BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

Most candidates performed well on this paper. Others need to be careful to read the questions accurately. This is especially true where apparently familiar information is provided, but where the question is framed in an unfamiliar context.

Comments on specific questions

Question 7

Many candidates found this question challenging, as they were unfamiliar with the structure and function of the cuticle.

Question 10

The role of bacteria in producing mouth acid was not well understood.

Questions 13 and 14

These were questions where candidates needed to read the question carefully. In **Question 13**, the graph showed pressure in the heart ventricle but the question was about the *atrium*; and in **Question 14**, the pulse rate when walking slowly had to be compared to the *resting pulse rate*.

Question 15

This question (about the formation of tissue fluid) proved difficult for many candidates.

Question 17

A common error was the belief that the alveoli have cilia.

Question 19

There was confusion between *urethra* and *ureter*.

Question 24

Most candidates understood that there are antagonistic muscles in the arm, but few realised that this arrangement of muscles also occurs in the iris and in the oesophagus.

Question 25

A common misconception was that the tar in cigarette smoke causes constriction of blood vessels.

Question 28

This question on the ecosystem proved to be difficult, with a relatively small proportion of candidates choosing the correct answer.

Question 32

This was also difficult, and was another occasion where candidates had to read the question carefully – the key concept was *biodiversity*.

Question 38

Genetic engineering is poorly understood by many candidates, and a significant proportion of candidates thought that GM bacteria are themselves injected into diabetes patients.

Question 39

This was a challenging genetics question, and was only answered correctly by the strongest candidates.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General comments

Most candidates performed well on this paper. Others needed to be careful to read the questions accurately. This is especially true where apparently familiar information is provided, but where the question is framed in an unfamiliar context.

Comments on specific questions

Question 7

Relatively few candidates correctly identified the structure and function of the leaf cuticle. A common error was the belief that the cuticle is a cellular layer.

Question 10

The role of bacteria in producing mouth acid was not well understood.

Question 13

This was an instance where candidates had to read the question carefully. The graph showed pressure in the heart ventricle but the question was about the *atrium*.

Question 15

This question (about the formation of tissue fluid) proved difficult for many candidates.

Question 22

Many candidates were unsure of the role of the eye muscles in accommodation.

Question 25

Weaker candidates were confused that this question, which referred to tobacco smoke, was really testing understanding of the circulatory system.

Question 28

This question about ecosystems proved to be difficult for many candidates.

Question 30

Candidates had to read this question carefully. While the diagram showed the carbon cycle, the question referred to oxygen excretion, and many candidates consequently confused plant respiration and photosynthesis.

Question 38

This was a challenging genetics question, and even the strongest candidates found it difficult.

BIOLOGY

Paper 5090/21
Theory

Key messages

Candidates should also be aware that, though a question at first sight may appear to be examining a topic with which they are not familiar, the answer will always be accessible to those who have followed the syllabus. This ability to interpret an unfamiliar situation is one of the requirements of this examination.

General comments

There were very few candidates who found the paper beyond their ability. Comprehension of energy flow in food chains and knowledge of the structure and function of the excretory system generally were not well known by candidates.

Comments on specific questions

Section A

Question 1

(a) Occasionally, the answers to the two separate parts of this question were reversed. Canines were sometimes identified as incisors, and molars as pre-molars. Otherwise, most candidates scored very well on this question.

(b) (i) There was some confusion between what causes tooth decay and how tooth decay may be prevented. It was surprising how rarely bacteria were mentioned. .

(ii) There were no problems here. Brushing and flossing teeth were regularly mentioned, as was the desirability of regular dental check-ups.

Question 2

(a) (i) Excretion appeared to be a less well known subject for many candidates. Often, the names of the relevant blood vessels were not known. Artery and vein were often reversed, and pulmonary blood vessels, hepatic portal vein and aorta were regularly suggested. Sometimes, artery and vein were given the correct way round, but without the addition of 'renal'.

(ii) There was considerable confusion between 'urea' and 'urine' with both appearing equally often. This was often followed by a failure to appreciate the difference between the ureter and the urethra.

(b) (i) Although most candidates appreciated the reason for referring to the connection as an AV fistula, several believed that the shapes of the letters 'A' and 'V' resembled the appearance of the blood vessels at the point where they join.

(ii) Although a few candidates reversed the blood vessels, stating that there would be more urea in the vein, most gave a correct answer.

(c) The fact that the artificial membrane is involved in diffusion was well known, but few thought to mention its partial permeability.

There were very few references to the need to regulate the concentration of some of the solutes to equal their concentration in the blood, but many candidates, perhaps taking their cue from **(b)(ii)** realised that urea would pass from the blood to the dialysis fluid.

Question 3

(a) (i) 'Food chain' was a common correct answer.

(ii) A producer and a carnivore were usually correctly identified, but when errors were made, it was often to suggest that either the Sun or the caterpillars were producers.

(b) (i) There needed to be a reference to photosynthesis before the first mark was scored. The remaining 95 per cent energy was often described as being 'lost to the environment', but a more specific qualifying statement was needed for the second mark.

(ii) There were some full answers here, but several candidates suggested that the hawk rather than the songbird loses energy.

(c) This question proved to be one of the most demanding on the paper. Few candidates ventured beyond saying that the wheat produces more food than the sheep. There was little appreciation of the relative trophic levels of the two organisms in a food chain or web, though some candidates did appreciate that less energy was lost in the production of carbohydrate by the wheat plant than in production of meat by a sheep.

Question 4

(a) Most candidates correctly identified a red blood cell. However, a significant number believed that the cell is responsible for carrying oxygen *and nutrients* round the body.

(b) The question asked for symptoms, but there were many candidates who identified the condition as sickle-cell anaemia. Relatively few mentioned the effect of reduced oxygen carriage on respiration and energy release.

(c) This question was well understood and well explained. A few candidates, however, showed some confusion with the relevant terminology when describing the intake of water before going on to say that this leads to plasmolysis.

Question 5

There was some confusion between dispersal and pollination, with frequent reference to insects being involved and a belief that the diagrams showed flowers, including petals.

Section B

Question 6

(a) (i) The large majority of candidates correctly drew a pupil smaller in size than that shown in Fig. 6.1a.

(ii) Ciliary muscles were regularly mentioned, and iris muscles very rarely. More often than not, though, there was an accurate mention of the circular muscles contracting and the radial muscles relaxing.

(b) A few candidates mis-identified the type of action as accommodation – but usually realised that the action had the effect of reducing the amount of light entering the eye.

Question 7

(a) (i) It would appear that a labelled diagram of a fermenter was unfamiliar to a considerable number of candidates. This part was, quite often, left blank or some of the parts were left unanswered. The antibiotic being harvested at **Z** was relatively well known, and it was appreciated by some that the microorganism would be introduced at **W** and that carbon dioxide would be removed at **X**. Rarely was oxygen mentioned as entering at **Y**. Despite antibiotic being mentioned in the question, several referred to alcohol production.

(ii) Few candidates provided a correct answer to this part, but occasionally, candidates recognised the perforation at the top of the widened exit of **X** and were able to relate this to bubble production.

(b) Marks were frequently scored here because candidates linked temperature and pH control with enzymes. Few however appeared to realise that it is important to keep the temperature and pH monitored so that changes in both can be detected and thus controlled at the *optimum* in each case for the enzymes involved in the process.

(c) The commonest correct response referred to the heat likely to be emitted by the motor.

Section C

Question 8

(a) Many candidates failed to relate their answers to age and activity, as required by the question. However, the need for carbohydrates by those with an active lifestyle, the need for protein for a growing child and, to a lesser extent, the lower requirement for named constituents in the elderly were often correctly described.

(b) Rarely was it mentioned that churning occurs in the stomach. However this question allowed those candidates with precise and accurate knowledge to score highly, which many did.

Question 9

(a) This was the less popular of the optional questions, but those who attempted it often scored well. Less well known was the hypothalamus being involved in monitoring blood (core) temperature and that control involves a negative feedback system.

(b) Less thorough answers mentioned only that adrenaline is secreted at times of fear etc., and references to the term ‘target organ’ were rare. Most candidates were aware of the increase in heart beat. Several believed, incorrectly, that adrenaline is produced in the pancreas which then led to a confusion with glucagon and its effects.

BIOLOGY

Paper 5090/22
Theory

Key messages

A feature of many but the best candidates was sometimes to read the question only sufficiently thoroughly to ascertain the topic being examined, but then to give a general account of it, rather than to restrict their response to the specific aspect of that topic as required by the question. Centres are reminded that candidates should be guided in the length of each of their responses by the number of lines provided and by the number of marks available. A number of questions required the candidate to study carefully and to understand clearly a significant amount of information provided by the question. It was felt by Examiners that a proportion of candidates may not have allocated sufficient time to this task prior to responding.

General comments

Some very competent work was seen from the more highly attaining candidates. The role of hormones in the menstrual cycle in **Question 1** and the concept of limiting factors in **Question 6** were often less well understood. Questions requiring tailoring and application of knowledge to a previously unfamiliar context continued to provide more challenge for even the more highly attaining candidates.

Section A

Question 1

(a) The majority of candidates were able to correctly label and name a gamete. Fewer candidates were able to correctly label and name a zygote, with the most common incorrect response being to label the result of the first cell division; thereby incorrectly implying that there are two zygotes shown.

(b) The majority of candidates identified the correct part of the female reproductive system, with the most common incorrect responses including ‘vagina’, ‘oviduct’ and ‘ovary’.

(c) Many candidates correctly identified both children as ‘male’. This offered such candidates the potential to gain full credit for a valid explanation, however full credit was rarely awarded. Candidates often linked ‘XY’ to ‘male’ but did not go on to make reference to ‘zygote’. Very few candidates made reference in their explanation to ‘mitosis’ having taken place.

(d) This question provided challenge to even the most able candidates. Many candidates correctly identified the involvement of ‘progesterone’. The roles of LH and FSH in the menstrual cycle, and in particular the inhibition during pregnancy of their production and the results of this, were much less commonly known by candidates.

Question 2

(a) The majority of candidates were able to answer this correctly. There was some confusion between ‘homeostasis’ and ‘negative feedback’ evident in the responses of some candidates to this question and to **(d)(i)**.

(b) A significant number of candidates incorrectly stated one or more physiological responses that would result in an increase in body temperature **back to normal** as a result of homeostasis. During time **E** in Fig. 2.1 the body temperature is **rising above normal**. Such homeostatic actions are therefore not correct in this context. Many candidates did though gain either full or part credit for

this question for valid suggestions. Occasionally the suggestions made were closely related alternatives (e.g. 'exercise' and 'running') and therefore did not each gain separate credit.

(c) This was well answered by the majority of candidates, with homeostatic mechanisms to result in heat loss from the body being well known. A minority of candidates gave responses that indicated the reverse of the actions that would take place; perhaps indicating the necessity to study closely the information provided in the question before constructing a response. Credit was not awarded for reference to the action of 'erector muscles' or to 'hairs' as the action of these is not considered to be of relevance in human thermoregulation.

(d) Except for where the confusion noted in **(a)** between 'homeostasis' and 'negative feedback' was seen, both **(d)(i)** and **(d)(ii)** were well answered by the majority of candidates. Examiners were notably impressed by the almost universal knowledge by candidates of the role of the 'hypothalamus' in **(d)(ii)**.

Question 3

Candidates were required to study carefully and understand clearly the information provided by the question prior to responding. For candidates who did so, this was a question in which significant credit was gained.

(a) Many candidates did answer this question correctly. A significant proportion however answered 'white' or stated a letter taken from the information provided, to represent the identity of a particular plant.

(b) (i) Candidates with a greater understanding of the relevant concepts were able to state three correct genotypes. Some responded using incorrect letters in place of **B** or **b** to represent alleles.

(ii) Examiners gave credit for a correct response relating to each individual candidate's response to **(b)(i)**. This enabled a higher number of candidates to gain credit here than would otherwise have been the case.

(c) Again Examiners gave credit for a correct response relating to each individual candidate's response to **(b)(i)**. This enabled a higher number of candidates to gain credit here than would otherwise have been the case. The principle being examined was that of being able to correctly draw and format a genetic diagram. Centres are guided towards the mark scheme for this question when considering how best to advise future candidates to demonstrate these skills. In particular **correct ratios** and **labels to indicate the stages** of the genetic diagram were unfortunately omitted by a significant number of candidates.

Question 4

Again candidates were required to study carefully and understand clearly the significant amount of information provided by the question prior to responding.

(a) The majority of candidates found completion of the food web from the information provided to be challenging. There was little appreciation that the lower two boxes would represent the producers from Fig. 4.1 with the middle and higher boxes representing successive trophic levels. A significant number of candidates did not complete the arrows by drawing in arrow heads. Those who did sometimes had not appreciated the correct nature of the flow of energy between successive trophic levels.

(b) Animal dispersal was often correctly deduced, with many candidates going on to also name a correct animal. Incorrect reference to 'insect' or to 'pollination' was sometimes seen. Such incorrect responses further illustrate the potential for confusion by candidates between the processes of 'pollination' and 'seed dispersal' noted on previous occasions.

(c) Examiners were encouraged by the significant proportion of candidates who took the information provided and used this to suggest possible effects on the community. Full reference was not always made to the role of each gender of bee, or to a reduction in the instance of pollination of Brazil nut trees. Centres are advised that responses that refer in neutral terms to an 'effect', without reference to the specific nature of the effect, are unlikely to gain credit. As an example, in response to this question the statement 'the population of jaguars will be affected' did not gain credit whereas 'the population of jaguars will decrease' did.

Question 5

(a) Both parts of this question were generally well answered.

(b) (i) Quite frequently candidates did not correctly identify both muscles correctly. Such candidates had perhaps not considered the change in position to have involved two distinct movements – one of the upper leg and separately that of the lower leg; each requiring the contraction of a separate muscle. A proportion of candidates did not use letters as instructed and therefore were unable to gain credit.

(ii) This question was answered correctly by the large majority of candidates.

(c) Candidates were often able to correctly identify the action of both 'radial' and 'circular' muscles and the resulting effect on the pupil and/or on the amount of light entering the eye. A significant number of candidates incorrectly made reference to 'ciliary muscles' indicating confusion between the pupil reflex and the process of accommodation. Such candidates were able to go on to gain full credit for the question, however they gained no credit for the part of their response relating to muscle location or action.

Section B

Question 6

(a) This question was usually very well answered with responses often full, correctly detailed and well structured. Reference to the production of 'food' in the process of photosynthesis did not gain credit, whereas specification of the nature of this food as 'glucose' did. Incorrect reference to 'breathing' rather than to 'respiration' was common when accounting for the production of the carbon dioxide used in photosynthesis or for the subsequent use of the oxygen and glucose produced.

(b) The term 'limiting factors' was known and stated by a significant number of candidates. Few candidates went on to name any limiting factors other than light intensity which was stated in the question. Those who did unfortunately did not also make reference to the named limiting factor being in short supply; or in the case of temperature being either too low or too high. A number of candidates incorrectly referred to light intensity becoming a limiting factor **beyond when** the rate of photosynthesis no longer increases as light intensity is further increased; instead it is a limiting factor **up to when** this point is reached.

Question 7

(a) Both parts of this question were generally well answered, however the majority of candidates did not gain full credit. A proportion of candidates did not answer the question asked regarding the **causes** and **symptoms**, instead giving details of suggested **uses** of the dietary components or suggested **cures** for the deficiency diseases. Such information did not gain credit. There was some incorrect transference of knowledge regarding deficiency diseases, both between those referred to in the question and those not (e.g. kwashiorkor and anaemia).

(b) The principle of vitamins being small molecules not requiring digestion was well deduced by some candidates. This was an example of candidates being expected to apply their knowledge, in this case of the function of enzymes on substrate molecules in digestion, to a previously unfamiliar context.

Section C

Question 8

This question was the least commonly answered in ***Section C***.

(a) Many candidates were able to explain the entry of water into a plant by osmosis through the root hairs. Fewer candidates made reference to passage through the wall and membrane of these cells. Correct reference was often made to a water potential gradient. Some incorrect reference to the movement of water by active transport was seen. Candidates quite often went on to provide a

detailed account of the subsequent passage of water through the plant. Such accounts, despite being often factually correct, were beyond the scope of the question.

(b) This question was found by the majority of candidates to be challenging. Responses often lacked relevant detail concerning the effects of the **slowed rate of respiration** referred to in the question. Responses instead often made reference to the possibility of a toxic chemical from the soil killing the plant, without reference to a suggested mechanism by which this would occur. Candidates who made reference to the role of 'nitrates for growth' or to that of 'magnesium for chlorophyll' often did so without consideration of the fact that these minerals would now be in reduced quantity. Reference to less photosynthesis was the most commonly awarded marking point.

Question 9

This question was the more commonly answered in ***Section C***.

(a) This was well answered by the majority of candidates. The features of a gas exchange surface were well known and the majority of candidates were able to correctly make reference to the importance of these features. Many candidates responded with reference to the human gas exchange surface. A minority of candidates made irrelevant reference to the mechanics of breathing, further illustrating the potential for confusion by candidates between the processes of 'breathing' and 'gas exchange' noted on previous occasions.

(b) The majority of candidates were able to identify correctly the increased rate of breathing during exercise. Irrelevant reference was sometimes made to the increase in heart rate during exercise. It was common for candidates to describe anaerobic respiration but few explained how the increased breathing rate delays or prevents this from occurring.

(c) It was common for candidates to repeat the observation that the number of red blood cells would increase. Many went on to correctly describe how this would enable an increased transport of oxygen and to suggest a competitive advantage to the athlete. Reference to an increased amount of haemoglobin was less frequently seen than was anticipated by Examiners.

BIOLOGY

Paper 5090/31
Practical Test

Key messages

Candidates should be ready to apply their knowledge and experience of practical work and should ensure that they make careful observations and recordings.

They should be able to interpret data obtained by themselves, or which has been provided for them. In questions where calculations are required, it is important that candidates show their working in the relevant space where required. Credit may be awarded for correct working even if the final answer is incorrect.

General comments

The questions set were designed to test candidates' abilities to follow instructions carefully, to observe and record scientific information accurately, to take measurements and to carry out simple calculations. Candidates were also expected to plan an investigation. Candidates appeared to have sufficient time to deal with all the questions set and the vast majority of the scripts were clear and legible.

Comments on specific questions

Question 1

(a) (i) Candidates were asked to investigate the activity of yeast in solutions of different sugars. They were expected to measure accurately equal volumes of three sugar solutions, glucose, sucrose and lactose, and distilled water. A water bath was set up to incubate the solutions before dried yeast was added to each. The height of any froth above the yeast mixture was measured and recorded in the table provided. Most candidates performed the experiment well and were able to enter their results correctly.

(b) (i) Using their results, candidates were asked to construct a bar chart to show the height of froth in each of the four test-tubes after ten minutes. Generally, the bar charts were neatly drawn but on occasion axes were incorrectly labelled.

(ii) Candidates were asked to draw conclusions about the activity of yeast from their results. Many candidates were unable to conclude that yeast is unable to act on lactose.

(c) (i) Most candidates were able to state that respiration was responsible for the production of bubbles which form the froth.

(ii) Carbon dioxide was correctly identified by many as the gas producing the froth.

(iii) Many candidates were unable to explain the role of the water bath as a means of equilibrating the temperature of the solutions.

(iv) One of the test-tubes contained yeast and distilled water. Many candidates were unable to explain the inclusion of this test-tube as a control.

(d) When asked to suggest why yeast was less active with some sugars than others, the better answers referred to specificity of enzymes acting on specific sugars.

(e) Most candidates explained how they could improve the reliability of their results.

Question 2

(a) Candidates were presented with a photograph showing flowers of the sweet pea plant and asked to suggest its means of pollination. Many stated that it was insect-pollinated because of its large petals. Some candidates suggested colour and scent but failed to get the mark as this did not use the information from Fig. 2.1 as instructed.

(b) Most candidates were able to accurately identify the parts of a developing fruit and the remains of a flower.

(c) (i) Most candidates were able to suggest that cutting a small part of the testa would help germination.

(ii) Candidates were asked to design an investigation to determine whether this was the case. Credit was given for the use of more than one seed in each case, use of suitable containers in which to perform the experiment, the control of variables and the provision of conditions needed for germination.

Question 3

(a) Candidates were provided with a photograph showing some starch grains in a potato cell as seen under a microscope. The majority of candidates could recognise the cell wall as the labelled structure G.

(b) Candidates were asked to draw the three starch grains labelled H, J and K. Better answers produced large, clear drawings which showed the correct proportions of all three grains.

(c) (i) Candidates drew a line to indicate the maximum length on grain J and most correctly measured and recorded this value.

(ii) Using the information provided of the actual length of grain J, many candidates were able to calculate the magnification of their drawing.

(d) When asked to describe how a slide of potato tissue, showing starch grains under the microscope could be prepared, most candidates were able to show a knowledge of practical skills involving the need for thin sections, stains and careful mounting techniques.

BIOLOGY

Paper 5090/32
Practical Test

Key messages

The main objectives of this paper were to test not only biological knowledge, with emphasis on structure and function, but also the application of practical skills and techniques. Requirements for performing well included in **Question 1**, an initial understanding of determining the concentration of an unknown glucose solution from a known range using the Benedict's test with distilled water as a control. Candidates then needed to describe differences not only in the contents of test-tubes left to stand for 20 minutes, but also methods of separating and obtaining the mass of any solids produced.

In **Question 2**, apart from drawing, measuring and calculating the magnification of the cut surface of the root of a carrot plant, the key requirements included an understanding of the effects of boiling, cooling and freezing on the vitamin C content in carrots from data presented (Table 2.1) followed by describing the procedures required for a vitamin C test to compare carrots boiled in an oven or in water.

In **Question 3**, the key requirements included describing differences in the number, shape and size of normal and abnormal red blood cells from a photomicrograph of these cells in a person suffering from sickle cell anaemia, and then giving valid reasons why abnormal cells can lead to problems in blood circulation.

General comments

The questions tested the ability of candidates to follow instructions, make and record accurate observations using written and drawing skills, in addition to taking measurements and performing simple calculations. The ability to accurately plot and evaluate tabulated data was also tested. Candidates appeared to have more than sufficient time to complete the paper.

Comments on specific questions

Question 1

(a) Using the Benedict's test, candidates were asked to compare the appearance of contents of test-tubes containing distilled water, 0.2%, 0.4% and 0.6% concentrations of glucose solutions with an unknown glucose concentration (X), and record their observations. The majority of candidates were able to satisfactorily complete all sections of the table and the best answers showed distilled water remaining blue with no change in colour. The three known concentrations of glucose solutions generally showed positive changes in colour ranging from blue to orange (0.2%, 0.4%), orange to brick red (0.6%) with the unknown solution showing the similarities to 0.2% – 0.4%.

(b) (i) – (iii) When asked to estimate, explain and determine the concentration of glucose in X, the best answers confirmed this to be 0.3% or on occasions 0.2% or 0.4% based on colour changes using the Benedict's test and recorded in Table 1. Many excellent responses satisfactorily compared the dilutions of glucose between 0.2% and 0.4% to be close to the colour of X solution. Candidates who did not perform well estimated much higher values for X either providing no explanation or estimating much lower or higher concentrations.

(c) Candidates were asked to produce a known volume of 0.5% glucose from a 1.0% glucose solution. Good answers demonstrated that the same volume of distilled water should be added to known, measured or stated volumes of glucose solution. Incorrect responses assumed that dividing the 1.0% stock glucose by half would reduce its concentration and that Benedict's solution could also be used to achieve such a dilution.

(d) Candidates were asked to explain why Benedict's solution was used to test distilled water. Many excellent answers confirmed that a control was necessary to show the colour of Benedict's when no reducing sugar/glucose was present. Some incorrect responses suggested the need to identify impurities in the water.

(e) (i) and (ii) At this stage in the examination, test-tubes containing either distilled water or the respective glucose solutions had been left standing in a test-tube rack for 20 minutes. Candidates were asked to describe any differences in the appearance of contents over this period and to suggest how any solids produced after the Benedict's test could be separated and weighed. Many good answers described precipitates/solids settling at the bottom of test-tubes and with increasing amounts linked with increasing concentrations of glucose such as the 0.6% solution. These candidates also showed that the solids need to be filtered and the residue appropriately dried prior to any mass being measured.

Question 2

(a) (i) and (ii) Candidates were asked to make a large drawing and measure the diameter of the cut surface of the root of a carrot plant, label the vascular tissue and calculate the magnification of the drawing. Many excellent responses included a clear, circular drawing, at least 60 mm in diameter, with a continuous line and no shading. Vascular tissue was indicated centrally and labelled accordingly. Good responses also included precise measurements being made with correct units, plus a line drawn on the drawing, together with a correct working and calculation of the magnification.

(b) (i) Candidates were given measurements of the content of vitamin C as mg/100 g in fresh and frozen carrots, which were then measured again after being cooked in boiling water (Table 2.1). When asked to construct a bar chart of these data on a grid, many excellent answers showed well-drawn charts, the axes fully labelled with a linear scale for the vitamin C content and at least half of the grid used in both directions. Four data values were correctly plotted with all bars ruled and of equal width.

(b) (ii) Candidates were asked to suggest two conclusions from data presented in **(b)(i)**. Many correct responses confirmed that more vitamin C was present in uncooked/fresh than boiled carrots and also in fresh than frozen carrots, thus confirming that boiling/cooling/freezing decrease the amount of vitamin C in carrots.

(b) (iii) Candidates were asked to describe in detail how they would investigate the effect of two cooking methods, using an oven or boiled in water, on the vitamin C content of carrots. Many excellent responses clearly showed that the same carrot or of the same age, type or species should be subjected to both methods of cooking, and that the same mass or volume of carrots be cooked for the same time or same temperature prior to undertaking the vitamin C test.

Question 3

(a) Candidates were presented with a photomicrograph of red blood cells in a person suffering from sickle cell anaemia (Fig 3.1). Many candidates correctly calculated the number of normal red blood cells in addition to describing their small size and biconcave/disc-shaped/circular shape compared with the larger or more elongated/flat shape of abnormal red blood cells. Less satisfactory responses either incorrectly compared the number, shape and size of both red blood cell types or frequently referred to abnormal cells as 'sickle-shaped'.

(b) Candidates were asked to suggest why the rigidity and shape of abnormal cells can lead to problems of blood circulation in a person suffering from sickle cell anaemia. Many excellent responses made reference to abnormal cells being unable to pass through the blood capillaries, thereby being squeezed or getting stuck. Valid comments also indicated that the abnormal cells could cause blockages thus stopping blood flow, which in turn could increase blood pressure, damage capillaries or cause internal bleeding. Less oxygen would therefore be transported in the bloodstream.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key messages

It is important that candidates read the questions carefully to ensure that they answer what is being asked. When drawing graphs or bar charts, candidates should label axes fully. Linear scales should be used and values at the origin should be included.

General comments

It appeared that candidates had sufficient time to complete the paper. The majority of scripts were clearly legible, with the answers written in the spaces provided and there were few instances of questions that were not attempted.

There continues to be an improvement in the responses to questions relating to experimental design, as candidates become more familiar with this style of question.

Comments on specific questions

Question 1

(a) (i) Most candidates, having read the procedure for the investigation, were able to correctly work out what had to be measured. Most measurements were accurate and were then used to complete the table.

(ii) Almost all candidates subtracted 25 mm from 65 mm to give the correct increase in the height of froth of 40 mm. Some omitted units. Since units had not been provided on the answer line, they should have been given by the candidate.

(b) (i) There were some excellent bar charts drawn. In most instances the values asked for i.e. the height of the froth after 10 minutes, were selected correctly. In a few cases candidates had also drawn bars to represent the height of the froth after 5 minutes, which was not required. The majority of bar charts drawn were of a good size, filling most of the available space. The most common error on the bar chart was to omit the value at the origin of the *height of froth* axis. Without that value it could not be determined that the scale chosen was linear. Most points were plotted accurately. On almost all, bars of equal width were drawn with ruled lines. A small number of candidates drew line graphs rather than bar charts as instructed.

(ii) Many candidates were able to conclude that yeast was more active in glucose and/or sucrose solution with little activity in lactose solution and/or water.

(c) (i) The majority of candidates correctly identified fermentation or (anaerobic) respiration as the process by which the froth is formed. A few incorrectly named the process as aerobic respiration or ‘effervescence’.

(ii) There were a few incorrect answers which gave oxygen being the gas produced by yeast, but the majority of candidates correctly identified carbon dioxide.

(iii) Candidates were asked why the test-tubes were placed in the water bath for 5 minutes before the yeast was added. The quality of answers here was mixed. Creditworthy explanations included 'to allow all the test-tubes to come to the same temperature' or, in the context of this investigation, 'because 40 °C is the optimum temperature for enzyme activity'. 'To increase the rate of reaction' or 'to kill microbes' were not creditworthy responses here.

(iv) Many candidates explained that using a thermometer would have helped to maintain the temperature. Others correctly described how the temperature might be increased or reduced as necessary. Some candidates described methods of thermostatic control, which in the context of this investigation was not creditworthy.

(v) In this question candidates were asked to describe why a test-tube containing yeast and distilled water was used in the investigation. Many gained full credit for simply stating that this was 'a control'. Others went into more detail, explaining that it was a comparison to see what happened when no sugar was present.

(d) Only a few candidates related the lack of activity to the lack of a suitable enzyme in the yeast to help in the breakdown of some sugars for use in respiration. The majority of answers suggested that different sugars have different reactivity or even different concentrations, despite being told at the beginning of the question that all the sugar solutions used were 5% concentration.

(e) Some candidates recognised that to be considered reliable, it should be possible to repeat an investigation and obtain similar results. Some described this idea in more detail e.g. using more test-tubes with the various solutions and then calculating the mean (average) results. A few recognised that repeating the investigation would reveal anomalous results that should be disregarded. All these ideas were creditworthy. Some thought that making an investigation more reliable involved using different sugars to the ones previously used. This idea could not be credited.

Question 2

(a) The majority of candidates correctly suggested that the flower was insect-pollinated because of the presence of petals. Some mentioned insects but not petals; a few confused pollination with seed dispersal and wrote about animal dispersal instead.

(b) Many candidates were able to name all four parts of the flower indicated. Identifying the sepals and petals generally proved to be easier than the stamens and particularly the stigma (or style).

(c) (i) Creditworthy answers about cutting the testa suggested allowing more water or oxygen to enter, or to allow easier growth of the radicle or plumule. These answers were not frequently seen. Many candidates referred to 'the entry of nutrients' or 'the seed emerging'.

(ii) The best investigations described took into account the desirability of having replicates of cut and uncut seeds and of controlling variables such as temperature, water and conditions for germination. The end point was also clearly identified – time taken for germination or numbers germinated in a given time. The majority of responses only referred to having one of each seed (cut and uncut) and leaving them in the same conditions or at the same temperature. In many cases the end point of the investigation was not well described and a significant number of candidates appeared to confuse germination with growth, resulting in the length of the seedlings being measured which was inappropriate in this context.

Question 3

(a) Many candidates correctly identified **G** as the cell wall. Incorrect responses included cytoplasm and cell membrane.

(b) The best drawings were of a good size, with clear continuous lines and no shading, and the proportions of the three grains and their positions in relation to one another well represented. Those drawings that were small, had broken or sketchy lines, shading, or poor proportions could not be given full credit. A few candidates separated the grains in their drawings and others attempted to draw all the grains shown instead of just **H**, **J** and **K** as instructed.

(c) (i) Some candidates did not follow the instruction to draw a line on their drawing to indicate its maximum length. Some drew the line across its maximum width, which could not be credited. The majority of candidates correctly measured their drawing of grain **J**.

(ii) Most candidates calculated the magnification correctly. The most common error was to divide 0.03 by their measurement. A few candidates included units in their answer which, in the case of a magnification factor, is incorrect.

(d) It was apparent from answers to this question that many candidates had prepared microscope slides themselves (or had seen them being prepared) whereas some had not. To see starch grains, a very thin piece of potato or cells scraped off a potato should first be treated with iodine solution to stain any starch grains present. In many responses it was not clear that the piece of tissue being used was thin enough to be viewed clearly under a microscope. The best responses included details such as covering the specimen with a coverslip (without air bubbles) and/or removing any excess stain before observing under the microscope.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key messages

Candidates should read questions carefully, noticing particularly whether successive questions are related to the same material or not.

If a question asks for working to be shown, marks may be lost if it is not.

Units should always be included with recorded measurements.

Correction fluid should not be used, as stated on the front cover of the question paper.

General comments

Candidates had sufficient time to complete the paper.

Most scripts were clearly legible. However, it appears that a few candidates write their answers in pencil and then write over them in ink. These are often difficult to read.

Comments on specific questions

Question 1

(a) This question was asking candidates how they would use Benedict's solution to find out if potato contains reducing sugar. Results of the test were not needed, so were irrelevant here. Many candidates correctly described adding the Benedict's solution to some form of the potato in a test-tube and then heating the mixture. However, some omitted to heat the mixture. There were those who added Benedict's to food, or glucose and others who added other substances in addition to the Benedict's solution – answers that could not be credited. Placing test-tubes in a water-bath does not necessarily mean that they are heated; it should be stated that the water bath is hot or at a particular temperature.

A safety feature should also have been included. Often this was the use of a water bath, but references to not heating the test-tube directly in a flame or the wearing of goggles or other eye-protection were acceptable. Some candidates thought, in error, that Benedict's solution is flammable.

(b) (i) To answer this question, experience of using the reducing sugar test was needed. The majority of candidates knew that when the test is done with no reducing sugar present, the colour of the mixture after heating is blue. Incorrect answers included colourless, white or blue-black. A few candidates stated that there was 'no change' which could not be credited as the original colour had not been stated.

(ii) Very few candidates recognised that a range of standard solutions had been produced and that the distilled water test was carried out to see the colour of the heated mixture when no glucose was present. The other tests could then be compared with this. Credit was given for suggesting that it was done as a control but answers such as 'to prove that the water contained no reducing sugar' or 'to see if it contained impurities' could not be credited.

(c) Candidates correctly recognised that all volumes of the glucose solutions tested should have been identical, and also that the same volume of Benedict's solution should have been added to each one. Using the same concentration of Benedict's solution each time and the same temperature were also creditworthy. The concentration of the glucose solutions could not be credited as it was the independent variable in this investigation.

(d) (i) Many candidates correctly concluded that the concentration of solution X was between 0.3 and 0.4%. Occasionally, 3.0% – 4.0% or 3.5% appeared which could not be credited.

(ii) The most frequently appearing answer was to repeatedly test solution X with Benedict's solution and obtain a mean result. This could not be credited as, although this would have increased the reliability of the result obtained for the colour change, it would not have given any further indication of the actual percentage of glucose present. Creditworthy answers recognised that a range of known dilutions of glucose between 0.3% and 0.4% should be produced e.g. 0.31%, 0.32% etc. These should then be tested with Benedict's solution and the colour produced in the test with solution X compared with the resulting colours of the known dilutions.

(e) Many candidates correctly recognised that water should be added to the given glucose solution to dilute it. However, the need for equal volumes to be mixed to then produce 5cm^3 of diluted solution was noted by only a few. Some candidates introduced Benedict's solution although there is no reference to using the test in the question itself. There were a number who erroneously thought that equally distributing the 1% solution between two test-tubes would produce 0.5% solutions.

(f) Filtering or decanting was correctly suggested by many as a means of separating the solid from the solution. However, fewer candidates recognised the need for the residue obtained to be dried before measuring, so that only the mass of the residue was recorded.

Question 2

(a) (i) The use of good technique was visible in many drawings. Good drawings were larger than the original and drawn with continuous lines using a sharp pencil and no shading anywhere. Good observation was also obvious from the more or less circular shape and the delimiting of the vascular tissue. Although there was an instruction to label the vascular tissue, this label was quite frequently omitted.

(ii) The recorded measurements were almost always accurate. A few candidates were unable to read a ruler correctly recording, for example, 75 mm as 70.5 mm. Although mm was written on the answer lines, there were candidates who recorded measurements in centimetres without changing the mm to cm.

There was an instruction to candidates to draw a line between X and Y on Fig. 2.1 and a line in a similar position on their drawing. Such instructions should be followed. There were candidates who omitted the line and others who drew a line below or at the side of their drawing, which could not be credited.

Most candidates correctly calculated the magnification of their drawing by dividing the measurement of their drawing by the measurement of Fig. 2.1. There should be no units with a magnification value.

(b) (i) Bar charts were generally well constructed. A mark could not be awarded if both axes were not fully labelled. If labels are written under the upright of a bar it is not clear to which bar they belong. If there was no value written at the origin of the vitamin C axis, it was not possible to tell whether a linear scale had been used so that mark could not be awarded. The values in the table were plotted well with an occasional 6.0 instead of 5.9, which could not credited. Bars should be drawn with equal width and ruled lines.

(ii) Conclusions that had been drawn from the information given were asked for in this question. This proved challenging for many candidates. However there were those who were able to conclude correctly that boiling or freezing reduced the vitamin C content of fresh uncooked carrots. A few candidates made general statements about fresh carrots being healthier without explaining why; these could not be credited.

(iii) There were some good descriptions of an investigation to find the effect of two cooking methods on the vitamin C content of carrots. In the best answers, the method of cooking was the only variable, with similar masses of carrot being cooked at similar temperatures or for similar periods of time before testing for vitamin C. Some candidates did not answer the question as set but wrote about the benefits of eating fresh carrots as opposed to cooked. Such answers were not creditworthy.

Question 3

(a) Counting the numbers of normal cells in Fig. 3.1 was a good test of observation. A significant number of candidates did not recognise a normal cell in side view. Describing the shape of the cells proved more difficult as, although a concave surface could be seen in the roughly circular normal cells, the abnormal cells were not sickle-shaped but were elongated and flat. No magnification was given because it was not needed; it could be seen that the normal cells were smaller or shorter than the abnormal ones. Some candidates gained credit by actually measuring cells in Fig. 3.1 and recording the measurements to show the difference in size.

(b) Some candidates knew that, if abnormal cells cannot bend easily, it is their ability to pass through very narrow capillaries that will be restricted. Others erroneously mentioned difficulty in passing though veins and arteries. Some correctly stated that the abnormal cells may cause blockages or damage the capillaries leading to internal bleeding and that, if blood flow is restricted, then less oxygen will reach the body tissues.