

BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

This paper produced a wide spread of marks and so differentiated well.

Comments on specific questions

Question 8

Option **B** proved popular - there seems to be a lack of understanding that if a nutrient (for example, fat) is in excess, it can lead to malnutrition.

Question 10

In this question, many candidates selected option **A**. This indicates that they may have missed the critical 'not' in the wording of the question. Candidates must read the question carefully before answering.

Question 11

This question was not well answered. Since the distractors are all about physical processes, it would seem that the link between active transport and the need for energy is not widely understood.

Question 15

This is a difficult question. **D** was the most popular answer with candidates of all abilities, showing that they understand that blood leaving the kidneys has a low concentration of urea, and that blood about to enter the kidneys does have a high concentration, but it will be less than that leaving the liver where it is produced and before it is diluted by mixing with blood from other parts of the body.

Question 19

This question was not well answered. There seems to be a lack of understanding that the kidney filters a large volume of blood to produce a small volume of concentrated urine.

Question 23

Many candidates of all abilities selected option **A** and the question therefore discriminated poorly. A block at X would prevent the person feeling the pinprick but would also of course prevent the reflex action described.

Question 30

This question was not well answered. It was expected to be an easy question on the carbon cycle and the mathematical demand of the question was low, so the problem seems to have been in identifying which of the arrows represented the process of respiration.

Question 33

The majority of candidates of all ability levels selected option **B**. They were perhaps understandably confused by the diagram which they seem to have interpreted as showing a daughter plant being produced from a flower. However, the presence of both flowers and bulbs should have signalled both sexual and asexual reproduction taking place (option **C**).

BIOLOGY

Paper 5090/12
Multiple Choice

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

General comments

This paper produced a wide spread of marks and so differentiated well.

Comments on specific questions

Question 1

Option **A** proved popular - many candidates apparently believe that chloroplasts are cells or perhaps struggle with the use of the terms organ and organ system with respect to plants.

Question 15

This is a difficult question. **D** was the most popular answer with candidates of all abilities, showing that they understand that blood leaving the kidneys has a low concentration of urea, and that blood about to enter the kidneys does have a high concentration, but it will be less than that leaving the liver where it is produced and before it is diluted by mixing with blood from other parts of the body.

Question 19

This question was not well answered. There seems to be a lack of understanding that the kidney filters a large volume of blood to produce a small volume of concentrated urine.

Question 22

This question was not well answered. Candidates frequently confuse the pupil reflex with accommodation, and this is likely to have been the problem.

Question 23

Many candidates of all abilities selected option **A**. A block at X would prevent the person feeling the pinprick but would also prevent the reflex action described.

Questions 4, 27, 30, 36

These questions were all well answered by the majority of candidates. They all are legitimate questions targeting syllabus content and the high success rate reflects the fact that candidates were well-prepared for this examination.

BIOLOGY

Paper 5090/21
Theory

Key messages

It was clear that many candidates had been well prepared and were able to demonstrate their understanding and knowledge on this paper. Generally, candidates found straightforward recall questions more accessible than those requiring an application of knowledge. The optional questions demonstrate this very clearly; candidates failed to score credit here because they did not develop their ideas fully, perhaps because they were not fully secure about their suggestions. Plenty of in-depth questioning during lessons may perhaps help them to feel more confident.

General comments

It was pleasing to see that most candidates attempted all the compulsory questions and that there was no evidence of any being short of time. The space available for answering was appropriate and, in general, candidates gave concise answers that addressed the question. It is still the case that candidates sometimes lost marks because they did not read the question carefully enough. Good examination technique involves giving yourself the time to understand what the question is asking so that you can define the scope of your answer. It may be helpful to some candidates to underline particular phrases, to read the question more than once or to jot down some ideas before re-reading the question. It will always be the case that there are no marks for repeating statements in the stem of the question so candidates should avoid this.

Comments on specific questions

Section A

Question 1

This first question about the uptake and use of mineral ions was generally well attempted by candidates.

- (a) (i) Most candidates were able to gain credit for recognising either the cell wall or the sap vacuole as a feature identifying the cell as a plant cell. Some candidates lost a mark because they only used the word 'vacuole' rather than distinguishing it from animal cell vacuoles by describing it as large, central or as a sap vacuole.
- (ii) Many candidates scored well on this question by giving accurate and detailed accounts of the active transport of mineral ions. Many also mentioned conditions where diffusion would be the mechanism for uptake. Candidates were most likely to lose marks for failing to include detail or for not correctly linking the concentration gradient of the mineral ions to the mode of transport. It was rare to see candidates mentioning the fact that mineral ions were dissolved in soil water or that they passed through the cell wall before moving across the partially permeable cell membrane.
- (b) The fact that magnesium deficiency results in yellowing of leaves is well known and many also knew that this was caused by a deficiency of chlorophyll. Candidates need to make sure that they express themselves clearly; it was not enough for them to state that magnesium is a component of chlorophyll. They had to make it explicit that less magnesium results in less chlorophyll and therefore causes yellow leaves.

Question 2

This question assessed knowledge and understanding across a range of topics in the syllabus.

- (a) (i) Most candidates were able to identify the lens although a common incorrect answer was to identify it as the pupil, indicating that these candidates do not understand that the pupil is a hole in the iris through which light passes.
- (ii) Many candidates were able to score at least one of the two marks available, usually for describing a function of the lens as refraction, focussing or accommodation. A smaller number were able to describe the structure of the lens and how it relates to its function. Credit was given for any answers that explained that the lens was able to change shape or that it was curved or spherical. Relatively few candidates chose to explain that the lens is transparent so that light can pass through and reach the retina.
- (iii) The majority of candidates knew that layer Y is the retina although a common incorrect answer was the sclera.
- (b) (i) This question proved difficult for candidates and only a few were able to use the diagram of a section through an eye and their knowledge to interpret the photograph of the back of an eye. To develop this skill it would help students to have plenty of practice at comparing actual biological specimens or photographs with biological diagrams.
- (ii) The focus here was the role of blood in transport and many good, detailed answers were seen gaining three or four of the available marks. Other candidates recognised that blood was important for the eye but gave very vague answers about keeping the eye alive or providing nutrients. Students should be encouraged to be specific in their answers by explaining how blood is essential for keeping cells alive, or by specifying which nutrients are being used and why.
- (c) In this question candidates needed to be able to combine their knowledge of reflex arcs with their understanding of how the pupil of the eye becomes smaller. There were eight different marking points available which enabled those with a good understanding of these topics to gain the maximum four marks. Candidates should be encouraged to use the term 'electrical impulse' when describing what happens in a neurone rather than 'information' or 'message'. Also, many seemed unaware that it is the brain rather than the spinal cord that is involved in reflexes involving structures located in the head. Although many gained marks for correctly remembering the action of the radial and circular muscles of the iris, others incorrectly suggested that the radial muscles contracted.
- (d) (i) This question scored highly with many candidates gaining three or four marks. Marks were most often lost because of a lack of understanding of the term phenotype which resulted in some leaving this line blank or writing a letter instead of a description of whether or not the individual produced melanin. Very occasionally a candidate lost marks for not following the rubric and using letters other than A and a.
- (ii) This question was successfully answered by the majority of candidates.

Question 3

The ecological parts of this question required candidates to explain ideas accurately and with clarity.

- (a) (i) Ecological terms have precise definitions and it is advised that candidates learn definitions provided in the syllabus. Here, many candidates lost a mark because they simply said that producers make food, which is too vague a statement to score marks.
- (ii) Many candidates lost a mark here because they could not use their own words to convey the idea that a food chain represents the transfer of energy from organism to organism.
- (b) It was rare to find a candidate scoring all four marks for this question; partly because many struggled to interpret the pyramids correctly and partly because many found it difficult to express their understanding with sufficient clarity. More practice at interpreting pyramids of numbers and biomass from different ecosystems should help candidates to interpret these diagrams.

- (c) This question was well answered by the majority. Only a few candidates struggled to suggest adaptations for insect-pollination.
- (d) Meiosis and mitosis are two terms that need to be spelled correctly when answering questions since they have many letters in common and the Examiner needs to be sure that the candidate has picked the correct term. For this question meiosis is the answer but many lost a mark because of incorrect spelling or because mitosis was the answer given.

Question 4

The alimentary canal and its associated organs are generally well understood by candidates.

- (a) Most could identify the oesophagus, duodenum and gall bladder. The most common error was to forget that this was the first loop of the small intestine, the duodenum, and to label it the ileum instead. Some incorrectly labelled the gall bladder as the bile duct.
- (b)(i) The functions of the stomach are well understood by candidates with many scoring the maximum three marks.
- (ii) Providing candidates read the question carefully they were able to identify the pancreas as the organ involved in homeostasis and make a correct reference to its role in the control of blood glucose concentration in their answer. Some, who identified the pancreas correctly, then went on to describe its role in digestion rather than homeostasis and so did not access the second mark.

Question 5

This question tested candidates' knowledge of two areas of the syllabus; locomotion and the effect of humans on the environment.

- (a) The majority of candidates were able to obtain marks on this question with most having a clear idea of the antagonistic action of the biceps and triceps muscles in the arm. It was rare, however, for candidates to gain marks for mentioning what happened to the bones. To do this they needed to either locate the position of a bone in the arm or to describe the radius and ulna being pulled closer to the humerus.
- (b) The harmful effects of artificial fertilisers leaching into streams and lakes are generally well understood and describing these effects is where candidates were most likely to gain marks. The effects of insecticides are less well known and only a few candidates explained that insecticides can kill helpful as well as harmful insects. Fewer still went on to explain how application of insecticides impacts biodiversity and ecosystems.

Question 6

In this question about yoghurt, candidates were asked to explain how yoghurt is produced and to what extent it can contribute to a balanced diet.

- (a) Many candidates had an excellent recall of the yoghurt-making process and those that had revised this topic were often able to score the full five marks with concise, accurate answers. Candidates were most likely to struggle to explain when and why milk is heated. Some described the starter culture being added to the milk and then the milk being pasteurised to remove unwanted microbes, not realising that *Lactobacillus* would also be destroyed.
- (b) This question required candidates to analyse the nutritional values in yoghurt and to apply their knowledge of a balanced diet. Many answers tended to focus on components of a balanced diet that were missing from yoghurt such as fibre, iron and vitamin C and did not address the first part of the statement which stated that yoghurt can contribute to a balanced diet e.g. by providing fats and carbohydrates for energy and proteins for growth and repair.

Question 7

Knowledge of the circulatory system, the excretory system and the nitrogen cycle were being assessed in this question.

- (a) Candidates were expected to start their answers from the point at which urea left the liver cells but some candidates forgot that they had already been told that amino acids are broken down to form urea and supplied details of deamination which were beyond the scope of the question. Almost all understood that the urea is transported to the kidneys. Candidates usually gained credit for mentioning that urea is carried in the bloodstream and often candidates correctly mentioned renal arteries being involved. Less frequently, candidates gave correct details of the involvement of the hepatic vein, vena cava and aorta. It was very rare for candidates to mention that the urea is dissolved in the plasma. The gross structure of the urinary system is generally well understood with relatively few candidates getting confused with the ureters and the urethra. Candidates were most likely to struggle with explaining that urea is filtered from the blood by the kidney. Candidates also need to be careful about how they use the words urea and urine. Some used phrases such as 'urea becomes urine in the kidney' suggesting that they do not understand that urea is a component of urine.
- (b) Candidates needed to apply their knowledge of the nitrogen cycle to answer this question. Some very good answers were seen with candidates explaining that nitrifying bacteria convert the urea to nitrates and that plants take up nitrates to make proteins. Marks were available for conveying the idea that nitrates taken from the soil need to be replenished but candidates did not often mention the nitrogen cycle explicitly.

Question 8

Approximately half of the candidates opted for this question on photosynthesis and the effects of an increasing human population.

- (a) Most candidates found this part of the question more accessible and were able to explain that photosynthesis is the mechanism by which plants manufacture carbohydrates. The highest scoring answers were those from candidates who had read the question carefully and described how water for photosynthesis is absorbed via root hairs and that carbon dioxide is absorbed from the atmosphere through the stomata. A misconception for some candidates is that water is absorbed through the leaves. Quite a few candidates missed out on a mark for describing the carbohydrates, or a named carbohydrate, produced. Candidates should be encouraged to be as precise as possible in their answers. For example, 'food' is too general a term to be awarded credit here.
- (b) Many candidates struggled to score credit here. The majority appreciated that an increase in population size would increase the demand for food for the first marking point, but were unable to identify other effects of an increase in population size and the consequences of this for the environment. They were most likely to appreciate that more crops require more space but then did not explain fully why this space was unlikely to be available.

Question 9

The candidates who chose this question were well prepared and had a detailed knowledge of the way in which the diaphragm and rib cage work together to increase the volume of the thoracic cavity, lowering pressure and causing air to be drawn into the lungs. This allowed them to do very well on the first part of the question.

- (a) Some excellent answers were seen and many candidates were able to score the maximum five marks. Those losing marks generally lost them through a lack of detail in their answers or because there was some confusion in their minds about the actions of the diaphragm or the muscles attached to the rib cage.
- (b) Candidates were expected to apply their knowledge here to suggest how inflammation and a collection of mucus would affect an individual and how they could avoid developing bronchitis. It was very rare to see full marks on this question. Candidates were generally able to give at least one effect of bronchitis such as coughing to remove mucus or the idea that the airways would become blocked by mucus. They could also suggest avoiding cigarette smoke as a means of preventing bronchitis. The best answers were from candidates who extended their thinking and

were able to explain the consequences of blocked airways on the availability of oxygen for respiration and how this might make people tired and breathless when carrying out activities.

BIOLOGY

Paper 5090/22
Theory

Key messages

Examiners noted that some candidates were able to respond well to information presented in unfamiliar contexts. 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. The necessity to link concepts between different areas of the syllabus is important when answering some questions. 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. Examiners were pleased to see that a greater proportion of candidates this session were able to correctly identify and compare the processes of mitosis and meiosis in **Question 6**. Detail relating to the processes by which named molecules are absorbed from the contents of the small intestine into the blood were less well known in **Question 5**. Questions requiring tailoring and application of knowledge continued to provide more challenge for even some highly attaining candidates. A greater degree of specificity was required in some responses as noted for individual questions below. 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) This question well answered, with a large majority of candidates correctly identifying the tooth as a 'canine'. The most common incorrect answer was 'incisor'. A majority of candidates did score the mark for function, with 'tearing' being the most commonly seen correct response. Reference to 'cutting' was a commonly seen incorrect response.
- (b) (i) This question was correctly answered by a large majority of candidates. Some candidates did not score the available mark because they rounded up/down to one decimal place.
- (ii) This question was moderately well answered. Almost all candidates correctly identified 'minutes' as being the correct unit. A variety of incorrect numerical answers were seen.
- (c) (i) A large proportion of candidates scored one of the two marks for discussing one of the two differences. Some candidates incorrectly referred to 'honey' in their response instead of to 'sugar'.
- (ii) A large number of candidates scored two marks for reference to 'brushing teeth' and to 'reducing sugar intake'. Many candidates suggested 'regular dental check-ups' which, whilst correct for the correct care of teeth, was not considered to be a sufficiently specific way in which to prevent dental decay.
- (iii) This question proved a good discriminator. A significant number of candidates made reference to 'heart attack; or to 'heart failure'. Few candidates made reference to 'fatigue on physical activity' or to 'aerobic respiration' resulting in the production of 'lactic acid'.

Question 2

- (a) This question elicited a wide range of responses; stronger candidates were able to score all marks. The most commonly seen incorrect response was the 'hepatic vein' carrying blood 'at the highest pressure'.
- (b) This question was well answered by a majority of candidates who usually attained at least two of the available three marks. A number of candidates give imprecise descriptions of the 'pulmonary' and 'systemic' circulations. A large proportion of candidates did not specify the flow of 'blood through the heart twice'. Incorrect use of the word 'systematic' was sometimes seen.

Question 3

- (a) Few candidates attained both of the available marks. Many candidates named a general feature of a cell (e.g. nucleus, membrane etc.) without being specific to a fungus. Correct reference to 'hyphae', 'spores', 'saprophyte' or 'cell wall with chitin' were most commonly seen.
- (b) A small number of candidates did not attempt to answer this question, and of those who did, very few attained full credit. Many candidates scored marks for reference to 'less water transported', often in combination with reference to 'magnesium'. Most candidates were able to link this to the concept of 'less chlorophyll'. Some candidates made reference to 'loss of turgor', however very few candidates made reference to 'less water in cells'.
- (c) Many responses were characterised by incorrect reference to the carriage or transmission of a 'disease' rather than of the causative organism. Reference to the concept of transmission 'from one organism to another' was well known. A small number of candidates made reference to the vector not itself being infected.
- (d) (i) The majority of candidates gained credit here. Candidates who did not gain credit made reference to either another form of reproduction, or simply to 'gametes'.
- (ii) This question elicited a wide range of responses. Few candidates made reference to the plants being 'genetically identical', but instead made less specific reference to them containing the 'same genes'. A significant number of candidates answered incorrectly in terms of the 'inheritance' of the disease by the trees rather than their genetic susceptibility.

Question 4

- (a) (i) The majority of candidates scored the mark for reference to either 'rises' or 'expands'.
- (ii) A large proportion of candidates attained either full or partial credit. A small number of candidates did not gain credit as they did not identify the 'tubes' referenced in the question and instead made reference to organs such as the 'lungs' or the 'heart'.
- (iii) This was generally well answered.
- (b) Many candidates gained credit for reference to 'blood to organs' however many made reference to only 'air' in the lungs rather than to 'oxygen'. Very few candidates made reference to either 'diffusion', 'concentration gradient' or to 'aerobic respiration'. Whilst many candidates made reference to the pumping action causing the heart to beat they did not go on to suggest that this might result in the heart re-starting its own independent activity.

Question 5

A majority of candidates scored between one and three of the available six marks. A lack of knowledge directly relevant to the question was a common issue. Some candidates wrote extensively about general characteristics of villi (e.g. their location, size, surface area etc.) but then did not then go on to answer the question asked. Many candidates named incorrect molecules said to move by diffusion and active transport. Candidates that made reference to either a 'membrane' or 'epithelium' did not always make correct reference to the movement of molecules 'through' this so did not gain credit.

Section B

Question 6

- (a) This was correctly answered by a majority of candidates. Those who did not gain credit most commonly made incomplete reference to either 'sperm' or 'ovum' alone or to 'sex cell'.
- (b) A majority of candidates made correct reference to the cells being either 'haploid' or 'diploid'. A large number of candidates made irrelevant reference to the relative size of the cells and to whether they are the result of fertilisation. A common error was incorrect reference to 23 'pairs' of chromosomes in **M** and to 46 'pairs' of chromosomes in **N**.
- (c) The number of marks achieved for this question varied widely; with candidates who had correctly identified meiosis and mitosis for **K** and **O** often going on to gain further credit. Centres are reminded that only correct spelling of the terms 'mitosis' and 'meiosis' will be accepted. Very few candidates referred to meiosis as being 'reduction division' or identified that it takes place in the 'gonads'. Incorrect reference that equated the process of 'meiosis' to that of 'sexual reproduction' was common. Reference to a correct specific number of chromosomes at the start and end of each process was rarely seen.

Question 7

- (a) (i) This question was generally well answered by a significant majority of candidates, most of whom scored full credit. Centres are directed to the correct terminology on the mark scheme for each structure. Some candidates incorrectly identified **P** as a 'receptor'. Some candidates incorrectly identified **R** as an 'effector neurone' instead of as a 'motor neurone'. Whilst the passage of an 'impulse' was commonly seen, also was incorrect reference to passage of a 'signal' or 'message' which, as in previous sessions, did not gain credit.
- (ii) A majority of the candidates attained one mark for reference to the 'CNS' or the 'spinal cord'. Incorrect reference to either the 'brain' or to the 'spine' was common. A description of **Q** as being located 'between the sensory and motor neurones' was insufficient to gain credit.

Section C

Question 8

This was the most commonly answered question in this section.

Very few candidates gained full credit, however scores of seven or eight marks were quite common. Most candidates made correct reference to 'bile', but were often unable to explain the significance of this in fat digestion. Many candidates made correct reference to 'deamination' and to the production of 'urea'. The breakdown of alcohol was widely recognised, however the 'breakdown of hormones' was less commonly referred to. Most of the candidates recognised the relationship between 'glucose' and 'glycogen', however some confused 'glycogen' with 'glucagon'. Marking points relating to glycogen being 'insoluble' and 'not changing the water potential of cells' were very rarely seen. Many candidates made reference to the involvement of metabolism in the liver to thermoregulation, however only a few gained credit for reference to 'high metabolic rate'. The presence of 'iron' in the liver was quite widely recognised, whereas the role of the liver in the 'storage of vitamins' was very rarely credited.

Question 9

This was the least commonly answered question in this section.

A small number of candidates did not gain credit as they wrote about irrelevant processes including why antibiotics are used, what diseases can be treated by antibiotics, and genetically engineering bacteria to produce insulin. A small number of candidates misinterpreted the question to be about yogurt making rather than the production of an antibiotic. Penicillin was universally seen as a correct named antibiotic, however a significant proportion of candidates incorrectly made reference to penicillin being produced by a bacterium. A majority of the candidates recognised the role of a fermenter. Only a small proportion of candidates were able to clearly relate sterilisation with the need to prevent contamination or to give reasons for other aspects of management of the process. For example, specific reasons for the addition of carbohydrates and of

proteins were rarely seen. A majority of the candidates gained credit for correctly describing the control of temperature and pH, and a proportion of these candidates went on to link this control to the requirements of 'enzymes'. Many candidates described control of the conditions for growth, however most did not go on to acknowledge that this would result in 'increased' growth. Most candidates correctly described collection of the antibiotic.

BIOLOGY

Paper 5090/31
Practical Test

Key messages

Candidates should read all instructions given in questions carefully and respond accordingly.

Designing an investigation requires practical details of procedures that should be followed to achieve the aim.

In constructing a line graph, the independent variable should be plotted on the x-axis.

General comments

There was no evidence that candidates had insufficient time to answer all the questions set. Scripts were legible and answers were written in the spaces provided or, if there was insufficient space, a clear indication of where the continuation had been written was given.

Comments on specific questions

Question 1

(a) (i) There were some good tables constructed with two columns or rows defined by ruled lines. One column or row was headed 'seedling' for the number of the seedling measured and the other, 'height' with the units, mm, for recording the six measurements taken. It should be noted that in a table when units are given in a header, no units should be written in the cells of the table. Six measurements were usually recorded in millimetres, therefore in whole numbers, as asked for.

A few candidates did not actually construct a table but simply listed their results so could not be fully credited. Most candidates knew how to calculate the mean height but a few, in error, simply recorded the total number of millimetres without dividing by the number of measurements taken.

(ii) Although candidates had selected seedlings and measured them, many found identifying two possible sources of error difficult. However, some had selected seedlings with bent or curved stems that they had found difficult to measure while others found it difficult to be certain where the length of stem to be measured began and ended. Using a ruler where the 0 is not at the very end proved a source of uncertainty for some. These were all creditworthy answers. Frequently parallax was given as an answer but this is not applicable here because candidates should have avoided parallax error when taking the measurements. Measuring the wrong part was also mentioned, but again, this should not have happened if candidates had followed instructions.

(iii) When recording observations, as in this question, what was observed should be described rather than giving statements such as 'no change' or 'nothing happened'. Because the nature of biological material is variable, different answers describing what the candidate saw were credited, i.e. either the iodine solution remained yellow or the colour changed from yellow to blue-black. The conclusion drawn from the observation needed to match it i.e. no starch was present or starch was present.

(b) (i) Although some very good graphs were seen, constructing a line graph proved challenging for some candidates. Some did not appreciate that the independent variable, in this case, time, should be plotted on the x-axis. Axes were not always fully labelled with the variables given in the instruction – time and mean height – or omitted the units given in the list of results – days and mm. Many

candidates chose good scales which made full use of the grid provided but some were too small. Most scales were linear but some lacked appropriate values at the origin. A few thought, incorrectly, that simply using the given values equidistantly on the axes i.e. 6, 10, 12 etc. and 8, 23, 27 etc. would suffice. Some wrote only the values given in the results on linear axes but that was insufficient. The plotting of points was generally well done. However, although there was a clear instruction to join the points with ruled lines, some drew curves that could not be credited. Neither could ruled lines of best fit be credited as the joining of points was required. Frequently, the line was extrapolated from 6, 8 to 0, 0, although no data was given for 0, 0 and so no credit could be given for the line drawn.

- (ii) Many correctly stated that growth or mean height increased with time. Fewer candidates also stated that growth was either faster initially or slower at the end.
 - (iii) The time period when the rate of growth was the greatest, 6 – 10 days, could be worked out from the graph by recording the days when the upward gradient of the line was its steepest. The most common error here was to state the time at which the mean height of the seedlings was the greatest i.e. 23 days.
 - (iv) A rate of growth is an expression of how much growth occurred in a given time. On day 15 the seedlings' mean height was 32 mm; on day 20 it was 36 mm. The seedlings had grown 4 mm in 5 days so the rate of growth was 0.8 ($4 \div 5$) mm/day. Some candidates omitted mm/day so could not be fully credited. There were too many candidates who did not appreciate what a rate is or how to calculate one from given data.
 - (v) Many candidates were able to correctly identify two variables that should have been controlled. However, only a minority were able to give a good explanation for the need to control them. The effect of time on the growth of these seedlings was being investigated, so time should be the only quantity in the investigation that changed – the independent variable. All other dependent variables needed to remain the same throughout so that effect of time could be determined.
- (c) Some of the investigations designed to determine the effect of the pH of water on the growth of seedlings were excellent. At least three samples of seedlings were grown in Petri dishes with the pH of the water given to them being the only variable. Different pHs were achieved by using buffer solutions or adding acid or alkali to water to produce a range of identified pHs. The heights of a sample of seeds from each dish were measured after they had been growing for the same period of time and their mean height calculated in order to compare the growth in the different pHs of water.

Some points to be noted from answers seen:

- Mean heights cannot be measured; actual heights can be measured from which mean heights may be calculated.
- Measuring growth is not equivalent to measuring height.
- Specific time periods should be identified rather than using general terms such as 'several' or 'a few days'.
- Boiling then cooling water is not a method that will change its pH.

There were a few candidates who, not reading the question sufficiently carefully, described determining the effect of the seedlings on the pH of the water in which they were growing rather than growing seedlings in water of different pHs.

Many candidates made no attempt at designing an investigation with practical details, but rather described what they thought would be the effect of varying the pH on the growth of the seedlings or how to measure pH. Some described using food tests. Six marks were available, but these answers received no credit.

Question 2

- (a) (i) The majority of candidates were able to correctly identify the heart shown in the photograph.
- Liver, lung and kidney were among the few incorrect identifications.

- (ii) The structures labelled were correctly identified by many as blood vessels, veins or arteries. As they were clearly visible, they could not have been capillaries. Unacceptable identifications were as atria – they were clearly visible as structures top right and left in the photograph – and as septum or valves that are internal structures not visible in a surface view of the heart.
- (b) There were many excellent drawings of the heart. Sharp pencils were used to make clear continuous lines and no shading was used. The drawings were of a size larger than the heart in the photograph and the shape of the heart drawn was a good representation, its length being greater than its width and its sides tapering. The two atria were well drawn and at least one large blood vessel was shown. The most common reasons for marks not being credited were the small size of the drawing and only the outline being drawn with no detail of the left atrium or blood vessel.
- (c) (i) Many candidates followed the instruction to join B and C on the photograph with a ruled line. Most measurements were accurate and recorded in millimetres as required, with only a few incorrectly recorded in centimetres.
- (ii) There was a clear instruction to draw a line on the drawing in the same place as the line B-C drawn on the photograph and many candidates did this. Some drew a line which was not in the same position as B-C which could not be credited. Simply drawing the short marker lines at B and C but not joining them was not sufficient. The majority of measurements were accurate and recorded in millimetres as required, but some recorded in centimetres were seen. Occasionally a measurement was recorded which showed an inability to read a ruler scale correctly e.g. what should have been 75 mm was recorded as 70.5 mm.
- (iii) Many candidates correctly divided the measurement recorded for the line on their drawing by the measurement recorded for the line on the photograph to calculate the magnification of their drawing. Some, having done this correctly, included a factor of $\times 100$ so could not receive credit. There were those who, in error, divided the photograph measurement by the drawing measurement. They should have realised their error when it appeared that their drawing, larger than the photograph, had a magnification of less than $\times 1$. There was a clear instruction to record the calculated magnification to 1 decimal place. Those who did were credited but many did not. In error, a minority included units with their answer.

BIOLOGY

Paper 5090/32
Practical Test

Key messages

Candidates should read all instructions given in questions carefully and respond accordingly.

Designing an investigation requires practical details of procedures that should be followed to achieve the aim.

In constructing a line graph, the independent variable should be plotted on the x-axis.

General comments

There was no evidence that candidates had insufficient time to answer all the questions set. Scripts were legible and answers were written in the spaces provided or, if there was insufficient space, a clear indication of where the continuation had been written was given.

Comments on specific questions

Question 1

(a) (i) There were some good tables constructed with two columns or rows defined by ruled lines. One column or row was headed 'seedling' for the number of the seedling measured and the other, 'height' with the units, mm, for recording the six measurements taken. It should be noted that in a table when units are given in a header, no units should be written in the cells of the table. Six measurements were usually recorded in millimetres, therefore in whole numbers, as asked for.

A few candidates did not actually construct a table but simply listed their results so could not be fully credited. Most candidates knew how to calculate the mean height but a few, in error, simply recorded the total number of millimetres without dividing by the number of measurements taken.

(ii) Although candidates had selected seedlings and measured them, many found identifying two possible sources of error difficult. However, some had selected seedlings with bent or curved stems that they had found difficult to measure while others found it difficult to be certain where the length of stem to be measured began and ended. Using a ruler where the 0 is not at the very end proved a source of uncertainty for some. These were all creditworthy answers. Frequently parallax was given as an answer but this is not applicable here because candidates should have avoided parallax error when taking the measurements. Measuring the wrong part was also mentioned, but again, this should not have happened if candidates had followed instructions.

(iii) When recording observations, as in this question, what was observed should be described rather than giving statements such as 'no change' or 'nothing happened'. Because the nature of biological material is variable, different answers describing what the candidate saw were credited, i.e. either the iodine solution remained yellow or the colour changed from yellow to blue-black. The conclusion drawn from the observation needed to match it i.e. no starch was present or starch was present.

(b) (i) Although some very good graphs were seen, constructing a line graph proved challenging for some candidates. Some did not appreciate that the independent variable, in this case, time, should be plotted on the x-axis. Axes were not always fully labelled with the variables given in the instruction – time and mean height – or omitted the units given in the list of results – days and mm. Many

candidates chose good scales which made full use of the grid provided but some were too small. Most scales were linear but some lacked appropriate values at the origin. A few thought, incorrectly, that simply using the given values equidistantly on the axes i.e. 6, 10, 12 etc. and 8, 23, 27 etc. would suffice. Some wrote only the values given in the results on linear axes but that was insufficient. The plotting of points was generally well done. However, although there was a clear instruction to join the points with ruled lines, some drew curves that could not be credited. Neither could ruled lines of best fit be credited as the joining of points was required. Frequently, the line was extrapolated from 6, 8 to 0, 0, although no data was given for 0, 0 and so no credit could be given for the line drawn.

- (ii) Many correctly stated that growth or mean height increased with time. Fewer candidates also stated that growth was either faster initially or slower at the end.
 - (iii) The time period when the rate of growth was the greatest, 6 – 10 days, could be worked out from the graph by recording the days when the upward gradient of the line was its steepest. The most common error here was to state the time at which the mean height of the seedlings was the greatest i.e. 23 days.
 - (iv) A rate of growth is an expression of how much growth occurred in a given time. On day 15 the seedlings' mean height was 32 mm; on day 20 it was 36 mm. The seedlings had grown 4 mm in 5 days so the rate of growth was 0.8 ($4 \div 5$) mm/day. Some candidates omitted mm/day so could not be fully credited. There were too many candidates who did not appreciate what a rate is or how to calculate one from given data.
 - (v) Many candidates were able to correctly identify two variables that should have been controlled. However, only a minority were able to give a good explanation for the need to control them. The effect of time on the growth of these seedlings was being investigated, so time should be the only quantity in the investigation that changed – the independent variable. All other dependent variables needed to remain the same throughout so that effect of time could be determined.
- (c) Some of the investigations designed to determine the effect of the pH of water on the growth of seedlings were excellent. At least three samples of seedlings were grown in Petri dishes with the pH of the water given to them being the only variable. Different pHs were achieved by using buffer solutions or adding acid or alkali to water to produce a range of identified pHs. The heights of a sample of seeds from each dish were measured after they had been growing for the same period of time and their mean height calculated in order to compare the growth in the different pHs of water.

Some points to be noted from answers seen:

- Mean heights cannot be measured; actual heights can be measured from which mean heights may be calculated.
- Measuring growth is not equivalent to measuring height.
- Specific time periods should be identified rather than using general terms such as 'several' or 'a few days'.
- Boiling then cooling water is not a method that will change its pH.

There were a few candidates who, not reading the question sufficiently carefully, described determining the effect of the seedlings on the pH of the water in which they were growing rather than growing seedlings in water of different pHs.

Many candidates made no attempt at designing an investigation with practical details, but rather described what they thought would be the effect of varying the pH on the growth of the seedlings or how to measure pH. Some described using food tests. Six marks were available, but these answers received no credit.

Question 2

- (a) (i) The majority of candidates were able to correctly identify the heart shown in the photograph.
- Liver, lung and kidney were among the few incorrect identifications.

- (ii) The structures labelled were correctly identified by many as blood vessels, veins or arteries. As they were clearly visible, they could not have been capillaries. Unacceptable identifications were as atria – they were clearly visible as structures top right and left in the photograph – and as septum or valves that are internal structures not visible in a surface view of the heart.
- (b) There were many excellent drawings of the heart. Sharp pencils were used to make clear continuous lines and no shading was used. The drawings were of a size larger than the heart in the photograph and the shape of the heart drawn was a good representation, its length being greater than its width and its sides tapering. The two atria were well drawn and at least one large blood vessel was shown. The most common reasons for marks not being credited were the small size of the drawing and only the outline being drawn with no detail of the left atrium or blood vessel.
- (c) (i) Many candidates followed the instruction to join B and C on the photograph with a ruled line. Most measurements were accurate and recorded in millimetres as required, with only a few incorrectly recorded in centimetres.
- (ii) There was a clear instruction to draw a line on the drawing in the same place as the line B-C drawn on the photograph and many candidates did this. Some drew a line which was not in the same position as B-C which could not be credited. Simply drawing the short marker lines at B and C but not joining them was not sufficient. The majority of measurements were accurate and recorded in millimetres as required, but some recorded in centimetres were seen. Occasionally a measurement was recorded which showed an inability to read a ruler scale correctly e.g. what should have been 75 mm was recorded as 70.5 mm.
- (iii) Many candidates correctly divided the measurement recorded for the line on their drawing by the measurement recorded for the line on the photograph to calculate the magnification of their drawing. Some, having done this correctly, included a factor of $\times 100$ so could not receive credit. There were those who, in error, divided the photograph measurement by the drawing measurement. They should have realised their error when it appeared that their drawing, larger than the photograph, had a magnification of less than $\times 1$. There was a clear instruction to record the calculated magnification to 1 decimal place. Those who did were credited but many did not. In error, a minority included units with their answer.

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 be able to draw graphs, manipulate data, and carry out simple calculations e.g. calculate a mean or a magnification. When asked to describe differences between graphs, comparative descriptions as well as differences in data values should be included.

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 improvement in the construction and presentation of bar charts. Most candidates are drawing ruled bars of equal width which are labelled centrally, however it should be noted that there should also be a general label for the axis. A value should always be entered at the origin of the axis where there is a linear scale.

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

Comments on specific questions

Question 1

- (a) (i) Most candidates correctly counted the number of woodlice in each area of choice chamber **C**.
- (ii) Most candidates correctly calculated the mean number of woodlice in each of the four areas of the choice chamber, however some did not follow the instruction given to record these values to the nearest whole number. A few did not calculate a mean but simply added the numbers together.
- (b) Candidates were asked to construct a bar chart to show the mean number of woodlice found in each area of the choice chamber. There were some good bar charts drawn – using most of the space provided with axes fully labelled and ruled bars of equal width. A few missed part of the labelling, most commonly ‘mean’ or ‘condition/area’ and some omitted the value at the origin of the mean number axis.
- (c) (i) The majority of candidates correctly stated that the dark and damp area was the preferred area of the woodlice in the choice chamber.
- (ii) Most candidates selected one of the four areas of the choice chamber in which to place the woodlice at the start of the experiment thus not recognising that this could cause bias. Some correctly suggested the woodlice should be placed in the centre, but few could give a creditworthy explanation for their answer.
- (iii) There were some good answers here with most candidates suggesting that the experiment be repeated more times and that more woodlice should be used or, less commonly, that the woodlice should be left for longer than 20 minutes.

- (iv) This question was well answered with the majority of candidates recognising that putting holes in the lid of the choice chamber would provide air for the woodlice, but the disadvantage being that the woodlice might escape or that the damp areas may dry out.

Question 2

- (a) (i) The majority of candidates correctly recognised the lung, although answers of liver, heart and kidney were also seen.
- (ii) The majority of candidates correctly identified the trachea, although some thought the structure shown was a bronchus or bronchiole.
- (b) Candidates were asked to make a large drawing of the lung and trachea as shown in the photograph; only a few scored full marks here. Most were drawn with a clear and clean outline but there were some drawings with shading and sketchy lines and a few did not leave sufficient room to draw the trachea extending beyond the top of the lung. The detail on the trachea and the ridged sides were rarely seen. Sometimes the ridged sides were drawn but the detail on the trachea was omitted. Most drawings were of a good size and proportion, but a minority were too small and not many included the detail of both the upper and lower lobe.
- (c) (i) Most candidates drew the line as instructed and the majority of measurements were correct. A few candidates wrote down a measurement in centimetres despite millimetres (mm) being given on the answer line, and a few multiplied their millimetre value by 10 thus giving an incorrect measurement.
- (ii) The majority of measurements were correct although some repeated the errors made in (c)(i). Some candidates did not draw a line as instructed or drew a line in a different place.
- (iii) Most candidates used their measurements correctly to work out the magnification of their drawing compared to the photograph. Common errors included: dividing the measurement of the photograph by that of the drawing; multiplying the answer obtained by 100; including units (mm) with the answer and not expressing the answer to 1 decimal place as instructed.
- (d) Most answers correctly referred to the relative sizes of the alveoli and blood vessels in the two photomicrographs.

Question 3

- (a) (i) Virtually all candidates were able to correctly calculate 320 heart beats for the 3 minutes after the step exercise.
- (ii) Most candidates correctly calculated the resting pulse rate as 64 beats per minute using the information provided.
- (iii) Again, the majority of candidates correctly noted that exercise increases the pulse rate.
- (iv) Most candidates correctly calculated the fitness rating of 75 – very good, using the information given.
- (b) (i) Few candidates noted the simple fact that the fitter candidate had a lower pulse rate throughout the experiment. Many responses referred to data from the table and credit was awarded where appropriate. Fewer answers included the descriptions of the differences asked for in the question; for example there were very few references to a *slower* increase in pulse rate during exercise or the pulse rate returning to resting *more quickly* for the fit candidate, i.e. interpretation of the data.
- (ii) Many candidates scored full marks here by correctly reading the graph at **8** minutes, i.e. 6 minutes **after** the start of the exercise, although some incorrectly read the graph at 6 minutes. It should be noted that units should be written after the answer if not already provided on the answer line.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key messages

Candidates should read all instructions given in questions carefully and respond accordingly.

The difference between reliability, accuracy and validity in relation to investigations should be understood.

Designing an investigation requires practical details of procedures that should be followed to achieve the aim.

In constructing a line graph, the independent variable should be plotted on the x-axis.

General comments

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

Scripts were legible and answers were written in the spaces provided or, if there was insufficient space, a clear indication of where the continuation had been written was given.

Comments on specific questions

Question 1

- (a) (i) Most candidates were able to measure accurately and record their measurements in the table. As measurements to the nearest millimetre were asked for, any given in centimetres or including decimal places could not be credited. Even when measuring had been inaccurate, seedling 2 was usually the tallest and seedling 3 the shortest. It should be noted that in a table when units are given in the headers, no units should be written in the cells of the table.
- (ii) The majority of candidates knew how to calculate means and expressed them to the nearest millimetre. A few in error simply recorded the total number of millimetres without dividing by the number of measurements taken.
- (iii) Although the question referred to seedlings, some candidates answered in terms of one particular seedling and so received no credit. Many of those who correctly suggested that the seedlings in dish A were the ones that had been growing for the longest period of time correctly related their suggestion to those seedlings having the greatest mean height.
- (iv) Some candidates correctly recognised that using many seeds was advantageous because some seeds may not have been viable, or that being able to identify anomalies would be possible with many seeds but not with one. Others thought that calculating a mean result from many seeds would increase the reliability of the investigation. All of these were creditworthy answers.

The purpose of calculating a mean was not understood by some candidates who referred to it, incorrectly, as increasing the accuracy or the validity of the investigation. The meaning of the terms reliability, accuracy and validity in the context of investigations should be clearly understood.

- (v) This proved a challenging question for most candidates. A small number interpreted this as applying to which apparatus should be used e.g. forceps or gloves which was not what was required. Those who visualised doing the investigation realised correctly that choosing seedlings

with straight stems would make measuring easier; or choosing the tallest and shortest to measure, and, as there were three, one in between, would give a good representative range; or choosing at random, sometimes expressed in terms of being blindfolded and picking three. Only a few stated that this method would eliminate any bias in the selection process.

- (b) (i)** Although some very good graphs were seen, constructing a line graph proved challenging for some candidates. Some did not appreciate that the independent variable, in this case, time, should be plotted on the x-axis. Axes were not always fully labelled with the variables given in the instruction – time and mean height – or omitted the units given in the list of results – days and mm. Many candidates chose good scales which made full use of the grid provided but some were too small. Most scales were linear but some lacked appropriate values at the origin. A few thought, incorrectly, that simply using the given values equidistantly on the axes i.e. 6, 10, 12 etc. and 8, 23, 27 etc. would suffice. Some wrote only the values given in the results on linear axes but that was insufficient. The plotting of points was generally well done. However, although there was a clear instruction to join the points with ruled lines, some drew curves that could not be credited. Neither could ruled lines of best fit be credited as the joining of points was required. Frequently, the line was extrapolated from 6,8 to 0,0, although no data was given for 0,0 and so no credit could be given for the line drawn.
- (ii)** Many correctly stated that growth or mean height increased with time. Fewer candidates also stated that growth was either faster initially or slower at the end.
- (iii)** The time period when the rate of growth was the greatest, 6 – 10 days, could be worked out from the graph by recording the days when the upward gradient of the line was its steepest. The most common error here was to state the time at which the mean height of the seedlings was the greatest i.e. 23 days.
- (iv)** A rate of growth is an expression of how much growth occurred in a given time. On day 15 the seedlings' mean height was 32 mm; on day 20 it was 36 mm. The seedlings had grown 4 mm in 5 days so the rate of growth was 0.8 ($4 \div 5$) mm/day. Some candidates omitted mm/day so could not be fully credited. There were many candidates who did not appreciate what a rate is or how to calculate one from given data.
- (v)** Many candidates were able to correctly identify two variables that should have been controlled. However, only a minority were able to give a good explanation for the need to control them. The effect of time on the growth of these seedlings was being investigated, so time should be the only quantity in the investigation that changed – the independent variable. All other dependent variables needed to remain the same throughout so that the effect of time could be determined.
- (c)** Some of the investigations designed to determine the effect of the pH of water on the growth of seedlings were excellent. At least three samples of seedlings were grown in Petri dishes with the pH of the water given to them being the only variable. Different pHs were achieved by using buffer solutions or adding acid or alkali to water to produce a range of identified pHs. The heights of a sample of seeds from each dish were measured after they had been growing for the same period of time and their mean height calculated in order to compare the growth in the different pHs of water.

Some points to be noted from answers seen:

- Mean heights cannot be measured; actual heights can be measured from which mean heights may be calculated.
- Measuring growth is not equivalent to measuring height.
- Specific time periods should be identified rather than using general terms such as 'several' or 'a few days'.
- Boiling then cooling water is not a method that will change its pH.

There were a few candidates who, not reading the question sufficiently carefully, described determining the effect of the seedlings on the pH of the water in which they were growing rather than growing seedlings in water of different pHs.

Many candidates made no attempt at designing an investigation with practical details but described what they thought would be the effect of varying the pH on the growth of the seedlings or how to measure pH. Some described using food tests. Six marks were available, but these answers received no credit.

Question 2

- (a) (i) The majority of candidates were able to correctly identify the heart shown in the photograph. Liver, lung and kidney were among the few incorrect identifications.
- (ii) The structures labelled were correctly identified by many as blood vessels, veins or arteries. As they were clearly visible, they could not have been capillaries. Unacceptable identifications were as atria – they were clearly visible as structures top right and left in the photograph – and as septum or valves that are internal structures not visible in a surface view of the heart.
- (b) There were many excellent drawings of the heart. Sharp pencils were used to make clear continuous lines and no shading was used. The drawings were of a size larger than the heart in the photograph and the shape of the heart drawn was a good representation, its length being greater than its width and its sides tapering. The two atria were well drawn and at least one large blood vessel was shown. The most common reasons for marks not being scored were the small size of the drawing and only the outline being drawn with no detail of the left atrium or blood vessel.
- (c) (i) Many candidates followed the instruction to join B and C on the photograph with a ruled line. However, too many did not so could not receive credit. Most measurements were accurate and recorded in millimetres as required with only a few incorrectly recorded in centimetres.
- (ii) There was a clear instruction to draw a line on the drawing in the same place as the line B-C drawn on the photograph and many candidates did this. Some drew a line which was not in the same position as B-C which could not be credited. Simply drawing the short marker lines at B and C but not joining them was not sufficient. The majority of measurements were accurate and recorded in millimetres as required, but some recorded in centimetres were seen. Occasionally a measurement was recorded which showed an inability to read a ruler scale correctly e.g. what should have been 75 mm was recorded as 70.5 mm.
- (iii) Many candidates correctly divided the measurement recorded for the line on their drawing by the measurement recorded for the line on the photograph to calculate the magnification of their drawing. Some, having done this correctly, included a factor of $\times 100$ so could not receive credit. There were those who, in error, divided the photograph measurement by the drawing measurement. They should have realised their error when it appeared that their drawing, larger than the photograph, had a magnification of less than $\times 1$. There was a clear instruction to record the calculated magnification to 1 decimal place. Those who did were credited but too many did not. In error, a minority included units with their answer.