

# BIOLOGY

Paper 0970/12  
Multiple Choice (Core)

Question Number	Key						
1	C	11	C	21	C	31	D
2	C	12	D	22	C	32	C
3	C	13	C	23	C	33	A
4	B	14	D	24	B	34	C
5	B	15	B	25	A	35	D
6	A	16	C	26	A	36	B
7	C	17	C	27	B	37	C
8	B	18	D	28	D	38	C
9	B	19	D	29	C	39	A
10	D	20	A	30	A	40	A

## General comments

There was good understanding of: the definition of a pathogen; the definition of fertilisation; that plants obtain mineral ions from the soil; the effects of adrenaline on the body; the definition of a drug and the role of testosterone in the development of secondary sexual characteristics in human males.

There was some uncertainty about: the position of the xylem in the root and the leaf; the approximate percentage of oxygen in expired air; transpiration; anaerobic respiration and the part of the eye that refracts light.

It is important for candidates to work methodically through information provided in questions, such as in **Questions 33** and **37**.

## Comments on specific questions

### **Question 4**

Few candidates appreciated that root hair cells have a cell wall and sperm cells do not. A number of candidates incorrectly believed that root hair cells contain chloroplasts.

### **Question 5**

While many candidates knew that ciliated cells and sperm cells have structures that can move, some candidates incorrectly believed that nerve cells also have structures that can move.

### Question 6

Many candidates were able to calculate the length of the cell in the image. Some candidates incorrectly divided the magnification of the image by the actual length of the cell.

### Question 7

There was some uncertainty about the position of the xylem in the root and the leaf. Candidates often confused the xylem with the phloem.

### Question 9

While many candidates appreciated that the chemical used to test for the presence of protein in a food sample is biuret solution, some candidates incorrectly believed that Benedict's solution is used.

### Question 10

Many candidates understood that enzymes have a complementary shape to their substrate. Some candidates incorrectly believed that enzymes are used up during the reaction.

### Question 14

Few candidates correctly identified the parts of the tooth. Some candidates were uncertain about which part is the enamel and which part is the dentine.

### Question 16

Few candidates understood that the small intestine absorbs most of the water in the alimentary canal. Some candidates incorrectly believed that the large intestine absorbs most of the water in the alimentary canal.

### Question 18

There was some uncertainty about the process that occurs during transpiration. While many candidates understood that transpiration is the movement of water vapour through the stomata by diffusion, a significant number of candidates opted for one of the distractors.

### Question 19

Few candidates were able to correctly identify the coronary artery.

### Question 22

The approximate percentage of oxygen (16%) in expired air was not widely known.

### Question 24

Many candidates did not know the products of anaerobic respiration in humans and yeast.

### Question 26

Most candidates did not know that the part of the eye that refracts light is the cornea.

### Question 28

While many candidates identified the tropic responses that represented phototropism and gravitropism, some candidates incorrectly believed that in gravitropism, the root grows away from gravity.

### Questions 33

Few candidates were able to derive the correct answer for the cross.

**Question 34**

While many candidates knew that sex is an example of discontinuous variation in humans, a significant number of candidates selected one of the distractors.

**Question 35**

It was understood by many candidates that mutation can increase the genetic variation in a species. Some candidates incorrectly believed that mitosis can increase genetic variation in a species.

**Question 36**

Many candidates were able to correctly identify the processes that reduce or increase the carbon dioxide concentration in the atmosphere. Some candidates incorrectly believed that decomposers reduce the carbon dioxide concentration in the atmosphere.

# BIOLOGY

Paper 0970/22  
Multiple Choice (Extended)

Question Number	Key						
1	C	11	A	21	C	31	C
2	C	12	D	22	B	32	C
3	B	13	C	23	A	33	A
4	B	14	C	24	B	34	B
5	B	15	C	25	B	35	A
6	C	16	A	26	D	36	C
7	C	17	D	27	C	37	B
8	A	18	B	28	D	38	D
9	B	19	C	29	B	39	B
10	D	20	C	30	C	40	A

## General comments

There was good understanding of: the definition of a species; enzymes; the role of hormones and energy flow.

There was some uncertainty about: the requirements for active transport and water potential changes.

It is important for candidates to work methodically through information provided in questions, such as in **Question 31**.

## Comments on specific questions

### Question 3

Many candidates appreciated that the root hair cell has a cell wall, and a sperm cell does not. Some candidates incorrectly believed that root hair cells contain chloroplasts.

### Question 5

Only a minority of candidates appreciated that the movement of glucose molecules into the epithelium and the movement of nitrate ions from a dilute solution in soil into a more concentrated solution in root hairs require oxygen.

### Question 6

Few candidates selected correctly with many not understanding the meaning of higher and lower water potential.

### Question 8

Many candidates understood that the concentration of an enzyme during the course of an enzyme-controlled reaction remains the same.

### Question 11

Many candidates did not appreciate that the colour changes in the hydrogencarbonate indicator in test-tube X are caused by photosynthesis removing carbon dioxide from inside the test-tube and decreasing its concentration. The colour changes in the hydrogencarbonate indicator in test-tube Y are caused by respiration releasing carbon dioxide inside the test-tube and increasing its concentration.

### Question 13

This was a demanding question with only a minority of candidates selecting correctly. Candidates need to appreciate that a reduction of chloride ions in a solution will increase the water potential.

### Question 14

Few candidates appreciated that at X, maltose is broken down by maltase and therefore its concentration is decreasing.

### Question 18

While most candidates correctly identified the function of the cell labelled X as phagocytosis, some candidates incorrectly thought that it produced antibodies.

### Question 20

The approximate percentage of oxygen (16%) in expired air was not widely known.

### Question 22

Many candidates correctly selected option **B**. Some candidates incorrectly believed that anaerobic respiration in humans produces lactic acid and carbon dioxide whereas only lactic acid is produced.

### Question 24

Many candidates appreciated that glucagon will cause the body to convert glycogen into glucose. Some candidates incorrectly believed that insulin would cause the body to convert glycogen into glucose.

### Question 28

Most candidates correctly selected option **D**. Some candidates incorrectly believed that the pollen tube grows before pollination occurs.

### Question 31

Few candidates were able to correctly derive the answer. It is important that candidates work through each stage of the problem, in order to derive the correct answer.

### Question 32

Most candidates did not appreciate that the cells were stem cells undergoing mitosis.

**Question 34**

Many candidates appreciated that the development of antibiotic-resistant bacteria is an example of evolution. Some candidates incorrectly believed that the changes made to livestock as a result of artificial selection is an example of evolution.

**Question 36**

Most candidates correctly identified nitrification. Some candidates incorrectly selected option **A** which is nitrogen fixation.

# BIOLOGY

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Paper 0970/32  
Theory (Core)

## Key messages

Candidates would benefit from reading the question carefully, as it often contains specific information that must be used in the answer. For example, when the question asks for four lines to be drawn, it is important that only four lines are drawn. Also, the question may ask for a definition rather than a discussion and that indicates the level of detail required in the answer.

Command words such as describe, explain, suggest, and compare require different responses from candidates. If a description is required, including a reference to a graph or table, then it will be expected that data will be used in the description given. Many candidates can do this effectively. An explanation requires more than just a description and candidates should be encouraged to practice the difference between explain and describe.

## General comments

Many candidates were well prepared for the exam and had obviously referred to past papers and mark schemes when preparing. This type of preparation allows candidates to express themselves clearly.

## Comments on specific questions

### Question 1

- (a) This question was well answered. A few candidates confused the two hairy crustaceans.
- (b) While most candidates gave the correct names for the groups, some gave examples of the groups. Other common incorrect answers included vertebrates and names of vertebrate groups.
- (c) Candidates showed an excellent understanding of the difference between arthropods and vertebrates. Candidates should make it clear in their answer whether it is vertebrate or arthropod which is being referred to.

### Question 2

- (a) (i) Many candidates did not identify the red and white blood cells. The presence of a nucleus identifies the cell as a white blood cell. Some detail of the role of each cell is needed, rather than just protection or transport. Common incorrect answers included fighting or killing infection / disease.
- (ii) It is important to read the question carefully, as many candidates listed various items carried in the blood, rather than the liquid that carries the cells.
- (b) Very few candidates were able to fully complete the table. Most scored one or two marks, usually for the column describing energy and the column describing the movement of water. The most difficulty was with osmosis, where many thought that it takes place against a concentration gradient.

### Question 3

- (a) (i) The vast majority of candidates were able to read off the correct year from the bar chart.

- (ii) Candidates were usually able to read the correct figures from the graph but were not always able to correctly calculate the percentage decrease. Candidates generally set out their working clearly so if they did the calculation incorrectly, they could gain credit for selection of the correct figures.
- (b) Many candidates were able to explain that plastic pollution could be reduced by recycling or reusing it. Many answers incorrectly made references to fines for dumping plastic, burning the plastic, legislation and having more bins.
- (c) Candidates gave a good range of responses with most able to state hunting, predation, and lack of food as the most common causes for the population decrease. Many candidates incorrectly gave examples of pollution and deforestation as causes. Candidates should be reminded to read the question carefully and take note of all the information given in the question.
- (d) Candidates did not always gain full credit on this question as they used terms which did not show full understanding of the concept. Candidates should be encouraged to learn set definitions. Finished was a common but incorrect response for the second gap.

#### Question 4

- (a) Candidates commonly confused dentine and enamel. Gum and nerve were consistently identified correctly.
- (b) The majority of candidates were able to recall two of the four tooth types. The occasional references to wisdom teeth, milk and baby teeth were seen.
- (c) Many candidates gave the answer to (d) here – and then repeated it again in (d). Candidates frequently referred to the main causes of dental decay as not brushing teeth but without references to this meaning that food and bacteria would remain on the teeth. Many responses referred to bacteria feeding on the sugar or tooth. Acid was referenced in many responses though not all candidates linked the acid as being a waste product of respiration. Candidates were aware that the acid could damage the tooth, but many were too vague and did not link it to dissolving the enamel or dentine. They thought that the acid came directly from ingested food and drink.
- (d) Candidates gave a good range of responses including brushing, visiting a dentist, and reducing sugary foods. Quite often the same marking point was made, for instance stating both brushing and flossing.
- (e) Many candidates were able to recall mechanical or less commonly physical, as the correct type of digestion. Common incorrect answers included ingestion, digestion, indigestion, and chewing.

#### Question 5

- (a) Almost all candidates correctly identified the bladder with an **X**.
- (b)(i) Almost all candidates correctly identified **C** as the mammal species with the lowest volume of urine. Occasionally **D** was seen.
  - (ii) Almost all candidates correctly identified **B** as the mammal species with the largest range of volumes of urine.
- (c) Candidates found it difficult to express their ideas often referring to non-scientific language such as going to the bathroom, etc. Most candidates identified variation in water intake but did not explain the point. Some incorrectly linked high temperatures with higher volumes of urine produced – either because they simply got the link the wrong way round or because they thought that if it is hotter you drink more, so you would produce more urine. Some referred to the frequency of urination or the concentration of urine rather than volume as required by the question. Very few mentioned exercise.
- (d)(i) Many candidates were confused as to which organ produces urea with many incorrectly stating the kidneys.
  - (ii) Some candidates knew that the kidney excretes urea, but ureter and urethra were also seen.

- (e) Mostly well-known but a significant number answered ureter, urethra, or kidney – still choosing an answer from the list in (d).

### Question 6

- (a) Many candidates correctly stated lactic acid, but ethanol was frequently seen. Candidates need to ensure that they read the question carefully.
- (b) (i) The majority of candidates were able to correctly perform the calculation.
- (ii) Candidates demonstrated a good recall of the word equation for aerobic respiration although some responses stated the equation for photosynthesis. Some candidates attempted to write a balanced chemical equation.
- (c) (i) Majority of candidates could use the information given to calculate and select the correct responses. Selecting which country that produces twice as much biofuel as country E was the most likely to be incorrect with students selecting country B.
- (ii) Candidates generally recalled carbon dioxide.
- (iii) Candidates often gave answers that were too vague, e.g., baking or alcohol. Bread-making was the most frequent correct answer.

### Question 7

- (a) Some answers referred to wind or insect pollinated plants, e.g. nectar, scent, or colour instead of pollen. Some answers referred to pollen from insect-pollinated plants rather than wind-pollinated plants.
- (b) Generally, these structures were well known by candidates. Some were not awarded the mark for the site of fertilisation as the X was placed outside the ovary.
- (c) Water (or moisture) was a frequent correct response. Light was a common incorrect answer. Many were not awarded the mark for stating a suitable temperature as they stated temperature unqualified or simply referred to warmth.
- (d) Candidates found this question demanding. The fact that xylem are hollow or dead cells was the most common correct answer. Many candidates described water uptake and transpiration rather than how xylem tissue is adapted for this function.

### Question 8

Many candidates were awarded full marks for this question.

### Question 9

- (a) (i) Many candidates incorrectly stated parts of the nervous system with only a few correctly stating temperature.
- (ii) Candidates needed to consider what makes the arm move, rather than the arm itself as an effector. Common incorrect answers were hot pan, receptor, and spinal cord.
- (iii) This question was generally well answered. Some gave spine or backbone which were insufficient.
- (b) Very few candidates were able to recognise the different neurones in the diagrams even though they were aware of the different types. Some got the right names but in the wrong order.
- (c) Some candidates correctly named the synapse. Septum was an incorrect answer.

# BIOLOGY

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Paper 0970/42  
Theory (Extended)

## Key messages

Candidates are advised to read questions very carefully and to make sure that they are using all the information, including the command words. Candidates should be aware that when they have been asked to make a comparison, their answer should include appropriate vocabulary that makes the comparison clear.

Candidates should look carefully at the key and axes titles and units on graphs before reading any key data points or making any interpretations. Answers to **Question 4(b)(i)** often included data quotes that had no units or incorrect units. Candidates should always use appropriate units when quoting data.

Answers to some questions suggested that candidates did not always have a good understanding of the command words used in this paper. Descriptions of the command words can be found in the syllabus.

## General comments

Some candidates had a good understanding of biological processes and mechanisms, and they were generally able to communicate their responses clearly. There was evidence of a wide variety of knowledge and understanding of all parts of the syllabus and an ability to apply different skills depending on the question demand.

Candidates should ensure they use terminology appropriately. For instance, organisms do not produce energy or create energy, they release energy during respiration. Some candidates confused respiration with breathing, and it is often a good idea to qualify the term respiration with 'cell' or 'tissue'.

Candidates should always ensure their answers address the questions asked. They must also check that their answers make sense within the context of each question. Many wrote answers to **Question 4(b)(i)** that contradicted the information provided about xylose and ethanoic acid in the stem of the question. Also, in **Question 1(d)**, candidates identified phytoplankton as producers and then wrote that they provide energy for the primary, secondary and tertiary producers.

## Comments on specific questions

### Question 1

- (a) The majority of candidates identified the kingdom correctly as the plant kingdom or as Plantae. Common incorrect answers were prokaryote and fungi. Some candidates wrote Eukaryote: plants and were given credit.
- (b) Many candidates correctly calculated the actual length as 190  $\mu\text{m}$ . Some answers were incorrect by several orders of magnitude.
- (c) Many candidates used the key to identify the seven types of algae correctly. Some candidates wrote answers in all the boxes including those that were greyed out. A few candidates wrote their answers only in the greyed-out boxes and not in the boxes opposite the scientific names.
- (d) Many candidates realised that the question was asking about trophic levels. They explained that phytoplankton are producers and occupy the first trophic level. Candidates often explained that phytoplankton provide food for herbivores, which they often called primary consumers. Often candidates just referred to fish eating the phytoplankton but did not describe the fish as herbivores

or primary consumers. Many candidates did not refer to the phytoplankton providing energy for the other trophic levels, although some did make it clear that they were a source of energy within the food web or ecosystem. A common error was to describe the consequences for the ecosystem if the phytoplankton were to die or were not in the lake in the first place. Very few candidates stated that light energy was converted to chemical energy.

## Question 2

- (a) Few candidates completed the whole table correctly. Common errors were stating the mouth as the organ that secretes amylase, identifying the small intestine as organ 4 and giving starch as the substrate for maltase. Many thought that maltase is secreted by the pancreas.
- (b) Many candidates stated that hydrochloric acid is produced by the stomach or is active in the stomach. Some candidates incorrectly thought that hydrochloric acid was an enzyme.
- (c) Many candidates correctly stated that the colon, labelled 6 on Fig. 2.1, absorbs water.
- (d) There were many detailed answers to this question on mechanical or physical digestion. Many candidates saw chemical digestion in the question and that prompted them to write about the action of enzymes in the stomach. This meant that the churning action of the stomach and emulsification were not included in their answers. Candidates rarely gave full details about the action of the different types of teeth in biting and chewing. A common mistake was referring to mechanical digestion breaking down large insoluble molecules into small soluble molecules; for example, some candidates referred to molecules being broken down by the teeth.

## Question 3

- (a) (i) Candidates were asked for two features of the aphid visible in the photograph in Fig. 3.1 that indicate it is an insect. Many gave features of all arthropods, such as jointed limbs and segmented body. As the aphid shown in the photograph does not have wings the only two features that were credited were three pairs of legs and a body divided into three regions or parts (head, thorax, and abdomen). Answers that were not accepted included one pair of antennae (a feature shared with myriapods), jointed limbs (shared with all arthropods) and compound eyes (shared with some crustaceans).
  - (ii) Candidates were largely aware of steps that can be taken to reduce infestations of aphids. Spraying pesticides or insecticides was common and so was growing crops that were pest resistant. Many referred to genetic modification in the context of resistance. Some candidates also explained that selective breeding could be used to develop pest resistant crops. Other strong responses explained the use of crop husbandry such as the use of crop rotation and intercropping or planting crops that aphids dislike, such as onion and garlic. Some candidates misread the question and thought that they had to give methods of reducing the effect of the viral pathogens transmitted by aphids.
  - (iii) There were many answers to this question that gained full marks. Candidates used their knowledge of leaf structure to state that the tissues through which the aphid mouthparts would penetrate include the upper epidermis, palisade and spongy mesophyll and the xylem. Some candidates incorrectly gave names of cell structures, such as cell walls and cell membranes.
- (b) (i) Candidates gave a wide range of values and clearly did not use the other values in the table to check their answer.
  - (ii) A number of candidates realised that this question was about photosynthesis. However, many assumed that the  $^{14}\text{CO}_2$  entered the leaf, moved into the phloem, and somehow reached sucrose by diffusion or active transport and then joined onto sucrose. Correct responses explained that the labelled carbon dioxide diffuses through stomata into the leaf and is used by chloroplasts in photosynthesis to make glucose. The glucose that is now radioactively labelled is converted into sucrose and enters the phloem to be translocated throughout the plant.
- (c) (i) This question asked for two examples of sinks for sucrose. The most common incorrect answer was leaf – the main source of sucrose during plant growing seasons. At other seasons, new leaves can be sinks and this was accepted as were other sinks such as buds, roots, seeds, fruits, and storage organs.

- (ii) Many candidates realised that sucrose would be converted to glucose once it arrived at a sink and that it would then be converted in to something else or respired to release energy. The uses of the energy released were credited. Other uses of glucose that were often seen included conversion to cellulose for growth of cell walls.

#### Question 4

- (a) (i) Many correctly completed the balanced chemical equation for respiration by yeast. Common errors included giving incorrect formulae for glucose and ethanol and not balancing the equation correctly. Some gave the word equation rather than the balanced chemical equation.
- (ii) There were some very good answers to this question on the environmental advantages of using biofuels. Most concentrated on the effect of using biofuels as a sustainable alternative to using fossil fuels. They often referred to this as a renewable form of fuel. Others discussed the effect on global warming and climate change; however, some did so in very simplistic terms such as stating that biofuels do not emit carbon dioxide. Others took more care over their answers and stated that the carbon dioxide emitted is equal to the volume of carbon dioxide absorbed by the plants that provide the biomass. A common error was using the term reusable rather than renewable. The pollution aspect of this question was largely ignored or misunderstood, damage to the environment by drilling or mining and the effect on air pollution were rarely given. Simplistic answers such as there would be no greenhouse effect or pollution would not occur did not gain any credit. Candidates also stated that there would be few or no toxic gases emitted without stating what these were likely to be. Stronger answers identified sulfur dioxide as an example.
- (iii) This question was about the disadvantages of monocultures, and it prompted some good answers that dealt with the risks of heavy infestations of pests, the rapid spread of disease through a crop and various negative effects on soils. Many candidates also discussed the fact that land used for growing biofuels could be used for growing crops. Fewer candidates wrote about the genetic consequences of small population size.
- (b) (i) Descriptions of the graph in Fig. 4.2 rarely went beyond stating that the concentrations of xylose and ethanoic acid decreased and the concentration of ethanol increased. A large number of candidates misread the vertical axes and so gave completely incorrect descriptions of the changes in concentration. Better answers supported correct descriptions of the change in concentrations with references to the steep decrease in concentration of the substrates until 62 hours. The final concentration of ethanol was often given as 42 or 43 g per dm<sup>3</sup> instead of 44 g per dm<sup>3</sup>. Many gave 60 hours rather than 62 hours.
- (ii) The majority of candidates stated that the concentration of ethanol would be less if the reaction was conducted at 20°C rather than 30°C. Some referred to the effect of temperature on the reaction to produce ethanol and these answers also gained credit.

#### Question 5

- (a) (i) Many candidates defined the term community correctly. Common errors were to refer to a single species rather than many species or all species and to omit reference to an ecosystem or place. Some candidates incorrectly wrote about populations of humans.
- (ii) There were many correct answers to this question. Of those that did not gain full credit, the majority gave the environment for the second answer but gave a variety of incorrect answers instead of natural selection or mutation.
- (b) (i) Many candidates found this question demanding, perhaps because they did not spend enough time looking at the information in Fig. 5.2. Those that did understand the data often found it difficult to describe the change in the range of Meyer's goshawk (**A**) on Karkar Island between 1969 and 2013. An example of a good answer was: 'in 2013, the maximum and minimum altitude have decreased, but the range is maintained'. Some candidates also struggled to describe what was happening to the island thrush (**C**) as they confused altitude and range. Some candidates also described ranges as increasing or decreasing populations perhaps because they thought the difference in the thickness of the lines on Fig. 5.2 was significant.
- (ii) Many candidates gave likely reasons for the disappearance of the island thrush from the lower altitudes of the range recorded in 1969. Some candidates incorrectly thought that the birds could be

at risk of predators that lived in the sea. Some thought that the sea level was rising resulting in their death or in habitat destruction.

- (c) Many candidates gave answers similar to those they had given in (b)(ii) and did not state the risks associated with small population size and focused instead on what would decrease the population. Strong responses stated that the birds may be at risk of extinction and developed this idea by explaining they were also at risk of inbreeding and reduced genetic variation and thus less able to adapt to changes in the environment that might happen with climate change.

### Question 6

- (a) (i) There were many good answers to this question identifying the blood vessels in a single and a double circulation. Almost all identified the heart in the single circulation. Artery and vein (**X** and **T**) were sometimes confused.
- (ii) Many candidates identified the structure as the septum of the heart. Fewer gave the function as separating the oxygenated and deoxygenated blood. Common errors were to write about the pumping action of the heart and the role of valves in preventing backflow.
- (iii) Although there were many correct answers, candidates often did not make it clear that in a single circulation blood flows through the heart once in each circulation around the body. Answers that simply stated blood flows through the heart once were too vague and could not be credited.
- (iv) Some candidates gave very thorough answers to this question on the advantages of a double circulation. Many of these explained that blood could flow through the lungs at low pressure and the rest of the body at high pressure. Rarely were the advantages of low-pressure blood through the lungs made clear; more often candidates only explained that blood at high pressure leads to a good supply of oxygen to the body. There were only a few references to the advantage of having blood with a high pressure for filtration of blood in the kidneys for removal of waste or to the idea of a high metabolic rate or large size.
- (b) (i) Common incorrect answers were cardiac artery and pulmonary artery. Coronary unqualified was often given.
- (ii) There were many correct answers to this question on the treatment of blockages in the coronary arteries. Some gave surgical treatments, such as the use of stents and by-passes. Others gave the names of suitable drugs to use, such as aspirin. Many candidates chose methods used for prevention of these blockages, such as exercise and avoiding fatty foods.
- (c) The parts of this question asked for a variety of terms relating to the exchange of substances with the blood. The table lists the correct answers and some of the more common incorrect answers.

	Correct answer(s)	Common incorrect answers
(i)	alveolus / alveoli	lungs, bronchus, bronchioles, capillaries
(ii)	glomerulus / Bowman's capsule cortex was also accepted	medulla, loop of Henle, renal capsule kidney was ignored
(iii)	assimilation	absorption, digestion
(iv)	deamination	nitrification, deaminification, ammonification, excretion
(v)	ovary follicle was also accepted	pancreas, pituitary gland, uterus, brain

# BIOLOGY

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Paper 0970/62  
Alternative to Practical

## Key messages

Candidates should ensure that they read the questions carefully before starting to answer. This is particularly important for any planning exercise that is required. Identification of the dependent and independent variables is vital before a plan is completed. Candidates should also consider which variables need to be kept constant and include them in their plan. When planning an investigation, candidates do not need to describe the expected results or include any theory on the subject being investigated.

When drawing graphs, candidates should be careful to choose a scale so that their data fills at least half of the grid in both directions.

Candidates are advised to show their working in calculations, as partial credit may be awarded even if a mistake is made during the calculation.

## General comments

Many candidates demonstrated good skills throughout the paper, including table drawing and graph drawing. It is essential that all questions are attempted, even if the candidate is unsure of the answer as they may gain partial credit even if full marks are not awarded.

The drawing skills of most candidates were good, with suitable detail included. Lines should not be incomplete or feathered. Drawings should be neat, in proportion and show sufficient detail.

## Comments on specific questions

### Question 1

(a) (i) The mark for constructing the table was sometimes missed because candidates repeated the time column creating contiguous tables. Tables should be designed so that columns are not repeated.

Common mistakes were to include units in the body of the table or give the unit for time (minutes) as 'm'. Candidates should remember that most headings require units. For example, some gave time, but not minutes and some gave minutes but not time.

Some candidates omitted the starting temperature for test-tube **A**. Candidates had to read through the method to find this piece of information. The rest of the data was recorded correctly in nearly all cases. Occasionally, candidates only included the data for one of the test-tubes.

(ii) The majority of candidates correctly calculated the maximum temperature change in test-tube **B**. However, fewer gave the correct answer for test-tube **A**. This was most likely because they had not considered the starting temperature of test-tube **A**. Some candidates added up all the data and others gave the highest temperature, rather than the temperature change.

(iii) Few candidates were able to give a correct conclusion that linked the independent variable (hydrogen peroxide concentration) to the activity of catalase. Many restated the results, describing which test-tube had the greater temperature change. This was insufficient for the mark to be awarded. Candidates should refer back to the aim of the investigation when writing their conclusions.

(iv) Temperature was correctly identified as the dependent variable by the majority of candidates. A common mistake was to state the concentration of hydrogen peroxide, which was the independent variable, or time, which was monitored, but did not change as a result of the independent variable changing.

(b) (i) Many candidates understood that the foil acted as an insulator for the test-tube and that without the foil heat would be lost. However, fewer predicted that the result of this would be that the temperature change would be lower. Many stated that the temperature would be different or inaccurate, which was too vague to be awarded a mark.

Some candidates confused temperature and heat. For example, they described temperature being lost rather than heat.

(ii) At least one constant variable in the investigation was correctly identified by many candidates. The most common answer was time and volume of yeast. Some gave unqualified answers such as yeast or temperature but did not give enough detail to be awarded the mark. Common incorrect responses included volume of catalase, pH, size of test-tube and volume of hydrogen peroxide solution.

(c) (i) Many candidates recognised that the volume of oxygen and the time were the two measurements needed for calculating the rate of oxygen production. A common incorrect answer was counting bubbles of oxygen. Many gave pieces of equipment used to measure volume and time rather than naming the quantities.

(ii) Many candidates were familiar with the term anomalous. Correct responses compared the anomalous result to the other results, stating that it is a result that does not fit the pattern or trend of the collected data. A common incorrect answer was to describe an anomalous result as a result that was different from expected, or an inaccurate or abnormal result.

(iii) Many candidates correctly described how to calculate the average by excluding the anomalous result. However, some described how to calculate an average using all three results and some thought that the anomaly would be replaced by an estimated result and then all three results used. Some candidates discarded the result for trial 3 rather than trial 2, which was not correct.

(iv) Most candidates gave the correct axes labels for their graph. The most common mistake was to omit 'average' or the units from 'average rate of oxygen production'.

Many candidates did not use a scale where their data covered at least half of the grid in both directions. This was especially true for the pH axis which needed to start at five rather than zero. Some that started at five put zero at the origin, which meant their scale was not linear. Candidates should use easily divisible scales, to avoid making errors in plotting. Those that did not use an appropriate scale often extrapolated their line to the origin. Candidates should use a ruler to join the data points from one plot to the next, without extrapolation.

Most candidates were able to plot the points accurately, although some made a mistake plotting the point at pH 5.

(v) Generally, candidates were able to describe the overall trend shown by the data. Some found it difficult to identify the pH with the greatest rate. A significant number thought this was pH 7, rather than pH 8. Few candidates quoted data, including correct units, in their answer.

(vi) A significant number of candidates could not suggest further investigative work to obtain a more accurate value for the pH with the greatest rate. Common incorrect answers centred on repeating the investigation, controlling variables, and extending the range of pH values.

## Question 2

(a) (i) Many high-quality drawings of the celery stalk were seen. Most drawings were a good size, with a clear, continuous outline. Many accurately showed the vascular bundles and the indent at the top. Some omitted the label for the vascular bundle or labelled it as xylem or phloem. Some included shading or had drawn individual cells.

(ii) The line **PQ** was generally measured accurately. The units were given on the line (mm) and most measured in millimetres rather than centimetres. Some candidates gave units for their final

magnification. Most divided their measurement by 27, but some rounded incorrectly e.g.  $78 \div 27$  as 2.8 rather than 2.9. A significant number did not give their final answer as a whole number.

- (b) Candidates were asked to plan an investigation to determine the effect of air temperature on the movement of dye up a celery stalk. Most candidates described an investigation where the celery was left for a set time at different temperatures. Fewer candidates were able to describe a method to keep the air temperature constant. They were more likely to describe use of a thermostatically controlled water-bath, which would be acceptable for controlling water temperature, but not air temperature. Very few candidates seemed familiar with the method to measure the dependent variable: cutting sections of celery to determine how far the dye has travelled in a set time.

Most candidates were able to name some relevant variables that should be kept constant, although some gave irrelevant variables such as pH.

Many candidates were familiar with the need to repeat an investigation multiple times and to take safety into consideration. Candidates should decide which aspects of an investigation need safety considerations. In this case, the use of a knife to cut sections and the use of a staining dye both had risk.

Some candidates did not describe an experimental method, but instead described the expected result and in some cases described the theory to explain the expected results. Expected results and theory are not required.

- (c) The Benedict's test was well known. However, candidates should remember that the sample should be prepared before the test is conducted, e.g. by grinding the plant tissue. Some referred to the use of a water-bath but did not specify that it contained hot water.

Occasionally, candidates described the use of heat and ethanol to remove chlorophyll, rather than the use of heat with Benedict's solution. A few suggested other tests such as use of iodine solution or the biuret test.