BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

Marks were distributed between 8 and 37 out of 40.

Comments on specific questions

Question 1

While more able candidates remembered that chlorophyll and therefore chloroplasts contain magnesium (Option **B**), less-able candidates were seemingly thinking about transport of ions from the soil and preferred Option **D**.

Question 10

This question took some thought. Most candidates chose Option **A**, understanding that the products of the digestion of the oil included fatty acids which would diffuse through the membrane giving a lower pH. However, lipase is a protein so would give a positive reaction with Biuret solution, so the correct response is Option **B**.

Question 20

This question proved to be more difficult than anticipated with more candidates preferring Option **B** to the correct response, Option **A**. This may be because while the question related to a comparison between renal artery and renal vein, the columns in the table were both headed ‘renal artery’. Candidates were expected to

recognise that the oxygen concentration in the renal artery was higher than in the vein and that the urea concentration was lower than in the vein.

Question 22

This question also proved much more difficult than anticipated; candidates seemed simply not to recognise **D** as a layer of fat, or perhaps not to understand the meaning of the term 'insulator'.

Question 23

Questions of this type have been set several times before but this one was found to be particularly difficult. If the bird is flying towards the observer, the lens of the eye will become more curved to focus the image. This is happening most rapidly at **C**. Options **B** and **D** were more popular responses.

Question 31

This question was found to be difficult, one reason probably being that candidates did not appreciate that the larval stages of the vector mosquito in ponds and lakes would be eaten by the fish. However, **D** was the most popular response so candidates may have picked up that vaccination against malaria is now being attempted following successful pilots, but this is not against the vector (the mosquito).

Question 32

This question also proved more difficult than anticipated, perhaps because the x-axis represented distance but also time, because the flow of water was from left to right. Most candidates selected **C** as the discharge point but the drop in concentration of oxygen from B to C means that the discharge must be at **B**, with the maximum effect taking some time and therefore a short distance to develop.

Question 37

Here most candidates preferred Option **C**, which would be the outcome if the double recessive genotype had not been fatal. So of the surviving offspring, two out of three would be heterozygote (Option **D**).

Question 38

This question was intended to test the understanding that genetic ratios may not be expressed in small numbers of offspring and that they represent the probability of outcomes only. Options **C** and **B** were popular, both being clearly incorrect.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General comments

Marks were distributed between 6 and 40 out of 40. Candidates seemed well-prepared and a number of candidates achieved full marks.

Comments on specific questions

Question 1

While more able candidates remembered that chlorophyll and therefore chloroplasts contain magnesium (Option **B**), less-able candidates were seemingly thinking about transport of ions from the soil and preferred Option **D**.

Question 5

Here less-able candidates tended to prefer Option **B**, thinking of the enzyme as the 'key' fitting into the 'lock' of the substrate, which is the reverse of the model.

Question 26

This question proved to be more difficult than expected with significant numbers of candidates selecting Option **D** rather than **C**. If the arm is extended, the triceps must be contracted (and therefore shorter) with the biceps being relaxed and therefore longer.

Question 32

This question also proved more difficult than anticipated, perhaps because the *x*-axis represented distance but also time, because the flow of water was from left to right. Most candidates selected **C** as the discharge point but the drop in concentration of oxygen from B to C means that the discharge must be at **B**, with the maximum effect taking some time and therefore a short distance to develop.

Question 33

Most candidates selected the correct response, Option **B**, but the second most popular was Option **D** which explained his conclusions about Y but not about X.

Question 37

This was the first of three demanding questions. Here, Options **A** (correct), **B** and **D** attracted significant numbers of candidates. It is an area where some more attention could perhaps be paid during the teaching of the course.

Question 38

This question was intended to test the understanding that genetic ratios may not be expressed in small numbers of offspring and that they represent the probability of outcomes only. Options **C** and **B** were popular, both being clearly incorrect.

Question 39

This question proved more demanding than expected mainly because Option **C** was a correct statement about global warming but did not explain how natural selection would be affected.

BIOLOGY

Paper 5090/21
Theory

Key messages

The factually based questions in this paper did elicit excellent answers from many candidates but questions requiring application of knowledge appeared much more challenging. This was clearly visible in the optional **Questions 8** and **9**, where the first parts of each question were often awarded full marks whereas **part b** in each case did not score so highly. Perhaps increased discussion about the implications of the biology that is being learnt would benefit some candidates.

General comments

There was no evidence that candidates ran out of time on this paper and virtually all used the spaces provided to answer the questions concisely, without needing to use extra paper. Nearly all candidates only answered one of the two optional questions, as instructed. A small number answered both, crossing out one of the answers afterwards. Presumably this was the answer that they were least confident about. Candidates displayed a sound understanding of certain areas of the syllabus such as the process of photosynthesis, enzyme action and anaerobic respiration. However, the questions asking about the functioning of the kidney and accommodation in the eye did uncover basic misconceptions in some candidates.

Comments on specific questions

Section A

Question 1

This question tested the candidates' knowledge and understanding of the structure and function of the human excretory system. Candidates were asked to interpret a familiar diagram of the system and describe how the system deals with waste products.

(a) Identifying the liquid passing through tube D and the waste product that it contained proved straightforward for most candidates. A small minority did confuse urea with urine and reversed the correct answers.

(b) Most candidates could describe the function of part A in bringing waste to the kidney. However, there were fewer correct references to the removal of waste by the kidney through filtration. The function of the bladder in storage of urine was well understood. In some answers, there were major confusions between the excretory system and the digestive system with suggestions that the products of the kidney are excreted through the anus.

Question 2

Different aspects of the specification were linked together in this question. This included photosynthesis, transport in plants, asexual reproduction, the action of fertilisers and yeast structure and respiration. Many candidates showed a good understanding of the process of photosynthesis in **part a** but found the explanations in **part b ii** and **c** more challenging.

(a) Most candidates could explain how plants make sugar by photosynthesis, including the reactants and the products. However, there were answers that stated that starch was the initial product which was then converted to sugar. Regarding the transport of sugars to the fruit, there was some

confusion between xylem and phloem in the process but there were correct references to translocation and active transport.

(b) (i) The candidates that had learnt this definition gained both marks. Others appreciated that mutation involves a change but were not clear about what was physically being changed.

(ii) The best answers correctly stated that asexual reproduction and mitosis were involved. However, there was some confusion between self-pollination and asexual reproduction, with some candidates thinking that one process leads to the other.

(c) Most candidates appreciated that insecticides kill insects therefore reducing biodiversity. However, some answers only went on to discuss how this would increase the yield of crops. Better answers pointed out that other animals may be killed, either directly or due to the disturbance of food webs. A common error was to suggest that plants were killed by the insecticide.

(d) (i) Most candidates answered correctly with two structural similarities. Incorrect answers often referred to processes rather than structural differences.

(ii) Candidates found this part of the question quite challenging. Despite the earlier references in the question to sugars in grapes there were few references to the yeast being able to feed from this substrate. The alternative answer of spores being blown by the wind was also rarely seen.

(iii) Most candidates gave correct answers involving alcoholic drink production or bread making. Common incorrect answers simply stated fermentation without any reference to the product or just baking.

Question 3

This question used guinea pigs as a stimulus for genetics questions and for a comparison of their gestation with that of humans. Many candidates handled these questions well and scored highly.

(a) (i) This proved to be the most challenging part of the question. Most candidates appreciated that genes and alleles both described aspects of inheritance but few could explain the difference between the two. The best answers stated that a gene was a length of DNA coding for a protein and that an allele was an alternative form of a gene.

(ii) There were many candidates who scored full marks in this question with a correct genetic cross. The most common error seen was to include two alleles in each of the gamete circles.

(b) In comparing the development of guinea pigs and humans, candidates often highlighted the similarities of relying on a placenta and an umbilical cord for nutrition. For differences, the best answers referred to the different lengths of gestation and the numbers of offspring produced. A mark was also awarded for reference to the differences in structure of the uterus. However, there were incorrect references, for example stating that the guinea pig uterus is divided into three rather than two.

Question 4

This question asked general questions about enzymes before moving on to specific properties of amylase and its use in producing biofuels. Many of the earlier questions were well answered. However, in the final question asking how biofuels can cause pollution and environmental change, there was often considerable confusion about the effects of different pollutants.

(a) (i) There were many accurate definitions of an enzyme, scoring two marks. In answers that failed to score, the most common error was to think that enzymes are only involved in digestion in the alimentary canal.

(ii) The main error that candidates made was to refer to the functioning of enzymes, rather than concentrating on their structural features as asked. There were correct references to active sites, their proteinaceous nature, and the fact that they have a specific shape. The candidates that referred to functional features often discussed the lock and key hypothesis.

(iii) Many candidates appreciated that the substrate for amylase is starch. There were also many correct answers giving maltose as the product. Some answers gave sugar or glucose, but these were both credited.

(b) (i) Many candidates correctly identified the optimum pH and temperature for the amylase and so were awarded two marks. Fewer answers went on to explain why this information would be useful to producers in terms of choosing the best conditions to maximise the yield of biofuel.

(ii) Answers to this question were very confused. Candidates often gave a long list of pollutants or focused on carbon monoxide being the pollutant rather than carbon dioxide. In terms of the environmental change, many answers claimed that the ozone layer would be damaged and that this would cause global warming.

Question 5

This question tested candidates' knowledge of the bones and muscles of the forelimb of a mammal. It then moved on to cover the process of anaerobic respiration in muscles. Both aspects of this question were answered well by most candidates.

(a) Some candidates confused the forelimb with the hind limb and so gave the answer of femur for structure X. Triceps was the most common incorrect answer for the muscle, with some candidates being unsure and writing both biceps and triceps.

(b) (i) The majority of candidates correctly answered respiration.

(ii) This question wanted candidates to appreciate that the lion could only respire anaerobically for a short period of time before lactic acid accumulated in the muscles causing muscle fatigue. This idea was explained in most of the answers.

Section B

Question 6

Candidates' knowledge and understanding of the structure of the leaf and the processes involved in transpiration was tested by this question. In the final part of the question candidates were asked to use this knowledge to suggest and explain structural differences between different leaves.

(a) (i) About half of the candidates could correctly identify B as being a spongy mesophyll cell. Some just stated mesophyll and others palisade mesophyll. Neither of these answers gained credit.

(ii) This question proved quite challenging. Some candidates could identify the three processes involved but often they were allocated to the wrong arrow. When trying to give definitions for the processes, diffusion was often defined correctly. However, candidates found definitions for osmosis and evaporation more challenging. Candidates should be encouraged to define osmosis in terms of the differences in water potential as stated in the syllabus. This would avoid the ambiguity seen in some answers, where it was unclear whether candidates were referring to the concentration of water or the concentration of the solute.

(b) Most candidates were able to make suggestions for possible structural differences that might change transpiration rate and were given credit for this. However, very few were awarded full marks because they were not able to explain how the differences altered the rate. Some candidates gave differences which referred to the whole plant or parts of the leaf other than the lower surface.

Question 7

This question covered response to stimuli and tested candidates on their knowledge of the various parts of the nervous system and the processes in the eye involved in accommodation.

(a) Many candidates were awarded four marks out of five for this question. The one mistake made by many was to locate the relay neurone in nerves rather than in the spinal cord or brain.

(b) This question elicited some excellent explanations of accommodation, involving correct references to the ciliary muscle, suspensory ligaments and thickening of the lens. A common misconception involved confusing the circular muscles of the iris with the ciliary muscles and weaker answers concentrated entirely on the action of the iris.

Section C

Question 8

The majority of candidates decided to answer this optional question on the balanced diet and the effects of being underweight and overweight.

(a) Full marks were frequently awarded for this part of the question. Most candidates appreciated that a balanced diet contains all the seven food groups but not all stated that they needed to be in the correct proportions. Some answers incorrectly stated that there needs to be equal amounts or enough. In listing the seven food groups, fibre was the one that was most often missed.

(b) The second part of the question proved more challenging. Some answers discussed issues of anorexia, which were not required. In the overweight section, candidates often made the link to coronary heart disease but explanations for the cause of this were very confused or vague. Many just said that the fat accumulates around the heart. There were some correct links to diabetes and strokes given.

Question 9

Although this question about the blood was only answered by a minority of candidates, the marks awarded were just as high as in **Question 8**.

(a) Most candidates could list the components of human blood, in terms of the cell types and plasma. There were less references to the actual composition of plasma but marks of four out of five were quite common.

(b) This question required candidates to suggest a feature of blood that could be measured and to then indicate what aspect of health and disease it could provide information about. Some credit was given if candidates just listed the factors that could be measured but most did try to link them to a disease. References to glucose levels linked to diabetes, white blood cell count linked to infectious diseases and red blood cell count linked to anaemia were the most common marking points that were awarded.

BIOLOGY

Paper 5090/22
Theory

Key messages

It is clear that many candidates were well-prepared for the knowledge-based questions on this paper and they were able to write coherent, accurate and succinct answers. In general, questions set in an unfamiliar context and requiring application of a candidate's understanding of biological concepts or analysis of data, were more challenging for candidates. The skills of application of knowledge, analysis, synthesis and evaluation take time, practice and effort to develop. Any type of biological data resource, whether from a past paper, the internet, a biological journal or a newspaper can be a useful resource to help candidates develop these skills.

General comments

Candidates generally followed the rubric of the question paper, answering all the questions in ***sections A*** and ***B*** and choosing one of the two optional questions in ***section C***. Occasionally candidates answered both of the optional questions and in these instances the higher of the two marks was awarded. It was pleasing to see that most candidates wrote legibly in the spaces provided and that they attempted to provide answers for every question. Although candidates had plenty of time to complete the examination paper, some lost marks because of insufficient relevant detail in their answers. This may be because of lack of knowledge but there was evidence that sometimes the focus of their answers was incorrect. Careful reading of the questions should help candidates to include the important facts and reasoning in their answers.

Comments on specific questions

Section A

Question 1

This initial question assessed knowledge of lipase, bile and adrenaline. Candidates were asked to match each substance to its function and to the organ where it is produced. It was pleasing to see that all candidates attempted the question and that the majority followed the instructions. Any crossed out lines, were, in general, clearly shown so that markers knew which lines were intended as the answer. This question proved to be high-scoring for the majority but sometimes candidates mixed up the organs where lipase and bile are produced. Others did not match bile to emulsification and lipase to chemical digestion.

Question 2

This question gave candidates the opportunity to demonstrate their knowledge of leaf and plant cell structure and their understanding of the effects of osmosis on cells.

(a) (i) A group of cells with the same structure and function, such as those indicated by labels **A** and **B**, is a tissue. Many gave this as the answer but others gave the answer mesophyll and this was also given credit. Incorrect answers included: organelle, epidermis, plant cell and chloroplast.

(ii) The majority of candidates were able to score marks on this question with many scoring either three or four marks. The question asked for the cell components to be drawn, labelled and their position shown clearly. Candidates were most likely to get into difficulties with the placement of cell components. It was not uncommon to find components positioned on the wrong side of a labelled cell membrane. Sometimes the chloroplasts were drawn larger than the nucleus and at other times marks were lost because label lines were carelessly drawn.

(iii) This question was not answered by quite a few candidates. It is advised that candidates should develop a strategy for ensuring that they have read every question.

Those correctly answering drew a line to one of the four cells that contain chloroplasts and labelled it 'guard cell'. Common mistakes included drawing a line to a stoma or an epidermal cell or labelling a cell not in the lower epidermis.

(b) (i) To gain a mark here, candidates needed to know that cellulose is the main structural component of a cell wall and to understand the term substrate. Unfortunately, some gave 'cellulase' as their answer either because they had not read the question properly or because they struggled to differentiate between the meaning of substrate and enzyme. This question proved to be challenging and numerous incorrect chemicals were suggested.

(ii) Many realised that osmosis was the process that would explain the changes in the visibility of the cells and were able to give good answers describing water molecules entering through the selectively permeable membranes of the cells from a high to a lower water potential. The best answers went on to describe how the cell contents would increase in volume and eventually the cells would burst because there was no cell wall. Some candidates lost a mark when they were not precise enough with their language. When describing osmosis it is important that the candidates make it clear whether they are referring to the water (solvent) or the solute concentration. Quite a few candidates thought that the reason the cells would disappear from view was because they had shrunk when water was lost. Some went no further than to state that the digestion of the cell walls was completed after an hour. Others thought that the absence of cell walls explained why the cells could no longer be seen.

Question 3

This question covered a variety of syllabus topics including yoghurt production, genetics and nutrition.

(a) (i) The majority gave the correct answer, bacteria. Credit was also given for providing an appropriate genus name such as *Lactobacillus* or *Streptococcus*. The most frequent incorrect answers were fungi or yeast.

(ii) Binary fission and mitosis were both credited as correct answers.

(iii) Most candidates knew that lactose is broken down to lactic acid in the formation of yoghurt.

(iv) The graph showed how the lactose concentration decreased at first slowly and then more rapidly before reaching a constant, much lower concentration after 40 hours. When asked to draw a line to show the corresponding changes in the acid product the best candidates understood that the shape of the line should mirror that of the lactose line; increasing slowly at first and then more rapidly until it reaches a constant, much higher concentration after 40 hours. Many understood that the lactic acid would increase and they were credited a mark if they drew a line that started on the y-axis and increased as it crossed the decreasing lactose line. Quite a few showed the lactic acid reaching a constant concentration but they were only credited if they indicated this constant concentration starting at 40 hours.

(b) (i) Candidates were most likely to gain a mark for naming the genetic change as a mutation.

Additional marks were available for explaining why a genetic change can result in a change to an enzyme molecule and how this change can then lead to the enzyme not catalysing a reaction.

(ii) This question was straightforward with many candidates recognising that milk provides a good source of vitamin D, calcium, protein and lipids and they were able to give reasons why each is important in the diet. Some, however, did not read the question carefully enough and gave answers relating to the low concentration of lactose which did not score marks.

Question 4

In this question about the heart, candidates were assessed on their knowledge of specific blood vessels, their understanding of how semi-lunar valves function and how faulty valves could impact on a person's ability to exercise.

(a) This part of the question proved to be the most accessible for candidates with many correctly naming the aorta and the pulmonary vein. Some named other blood vessels, not necessarily attached to the heart, and others gave parts of the heart, such as atria or ventricles, as their answer.

(b) (i) To answer this correctly, candidates needed to be able to identify the left side of the heart on the diagram and to recognise the valve as a semi-lunar valve that is open when the left ventricle of the heart contracts. Many candidates labelled the semi-lunar valve at the base of the pulmonary artery as X or labelled one or other of the atrioventricular valves. Quite a few labelled all four valves as X.

(ii) Those that had struggled to identify the position of the valve then found it difficult to gain marks on this question. The mark most commonly awarded was for recognising that the valve did not open or close properly. There were some excellent answers which showed a very clear understanding of how contraction and relaxation of the left ventricle is related to valve opening and closing, and blood flow.

(iii) Candidates were able to perform much better on this question with many providing detailed answers which easily scored the three marks available. Most recognised that exercise would be impacted adversely because there would be a reduced delivery of oxygen to the muscles because the blood was not circulating as well. Some also mentioned a possible switch from aerobic to anaerobic respiration and the production of lactic acid.

(c) This proved to be the most challenging question on the paper. Very few candidates were able to suggest a way in which chemical treatment could modify the heart valve from another animal so it was not rejected. Any suggestions that the antigens/proteins were in some way removed or masked gained credit. Those not able to give a suggestion were still able to pick up marks if they understood that tissue rejection is the result of the body's immune response. References to white blood cells and antibodies were the most common ways to score marks.

Question 5

This data analysis question was based on the relationship between the type of food production and the mass of carbon dioxide released.

(a) Candidates with a good knowledge of the carbon cycle were able to apply their understanding to the context of human food crops and carbon dioxide release. Quite a few appreciated that the food would need transporting or cooking which would involve the burning of carbon-containing fuels thus releasing carbon dioxide. Others, although not thinking about the journey of food from farm to human mouth, were able to gain a mark for mentioning continuing respiration of the plants or decomposition.

(b) (i) There were three marks available for this percentage change calculation. A correct answer of –94.9 or –95 scored three marks. It was rare to see candidates indicating a negative change either in their final answer or in their working. Quite a few were able to gain two marks for carrying out the percentage change calculation and rounding up their answer correctly. A single mark was available for those indicating that the switch from lamb to beans resulted in a difference of 37.2 kg.

(ii) Many candidates were able to score two of the four marks available by explaining that a diet of plants would result in the release of less carbon dioxide which is a greenhouse gas. Those scoring more marks went on to explain the impacts of greenhouse gases on climate change. Others were given credit for explaining that growing plants requires less land resulting in reduced loss of natural habitats and therefore biodiversity.

Section B

Question 6

Candidates were provided with a food web for an area of grassland and asked to apply their knowledge to explain the feeding relationships within the food web and describe the energy flow into and through it. In general, candidates obtained higher scores on **part (a)** than **part (b)**.

(a) The majority of candidates scored at least some of the five marks available here but it was quite unusual for a candidate to achieve full marks. When describing each type of feeding relationship candidates could use different biological terms. For example, a rabbit feeding on grass could be described as a herbivore, a primary consumer or an organism in the second trophic level. Three of the available marks required candidates to correctly link a named organism with what it feeds on and the biological term used to describe this organism. Marks were often lost when there was only partial linking. Candidates were most often confused about which trophic level an organism was in with many forgetting that plants are trophic level one. It was clear, however, that most were able to relate well to the context.

(b) Energy flow is less well understood than feeding relationships. Candidates were asked to describe both the flow into the web and the flow through the web. Quite a few ignored the 'into' thereby missing out on a potential three marks for describing the energy change from light to chemical energy that happens during plant photosynthesis. Others forgot to mention that some energy is transferred (or 'lost') from the food web to the environment and did not give an example of how this happens e.g. transferred as heat energy from respiration. Finally some forgot to relate the flow of energy to the biomass at different levels. For these reasons few scored the full five marks. Some candidates appear to think that as the trophic level increases so does the accumulated biomass of the organisms. Perhaps this misconception has arisen because they have not fully appreciated how food being eaten is linked to the flow of energy.

Question 7

Flowering plant reproduction and seed dispersal were the topics being assessed by this question. Candidates were asked to apply their knowledge and understanding to a context that may or may not have been familiar to them.

(a) This proved to be the most difficult part of the question for candidates. Many struggled to relate P, the tomato fruit, to the ovary in the flower and Q, the tomato seed, to the ovule in the ovary. Frequently P was named as the seed and Q as the fruit or correct answers were transposed or candidates gave more than one answer thus negating any correct answer given.

(b) (i) Most candidates appreciated that this question was about seed dispersal and not pollination. Those that got the processes mixed up were generally able to score at least one mark for recognising that the red colour of P was there to attract. Many gave full accounts of the fruit being eaten and the undigested seeds being passed out in faeces some distance from the plant. When referencing adaptations for dispersal the majority only mentioned the colour but some did gain credit for suggesting that the jelly surrounding the seed would protect it from digestion. Candidates continue to be confused between the processes of excretion and egestion.

(ii) This is an area of the syllabus which would benefit from more attention. Candidates were most likely to achieve a mark for the idea that tomato plants could colonise new areas or that dispersal would prevent overcrowding. Expanding on this idea was more challenging. Reduced competition for resources was mentioned by many and then they could score an additional mark for naming a resource. The term 'competition' was expected so vague references to plants fighting or not being able to get everything they needed did not get a mark. The ideas of increased survival and increased germination were both given credit. Some described the idea of less risk of disease but to score marks here they needed to be careful with their wording so it did not imply anything other than that increased distance from an infected plant would reduce the risk.

Section C

Question 8

Nearly 61 per cent of candidates chose to answer this optional question about gas exchange and transpiration in a leaf. Candidates did equally well on both parts of this knowledge-based question.

(a) Most candidates started their answers by describing what happens during daylight hours. Almost all mentioned that photosynthesis occurred during daylight hours resulting in carbon dioxide being taken into the leaf and oxygen being released out of the leaf. It was rare for candidates to mention that respiration was also taking place during daylight hours or to discuss the impact of the rates of respiration and photosynthesis on the gaseous exchange of carbon dioxide and oxygen. The idea that respiration is a 24-hour process is still not well known or understood by candidates.

Many went on to give a good account of what happened during the hours of darkness, mentioning respiration for the first time here.

Credit was given for candidates mentioning the opening of stomata during the daytime or the closing at night. In addition, there was a mark available for any candidate who compared the amount of water vapour lost during the hours of daylight and darkness.

(b) Candidates were asked to outline the movement of water through a leaf during the process of transpiration. Some missed the instruction to focus on the leaf and instead described the whole transpiration stream. In these cases they were generally able to pick up marks when their answers started to describe the journey of water molecules through the leaf.

Many candidates were able to give accurate and detailed answers which described how water molecules travel through different parts of the plant leaf and the processes involved. Candidates do need to be careful when describing the water molecules. In the xylem, the mesophyll cell cytoplasm and in the mesophyll cell walls water molecules are in a liquid state but they then evaporate and move into the air spaces and out through the stomata in the gaseous state as water vapour. It was quite common to find candidates stating that water vapour evaporates rather than correctly stating that water molecules evaporate to form water vapour.

Question 9

This optional question about insecticides and control of the malaria vector was less popular than Question 8. The candidates performed much better on **part (b)** of the question than **part (a)** indicating that the use of insecticides is a topic that would benefit from greater attention.

(a) There appears to be a certain amount of uncertainty about why insecticides are applied to crops and this led to many vague and incorrect answers with some confusing insecticides with fertilisers. A mark was available for candidates stating that an advantage of insecticides is that they kill pest insects or insects that are harmful to plants, but relatively few obtained this straightforward mark. The advantage of insecticides that was most commonly given was that they improve crop yield which was credited providing it was not in the context of fertilisers. When discussing the disadvantages of insecticide use many answers indicated that there was once again confusion between the effects of insecticides and fertilisers. Many correctly mentioned water pollution but then went on to describe eutrophication which is related to fertiliser use. The best answers were able to describe ideas such as the harm caused to useful insect populations, bioaccumulation and pests developing resistance to the insecticides.

(b) The methods of reducing mosquito populations to prevent the spread of malaria are well known and understood. Some very good, detailed answers were seen from candidates. Those scoring full marks named the vector of malaria as the mosquito and then went on to give at least two control methods with correct explanations. Quite a few candidates were able to use the word ‘stagnant’ but their answers indicated that they did not fully understand what it meant and some used the word ‘sewage’ instead of stagnant. It may be helpful to use the term ‘still water’ rather than ‘stagnant water’ to emphasise the idea that it is the stillness of the water not the quality of the water that is important for mosquito breeding. The least well known method of mosquito control is that of sterile males being released.

BIOLOGY

Paper 5090/31
Practical Test

Key messages

This paper tests the ability to use a range of practical skills. Candidates should have experience of practical work, including biological tests and experimental design. They should be able to recognise potential sources of error and suggest possible improvements to experimental methods. Candidates should be able to draw and interpret graphs, as well as suggest explanations for the data obtained.

General comments

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

There continues to be 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. To improve further, candidates should be aware that all data needs to be plotted – including that with values of zero. Some candidates found the plotting of two sets of data on one set of axes to be challenging.

There were some good biological drawings and few instances of drawings that were too small. However many drawings still had sketchy outlines or were shaded – an area that requires further improvement.

Comments on specific questions

Question 1

(a) (i) Many candidates were able to explain that the rod was cleaned to prevent food **B** being contaminated by food **A**.

(ii) As it was stated that the volumes of ethanol used were 2 cm^3, the only variables that could be controlled to ensure that the results were comparable were the size of the small pieces of food or that they were shaken in the ethanol in same way. Very few candidates recognised this.

(b) (i) Most candidates wrote something in each cell of the table. The best responses described only the observations or colour change seen for each test. The conclusions that may have been drawn from those observations were not asked for – though some gave them.

(ii) This question did require conclusions to be drawn about the results of the tests. For this, candidates needed to be familiar with which test solutions are used to test for different food types and their positive and negative results. Many candidates applied their practical knowledge well. In some cases candidates clearly knew the colours that represented positive and negative results but were unable to match these with the correct type of food.

(c) Despite the candidates having carried out this experiment themselves, this proved a challenging question requiring candidates to identify potential sources of error and consider ways in which to overcome them. The most common suggestions centred round recognising that the crumbly nature of **B** meant that it was difficult to ensure equal volumes or surface areas of **A** and **B**; in some cases suitable improvements were suggested. Difficulty in identifying the intensity of the colour was also noted and the use of a colorimeter suggested as an improvement.

Question 2

(a) The best drawings were of a good size and shape, drawn with a sharp pencil and not shaded. Few candidates scored full marks on this question as many drawings were shaded or did not indicate the outer and inner layers of the artery. The most frequently scored marks were for a drawing only of the artery of good shape and size and depicting the folded inner layer.

(b) Measurements were usually correct but sometimes units were omitted. Some did not know how to calculate the actual size – either dividing or multiplying 90 by the measurement – and those who did sometimes did not give their answer to 2 decimal places as required. Some candidates made the correct measurement of the photomicrograph but then went on to use a measurement of their drawing to calculate the size, which could not gain full credit.

(c) There were some good answers. Frequent errors were to use a thumb to feel the pulse or to measure the number of beats per second. Few candidates noted that in order to take an accurate reading of the pulse at rest, the subject would have to sit quietly for a few minutes prior to taking any measurements.

Question 3

(a) There were some good graphs with fully labelled axes, good scales and two identified lines plotted correctly. Some candidates only plotted the points for one line, or in some cases plotted all the points but attempted to join them all together in one 'zigzag' line. Some did not realise that zero values should also be plotted so missed out several of the plots for the fruits data without bracts.

(b) (i) It was recognised by many that most fruits fall within 5 m of the base of the tree and not beyond 10 m however there were some candidates who did not appear to understand the word *distribution*.

(ii) The distribution of fruits with bracts was more difficult to describe but some candidates correctly referred to the increasing then decreasing numbers of fruits as the distance from the base of the tree increased from 0 – 30 m.

(c) The presence of the bract and the information from the data and graph should have led to the conclusion that these were wind-dispersed fruits. There was nothing to suggest that animals might eat them or that they might cling to fur or feathers.

(d) Other possible factors affecting the distribution could have been the surface area of the bract or the mass of the fruit and they were correctly identified with good explanations given of how they might affect distribution. Rainfall or water could also be effective in washing the fruits away from the tree.

BIOLOGY

Paper 5090/32
Practical Test

Key messages

Candidates should be aware that all questions on this paper will relate in some way to practical work so purely theoretical answers are not required.

Candidates should read questions carefully before answering to ensure that they understand what is being asked of them and follow any instructions given.

Candidates should understand the difference between the results of an investigation and any conclusions that can be made from those results.

The difference between scientific terms should be clearly understood e.g. between accuracy and reliability; between volume and concentration; between heating and boiling.

Appropriate units should be included with any measurements.

General comments

It appears that candidates had adequate time to complete the paper.

The spaces provided were generally sufficient for candidates' answers with only of few needing to make use of blank pages or extra sheets.

Comments on specific questions

Question 1

(a) (i) The water-bath temperature should have been between 35°C and 40°C and most candidates successfully adjusted the temperature of the water to within that range and recorded it.

(ii) The majority of candidates recorded the start time but a few omitted to do so.

Nearly all candidates recorded eight measurements in the table provided but some included the units (mm) in the cells of the table with the measurements. As units are stated in the header, they should not be included in the cells of the table.

A few candidates recorded their results in centimetres although the header indicated they should be in millimetres.

The results recorded show that most candidates had carried out the practical as instructed with growth of yeast taking place in each sucrose concentration and the yeast showing most growth in the highest sucrose concentration and least in test-tube **D**. The results of a very small minority of candidates showed that they had mis-identified the test-tubes.

(iii) Describing the effect of the sucrose concentration on the growth of the yeast proved challenging.

Candidates were being asked to come to a conclusion from their results. Simply writing out the results of the investigation could therefore receive no credit.

A good number scored a mark by stating that, as the sucrose concentration increased (or decreased), the yeast growth increased (or decreased). Some omitted concentration or percentage of sucrose so could not be credited. Very few noted any differences in the rates of growth in the two five-minute periods.

Some noted unexpected growth observed when only distilled water had been used.

(iv) Some candidates' results showed that there had been no growth of yeast in test-tube **D** and they correctly explained that, as no sucrose had been provided, there had been no substrate for gaining energy for growing through respiration. However, the results for most candidates showed that there had been some growth in distilled water. Many of these candidates had expected there to be no growth and answered the question as if that had been the case and so could not be credited. If growth had occurred without the addition of sucrose then either the yeast cells themselves must have had some sucrose within them or the yeast used in the investigation must have been contaminated with sucrose.

(b) Identifying possible sources of error in the method used, as opposed to errors made in applying that method, proved difficult for many. However some recorded that it had not been possible to ensure that all the test-tubes were heated in the water for the same amount of time and that doing the test with different concentrations one by one would have made that possible. Some recorded that the test-tubes provided were not large enough and the yeast overflowed so larger test-tubes should have been provided. For some measuring height proved very difficult or an unsatisfactory assessment of growth and correctly suggested that performing the investigation in measuring cylinders or graduated test-tubes would have made measuring growth easier.

(c) This question was generally not answered well. An experimental method was asked for here so theoretical descriptions of how enzymes work, the lock-and-key hypothesis or even bread-making could not be credited. The best method described heating yeast to denature (not kill) any enzymes in it. When some of this yeast and some unheated yeast were placed in equal volumes and concentrations of sucrose solution in separate test-tubes and observed, no growth happening with the heated yeast would show that enzymes need to be present for growth to occur. A misconception was that any heating above the optimum temperature for the enzyme's activity would cause its denaturing. It may not, but heating above the maximum temperature for its activity would. Other misunderstandings were that 'heating' means 'boiling' and that there might be some growth in the yeast that had had its enzymes denatured.

Question 2

(a) (i) Some excellent graphs were constructed with the independent variable, time, plotted on the x-axis and the dependent variable, seeds germinated / mean number per dish, on the y-axis. Axes were fully labelled and good scales used to maximise the use of the grid. The two sets of data were plotted separately, the plotted points joined with ruled lines as instructed and the lines clearly identified.

Some graphs were plotted on the wrong axes, sometimes the axes were not fully labelled or there were no values given at the origin of the axes. A few candidates drew curved lines and others did not label their lines. A small minority obviously had no experience of plotting two sets of data on the same axes. An even smaller minority attempted to construct a bar chart from the data although line graphs were clearly asked for.

(ii) Many candidates were able to make a correct estimate from their graph. Although they were asked to show their working on their graph, some did not and so could not be credited for any working. The question asked for the number of seeds that germinated in the dark to be estimated. A few either recorded numbers that germinated in the light or calculated the mean number for those germinating in the dark and the light. These could not be credited.

(iii) Credit was given for concluding that more seeds germinated in the dark than in the light and that those in the dark germinated more quickly than those in the light. Often just one of these conclusions was stated although 2 marks were available. Some candidates quoted the data but drew no conclusions so could not be credited. A few answered with a general theoretical statement about the conditions needed for germination to take place and so received no credit.

(b) (i) The most common correctly stated variables were water and temperature, with type or species of seeds also frequently being seen. Light and the number of seeds were given quantities so not variables to be controlled.

(ii) Many candidates suggested that using the same number of seeds in each Petri dish would lead to more accurate results, revealing a misunderstanding of accuracy. Accuracy is about precision of measurement and would only apply in this case to the careful counting of the number of seeds. Using 20 seeds in each dish to start with would increase the reliability of the results. It would also make the results in the various dishes comparable and, if some of the 20 seeds were not viable, still mean that there would be some which germinated.

Question 3

(a) Some excellent drawings were seen. They were of a good size with clear, clean lines drawn with a sharp pencil and no shading. Most showed the eight similar cells but drawings with more or fewer than eight cells or of differing cell shapes were seen. Many observed the positioning of the nuclei correctly but a small number of candidates did not draw the nuclei. Most drew the four spines with double lines in the correct positions and delimited them from the cells; single lines were not acceptable.

(b) Many candidates measured the length on the photomicrograph accurately and recorded their measurements with units. They went on to calculate the actual length of the specimen correctly and recorded their answer to 3 decimal places as asked.

A few measured their drawings and not the specimen, although clearly instructed to take the measurement on the photomicrograph.

The magnification of the specimen was given as ×630. Most candidates recognised that this was therefore a very small specimen as was shown by their answers.

Those who miscalculated the actual length by dividing the magnification by the length of G-H, should have realised that the specimen could not have been, e.g.15 mm long.

A few did not record their answers to 3 decimal places as asked, rounded the answer incorrectly or recorded it to 3 significant figures. Occasionally an answer in standard form was given which was not asked for.

(c) Having recognised how small the specimen was, the use of a microscope to find out whether it was present in a sample of pond water should have been prompted. For some candidates it was and some even correctly recognised that the use of a high power lens would be needed.

But there were many irrelevant answers, e.g. collecting oxygen bubbles because it would photosynthesise or carrying out a Benedict's test on the water because it would produce sugar.

Some answers showed that candidates thought that 'microscope' and 'photomicrograph' were the same, e.g. place a drop of water on the stage of a photomicrograph.

BIOLOGY

Paper 5090/61
Alternative to Practical

Key messages

This paper tests the ability to use a range of practical skills. Candidates should have experience of practical work, including biological tests and experimental design. They should be able to recognise potential sources of error and suggest possible improvements to experimental methods. Candidates should be able to draw and interpret graphs, as well as suggest explanations for the data obtained.

General comments

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 were few instances of questions that were not attempted.

There continues to be 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. To improve further, candidates should be aware that all data needs to be plotted – including that with values of zero. Some candidates found the plotting of two sets of data on one set of axes to be challenging.

There were some good biological drawings and few instances of drawings that were too small. However many drawings still had sketchy outlines or were shaded – an area that requires further improvement.

Comments on specific questions

Question 1

(a) (i) The answer required candidates to identify something with which to measure and something with which to cut to produce the cubes of food. Many candidates stated either only a means of measuring or a means of cutting rather than both, which were required for the mark.

(ii) As it was stated that the volumes of ethanol used were 2 cm^3, the only variables that could be controlled to ensure that the results were comparable were the size of the small pieces of food or that they were shaken in the ethanol in the same way. Very few candidates recognised this.

(iii) Many candidates were able to explain that the rod was cleaned to prevent the contents of test-tube **B2** being contaminated by the contents of test-tube **A2**.

(iv) Many candidates took the reading from the top of the meniscus instead of the bottom thus giving an incorrect answer of 7.2 cm^3. The commonly seen incorrect answers of 6.5, 6.6 and 7.1 cm^3 indicated that some candidates did not know how to read a scale.

(b) (i) Many candidates correctly transferred the information in the notebook into the table, keeping to the correct numbering of the tests and just entering the observations recorded. Some omitted to supply the missing table header; *observations* or *appearance* being suitable headers.

The question asked the candidates to transfer only information from the method and the notebook to the table. The conclusions that may have been drawn from the results were not asked for – though some gave them.

A few candidates changed the numbering of the tests which led to confused entries in the *appearance* columns.

(ii) This question did require conclusions to be drawn about the results of the tests. For this, candidates needed to be familiar with which test solutions are used to test for different types of food and their positive and negative results. Many candidates applied their practical knowledge well. Those who had confused their entries in the table or who were not familiar with food tests fared less well.

(c) (i) This proved a challenging question requiring candidates to imagine what would happen practically as food **B** crumbled (easily fell apart). There were those who recognised that crumbling could have meant that equal volumes or surface areas of **A** and **B** may not have been tested which could have led to questionable colour changes in the tests and unreliable conclusions.

(ii) Using equal masses of the foods or crushing both if they were of the same volumes were good suggestions for changing the method in order to overcome these problems.

Question 2

(a) The best drawings were of a good size and shape, drawn with a sharp pencil and not shaded. Few candidates scored full marks on this question as many drawings were shaded or did not indicate the outer and inner layers. The most frequently scored marks were for a drawing only of the artery of good shape and size and depicting the folded inner layer.

(b) Measurements were usually correct but sometimes units were omitted. Some candidates did not know how to calculate the actual size – either dividing or multiplying 90 by the measurement – and those who did sometimes did not give their answer to 2 decimal places as required. Some candidates made the correct measurement of the photomicrograph but then went on to use a measurement of their drawing to calculate the size, which could not gain full credit.

(c) There were some good answers. Frequent errors were to use a thumb to feel the pulse or to measure the number of beats per second. Few candidates noted that, in order to take an accurate reading of the pulse at rest, the subject would have to sit quietly for a few minutes prior to taking any measurements.

Question 3

(a) There were some good graphs with fully labelled axes, good scales and two identified lines plotted correctly. Some candidates only plotted the points for one line, or in some cases plotted all the points but attempted to join them all together in one 'zigzag' line. Some did not realise that zero values should also be plotted so missed out several of the plots for the fruits without bracts data.

(b) (i) It was recognised by many that most fruits fall within 5 m of the base of the tree and not beyond 10 m however there were some candidates who did not understand the word *distribution*.

(ii) The distribution of fruits with bracts was more difficult to describe but some correctly referred to increasing then decreasing numbers of fruits as the distance from the base of the tree increased from 0 – 30 m.

(c) The presence of the bract and the information from the data and graph should have led to the conclusion that these were wind-dispersed fruits. There was nothing to suggest that animals might eat them or that they might cling to fur or feathers.

(d) Other possible factors affecting the distribution could have been the surface area of the bract or the mass of the fruit and they were correctly identified with good explanations given of how they might affect distribution. Rainfall or water could also be effective in washing the fruits away from the tree.

BIOLOGY

Paper 5090/62
Alternative to Practical

Key messages

Candidates should be aware that all questions on this paper will relate in some way to practical work so purely theoretical answers are not required.

Candidates should read questions carefully before answering to ensure that they understand what is being asked of them and then follow any instructions given.

Candidates should understand the difference between the results of an investigation and any conclusions that can be made from those results.

The difference between scientific terms should be clearly understood, e.g. between accuracy and reliability; between volume and concentration; between heating and boiling.

Appropriate units should be included with any measurements.

General comments

It appears that candidates had adequate time to complete the paper.

Almost all scripts were legible. However, in a very few cases, answers were almost illegible, especially when they had been written in pencil and then written over in ink.

The spaces provided were generally sufficient for candidates' answers with only a few needing to make use of blank pages or extra sheets.

Comments on specific questions

Question 1

(a)(i) The question asked what the candidates would use to label four test-tubes which would contain varying concentrations of sucrose solution. Most candidates showed that they had experience of labelling test-tubes using marker pens, wax pencils or sticky labels. A minority however misread the question and suggested what they would write on labels which was not what was asked.

(ii) This proved to be a very challenging question for most candidates. The question was asking how human error could be avoided while carrying out the given procedure. Answers in terms of using different equipment or changing the method could not be credited.

Those who thought through the given procedure recognised the need to ensure that the measuring cylinder being used should be cleaned after each usage or that, when reading the volumes from the scale on the measuring cylinder, parallax error should be avoided by reading the bottom of the meniscus at eye level.

(b) (i) Many candidates transferred the information in the notebook into the table well to score full marks. The header to the table needed to include what was being recorded (total increase in height) and the units in which that height was measured (mm). A few candidates entered dilutions rather than the percentage sucrose solutions given. It should be noted that, as the header indicates which units had been used, those units (mm) should not appear with the actual heights recorded in the cells of the table.

(ii) Describing the effect of the sucrose concentration on the growth of the yeast proved challenging.

Candidates were being asked to come to a conclusion from the results given. Simply writing out the results of the investigation could therefore receive no credit.

A good number scored a mark by stating that, as the sucrose concentration increased (or decreased), the yeast growth increased (or decreased). Some omitted concentration or percentage of sucrose so could not be credited. From some answers it became apparent that a few candidates wrongly consider that 'volume' and 'concentration' are the same.

Very few noticed that, with all concentrations of sucrose, yeast growth was greater during the second five minutes than in the first five or that there was even a little growth in the test-tube which contained only distilled water and no sucrose.

(iii) The vast majority of candidates based their answer to this question on what they had expected to happen and not on the data given. They had expected, and so stated, that as there was no sucrose the yeast did not grow. But the data given showed that, in fact, there was a little growth in the first five minutes. The only way for that growth to have been possible was for the yeast cells themselves to have had a little sucrose within them or for the yeast used in the investigation to have been contaminated with a little sucrose. In either case, the sucrose was quickly used up so no further growth occurred.

(c) (i) Most candidates were able to take correct readings from the thermometers and record them with the units given, °C, but units were sometimes omitted. There are still some candidates who are unable to read values correctly e.g. 38.5°C was read as 30.85°C.

(ii) Using a beaker as a water-bath is a common method of heating test-tubes for a period of time in investigations. Candidates who thought through what was happening in this investigation recognised the need to use a thermometer to keep checking that the temperature was staying at the required 40°C and, when it fell below that, to apply heat in some way to raise it to 40°C again. The use of an electronically heated water-bath at 40°C also received some credit.

Merely stating that some form of insulation should be used could not be credited unless the need to keep checking the temperature and suitably adjusting it was also stated.

(d) An experimental method was asked for here so theoretical descriptions of how enzymes work, the lock-and-key hypothesis or even bread-making could not be credited. The best method described heating yeast to denature (not kill) any enzymes in it. When some of this yeast and some unheated yeast were placed in equal volumes and concentrations of sucrose solution in separate test-tubes and observed, no growth happening with the heated yeast would show that enzymes need to be present for growth to occur. A misconception was that any heating above the optimum temperature for the enzyme's activity would cause its denaturing. It may not, but heating above the maximum temperature for its activity would. Other misunderstandings were that 'heating' means 'boiling' and that there might be some growth in the yeast that had had its enzymes denatured.

Question 2

(a) (i) Some excellent graphs were constructed with the independent variable, time, plotted on the x-axis and the dependent variable, seeds germinated/mean number per dish, on the y-axis. Axes were fully labelled and good scales used to maximise the use of the grid. The two sets of data were plotted separately, the plotted points joined with ruled lines as instructed and the lines clearly identified.

Some graphs were plotted on the wrong axes, sometimes the axes were not fully labelled or there were no values given at the origin of the axes. A few candidates drew curved lines and others did not label their lines. A small minority obviously had no experience of plotting two sets of data on the

same axes. An even smaller minority attempted to construct a bar chart from the data although line graphs were clearly asked for.

(ii) Many candidates were able to make a correct estimate from their graph. Although they were asked to show their working on their graph, some did not and so could not be credited for any working. The question asked for the number of seeds that germinated in the dark to be estimated. A few either recorded numbers that germinated in the light or calculated the mean number for those germinating in the dark and the light. These could not be credited.

(iii) Credit was given for concluding that more seeds germinated in the dark than in the light and that those in the dark germinated more quickly than those in the light. Often just one of these conclusions was stated although two marks were available. Some quoted the data but drew no conclusions so could not be credited. A few answered with a general theoretical statement about the conditions needed for germination to take place and so received no credit.

(b) (i) The most common correctly stated variables were water and temperature, with type or species of seeds also frequently being seen. Light and the number of seeds were given quantities so not variables to be controlled.

(ii) Many candidates suggested that using the same number of seeds in each Petri dish would lead to more accurate results, revealing a misunderstanding of accuracy. Accuracy is about precision of measurement and would only apply in this case to the careful counting of the number of seeds. Using 20 seeds in each dish to start with would increase the reliability of the result. It would also make the results in the various dishes comparable and, if some of the 20 seeds were not viable, still mean that there would be some which germinated.

Question 3

(a) Some excellent drawings were seen. They were of a good size with clear, clean lines drawn with a sharp pencil and no shading. Most showed the eight similar cells but drawings with more or fewer than eight cells or of differing cell shapes were seen. Many observed the positioning of the nuclei correctly but a small number of candidates did not draw the nuclei. Most drew the four spines with double lines in the correct positions and delimited them from the cells; single lines were not acceptable.

(b) Many candidates measured the length on the photomicrograph accurately and recorded their measurements with units. They went on to calculate the actual length of the specimen correctly and recorded their answer to 3 decimal places as asked.

A few measured their drawings and not the specimen although clearly instructed to take the measurement on the photomicrograph.

The magnification of the specimen was given as ×630. Most candidates recognised that this was therefore a very small specimen as was shown by their answers. Those who miscalculated the actual length by dividing the magnification by the length of G-H, should have realised that the specimen could not have been, e.g.15 mm long.

A few did not record their answers to 3 decimal places as asked, rounded their answer incorrectly or recorded it to 3 significant figures. Occasionally an answer in standard form was given which was not asked for.

(c) Having recognised how small the specimen was, the use of a microscope to find out whether it was present in a sample of pond water should have been prompted. For some it was and some even correctly recognised that the use of a high power lens would be needed.

But there were many irrelevant answers, e.g. collecting oxygen bubbles because it would photosynthesise or carrying out a Benedict's test on the water because it would produce sugar.

Some answers showed that candidates thought that 'microscope' and 'photomicrograph' were the same, e.g. place a drop of water on the stage of a photomicrograph.