3.3 BIOLOGY (231)

Biology (231) is examined in 3 papers; two theory and one practical.

Both paper 1 and 2 are marked out of 80 while paper 3 is marked out of 40.
Paper 1 assesses concepts randomly drawn from the entire secondary school Biology syllabus across all the cognitive levels. The questions are structured and are all compulsory.

Paper 2 has a total of 8 questions, divided in two sections, **A** and **B**. Section **A** has five compulsory, structured questions, drawn from any five topics in the Biology syllabus, each carrying 8 marks. Section **B** has three questions, each carrying 20 marks. Question six is compulsory; mainly assessing data manipulation and interpretation skills while questions seven and eight are essays. A candidate is expected to attempt only one of the two essay questions.

Paper 3 is a practical paper, with three questions drawn from any three topics in the secondary school Biology syllabus. The paper mainly tests the candidate's manipulative, observation and interpretation skills and/or abilities from the hands-on tasks presented in the paper.

3.3.1 Candidates' general performance

The performance of the candidates in the three Biology papers from 2013 to 2022 is presented in the table below.

Table 12: Candidates' overall performance in Biology from 2013 to 2022

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
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**
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	16.40
	2		80	20.11	14.14
	3		40	10.99	6.76
	Overall	**509,982**	**200**	**58.37**	**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**

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
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**
2019	1		80	18.00	11.210
	2		80	18.00	10.036
	3		40	16.00	6.484
	Overall	**618,730**	**200**	**49.87**	**25.50**
2020	1		80	16.03	11.70
	2		80	19.83	11.75
	3		40	16.59	8.48
	Overall	**651,236**	**200**	**53.03**	**29.50**
2021	1		80	19.58	14.88
	2		80	21.73	13.87
	3		40	15.72	7.05
	Overall	**710,533**	**200**	**57.01**	**32.98**
2022	1		80	24.04	15.29
	2		80	19.87	12.83
	3		40	13.47	7.32
	Overall	**752,154**	**200**	**57.37**	**32.39**

It can be deduced from the table that:

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

(ii) There has been continued improvement in performance since 2017.

(iii) Papers 2 and 3 recorded a decline in performance while an improvement was noted in paper 1. The standard deviations of the two papers (Paper 2 and 3) also dropped.

3.3.2 Analysis of Perormance in the Papers

3.3.2.1 Biology Paper 1 (231/1)

There was a significant improvement in performance in the paper.

(i) Analysis of popular items in Paper 1, (231/1)

Question 4

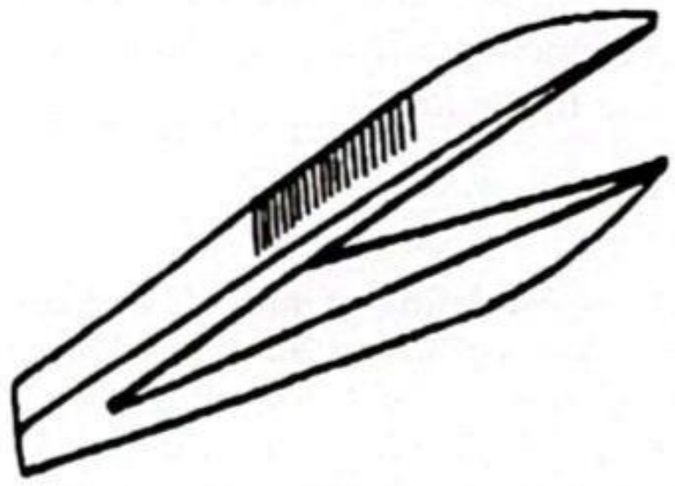
State the significance of each of the following characteristics of the mammalian lungs:

(a) being elastic (1 mark)

(b) having pleural fluid (1 mark)

Question 8

The following apparatus is used in biological studies.



(a) Identify the apparatus. (1 mark)

(b) State its function. (1 mark)

Most candidates scored maximally in the items above. This could either be due to the candidates having prepared and adequately mastered content in the examined content areas or the items tested low cognitive abilities.

(ii) Analysis of poorly performed questions

Question 10(a)

The table below shows the concentration in parts per million of sodium and iodide ions in sea water and cell sap of a plant.

	Sodium ions concentration	**Iodide ions concentration**
Sea water	326	39
Cell sap	162	574

(a) (i) Which of the two ions intake will be affected if the plant was sprayed with a chemical that inhibits respiration. (1 mark)

(ii) explain your answer in 10(a)(i). (2 marks)

Weakness

Most candidates had difficulty interpreting the presented data and linking the same to the processes of active transport and diffusion based on the concentration of the ions in the scenarios given. They too, had challenge connecting active transport to respiration. Practical activities during the teaching of the topic, Cell Physiology should be encouraged.

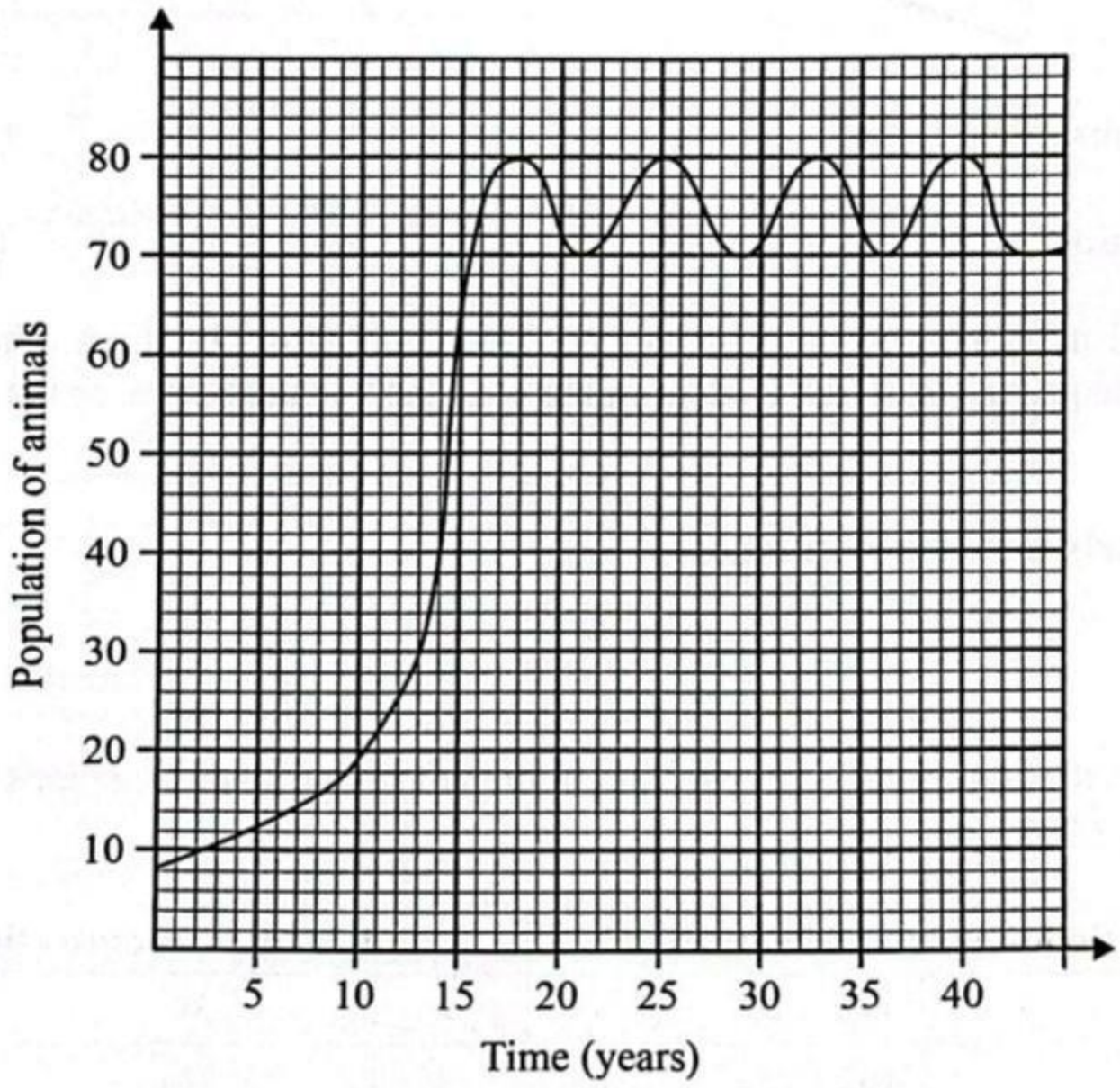
Expected Response

10 (a) (i) Iodide ion (I^-);

(ii) The uptake of I^- is done by active transport; which is respiration/energy-dependent which when inhibited consequently affects/impairs the active transport process which is responsible for the uptake of the ions;

Question 24

Below is a graphical representation of the population of animals in a certain ecosystem over a period of time.



(a) Determine the carrying capacity of the ecosystem. (1 mark)

(b) Account for the change in population for the first 15 years. (3 marks)

Weakness

Most candidates, about 98%, were unable to determine the carrying capacity of the ecosystem and hence unable to account for the change in growth of the population. Teaching approaches should be diversified and more emphasis placed on data interpretation.

Expected Response

24. (a) 75 ± 1;

(b) The population increased exponentially; because the organisms had adjusted to the environment; conditions were favourable (for reproduction/breeding); there was adequate food/ water/ space/ no competition (for resources); there were no diseases; more reproduced/ fewer deaths;

3.3.2.2 Biology Paper 2 (231/2)

A decline was noted in performance in the paper. Items that required candidates to display higher cognitive abilities like comprehension, application, analysis, synthesis and evaluation recorded the lowest performance.

(i) Analysis of popular items in the paper

Question 2

A fresh water lake surrounded by agricultural farms has the following organisms:

- Fish
- Hippopotamus
- Reeds
- Algae

(a) State the roles of each of the following organisms in the lake ecosystem:

(i) hippopotamus (2 marks)

(ii) algae (2 marks)

(b) Explain the likely positive and negative effects of the surrounding agricultural farms on the lake ecosystem.

(i) Positive effects (2 marks)

(ii) Negative effects (2 marks)

Most candidates performed well in this item. This could be because the scenario presented in the item (of an aquatic habitat) was familiar to most candidates or had adequately prepared for items in the topic.

(ii) Analysis of poorly performed questions

It was further generally observed that most candidates had difficulty understanding and using Biological terms in their responses, for instance, not knowing what pyrogallic acid/its role, not knowing what **reeds** are, failure to differentiate between the heartbeat and pumping mechanis, inability to relate structures to their functions,failure to differentiate between sound waves and vibrations, sensory cells and sensory hairs, among others.

Question 4

(a) Explain how each of the following factors affect uptake of mineral ions in plants:

(i) temperature (3 marks)

(ii) glucose concentration in root hair cell sap (3 marks)

(b) State **two** characteristics of the root hairs that increase their surface area for absorption of mineral ions. (2 marks)

Weakness

Most candidates who attempted the question could not explain the effect of temperature and glucose concentration on uptake of mineral ions. A significant number could not differentiate between a root hair and a root.

Practical-based approach and ICT integration should be encouraged in schools.

Expected responses

(a) (i) At temperatures below optimum, the rate (of mineral ions uptake) is slow due to inactive respiratory enzymes; at optimum temperature, the rate (of mineral ions uptake) is highest since respiratory enzymes are most active; at temperatures beyond optimum, the rate (of mineral ions uptake) slows since the respiratory enzymes are destroyed/denatured;

(ii) Glucose is a respiratory substrate (which when oxidized releases energy); needed for active uptake of mineral ions; high glucose concentration produces more energy; while low glucose concentration produces less energy;

(b)
- Are long/elongated (to penetrate through the soil) to reach more mineral ions;
- Are numerous/ many;

Question 6(f)

State **two** modifications one would make on the experimental set up to increase the rate of gas bubble production. (2 marks)

Weakness

Most candidates who attempted the question displayed lack of creativity as they were expected to suggest possible modifications on the set-up. Having candidates undertake practical activities in groups for them to discover concepts by themselves should be encouraged.

Expected responses 6(f)

- Supply sodium hydrogen carbonates in the set-up/ any other source of carbon (IV) oxide;
- Increase the number of shoots of aquatic plants;
- Increase temperature to optimum;

3.3.2.3 Biology Paper 3 (231/3)

(i) Analysis of Popular Items in the Paper

As observed above, the performance in 231/3 has been on an improvement trajectory since 2016 save for 2021 and 2022 where a decline was recorded.

This is largely due to candidates' inability to make accurate observations and inferences, failure to follow prescribed procedures/instructions and presenting incorrect spelling of technical terms. Majority of candidates' responses implied lack of independence during the performance of the tasks, especially in question 2. Majority of candidates, nearly 90%, presented responses related to osmosis; a concept the question did not test.

Candidates should be accorded opportunities to work and present their work independently. Being exposed to the contents of the advance instructions dwarfs the achievement and development of their Scientific skills as outlined in the secondary school syllabus.

Teachers should interpret the syllabus well and teach as prescribed and not according to the published course books.

(ii) Analysis of poorly performed questions

Question 2

You are provided with the following materials and reagents.

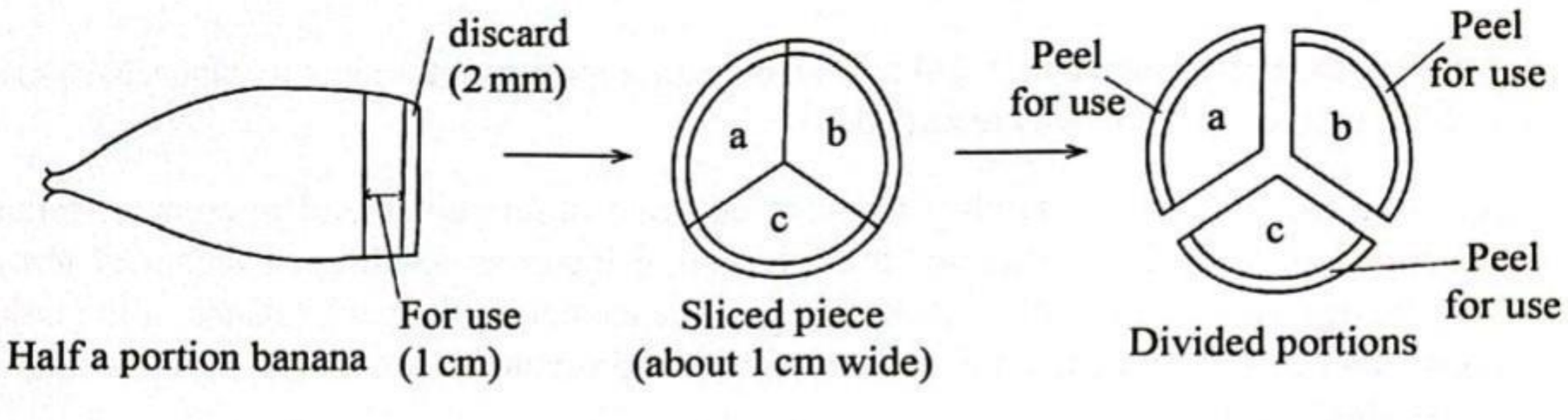
- Half a portion of raw banana
- 3 beakers labelled **G, H** and **J** treated as follows:
  - Beaker **G** contains 50 ml of dilute hydrochloric acid
  - Beaker **H** contains 50 ml of distilled water
  - Beaker **J** is empty
- Scalpel
- Spatula/pair of forceps
- A white plain paper or white tile
- Stopwatch/means of timing

When some plant tissues are exposed, enzymes on the exposed surfaces react with oxygen. Using the provided materials, investigate the enzyme-oxygen reaction using the procedure below.

I. Slice off about 2 mm from the exposed end of the raw banana and discard the slice.

II. Slice another piece, about 1 cm wide from the remaining banana to use in the investigation.

III. Divide the portion obtained in (II.) above into three parts (**a**, **b** and **c**) as illustrated in the diagram below.



IV. Remove the peel from portion **a**, cut the peel into three pieces and immediately drop all the three pieces into beaker **G** (containing hydrochloric acid). Obtain peels **only**, without remnants of banana flesh.

V. Repeat procedure IV with peels from portion **b** into beaker **H** (containing distilled water) and those from portion **c** into beaker **J**.

VI. Leave the set-up for five minutes and observe the inner surfaces of the banana peels in each beaker.

(a) (i) Record the observations made in each case. (3 marks)

G

H

J

(ii) Account for the observations made in beakers **H** and **J**.

Beaker **H** (2 marks)

Beaker **J** (2 marks)

VII. Using the spatula/pair of forceps provided, remove the peels from each beaker and expose the sets of peels separately on the plain paper/white tile provided. Leave them for a further five minutes and observe.

(b) (i) Record the observations made on the peels from beakers **H** and **J**.

H (1 mark)

J (1 mark)

(ii) Account for the observations on the surfaces of peels from beakers **G** and **J** after a further 5 minutes.

G (1 mark)

J (1 mark)

(c) Suggest the suitable pH for the enzymes found on the surface of the banana peels. (1 mark)

(d) Suppose the peels in set up **J** were initially boiled for 5 minutes.

(i) Suggest the observations that would have been made. (1 mark)

(ii) Explain the observations made in (d)(i). (1 mark)

Weaknesses

The question tested candidates' investigative, observation and recording skills. It sought to investigate presence of enzymes in the provided plant tissue. A context to focus candidates on what was to be observed (colour change in the banana peel when exposed to oxygen) was provided in the stem of the question at the beginning. Inspite of this, most candidates gravitated towards osmosis, which was not examined. This might also be attributed to candidates predicting and preparing for a concept that was not examined (osmosis). This should be discouraged.

Expected responses

2.

(a) (i) In **G** – white/cream/ yellow/cream-yellow/white-yellow;
H – (a little) brown; (less colour change/black/browning;
J – more brown/ more colour change/more black/browning/blackening;
(3 marks)

(ii) In **H** – water covered the surface of banana peels/ diluted/dissolved the enzymes/little oxygen in water; hence less enzyme-air/oxygen reaction;
(2 marks)

In **J** – The peeled surface was fully exposed to the atmospheric air/oxygen; hence maximum enzyme-air reaction/oxidation, resulting in the significant colour change;
(2 marks)

(b) (i) **H** – turns brown/brown colour increases (to look like the peel placed in beaker **J**);
(1 mark)

J –remained brown/continued to be brown/black; **(1 mark)**

(ii) **G** – No colour change/white/cream/yellow. The acid/low pH/hydrochloric acid denatured/destroyed the enzymes; **(1 mark)**

J – The enzymes on the surface of the peel were (fully) exposed to the atmospheric air/oxygen, hence the surface was fully oxidized, turning brown/black/were exposed to optimum/best/suitable/favourable pH; **(1 mark)**

(c) Neutral/pH 7.0; **(1 mark)**

(d) (i) No colour change/ white/cream/yellow/cream yellow; **(1 mark)**

(ii) Boiling denatures/destroys/kills enzymes; **(1 mark)**

3.3.4 General advice to teachers

Independence during hands-on practical activities to enhance the acquisition and development of scientific skills amongst learners. Resources/materials within the students' environment should be used to demystify and reinforce students' understanding of some biological concepts and processes. A variety of reference materials should be used during the teaching and learning process (textbooks, scientific journals and publications as well as animations and videos).