# BIOLOGY

**Paper 5090/11**

**Multiple Choice**

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

## General comments

Overall, the paper was accessible to candidates with some strong performances.

## Comments on specific questions

### Question 1

Weaker candidates thought that plant epidermal cells always contain chloroplasts.

### Question 11

Plant biology is often a less secure area for many candidates, and a common mistake here was the belief that water moves up a plant stem by osmosis.

**Question 15**

Many candidates found it difficult to interpret the graph and relate this to the state of the heart valves.

**Question 17**

Weaker candidates appeared to guess at the answer to this question about the intercostal muscles with all incorrect options proving attractive.

**Question 19**

This question highlighted a common misconception, even among the better candidates. Candidates failed to appreciate that both biceps and triceps muscles can be contracted together, for example when holding the arm in a fixed position.

**Question 25**

This was a challenging data interpretation question which was answered correctly by stronger candidates. It required candidates to appreciate the time delay that may occur between cigarette smoking and its effects on health.

**Question 26**

A common error was the belief that penicillin is produced by bacteria.

**Question 30**

Weaker candidates often chose option **A**, perhaps not appreciating that decomposition is an example of respiration; this choice also suggested that plants produce carbon dioxide by photosynthesis.

**Question 35**

The usual error here was the belief that the umbilical cord is the site of exchange of materials between mother and fetus.

# BIOLOGY

**Paper 5090/12**

**Multiple Choice**

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

## General comments

Overall, the paper was accessible to candidates with some strong performances.

## Comments on specific questions

### Question 4

This required candidates to recognise that amylase is a protein, and then identify the result of a test with biuret solution.

### Question 8

The usual error was the belief that urea is formed in the kidneys.

**Question 12**

Plant biology is often a less secure area for many candidates, and there was evidence that many candidates were unsure of the answer to this question on plant transport.

**Question 13**

Candidates showed a sound knowledge of the causes of heart disease.

**Question 14**

Some candidates thought that arteries always carry oxygenated blood.

**Question 15**

Many candidates found it difficult to interpret the graph and relate this to the state of the heart valves.

**Question 17**

Candidates understood the role of the diaphragm but had difficulty in distinguishing between the roles of the internal and external intercostal muscles.

**Question 18**

Many candidates did not realise that protein synthesis requires energy from respiration.

**Question 25**

This was a challenging data interpretation question which was answered correctly by stronger candidates. It required candidates to appreciate the time delay that may occur between cigarette smoking and its effects on health.

**Question 28**

A common error, even among the better candidates, was the belief that herbivorous insects are feeding at the first trophic level.

**Question 30**

Knowledge of the nitrogen cycle was not strong, with many candidates identifying the conversion of ammonium to nitrate as ‘nitrogen fixation’.

**Question 35**

The usual error here was the belief that the umbilical cord is the site of exchange of materials between mother and fetus.

**Question 38**

This question on genetic engineering also proved challenging but was answered correctly by stronger candidates.

# BIOLOGY

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

## Key messages

Candidates are advised to follow the instructions carefully. For example if two examples are asked for, then three should not be given.

## General comments

Many candidates have an excellent recall of the factual information in the syllabus. The next step is to apply this knowledge to unfamiliar scenarios or diagrams. These questions will always be based on the knowledge acquired by the candidates whilst studying the syllabus. General statements do not always gain credit. Where possible, candidates should not state that something 'has an effect' on something else without clarifying what the effect is.

## Comments on specific questions

### Section A

### Question 1

This question was well answered.

**(a)** Candidates followed the instructions and most correctly labelled the xylem tissue. Several vascular bundles were shown in the correct position and the phloem cells identified.

**(b)** Named examples of the molecules translocated, e.g. sucrose and amino acids, should be used rather than a general term such as 'nutrients'. Mention should be made that these molecules are transported in solution.

### Question 2

**(a)** The name testa was not as well known as the radicle.

**(b)** In this most challenging part of the question, the change, as an increase or decrease in dry mass, should have been stated for each stage and then an explanation offered for the observed result. Descriptions of visual changes were not credited and neither were references to the amount of water present. For stages A and B, candidates needed to explain that respiration used up the stored food in growth leading to a loss of mass, and that in stage C photosynthesis increased the food available hence the increase in mass.

**(c)** In this part the word 'temperature' did not gain credit. It should be qualified to suggest that a suitable temperature for germination is present. Credit was also given to candidates who gave a numerical temperature range within which germination might occur.

### Question 3

This question was well answered by most candidates.

**(a)** Many candidates gained full credit here.

**(b)** Many clear and logical answers were seen which scored well. Those candidates who described protein digestion were not awarded any credit.

**Question 4**

The recall elements of this question were well answered, but candidates found 4**(a)(i)** and 4**(b)** to be challenging.

**(a) (i)** This was a question which required the candidates to interpret diagrams and to apply their knowledge. Few mentioned that in humans the DNA was contained within the nucleus on paired chromosomes.

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

**(iii)** Some candidates stated that the cells produced would be genetically similar, rather than genetically identical. Few candidates then continued to say that the insulin produced would also be identical from all of the bacteria.

**(iv)** This part was well answered.

**(v)** Fermenters or bioreactors were credited.

**(b)** Specific examples and arguments are required to gain credit in these questions. Vague statements, such as “they are harmful” or “it can cause problems” were not acceptable.

**Question 5**

Part **(b)(ii)** was the most challenging for candidates.

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

**(b) (i)** This was well answered by those who read the question carefully, and stated methods to control the malarial vector i.e. the mosquito.

**(ii)** Some excellent answers were seen which gained full credit, but some candidates thought that exposure to the insecticide gradually builds up the resistance within the mosquito and it then becomes immune, so sentences such as “When the insecticide is used again, it will not affect them” were often seen.

**Section B**

**Question 6**

This question was well answered.

**(a) (i)** Most candidates correctly identified the stomach.

**(ii)** Well prepared candidates gave excellent answers. Some omitted to state that the pH in other regions of the alimentary canal would be different. Those who did not read the question carefully and described the effect of changing temperature on the reaction found it difficult to score many marks.

**(b)** This was very well answered.

**Question 7**

This question was well answered by most candidates.

**(a)** This question required understanding of the nitrogen cycle and food chains. There were many good answers, but most candidates omitted to mention amino acids and that the plants needed to be eaten.

**(b)** This was well answered, especially the section on the environment.

**Section C**

**Question 8**

Candidates who chose this question had a good knowledge of the functions of the brain.

**(a)** Most candidates achieved full credit, although some were confused and gave examples of endocrine glands.

**(b)** This was very well answered by many, although there was some confusion between the cerebrum and the cerebellum. This was another question where qualified statements were required. For example, “It helps in movement” would not be credited for either cerebrum or cerebellum, but “it is concerned with voluntary movements” or “it is concerned with co-ordinating balance while moving” would achieve credit.

**Question 9**

Candidates who chose this question answered **Question 9(a)** and **9(b)(i)** very well but found **Question 9(b)(ii)** more challenging.

**(a)** Most candidates gave a good definition of a drug.

**(b) (i)** Candidates named the toxic components and usually associated the effects with the components.

**(ii)** Candidates tended to make vague statements rather than make specific points, e.g. “It is dangerous for children”.

# BIOLOGY

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

## Key messages

Some questions required candidates to adapt knowledge they have gained and apply it to an unfamiliar situation, and there were occasions where good factual accounts were given on this paper. However, these were often not answers to the questions set. **Questions 2(b)(ii)**, **7(b)** and, to a lesser extent, **Question 4(b)** exemplify this point. Greater care needs to be taken to avoid reproducing learned information; rather, this information should be used to address the question as set.

## General comments

Many candidates showed a good level of knowledge and understanding. Marks were spread across the entire mark range, with some papers scoring very highly.

## Comments on specific questions

***Section A***

**Question 1**

**(a) (i)** This question was generally well answered, with most candidates gaining full credit.

'Stigma' was amongst the more popular of the incorrect answers.

**(ii)** This was reasonably well answered, with most candidates gaining some credit. Some candidates incorrectly named features (e.g. feathery stigma) which were not apparent in **Fig. 1.1**. A relatively small number of candidates made incorrect reference to cross-pollination.

**(b) (i)** A large majority of candidates correctly named structure A.

**(ii)** Most candidates gave full and accurate answers and achieved full credit. A small number were confused about insect pollination and so referred to insects in their answer.

**(c) (i)** The majority of candidates successfully named the organism involved. The most common incorrect answer given was to suggest that the organism would be a bacterium.

**(ii)** Most candidates made correct reference to anaerobic respiration or fermentation. Sugar was sometimes stated, but references to enzymes and a suitable temperature were rare.

**Question 2**

**(a)** Whilst most candidates gained some credit here, full credit was rarely seen. The amnion was often thought to be responsible for birth and the spongy lining to the uterus and the muscular wall were often confused.

**(b) (i)** Most candidates were successful here, although reference to smoking and cigarettes was often seen.

**(ii)** A very large majority of candidates failed to show understanding of the requirements of this question and gave long and detailed, often correct, descriptions of the effects on the fetus (and sometimes on the mother) of smoking, and included descriptions of tar and carbon monoxide, with

quite often no mention of nicotine. The effect of drugs on the embryo were often given rather than a description of the mechanism of entry into the fetus. As a result, such answers often gained no credit. A number believed that the mother's blood crosses the placenta.

**Question 3**

**(a) (i)** A large majority of candidates were able to give the correct constituent.

**(ii)** Although generally well answered, common errors included carbohydrates (often given) and proteins (less often seen).

**(b)** Many candidates gave full and correct answers, thereby scoring full credit. A significant number of candidates incorrectly named a mineral, e.g. calcium, and then gave an accurate account of the importance of the named mineral, not appreciating that mineral ions were covered in the table.

**(c)** Candidates who correctly mentioned the role of amylase in the digestion of starch often then failed to mention the need for some other constituent to provide the required energy. A significantly large number of candidates incorrectly referred to the digestion of carbohydrates rather than starch and sometimes did not appear to understand the difference between them. Many attempted to describe the effect on the animal itself (e.g. lack of energy) rather than on the diet of the animal.

**Question 4**

**(a)** This part was very well answered. A large majority of candidates gained full credit. A small number correctly named photosynthesis, but then failed to link photosynthesis with the role of the leaf in their explanation.

**(b)** Stronger candidates gained full credit here. The standard of answer among the remainder was variable. Many candidates appeared not to consider carefully the information given in the question, and, based on the appearance of the plant, gave answers related to wilting.

**(c) (i)(ii)** It was fairly common for candidates to be confused by the appearance of the graph and by the terminology used here. Many failed to realise the oxygen was still being lost during the time specified in question **(i)**, seeming to believe that a rise in the graph indicated an increase in uptake. Many candidates struggled to show understanding of the relative diurnal roles of photosynthesis and respiration and how they interact. A common misconception was that they are mutually exclusive and that one starts as the other ends (and vice versa). Some candidates made a confused reference to 'light dependent' and 'light independent' stages of photosynthesis; a level of detail that goes well beyond syllabus requirements.

**Question 5**

**(a)** Stronger candidates were able to gain full credit here. However, neither of the intercostal muscle actions mentioned is involved in the process of exhalation, but it was common for candidates to believe that they were. Several candidates placed ticks in a large number of the boxes, thereby reducing their potential score.

**(b)** This question was only moderately well answered. Whilst most candidates realised that individual K was 'normal' i.e. a control, many misidentified the significance of individuals J and L, with a relatively small but significant number believing that L was the most active, and J the least active of the three individuals. That respiration was the process responsible for the statistics was regularly overlooked.

***Section B***

**Question 6**

In general, both parts **(a)** and **(b)** of this question were well answered.

**(a)** Most candidates demonstrated a sound understanding of the relative structure and function of cell walls and membranes. In particular, the role of the cell wall in the maintenance of turgor and its consequences was well understood. Common errors included confusion concerning permeability,

partial permeability and non-permeability, and the application of these terms to walls and membranes. Only the most proficient candidates made reference to both 'osmosis' and to 'active transport' with reference to the cell membrane.

**(b)** The distinctions, as well as the connections between cells, tissues and organs were well known. However, many omitted to provide examples of each, or gave two examples, omitting a third.

**Question 7**

**(a)** The majority of candidates provided correct and detailed answers, achieving full credit or approaching this. It would appear that this part of the syllabus is well understood. One relatively common failing was simply to refer to 'temperature' rather than to give a correctly qualified reference.

**(b)** A large majority of candidates gained only little credit here. Many answers were characterised by detailed, often correct, descriptions of fertilisation and the formation of endosperm or cotyledon; others were detailed, often correct descriptions of the breakdown and subsequent fate of materials stored in the endosperm or cotyledon during seedling growth. In neither case were these answers relevant to the question asked and thus failed to gain any credit. Further failings were to describe the original source of storage materials *in the parent plant*, and also to confuse photosynthesis in the seedling as part of the process of germination.

***Section C***

**Question 8**

This question was the less popular Section C choice. It was, however, often well answered with a majority of candidates performing well. Part **(b)** proved more challenging than **(a)** for the majority of candidates.

**(a)** Most candidates gave full, detailed, and correct answers thereby scoring well. A small number of candidates provided answers which were based on an incorrect substance, e.g. the manufacture of insulin or antibiotics which precluded credit for several of the marking points. However, such answers usually contained sufficient correct details of the process to allow them to gain a degree of credit.

**(b)** The majority of candidates gained credit for a reference to viruses causing harm. Apart from the occasional mention of the inconvenience caused by the size of viruses, no other valid points were usually made.

**Question 9**

In general, the standard of answers to this question was good.

**(a) (i)(ii)** These parts were quite well answered with a majority of candidates gaining some credit. Amongst candidates scoring less well, confusion was often apparent between alleles, genes and chromosomes. Some candidates gave answers which were not based upon blood groups but some other feature, e.g. height, hair colour etc. It was common to read that one blood group, rather than an allele responsible for it, is dominant over another. There were often genetic diagrams drawn, but, as they were usually lacking in explanation or a description of relevance, they failed to score.

**(b)** Stronger candidates usually gained full credit here. Others often showed confusion between: haploid and diploid; meiosis and mitosis; chromosomes and chromosome pairs. A very common error, even among stronger candidates, was the mistaken belief that gametes divide by meiosis (rather than that they are the result of meiotic division of diploid cells).

# BIOLOGY

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

## Key messages

- Candidates should be ready to apply their knowledge and experience of practical work, as well as using the skills and techniques that they have acquired in planning and carrying out practical exercises. They should ensure that they make careful observations and recordings and are able to interpret data that they have obtained for themselves, or has been provided to them.
- In questions where calculations are required, it is important that candidates show their working in the relevant space where required.

## General comments

The questions set were designed to test the candidates' abilities to follow instructions carefully and methodically, to observe and record scientific information accurately and to take measurements and carry out simple calculations. The ability to draw conclusions based on observations and scientific knowledge and to plan an investigation based on previous experience were also tested. Candidates appeared to have sufficient time to deal with all the questions set and the vast majority of the scripts were clear and legible.

## Comments on specific questions

### Question 1

**(a) (i)** This required candidates to record the colour changes of methylene blue indicator in response to the activity of dehydrogenase enzyme in yeast cells at two different temperatures. In answers scoring well the table was completed clearly, each section containing the appropriate colour, ranging from blue to light blue to colourless in tubes **A**, with the blue colour remaining in tubes **B**. Weaker answers lacked clarity and accuracy of the colours observed and it is possible that the careful mixing of the tube contents, as directed in the question instructions, may have been overlooked in some cases. In completing the table candidates should make sure they confine each answer to its specific section of the table.

**(ii)** Almost every candidate could state that a thermometer was used to check the temperature of the water in the beaker.

**(iii)** Most candidates were able to explain that adding cold water or ice would reduce the temperature, or heating with a Bunsen burner would raise the temperature. Those who suggested that stirring the water would be sufficient were confusing distribution of heat in the water with the maintenance of a specific temperature.

**(iv)** The stronger answers related to allowing the test-tube contents to adjust to the water temperature of 25 °C or 35 °C in the beaker, before the indicator is added and colour readings begin. The most common error was stating that it allowed the dehydrogenase enzyme to be active or activated.

**(v)** Explanations given were often excellent. The majority realised that yeast suspension **B** had been killed by previous boiling and its dehydrogenase had been denatured, and hence no colour changes from blue were seen over the five-minute period at either temperature. It should be remembered that it is the yeast that is killed and not the enzyme, and it is the enzyme that is denatured and not the yeast. Very good responses stated that the dehydrogenase was active in suspension **A** and that activity occurred more quickly at 35 °C. To obtain the higher credit

candidates should make sure they read the question instructions carefully and that they explain their observations rather than restate the colour changes they have seen. They should also resist giving theoretical answers relating to the effect of temperature on enzymes in general.

**(b)** This part of the question asked candidates to describe an experiment that they could carry out to investigate the effect of pH on dehydrogenase activity, again using methylene blue indicator and yeast suspension (not litmus or other indicators in this case). There were some excellent answers giving the full experimental details requested, with reference to the testing of different pH solutions, of an appropriate range, on yeast suspensions kept at the same constant temperature. After the addition of methylene blue, timing how long it took for the blue colour to disappear was a measure of how each pH solution affected dehydrogenase activity. Weaker responses to this question showed insufficient reference to the experimental procedure required. Sometimes the emphasis was on theoretical descriptions of how an acid, alkaline or neutral pH affects enzyme activity in general.

**(c) (i)** Using the data provided in **Table 1.2**, of alcohol production by yeast over a 25-hour time period, candidates were asked to construct a line graph of the given data. The graphs that scored most credit showed correct orientation and full labelling of the *x*-axis (time / hr) and the *y*-axis (alcohol concentration / g per $dm^3$) and a smooth curve linking the plotting points as requested. To score highly, candidates needed to ensure there were linear scales on each axis with full labels and the relevant units.

**(ii)** The completed graph in **(c)(i)** was used to calculate the concentration of alcohol after 12 hours. For most candidates this gave an answer of between 6.1 and 6.2 g per $dm^3$. Misreading the *x*-axis at 12 hours and omitting units were common errors.

**Question 2**

**(a)** Candidates were asked to make a drawing of the horse chestnut leaf shown in **Fig. 2.1**. The stronger responses produced large, clear diagrams indicating the serrated margin and pointed tips of the leaflets. The very good diagrams seen also paid attention to the venation of the leaflets and were clear and accurate in terms of number and size of the leaflets.

**(b)** Completing **Table 2.1** with a description of the shape and edge of the laurel and oak leaves resulted in some excellent responses in line with the one given in the table for the hornbeam leaf. Weaker responses gave a negative rather than a positive description e.g. not oval for the oak leaf and not serrated for the laurel leaf. Vague answers should be avoided e.g. triangular shaped, feather-like and tree shaped.

**(c) (i)** Many candidates carefully measured the maximum width of the laurel leaf in **Fig. 2.1**, and drew a line on the figure to show where the measurement was taken. The main errors here were either to measure a different leaf (usually the drawing made of the horse chestnut leaf) or to omit the line indicating which part of the leaf had been measured.

**(ii)** Calculation of the magnification of the laurel leaf in **Fig. 2.1** was accurately carried out by many candidates. There should be no units to accompany the magnification figure.

**Question 3**

**(a) (i)** Using the data from the table, the general relationship between cycling speed and breathing rate was asked for. The majority of answers correctly quoted that 'as the cycling speed increases the breathing rate also increases'. However, they are not directly proportional as was indicated by a number of candidates. Sometimes a faster cycling speed was incorrectly seen to cause a higher breathing rate.

**(ii)** There were many excellent explanations for the relationship given in **(a)(i)**. These usually referred to the increase in cycling speed requiring, or using, more energy which would be gained from respiration, which in turn would require more oxygen and hence an increased breathing rate. The production of more carbon dioxide, which needs to be more quickly removed, was also appreciated by some candidates.

**(b)** Calculating the minute volume after cycling at 25 km per hour was successfully carried out by many candidates. They used the data given in the question correctly. Incorrect answers were the result

of an incorrect choice of data, commonly 3000 × 25, or incorrect handling of the data, e.g. 3000 divided by 27.

# BIOLOGY

**Paper 5090/32**
**Practical Test**

## Key messages

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- In questions where calculations are required, it is important that candidates show their working in the relevant space where required.

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**(ii)** Almost every candidate could state that a thermometer was used to check the temperature of the water in the beaker.

**(iii)** Most candidates were able to explain that adding cold water or ice would reduce the temperature, or heating with a Bunsen burner would raise the temperature. Those who suggested that stirring the water would be sufficient were confusing distribution of heat in the water with the maintenance of a specific temperature.

**(iv)** The stronger answers related to allowing the test-tube contents to adjust to the water temperature of 25 °C or 35 °C in the beaker, before the indicator is added and colour readings begin. The most common error was stating that it allowed the dehydrogenase enzyme to be active or activated.

**(v)** Explanations given were often excellent. The majority realised that yeast suspension **B** had been killed by previous boiling and its dehydrogenase had been denatured, and hence no colour changes from blue were seen over the five-minute period at either temperature. It should be remembered that it is the yeast that is killed and not the enzyme, and it is the enzyme that is denatured and not the yeast. Very good responses stated that the dehydrogenase was active in suspension **A** and that activity occurred more quickly at 35 °C. To obtain the higher credit

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**(ii)** There were many excellent explanations for the relationship given in **(a)(i)**. These usually referred to the increase in cycling speed requiring, or using, more energy which would be gained from respiration, which in turn would require more oxygen and hence an increased breathing rate. The production of more carbon dioxide, which needs to be more quickly removed, was also appreciated by some candidates.

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of an incorrect choice of data, commonly 3000 × 25, or incorrect handling of the data, e.g. 3000 divided by 27.

# BIOLOGY

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

## Key messages

This paper tests the ability to apply a range of practical skills and techniques. Candidates should have experience of practical work, including biological tests and experimental design.

It is important that candidates consider carefully what is asked for by the terms *description* and *explanation.* If a description of experimental observations is asked for, an explanation for those observations is not required in the answer, and will not score additional credit.

## General comments

The number of marks awarded overall covered the whole range available and it appears that candidates had sufficient time to complete the paper. The majority of scripts were clearly legible, with the answers written in the spaces provided. There were few instances of questions that were not attempted.

There has been continued improvement in the responses to questions relating to experimental design and more candidates are using precise terminology such as *mass, length* and *volume*, rather than *amount* or *quantity* when describing measurements or listing variables to be controlled. To improve further, consideration should also be given to the range of values chosen for the independent variable as well as providing a precise description of what is being observed or measured in order to collect the results.

## Comments on specific questions

### Question 1

**(a) (i)** This was very well answered and nearly all candidates knew that a thermometer or temperature probe could be used to check the temperature of the water in the beaker.

**(ii)** The most common error was not describing a *method* of heating or cooling the water if it became higher or lower than 25 °C, but just making vague statements about heating the water or cooling it. A few candidates thought that lowering the Bunsen burner flame was the equivalent of cooling.

**(iii)** Many candidates understood that leaving the tubes in the beaker of water for 5 minutes would allow the contents of the tubes to adjust to the temperature of the water, and this part was quite well answered. Some thought that it would allow the contents of the test-tube to settle and others wrote about the enzyme being activated. Neither of these answers was creditworthy.

**(iv)** Many candidates gave good descriptions of the student's observations, but some just tried to explain what had happened. Others omitted references to the times at which changes occurred.

**(v)** In this part, candidates were asked to explain their observations. There were many good answers with most candidates recognising that boiling denatures an enzyme, thus making it inactive. Some expressed the idea that dehydrogenase was not present in the test-tubes that had been boiled. A few candidates mixed up the tubes and some thought erroneously that the disappearance of the colour indicated that the dehydrogenase had stopped working, hence where the colour was present throughout (as in test-tube **B**), the dehydrogenase was active throughout the full 10 minutes.

Some candidates did not score full credit as they did not refer to all three test-tubes. Whilst many noted that the enzyme was denatured in **B**, some did not refer to the fact that the enzyme was

active in **A** and fewer still compared the rate of enzyme activity in tube **A** at 25 °C with that of tube **A** at 35 °C.

Some candidates gave descriptions here rather than explanations.

**(vi)** Many candidates knew that the experiment should be repeated and mean values calculated. Answers that were not creditworthy included observing the test-tubes for a longer period of time, increasing the range of temperatures, or simply repeating the experiment with no reference to finding a mean value.

**(b)** Candidates were asked to describe an experiment to investigate the effect of pH on the activity of dehydrogenase. Most candidates correctly described an acid or an alkali being added to the yeast suspension, although non-creditworthy descriptions of placing the test-tubes of yeast suspension in beakers of acid or alkali were also seen. Stronger candidates correctly described using equal volumes rather than amounts when referring to yeast suspension, pH solution or methylene blue. The best answers described a range of at least three pH values that should be used and recognised that external factors, such as temperature, should be controlled.

Many candidates referred to the results table given, **Table 1.1,** to describe how they would collect data, but few stated clearly that they would record the time taken for the colour to change (for each pH value used). Some answers were vague and merely suggested waiting 5 minutes and recording the colour changes, which was not creditworthy.

**(c) (i)** There were some excellent graphs and many candidates scored maximum credit. Of the rest, most were of a good size and had linear scales although some omitted 0 at the origin. A few had reversed axes. Most had axes fully labelled and plotting was well done.

One common error was not following the instruction to join the points with a smooth curve and using ruled lines instead.

**(ii)** Most candidates were able to read the value from their graphs but a few omitted units.

**Question 2**

**(a)** There were some excellent drawings of good size with continuous clear lines and no shading. The best drawings showed all five pointed leaflets with the bottom two being smaller than the others, and detail of the serrated margins, midrib and veins included. The drawing of the veins proved to be the most difficult part, with midribs being represented by single lines or veins shown to be thicker than the midribs or extending beyond the margin of the leaflet.

**(b)** Candidates were asked to complete a table showing the differences between two leaves. Few candidates gained full credit. The description of the margin of the oak leaf proved to be most difficult.

**(c) (i)** Most candidates drew a line on the laurel leaf as instructed, although some did not. A few drew a line on one of the other leaves and measured that instead. Some candidates measured the length of the leaf rather than the width, although most measured the leaf accurately.

**(ii)** Some candidates were able to calculate the magnification of the laurel leaf correctly, dividing their measurement of the image by the measurement of the actual leaf. Others, however, divided the actual leaf measurement by the measurement of the image. Some candidates presented their answer using a number of decimal places that could never be measured practically in a school laboratory. A few expressed their answer with units, which was incorrect.

**Question 3**

**(a) (i)** Candidates were asked to describe the general relationship between cycling speed and breathing rate, based on the data presented in **Table 3.1**. Most answered this question well. A few candidates expressed this relationship the wrong way round, suggesting that cycling speed was dependent on breathing rate. Occasionally the term ‘directly proportional’ was used, which is incorrect in this context.

**(ii)** Candidates were asked to suggest an explanation for this relationship. Good answers referred to the need for more energy and therefore increased respiration and oxygen intake. Others realised that more carbon dioxide and/or lactic acid would be produced and therefore would need to be removed. A significant number of candidates wrote at length about increased heart rate and blood flow, and the need for more glucose. Whilst not incorrect, this information was irrelevant here.

**(b)** The majority of candidates were able to calculate the minute volume correctly using the information supplied.

# BIOLOGY

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

## Key messages

Candidates should take care when reading instructions in questions and should ensure that those instructions are carried out.

Candidates should be able to distinguish between the instructions 'describe' and 'explain'.

The number of marks to be awarded for each question is indicated. If more than one mark is available then answers should contain more than one piece of information. Candidates should make sure that they have answered the question as fully as possible.

Sharpened pencils should be used for drawings to ensure accuracy.

## General comments

There was no evidence to suggest that candidates did not have sufficient time to complete the paper. Most scripts were clearly legible but there were some that were very difficult to read.

### Question 1

**(a) (i)** Most candidates answered this question well. They ruled the outer borders of the table and inserted at least two columns. To be credited, the table header needed to include the number of spines at 1 m and 3 m, but some candidates omitted 'number'. All the data was transferred to the table in many cases, sometimes as tallies or frequencies which were acceptable. One or two measurements were omitted by some candidates. There were candidates who mistakenly added the numbers for 1 m and 3 m together before inserting the total in the table. Candidates were clearly instructed to arrange the number of spines in rank order from lowest to highest. However some arranged them in the order in which they appeared in the figure or even ranked them from highest to lowest and could not be credited. A few candidates presented the results for 1 m and 3 m in two separate lists, indicating that the nature of a scientific table had not been understood.

**(ii)** The majority of candidates knew that the mean for each data set could be calculated by adding all the numbers of spines at one height together (192 at 1 m and 168 at 3 m) and dividing that total by the number of leaves sampled (12 in both cases). A few candidates presented the total numbers of spines in each case as their answers and a small minority of candidates added the numbers together incorrectly.

**(iii)** Only the strongest candidates gained full credit for the construction of the bar chart. Many were able to draw two bars of equal width with ruled lines and to plot their mean values correctly. There were candidates who did not read the instruction about plotting their means and who attempted to plot the 24 numbers from the figure. Frequent errors or omissions were not labelling axes fully, for example, mean was often omitted from 'mean number of spines', labels included 'spines' on both axes, no value was given at the origin of the mean number of spines axis and the bars were not clearly labelled.

**(iv)** Many candidates correctly concluded that the leaves at 1 m had more spines than those at 3 m. Some supported this by working out that the difference in the mean numbers was 2. Better candidates realised that there was more that could be concluded and noted that the number of spines is more variable at 1 m than at 3 m, sometimes using data from the figure which showed a range of 12 spines at 1 m and only 8 spines at 3 m. A few candidates correctly noted that there was not a lot of difference in the numbers of spines at the two heights and wondered whether the

difference was significant. Although the question asked for a description of the conclusion, a number of candidates offered an explanation of the results which did not address the question as set.

**(v)** Many candidates recognised that by increasing the size of the leaf samples taken in some way, the results would be more reliable and valid. Some suggested doing the investigation with leaves from different holly trees or by sampling leaves from different heights of the trees and gave answers that were creditworthy. The question related to the investigation described. Some answers described ways in which the investigation could have been extended e.g. by sampling trees with with spined leaves of different species which would not have increased the reliability of the original investigation.

**(b)** There were many very good answers to his question and only a small number of candidates who did not attempt it. There were also a small number who did not read the question carefully and, instead of describing an experiment, gave theoretical answers about the working or distribution of stomata. There were a number of methods to compare the numbers of stomata on the upper and lower surfaces of a holly leaf. Preparing the two surfaces of the leaf in some way that made it possible for the numbers of stomata to be actually counted under a microscope was frequently given as the method. Not many candidates described the preparation of the material to be observed, peeling off the upper and lower surfaces, well. Very few described making impressions of the leaf's surfaces e.g. with nail varnish and peeling those off to examine under the microscope and compare – a method that works well. Some candidates described immersing the leaf in hot water and counting the number of air bubbles seen on each surface. The air emerges through the stomata so more bubbles indicated more stomata. Often, though, it was not stated that the air bubbles had emerged through stomata. Many candidates used methods involving measuring and comparing water loss from the two surfaces. A number of candidates described applying cobalt chloride paper to both leaf surfaces, although some mistakenly referred to it as copper chloride or copper cobalt. Candidates using this method should have stated that dry blue cobalt chloride paper turns pink in the presence of water and that water (vapour) comes out of the leaf through stomata. The faster the paper changes colour, the more water is being lost and therefore the more stomata there must be. In a number of cases, statements were made which indicated that the candidate may not have actually seen this colour change. Some left the paper for long periods of time and then compared the intensity of the pink colour and a few described pink dots over stomata on the blue paper – but neither of these is discernable. Other methods involved sealing the upper surface of one leaf and the lower surface on another, measuring their masses and leaving them exposed for a period of time. By then re-measuring the masses, it could be determined which leaf had lost most mass and therefore the most water. In methods like this it was necessary for candidates to made the link between stomata and water loss with the more water loss showing the presence of more stomata.

**Question 2**

**(a)** This question was generally answered very well, with many candidates gaining full credit. Most knew that Benedict's solution should be added to the milk samples to test for reducing sugar but a few candidates failed to mention that the mixtures should then be heated. A small minority incorrectly used Biuret reagent or iodine solution. Many candidates made good reference to the need to use equal volumes of milk and/or Benedict's solution but a few still referred to amounts, which could not be credited. Some answers did not state the original colour of Benedict's solution, blue, but many knew the colour changes that would indicate the presence of reducing sugar in differing quantities that could be compared. A few candidates incorrectly considered that green indicated the presence of most reducing sugar and red, the least. Some candidates omitted a reference to a safety procedure in their method although they were asked to "safely compare".

**(b) (i)** The vast majority of candidates followed the instructions and correctly joined the plotted points on the figure with ruled lines but there were some who drew freehand curves that could not be credited. Occasionally in weaker answers, lines did not join the centres of the plots, the line between week 0 and week 1 was omitted or the line at week 6 extrapolated beyond the plotted point.

**(ii)** Most candidates correctly described a decrease in the pH level with time, some also noting that the decrease was more rapid at first and then slowed. Some simply referred to pH changing which is not a description of the change. References to the value of overall actual decrease or weekly

decrease were also creditworthy. As the question asked for a description of the changes, no credit could be given to answers only explaining why the pH had changed.

**(iii)** This question was answered well by many candidates who were credited for recognising that lactic acid is formed by bacterial or enzyme action on the lactose in milk.

**Question 3**

**(a)** The humerus (**A**) and ulna (**B**) were correctly identified by some candidates but many wrongly identified the ulna as the radius.

**(b)** A few candidates did not follow the instruction to draw bone **B** and drew bone **A.** A few others failed to notice the instruction that the drawing should be of the same size as the bone in the figure and made larger or smaller drawings. In the best answers lines were drawn with sharpened pencils, were clear and continuous rather than sketchy and, even if appearing relatively straight, were not ruled. Details were included but not indicated with shading.

**(c) (i)** Most candidates measured bone **B** in the figure accurately. A few measured bone **A** in error. Some measured and recorded their measurement in centimetres but did not change the mm already written on the answer line to cm.

**(ii)** Those candidates who correctly divided their measurement in **(c)(i)** by the given 243, obtained a realistic magnification in the region of × 0.40. However, there were many incorrect cases of 243 being divided by the measurement in **(c)(i)** resulting in a magnification in the region of × 2.5. Care should be taken with rounding up or down when decreasing the number of decimal points for a final answer.

**(d) (i)** Many candidates identified the hinge joint correctly. Occasionally it was named as a hind joint which could not be credited. A significant number of candidates identified the joint wrongly as a ball and socket.

**(ii)** Some candidates were able to describe the movement in terms of flexion (bending) and extension (straightening) in one plane or up to $180^{o}$. Some of these good answers could not be fully credited because reference was also made to the movement as rotation, a movement permitted by a ball and socket joint, but not by a hinge joint.