

BIOLOGY

Paper 5090/11
Multiple Choice

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

General Comments

The answers given by the candidates showed a spread of ability.

It was evident (for example in **Questions 3, 7 and 36**) that some candidates do not read the questions carefully enough.

Many candidates struggled with specific areas of the syllabus:

- the human transport system, specifically major blood vessels and their structure (**Q13**)
- the pupil reflex (**Q23**)
- movement at the hinge joint of the forelimb (**Q24**)
- antibiotics (**Q26**).

Comments on Specific Questions

Question 1

This question on a well-known topic was unusual in its format. Consequently, a minority of candidates answered it correctly.

Question 4

Candidates were confusing enzyme and substrate here. The tip to recognising the substrate was in realising that only 'X' could be produced by adding together the product molecules 'Y' and 'Z'.

Question 7

This question (about a standard experiment on photosynthesis) proved surprisingly difficult. Candidates apparently made the assumption that at least one of the leaf areas would give a positive result with the starch test. Plants require both light and carbon dioxide to photosynthesise.

Question 12

The great majority of candidates have a clear idea of the concept of transpiration.

Question 17 and 18

These questions were about experiments on respiration. The majority of candidates showed understanding of the oxygen absorption experiment. However, the significance of the oil layer in ensuring anaerobic conditions in the experiment on anaerobic respiration in yeast was not so well known.

Question 21

This highlighted a common misconception, namely that the iris is involved in the focusing of light by the eye.

Question 27

Candidates found this question taxing. It required them to identify the three organisms as bacterium, virus and fungus and then apply this knowledge to the scale lines provided.

Question 31

The commonest mistake here was forgetting the role of drugs in controlling malaria.

Question 32

A minority of candidates answered this question correctly, with many not appreciating the importance of a large population size in maintaining genetic diversity.

Question 35

Most candidates showed understanding of the complexities of the menstrual cycle.

Question 36

A number of candidates did not study the diagram carefully enough and so had the functions of the artery and the vein reversed.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General Comments

The answers given by the candidates showed a spread of ability.

It was evident (for example in **Questions 3, 7 and 36**) that some candidates do not read the questions carefully enough.

Many candidates struggled with specific areas of the syllabus:

- the human transport system, specifically the blood vessels serving major organs (**Q13**)
- active transport in plant roots (**Q17**)
- the effect of nicotine on the body (**Q25**).

Comments on Specific Questions

Question 4

Candidates generally knew that the stomach is acidic, but they did not appreciate just how acidic.

Question 6

Many candidates think that water vapour enters the leaves through the stomata.

Question 7

This question (about a standard experiment on photosynthesis) proved surprisingly difficult. Candidates apparently made the assumption that at least one of the leaf areas would give a positive result with the starch test. Plants require both light and carbon dioxide to photosynthesise.

Question 12

A majority of candidates thought that the diffusion of water vapour out of the stomata constitutes evaporation.

Question 21

This highlighted a common misconception, that the iris is involved in the focusing of light by the eye.

Question 22

A common error was the belief that the cerebellum coordinates breathing; rather, it coordinates movement overall.

Question 27

Candidates had a poor understanding of the process of cheese production.

Question 28

This question proved to be more difficult than expected, with many candidates thinking that energy can be converted to matter.

Question 31

The commonest mistake here was forgetting the role of drugs in controlling malaria.

Question 36

A number of candidates did not study the diagram carefully enough and so had the functions of the artery and the vein reversed.

Question 37

The distinction between “natural selection” and “survival of the fittest” is quite subtle. It eluded many candidates.

Question 40

The commonest error was to have the meanings of the terms *gene* and *allele* exactly reversed.

BIOLOGY

Paper 5090/21
Theory

Key Messages

Where ambiguity might arise, it is expected that biological and chemical names and processes specified in the syllabus should be correctly spelt by the candidates.

General Comments

Some excellent scripts from well prepared candidates were submitted. Many candidates show a good knowledge of basic information but are finding it difficult to select and marshal this, to provide a logical argument in the longer answers. Also, merely repeating phrases from the question does not gain any credit. Candidates should be encouraged to express the answer using their own words. Candidates should be able to state clear and unambiguous examples of biological phenomena.

Comments on Specific Questions

Section A

Question 1

Although the stem and phloem were correctly identified, the candidates found parts **(b)** and **(c)** to be challenging.

- (a) (i)** Candidates were able to correctly identify the stem.
- (ii)** Some candidates confused the positions of the phloem and xylem.
- (b)** Answers should have referred to the contents of the phloem and related their variation to changes in the rate of photosynthesis. A good answer was "Tissue A (the phloem) carries sugars and amino acids. These are products of photosynthesis. The concentration shows how much the photosynthesis varies at each time. An increase in concentration shows that the rate is faster".
- (c)** Candidates should have identified that sucrose and amino acids were present and shown how these would be used by the insects. A good answer was "Insects use Tissue A for their food supply because this is where the sugar is located. Amino acids can also be found there and they use these for growth. The insects use the glucose for respiration to provide energy for their activities".

Question 2

- (a)** From the information candidates were able to identify Chemical B as a protein. Those who misidentified it as a fat or a carbohydrate were awarded some credit if they correctly identified the enzyme and end products for their chosen substrate. Chemical E, glycogen, is an example where correct spelling is necessary. Variations of glucose/glycogen/glucagon were regularly seen.
- (b) (i)** This was answered well.
- (ii)** Many candidates recognised that the glucose was used in the process of respiration. Assimilation is not a specific process, so did not gain credit.

- (iii) Examples of how the released energy is used by different cells and tissues was required, thus a reference to muscle cells making use of the energy released by respiration when contracting, or to nerve cells needing energy released from respiration so that nerve impulses can be passed around the body, would have gained credit.

Question 3

Spelling of the names of the hormones was often too vague for candidates to be awarded credit.

- (a) (i) Most candidates gave a correct characteristic.
- (ii) Most candidates identified testosterone.
- (iii) Most candidates identified the testes.
- (b) (i) This was answered well.
- (ii) Although many candidates correctly identified ovulation, some thought that it was the start of menstruation.
- (c) Candidates were told that the timings on the two graphs were not the same. On Fig.3.2. they should have identified the start of menstruation and indicated that ovulation would have occurred two weeks later. Having correctly identified the position of J, one candidate wrote "After menstruation the uterus lining builds up again ready to receive an egg. After about 7 days from the end of menstruation, ovulation as represented by H occurred". This was a good answer.

Question 4

- (a) The candidates should have identified the start of exercise as being when the oxygen graph started to dip.
- (b) (i) In this answer it was necessary to state that aerobic respiration was occurring. Many candidates merely answered "respiration".
- (c) The good answers indicated the effect of emphysema on the structure of the alveoli and also referred to the changes in both the oxygen and the lactic acid curve. Good answers referred to a breakdown of the alveolar walls so less oxygen will diffuse into the blood in a given time. This means there will be less oxygen available during exercise. The oxygen concentration will be reduced and so lactic acid will be produced more quickly and in higher quantities.

Question 5

- (a) Most candidates recognised this as an incisor or canine.
- (b) Candidates rarely gained full credit. The blood vessels were mentioned, but only a few candidates mentioned the nerves.
- (c) This question was well answered. Bacteria, sugar and acids were mentioned, but there was only the occasional reference to the effect of the acid on the enamel of the tooth.
- (d) (i) Candidates found it difficult to interpret the data in the table. The table refers to the "mean number of decayed teeth per child". Many answers referred to the decrease in the number of children with decayed teeth, which cannot be inferred from this data.
- (ii) The candidates should be reminded that all the information given in the question will be relevant to their answers. It might be helpful to make notes around the table to clarify the information before attempting to answer the question. The weaker candidates misinterpreted the data and stated that fluoride was the cause of tooth decay.

Section B

Question 6

- (a) Most candidates knew that there was continuous and discontinuous variation, but found it difficult to explain the difference. Very few mentioned the interaction of the environment and genes in the 'continuous' examples. An excellent answer was "Two forms of variation are continuous and discontinuous. Discontinuous shows clear cut differences and no intermediate forms. It cannot be changed or affected by the environment. An example is your blood group. Continuous has no clear cut differences and shows intermediate forms of the characteristic. It is influenced by genes and environmental conditions. An example is adult body weight."
- (b) Candidates find questions about evolution and variation to be challenging. It is necessary to look at the wording of the question and then to select appropriate arguments to illustrate their points. Many candidates wrote about the survival of an individual, rather than the species over a long time period. They also forgot that unless reproduction occurs the alleles cannot be passed on and there can be no selection of advantageous alleles if the environment changes.

Question 7

- (a) There were excellent answers to this question. The candidates had a clear understanding of the similar roles of villi and root hairs.
- (b) There were also excellent answers to this question, although some found it harder to express the differences clearly. An answer gaining some credit was "The root hair cells absorb minerals from the soil, while the villi absorb small molecules through the ileum. The root hairs have cell walls". Had the candidate expanded their answer and mentioned which molecules were absorbed in the ileum, or mentioned the presence of capillaries or lacteals, they would have gained full credit.

Section C

A few candidates attempt both questions in this section. They do not gain any extra credit by doing so.

Question 8

- (a) (i) Good, clear answers were seen.
- (ii) The candidates who answered this question well tended to use fully annotated, well-drawn diagrams. The examiners were looking for the correct use of biological words as well as an explanation of the stated phenomenon.
- (b) As a "suggest" question, candidates are expected to provide a possible explanation for the appearance of pink flowers, based on their biological knowledge. Many candidates suggested that the alleles would have equal effect in the F1 generation. Others chose mutation as their explanation.

Question 9

- (a) Some excellent descriptions were given for this question. Candidates who did not gain full credit omitted part of the pathway from the air to the mesophyll cell, or did not incorporate the carbon dioxide into a glucose molecule so that starch could be formed.
- (b) Again some very good answers from candidates who highlighted the results of lack of magnesium in the soil. An excellent answer was "In soils lacking magnesium the plants will not absorb enough magnesium, so will not be able to make enough chlorophyll. So not enough light can be trapped and little photosynthesis will take place."

BIOLOGY

Paper 5090/22
Theory

Key Messages

Section A on the paper tests simple knowledge, but it also tests a candidate's ability to select routine information acquired from following the syllabus and then to apply it to situations that are likely to be relatively unfamiliar. It is not expected that a candidate will be required to draw on any information that is outside the syllabus.

It was evident, particularly in **Question 7**, that candidates were not reading the questions carefully before starting their answers. To have done so would have helped them to decide what should be included in part **(a)** and what should have been mentioned in part **(b)(i)**.

General Comments

Although there was a wide range of ability shown by candidates, there were a significant number that did not appear to understand the requirements of some of the questions since they produced a good deal of information that was wide of the mark, often producing an answer that was a re-cast of the wording of the question. Despite these shortcomings, some most impressive work was seen.

Comments on Specific Questions

Section A

Question 1

- (a)** The accuracy of the answers to this part was often a guide to the overall quality of the script. Part **(i)** was commonly misidentified as the renal artery and, sometimes, as the vena cava. The commonest inaccuracy in part **(ii)** was to believe that blood is sent round the body by the right ventricle, but a significantly large number of candidates named a blood vessel rather than a chamber of the heart.
- (b)** It was difficult to determine on what some of the candidates based their calculations. Some extremely implausible results were seen, e.g. structure D containing 16.00 or more units of protein. Nevertheless, careful, logical thought allowed a significant number of candidates to gain full credit.
- (c)** The link between diabetes and its effect on the content of the structures involved was sometimes hazy. Several confused the effects of insulin with the effects of glucagon, and, despite the requirement to *explain* how the relative concentrations might vary, it was far from common to read anything about insulin and its effects.

Question 2

- (a)** Both parts were usually correct, though digestion and absorption were sometimes offered as answers to part **(ii)**.
- (b)** It was rare to read that a candidate realised that the stomach walls are made of protein, and thus would be at the mercy of gastric protease without some form of protection. When enzymes were mentioned, they often included a reference to amylase as well. The probable effect of gastric acid was often mentioned, though 'corrosion' was not a term that was an accurate description of it. It was far from uncommon to see answers that suggested that candidates, seeing the word mucus,

immediately thought of the respiratory tract and thus supplied information on cilia and their function in the trachea.

- (c) Both parts were correctly answered by a high percentage of candidates.

Question 3

- (a) (i) The appearance of the word “nectar” in the question appeared to lead candidates down the wrong path. The most common of the incorrect answers was ‘pollination’, though ‘nectarification’ was surprisingly common (especially as no such word features in the syllabus).
- (ii) The significance of phloem was known by many, though there were many who opted for xylem, as well as those who, unsuccessfully, hedged their bets, suggesting both. It was evident that those who knew that the phloem was involved tended to believe that the translocated carbohydrate is glucose, with very few thinking to say that it needed to be in solution.
- (b) It is regrettable that reference to “lavatory” and a drawing of a shrew using the pitcher as such, did not lead candidates to a viable answer. However, in other circumstances, the release of carbon dioxide from the shrew as a result of respiration, and its use by the plant for photosynthesis, is knowledge that candidates usually display with confidence. On this occasion, it was rarely mentioned, with candidates following their initial error in part (a)(i), by continuing to suggest that the shrew was carrying out pollination. More surprising still was the suggestion that shrews and bats would be digested by the plants, or that they would attract insects to be digested by the plants, even though the question stated that this was unlikely.

Question 4

- (a) This was usually quite well answered. However, carbon dioxide was often thought to be a waste product of anaerobic respiration in muscles.
- (b) (i) There are two specific examples of anaerobic respiration mentioned in the syllabus, yet many seemed insufficiently familiar with the process of making alcoholic drinks to know that the temperatures used would never be high enough to kill the yeast. Some also believed that alcohol is acidic and that this is what kills the yeast, and that bacteria are deliberately added in order to kill the yeast.
- (ii) This was usually correct, but there were quite a few that did not seem to appreciate that it is the high temperature employed during the process of baking that kills (not ‘denatures’) the yeast cells.
- (c) Despite a correct answer to part (a), there were surprisingly few references to the fact that lactic acid is removed by the blood to be broken down before reaching toxic levels.
- (d) Although a few candidates realised that the substrate is not completely broken down in anaerobic respiration, and thus that there is still energy within the product, most answers stated that aerobic respiration happens in the presence of oxygen, whereas anaerobic respiration occurs in the absence of oxygen. This is correct science, but not relevant in this instance and so not creditworthy.

Question 5

- (a) (i) Very few candidates realised that the group not taking the drug were the control group. A description of their condition, such as “healthy” was often mentioned.
- (ii) A description of the effect of taking the drug, based on the information in the graph, was expected, and many candidates produced valid answers. However, many also spoke of the effect of beta-blockers on blood pressure rather than on heart rate. Those who did refer to heart rate occasionally omitted units when reading from the graph.
- (b) Graphs of an almost infinite number of shapes were drawn. Many showed a decrease in rate from time 0, even though the group did not take the medication for the first 3 years. Others did not take into consideration the fact that if only half the group took the medication the *mean* rate would not fall as far. This question demonstrated the importance of thinking *very carefully* about an answer before committing pen to paper.

- (c) Relatively few realised that it is specifically the artery walls that must dilate, though many realised that to increase the size of the lumen would reduce the blood pressure. There were many references to the drugs being used to remove deposits from blood vessel walls, but it was rare, indeed, to see a reference to relaxation of muscles in the artery walls.

Section B

Question 6

- (a) Knowledge of the terminology used in plant reproduction was often hazy in the extreme. Although ovules were correctly said to be in the ovary, many thought that an ovule is a gamete. Even those who did not often believed that the entire ovule contained haploid nuclei. Seed structure, when described, was generally well known, but seeds and fruits were sometimes confused, and references to either being dispersed were rare. A relatively common error was to believe that an ovule is part of human reproduction and thus accounts of ovulation were seen.
- (b) This part was generally well answered. Candidates knew that wind-dispersed fruits and/or seeds would be light in weight / mass and have some modification to increase their surface area. Few, however, realised that this extension would help the fruit or seed to be detached by the wind from its parent or that it would delay its descent allowing it to be carried a distance away from its parent. Confusions with wind-pollination abounded, but were, perhaps, a little less common than in past years.

Question 7

- (a) Candidates were asked what is meant by the term *reflex action*. Not until part (b) were they required to describe one. It was evident that many did not read the question before beginning and thus described a specific example rather than restricting themselves to explaining the term. Nevertheless, high marks were often scored, the only real problem being the distinction between the notions of voluntary and involuntary which, perhaps, stemmed from an insecure grasp of the meanings of those terms.
- (b) (i) Many candidates provided excellent answers to this question and even included accurate detail on synaptic junctions (not specified in the syllabus). The familiar recurrent inaccuracy, however, involved the part played by the brain in a reflex action. Even when the action described was a spinal reflex, many believed that the brain has a controlling role in the response. Otherwise good answers sometimes failed to pick up credit for reference to muscle contraction being the concluding event in their description.
- (ii) Most candidates realised that reflex actions protect against possible harm, but the importance of such an action occurring automatically, or without having to think about it and make a decision to act, was rarely considered.

Section C

Question 8

- (a) By far the majority of candidates were able to supply a sound food chain. However, some omitted the arrows, some chains were shown starting with a top carnivore and ending with a producer, a few could not think of four valid organisms, and there were several implausible suggestions. The pyramid of numbers was also usually acceptable for the food chain given, though it was not uncommon for the pyramid to be drawn upside down.
- (b) Candidates often stated that energy is lost as heat along the food chain, and some realised that not all organisms at each trophic level are eaten. Otherwise, answers often referred to the (several times repeated) percentage of energy passing from one level to another, with no reference to how the energy is used by organisms at each level. It was common to read that energy is used *for* respiration rather than released *by* it, and often when energy was said to be lost in faeces it was a repeat of the heat loss idea rather than a reference to undigested material in the faeces. When "waste" was mentioned, there was often a failure to identify precisely which form of waste was under consideration.

Question 9

- (a) Candidates had few problems with stating that in the double circulation blood passes through the heart twice, whilst being sent to the lungs and then again before being sent to the rest of the body. It was rare indeed to see a reference to the difference in pressure between the two circulations, as mentioned in the syllabus.
- (b) This part was seen by those who selected this option as an opportunity to describe the structure and general function of the heart, when the question specifically required an explanation of how the heart keeps blood flowing. They were still able to pick up relevant marks but, though valves were often mentioned, it was usually a positional reference with rarely any description of the part they played in the process. Indeed, often a mention of valves was with reference to veins and not to the heart. Likewise, it was rare to see a reference to the importance of the differential thickness in the walls of atria and ventricles or even the differential thickness in the walls of the ventricles. There were a few predictable confusions between the left and right sides of the heart but, despite these shortcomings, the better candidates were able to score highly in this part.

BIOLOGY

Paper 5090/31
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 doing well included, in **Question 1**, a clear understanding of the effects of water and ethanol on anaerobic respiration of yeast and the use of control variables in experimental investigations. In **Question 2**, the key requirements included an understanding of the features involved in the strength of plant fibres, composed mainly of xylem vessels, within the vascular bundles in the stem of dicotyledonous plants. In **Question 3**, the key requirements included knowledge of the comparative features of germinating cress seedlings grown in the light and dark and also an understanding of how variables can be controlled to show how temperature influences seed germination.

General Comments

The questions tested the ability of candidates to follow instructions and 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.

Comments on Specific Questions

Question 1

- (a) (i)(ii) Candidates were presented with two beakers, each containing a mixture of yeast in glucose solution, with **A** containing water and **B** undiluted ethanol. Using a syringe attached to a narrow glass tube, marked with ink, and inserted into each of beakers **A** and **B**, candidates were asked to measure and record in Table 1.1 the distance in mm between the ink mark and meniscus on the respective glass tubes after 10, 15 and 20 minutes. The majority of candidates correctly completed both sets of readings, which showed different trends.
- (b) (i) When asked to describe and explain why the meniscus of the yeast mixture in **A** moved along the tube, the best answers indicated that movement was faster or had increased due to the occurrence of anaerobic respiration / fermentation or that more carbon dioxide had been produced, which was confirmed using the specific data obtained.
- (ii) Conversely, in **B** the majority of excellent answers described less / slight movement of the meniscus suggesting that the yeast had not respired and little or no carbon dioxide was produced. Weaker responses suggested that less energy had been produced or that various concentrations of yeast were used.
- (iii) When asked to explain why syringe **A** was included in this investigation, candidates who performed well suggested that this was a control and acted as a comparison to demonstrate the activity or otherwise of the yeast. Weaker comments regarded the role of the syringe as a means of measuring liquid expansion or ensuring that the solutions did not get mixed up.
- (c) In first class answers, the two correct variables to be kept constant during the investigation included the volume of active yeast and the time intervals at which measurements were taken. Maintaining the same diameter of the tubing attached to the syringe was occasionally offered as an answer.

Question 2

- (a) (i) From a high power transverse section of a vascular bundle in the stem of a dicotyledonous plant (Fig. 2.1), labelling a phloem cell was generally well done despite the occasional confusion with the xylem vessels.
- (ii) The three xylem vessels highlighted in Fig. 2.1 were well drawn by the majority of candidates and this included a large drawing with a clear outline of all three cells which were linked together and in correct proportion. Only the best answers additionally included a double line around each cell to represent the cell wall.
- (b) Candidates who performed well included a clearly drawn line across cell **K** within Fig. 2.1, plus a line indicated across their drawing of cell **K** which represented its maximum diameter. This was followed by candidates correctly calculating the magnification by dividing the measurement given on the drawing by that given on Fig. 2.1 and allowing for the x240 magnification shown on the figure. Weaker answers not only showed incorrect calculations but also no allowances were made for the x240 magnification.
- (c) (i) In a theoretical exercise investigating the strength of plant fibres, which are mainly composed of xylem vessels, candidates were asked to construct a bar chart from data given in Table 2.1. The best answers showed the correct orientation of the X axis (mass/g) and Y axis (plant fibres, with names inserted in the middle of the bars) and with correct plots represented by ruled columns of equal width. The bars also filled at least half the grid and the scale along the Y axis was linear. Candidates who performed less well reversed the axes, often without units, and produced graphs with bars of unequal width that occupied less than half the grid.
- (ii) Calculations from data in Table 2.1, to show how many times the jute is stronger than the nettle fibre, were generally well done with the value for jute being divided by that given for nettle producing a magnification of x 4.8.
- (iii) When asked to suggest one feature of plant fibres that could affect their strength, correct answers mentioned the diameter or thickness of the fibre or the presence of lignin or cellulose. Weaker responses ignored these features and incorrectly referred to surface area or water.

Question 3

- (a) When asked to complete Table 3.1 to compare the features of the seedlings shown in Fig. 3.1, the majority of answers were very well attempted with candidates carrying out first class comparisons. These included observations that leaves in the dark are either undeveloped, small and pale coloured, compared with those in the light with developed, large and dark coloured leaves. Correct comparisons of the stem showed that in the dark this is tall and long compared with short and dwarf-like in the light. Roots on the other hand are narrow / thin and straight when grown in the dark as opposed to wide, thick and bent / curled in the light.
- (b) Only a minority of first class answers explained how variables need to be controlled in an investigation to show how temperature influences seed germination. Correct responses indicated that cress seeds of the same type / batch / age or number should be grown in similar containers under the same external conditions for a similar length of time. Candidates who did not perform well ignored the idea of control altogether and focused on seeds being germinated in darkness for comparison with those germinated in sunlight or compared germination of seeds in warm and cold ventilated rooms.

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 doing well included, in **Question 1**, a clear understanding that, when investigating the effect of body shape on heat loss from the body of an animal, heat loss, measured as a decrease in temperature, will be related to surface area or to surface area : volume ratio. In **Question 2**, key requirements included an understanding of how to calculate the area of the lower surface area of a dicotyledonous leaf and to explain how the features and positions of palisade cells and xylem vessels within the leaf are related to their respective functions of photosynthesis and support.

General Comments

The questions tested the ability of candidates to follow instructions and 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.

Comments on Specific Questions

Question 1

- (a) (i)(ii) Candidates were asked to measure and record water temperatures in two differently-shaped containers every two minutes for a total of 8 minutes. The best answers not only completed headings within Table 1.1, but also recorded the initial temperatures within the containers. Then 5 recordings were made for each of containers **A** and **B** with both likely to show decreasing temperatures. In weaker answers, headings in Table 1.1 were either omitted or wrongly completed.
- (b) The majority of candidates correctly recorded and calculated the total decreases in temperature, although some candidates misunderstood the question and added up all the recordings.
- (c) (i) When constructing a graph to display their results, first class responses showed correct labelling of axes, with units, with time on the X axis and temperature on the Y axis. Two continuous lines or smooth curves or lines of best fit, both correctly identified, were drawn between all points plotted. Weaker answers lacked fully labelled axes and lines were poorly drawn and not identified.
- (ii) The best responses described the decrease in temperature in both containers and then provided a comparative statement describing the rate in temperature drop being greater in one container, especially at an early stage in the experiment. Many answers highlighted a decrease but without any reference to temperature or heat loss and simply stated that the contents of container **A** evaporated more than **B**, or vice versa.
- (iii) When asked to explain why the shape of a container influences heat loss, excellent answers showed that the container with the larger surface area or a surface area : volume ratio loses more heat. This conclusion was supported with data obtained earlier in (a) or with reference to radiation / evaporation / convection / conduction. Many incorrect responses did not relate the shape of the container with surface area but instead focused on the size of the container.

- (d) Identifying three factors that should be kept constant under experimental conditions was rarely achieved. The best responses did suggest that environmental / room temperature was essential together with the volume / mass of water used and the glass or plastic material used in the manufacture of the containers. There were occasional and correct references to times at which temperature was measured or that the same type of liquid should be used in the containers. In weaker answers, factors such as light intensity, atmospheric pressure or humidity were highlighted but these factors would have little influence on the present investigation.
- (e) Excellent answers given in (d) were frequently followed in this section by candidates suggesting and explaining improvements that could be undertaken in the investigation. These included the use of digital thermometers to increase precision or accuracy or using two thermometers to produce simultaneous readings. Other valid responses included maintaining external conditions by screening to prevent heat loss and/or to undertake more frequent monitoring to provide clear trends in their graphical representation. Occasionally replication was suggested to improve reliability but without reference to means / averages being calculated. Those candidates who were unable to critically suggest practical methods and potential improvements to their investigation confined their responses to stirring the thermometer or cleaning the containers, both of which would have little or no effect.

Question 2

- (a) (i) Candidates were provided with a fresh, green, oval-shaped dicotyledonous leaf to explain how they might identify the lower compared with the upper surface of the leaf. The best answers referred to the presence of prominent veins or that the lower surface is lighter (light green) in colour or less waxy. Some candidates, on the other hand, had clearly misinterpreted the question by describing how the lower surface could be examined using a hand lens or light microscope, primarily to highlight the number of stomata present.
- (ii) Candidates were asked to make a large labelled drawing of the lower surface of the leaf and those who performed well produced large clear drawings with a realistic shape, no shading and with veins and a midrib drawn. Appropriate labels included the leaf stalk / petiole, midrib / main vein, blade / lamina and cuticle. Weaker attempts included small drawings with poor quality lines and shading, together with incomplete or confused labels such as the root or stem for the leaf stalk.
- (b) (i) The majority of candidates successfully completed a clear outline of the leaf, drawn on the grid provided.
- (ii) An explanation of how to calculate the surface area of the leaf within the outline in (i) was generally confused except for some excellent answers which identified both completely covered and partially covered boxes within the grid.
- (iii) From the explanation given in (ii), the best answers showed correct calculations of the area of the lower leaf surface with precise workings indicated. These included ticks, numbers or shaded areas in relevant positions on the grid.
- (c) (i) The best answers correctly labelled a palisade cell or xylem vessel on Fig. 2.1. In some less satisfactory answers, the palisade cell was shown as an epidermal cell or a parenchyma cell below the midrib, whereas the xylem vessel, on occasions, was incorrectly positioned above or below the midrib.
- (ii) In general, candidates answered this question well, with excellent responses linking the presence of chloroplasts / chlorophyll for photosynthesis in palisade cells and the presence of thick / lignified walls for the strengthening of xylem vessels.
- (iii) An explanation as to how the position of either palisade cells or xylem vessels in the leaf is related to the stated function in (ii) was less well attempted. The best answers included reference to the palisade cell being positioned near the upper surface to absorb light for photosynthesis and the xylem vessels being centrally positioned in the midrib / veins to prevent collapse. Weaker responses did not consider the position of these cells in the leaf but once again described function by referring to gaseous exchange for palisade cells or water / mineral transport in xylem vessels.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key Messages

This paper tests the ability to use a range of practical skills so candidates should have experience of a variety of practical work, including biological tests and experimental design. In particular, candidates should be familiar with the concept of variables and the reasons why they should be controlled. Candidates should use precise terminology such as *mass* and *volume*, rather than *amount* or *quantity* when describing measurements or listing the variables to be controlled.

All the information provided with each question should be read thoroughly as this information may be necessary for answering the questions that follow. This includes information provided with Figures, such as the magnification of a specimen. Where the measurement of a specimen is required, a line should be drawn to indicate where the measurement has been taken.

General Comments

The majority of scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written. Candidates should ensure that any alterations to answers are clearly legible, i.e. not written on top of their original answer.

It is important that candidates understand the differences between the meanings of key terms used in the questions, such as *describe* and *explain*.

Comments on Specific Questions

Question 1

This question was about an investigation into the effect of two solutions, ethanol and sucrose, on the respiration of yeast.

- (a) Candidates were asked to complete the headings in a partially completed table of results. The majority of candidates correctly wrote **A** and **C** for the column headings, but many did not complete the 'time' box at all. Of those that did, many omitted 'minutes' or wrote 'time taken' which was incorrect. A small number of candidates incorrectly used 'm' as the abbreviation for minutes.
- (b) This part of the question required further completion of the results table using data that had been provided. A number of candidates omitted the zeroes at the start of each column. Although column **C** was the column most often completed correctly, a significant number of candidates did not look at the way the data had been presented and added 10, 15 and 22, which was incorrect.
- (c) (i) Many candidates noted the very slight movement of the meniscus in **B** but did not always relate it to a low rate of respiration by the yeast. A common explanation given was that ethanol is a product of fermentation and therefore will not affect the movement of the meniscus. However without reference to the inhibitive effect of the ethanol on the yeast, this was insufficient to gain credit.

Some did not appear to understand the difference between a description and an explanation and merely re-stated the results from Table 1.1 as the explanation, which was not creditworthy.

- (ii) Many candidates noted the greater movement of the meniscus in **C** but did not always relate it to increased respiration or the increased availability of substrate. Again, there appeared to be a lack of understanding about the difference between a description and an explanation.

(iii) Many candidates correctly stated that syringe **A** was included in this experiment as a control. In better answers, candidates went on to explain that the control could be used as a comparison with **B** and **C**.

(d) Candidates were asked to name two variables that were kept constant during the investigation. The best answers were specific – clearly describing a controlled variable, such as volume of the active yeast mixture. Some candidates simply wrote the word volume without specifying of what, which was not creditworthy.

A significant number of candidates wrote that temperature was controlled in this experiment although there was no reference to temperature in the introduction and thus this could not be credited.

A significant number of candidates continue to use the word ‘amount’ instead of ‘volume’. It should be noted that this is not creditworthy as candidates are expected to demonstrate knowledge of correct terminology when describing how to measure quantities of different substances.

(e) Candidates were asked to describe a test for carbon dioxide. This was generally well answered. Most candidates knew that carbon dioxide turns limewater white / milky. Some gave unnecessary details of experiments involving the production of carbon dioxide which was then tested.

A small number of candidates described the wrong test or left this question blank.

Question 2

(a) (i) Candidates were asked to draw a label line and label a phloem cell on Fig. 2.1. Many candidates could not identify the phloem and in some instances the labelling line was not clearly drawn. A few candidates misread the question and drew something in the space below.

(ii) Candidates were asked to make a large drawing of the three xylem vessels shown in the box. The best drawings were large and clear - drawn with clean, continuous lines and attention to detail. In some cases the proportions of the three cells were not accurately represented and only a few candidates used double lines to indicate the cell walls.

(b) In this part, candidates were required to measure cell **K** and use this measurement to calculate the magnification of their drawing compared to the actual size of cell **K**. Some candidates answered this question well and gained full credit. A significant number of candidates incorrectly measured the longest length across all three cells instead of only cell **K**.

The majority of candidates knew that the measurement of the drawing should be divided by the Fig. 2.1 measurement, although many omitted to take the magnification of Fig. 2.1 into consideration. Most candidates were able to calculate and express the answer correctly although a few expressed the answer with units that were irrelevant or with too many decimal places.

(c) (i) There were some very good bar charts with many candidates gaining maximum credit. There were a few instances where one or more plots were incorrect, but most candidates drew neat columns with a ruler.

The most common mistakes occurred with the labelling of the axes, which were sometimes incomplete (no ‘plant fibre’ on the x-axis or ‘g’ on the y-axis), or (in the case of the y-axis), had a non-linear scale. It should be noted that a clear indication of the start of the scale is required.

(ii) In this part of the question candidates were asked to calculate by how many times the jute fibre is stronger than the nettle fibre. The majority of candidates were able to calculate this correctly. The most common error was to subtract 600 from 2900. A few did not follow the instruction to express their answer to one decimal place.

(iii) Many candidates were able to suggest a feature of plant fibres that could affect their strength. Some common incorrect answers referred to water content and / or turgidity.

Question 3

- (a) Candidates were asked to compare three named features of seedlings grown in the light and in the dark. The majority of candidates made good observations that were well expressed. A few candidates gave answers that were not comparative, e.g. describing the leaf as pale as opposed to spread out.
- (b) In this question candidates were asked to design an investigation to show the effect of temperature on the germination of cress seeds. There were some excellent answers and many candidates clearly demonstrated an awareness of the need to control variables to ensure the validity of the experiment.

The best answers suggested a number of variables that could be controlled and described how these should be measured, e.g. the same light *intensity*, the same *volume* of water, or suggested an appropriate value, e.g. add 50 cm³ of water to each sample of seeds. Some candidates wrote in very general terms that were not creditworthy, e.g. using *amount* instead of *volume*.

As the experiment was investigating the effect of temperature on the germination of the seeds, credit was given for suggesting that samples of seeds should be planted in a suitable substrate and left to germinate at different temperatures. Many candidates suggested that some seeds should be placed in hot conditions and others in cooler conditions and while this was creditworthy, better answers were more specific and stated an appropriate range of temperatures to use, e.g. 10, 20 and 30 °C.

A number of candidates described experiments on growing seeds in the light and in the dark, suggesting that light is equivalent to warmth, and dark to cold. This was not creditworthy.

Many candidates suggested using only one seed in each experiment, i.e. one in a warm environment and one in a cool environment. Whilst this is acceptable, better answers demonstrated an understanding that a number of seeds should be used, or replicates of the experiment carried out (with a mean calculated if appropriate) to ensure reliability.

Some did not understand the question and wrote about experiments they were familiar with, which resulted in some answers that suggested that some seeds should be boiled and others not boiled, as germinating seeds produce heat. Alternatively, some candidates wrote about the effects of light and dark conditions or warm and cold temperatures on the growth of plants generally, with no experiment described.

In many cases, growth and germination were used interchangeably resulting in some candidates incorrectly planting seedlings instead of seeds.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key Messages

Candidates should read questions very carefully in order to identify precisely what is required in their response, for example whether a description or an explanation of what has been observed is being asked for.

Candidates are becoming more precise in their terminology, e.g. referring to volume or mass rather than amount or quantity where appropriate.

In drawings, candidates should pay attention when observing detail and label only structures that are visible in their drawings.

General Comments

The majority of candidates expressed themselves well and their writing was clearly legible.

There was no indication that candidates had insufficient time to answer all the questions set.

There were very few instances of candidates not attempting a response to a question.

Comments on Specific Questions

Question 1

- (a) This was generally well answered. The most frequent errors concerned the completing of the top left hand box of Table 1.1. Instead of correctly inserting time /minutes, a few candidates left this blank or recorded time /m. Others included no units with time, or recorded only minutes with no time. Some recorded time /seconds although there had been no attempt to change the time measurements in the table from minutes to seconds. Some referred to time taken as though that had been the quantity under investigation rather than a given. Very occasionally the thermometer in **B** was read incorrectly, e.g. as 59 °C, or 54 °C was incorrectly expressed as 50.4 °C.
- (b) The question asked for the overall decrease in temperature to be calculated which many candidates did correctly by subtracting the final temperature of the water in each container from the initial temperature. Some candidates, however, added together the five temperatures recorded for a container and calculated the mean temperature, which was not asked for.
- (c) (i) There were many excellent graphs drawn, with time /minutes (the independent variable) on the x-axis and temperature / °C (the dependent variable) on the y-axis, and both axes fully and correctly labelled. A significant number of candidates failed to include a scale break or to label the y axis origin when their scales did not start at zero. The plotting of points was done well and the neatly drawn lines were usually identified as **A** and **B**. Most candidates plotted the actual temperatures recorded showing the decrease in temperature of the water over the eight minute period. A few candidates plotted the cumulative decrease in temperature, i.e. **A** 0, 10, 15, 19, 25; **B** 0, 7, 11, 15, 18, which was also acceptable. Occasionally a candidate incorrectly constructed two scales from 0 to 8 on the x axis and plotted lines **A** and **B** separately, or constructed a y-axis for plotting **A** on the left hand side of the grid and for **B** on the right hand side. Only a few candidates drew bar charts, which had not been asked for.

- (ii) Most candidates gained full credit here by describing the faster or greater loss of heat in container **A** as compared to **B**. A few candidates correctly described that in both there was the greatest rate of temperature decrease in the first two minutes. There were some candidates who did not describe the results, i.e. what they had observed in the data they had been handling, but attempted to explain the results which was not asked for in this question.
- (iii) The candidates were given a general statement of fact - that the shape of a container **does** affect the heat loss from that container. A few candidates, in suggesting an explanation for this, actually stated that the shape does not affect heat loss although they had been told that it does. Those candidates who did attempt an explanation often did so in terms of height, length or width of the container without making the necessary link with the surface area of any container being important in relation to the heat lost from it. Some candidates correctly identified the way in which heat may be lost.
- (d) Candidates had been presented with information about the method used in the investigation. Many used this to identify that care had been taken to ensure that certain factors had been kept constant, e.g. the containers were of the same volume or the same volume of water was added to each; the containers were made of the same material, plastic; the temperature of the water added to each container was 65°C and that the temperature of the water was measured at two minute intervals for both containers. Often imprecise answers were given which could not be credited, e.g. volume (of what?), temperature (without stating that it was the same only initially). Some candidates incorrectly stated that the shape of the containers was a constant despite two different shapes being described and illustrated. A significant number of candidates recorded factors that they thought should have been kept constant, e.g. room temperature, humidity and light, which could not be credited as they had not been included in the given description of the experiment's method.
- (e) This proved a challenging question for many candidates. Often extensions to the investigation in terms of using more containers or recording temperatures for a longer period of time were described and explained. As the question asked for improvements to the actual method used these could not be credited. Good answers were in terms of measuring the temperature at shorter time intervals, ensuring that the external conditions were exactly the same for both containers, using a more sensitive means of measuring the temperatures or that the investigation should have been repeated and the mean temperatures at the two minute intervals calculated. It should be noted that there is no point in repeating an investigation if the mean values of the results are not obtained. Those candidates who described creditworthy improvements often found it difficult to explain what the benefits of the improvement would be. Many referred incorrectly to obtaining mean values making the results more accurate; the mean value, in fact, makes the results more reliable. The use of more sensitive temperature-measuring devices would make the results more accurate.

Question 2

- (a) (i) Many candidates knew that the number of squares covered by the leaf should be counted in order to determine its surface area. Answers that could not be credited related to multiplying the height of the grid by its width, which would give the total surface area of the grid, not of the leaf.
- (ii) Candidates who had correctly described how to calculate the surface area of the leaf were often able to do the calculation successfully. Some gained credit in showing the method of their working although the final answer was too inaccurate.
- (b) The outlines of most drawings were clean and clear and the drawings were almost always of a size larger than the leaf shown in Fig. 2.1. Because the midrib was a significant structure it should have been represented with a double line, drawn freehand, not ruled, and showing that the tapering towards the apex of the leaf had been observed. The labelling of the drawings was generally not well done. It was expected that candidates would be able to identify structures such as the midrib, veins, petiole (leaf stalk) and lamina. Labels of microscopic structures which cannot be seen in the figure, e.g. stomata, were not creditworthy. A significant number of candidates omitted labels altogether.
- (c) (i) More candidates correctly identified a palisade cell than a xylem vessel.

- (ii) Candidates were asked to describe a feature of a palisade cell that is related specifically to its function of carrying out photosynthesis and many were able to state that the cell contains chloroplasts or chlorophyll. Fewer were able to correctly relate the structure of a xylem vessel to its supporting function.
- (iii) For each of the named cells, both its position in the leaf and how that position relates to the function stated was required. For the palisade cell, some reference to being in the upper part of the leaf or below the upper epidermis was needed as well as a reference to more light being available (for photosynthesis). Some stated only the position or the absorption of light. Not many candidates were able to relate the position of the xylem to its supporting role, referring instead to the transport of water, which could not be credited.

Question 3

- (a) Many candidates were familiar with the tests for reducing sugar, protein and starch. However, comparatively few took note of the conclusion to the Benedict's test being that only a trace of reducing sugar was present. This means that the final colour of the reagent would not have been orange or red but green. Many candidates correctly identified that the final colour for a positive biuret test is mauve, lilac or purple. A significant minority of candidates was unable to state the initial colour of iodine solution, often recording it incorrectly as blue or red. A few even incorrectly stated that the final black colour indicated that starch, or fat, was absent instead of present.