3.3 BIOLOGY (231)

Biology (231) is examined in 3 Papers; two Theory and one Practical.

Paper 1 assesses concepts across the secondary school syllabus and is marked out of 80. The questions are usually structured and are all compulsory.

Paper 2 consists of 8 questions, five of which are structured, sampled from 5 topics across the syllabus, each carrying 8 marks; question six usually assesses concepts on data manipulation and interpretation (20 marks) while questions seven and eight are usually essays, each carrying 20 marks. A candidate is expected to attempt only one of the two essay questions. Paper 2 is also marked out of 80.

Paper 3 is usually a practical paper, with three questions drawn from any three topics within the secondary school Biology syllabus. It is marked out of 40.

3.3.1 CANDIDATES' GENERAL PERFORMANCE

The performance of the candidates in the three Biology papers from 2009 to 2018 is outlined in the Table below.

Table 11: Candidates' Overall Performance in Biology from to 2018

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
2009	1		80	20.14	12.31
	2		80	18.41	10.30
	3		40	15.86	8.43
	Overall	**299,302**	**200**	**54.29**	**28.80**
2010	1		80	20.14	13.76
	2		80	18.41	10.82
	3		40	15.86	8.31
	Overall	**317,135**	**200**	**58.39**	**30.44**
2011	1		80	22.74	12.41
	2		80	23.31	13.04
	3		40	18.84	8.10
	Overall	**363,817**	**200**	**64.87**	**31.05**
2012	1		80	19.77	12.84
	2		80	20.70	12.09
	3		40	11.97	6.59
	Overall	**389,523**	**200**	**52.41**	**29.43**
2013	1		80	28.03	14.49
	2		80	22.36	12.70
	3		40	12.88	7.64
	Overall	**397,319**	**200**	**63.26**	**32.06**
2014	1		80	23.91	14.49
	2		80	18.92	11.83
	3		40	20.82	8.39
	Overall	**432,977**	**200**	**63.65**	**32.57**

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
2015	1		80	27.42	14.46
	2		80	19.56	11.86
	3		40	22.62	9.15
	Overall	465,584	200	69.59	31.55
2016	1		80	27.30	
	2		80	20.11	16.40
	3		40	10.99	14.14
	Overall		200	58.37	6.76
		509,982			35.16
2017	1		80	13.74	10.24
	2		80	16.43	10.37
	3		40	7.68	5.05
	Overall	545,663	200	37.85	23.45
2018	1		80	15.81	9.26
	2		80	11.92	8.67
	3		40	13.65	7.38
	Overall	589,900	200	51.38	23.26

From the Table it can be observed that:

i) There has been a continuous increase in candidature for the past ten years.

ii) The worst performance was in 2017. There was a significant improvement in 2018. The standard deviation values indicate that the papers adequately discriminated learners of different abilities.

OVERALL CANDIDATES' PERFORMANCE BY GENDER IN 2018 AND 2017 KCSE BIOLOGY

SUBJECT CODE & NAME	2018						2017					
	ALL		FEMALE		MALE		ALL		FEMALE		MALE	
	No. SAT	MEAN %	No. SAT	MEAN %	No. SAT	MEAN %	No. SAT	MEAN %	No. SAT	MEAN %	No. SAT	MEAN %
231 Biology	589,900	25.69	301,608	24.65	288,292	26.78	545,666	18.93	277,242	17.98	268,424	19.91

From the Table, it is evident that:

i) Candidature for both male and female significantly increased in 2017 and 2018. There were more male than female candidates in the two years.

ii) Males performed better than females in the two years.

ANALYSIS OF PERORMANCE IN THE PAPERS

3.3.2 Biology Paper 1 (231/1)

ANALYSIS OF POPULAR ITEMS IN PAPER 1, (231/1)

1. (a) Name the cell organelle found in abundance in the white blood cells.   (1 mark)

    (b) Give a reason for your answer in (a) above.   (1 mark)

2. State **two** observable features that place a millipede into its Class.   (2 marks)

Most candidates scored all the marks in these two items. This could be attributed to the fact that these are knowledge questions in terms of the Bloom's Taxonomy.

ANALYSIS OF POORLY PERFORMED QUESTIONS

The questions that were performed poorly by the candidates are discussed below.

Question 6
The diagram below illustrates tissue fluid and cells surrounding a capillary.
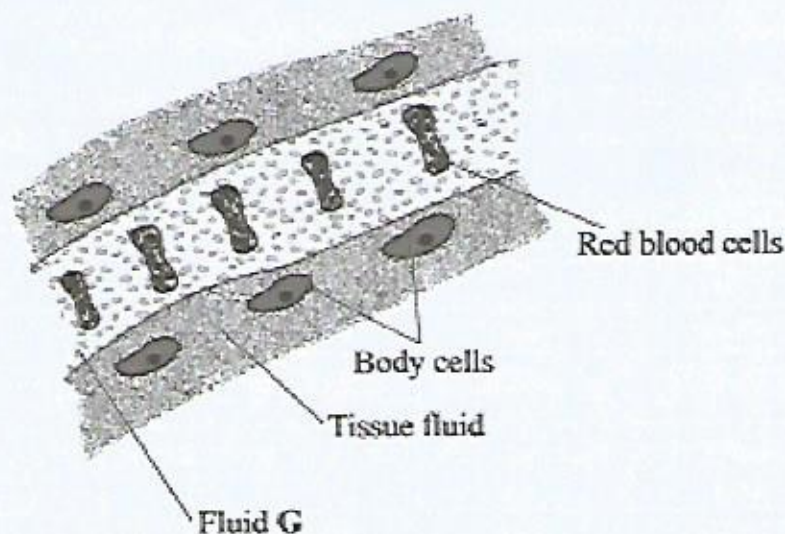
(i)   Name fluid G.   (1 mark)

(ii)   Give **two** ways by which fluid **G** is different from tissue fluid.   (2 marks)

Weakness

Most candidates failed to identify fluid G as plasma. They also demonstrated lack of understanding of the relationship between the plasma and tissue fluid. This illustrates inadequate understanding of biological principles and processes like ultrafiltration (that results in the formation of tissue fluid) as well as a gap in the students' observation and interpretation skills.

Expected response

(i)   (Blood) plasma;   (1 mark)

(ii)   Has (more/large) proteins/blood platelets;
High (hydrostatic) pressure/low pressure of tissue fluid;
Has red blood cells;   (2 marks)

Question 12

Explain why the nephron is long and convoluted.   (3 marks)

Weakness

Majority of the candidates who came closer to giving the expected response confused **reabsorption** for **absorption**, while many others went ahead to generally state how the mammalian kidney is adapted to its function.

This further illustrates inadequacy in understanding and application of biological terms as well as the functioning of various body organs and processes.

A variety of (Biology) text books to be used in the teaching and learning of Biology to enhance understanding of concepts from different perspectives. Besides, integrating ICT in the teaching of the working of the body processes and organs like the kidney would help. This can further be demystified by carrying out dissections in the laboratory.

Expected responses

☐   To fit in the (limited space) in the kidney/occupy less space;
☐   Increase surface area for (selective) reabsorption;
☐   Allow for more time for (selective) reabsorption;   (3 marks)

Question 18

A tall, light skinned lady with pimples on her face has long hair and limps.

(a) List two features which the lady has that are due to inheritance.   (2 marks)

(b) Explain why most recessive genes are expressed phenotypically in male offspring of humans.
                                                       (3 marks)

Weakness

Most candidates failed to link the genetic knowledge to daily life situations, hence failed the question. A good number further confused "**limps**" for "**limbs**", hence giving out of context responses.
Candidates should keenly read and comprehend questions before responding. Writing incorrect spellings of most biological/technical terms continue to significantly affect students' performance in the subject hence the need for more emphasis on precision and accuracy in the understanding and presentation of responses.

Learners should be exposed to a range of scientific processes and practical activities that develop their interpretation, critical thinking and analytical skills, especially in topics like Genetics, Cell Physiology, Transport, Gaseous Exchange, Respiration, Ecology, among others. This can be (easily) achieved by relating the content taught to existing life situations in the immediate students' environment.

Expected responses

(a) Height (tallness);
   Long hair;
   Skin colour (light); **Any 2,**   (2 marks)

b) Most of the genes are sex-linked and are carried on the X - chromosomes; boys receive X chromosomes from the mother (and Y chromosomes from the father); if the X carries a recessive gene, it is more likely to be phenotypically expressed in boys;   (3 marks)

3.3.3 Biology Paper 2 (231/2)

(a)   ANALYSIS OF POPULAR ITEMS IN THE PAPER

None of the eight questions in the paper fully recorded consistent scores as to be regarded as popular to the candidates. However, it was generally observed that sections of the questions in the paper that required an extra effort to comprehend, interpret, infer (from a diagram, photograph, a process and data) were poorly performed compared to those that were rather straight-forward. This calls for concerted efforts from the teachers to inculcate and nurture, at an early stage, not only analytical and critical thinking skills in the learners but also precision in the presentation of biological principles.

(b)   ANALYSIS OF POORLY PERFORMED QUESTIONS

Question 3

The amount of blood flowing through certain parts in the mammalian body at different activity levels was measured and results tabulated as shown in the table below.

Parts of the body	Blood flow (cm^3/minute)		
	At rest	During light exercises	During strenuous exercise
Alimentary canal	1,100	780	350
Cardiac muscles	100	200	1,300
Skeletal muscles	900	4600	15,000

(a)   Account for:

(i)   the high blood-flow through the cardiac and skeletal muscles during strenuous exercises.   (4 marks)

(ii)   the results obtained for the alimentary canal at rest.   (2 marks)

(b)   Name two waste materials excreted by both the skin and the kidneys.   (2 marks)

Weakness

Majority of the candidates displayed low comprehension of the data hence were unable to make the necessary deductions and inferences. This further illustrates the students' inability to link and/or apply concepts taught in one topic in another content area/topic, for instance, the relationship between the topics Transport, Respiration and Nutrition. In addition, most had difficulty in using comparative terms such as, higher/more/more than/faster blood flow.

Learners to be exposed to all possible approaches to various topics and sub-topics in the course and how they are related. Emphasis should further be laid on data manipulation and interpretation, presented graphically or in tabular form.

Question 6

The effect of auxin concentration on growth response of two parts of a plant, X and Y was investigated over a period of time. The results were tabulated as shown in the table below.

| Concentration of Auxin (in parts per million)	10^{-6}	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1	10^{1}	10^{2}
Percentage inhibition /stimulation on part X	0	40	55	40	0	−45	−90	0	0
Percentage inhibition /stimulation on part Y	0	0	0	25	65	155	210	125	−25

(a)   On the same axis, draw line graphs of the effect on growth of the two parts, X and Y (percentage inhibition or stimulation) against the concentration.   (8 marks)

Weaknesses

Most candidates were unable to get the appropriate scale to plot the correct graphs from the presented data. As a result, they could not make correct readings and/or inferences from the graphs.

Learners should be exposed to a wider variety of data, with diverse units.
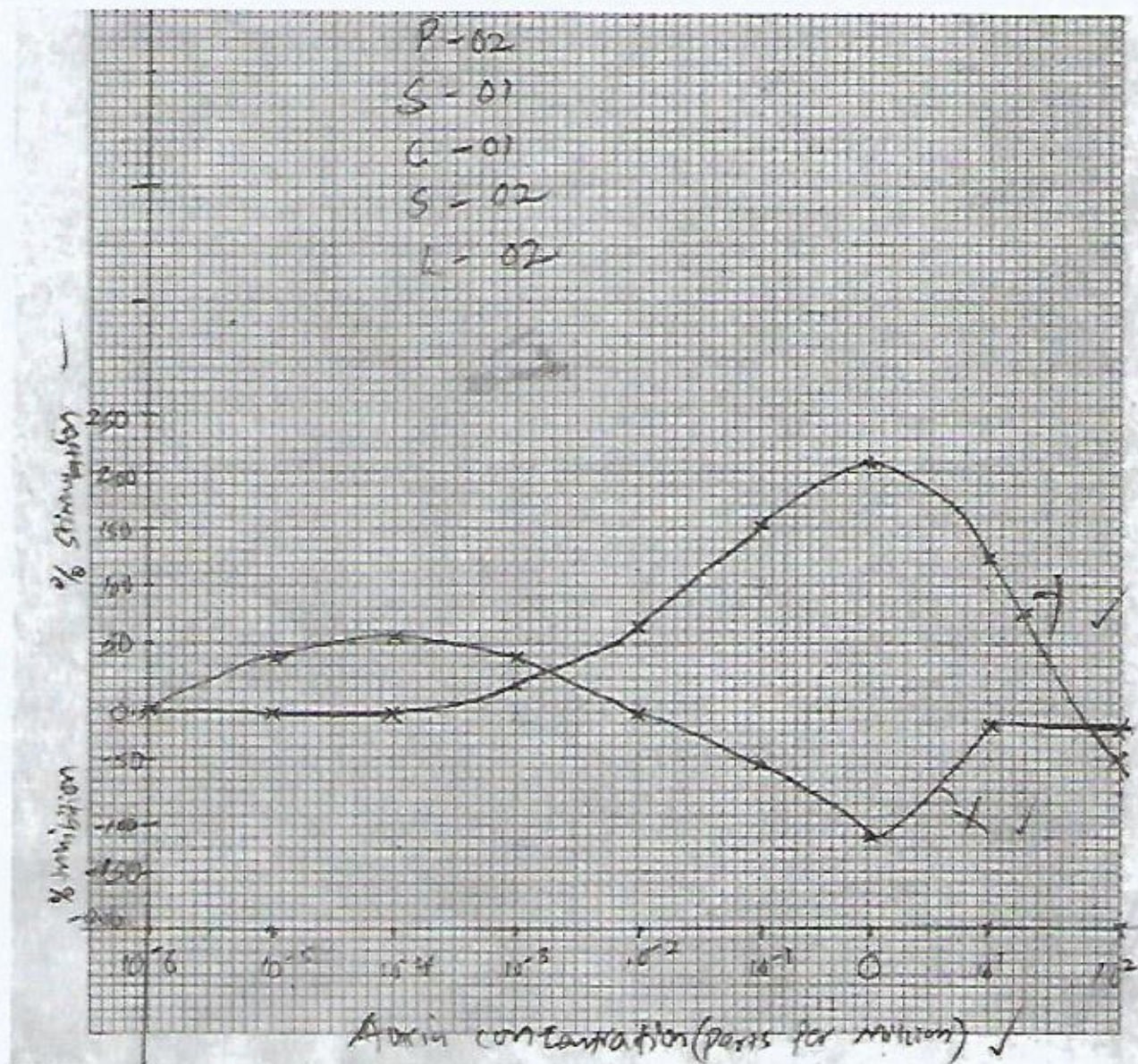
Question 8

Describe what happens to a meal rich in proteins along the alimentary canal from ingestion to egestion.
(20 marks)

Weaknesses

The concept of ingestion was not clear to most candidates. Most of them did not understand the sequence in which food passes along the alimentary canal till egestion. Majority presented biologically incorrect responses/statements, for instance, "....Rennin digests Caseinogen.......the enzyme reacts with proteins.......undigested materials are excreted through the anus". In the same breath, most candidates presented glaring incorrect spellings of technical/biological terms, especially for enzymes.

Effective integration of Information Communication Technology, use of detailed flow charts and carrying out dissections in the laboratory during the teaching of Nutrition and related topics would help.

Expected responses

The meal is ingested through the mouth; (In the mouth), it is chewed/masticated (by teeth); to reduce/break it into smaller particles; mixed with saliva (from salivary gland);

The food is then rolled (by the tongue) into boluses; and pushed down/ into the oesophaghus/swallowed; The boluses move by peristalsis (into the stomach);

Constant contractions/relaxations of the stomach walls mix the food, (giving rise to chime); Presence of food in the stomach further stimulates production of gastric juice; which contains pepsinogen; and rennin/chymosin;

Pepsinogen is activated to pepsin; by hydrochloric acid; (contained in the gastric juice). Pepsin breaks down proteins to peptides;

Rennin converts/coagulates the protein, caseinogen; in milk to casein; (which is abundant in young children). It is then pushed into the duodenum (through the pyloric sphincter); Pancreatic juice in the duodenum contains trypsin; which digests proteins into peptides; (secreted in an inactive form, trypsinogen)

In the ileum, intestinal juice/*Succus entericus* is secreted; It contains peptidase enzymes; which breaks down polypeptides into amino acids; It also contains polypeptidase enzyme; which breaks down peptides to amino acids, completing the process of digestion of the proteins;

The amino acids are absorbed into the bloodstream/pass through the epithelia of the villi, and the capillary walls into the blood-stream; by active transport;

The undigested/indigestible proteins/food substances pass through to the colon/large intestines; where water is absorbed; leaving a semi-solid waste material being passed on to the rectum; then out through the anus (as faeces);

3.3.4   Biology Paper 3 (231/3)

### (a)   ANALYSIS OF POPULAR ITEMS IN THE PAPER

Just like in paper 2, none of the three questions in paper three (231/3) fully recorded consistent scores as to be regarded as popular to the candidates. However, it was also generally observed that sections of the questions in the paper that required an extra effort to comprehend, make a labelled drawing, interpret, infer (from a photograph) were poorly performed compared to those that were straight-forward, merely requiring recall of facts. This also calls for concerted efforts from the teachers to inculcate and nurture, at an early stage, the key scientific skills (observing, communicating, classifying, measuring, inferring and predicting) as well as analytical and critical thinking skills in the learners.

Question 2 (b)

The photograph below is of a section of the human intestines of a patient suffering from a common parasitic disease.
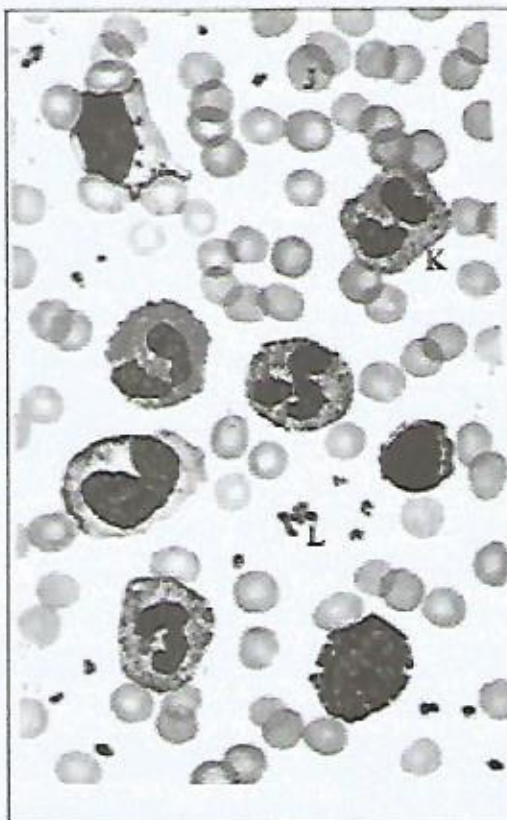
(i) Name the disease. (1 mark)
(ii) Name the parasite that causes the disease in (b) (i) above. (1 mark)
(iii) State **two** control measures for the disease. (2 marks)
(iv) State the effects of having the parts labelled G in the patient's intestines. (2 marks)

Weaknesses

Most unpopular. Candidates could not relate the theoretical knowledge acquired on Symptoms of a Common Parasitic Disease (*Amoebiasis*/Dysentery) to the photographic manifestation of the same. Teachers should go an extra mile and depict some of the symptoms for common human diseases by using photographs or videos. This can also be done to illustrate some biological processes like gaseous exchange, digestion, urine formation, pumping mechanism of the heart, among others. This, not only enhances retention but also brings them on board with the actual damage to the body systems/organs by some microorganisms, behaviors (smoking/drug abuse, poor diet and lifestyles).

Expected responses

i)   Amoebic dysentery; (1 mark)

ii)   *Entamoeba hystolytica;* (1 mark)

(iii) - Boiling drinking water (before drinking);/

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- Chlorinating/treating drinking water;
- Keeping the food covered (to keep away flies/prevent contamination/proper storage of food;
- Proper faecal disposal in pit latrines/toilets/keeping the same clean/not to dispose faecal materials in the open/washing hands before handling food/ washing fruits/food before eating/after visiting toilet/latrine;
- Proper cooking of food;   Any 2   (2 marks)

(iv)   – Pain (especially during feeding);
- Bloody stool;/
- Impaired absorption (of digested food materials);   (2marks)

4.0   GENERAL ADVICE TO TEACHERS

Learners should endeavor to master Biological processes, general content and present it precisely and accurately. This requires closer mentorship and or pupillage (from teachers) or fellow students through functional, guided groups.

Besides effective integration of Information Communication Technology (ICT), inquiry-based learning should be strongly encouraged. To this end, a wider variety of Biology materials in form of text books, scientific journals and publications should be availed to enrich the students' learning environment.

Thematic learning should also be embraced as it freely and naturally allows learners to connect topics and subjects.

Gradual and systematic development of manipulative skills amongst learners (as opposed to sheer memorization of facts). Resources/materials within the students' environment should be used to demystify and reinforce students' understanding of some Biological concepts and processes.

Learners should be fully involved in practical activities with closer guidance from the teacher to inculcate and nurture the requisite scientific skills at an early stage.