

BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

This paper was clearly accessible to candidates and produced a wide distribution of marks.

Comments on specific questions

Questions 1 and 29

These questions were very well answered with **Question 1** providing an easy start to the paper for almost all candidates.

Question 7

In the level portion of the graphs, P and R, light intensity continues to increase without any corresponding increase in the rate of photosynthesis, so factors other than light must be limiting. However, many candidates of all abilities selected Option **A** rather than Option **B**.

Question 9

This question discriminated well, with more able candidates opting for the correct Option **C**, while the less able generally opted for **B**, believing that the hepatic portal vein carries blood from the small intestine to the kidneys.

Question 13

Almost all candidates understood the role of platelets, so selecting Options **A** or **B**, but many then chose Option **A**, getting confused between fibrin and fibrinogen.

Question 16

Almost all candidates selected Options **A** or **B**, but **A** proved popular showing a lack of understanding of the much lower energy yield from anaerobic respiration.

Question 26

All options other than the correct one, **A**, were popular. Perhaps candidates lacked the confidence to select an option with three negatives.

Question 34

Many candidates selected Option **B**, perhaps thinking that seeds growing under the soil would not have access to, and therefore would not need, oxygen.

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Paper 5090/12
Multiple Choice

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

General comments

This paper was clearly accessible to candidates and produced a wide distribution of marks.

Comments on specific questions

Question 2

Option **C** was the least popular with candidates of all abilities, but the other three (including the correct answer, **A**) were selected by many, perhaps showing a level of confusion with this topic.

Question 7

In the level portion of the graphs, P and R, light intensity continues to increase without any corresponding increase in the rate of photosynthesis, so factors other than light must be limiting. However, many candidates of all abilities selected Option **A** rather than Option **B**.

Question 13

Most candidates were divided between Options **B** and **D** (the correct response), probably showing some confusion about the roles of the pulmonary artery and vein.

Question 15

Option **C** proved to be a strong distractor for candidates of all abilities. However, if pressure in the vein was higher than in the capillary, blood would not drain out of the capillary into the vein.

Question 20

Many less-able candidates selected Option **D**, seeming to show a lack of understanding of the meaning of the term 'insulation'.

Question 25

Option **C** was a strong distractor, perhaps suggesting that many candidates believe that malaria is caused by bacteria and can be treated with antibiotics.

Question 26

Options **B** and **C** were popular choices. Perhaps candidates lacked the confidence to select the correct Option **A** with three negatives.

BIOLOGY

Paper 5090/21 Theory

Key messages

Straightforward, recall of knowledge questions tended to be the highest scoring on this question paper, suggesting that, in general, candidates have a good grasp of biological facts. Many candidates seemed less confident with questions where they were expected to apply their knowledge. It is likely that some would benefit from class discussions on how to approach these questions, as detailed later in the report.

General comments

Candidates appeared to use their time wisely with the vast majority following the rubric by attempting all the compulsory questions and choosing just one of the optional questions to answer. There was no evidence that candidates experienced any time pressure. In general, candidates answered questions concisely but sometimes their focus was too narrow and they would be advised, when answering an open-ended question, to take time to collate their ideas before summarising them in their answer. When providing an answer it is not necessary to repeat the question itself; time can be more usefully spent focussing on including all the relevant facts and explanations.

Comments on specific questions

Section A

Question 1

This question tested the candidate's knowledge and understanding of the structure and function of the alimentary canal. Candidates were asked to interpret two unfamiliar diagrams, a straightened out version of the alimentary canal and a diagram illustrating stomach by-pass surgery.

- (a) (i) Identifying the parts of the alimentary canal proved straightforward for many with the majority of candidates scoring well. Candidates found identifying D the most difficult. Quite a few named it as the anus rather than the rectum. Some candidates thought that B and C were both parts of the small intestine labelling B as the duodenum and C as the ileum. A number thought that B was the large intestine and C the small intestine perhaps because they were thinking about the relative lengths of the two parts rather than the relative diameters. It is a point worth emphasising that the small intestine is named for its diameter relative to the large intestine, not its length which is considerably longer.
- (ii) Many candidates gave the correct answer, **Part C**, the colon, to gain the mark. A significant number, however, suggested B as the answer. Perhaps candidates were remembering that more water is absorbed in B than C but this is just one of many functions in **part B** whereas absorbing much of the remaining water before egestion is the main function of **part C**.
- (b) (i) Those candidates who correctly identified protein as the food substance were generally able to explain that the stomach releases pepsin, a protease, to digest the protein. Many other candidates seemed to be focused on the idea of weight reduction so suggested fat as the substance, forgetting that the stomach only digests proteins.
- (ii) It was rare to see answers that scored three marks. Candidates could often gain one of the marks available by identifying that there would be less digestion or less absorption. Very few studied the diagram carefully and made use of the information in their answers. If they had, they would have

noticed that this surgery reduces the size of the stomach rather than removes it completely and they would have been able to think about the consequences. Some suggested that the reduction in stomach size meant less fat could be stored in it so weight would be lost. This is a misconception that needs to be addressed and possibly arises from the abdomen of humans (where fat is stored under the skin and around organs) being referred to in general conversation as the stomach.

Question 2

The symbiotic relationship that exists between corals and algae was explored in this question. Candidates needed to apply their understanding of photosynthesis and respiration when answering. Many candidates, helped by the introductory **part (a)**, were able to think about and explain the mutual benefits of the coral and algae association.

- (a) The majority of candidates were able to name the process as photosynthesis and then provide an explanation. Most candidates then went on to explain that photosynthesis was indicated by the green colour of the algae, which suggests the presence of chlorophyll, or they gave a good explanation of the process of photosynthesis.
- (b) It was rare to see all five marks scored on this question. Those that appreciated that the carbon dioxide released by the respiration of corals could be used by algae for photosynthesis and that the oxygen released by this process could then be used by the coral for respiration were often able to score 4 marks. Another relatively straightforward mark could be obtained by mentioning the protection the corals gave the algae. Some candidates were able to access the mark available for explaining that algae manufactured food which could be used by corals. Some candidates had missed the fact that the algae are inside the cells of the corals and incorrectly described the algae being consumed by corals.
- (c) Many could access two straightforward marks for recognising that the corals would be poisoned and die and, as a consequence, the algae would also die. The third mark, for explaining why the algae died, proved more difficult.

Question 3

This question, investigating candidates' understanding of the link between gases in the air and the human activity that produces them, proved to be challenging for candidates.

- (a) The percentage of gases in the air was known by about two thirds of candidates and, perhaps surprisingly, candidates who did not know all three gases were most likely to give the correct figure for nitrogen.
- (b)(i) It was expected that candidates were most likely to give the answer of sulfur dioxide but carbon monoxide proved more popular. Any gas either produced in a manufacturing process or involved in one was credited.
- (ii) The best answers linked the manufacturing of products to the combustion of fossil fuels. A significant number did not appreciate this link and as a result scored no marks or picked up a mark for explaining that the gas was released because of manufacturing or vehicle emission.
- (c) Candidates found this question difficult and as a result many answers were rather superficial and vague in nature and therefore did not score many marks. Candidates need practice at analysing problems and thinking about them in a logical step-by-step way. What is wildlife? What are the differences between an industrial and countryside landscape? How would each difference impact on different types of wildlife? Thinking about it carefully would have given candidates plenty of ideas to write about. Instead, some spent valuable thinking time rewriting the stem of the question and then focussing on the first idea that sprung to mind. For four marks candidates need to think more broadly.

Question 4

This question was about the chemicals released from smoking, their effects and how they can reach a foetus. It mainly assessed recall of facts.

- (a) Those that knew the respiratory diseases associated with smoking such as emphysema, bronchitis and lung cancer could score marks for naming them or accurately describing their effects. Lung cancer was the most well-known problem associated with tar.
- (b)(i) Most candidates could get at least two marks for naming two chemicals; nicotine and carbon monoxide were the most commonly named. Stating the effects of these chemicals was more challenging for candidates with many giving answers that related to the chemicals in tar. Interestingly, some mentioned carbon dioxide and were then credited with a mark if they explained a harmful effect in the environment since the question did not specify that the effect had to be in the body.
- (ii) This was the most accessible part of question four. It was the level of detail in the answers that determined the mark awarded. As in every question, candidates are advised to check the number of marks available to determine the number of points to include in their answers. Some very good answers were so concise and detailed that four marks could be awarded for a well-constructed single sentence.

Question 5

This question required candidates to interpret a model of osmosis. Careful reading and analysis of the diagram was essential for candidates to access all the marks.

- (a) The answer, water, was known by the majority of candidates although some incorrectly mentioned mineral ions in addition to water.
- (b) Approximately half the candidates correctly interpreted the diagram, naming molecule E sucrose and G water. Some had not read the introduction that stated that the model represented two sucrose solutions and so they guessed at the name of the solute. Others missed the fact that the labels E and G were pointing at molecules and stated that E was concentrated sucrose solution and G dilute sucrose solution. F was generally recognised as a membrane but to score credit candidates needed to explain it was a selectively or partially permeable one. Candidates that did not score this mark were often able to get a mark in **part c** for describing its role in osmosis; so, although they know the significance of the partial permeability they were not applying this knowledge fully in **part b**.
- (c) Candidates who could recall the definition of osmosis and record it accurately were able to pick up three of the five marks easily. Difficulties were most likely to arise when candidates were not specific about the type of molecule moving or when they referred to concentration and did not specify whether it was the concentration of the solute or solvent. Other marks were available for relating the diagram to the process by describing the relative size of the molecules or by describing the direction of movement. Additionally, candidates could score if they described equilibrium. These marks were less frequently obtained than those available for a definition of osmosis.

Section B

Question 6

Candidates' knowledge and understanding of the structure and function of the circulatory system was tested by this question.

- (a) Initially, candidates needed to appreciate that the aorta is an artery and the vena cava a vein to successfully tackle this part of the question. A few candidates did not make the link correctly. Others did make the link but mixed up the structures and functions of arteries and veins. Many answered this question well, scoring full marks for detailed and accurate answers. The fact that arteries carry oxygenated blood and veins deoxygenated was well known as was the fact that veins have valves, a wide lumen and thin walls compared to arteries. Few candidates described the relative amounts of elastic and muscle tissue in the two types of blood vessel. They may find this easier to remember if they fully understand that arteries receive pulses of blood so the artery lumen

is variable in diameter to accommodate these pulses and has plenty of elastic tissue so it can stretch and recoil with each pulse.

- (b) This question proved challenging for candidates. Most could explain that the hole in the heart meant that oxygenated and deoxygenated would mix. A smaller number gave a consequence of this mixing as a reduced oxygen supply to the tissues. Only a very few went on to explain that this could have an impact on respiration.

Question 7

This question covered two aspects of environmental biology; energy flow through a food chain and the importance of recycling materials.

- (a) The majority of candidates, when asked to explain how energy supplied by the Sun is used to power the muscles of a lion when it runs, realised that energy must be transferred via a food chain and went on to describe this process. Some candidates missed this idea and attempted to answer in terms of the Sun's energy being directly absorbed by the lion's skin and suggesting that it helped the lion make vitamin D. For those that understood that light energy from the Sun it transferred to chemical energy in plants and then animals, most were able to provide sufficient detail to gain four of five marks. The role of respiration in releasing energy for locomotion was not accurately described, so it was rare to find all seven marks achieved on this question. Energy is neither created nor destroyed; it flows or is transferred through the abiotic and biotic parts of the environment. It is important to emphasise to candidates that, through respiration, chemical energy from food is released for use in activities such as locomotion and then, ultimately the energy that has flowed through the organism is transferred to the environment as thermal or heat energy.
- (b) Some very good answers were seen but often candidates tended to focus on providing just one reason for the importance of recycling and frequently struggled to express their ideas clearly. Problems with non-biodegradable materials in the environment and the need to conserve non-renewable resources were most likely to be recognised and explained by candidates.

Section C

Question 8

Most candidates decided to answer this optional question on commercial asexual reproduction of plants.

- (a) This proved to be a challenging question for many candidates. Very few provided relevant details of asexual reproduction, i.e. it involves mitosis, only one parent and results in genetically identical offspring. The most likely mark for candidates to score was for mentioning that this allows growers to produce plants with desirable features. This is an area where practical work may help candidates to understand and learn the significance of asexual reproduction.
- (b) This part of the question proved to be more easily accessible to candidates than the first part. It was pleasing to see that many recognised the vital role of bees as pollinators and were able to explain, at least partially, the implications of this for plants and animals. Some also mentioned there would be a reduction in honey produced and others that consumers of bees or their products might decline because of reduced food availability.

Question 9

It is unusual for a question on plants to be more popular than one which focuses mainly on animals but relatively few candidates opted for this question on mutation and animal breeding.

- (a) Most candidates performed better on this part of the question than on **part b**. Quite a few had a good recall of mutation and were able to provide relevant examples and name a mutagen. Others struggled to differentiate between gene and chromosome mutation. It was important that candidates showed their understanding by linking the type of mutation to their examples. Those giving examples were most likely to give those mentioned on the syllabus, Down's syndrome and sickle cell anaemia.
- (b) The context in this question seemed to cause difficulties for candidates but, as with **Question 3c**, a step-by-step approach would be helpful to candidates when analysing the question they have been

asked to think about and answer. What animals do farmers breed? Why do they breed them? What is the difference between artificial and natural insemination? The most accessible mark here was for mentioning that artificial insemination is quicker or more efficient. Many candidates mentioned that the selected male could have desirable characteristics to introduce to the herd of animals.

BIOLOGY

Paper 5090/22 Theory

Key messages

Examiners noted that some candidates were able to respond well to information presented in unfamiliar contexts. There is evidence this session that candidates sometimes gave a general account of a topic rather than relate their knowledge to the specific question set. The length of candidate responses was largely appropriate. Centres are reminded that candidates should be guided in the length of each of their responses by the number of lines provided and by the number of marks available. The use of specific vocabulary by candidates is important when expressing scientific content clearly and correctly. Centres are reminded that credit will **not** be awarded for information re-stated by the candidate that was made available in the wording of the question.

General comments

Some very competent work was seen from the more highly attaining candidates. Only a small number of candidates this session confused the processes of 'pollination' and 'seed dispersal' in **Question 1**. Detail relating to the process of molecular movement in dialysis was less well known in **Question 7**. Questions requiring tailoring and application of knowledge continued to provide more challenge for even some highly attaining candidates. Centres are advised to instruct candidates to answer **either Question 8 or Question 9** as stated in the rubric.

Comments on specific questions

Section A

Question 1

- (a) (i) This was well answered by most candidates.
- (ii) A significant proportion of candidates answered in terms of a general definition of enzymes and their mode of action. The question required this knowledge to be related to the specific role of enzymes during the germination stage of the plant's life cycle. Relatively few candidates stated that the conversion reaction undertaken by the enzyme was a 'breakdown' reaction.
- (b) Candidates were often able to correctly identify both stages and many went on to explain both well. There was less confusion between the processes of 'pollination' and of 'seed dispersal' than in previous sessions. A proportion of candidates did not make specific reference to the movement of pollen 'from the anther to the stigma' in stage 1. In stage 4, a proportion of candidates incorrectly referred to 'excretion' rather than to 'egestion' when outlining the removal of an undigested seed from an animal.

Question 2

- (a) This proved challenging for many candidates. Many wrote in general terms about the reflex arc without reference to the specific example described in the question. Reference to 'impulse' is required rather than to 'message' or 'signal'. Candidates able to sequence the ideas in their response correctly, without reference to 'motor neurones' which would not be involved in this particular sensation pathway, were rewarded. Many candidates made incorrect reference to either 'motor neurones' and/or to an involvement of the 'spinal cord'.

- (b)(i) This was moderately well answered. The most common incorrect responses were 'homozygous' and 'heterozygous'.
- (ii) This was moderately well answered. The most common incorrect response was 'discontinuous'.
- (c)(i) This was well answered.
- (ii) This was well answered, although incorrect reference to 'primary consumer' was quite common.
- (iii) This discriminated between candidates well. Those who were able to understand the context recognised that the herbivores would be unable to taste the bitter nature of the food and would therefore have access to more food. Some candidates correctly deduced that this may result from a 'gene mutation' or via 'natural selection'. Candidates who did not fully understand the context of the question often repeated information provided as their response and therefore did not gain credit.

Question 3

- (a)(i) This was well answered by most candidates. A proportion of candidates stated that an enzyme will 'change the rate' of the reaction without indicating that the rate would 'increase'.
- (ii) This was well answered by candidates who recognised the need to adapt their knowledge to the information provided. Many candidates began by unnecessarily stating the lock and key hypothesis of enzyme action. Full credit was often awarded though, as a large proportion of candidates went on to clearly explain the effect of the boiling water on this model of enzyme action. Specific reference to a lack of 'fit' or 'complementarity' for the 'substrate' was required instead of simple reference to an inability for 'binding' to occur.
- (b) This was well answered and required candidates to suggest advantages based on the information provided. Many candidates were able to do this well and it was encouraging to see so many candidates successfully demonstrating this skill.

Question 4

- (a) A significant proportion of candidates did not attain full credit. Common errors were the inclusion of 'water' on both sides of the equation and symbol equations that were either unbalanced or incorrectly balanced. Some candidates mistakenly stated the equation for aerobic respiration rather than that for photosynthesis.
- (b)(i) The majority of candidates were not able to give a full or fluent response to this question. There was common incorrect reference to the air stone providing 'carbon dioxide' for 'photosynthesis' rather than 'oxygen' for 'aerobic respiration'. Correct reference to 'growth' was more common, however this was often attributed to the absorption of 'nutrients' by the plant rather than more specifically of the 'ions' or 'magnesium' provided in the nutrient solution.
- (ii) This was well answered, although incorrect reference to 'xylem' was sometimes seen.
- (iii) This was well answered. Infrequent incorrect reference to 'osmosis' or 'diffusion' was seen.
- (c)(i) The majority of candidates were able to identify the best concentration as 125 parts per million.
- (ii) In contrast to (c)(i) this explanation was only moderately well stated by most candidates. Many candidates did not correctly link the data in the table to their explanation. Most candidates were able to link 'magnesium' and 'chlorophyll', however a proportion stated incorrectly that 'magnesium contains chlorophyll'. Few candidates related the increased production of chlorophyll to an increased rate of photosynthesis or to the production of the carbohydrate product. Reference to the production of 'food' by photosynthesis was not sufficiently specific to gain credit.

Question 5

- (a) (i) This was well answered.
- (ii) This was well answered. Most candidates were able to manipulate a significant amount of data to derive the correct numerical response.
- (iii) This was moderately well answered. There was evidence that some candidates incorrectly thought the movement of water was into, rather than from, the ileum. Many candidates did not gain credit for their reference to a 'gradient' as this was often not sufficiently well defined as being a 'water potential gradient' or from a 'higher **water** concentration' to a 'lower **water** concentration'. Simple reference to 'from high to low concentration' was insufficient to gain credit.
- (b) The related theory appeared to be known by only a small proportion of candidates. Many candidates gained credit for reference to the 'kidney'. Only few went on to outline the 'filtration of' or 'removal of water from' the 'blood' to gain the second mark. A significant proportion of candidates made incorrect reference to 'egestion' rather than to 'excretion'.

Section B

Question 6

- (a) This was well answered by the most candidates. **P** was correctly identified by almost all candidates as a 'sweat gland'. Incorrect identification as either a 'sweat duct' or as a 'sebaceous gland' was sometimes seen. **Q** was correctly identified less often as a 'capillary'. Incorrect identification as an 'arteriole' was sometimes seen. Incorrect reference to 'movement' of capillary blood vessels within the skin was sometimes seen. Few candidates made specific reference to blood flow being increased to the skin 'surface'. Reference to 'cooling' was insufficient to gain credit as reference to 'heat loss' was required.
- (b) A lack of precision in some responses resulted in some candidates not gaining full credit here. With reference to negative feedback, a proportion of candidates incorrectly referred to the homeostatic control of factors other than temperature.

Question 7

- (a) The majority of candidates gained credit here for a good definition of the term. Reference to 'toxic' substances was less commonly seen. Reference to 'waste' rather than to 'metabolic waste' or to a correct waste substance was also commonly seen and did not gain credit. A significant proportion of candidates made incorrect reference to 'faeces' or 'egestion', which did not allow them to gain full credit.
- (b) (i) Candidates were better able to explain the function of the dialysis membrane than they were able to describe its structure. Reference to the increased 'length' and 'surface area' of the membrane was infrequent. Errors were often made when candidates attempted to outline the movement of specific molecules through the dialysis membrane in either direction.
- (ii) This was less well answered, with a significant number of candidates not gaining credit. The most common misconception seen was that the concentration of molecules removed from the blood can become **higher** in the dialysis fluid than in the blood. Many candidates went on to incorrectly suggest that these molecules would then **move back into** the blood. Some candidates made correct reference to the need for a continued concentration gradient. Examiners were pleased to see some go on to make correct reference to the continued removal of urea from the blood into the replaced fluid.

Section C

Question 8

This question was the less frequently answered of the two questions in **Section C**.

- (a) This was well answered. Many candidates made correct reference to 'memory', 'learning' and 'intelligence' which were alternatives for the same marking point. Candidates often did not then go

on to describe other roles of the cerebrum such as 'thought', 'speech' or the control of 'senses'. Reference to control of 'voluntary actions' was also less frequently seen.

- (b) The most common response here related to the control of body 'balance'. Few candidates went on to describe the role of the cerebellum in the control of 'involuntary actions'.
- (c) Most candidates made correct reference to the process of 'homeostasis'. Many went on to refer to a factor controlled by this process without specific reference to control of the factor in the 'blood'. Few candidates explained the principles of control in the detail required for full credit.

Question 9

This question was the more frequently answered of the two questions in **Section C**.

- (a) This was well answered. Many candidates were able to refer to specific structures that are cut during the surgery. Some candidates were able to correctly explain the consequence of this. A significant proportion of candidates incorrectly stated that cutting the sperm duct would prevent sperm 'production'. Specific reference to 'fertilisation' or to 'fusion of gametes' was required rather than simple reference to gametes 'meeting'. Reference to 'ovary duct' rather than to 'oviduct' was common, however credit was awarded by Examiners in this instance.
- (b) This was very well answered. Many candidates were able to list at least five points and therefore gained full credit. Commonly seen points included correct reference to sexual behaviour and to avoidance of sharing needles etc. Direct reference to 'sexual' behaviour was required to gain credit, with reference to a 'partner' alone being insufficient.

BIOLOGY

Paper 5090/31 Practical Test

Key messages

Candidates should read and follow the instructions thoroughly: if a question states for example, that a line should be drawn, then full marks are unlikely to be awarded if no line is evident.

Candidates should also read the questions carefully and be aware of the difference in command words such as *describing* an effect and *suggesting a reason* for that effect.

General comments

There were few instances of questions that were not attempted. The number of marks awarded overall covered the whole range of those available and it appeared that candidates had sufficient time to complete the paper.

There has been further improvement in the drawing of graphs. Most candidates are following instructions and drawing the type of graph indicated as well as using linear scales with values at the origin. However, candidates should be aware that, unless requested, graphs should not be extrapolated beyond the plotted data.

Drawings also continue to improve, with clearer outlines, less shading and more attention to detail.

Comments on specific questions

Question 1

- (a) (i) The majority of candidates recorded the expected colours.
- (ii) All candidates recorded something on the answer line – either a 0 if a timer was used or the actual time if a clock or watch was used.
- (iii) The majority of candidates gave good descriptions of what was seen although sometimes the changes were quite small. Most correctly recorded very little change in **A** over the 20 minutes and it was evident that **C** was darker than **A**. However, it was not always clear from the colour descriptions that **B** was darker than **C** after 20 minutes.
- (iv) Most pH values were correctly recorded in the table. In a few cases, one or more values were outside the acceptable range. Some candidates wrote 'pH' next to the value in the cells which should not be written when pH is given in the header of the table. A very small number of candidates recorded the colour of the indicator rather than the pH value.
- (b) (i) Candidates should understand what the command word at the beginning of a question is asking of them. Here 'describe' asks 'what was observed', in this case the effect of the hydrochloric acid on the banana – by comparing it with the banana with no treatment – using the observations recorded in the table, i.e. the acid stopped the banana from turning brown. Many candidates suggested reasons here rather than answering the question asked.
- (ii) Candidates were asked to suggest a reason for the effect of the acid, i.e. why it stopped the banana turning brown. In the introduction to **Question 1**, candidates were told that enzymes are



involved in this process and many realised that the acid was preventing the action of these enzymes, probably by denaturing them.

- (iii) Stating the effect of cutting up slice **B** involves only the observed difference between **B** and the slice that was not cut up (**C**), i.e. the pieces turned brown more quickly. Some answers gave explanations of *why* this happened without stating *what* had happened. This was not required in this question.
 - (iv) Most candidates correctly suggested that the increased surface area of the banana allowed more exposure to oxygen or to enzymes. A few incorrectly wrote that smaller pieces would give a smaller surface area.
- (c) This question was asking candidates to think about the method they had carried out in order to identify difficulties in describing their observations. There were those who recognised that describing the colours was not easy because it was very subjective. To improve on this, suggestions about using some sort of standard colour chart or leaving the slices for a longer time (so that any changes might be more noticeable) were given credit. Some candidates simply stated general principles of carrying out investigations, e.g. that they should be repeated to make the results more reliable. Whilst being true, this was not answering the question set.
- (d) This question required candidates to design an experiment to determine the optimum pH for a banana to turn brown. Some candidates simply repeated what they had already done and calculated a mean, which would not have determined the optimum pH. Creditworthy answers involved placing freshly cut banana slices in solutions of varying pH for a given time, then removing them from those solutions and observing which of them turned brown in the least time. Some candidates incorrectly thought that the slices would change colour while still immersed in the pH solutions.

Question 2

- (a) There were some very well constructed line graphs with fully labelled axes, good linear scales, accurate plotting and plotted points joined with ruled lines as instructed. Common errors were plotting the independent variable (time) on the y-axis, incompletely labelling the axes or labelling them with the wrong variable. Some candidates used a non-linear scale – particularly on the x-axis, and others were inaccurate when plotting the points. Despite the instruction to join the plotted points with ruled lines, some drew a curved line and a few ruled one line of best fit instead of joining their individually plotted points.
- (b) Most candidates knew how to use the graph to find the rate of breathing at 5 minutes, but a few did not show their working on the graph as asked for and a significant number did not include units with the value obtained.
- (c) Although the question asked about rate of breathing, many answers given described measuring pulse rate which could not be credited. Measuring a rate must involve a time factor and many responses noted that a timer could be used, although it was not always clear what was being measured and for how long.
- (d) Too many responses involved counting heart beats despite the question being about breathing. A few correctly recognised that depth of breathing or the volume of air breathed in and out could be measured to determine the full effect of exercise on breathing.

Question 3

- (a) (i) There were some good drawings – large as asked for, with clear, clean outlines, good proportions and the correct number of teeth on each side of the leaf. In some instances outlines were sketchy, the stalk of the leaf was drawn with a single line, or the number and/or relative positions of the teeth were inaccurate. These drawings did not gain full credit.
- (ii) Some candidates did not draw lines as requested and occasionally units were not given. However, most measurements of drawings were accurate and included correct units.

- (iii) Many candidates understood that dividing the measurement of their drawing by the measurement of the leaf in the photograph would give them the magnification of their drawing. It should be noted that a magnification has no units so including mm or cm in the answer would not gain full credit.
- (b) Reading all the information and following the instructions given was key to answering this question and many candidates did this well. A few candidates indicated the correct answer by ticking the correct boxes but then incorrectly went on to name a completely different tree – often not in the key – on the answer line.

BIOLOGY

Paper 5090/32 Practical Test

Key messages

Any instructions should be read and carefully carried out.

Information provided in a question should be read and taken into consideration when giving an answer.

The demands of the different command words should be understood and responded to when answering questions e.g. the difference between 'Describe' and 'Explain'.

When not specified, relevant units should be given with measurements.

General comments

Scripts were legible and there was nothing that indicated that candidates did not have sufficient time to complete all the questions

Comments on specific questions

Question 1

- (a) (i) The majority of candidates completed the table, recording that the seedlings grown in light had greener and larger leaves and shorter stems compared to the yellow/paler, smaller leaves and longer stems of those grown in the dark.
- (ii) The majority of candidates recorded 10 measurements and calculated the two mean lengths, of those grown in the light and those grown in the dark, correctly. In most cases, those in the dark had longer stems.

There were a minority of candidates who were unable to calculate the means and simply entered a total value for each set of 5 lengths without dividing by 5. These could not be credited.

Very occasionally there was evidence that a candidate was unable to read a measurement from a ruler correctly with values such as 20.3, 20.5, 30.1 being recorded instead of 23, 25 and 31.

It should be noted that, in a table, information given in the headers should not be repeated within the cells of the table. In this case 'mm' in the header should not appear with the values entered in the cells of the table.

- (b) The investigation was about the effect of light and dark on plant growth. The candidates' results showed that the mean height of those seedlings grown in the dark was greater than those grown in light and they were now asked to apply that to a given situation – a shady forest – so answers should have been in terms of light/dark. Answers in terms of e.g. the plants were less likely to be consumed if they were taller could not be credited. Neither could answers that suggested that the plants could grow without light or that were theoretical rather than applied e.g. statements that less photosynthesis can take place in shady areas. Creditworthy answers showed an understanding that a plant growing in shade would be deprived of light and so growing taller could help it to reach above any surrounding vegetation to receive more light.

- (c) (i) There were many very well-constructed line graphs with fully labelled axes, good linear scales, accurate plotting and plotted points joined with ruled lines as instructed. Common errors were plotting the independent variable (time) on the y-axis, incompletely labelling the axes or labelling them with the wrong variable, using a non-linear scale often shown by placing no 0 at the origin, and careless plotting. There were those who, although instructed to join the plotted points with ruled lines, drew a curved line, as well as those who ruled one line of best fit instead of joining their individually plotted points.
- (ii) Most candidates knew how to read this value from their graphs, but some failed to show their working on the graph as asked for and others did not include units with the value obtained.
- (iii) The question asked for a description of the rate of growth of the plants so answers relating only to changes in actual height of the plants could not be credited. As the rate of growth changed during the 110-day period, it was expected that the various stages would be identified by referring to the days. Good answers described a slow rate between days 0 and 10 and then a rapid increase up to day 60. The rate declined from then until day 90 after which growth stopped and the rate became 0.

It should be noted that 'constant' does not necessarily mean that the rate became 0; the rate could continue at the same (constant) rate of increase.

There were a minority of candidates who either did not read the question carefully or who did not understand what was required in the answer. They attempted to describe the beneficial effects of fertilisers on the plant growth and could receive no credit.

- (iv) Many candidates correctly described doing exactly the same investigation with the same controlled variables except for no fertiliser being used. Those who simply described possible effects of using fertiliser on the growth of plants could not be credited as that was not what the question asked.
- (v) Suggestions of features other than height that could have been used to measure the increase in growth were asked for but too many candidates simply repeated height, even if it was expressed as the length of the stem. Such answers could not be credited. Answers in terms of size/length/surface area of the leaves or the number (but not amount) of leaves could. Other creditworthy answers related to the mass of the plants or the yield they produced.

Question 2

- (a) (i) The vast majority of candidates recorded the volume of milk they added to the beaker to obscure the cross marked on its base as asked. Very occasionally a candidate recorded a volume so small that it could not have had the desired effect. On reading their answer to (a)(ii) it became apparent that what had been recorded was not a volume but the depth of milk measured in centimetres – and that could not be credited.
- (ii) There were a range of creditworthy methods described. The most straightforward was to transfer the milk into the measuring cylinder and carefully read the value on the scale. Others began with a known volume of milk in the measuring cylinder and poured sufficient of that milk into the beaker to obscure the cross. They then read the volume of milk left in the measuring cylinder and subtracted the final volume from the initial volume to give the volume of milk used.
- (iii) The command word in the question was 'Describe' and nearly all candidates correctly recorded descriptions of what they had observed i.e. that the milk curdled or became colourless. As an explanation of why this had occurred had not been asked for, answers in terms of the casein being digested could not be credited.
- (b) Some well thought out and clearly expressed investigations were designed. Credit was given for preparing the fruit in some way so that it could be best used in the investigation. The criterion for determining that a protease could digest casein was milk becoming clear so that a mark on the base of its container, previously obscured, became visible. Credit was given for adding the fruit to such a container of milk and then observing whether the milk became clear or not. If clear, then it could be concluded that protease digests casein.

A number of candidates repeated what they had done in adding dilute hydrochloric acid to the milk either with the fruit or without which made the investigation invalid.

Some, having described a method well, concluded that the fruit did contain a protease – information that had already been given.

A few candidates used the correct method but added a protease enzyme, having not appreciated that the fruit contained one. Some simply referred to casein as though it were something distinct from milk.

A minority added prepared fruit to a marked beaker with no milk being mentioned. It was erroneously anticipated that the fruit would become clear so that the mark could be seen.

Other candidates thought that, as protein had been mentioned, the biuret test should be carried out on the milk – which would only have confirmed the presence or not of protein. A few Benedict's tests were described. Neither of these two methods could be credited.

Question 3

- (a) This question asked the candidates to use their observational skills to discern differences between the two bones in the photograph. Reasons for those differences were not asked for. The majority of candidates correctly recorded differences in the lengths and in the curvature of the shaft of the bones. Some correctly observed that the lower end of **C** was divided into two whereas **D** was undivided.
- (b) There were some excellent drawings – large, as asked for, and showing the good technique of clear, clean outlines drawn with a sharp pencil with no shading.
- (c) (i) The majority of candidates measured the correct bone, **D**, accurately and in millimetres as asked. Answers which could not be credited were those that were too inaccurate, of the wrong bone, of the drawing instead of the photograph and those given in centimetres.
- (ii) Calculating the actual length of bone **D** was done well by many candidates, dividing their measurement in (c)(i) by the magnification of the photograph, 0.17, and giving their answer with the correct units.

It should be noted that care needs to be taken in applying correct rounding principles when reducing the number of decimal places given in answers on calculators.

Too many candidates incorrectly multiplied the length in (c)(i) by 0.17, the magnification of the photograph. Their error should have become apparent to them when the actual length of the adult human upper leg bone was calculated as e.g. 136 mm which was far too small to be realistic.

BIOLOGY

Paper 5090/61 Alternative to Practical

Key messages

Candidates should read and follow the instructions thoroughly: if a question states for example, that a line should be drawn, then full marks are unlikely to be awarded if no line is evident.

Candidates should also read the questions carefully and be aware of the difference in command words such as *describing* an effect and *suggesting a reason* for that effect.

General comments

There were few instances of questions that were not attempted. The number of marks awarded overall covered the whole range of those available and it appeared that the candidates had sufficient time to complete the paper.

There has been further improvement in the drawing of graphs. Most candidates are following instructions and drawing the type of graph indicated as well as using linear scales with values at the origin. However, candidates should be aware that, unless requested, graphs should not be extrapolated beyond the plotted data.

Drawings also continue to improve, with clearer outlines, less shading and more attention to detail.

Comments on specific questions

Question 1

- (a) (i) Candidates were asked to enter the student's data into the table provided. Almost all did this, entering a value in every box of the first table and pHs correctly in the second table. The majority identified the colours correctly in the first table but there was the occasional carelessness on transferring the colours from the text to the table. It should be noted that when what is being measured is given in the header of a table, it should not be repeated within the cells of the table. In this case, pH should not appear against the values of 2, 6 and 6 entered in the second table.
- (ii) Although the word 'control' is familiar to many candidates, a significant number found it difficult to explain why a control is included in an investigation, i.e. so that the effect of treatments can be *compared* with the effect of no treatment being given. 'To find the effect of no treatment' was a common incomplete answer.
- (iii) If a volume of 50 cm³ is to be measured accurately, the piece of apparatus used must be graduated i.e. have a scale on it. The most suitable in a school laboratory is a measuring cylinder although a graduated pipette might be used. A beaker is not suitable in this instance.
- (iv) Candidates should be familiar with using standard laboratory equipment and appreciate the need to handle acids safely. Forceps or tweezers should be used to remove the banana slice from the acid.
- (v) In many instances candidates described measuring the pH of the banana slices using litmus paper which would not have produced the actual pH values recorded in (a)(i). Applying universal indicator to the surfaces of the banana would result in a colour that could be compared to the standard pH

colour chart and thus lead to actual pH values. A pH meter or probe could be used but how it would be used should also be described.

- (b)(i) Candidates should understand what the command word at the beginning of a question is asking of them. Here 'describe' asks 'what was observed', in this case the effect of the hydrochloric acid on the banana – by comparing it with the banana with no treatment – using the observations recorded in the table, i.e. the acid stopped the banana from turning brown. Many candidates suggested reasons here rather than answering the question asked.
- (ii) Candidates were asked to suggest a reason for the effect of the acid, i.e. why it stopped the banana turning brown. In the introduction to **Question 1**, candidates were told that enzymes are involved in this process and many realised that the acid was preventing the action of these enzymes, probably by denaturing them.
- (iii) Stating the effect of cutting up slice **D** involves only the observed difference between **D** and the slice that was not cut up (**E**), i.e. the pieces turned brown more quickly. Some answers gave explanations of *why* this happened without stating *what* had happened. This was not required in this question.
- (iv) Many candidates correctly suggested that the increased surface area of the banana allowed more exposure to oxygen or to enzymes. A few incorrectly wrote that smaller pieces would give a smaller surface area.
- (c) This question was asking candidates to think through the method as though they had carried it out themselves in order to identify possible difficulties in describing the observations. There were those who, looking at the colour changes given in (a)(i), recognised that describing them was not easy because it was very subjective. To improve on this, suggestions about using some sort of standard colour chart or leaving the slices for a longer time (so that any changes might be more noticeable) were given credit. Some candidates simply stated general principles of carrying out investigations e.g. that they should be repeated to make the results more reliable. Whilst being true, this was not answering the question as set.
- (d) This question required candidates to design an experiment to determine the optimum pH for a banana to turn brown. Some candidates simply repeated what had already been done and calculated a mean, which would not have determined the optimum pH. Creditworthy answers involved placing freshly cut banana slices in solutions of varying pH for a given time, then removing them from those solutions and observing which of them turned brown in the least time. Some candidates incorrectly thought that the slices would change colour while still immersed in the pH solutions.

Question 2

- (a) There were some very well-constructed line graphs with fully labelled axes, good linear scales, accurate plotting and plotted points joined with ruled lines as instructed. Common errors were plotting the independent variable (time) on the y-axis, incompletely labelling the axes or labelling them with the wrong variable. Some candidates used a non-linear scale, particularly on the x-axis, and others were careless when plotting the points. Despite the instruction to join the plotted points with ruled lines, some drew a curved line and a few ruled one line of best fit instead of joining their individually plotted points.
- (b) Most candidates knew how to use the graph to find the rate of breathing at 5 minutes, but a few did not show their working on the graph as asked for and a significant number did not include units with the value obtained.
- (c) Although the question asked about rate of breathing, many answers given described measuring pulse rate which could not be credited. Measuring a rate must involve a time factor and many responses noted that a timer could be used, although it was not always clear what was being measured and for how long.
- (d) Too many responses involved counting heart beats despite the question being about breathing. A few correctly recognised that depth of breathing or the volume of air breathed in and out could be measured to determine the full effect of exercise on breathing.

Question 3

- (a) (i) There were some good drawings – large as asked for, with clear, clean outlines, good proportions and the correct number of teeth on each side of the leaf. In some instances outlines were sketchy, the stalk of the leaf was drawn with a single line, or the number and/or relative positions of the teeth were inaccurate. These drawings did not gain full credit.
- (ii) Some candidates did not draw lines as asked for and occasionally units were not given. However, most measurements of drawings were accurate and included correct units.
- (iii) Many candidates knew that dividing the measurement of their drawing by the measurement of the leaf in the photograph would give them the magnification of their drawing. It should be noted that a magnification has no units so including 'mm' or 'cm' in the answer would not gain full credit.
- (b) Reading all the information and following the instructions given was key to answering this question and many candidates did this well. A few candidates indicated the correct answer by ticking the correct boxes but then incorrectly went on to name a completely different tree – often not in the key – on the answer line.

BIOLOGY

Paper 5090/62 Alternative to Practical

Key messages

Any instructions should be read and carefully carried out.

Information provided in a question should be read and taken into consideration when giving an answer.

When not specified, relevant units should be given with measurements.

General comments

Scripts were legible and there was nothing that indicated that candidates did not have sufficient time to complete all the questions.

Comments on specific questions

Question 1

- (a) (i) Most candidates understood that factors in an investigation needed to be controlled and were able to correctly state two such factors in this investigation. Although the question stated that these factors should not include light and dark, there were those who gave light as one of them which could not be credited.
- (ii) The majority of candidates were able to measure the seedling accurately. A few recorded measurements in centimetres although mm was written on the answer line and so these could not be credited. An minority were unable to read a measurement from a ruler recording e.g. 20.3 mm instead of 23.
- (iii) The transferring of data into the table was completed well by most candidates and most knew how to calculate the means correctly. The most frequent error was the failure to include their own measurement from (a)(ii) in the light column as instructed.

It should be noted that, in a table, information given in the headers should not be repeated within the cells of the table. In this case, mm in the header should not have appeared with the values entered in the cells of the table.

- (b) (i) There were few good answers suggesting that increasing the sample size would increase the reliability of the investigation by helping to identify any anomalous results. Frequently, even when reliability was suggested, improving accuracy also appeared which could not be credited. Accuracy is involved in finding the true value; measuring more seedlings would not improve this.
- (ii) The investigation was about the effect of light and dark on plant growth. The candidates had worked out that the mean height of those seedlings grown without light was greater than those grown with light and were now asked to apply that to a given situation – a shady forest – so answers should have been in terms of light/dark. Answers in terms of e.g. the plants were less likely to be consumed if they were taller could not be credited. Neither could answers that suggested that the plants could grow without light or that were theoretical rather than applied e.g. statements that less photosynthesis can take place in shady areas. Creditworthy answers showed an understanding that a plant growing in shade would be deprived of light and so growing taller could help it to reach above any surrounding vegetation to receive more light.

- (iii) The question asked for one other visible difference between the seedlings i.e. apart from the length of the stems. Many candidates simply repeated that those in the dark were taller than those in the light and so received no credit. Good answers pointed out differences in the colour or the size of their leaves.

(c) (i) There were many well-constructed line graphs with fully labelled axes, good linear scales, accurate plotting and plotted points joined with ruled lines as instructed. Common errors were plotting the independent variable (time) on the y-axis, incompletely labelling the axes or labelling them with the wrong variable, using a non-linear scale often shown by placing no 0 at the origin, and careless plotting. There were those who, although instructed to join the plotted points with ruled lines, drew a curved line, as well as those who ruled one line of best fit instead of joining their individually plotted points.

- (ii) Most candidates knew how to read this value from their graphs, but some failed to show their working on the graph as asked for and others did not include units with the value obtained.

- (iii) The question asked for a description of the rate of growth of the plants so answers relating only to changes in actual height of the plants could not be credited. As the rate of growth changed during the 110-day period, it was expected that the various stages would be identified by referring to the days. Good answers described a slow rate between days 0 and 10 and then a rapid increase up to day 60. The rate declined from then until day 90 after which growth stopped and the rate became 0.

It should be noted that 'constant' does not necessarily mean that the rate became 0; the rate could continue at the same (constant) rate of increase.

There were a minority of candidates who either did not read the question carefully or who did not understand what was required in the answer. They attempted to describe the beneficial effects of fertilisers on plant growth and could receive no credit.

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- (v) Suggestions of features other than height that could have been used to measure the increase in growth were asked for but too many candidates simply repeated height, even if it was expressed as the length of the stem. Such answers could not be credited. Answers in terms of size/length/surface area of the leaves or the number (but not 'amount') of leaves could. Other creditworthy answers related to the mass of the plants or the yield they produced.

Question 2

- (a) This question asked the candidates to use their observational skills to discern differences between the two bones in the photograph. Reasons for those differences were not asked for. The majority of candidates correctly recorded differences in the lengths and in the curvature of the shaft of the bones. Some correctly observed that the lower end of **C** was divided into two whereas **D** was undivided.
- (b) There were some excellent drawings – large, as asked for, and showing the good technique of clear, clean outlines drawn with a sharp pencil with no shading.
- (c) (i) The majority of candidates measured the correct bone, **D**, accurately and in millimetres as asked. Answers which could not be credited were those that were too inaccurate, of the wrong bone, of the drawing instead of the photograph and those given in centimetres.
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It should be noted that care needs to be taken in applying correct rounding principles when reducing the number of decimal places given in answers on calculators.

Too many candidates incorrectly multiplied the length in **c)(i)** by 0.17, the magnification of the photograph. Their error should have become apparent to them when the actual length of the adult human upper leg bone was calculated as e.g. 136 mm which was far too small to be realistic.

Question 3

- (a) To answer this question well candidates needed to read the information provided carefully and to think through the method described as though they had carried it out themselves. There were some very good answers. For example, some realised that, once sufficient milk had been poured into the beaker to render the cross on the bottom invisible, that milk should then be poured into a measuring cylinder and a reading of the volume taken. Others began with a known volume of milk in a graduated container, poured sufficient of that milk to obscure the cross into the beaker, read the volume of milk left in the graduated container and subtracted the final volume from the initial volume to give the volume used. Another creditworthy method was to draw the cross on the bottom of a measuring cylinder rather than a beaker, pour the milk into that measuring cylinder until the cross could no longer be seen and simply take the reading of that volume on that measuring cylinder. In questions such as this, which relate specifically to measuring a volume, using the word 'amount' instead of 'volume' cannot be fully credited.

- (b) Some well thought out and clearly expressed investigations were designed. Credit was given for preparing the fruit in some way so that it could be best used in the investigation. The criterion for determining that a protease could digest casein was milk becoming clear so that a mark on the base of its container, previously obscured, became visible. Credit was given for adding the fruit to such a container of milk and then observing whether the milk became clear or not. If clear, then it could be concluded that protease digests casein.

A number of candidates, having described a method well, concluded that the fruit did contain a protease – information that had already been given.

A few candidates used the correct method but added a protease enzyme, having not appreciated that the fruit contained one.

A minority added prepared fruit to a marked beaker with no milk being mentioned. It was erroneously anticipated that the fruit would become clear so that the mark could be seen.

A few candidates did not use the method described previously and could not be credited e.g. as a protein had been mentioned, the biuret test was carried out on the milk – which would only have confirmed the presence or not of protein.