# BIOLOGY

**Paper 5090/11**
**Multiple Choice**

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

## General Comments

Most candidates show a good understanding of human biology, as well as of cells and ecology. Where there is a weakness, this is often in the area of plant biology.

## Comments on Specific Questions

**Questions 8, 11, 16, 20, 24, 27, 28, 29, 31, 35**

These questions were answered correctly by the great majority of candidates.

**Question 5**

Candidates knew that chloroplasts contain large amounts of magnesium. Candidates who performed less well forgot that chloroplasts produce oxygen in the light.

**Question 7**

Fewer than half of candidates realised that the guard cells (as opposed to the epidermis as a whole) contain chloroplasts, although the mesophyll was known well.

**Question 13**

Candidates correctly identified the aorta as carrying blood at high pressure. However, they did not always realise that the pulmonary artery contains blood at a higher pressure than in the veins.

**Question 14**

There was some confusion between atria and ventricles.

**Question 15**

Candidates were able to identify the hepatic portal vein, but some did not know that this vessel carries deoxygenated blood.

**Question 17**

This question (about the intercostal muscles) proved challenging to many candidates.

**Question 23**

Fewer than half the candidates understood why glucose appears in the urine of diabetics.

**Question 26**

A common misconception was that bacterial cells contain nuclei.

**Question 32**

This question required some care in reading the graph. A majority of candidates picked the low point on the oxygen curve as the place where sewage is discharged, but they did not take into account that this low point occurs after the oxygen concentration has started to fall and therefore after the point of sewage discharge.

**Question 37**

Candidates were often unclear about the meaning of the term ‘heterozygous’.

# BIOLOGY

**Paper 5090/12**
**Multiple Choice**

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

## General Comments

Most candidates show a good understanding of human biology, as well as of cells and ecology. Where there is a weakness, this is often in the area of plant biology.

## Comments on Specific Questions

**Questions 1, 6, 9, 10, 11, 12, 16, 20, 23, 29**

These questions were answered correctly by the great majority of candidates.

**Question 5**

Candidates knew that chloroplasts contain large amounts of magnesium. However, candidates who performed less well forgot that chloroplasts produce oxygen in the light.

**Question 7**

Fewer than half of candidates realised that the guard cells (as opposed to the epidermis as a whole) contain chloroplasts. The mesophyll was known well.

**Question 8**

Some candidates confused the terms *assimilation* and *absorption*.

**Question 13**

Candidates correctly identified the aorta as carrying blood at high pressure. However, they did not always realise that the pulmonary artery contains blood at a higher pressure than in the veins.

**Question 14**

There was some confusion between atria and ventricles.

**Question 15**

Candidates were able to identify the hepatic portal vein, but some did not know that this vessel carries deoxygenated blood.

**Question 17**

This question had a mathematical element, and some candidates found this challenging.

**Question 19**

A common error was the belief that the dialysis fluid contains protein and not salts.

**Question 21**

Some candidates did not distinguish between neurones and motor neurones.

**Question 32**

Option A was the most popular incorrect answer here. Candidates were perhaps attracted by the term ‘algal bloom’.

**Question 33**

The details of plant fertilisation were not well known.

# BIOLOGY

**Paper 5090/21**
**Theory**

## Key Messages

Candidates should note that when questions ask for a specific number of examples, that number should not be exceeded.

## General Comments

There were some excellent answers and it was noted that many candidates showed a good understanding of biological principles. The basic biological information was well known, although some candidates found difficulty in applying this information to novel situations. Other candidates did not give precise examples, e.g. reference to 'food' or 'gases' or 'protection' without the necessary detail. Most candidates presented their work well but it is recommended that, for clarity, those who wish to alter their answers should cross out the word or number and then rewrite it.

## Comments on Specific Questions

***Section A***

**Question 1**

**(a)** The majority of candidates correctly identified the capillary and the sweat gland. Some candidates incorrectly labelled the sweat duct as the gland.

**(b)** An answer comparing environmental conditions A and B was required, so the answer 'warm' unqualified did not gain any credit.

**(c) (i)** It was expected that candidates would state two differences which were visible on the diagrams. Most chose the presence of sweat in B and the difference in size of the capillaries.

**(ii)** To gain credit, candidates were asked specifically to relate the advantages to the answer they gave in **(c)(i)**.

**Question 2**

**(a) (i)** Candidates who incorrectly calculated their answer were given partial credit if correct working was clearly shown.

**(ii)** The question asked for the name of the blood vessels supplying blood to the kidney, so 'renal arteries' was the only correct answer.

**(iii)** This was answered correctly by many candidates.

**(b)** Most candidates correctly identified two parts from Table 2.1. The advantage of the increased blood supply had to be related to either the increased supply or removal of a chemical or to the increased rate of a process. Examples of good answers were: 'By increasing the supply of blood to the heart more oxygen is supplied to the heart muscles to enable them to respire more to release energy'; or 'When more blood runs beneath the skin surface it allows more heat to escape by radiation'.

**(c)** Many candidates identified that there was reduced blood flow to the gut, but did not go on to link this with the effect on digestion and absorption.

**Question 3**

**(a)** Most candidates could name the amniotic fluid but lost the second mark through giving an imprecise answer, e.g. 'protection', which needed further qualification.

**(b) (i)** Some candidates were confused and labelled the umbilical cord or the amniotic fluid instead of the placenta.

**(ii)** This was well answered by many candidates.

**(c)** The presence of the Y chromosome was noted by many, although some candidates confused genes and chromosomes in their explanation.

**(d) (i)** Reference should have been made to both the number and position of the chromosome. An example of a good answer was: 'Chromosome 21 does not appear paired, there are three different chromosomes'.

**(ii)** This was correctly answered by most candidates.

**Question 4**

**(a)** A good definition was given by most candidates, although a few simply stated that drugs were 'illegal substances'.

**(b)** The organs were nearly always correctly identified. The effect of heroin on the brain was rarely correctly stated.

**(c) (i)** This question was well answered.

**(ii)** Most candidates referred to a lower birth weight. Other correct effects on a young baby were credited, but references to effects on an adult were not.

**Question 5**

**(a) (i)** Most candidates answered the trophic levels correctly and knew that the element being cycled was nitrogen.

**(ii)** An answer such as 'The fish benefits from the dissolved oxygen' did not score the second mark as there was no explanation of why the oxygen was required. Candidates who referred to 'production of energy' rather than 'release of energy' did not score the second mark.

**(b) (i)** Decomposition was usually correct for process X, but answers for process Y were very varied and covered all aspects of the nitrogen cycle.

**(ii)** Most candidates answered this question correctly.

**(iii)** Some good answers were seen such as: 'They do this by active transport. The nitrate ions are absorbed into the root hairs of the plants against the concentration gradient'.

**(c)** This was well answered. A good response was 'Algae will multiply rapidly on the surface of the water. This blocks light from reaching the aquatic plants. The aquatic plants will die and so the fish will also die through lack of oxygen'.

***Section B***

**Question 6**

**(a) (i)** Most candidates correctly identified the villus and its position in the alimentary canal.

**(b)** Some excellent answers were seen with the candidates describing both the adaptations and their relevance to efficient functioning of the system. Examples of good sentences used in the answer were: 'The villi increase the surface area of the gut for absorption of digested food. Many capillaries are in this structure to transport glucose and amino acids to the liver. The villi have thin walls for the easy diffusion of dissolved substances'.

**Question 7**

**(a) (i)** Candidates found this question challenging. Good answers should have contained references to the position and relative numbers of chloroplasts within the tissues of a dicotyledonous leaf, and linked this to the benefits for photosynthesis. An example of a good answer was: 'There are more chloroplasts in the palisade layer than the spongy mesophyll. The palisade cells are found on the upper side of the leaf which enables the chloroplasts to capture more light energy'.

**(ii)** Many candidates made reference to the stomata, but ignored the mesophyll cells. Reference should have been made to the mesophyll's large surface area or moist surface to enhance gas exchange to gain full credit.

**(b)** Candidates found it very difficult to describe the distribution of the xylem and phloem in words. Those who drew accurate, labelled diagrams gained credit. Some candidates' diagrams lost marks as the tissues were not labelled and they omitted to say which was a root and which a stem. Most candidates gained a mark for naming the two tissues 'xylem' and 'phloem'.

***Section C***

A few candidates answered both questions in this section. They do not gain any benefit from doing so and should be reminded to answer **either** question 8 **or** question 9, as stated on the front of the question paper and at the start of Section C.

**Question 8**

**(a)** It was expected that the external features of the fruit or seed would be appropriate for the named example chosen. Examples from around the world were equally acceptable, e.g. *Tridax* or *Jacaranda*. An example of a good answer was: 'The sycamore seeds have two wing-like structures which reduce the speed at which the sycamore seed falls. This enables it to be directed by the wind away from the parent plant towards a place where it can thrive, without excess competition from the parent for nutrients and water'.

**(b)** Two environmental conditions were required and some candidates gave more than two. The 'importance in germination' needed to relate to the environmental conditions stated.

**Question 9**

**(a)** Candidates answered the temperature and humidity sections very well. For an increase in light intensity, many stated that the light increase would equate to a rise in temperature but did not mention the change in guard cells or size of the stomatal pores.

**(c)** Candidates found it difficult to tailor their knowledge to answer this question, and so generally did not score well.

# BIOLOGY

**Paper 5090/22**
**Theory**

**General Comments.**

Candidates found **Questions 4**, **6 and 8(b)** to be the most challenging.

More candidates chose to do **Question 9** over **8**. The quality of the answers to the optional questions was higher than in previous years.

The standard of English and legibility of the writing was good in most cases. Careful analysis of the question prior to answering was not obvious in some cases. Few found it necessary to use additional sheets and managed to complete the responses in the spaces provided. A few candidates tried to squeeze sentences between lines often making them illegible.

The time available seemed adequate, as there was no evidence to the contrary.

**Comments on Specific Questions**

***Section A***

**Question 1**

**(a)** Glucose was often named but a product rather than a substrate was frequently paired incorrectly. Yeast was also seen, despite the question requesting a chemical constituent.

**(b)** The majority gave a correct temperature and with units. A few gave 38.5, having read off the *y*-axis.

**(c)** The most common error was to describe the line rather than to explain its shape and so failing to refer to rate. The word ‘denatured‘ was frequently used incorrectly, with yeast being denatured and the enzyme being killed. The former was more popular.

**(d)** The answers were split 50:50 with those that clearly understood that the situation was irreversible and those that thought yeast cells could be resurrected.

**Question 2**

**(a)** The full range of possible pollination methods was seen. A significant number of candidates gave ‘wind’ as their response and also described features that were not shown in the diagram .

**(b) (i)** The most common incorrect answer was ‘tree roots’.

**(ii)** Some candidates appeared not to have read the question carefully, as they gave ‘water’ and not a nutrient as their response.

**(c)** The common mark point to be missed was the CHO obtained from the other organisms or the fact that they cannot make CHO. Many candidates understood the point but referred only to ‘food’.

**Question 3**

**(a) (i)** This part was answered.

**(ii)** The most popular trio of substances named were $CO_2$, urea and glucose.

**(b) (i)** Candidates described the glycogen to glucose conversion but generally ignored references to adrenaline stimulating glucagon.

**(ii)** A wide variety of acceptable situations were provided.

**(c) (i)** A large number of candidates knew the signs and symptoms of diabetes, with a few stating obesity and clearly confusing causes with symptoms.

**(ii)** This was well answered.

**Question 4**

**(a) (i)** Most candidates understood the term genotype.

**(ii)** Some candidates appeared to not read the question carefully. Having asked for alleles in the gametes, candidates should have realised they would be haploid. The majority incorrectly gave the possible genotypes of a woman who can smell the flower.

**(b)** A range of answers were provided to this question. Some candiates copied the diagram from above either for both sexes or for just the male but then failed to label the Y chromosome. Of those that did manage the rectangle and diamond, very few shaded one.

**(c)** Radiation was the most common correct answer; few just said chemicals.

**(d)** Candidates found this question challenging and many responses did ot address the question. There was some clear misunderstanding of the term dominant, with such expressions as ‘recessive alleles in the parents becoming dominant in the children.’ There was also the confusion between gene mutation and chromosome mutation, leading to Down’s Syndrome.

**Question 5**

Throughout this question about water and its role in the body, there was continual confusion between the role of sweat in temperature regulation and the role of urine in excretion. Comments like ‘urine contains all the sweat in the body’ and ‘urine helps us lose heat from the body’ were often seen.

**(a) (i)** This was often mathematically correct but lacking units.

**(ii)** Candidates found this question challenging. Very few answers included the idea that the water came from the alveoli and would evaporate. Most thought it was there because it had been inhaled. There were some who thought that ventilation was a form of temperature or water control.

**(b)** Many candidates scored highly here but the water being absorbed into the blood was very rarely seen.

**(c)** Most candidates missed the point of water being a solvent, but often named a solute. Some were clear that it would be painful to excrete without the water but could not quite make the leap to solvent or dissolving.

**(d)** Respiration mark was almost always given but a few excretion comments were incorrectly made.

***Section B***

**Question 6**

**(a)** Occasionally pollination was confused with fruit and seed dispersal. Some responses gave a mix and match approach, naming one edible fruit but then going onto talk about hook and clinging to fur. There was the misuse of the term excretion, when referring to faeces.

**(b) (i)** Candidates tended to know the conditions for germination, although often gave vague comments about soil/environmental conditions. Too many thought that they would not grow because of lack of nutrients. A few recognised they may be in dormancy.

**(ii)** A large number of answers were about seeds instead of seedlings. Many candiates recognised there would be overcrowding and so competition for light, nutrients and water but few mentioned other means of meeting their demise. Candidates would be well advised to always consider possible answers in their widest respect.

**Question 7**

Generally the whole of this question was well answered by candidates.

**(a) (i)** The definition of active transport was well known, although a few talked about from 'low to high concentration' but then followed it with 'down a concentration gradient'. Candidates would be well advised to avoid tautology and so not make such a mistake. The need for a cell/living membrane was rarely seen.

**(ii)** The definition of osmosis was also well known. There was the occasional mistake where the candidate included movement of other substances.

**(b)** A number of scientific inaccuracies were seen with red blood cells having vacuoles. Candidates would be well advised to check back with the question once they have completed their response.

***Section C***

**Question 8**

About a third of the candidate made this choice.

**(a)** This was well answered. Candidates understood that bacteria and milk makes yoghurt but rarely mentioned the need for incubation at a suitable temperature. Lactose to lactic acid was given frequently and lead to the coagulation of the protein. Many candidates knew the species names of the bacteria involved, suggesting the topic is taught in detail.

**(b)** The colonisation of a slice of bread by fungi proved more difficult and yet similar questions on decomposition have appeared on recent papers. The idea of spores and of digestion of the starch were rare but a few though that turning green was an important fact. The question was asking candidates to draw from different parts of the specification and they appear to find this difficult. Some 'mental flexibility' exercises would be helpful when preparing for the paper.

**Question 9**

Candidates answered this question well.

**(a)** Many candidates knew this well. They were familiar with the name of the bacterium and also that the symptoms came in different stages, although the latter was not a requirement of the answer. 'Spores/pores' often appeared instead of sores. Some did know the word 'chancre' but then did not add 'on contact part of body'. There were also vague descriptions of skin spots, instead of rash or the disease affecting brain/heart without giving the symptoms. A few were confused with 'the cause' and went on to talk about unprotected sex and promiscuous behaviour.

**(b)** Almost universally correct, with just a few confusing antibiotics with antibodies.

**(c)** This was a well answered question. Some responses included ineffective contraceptives. Abstinence was rarely mentioned, while sex with prostitutes figured frequently. Occasionally a candidate failed to use the negative i.e.not have sex with many people etc.

# BIOLOGY

**Paper 5090/31**
**Practical Test**

## KEY MESSAGE

This paper is designed to test a variety of practical skills, including studying live and photographic specimens, following given instructions, observing events and recording and interpreting data. Candidates should also be able to plan and design an investigation based on what they have done in the laboratory. They need to be clear about the difference between the results of an investigation, i.e. what is observed to happen, and the conclusions that can be drawn from the results.

It is very important that candidates read and follow the question instructions carefully as the marks awarded relate closely to the information given and the latter may well be necessary for answering questions that follow on.

## GENERAL COMMENTS

Marks awarded overall covered the whole range of those available and candidates appeared to have had time to deal with all the question set.

The vast majority of the scripts were clearly legible and answers used the space given on the question paper. Where corrections were made, candidates crossed out the original answer and indicated clearly where the revised one was to be found.

## COMMENTS ON SPECIFIC QUESTIONS

### QUESTION 1

**(a)** The majority of candidates produced large, clear, clean diagrams indicating the testa and cotyledon of the seed accurately. There were some diagrams that were either too small, or sketchy and lacking clear continuous lines. A small minority of scripts contained drawings of both halves of the seed.

**(b) (i)** Nearly all the candidates completed the table very well, giving good observations of what happened in their test tubes. Most commonly, the rate of bubbling or the amount of froth or foam produced was compared over the 2 minute period.

**(ii)** For the most part candidates were able to make the correct conclusions from their table of results, Table 1.1, and this part of the question was well-answered.

**(iii)** Some candidates repeated their answer given in **(b)(ii)** to try to explain the reasons for the larger amount of catalyse found in the cotyledon. It was a common misconception that there is more catalyse to break down the starch food reserve, or other stored food, present in the region. More able candidates had absorbed the information given in the question and realised that catalyse is needed to remove hydrogen peroxide produced in active tissue where reactions are occurring. e.g. respiration. No, or little, activity is seen in the protective seed coat.

**(iv)** Making an improvement to the experiment set out requires enhancing the way that this experiment is carried out, hence repeating or replicating the same procedure is not credit worthy. This was the most common answer given.

Best answers were seen from candidates who realised that temperature needed to be controlled or that the mass or weight or surface area of the cotyledons and testa needed to be the same at the

start. Candidates should be careful to use the precise terminology, rather than amount or quantity, when describing measurements.

Counting bubbles of gas evolved or measuring the depth of foam or froth was recorded by some candidates as part of their earlier observations in Table 1.1, either of these could have been cited as an improvement to the method given in the question.

**(c) (i)** Almost all candidates added iodine solution to the seed parts to test for starch. Sometimes they needed to make it more clear that the tests were carried out separately on the testa and cotyledon regions.

**(ii)** Many candidates gave the results of their tests, but it was the conclusions of more starch in the cotyledons and less or no starch in the testa which were credit worthy.

**(d) (i)** The majority of graphs drawn were accurate, clearly and neatly constructed and showed very good use of the grid provided. In the best scripts the plotting points were clear without being too large. The points needed to be joined by ruled and straight lines, some of the candidates lines were not clean and clear and some were too thick. Axes were sometimes oriented incorrectly or not fully labelled. The plotting points were sometimes linked with a line of best fit which is not accurate for this graph.

**(ii)** With an accurately plotted and drawn graph most candidates obtained the correct answer of 2.5 arbitrary units for amylase activity after 5 days of germination. A few candidates read the graph from the wrong side of day 6 and thus gave an incorrect answer for activity after 7 days of germination. Where candidates had made plotting errors allowance was made for a reading after 5 days of germination that related to the graph drawn.

**(iii)** The role of amylase in germinating barley grains was generally well reasoned, with its involvement in the breakdown of stored starch to maltose being widely quoted. Sometimes amylase was incorrectly seen to be breaking down protein reserve. Some candidates gave a 10 day history of amylase activity during germination taking figures directly from the graph or table and therefore missing the point of the question.

**Question 2**

**(a) (i)** Some candidates showed good evidence on the scripts of having measured the cells in **Fig 2.1** and then calculated the size required for the drawing. Many candidates, however, overlooked that the unlabelled drawing of the two cells should be 2.0 × larger than the cells shown in **Fig 2.1.** The most credit worthy diagrams showed clear, clean and continuous outlines to the 2 cells and to their cell walls, nuclei and chloroplasts; the latter needed to be clearly distinguishable from cytoplasm.

**(ii)** The majority of candidates identified 2 visible features present in **Fig. 2.1** but not present in animal cells; chloroplasts and cell wall being the most common. Vacuole needed to be qualified as large or sap in order to be creditworthy, as animal cells have small vacuoles.

**(b) (i)** A significant number of candidates correctly identified A as a xylem (vessel) with phloem as the most common incorrect response.

**(ii)** The transport of mineral ions and water were very well known as functions of the xylem, as was its role in mechanical support.

**(c)** There were some excellent descriptions of an investigation that the candidate could carry out in a laboratory to show the path taken by water in a cut stem of a plant. Such answers realised the need for the cut stem to have access to water, coloured with a dye, for a stated time so that its path through the stem could be tracked. Since the stain would be deposited in the walls of the elements involved in the pathway of the water, sectioning of the stem at intervals would provide specimens to be examined under a microscope or hand lens. The stain would be seen in these sections and thus the pathway taken by the water identified.

Many candidates described using a potometer to track the movement of water via an air bubble, but this investigates the movement of water along a stem rather than the route taken by water in the stem and so were not credit worthy.

There were also a significant number of descriptive answers, often detailing the pathway taken by water from root hairs to leaves. However, these usually had no reference to an investigation to show the path taken in the stem.

**QUESTION 3**

**(a)** Some candidates correctly identified P as the scapula, Q as the humerus and R as the ulna, the radius was labelled to help in the identification. Some candidates confused forelimb with hind limb and so pelvis, femur and tibia/fibula were common incorrect responses.

**(b)** The hinge joint between the humerus and ulna was very well known. Synovial joint was an acceptable alternative. Ball and socket joint was the main incorrect response.

**(c)** Many candidates scored maximum credit for describing accurately the activity of the antagonistic biceps and triceps muscle pair. The positioning of the muscles in the upper part of the forelimb and their attachment via tendons to the radius (biceps) and ulna/R (triceps) was not always correctly stated. Some candidates were unsure that it is the triceps which pulls on R to extend the lower part of the forelimb as indicated by the arrow on **Fig 3.1**. Weaker candidates gave vague answers relating to the hopping and jumping movements of rabbits with no reference to the detail required by the question.

# BIOLOGY

**Paper 5090/32**

**Practical Test**

## KEY MESSAGE

This paper is designed to test a variety of practical skills, including studying live and photographic specimens, following given instructions, observing events and recording and interpreting data. Candidates should also be able to plan and design an investigation based on what they have done in the laboratory. They need to be clear about the difference between the results of an investigation, i.e. what is observed to happen, and the conclusions that can be drawn from the results.

It is very important that candidates read and follow the question instructions carefully as the marks awarded relate closely to the information given and the latter may well be necessary for answering questions that follow on.

## GENERAL COMMENTS

Marks awarded overall covered the whole range of those available and candidates appeared to have had time to deal with all the question set.

The vast majority of the scripts were clearly legible and answers used the space given on the question paper. Where corrections were made, candidates crossed out the original answer and indicated clearly where the revised one was to be found.

## COMMENTS ON SPECIFIC QUESTIONS

### QUESTION 1

**(a)** The majority of candidates produced large, clear, clean diagrams indicating the testa and cotyledon of the seed accurately. There were some diagrams that were either too small, or sketchy and lacking clear continuous lines. A small minority of scripts contained drawings of both halves of the seed.

**(b) (i)** Nearly all the candidates completed the table very well, giving good observations of what happened in their test tubes. Most commonly, the rate of bubbling or the amount of froth or foam produced was compared over the 2 minute period.

**(ii)** For the most part candidates were able to make the correct conclusions from their table of results, Table 1.1, and this part of the question was well-answered.

**(iii)** Some candidates repeated their answer given in **(b)(ii)** to try to explain the reasons for the larger amount of catalyse found in the cotyledon. It was a common misconception that there is more catalyse to break down the starch food reserve, or other stored food, present in the region. More able candidates had absorbed the information given in the question and realised that catalyse is needed to remove hydrogen peroxide produced in active tissue where reactions are occurring. e.g. respiration. No, or little, activity is seen in the protective seed coat.

**(iv)** Making an improvement to the experiment set out requires enhancing the way that this experiment is carried out, hence repeating or replicating the same procedure is not credit worthy. This was the most common answer given.

Best answers were seen from candidates who realised that temperature needed to be controlled or that the mass or weight or surface area of the cotyledons and testa needed to be the same at the

start. Candidates should be careful to use the precise terminology, rather than amount or quantity, when describing measurements.

Counting bubbles of gas evolved or measuring the depth of foam or froth was recorded by some candidates as part of their earlier observations in Table 1.1, either of these could have been cited as an improvement to the method given in the question.

**(c) (i)** Almost all candidates added iodine solution to the seed parts to test for starch. Sometimes they needed to make it more clear that the tests were carried out separately on the testa and cotyledon regions.

**(ii)** Many candidates gave the results of their tests, but it was the conclusions of more starch in the cotyledons and less or no starch in the testa which were credit worthy.

**(d) (i)** The majority of graphs drawn were accurate, clearly and neatly constructed and showed very good use of the grid provided. In the best scripts the plotting points were clear without being too large. The points needed to be joined by ruled and straight lines, some of the candidates lines were not clean and clear and some were too thick. Axes were sometimes oriented incorrectly or not fully labelled. The plotting points were sometimes linked with a line of best fit which is not accurate for this graph.

**(ii)** With an accurately plotted and drawn graph most candidates obtained the correct answer of 2.5 arbitrary units for amylase activity after 5 days of germination. A few candidates read the graph from the wrong side of day 6 and thus gave an incorrect answer for activity after 7 days of germination. Where candidates had made plotting errors allowance was made for a reading after 5 days of germination that related to the graph drawn.

**(iii)** The role of amylase in germinating barley grains was generally well reasoned, with its involvement in the breakdown of stored starch to maltose being widely quoted. Sometimes amylase was incorrectly seen to be breaking down protein reserve. Some candidates gave a 10 day history of amylase activity during germination taking figures directly from the graph or table and therefore missing the point of the question.

**Question 2**

**(a) (i)** Some candidates showed good evidence on the scripts of having measured the cells in **Fig 2.1** and then calculated the size required for the drawing. Many candidates, however, overlooked that the unlabelled drawing of the two cells should be 2.0 × larger than the cells shown in **Fig 2.1.** The most credit worthy diagrams showed clear, clean and continuous outlines to the 2 cells and to their cell walls, nuclei and chloroplasts; the latter needed to be clearly distinguishable from cytoplasm.

**(ii)** The majority of candidates identified 2 visible features present in **Fig. 2.1** but not present in animal cells; chloroplasts and cell wall being the most common. Vacuole needed to be qualified as large or sap in order to be creditworthy, as animal cells have small vacuoles.

**(b) (i)** A significant number of candidates correctly identified A as a xylem (vessel) with phloem as the most common incorrect response.

**(ii)** The transport of mineral ions and water were very well known as functions of the xylem, as was its role in mechanical support.

**(c)** There were some excellent descriptions of an investigation that the candidate could carry out in a laboratory to show the path taken by water in a cut stem of a plant. Such answers realised the need for the cut stem to have access to water, coloured with a dye, for a stated time so that its path through the stem could be tracked. Since the stain would be deposited in the walls of the elements involved in the pathway of the water, sectioning of the stem at intervals would provide specimens to be examined under a microscope or hand lens. The stain would be seen in these sections and thus the pathway taken by the water identified.

Many candidates described using a potometer to track the movement of water via an air bubble, but this investigates the movement of water along a stem rather than the route taken by water in the stem and so were not credit worthy.

There were also a significant number of descriptive answers, often detailing the pathway taken by water from root hairs to leaves. However, these usually had no reference to an investigation to show the path taken in the stem.

**QUESTION 3**

**(a)** Some candidates correctly identified P as the scapula, Q as the humerus and R as the ulna, the radius was labelled to help in the identification. Some candidates confused forelimb with hind limb and so pelvis, femur and tibia/fibula were common incorrect responses.

**(b)** The hinge joint between the humerus and ulna was very well known. Synovial joint was an acceptable alternative. Ball and socket joint was the main incorrect response.

**(c)** Many candidates scored maximum credit for describing accurately the activity of the antagonistic biceps and triceps muscle pair. The positioning of the muscles in the upper part of the forelimb and their attachment via tendons to the radius (biceps) and ulna/R (triceps) was not always correctly stated. Some candidates were unsure that it is the triceps which pulls on R to extend the lower part of the forelimb as indicated by the arrow on **Fig 3.1**. Weaker candidates gave vague answers relating to the hopping and jumping movements of rabbits with no reference to the detail required by the question.

# BIOLOGY

**Paper 5090/61**
**Alternative to Practical**

## Key Messages

This paper tests the ability to use a range of practical skills. It is important that candidates have experience 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 be encouraged to read the questions carefully to ensure that they answer them fully. Understanding the difference between the meanings of key terms used in the questions, such as *describe* and *explain*, is essential in determining what is required in the answers.

## General comments

There has been a notable improvement in the responses to questions relating to experimental design. To improve further, candidates should use precise terminology such as *mass, length* and *volume*, rather than *amount* or *quantity* when describing measurements or listing variables to be controlled.

## Comments on specific questions

### Question 1

**(a) (i)** Candidates were asked to describe how you would safely test a sample of milk for the presence of reducing sugars. Many candidates knew that Benedict's solution could be used to test for the presence of reducing sugar, and that once added to the test material, it should be heated. The colour change to green, yellow, orange or red was well known but sometimes candidates did not describe the original blue colour of the solution.

The question asked how the test could be carried out safely. Some candidates mentioned the use of a water bath, eye protection or tongs which were credited; others omitted the safety feature.

A few candidates included the use of hydrochloric acid and sodium hydroxide which are used to test for non-reducing sugars, and therefore they did not receive full credit for their answers.

**(ii)** The use of biuret reagent or sodium or potassium hydroxide and copper sulfate solutions to test for the presence of proteins, was correctly described by many candidates. Most also knew that a purple / mauve colour would indicate the presence of proteins but many did not describe the original blue colour of the solution.

**(b) (i)** The transcribing of the figures into the table was well done with the concentrations of calcium chloride solution ranked in increasing order.

In this table, units are included in the headers for the columns and should not be recorded alongside each value entered into those columns.

**(ii)** Candidates were asked to construct a line graph of the data in Table 1.1. In constructing graphs, candidates should note that the independent variable, in this case the concentration of calcium chloride solution / g per $dm^3$, should be plotted on the x-axis. Many candidates incorrectly plotted the dependent variable, time / s, on this axis.

Most candidates made good use of the whole grid, although sometimes axes were not fully labelled with what had been measured and the units used. In the best examples, the points were clear,

without being too large. The majority of candidates plotted all the points correctly and, as instructed, joined their plots with ruled, straight lines.

**(iii)** The vast majority of candidates were able to read the value from their graph.

**(iv)** Better candidates recognised the inverse relationship between the concentration of calcium chloride solution and the time taken for Fromase® to coagulate the milk. Some candidates incorrectly expressed this relationship in terms of the concentration of Fromase® being dependent on the time taken.

**(v)** Candidates were asked to suggest how the test-tubes could be maintained at a constant temperature of 40°C throughout the experiment. The most frequent correct response was to suggest the use of a water bath. Often it was not stated that the water bath, if electric, needed to be set at 40°C, or alternatively maintained at 40°C by frequent measuring of the temperature with a thermometer and topping up with hot water when necessary.

**(c)** Candidates were asked to design an experiment to investigate the effect of pH on the time taken for milk to coagulate using Fromase®. Some good experiments were described in which test-tubes, each containing the same volume of milk with Fromase® and maintained at the same temperature, had solutions of different pH values added to them. The best answers included a suggested range of pH values. The length of time it took for the milk to coagulate in each pH was then measured.

It is important in any reference to experimental procedures to use correct scientific terms for measurements, e.g. volume, mass and not general terms, e.g. amount.

**Question 2**

**(a)** The majority of candidates followed instructions and drew only the cells P and Q. The better responses demonstrated a good biological drawing technique using a sharp pencil to draw clear continuous lines with no shading.

It was expected that the instruction to make drawings 3 x larger than the cells shown in Fig. 2.1 would be followed, but some candidates did not follow this instruction.

While many candidates observed and drew chloroplasts in the cells, very few observed and drew the cell walls.

**(b) (i)** Candidates were asked to describe how the rate of transpiration changed during the experiment. There were some good descriptions of the transpiration rate increasing up to 25 g/hr at 1400 and then decreasing. Some candidates attempted explanations for these changes in terms of increasing temperature even though explanations were not asked for. Other responses lacked reference to the data which the question required.

**(ii)** Many candidates correctly realised that the change in the rate of transpiration could be calculated by subtracting the rate at 0800, i.e. 2 g/hr, from the rate at 1400, i.e. 25 g/hr. However, in recording the value, often units were not given. As no units were given on the answer line, units were required for full credit.

**(c)** A number of creditworthy methods for showing that the liquid was water were described. Some candidates suggested using white anhydrous copper sulfate turning blue, some suggested blue cobalt chloride turning pink whilst others determined that the boiling point of the liquid was 100°C. In describing such a test, it is important to include full details of the colour change if appropriate, i.e. the starting colour and the final positive result colour.

**Question 3**

**(a) (i)** Many candidates measured the width of the leaf accurately and recorded their measurements correctly, with units. Some candidates confused millimetres and centimetres. A few candidates, seeing that the leaf in Fig. 3.1 was at a magnification of 0.5, multiplied their measurement by 2; this was not required as the question related to the leaf as shown in Fig. 3.1, not its actual width.

**(ii)** Most candidates correctly calculated the actual width of the leaf with units.

The majority of those with incorrect answers had divided 0.5 by their measurement, instead of their measurement by 0.5. A number of candidates arrived at the correct answer by recognising that a magnification of 0.5 means that the leaf shown is half its actual size and so multiplied their measurement by 2.

**(b) (i)** The majority of candidates correctly and clearly explained how the mean maximum widths were calculated. Some candidates added all 20 of the measurements together and divided the sum by the total number of measurements (20) instead of dealing with the sunny and shady samples separately.

**(ii)** Candidates were asked to suggest how the investigation could be improved to increase the validity of the conclusion. In better responses, candidates suggested measuring larger samples of leaves from sunny and shady areas or using leaves from different species in sunny and shady areas to see whether these leaves in shady positions were also wider.

**(iii)** Candidates were asked to suggest why it might be advantageous to leaves growing in a shady position to be wider than those growing in a sunny position. Good answers suggested that wider leaves had a greater surface area, thus enabling the plant to utilise as much of the limited light available in the shady area, as possible, for photosynthesis.

# BIOLOGY

**Paper 5090/62**
**Alternative to Practical**

## Key Messages

Candidates should read questions carefully to ensure that they answer them fully and as set.

Candidates should check that they have not overlooked questions; on this paper some did not attempt the final question.

In investigations, candidates need to have a good understanding of the difference between independent, dependent and control variables.

Candidates should be precise in their terminology and use e.g. volume or mass instead of size or amount.

Drawings and graphs should be drawn using a sharp pencil.

## General Comments

Candidates seemed to have adequate time to complete the paper, however, there were a number who made no response to the final **Question 3(d)**..

Almost all scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written.

## Comments on Specific Questions

### Question 1

**(a) (i)** The majority of candidates measured the correct dimension of fruit **A** accurately and recorded it with appropriate units. Recorded measurements without units could not be credited. A small number of candidates measured and recorded the length of the line drawn for guidance on the right hand side of **Fig. 1.1** instead of fruit **A**. A few candidates confused centimetres and millimetres recording e.g. 4.5 mm instead of 4.5 cm, 45 cm instead of 45 mm or 45 m instead of 45 mm. A few candidates misread rulers e.g. 45 mm was read as 40.5 mm.

**(ii)** A good number of candidates correctly calculated the magnification of the fruit A by dividing its measured length in **Fig. 1.1** by the actual length given and expressing their answer correctly with times or an × and without units.

**(b) (i)** The transcribing of the data into the table was generally accurate, with the independent variable, length / mm, ranked in increasing order of magnitude. A few candidates transcribed the data in a random order which could not be credited. A few candidates incorrectly recorded the units against each value, the unit is in the column header in a table.

**(ii)** Some candidates drew graphs which gained full credit. A common error was to plot time / s on the x axis rather than the independent variable length / mm. . Many candidates labelled the axes fully, including units although some did not use the correct abbreviation, s, for seconds. Most candidates used linear scales but then did not make good use of the size of the grid provided. There is no need for the scales on axes to start at 0 but if they do not then the starting value for both scales should be indicated and scale breaks used where appropriate. Many candidates were able to plot all 6 points with accuracy and then went on to join their plotted points with ruled straight lines as requested. Some candidates drew either freehand curves or one straight line as a line of

best fit, neither of these gained credit. these could not be credited. In many of the graphs where time / s had been plotted in error on the x axis the points were also joined incorrectly in ascending order of the dependent variable (time / s) rather than the independent variable (length / mm).

**(iii)** Nearly all candidates were able use their graph to find the correct number of seconds it would take a 30 mm long fruit to fall.

**(iv)** Stronger candidates were able to describe correctly the increasing time taken to fall as the length of the fruit increased up to 36 mm. A common error was to describe this relationship as directly proportional. A few candidates had the increasing time causing the increasing length, implying that time was the independent variable in the investigation, this was not credited. Candidates also needed to notice that after 36 mm the time taken to fall decreased with increasing length. Some candidates gave an explanation for the relationship described but these gained no credit as it was not asked for in the question.

**(v)** Many candidates recognised that the reliability of the investigation could have been improved by repeating it and finding the mean (average) times for each length or by using a larger sample of sycamore fruits. Suggestions that a wider range of fruit lengths could be used or lengths that increased regularly by 1 or 2 mm rather than irregularly were also creditworthy. Some candidates suggested changing the height from which the fruits were dropped or using a different species of fruit. These would not have increased the reliability of this investigation but would be different investigations so were not credited.

**(vi)** Most candidates were able to suggest at least one factor other than length that could affect the time taken for the fruits to fall and also used correct terminology for this factor for example surface area, mass or density. Some candidates used unspecific terms such as size and shape and these were not credited.

**Question 2**

**(a) (i)** The three tissues were identified correctly as epidermis, palisade and spongy mesophyll by many candidates. Common incorrect identifications included cuticle, stomata or epithelium for epidermis and vascular tissue for the mesophylls. Some candidates did not identify the mesophyll layers as palisade or spongy.

**(ii)** Few candidates gained full credit. Some drawings were too small, a large drawing was requested so it should have occupied at least half of the available space. Some candidates drew cells which were not in box X. The cells drawn should have been the ones in box X there should have been the appropriate numbers of each of P, Q and R and they also should have been of proportional size. The outlines of the cells should have been drawn with clean continuous lines using a sharp pencil and with no shading.

**(b) (i)** Candidates were given credit for recognising that in all three species the number of stomata on the lower surface of the leaves was higher than that on the upper surface. Where candidates used data from the table to support their comparison, credit was given if the data had been manipulated rather than just copied from the table e.g. sunflower has 55 more stomata per $mm^2$ on its lower surface than on its upper surface or there are almost 4 × as many stomata on the lower surface of tobacco leaves than on its upper. A few candidates misread the table and discussed surface area of the leaf. A significant number of candidates included information about transpiration in their answers but this was beyond the remit of the question.

**(ii)** Some candidates correctly identified sunflower as the species least likely to survive because it had more stomata in total than either of the other two, a comparative statement was needed to gain credit, so more water would be lost through transpiration. A number of candidates incorrectly discussed the broad bean surviving best due to its' low number of stomata. Common incorrect responses included water being taken into the leaf through the stomata, transpiration occurring only from the lower surface of a leaf even when there are stomata on both surfaces. A few candidates described cacti as surviving in dry conditions which gained no credit.

**(c)** Many correctly described attaching cobalt chloride paper to both upper and lower surfaces of a leaf. Stronger candidates described starting with dry or blue cobalt chloride paper and that the pieces should be of a similar size in order to make a fair comparison. Although some candidates described covering the papers with glass microscope slides, few could explain that this was to

prevent water in the atmosphere from reaching the paper. Some did mention that the paper should be handled with forceps so that it was not affected by any water on hands. The paper is sensitive and changes from blue to pink quickly in the presence of water so descriptions of leaving the leaves with cobalt chloride paper attached for several hours or overnight before looking at them could not be credited. The strongest candidates described measuring the time taken for the colour to change on each surface and that the faster the colour changed, the greater was the water loss from the leaf and therefore the faster the rate of transpiration. There was evidence in some answers that some candidates were not familiar with cobalt chloride paper. Few candidates gained full credit.

**Question 3**

**(a)** A few candidates suggested correctly that the potato tissue is ground in order to break down cell walls so that their contents, including the enzyme phosphorylase, become available for filtering. A number of candidates suggested that the grinding would increase the surface area for the activity of the enzyme but this was not creditworthy as the experiment is preparing an enzyme containing extract rather than investigating the activity of an enzyme.

**(b)** Many candidates explained correctly that they would use iodine solution to test the filtrate for the presence of starch, expecting that the iodine will remain brown or not change colour to blue-black indicating that no starch is present. A few candidates described the iodine solution as turning brown, this is not creditworthy as there is no colour change of the brown iodine in the absence of starch. A minority of candidates attempted to explain why there was no starch present in the initial filtrate which could not be credited. A few candidates did not know that iodine solution is used to test for starch.

**(c)** Stronger candidates identified factors to be controlled but few candidates gained full credit. Some candidates understood the principles of keeping certain factors constant e.g. volume of phosphorylase but instead of using correct terms such as volume, mass or concentration used general terms such as amount. Some referred to PH or Ph instead of pH. Incorrect responses included light, species of potato and size of potato cubes. A few candidates chose temperature (the independent variable) and time (the dependent variable) to be controlled.

**(d)** A few candidates left this question blank. Most of those who answered the question were able to draw a neat, ruled table with at least 2 columns and rows. Many knew that temperature should be the header of one column although not all included appropriate units. The header for the second column proved more difficult with many putting amount of starch rather than time or rate of starch production and many omitted the units.