	liver solution	Protein
		in a best tube,	turned	way
		2003 of sodium	to purple	Present
		hydroxide solution	colour	
		was added followed		
L		by 2 drupt of 1%		
		of copper (11) oulph		
		ate		
		2 und of liver	liver solution	
	Lipid	solution was taken	retained the	Lipid
		in a test type,	(dour of	was
		2 drops of sudan	Sudan II	orbrent
		I solution was	- mituloz	
		added and left		
		to settle for tive		
-		minuter	·····	ļ
		Long of liver roll 1	The series	
	Reducing	tim was taken 4	cour was	Reducio
	Sugar	in a test tube, d	bserved thom	g fu
		Rong Benedic 6	olue to green	gar
		t's solution to	o yellow to	was
		was added in o	range and	Present
		a test tube and t	inally to bri	
		the mitture was boiled in	k red Precipita	e

	Fired terbed	Procedure	Observation	Inference
	Non	Rom' of Live solu	The ser	
L	Reducing_	tivn was taken	ies of co	Non
L	Sugar	into a sest tube,	lour changes	Reduc
L	. 0	land of hydrochloric	was obser	ing
		auid was added, The	ved which	Sugar
		mixture was borled	started from	war
		and cooled under	blue tog	Present
		tap water then	reen to	
		tollowed by addition	yelloro to	
2		of 2cm3 of sodium.	orange and	L
,		hydrixide solution	finallyto	
		in order to neutralize	brids red	l
		The solution. Then,	precipitate	
·i		Rom of Benedictis		
		solution was added		
		and the mixture		
		was boiled		
	,			
10	<u> </u>			
5	Sautim	<u>x war hydrogen</u>	peroxic	le
(2)				
	Chemiza	equalizon		
	a H a	ordase Oll D 10		
	2 2 2 (ay) =		42	
	-4 100 000 2		<u>J</u>	
	in a ton	anopi of soutron.	<u>r was</u>	added
	Charlent Set	and all contraining	y uver	* he
	R. al Unant	Ubserved all	o ohere	way
	ing uppeller	if gas which	- Teugher	gien
	har na cir	the catalan	e this w	
		a sea contained	- vidy	· · ue

	present in the liver hudrolyses toxiz hydr	
2	open peroxide into harmless product of	
~~~	oxiden and water.	
d)	- A control experiment can be let by	
	taking 2cm? of liver solution and heating	
	It so that to denature the catalase	
	enzyme.	
	-It happens that after heating, the heated	
	liver will not chow any observation	·
	with hydrogen perphido -colution.	
	-This will a control experiment.	

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

In Extract 18.1(a), the responses indicate that the candidate correctly and appropriately used chemicals and measurement in the procedures which consequently resulted to correct observation and inferences. In addition, she/he wrote relevant chemical equation for the reaction that involved the addition of hydrogen peroxide to the liver tissue.

Likewise, in Biology 3B, the candidates who scored high marks (9 to 15 marks) were competent in conducting food test experiments given that the chemicals and the measurement used in the procedures were accurately presented in the report. Also, the observation and inferences were correct. In addition, the candidates were aware of the different types of food substances and their properties owing to the fact that the responses provided were correct. Moreover, the candidates were able to identify the food substances that were missing in solution  $S_2$  provided to make it a balanced diet for human being. Extract 18.1(b) is a sample of the correct responses to the question.

02	(9)				
	TESTED COOF	PROCEDURE	WITT TANT 200	INFERENCE	†
	LIPID	2 cm of ford sample	The Soundle Setular	Lipid www	
		Solution S'2 nous put	Sz retained the	Whent	
		in dry clean test tube	red colour of		
		followed by addition	Sudam I schufin		
		of three drops of			
		Indens II soundar			
		and shaken with			
		and allined to sertle			
		for five minutes			
	STARCH	20mil of ford 1 comple	The Sample Schulpm	Sterch way	
		Schulm S2 new put	Sz retained the	Wasent	
		in clean by test tube	brown certow of intere		
	-	fellined by addition	soluton		
		At three drops of			<u> </u>
		lodine schulen and			
		Sherken well.			- · · ·
	PROTEIN	2 cm of fire sample	The purple atour	Protein was	
_		solution S2 was put	was observed	Present	
		In dry test twhe			
		followed by addition			
		of equal volume (2003)			
_		of sodium hydroade			
		Schufiton (North) and			
		then followed too			
_		three drops is			
		apper suphate			
		Schulm (Cuso+)			
		and then ske			
-		Shewron			

					· ·
	FOOD TEITED	Precedure	OBSERVATION	INFERENCE	
201	REDWONT SUGAR	2 cm of ford sample	The Jerice of	Reducing	
		Solution Sz Mas	allow changes was	Suger Whit	
		put in by clear	abserved from	present	
		test two tolewed	blue, green, yellew		
		by addition it equal	me orange		
		Volume 4 (2001)			
		() Buredrath			
		Solution and			
		thin heated to			
		boil			
	MON-REDUCING	20m of four temple	The Series in Cellerur	,	
	SUGAR	schultun S2 vinu	Changes who closened	Non-reducing	
		put in dy tuttub	from Hove, green,	Sugar Muy	
		followed by addulta	bellow to wrange	present	
		of 1 cm is hydren.			
		time acid (Iter)			
		Hun heated to boy			
		thim the number of			
Kej		missiallowed to cost,			
		on closling 1 cm ²			
		of Sodrum hydroxide			
		Solution (NANK) was			
		added followed by			
		acm of Benedati			
		solution that weather			
		mu healed to beil	,		
					· · · · · · · · · · · · · · · · · · ·

Д.	(b) (i) Properties of Protein	
	- Partain is amphation in nature	
	- Proteins are here lase relative muleulor man	
	- Proteins are insclubble in water	
	- Proteins are made up of meny amino acids jurned by peptide bends.	
	- Pintana are culturized in nature	
	(ii) Reducing Suger	
	- Have smeet take They are setuple in water	
	- Have addeling to group which reduce Copper (11) in to Copper (1) m	
	- Have Inset taute.	
	(iii) Non-reducing Sugar	
	- They are Insclubble in warter	
	- Can nut be certy broken denn by hydright?	
	- Laek aldelyde jonup inited have keto group	
	-	
	(c) for2 Empstance or	
	(1) Hipid	
	(ii) Starch	
	(m) Vitamin	
	(iv) Water Roughage	
	(V) Water	

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

In Extract 18.1(b), the responses indicate that the candidate correctly used appropriate measurement in the procedure for each food tested, consequently the score for observation and inferences of the results. In addition, the candidate managed to identify the properties of each food substance identified in the solution; and correctly provided the type of food substances which were missing for the solution to become a balanced diet.

In the same vein, the candidates who scored high marks (9 to 15) in Biology 3C demonstrated good competence in conducting food test experiment. Most of them were able to accurately use measurement of chemical required to perform the procedure for each food tested. They also made correct observations and inferences which helped them to write a comprehensible report. Moreover, most of the candidates were knowledgeable about the importance of neutralization and cooling processes when testing of non-reducing sugar. Also, the candidates correctly gave the factors affecting enzyme activities in digestion process. Extract 18.1(c) is a sample of the correct responses.

20 Food Tested	Procedure	Observation	mference	
Starch	2ml at solutions	In solution Ca	Starch	
	C, and C2 Werr	the blue-black	was present	
	added in a separa	Colour was -	in solution	
	te test tuber then	abserved	C ₄ .	
	2 drops of Iodine	In solution Ca	starch	_
	solution were adde.	the brown color	was absent	
	d in each test tube	ur of Iodine	in solution	
		solution was	C ₂	
		retained		
Protein	2ml of solutions	Insolution Ca	Protein was	
	C1 and C2 WER	the purple colour	present in	
	poured in the sepa-	mas observed	solution Ca.	
	rate test tubes the	In solution Co	protein was	
	n. 2ml of sodium	the pale blue	absent in	
	hydroxi de solution	Colour of Copper	solution Ca	
	(Naott) Were added	(1) sulphate (cusoi		
	in each test tube	solution was		
	and then 3 drops of	retained.		
	12 copper (1) sulphate			
	rotation (Cusoze)-			
	Wore added in each			
	test tube then the			
	Mixtures wereshack			
	n.			
Reducing	2ml of solutions	In foot sample	Reducing	
Sugar O	C1 and C2 Were	solution C2 the	Sugar was	
	poured in the sepa.	Series of colours	present in	
	vate test tubes then	was from blue,	solution C2	
	2ml of benedict's	green, yellow,		
	Solution were added	orange and -		
	in each test tube-	finally brick		

<u> </u>	<u> </u>	1	•	· · · · · · · · · · · · · · · · · · ·
20	Food Tested	Procedura	observation	Inference
	Reducing	And then the Mixtu-	red precipitate	
	Sugar	res were heated to	was observed.	
	U	boil.	In solution Cs	Reducing
		:	the blue colour	Sugar Was
			of benedicts	abcont in
			Solution was.	solution C1.
			retained	
	Non-reducing	2ml of solutions	Insolution (2)	Non-reclusing
	Ngar	C1 and C2 Werp	the series of	Sugar was
	0	Poured in a separa-	(olours was -	present in
		te test tubes then	from blue gree	soluction Co
		Im of dilute hydro	n, yellow, orange	
		chloric acid war	and finally-	
		added in each test	brick red pre-	
		and then the nixture	cipitate was	
		were heated to	observed	
		boil and cooled 1	in solution C1 1	lon-reclucing
		then Imi of dilute t	the blue colourf	ugar was?
		Sodium hydroxicle 2	of benedict's a	brent in sol
		solution was added	solution was la	tion C1.
		in each test tube 1	retained	
		tollowed by 2ml		
		of benedict's sol		
		ution then the mix	-	
		tures were heated		
		again to boil.		
		U I		

xpju) Neutralization process	
This is important in the experiment in order to reduce.	
the acidity in the solution after addition of -	
dilute hydrochloric acid which is neutralized by	
the stilute sodium hydroxide solution to provide the	
best PH for the benedict's solution to work pro-	
Perty.	
ii) Cooling Process.	
This is important in order to reduce the temperature.	
of the mixture in order to provide the optimum to	
temporature for homodictic relation to work property	
20 17 Temperature: This is one of the Factor which-	
affects the sheet enzyme activities in food sub-	
stance observed as the required temperature is -	
optimum temperature for the ensume to work property	
17 Substrate concentration: high substrate concentration	
affect or lower the activities of the ensumer.	
1112 pt : This is another factor were by each -	
enzymes have its pH which is suitable for it to-	
work property which can either be avidic, basic-	
and nontral.	
IN Enzyme concentration: Low enzyme concentration	
lower the rate of reaction or rate of digestion.	
Dinhibitors: This can be competitive and non-	

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

In Extract 18.2 (c), the candidate provided correct responses to the procedure, observation and inferences, and demonstrated her/his expertise in report writing. Also the candidate correctly wrote the importance of neutralization and cooling processes in the experiment in conjunction with factors affecting enzyme activities in digestion process.

Despite the candidates' good performance in this question, 23.90 per cent of the candidates scored law (0 to 5 marks) in each of the three alternatives

3A, 3B or 3C. In Biology 3A, most of the candidates demonstrated inadequate knowledge about food test experiment and poor report writing. In part (a) of the question, some of the candidates used impolite language such as "put" to report the action already done while doing the real experiment. These candidates were not aware of the use of the passive voice rather than that of the active sentence in report writing. Most of the candidates scored lower marks because they wrote incorrect procedures for the food tested. For example, one candidate incorrectly wrote food tested reducing sugar; 1 ml of Benedict's solution was added to 2 ml of a solution C1 and C2 in the separate test tube instead of 2 ml of benedict's solution to 2 ml of reducing sugar solution. This response signifies that the candidate was not aware of the reducing property of simple carbohydrate and the principles for testing it. They failed to recognise that Benedict's solution contains cupric ions  $(Cu^{2+})$  which is reduced to cuprous ions  $(cu^{+})$ . They were also not aware that these cuprous form copper (1) oxide which react in the mixture and precipitate out as a brick-red coloured compound, and that to obtain the positive results, equal volume of reagent and the solution is required. Likewise, some candidates used incorrect measurement for testing of other food substances such as starch, protein and lipid and the thing which consequently, affected their observation and inference.

In addition, some of the candidates had made incorrect observation because they were not able to identify appropriate colour change. Example of incorrect observations were; *the solution not changed, the solution retained the colour of iodine, the solution acquired the colour of benedict solution, the solution retained the colour of Sudan III solution* instead of blown, blue and red colour respectively. These responses indicate that the candidates lacked knowledge about the colour.

In part (b), some of the candidates gave incorrect name of solution  $\mathbf{X}$ . For example, one candidate named it incorrectly as *biochemical catalyst* another candidate named it as *peroxidase* instead of hydrogen peroxide solution. This candidate was not aware that peroxidase is an enzyme which catalyse the decomposition of hydrogen peroxide solution. These candidates had inadequate knowledge and they could not differentiate the name of the solution and the enzyme. Other candidates failed to recognise the reaction which took place when hydrogen peroxide was put on the fresh liver in part (c). Most of these candidates provided incorrect chemical

formula for the reaction. For example, one candidate wrote the formula;  $X + Catalase \longrightarrow H_2O_{(l)} + O_{2}$  (g) and another candidate wrote  $X + H_2O_2 \longrightarrow H_2O + O_2$ . This indicates that the candidates lacked knowledge about the decomposition of hydrogen peroxide. In addition, some of the candidates failed to explain how the control experiment is set against the prior experiment with the fresh liver tissue in part (d). Examples of incorrect responses are such as; to set of control experiment use oxygen gas, by putting the cotton in the upper part of the test tube, detoxification of the liver and use exothermic reaction. Such candidates lacked knowledge of setting the control experiments. Extract 18.2(a) is part of an incorrect response from one of the candidates.

I conford tested	Pro (cdute	Obferra from	inference	
Storch	som of Stubon			
	wer added to the		_	
	test base follow	The above of	Stach were	
	day 1cm of	ladine Ducks	alteree	
	iden, thema	wy rebor.		
	bite was maker,			
	well.			
Reducing	2m of Subin			
- fugar	was added into	The adar or	Reducing	
	that have follow	toli benchat	Sugar	
	d by benedict	Stukon was	were abjeak	
	Stuber they	referen		
	the most way			
	buil			
Non-szdulag	Dem of John bon			
Juger	was added to	the clar of	6ton redail	
	the test file,	bardick	non - reducing	
	followed by lon	Sterlon .	Sugar were	
	of Hel then the	well rebon	absence.	
	mixture was			
	boiled. The			
	mixture allowed			
	to cod then			
	Army what			
	was odded fold			
	uch fin of			<u> </u>
	Box dict Solution			

2					
	Ford to At	pro Cedur	Obtervation	Inferente	
	protein	sem of Mubon			
		was added follo	The Colour		
		read to som of	change into	The pro	
		Neoff the mortes	furple	tin	
		wal thaten follow	,	Were	
		d b lim of		prefent	
		Cerpy Mixhete			
		Thatan again			
	Lipid	The sem of	The colour	The Cord	
		Sterbon way	of Judan III	real	
L		added into the	E we returned	abtenle:	
L		belle followed	·		
		by Acmit		<b> </b>	
		Judon III ASI	ų !		<b> </b>
		1 6m.		<u> </u>	
					<u> </u>
ļ	16) The	Name of John	in Kis Hyu	loo clousic	
	ah.	d (Hc()'			<u> </u>
	fict Pr	Okin + Hcl	errup	st	<u> </u>
					<u> </u>

**Extract 18.2 (a):** Part of a sample of the candidates' incorrect responses to question 2 in Biology 3A

In Extract 18.2 (a), the candidate wrote incorrect procedures. For example, in testing of reducing sugar, the candidate wrote add Benedict's solution but the volume used was not indicated. As for the testing of lipid, there was neither shaking of the mixture nor allowing it to settle before observation. Also, colour identification was incorrect. For example, the candidate wrote the colour of iodine, Benedict and Sudan III was retained. In addition, the name of solution X and the equation provided was incorrect.

Some of the candidates among those who scored low marks (0 to 5), in Biology 3B managed to mention the food required to be tested. However, the majority of them failed to write the correct procedures and make correct observations and inference. As for the procedure, some candidates either used incorrect volume of the solutions and reagents or the measurements of the solutions were missing. For example, one candidate wrote *to 2 mil of solution S*₂, *benedict solution was added, to 2 mil of solution S*₂, *sodium hydroxide was added followed by copper II sulphate*. These responses show that the candidates lacked knowledge about the volume required for the reaction to bring about the positive results.

In addition, there were candidates who failed to recognise heating procedure in Benedict's test. Others were not aware of the principles required for conducting lipid test experiment. For example, they wrote appropriate mixture of the lipid solution and Sudan III solution but failed to indicate the amount of time required for the mixture to settle (at least 3-5 minutes) after a vigorous shaking. These candidates failed to recognise that the time lag allows the red stained oil layer to separate out and float on water surface for observation if fat/lipid is present. Likewise, some candidates wrote incorrect observations such as; the *solution retained the colour of iodine, no change observed, the solution not changed, the solution remained with the colour of benedict's solution, the solution acquired the colour of Sudan III solution.* These responses indicate that the candidates lacked knowledge about proper colour change that suggests the presence of the food substances in the food sample.

On the other hand, some of the candidates lost marks in part (b) because they failed to identify the correct properties of the food substances identified in the solution as they wrote incorrect responses such as *have sweet smell*. Some of them wrote the advantages of the food substances identified in solution  $S_2$  instead of the properties of each food substance as in; *is a source of food to other living organisms, used as raw materials in industry, they add manure in the soil after decay.* 

In part (c), the candidates incorrectly listed the missing food substances in solution  $S_2$  to make a balanced diet. For example, one candidate wrote *starch*. This indicates that the candidate did not realize that reducing sugar present in solution  $S_2$  and starch form a group of carbohydrates in a

2. a/ FOOD TESTED	PROCEDURE	OBSERVATION	INFERENCE
NON-REDUCI	In bout table	In tart tube	Norreduc
NG SUGAR	contain volution	contain coludia	in ioara
	So ramochialy	So colour cha	prevent
	1 cm² or hydrochlo	me pon due	
	n'e acid ware	groon, vellav	
	added then the	and prally brik	
	mixture boat to	rg.d.	
	boil than the		
	mixture ware		-
	allowed to cool		
	200° q sodium		
	Indoxide wore		
	added in mixture		
	to noutralize the		
	habohonc acid		
	(t(1) pollaved		
	by Banaditt's rd		
	ution, then the		
	mixture ware		ç
	baat to boil roti		
· · ·	no puttor chang	)	
	a occurad.		
REDUCING	In tout pibe co	In tast tube	Reducing
	stais plubas Se	Contain colub	Jugar were
	rapactively, 100	on So colaur	provort
	of hydrochlonic	war chappe	
	dard (HCL) wave	blue, graces	
	addad and Follo	yellas and	
	Loge by Bandick	pinally brok	
	volution and the	rad	

balanced diet. Extract 18.2(b) is a sample of incorrect responses from one of the candidates.

2. g	FOOD TESTED	PROCEDURE	OBSERVATION	INFERENCE	
	REDUCING	monthere ware			
	SUGAR_	hard to boil who			
		no purther cham			
		9. occurod			
	PROTEIN	In tait tube con	In tart tibe	protain	
		tain volution	Contain ordu	word	
		So rappactively,	tron So colour	prevent	
		2 chr	Change to	1	
		or sodium hydr	purple colour		
		xido coro addo	1 1		
		d pollaved by			
		2 and a cooper	-		
		(11) alphate"			
		solution in drop			
		uisre			
	LIPID	In toot tuba	In tast type	Lipid Loare	
		Contain volution	contain solut.	provent	
		S2 to coactively	ion Sa the		
		R drops of sudan	didinat red		
		(111) solution were	ting 100000		
		added in doop	observed co.		
		use and the	top of mixt.		
		mixture rottle	ure.		
	STARCH	In to of he be cost	In four tube	starch	
L		ain volution Sa	contain soluti	LOORD	
		rappochively 2	on se it rata	abrant	
		I drips of Isdine	in the colour		
		solution ware	1 of loding		

2.91	FOOD TESTED	PROCEDURE	OBSERVATION	INFERENCE	
	STARCH	addad in drop	solution (vallas)		
		wire and the	(		
		mixturerices			
		(chaken			
1. 5	illow parily	2 abourbod such	as moredic	ing poor	
	in they are 9	apair out woom-	Brecha auchau	portain	
	in they act a	s' inclator, it ge	incirate bea	t in the	
	body ouch	as upid			
C/	The poor al	stance are migu	in To Juto	n sais	
/	corch to	make balanced	diot pr be	man	
	baing.		. 6		

**Extract 18.2(b)**: Part of a sample of the candidates' incorrect responses to question 2 in Biology 3B

In Extract 18.2(b), the candidate wrote incorrect procedures because the chemical measurements were wrong. Consequently, she/he made incorrect observation and inference. The candidate also wrote the advantage of food substance instead of the food properties and side-lined starch from carbohydrate present in solution  $S_2$ .

Similarly, in Biology 3C, the candidates who scored low marks (0 to 5 marks) in question 2 lacked knowledge about food test experiments as most of them mostly failed to write experimental report with correct procedures, observations and inference for the food tested. Some of them incorrectly wrote commanding statements. For example, one candidate wrote; to 2 ml of solution  $C_1$  and  $C_2$  in separate test tube put 2 drops of iodine solution. Others stated incorrect procedures as the measurements of the reagents added to the solution were inaccurate. For example, one candidate wrote incorrect procedure in Biuret test as to 2 ml of solution  $C_1$  and  $C_2$  in separate test tube 2 ml of sodium hydroxide solution were added followed by 3 ml of copper II sulphate solution. This response indicates that the candidate had inadequate knowledge about the principles of testing protein in biuret test. They also failed to recognise that biuret test determines the present of peptide bonds which are basis for the formation of protein when equal volume of sodium hydroxide is added to a solution and mixed carefully. This procedure is followed by the addition of a few drops of 1% CuSO4 solution. Thus, the copper II ion  $(Cu2^+)$  added to the solution reacts to form purple or violet complex.

Some candidates failed to differentiate the intensity of colour change from the concentration of the precipitate in Benedict's test. Consequently, their responses about observations and inferences were similar for both reducing and non-reducing sugar. These responses signify that the candidates were not aware that, in the Benedict's test, the concentration of simple sugar increases after the hydrolysis of non-reducing sugar solution. Therefore, the intensity to brick red colour and the concentration of precipitate formed in that solution is greater than the results obtained when testing reducing sugar solution.

Moreover, some of the candidates failed to state the importance of neutralization and cooling processes in the experiment. For example, one candidate wrote, *neutralization help to allow acid to react with food sample* and other reagent. Another candidate wrote, neutralization is done in order to catalyse the reaction and to identify the food substances considered with the reagent. On the other hand, incorrect responses provided for cooling process are; it helps to lower the acidic reaction with food sample, help in breaking down the bond existed between non-reducing sugar in order to be weak for proper reaction between benedict solution with mixture. These responses indicate that the candidates lacked knowledge about the principles governing the testing of non-reducing sugar. They failed to recognise that neutralization intends to remove acidity inhibition which reacts with copper in Benedict's test. Likewise, warmth speeds up the chemical reaction that leads to overlapping of the series in colour changes. Therefore, they ought to understand that the cooling process slow the reaction and the observer can identify clearly the series of colour changes. Extract 18.2(c) is a sample of incorrect responses from one of the candidates.

2 (9)	FOOD TESTED	PROCEDURE	OBSERVATION	INFERENCE
ť	TARCH	2 cm ² of sample solution	Blueblock	Storch present
		Good C2 Was put	colour was	in solution (1
		on dippornt test tube	present in	while in
		followed by addition	solution C1	solution C2
		of iodine solution	and yellow	storch was
		on each test tube	colour was	not present
		then the mixture was	observed in	berouse todine
		shaken on each	solution C2	retain colour
		test tube		of iodine solution
, ii	PROTEIN	2 cm ³ or sample	purple colour	protein was
		solution C1 and C2	was observed	present in
		was aut on different	in solution C1	colution C1
		lest type followed	while	while
		by addition of	Blue colour	Solution C2
		two drops OF NAOH	was observed	protein was
		then one drop of 1%	in solution C2	not present
		or (USO4 on each		
		test tube		
Ĩij	REDUCING	2 cm ² of somple.	solution C:	Reducing sugar
	SUGAR	solution C2 and C2	It has retained	was not present
		was transfer into q	the colour of	in sample solution
		different test tube	benedict solutor	sa while
		followed by addition	uhile	Sample solution
		or benedict solution	Solution C2	C2 reducing
		on each test tube the	Colour change	Sugar was
		followed by heating	from blue ->	present

	FOOD TESTED	PROCEDURE	OBSERVATION	INFERENCE	
(ii)	REDUCING	the mixture on each	green-yellow		
	SUGAR	lest tube	and finally		
			brick red		
١٧	NON REDUCING	2m ² of sample	Somple solution	Non reducing	
	SUGAR	solution C1 and solution	C1 17 has	Sugar was	
		Co was transformed into	retained the	not present	
		different tert tube	Colour of	is sample	
		thed followed by	henedict	solution Ce	
		addition of Holdilule	Solution	while	
		on each test tube	while	In sample	 
<u> </u>		then the mixture was		Solution C2	
		hoiled on Cooling	Sample	reducing	
		the mixture of	solution C2	Sugar was	
		different test tube	the colour	protectent	
		Noot and benedict	choose from		
		Solution was added	blue-green-		
		on each test tube	yellow and		
		then followed by	finally brick	-	ļ
		heating cently the	red		
		mixture of differen	4		
		lest tube		· .	

2(6) Neutralization was very important the. 10 process break required to experiment herouse. 10 AH TNG S ond to provide suitable pH alio to and band destroy the acidic nature NOOH the. process were important experiment 1) Coolina 01 ecause solution Hel ond benedict 50 6dour reen allocting the ensume Ladur Ć The. 0/ i the among i) concentration 01 the artivities οç enzyme among oi. Buiker or Prov. d 100 result to no tonro Course. mai bebo Lood

**Extract 18.2(c)**: Part of a sample of the candidates' incorrect responses to question 2 in Biology 3C

In Extract 18.2(c), the candidate lacked knowledge of conducting food test experiments. He/she used incorrect measurement which affected the observation and inference of the results. Similarly, the responses for other parts of the question were incorrect.

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

Questions 3 in alternatives paper 3A, 3B and 3C measured the candidates' competence in classification of living organisms to their respective groups. In Biology 3A, the candidates were provided with specimens  $A_1$  (bee),  $A_2$  (spider) and  $A_3$  (quill feather). Then, they were required to:

- (a) Suggest four organisms from which the specimen  $A_3$  must have been taken.
- (b) Observe specimens  $A_1$  and  $A_2$ , and then;
  - (i) State the Kingdom and Phylum of specimen A₂.
  - (ii) Give observable features in each of the specimens  $A_1$  and  $A_2$  representing their respective Class level.
- (c) Give three functions of specimen  $A_3$  to the organism from which it was taken.

Similarly, in Biology 3B, the candidates were provided with specimens  $N_2$  (freshly killed cockroach) and W (Housefly). Then, the candidates were required to:

- (a) State the type of metamorphosis undergone by each of the specimens  $N_2$  and W.
- (b) Describe the developmental stages in the life cycles of the specimens  $N_2$  and W with the aid of diagram.
- (c) State the advantage and disadvantage of specimen  $N_2$  in the ecosystem.

Likewise, in Biology 3C, the candidates were provided with specimen L (Irish potato), M (Grasshopper), P (Lizard) and Q (Tilapia fish). Then, the candidates were required to:

- (a) Give two observable features common to specimens **M**, **P** and **Q** at the Kingdom level.
- (b) State the observable features which makes the specimen **P** and **Q** look different at Class level.

- (c) Classify each of the specimens **l**, **M**, **P** and **Q** from the Phylum/Division to Class level.
- (d) Give two importance of the specimen **L** to the organism from which it was taken.
- (e) State where specimen **P** and **Q** are naturally found.
- (f) Draw a well labelled diagram of specimen **M**.

The data analysis reveals that 100 per cent of the candidates responded to question 3. Further analysis shows that the performance was good since the majority of candidates (93.66%) passed. The summary of their performance is shown in Figure 15.



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

Figure 15 shows that more than two third of the candidates (73.94%) scored high marks ranging from 9 to 15 while a few 6.34 per cent scored from 0.5 to 5 marks. However, none of the candidates scored zero in this question.

The candidates who scored high marks (12 - 20) demonstrated adequate competence in the topic of Classification of Living organisms. In Biology 3A, the analysis indicates that these candidates had adequate knowledge of the distinctive features of Kingdom Animalia. Their responses about the features observed from the members at the kingdom, phylum and class levels were well clarified. They correctly provided the names of animals covered with feathers in part (a). They also, correctly identified the Kingdom and phylum in which the spider belongs and gave correct observable features which formalized the placement of the bee and the

spider in the Class Insecta in part (b). They also clearly stated the functions of quill feather to the organism from which it was taken. Extract 19.1(a) is a sample of correct responses to this question from one of the candidates.

$\bigcirc$		
$\int q_{i}$	Organisms from which the specimen Az must have	
	been takon from are:	
6.		
- 1/	DUCK	
jų.	Haa	
iņ	Pigeon	
17	peacock	
ļ	,	
0 510		
12.0/1	Fa Specimen Az.	
	Ringcion, Filimalia	
	Phylum: Arthromola.	
ůj.	Observable jeatures for specimen to which keep it	
	in class insects are:	
<u> </u>	It has three bedy parts which give needy that	
	and abdomen.	
	It has three pairs of polking loss which are	
- ''	inned to the though on the body.	
iù/	It has one poir of wings which enable it for	
	flight	
iy.	It possesses antonnae for	
	detecting external stimuli-	

D'in Observeble reatures of specimen Az to keep it in its Keep it in its if It has four pairs of walking Legs in its body. It has two body parts cepholothorax & thorax juined to head) and the gladencen. ìŷ has pedipals but lack antennee For rensoling /4 hý and detection of external stimul. possesses chelicinae which produce silk which iy poisoner, solution for laptoning prey. h Functions of specimen A2 (quill father) to augunism from which it's taken arethe It aids for flight while excepting from negative external stimuli or for search of good and mgte · in It insulates the organism against environmental conditions more especially cold conditions iii Protects the body of organism from mechanical The damage of the intervice skin. Example from thom s.
3.	a. Organisms from which specimon As must have	
	been taken includes:	
	i/Hen.	
	11/ Duck	_
	iii/ Ostrich	
	iv/ Feale	
3. a. Organis been ta been ta		
	h. il Spaciman - Az	
	Kinadowa - ANIMALIA	
	PL June - APTHRODODA	
	Ingland /IKIIIKOFOD/	
	IV Specimen A1	
	-It belongs to class INSECTA.	
	- It has the tollowing observable teatures that	
	represent class insecta.	
	O H has two pairs of wings for during	
	(i) It has compound eyes for vision.	
		_
	(iii) It has a pair of Antennais for	
	concation	
	(iv) It has three same a rounted tage or	
	to it has three pairs of jointed regs for	
	move ment,	

3. b. il. Specimen Az	
- It belongs to class ARACHNIDA.	. <u> </u>
- 1t has the following observable reatures that	
ropresents it class arachnida.	
(D. H has eight (8) eyes for	
(1). It has pedipalps for sensory sensation.	
	<u> </u>
UP It has cheticerae for capitring prey.	
mit has jour pairs or rightim loss	
In in this full purs of Maching 1890.	
(1) It has (8) eight simple eves Lor vision.	
e. Functions of specimen As to the organisms	
trom which was taken:	
D. Used to provide insulation to the organism.	
(i) Used for plying thus helping in movement	
of the organism.	
(i) Hood to provide putration to the average	
UIU, USEY TO PIONICE PIOTECTION EO ING. ONGANISMA.	

**Extract 19.1(a):** Part of a sample of the candidates' correct responses to question 3 in Biology 3A

In Extract 19.1(a), the candidates gave correct name of the Kingdom and Phylum for spider and correct distinctive features for its respective class. Also, the candidate provided correct names of organisms with quill feather and the functions of the quill feather to the organism.

In Biology 3B, the candidates who scored from 9 to 15 marks were aware of the types of metamorphosis undergone by cockroach and housefly. They also managed to describe the developmental stages in both life cycles correctly. In addition, they demonstrated their good drawing skill on the life cycles. Furthermore, they correctly stated the advantage and disadvantage of cockroach in the ecosystem. Extract 19.1(b) is a sample of the correct responses from one of the candidates.

03	(G). Advantages of specimen N2 in the ecosystem.	
	(1) Used as tool to other organism. As they are rich	
	in protein can be teed to carniloger birds.	
	() Add accounts matter in the sort when they dip.	

-		-
03	(6) Dis-advantages of speeimon Nz	
	D They camp backeing Hence they can cause or	
	transmit diseases. Capating human being),	
	They cause food sportage. This is due to their	
	socretion.	
	(M) They cause alogic condition due to their bad small	
	they worke.	
	444	
03	(b)	
	NEVELOPMENT PERMEC (LIFE EVELED DE OPERMUNI NU	
	DE CE LOVINER (STATES (EFE DICE) OF IVECINER)	
	The England N. (compl) has not maken the	
	ushard a second of a second of the them of the	
	The first chose & provide all the start the	
	The first stage is any are they to then stary points	
	Some period of time pollowed for halding them. The read	
	stage is the occurance of Dymph (nymph inge) to	
	watch after notching the innoune cocroas called of hymph	
	develop in sile and other bady parts the this last for the	
	few days, trally the stault stage this but stage	
	which nymph develop into mature excitach (Adult)	
	which capable for reproduction and full developed wings and all effer	
ļ	body parts.	
	20 eggs.	
	Adul ATA NET Nymph	
	A A MAN	
	~~~	
	: Hecycle of Speimen N2 (cocroach),	
	, , , , , , , , , , , , , , , , , , , ,	

03 (b). DEVELOPMENT CTAKER [LIEFCH(LE) At	
SPECIMEN IN (110 mth)	
The program is (the main is bee complete mater)	
as uphilly has at loss they down to be the such of	
Furt theo Free are built on the different	
dead come matter where the a part of him in	
hatching the by the colling of home of period of the fit	
de.	
Second stop Aller broken the error drught and the	-
which is the fearling store inthe while the is that h	
tead on those tood make to assure the share of the the	
By the pollyage of prepare the stated por the peop JR	
tabo Pupa.	
Third stree Puper the marked a reaction strend	
taining by influence of Manna training the bige work	
Caved by the prototive head care when the ad my	
food tokly but all down and the thread find in	-
Scool stage At the charge of the stad for all the	
Fourth stage Adult (motive stages as he will) The	
Stage is the stage intere and the man a har the	_
Case and econe their where a thread the count and in	-
to the their first the At the tree coming when preparity	-
dire. They have that the ima	-
	-
Adult Min	-
lan	-
	-
	\neg
Pupg : Liberry of province w	\neg

Extract 19.2(b): A Part of a sample of the candidates' correct responses to question 3 in Biology 3B

In Extract 19.2 (b), the candidate provided correct types of metamorphosis, the developmental stages for both life cycles and demonstrated his/her expertise in drawing.

As for Biology 3C, the candidates who scored high from 9 to 15 marks had good mastery of classification of living organisms. They managed to provide correct features which formally placed grasshopper, lizard and tilapia fish in the Kingdom Animalia. Also, the candidates correctly gave the features which place the lizard and tilapia fish into different classes, namely the Class Amphibian and Class Osteichthyes respectively. In addition, these candidates managed to identify the Division/Phylum and Classes for each of the specimen including grasshopper, irish potato, lizard and tilapia fish. Moreover, the candidates were able to explain clearly the importance of irish potato tuber to a plant from which it was taken and correctly stated natural habitat for each specimen lizard and tilapia fish. On top of that, the candidates drew correctly a well labelled diagram of grasshopper. Extract 19.1(c) is part of the correct responses by one of the candidates.

03.									
(0)	Observable teatures common to								
	Specimen M, P and Q at the kingdom								
	lavel.								
	(2) The members have eyes for vision								
	(ii) the members have month for								
	teeding.								
10	Macanally last strict male case								
-201	Observable teamore which make speamer								
	Forna & CODE di PERENI al Cluit real								
	Specimen P Specimen C								
	filtige two pairs at 1- the not have leave								
	1890								
	(ii) Do not have find - It has find								
	- They have scales								
		_							
$\left \begin{array}{c} (c) \end{array} \right $	Specimen Phylum/Division Class								
	LAngjospermophyta Dicotyledonae								
	m Arthrippuda insecta								
	P Chardaita Keptina.								
	W Chordata Osteichthyes								

Extract 19.1(c): Part a sample of the candidates' correct responses to question 3 in Biology 3C

In Extract 19.1(c), the candidate provided correct distinctive features across the members of Kingdom Animalia and wrote correct observed features to differentiate the specimens provided at class level. Also, he/she gave correct importance of Irish potato and the natural habitat for lizard and tilapia fish.

Although the candidates' performance on question 3 was good, further analysis of candidates' responses in Biology 3A, 3B and 3C reveals that there were a few (6.34%) of candidates who scored from 0 to 5 marks. In Biology 3A, most of the candidates in this category demonstrated inadequate knowledge about the topic of Comparative Studies of Natural Groups of Organisms. Some of them failed to identify the common name of organism covered by feathers and the function of quill feather to the animal. For example, one of the candidates wrote *quill feather protect the*

organism against preys. Another candidate wrote, it facilitates organism movement towards the mate.

Also, the candidates were incompetent about the classification of living organisms. Some were not able to identify the Kingdom and the Phylum in which the spider belongs. Others wrote incorrect spelling of scientific words. For example, one candidate wrote the phylum of spider as *athopoda* instead Arthropoda. These misspelt words could lead to placing the organism into an incorrect taxonomic group or side-lining it from the required group due to miscommunication among the scientist worldwide. In addition, some of the candidates failed to identify the features which formally places the bee and the spider in their classes, namely the Class Insecta and Arachnida respectively. Consequently, they wrote features of other classes. For example, one candidate wrote; Bee *has two pairs of jointed leg per segment*, which is the typical feature for the Class Diplopoda. Some of the candidates wrote the features for Class Arachnida and Insecta interchangeably. Extract 19.2(a) is part of an incorrect response from one of the candidates.

3 @ Cil Duckle	
(ii) Dicken	
(iii) Kunpere	
$3 \bigcirc 1 \land - Bee$	
A, - Saider	
A Kingdum Apimolia	
A Phylum Churlesta	
J	
3 (b) (ii) A Kingdyn Apimulia	
A Mylum Charlesta	
A Clay lalecta	
A - Kindon Annulia	
As - Philum Arashnida	
A- Club Indector	
× -	
the Objervable fruitures	
i) they have the antinge	
(i) they have for limb	
iii) they have three pair of the trai	
(iv) they their bodies are divided by a trapposts or pair (three pairs)	

Extract 19.2 (a): Part of a sample of the candidates' incorrect responses to question 3 in Biology 3A

Extract 19.2(a) is a response from a candidate who had insufficient knowledge about classification of living organisms. The candidate's responses were not well organised to justify the similarities at kingdom level and differences at class level. Likewise, the candidate wrote incorrect groups in part (b). For example, he/she wrote phylum chordata for specimen A_1 – bee, phylum Arachnida for specimen A_2 - spider and class insect for specimen A_2 – spider.

Similarly, in Biology 3B, the candidates who scored from 0 to 5 marks demonstrated inadequate knowledge about the concept of metamorphosis in arthropods. Most of them failed to identify the types of metamorphosis occurring in cockroach and housefly in part (a). For example, one candidate wrote, the type of metamorphosis for specimen N_2 is moulting metamorphosis and that of W is full metamorphosis. In part (b), some of the candidates defined the terms complete and incomplete metamorphosis instead of giving the description of the developmental stages for the life cycles of cockroach and housefly. For example, one candidate wrote specimen W undergo a complete metamorphosis, complete metamorphosis is the process whereby a gradual change/development stage in a life cycle of organisms and specimen N_2 undergo incomplete metamorphosis, incomplete metamorphosis is the type of the metamorphosis whereby three stages involve in the development stage in the life cycles. In addition, the candidates drew diagrams of either incorrect life cycles required or life cycle with incorrect stages. For example, one candidate drew a diagram with lava stage in a place of pupa for complete metamorphosis.

In part (c), some of the candidates wrote incorrect advantages and disadvantages of cockroach in the ecosystem. For instance, some incorrect advantages were; they ensure energy flow in the ecosystem because they are carnivores which feed on small organisms, they are source of medicine, they can hide in small space because they are small in size, they can escape easily from danger as due to camouflage. Other incorrect disadvantages provided were such as: they cause diseases, are causative agents for diseases. These candidates lacked knowledge about the merits and demerits

of arthropods, particularly cockroaches in the ecosystem. Extract 19.2(b) is a sample of incorrect responses by one of the candidates.

. (<i>a</i>)	Type of Metamorphosis undergone by each of the specimen No and W is complete metamorphosis	
(b)	Stage developmental in the life cycles of the specimens No and W	
	Eggs - D Larva - D Lamph . r Adult	
e	Advantages of Specimen No. - It help in colligation process by transferri	
	ng & pollen grain from anther of one plant to the another stigma of the other plant.	
	Disadantage of Specimen No It cause disease from one place to another	

Extract 19.2 (b): Part of a sample of the candidates' incorrect responses to question 3 in Biology 3B

Extract 19.2(b) depicts the responses of a candidate who lacked knowledge about metamorphosis occurring in cockroach and housefly. The candidate incorrectly wrote that both undergo complete metamorphosis. Also, he/she drew an incorrect diagram with linear arranged development stages instead of circular manner of the life cycles. Similarly, the advantages and disadvantages provided were also incorrect. For example, he/she wrote incorrect statement as; *cockroach cause diseases from one place to another*.

As for Biology 3C, the candidates who scored from 0 to 5 marks demonstrated inadequate knowledge about classification of living organisms. Consequently, they gave features of the organisms which are

not related to the required group. In part (a), some of the candidates wrote observable features of each specimen provided instead of identifying the similar distinctive features which placed the grasshopper, lizard and tilapia fish in the Kingdom Animalia. Example of incorrect features are: *tilapia fish have swim bladder to control depth, lizard they use lungs for gaseous exchange*. These responses indicate that the candidates were not aware of the distinctive features of the Kingdom Animalia such as presence of sense organs, namely eyes, nose; locomotive structures such as legs, fines, wings; and the mouth for feeding.

In the same vein, some candidates either failed to identify the Class in which lizard and tilapia fish belong or provided incorrect observable features relevant to their respective Classes. Some of the candidates provided the features related to the Phylum level in part (b). For example, one candidate wrote that lizard have spinal cord. This candidate was not aware that tilapia fish and lizard look different at class level as lizard is placed into the Class Amphibian whereas tilapia fish belongs to the Class Osteichthyse. The difference features between the two classes are; tilapia is covered by skin with cycloid scales while lizard has skin with rough horny scales/dry scaly skin. Also, tilapia fish has fins for swimming while lizard has four limbs. In addition, some of the candidates wrote internal features which were not observable contrary to the question demand such as double circulation, kidneys and homodont teeth.

In part (c), some of candidates misspelled the scientific terminologies. For example, one candidate wrote the class name of grasshopper as Class *insect* instead of Insecta. Others gave incorrect habitat of lizard and tilapia fish in Part (e) and drew irrelevant diagram of a grasshopper in part (f). Extract 19.2(c) is a sample of incorrect responses from one of the candidates.

2	@ observable reasures of specimen M	
వ	- specimen M has a pair of legi	
	- Spermen M has compound eyes	
	Observable reakings of specimen P	
	- specimen p has scales	
	- spenner P has tail	
	Observable Reatures of speamer Q	
<u> </u>	-specimen of has pins	
	- spenner of has scales	
	B objection ble realized which makes spectree P	
<u> </u>	Look dillared of clay level are	
	- Spermes P has scales on the body	
<u> </u>	specimen p hay a teul	
	Observable reatures which makes specimen @	
	LOOK dyperent at days level are	
	- specimen of has fine which enable it to swimme	
	- specimen Q has scales which are impermiable	
	to water hence help in the problem of water	
	Looding	
	N	

Extract 19.2(c): Part of a sample of the candidates' incorrect responses to question 3 in Biology 3C

Extract 19.2(c) show the candidate's incompetent on classification of living organisms. He/she incorrectly gave poorly arranged responses on the similarities of the provided specimens. Likewise, the features provided were for the class level instead of the kingdom level. For example, the candidate wrote that *grasshopper has compound eyes, tilapia fish has scales*. In addition, the candidate gave incorrect and poorly arranged features to differentiate the organisms at class level.

3.0 ANALYSIS OF THE CANDIDATES' PERFORMANCE ON EACH TOPIC

Biology Subject Examination involved a total of 13 topics. Seven topics were tested in the133/1 Biology 1 paper and six topics in the133/2 Biology 2 paper. Two topics (one from paper 1 and the other one from paper 2) were also tested in 133/3 Biology 3, which is a practical paper.

The analysis of the candidates' performance in Biology subject shows that the candidates had good performance on four topics, average performance on eight topics and weak performance on one topic. The performance is as follows:

In the 133/1 Biology 1 paper, the candidates performed highly on the topic *Nutrition* (53.15%), followed by *Gaseous Exchange and Respiration* (38.94%), *Cytology* (49.80%), *Transportation* (49.70%), *Reproduction* (40.17%), *Coordination* (30.4%) and *Principles of Classification* (17.90%). In the 133/2 Biology 2 paper, the topic of *Evolution* (96.91%) ranked first followed by those of *Growth and Development* (79.96%), *Ecology* (69.01%), *Comparative Studies of Natural Groups of Organisms* (68.68%), *Regulation/Homeostasis* (54.39%) and *Genetics* (34.30%). In the 133/3 Biology 3 paper, the topics of *Comparative Studies of Natural Groups of Natural Groups of Organisms/ Principles of Classification* and *Cytology* were performed at 91.15 per cent and 76.10 per cent, respectively. The performance on each topic is summarized in Appendix A.

The comparison of the candidates' performance on each topic in Biology ACSEE 2021 and ACSEE 2022 reveals that the topics of *Comparative Studies of Natural groups of Living Things* and *Evolution* have maintained a good performance while that of *Reproduction* has maintained an average performance. On the other hand, the performance on the topics of *Growth and Development* and *Ecology* have improved from poor to good while those of on *Nutrition, Gaseous Exchange and Respiration, Coordination* and *Genetics* have improved from poor to average. Contrarily, the performance on the topics *Regulation, Cytology* and *Transportation* have dropped from good to average performance while that of *Principles of Classification* has dropped from good to poor. The comparison is summarised in Appendix B.

4.0 CONCLUSION

The candidates' performance in Biology in the ACSEE 2022 was good since 99.26 per cent of the candidates scored from 35 marks and above. This performance is a result of the effort made by education stakeholders in improving the teaching and learning which has ameliorated the candidates' knowledge, skills, competencies stipulated in the syllabus, and which have in turn enabled them to identify the demand of the questions and respond

accordingly. Although, most of the candidates demonstrated good knowledge, skills and competencies few of them (0.74%) seem to have these aspects thing which has greatly affected their performance. The weak performance for some of the candidates might have been caused by:

- (a) Provision of responses which were contrary to the task of the question. This is a result of either failure of the candidates to read the questions carefully and understand their demands before attempting them or carelessness when responding to the questions.
- (b) Candidates' partial knowledge of the tested concepts. This could be the result of the students' lack of mastery of the biological concepts stipulated in the syllabus.
- (c) Candidates' incompetence in conducting scientific experiments pertaining to dissection, food test and classification of living organisms. This might have been caused by the candidates' inadequate practices of carrying out food test experiment, dissection and practice in drawing skilful diagrams.
- (d) Candidates' little drawing skills. This is the result of lack of drawing exercises.

5.0 **RECOMMENDATIONS**

The candidates' good performance is a product of collective efforts between teachers and learners. Based on this fact, the following recommendations to teachers and learners are put forward with a view to improving the performance of prospective candidates:

- (a) Teachers have to continue using locally available materials (improvisation) and include the following teaching/learning resources:
 - (i) Charts, simple constructed keys, published key for plants and animals and a variety of organisms for teaching the topic of *Principles of Classification* whose performance has dropped drastically despite the fact that its good performance was constantly maintained for the last four years.

- (ii) Charts/diagrams/models or pictures for teaching the topic of *Nutrition* whose this year's performance has increased from weak to average despite the weak performance it maintained for the last four years. However, the target is good performance.
- (iii) Charts/diagrams or video showing the process of respiration of various respiratory substrates on the topic of *Gaseous Exchange and Respiration*, whose performance dropped from average to weak in 2021 but has been restored to average in this year (2022). However, the target is good performance.
- (iv) Photographs/diagrams/pictures or illustrations to teach the topic of *Coordination* whose performance has changed from weak in 2021 to average in 2022. However, the target is to have good performance.
- (v) Charts/illustrations or diagrams for teaching the concept of epistasis on the topics of *Genetics* whose performance has increased from weak to average, though more effort is needed to make its performance better.
- (vi) Charts, diagrams and models for teaching the topic *Transportation* whose performance has dropped from good in 2021 to weak in order to enhance the students' understanding and hence good performance.
- (vii) Apparatuses and materials for experimentation in order to investigate the properties of enzymes for teaching the topic *Cytology* which had good performance in the past four years but has dropped to average performance in this year (2022). The target is to restore its good performance.
- (viii) Charts, diagrams and video film for teaching the topic of *Reproduction* which never had good performance for the four consecutive years and this year the performance is weak.

- (ix) Chart and graphs for teaching the topic of *Regulation/ Homeostasis* with a view to restoring its performance which has dropped from good in 2021 to average in 2022.
- (x) Fresh specimens of small mammal (rat/mouse/guinea pig), arthropods (cockroach) and fog/toad, and guide students to dissect them to display various systems.
- (b) Students are advised to:
 - (i) build the habit of reading each question carefully to ensure that they clearly understand its requirement before attempting it.
 - (ii) concentrate on their studies and solve various questions in the Biology subject to ensure that they internalize the concepts taught under each topic.
 - (iii) practice drawing various biological diagrams in order to gain drawing skills owing to the fact that 'practice makes perfect'.





Topics

		2022			2021			
S/N	Topics	No of Question(s)	Per centage of Candidates who Scored an Average of 35 Per cent or Above	Remarks	No of Question	Per centage of Candidates who Scored an Average of 35 Per cent or Above	Remarks	
1.	Evolution	1	96.91	Good	1	71.1	Good	
2.	Growth and Development	1	79.96	Good	1	10.60	Weak	
3.	Ecology	1	69.01	Good	1	27.30	Weak	
4.	Comparative Studies of Natural Groups of Organisms	3	68.68	Good	3	75.90	Good	
5.	Regulation/ Homeostasis	1	54.39	Average	1	61.30	Good	
6.	Nutrition	2	53.15	Average	1	21.50	Weak	
7.	Gaseous Exchange and Respiration	2	52.05	Average	2	23.70	Weak	
8.	Cytology	2	49.80	Average	3	57.70	Good	
9.	Transportation	1	49.70	Average	1	76.90	Good	
10.	Reproduction	2	40.17	Average	2	43.70	Averag e	
11.	Coordination	1	38.94	Average	1	30.40	Weak	
12.	Genetics	1	34.30	Average	1	1.50	Weak	
13.	Principles of Classification	1	17.90	Weak	1	65.50	Good	

Appendix B: Comparison of the Candidates' Performance on 133 Biology ACSEE between 2021 and 2022 by Topic

