BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

Marks were well-distributed across the range between 6 and 39 out of 40.

Comments on specific questions

Question 4

This question proved to be very easy with almost all candidates selecting the correct response (**A**).

Question 5

Candidates seem to find questions about limiting factors quite difficult. Most candidates selected option **A** rather than the correct answer (**B**) and option **B** was in fact the least popular.

Question 6

This question proved to be more difficult than anticipated. Again, the correct option (**D**) was the least popular and amongst all candidates option **A** was selected by many, who perhaps failed to remember that guard cells do contain chloroplasts.

Question 15

This was a difficult question, with only a small proportion of candidates selecting the correct response (**A**). Most candidates, of all abilities, preferred option **C**, showing an understanding that with the pressure in the left ventricle being lower than that in the aorta, the semi-lunar valve must be closed. However, at X the pressure in the ventricle is still greater than that in the atrium, so the bicuspid valve must also be closed.

Question 22

It was not anticipated that this would be a difficult question but only a small proportion of candidates selected the correct option (**B**). Most candidates preferred option **D** but the diagram shows no interference with the reflex arc itself.

Question 38

There was quite a lot of work to do here, and it was pleasing that a good proportion of candidates selected the correct response (**C**) showing a very good understanding of this rather complicated scenario. Option **A** was almost as popular and one assumes that these candidates did not have an understanding of the terms ‘genotype’ and ‘phenotype’.

Question 40

Many candidates seemed to have read this question as requiring a disadvantage of genetic engineering and most of these opted for **C**, but one would expect options **A** and **D** to be more obvious disadvantages.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General comments

Marks were well-distributed across the range between 5 and 39 out of 40.

Comments on specific questions

Question 5

Candidates seem to find questions about limiting factors quite difficult. Most candidates selected option **A** rather than the correct answer (**B**) and option **B** was in almost the least popular.

Question 6

This question proved to be more difficult than anticipated. The correct option (**D**) was the least popular and amongst all candidates option **A** was selected by many, who perhaps failed to remember that guard cells do contain chloroplasts.

Question 7

Option **A** was a strong distractor for candidates and they perhaps did not appreciate that with a reduction in magnesium ions and therefore photosynthesis, the plants will not be able to grow as tall.

Question 15

This was a difficult question, with only a small proportion of candidates selecting the correct response (**A**). Most candidates preferred option **C**, showing an understanding that with the pressure in the left ventricle being lower than that in the aorta, the semi-lunar valve must be closed. However, at X the pressure in the ventricle is still greater than that in the atrium, so the bicuspid valve must also be closed.

Question 22

It was not anticipated that this would be a difficult question but only a small proportion of candidates selected the correct option (**B**). Most candidates preferred option **D** but the diagram shows no interference with the reflex arc itself.

Question 25

Here, the longer the time taken to catch the ruler, the longer the reaction time. Alcohol is a depressant (so increases reaction time) so the correct answer is option **A**. Option **B**, showing a variable response (some faster, some slower) was overall the most popular with candidates but alcohol does not shorten reaction time.

Question 36

Many candidates of all abilities selected option **D**, not understanding that not all HIV-positive people go on to develop AIDS. This common public misconception (that HIV positive and AIDS are the same) perhaps needs further attention in teaching this topic.

BIOLOGY

Paper 5090/21
Theory

Key messages

This year there appears to be a wider disparity in candidate preparedness than in previous years and perhaps this is because of global circumstances. Some candidates were able to demonstrate a deep and thorough understanding of biological ideas whereas a significant minority struggled to recall basic facts.

As in previous years candidates tended to do better on questions requiring recall of information rather than application of facts or interpretation. In particular, both of the questions requiring interpretation of graphical information proved difficult for candidates. Drawing and analysis of graphs are two important skills requiring plenty of practice.

General comments

It was pleasing to see that, in general, candidates wrote concise answers that were relevant to the question asked. Their writing was usually easy to read and the spelling, punctuation and grammar were, on the whole, accurate giving candidates the best opportunity to display their knowledge and understanding of biology. It was clear that candidates had sufficient time to complete the whole paper. Most candidates followed the rubric by attempting all questions in ***Sections A*** and ***B*** and choosing just one of the optional questions in ***Section C***.

Comments on specific questions

Section A

Question 1

This question assessed candidates' ability to identify parts of the respiratory system and to determine their understanding of lung function.

(a) The majority of candidates scored at least one of the three marks here. They were most likely to identify the trachea correctly. A significant number struggled to identify the larynx (voice box).

(b) Many of the answers to this question focused correctly on the role of the lungs in gaseous exchange with explanations of oxygen entering and carbon dioxide leaving the blood. The best answers went on to explain that oxygen is required for cellular aerobic respiration or gave some information about how the lungs are suited for their function. Candidates who merely stated that the lungs are involved in respiration, without further explanation, gained no credit. It is worth emphasising the difference between gaseous exchange and cellular respiration when teaching since this is an area where misconceptions are common.

Question 2

Most parts of this question about the process of photosynthesis and factors affecting its rate were relatively straightforward for candidates although **parts b(ii)** and **c(I)** did prove to be challenging.

(a) Many candidates scored the full three marks on this question which asked them to describe the process of photosynthesis. Quite a few had learned a standard definition and were able to repeat this verbatim. Many of the candidates explained that carbon dioxide and water were required 'in the presence of chlorophyll and light' to produce glucose and oxygen. Fuller descriptions indicated that

chlorophyll is required to absorb light energy which is then transferred to chemical energy in the form of glucose.

(b) (i) Many candidates recognised that a glasshouse allows some protection from pests and enables factors, such as carbon dioxide concentration, to be regulated to promote growth. Others realised that the glasshouse would be warmer than an open field and this would result in higher yields.

(ii) Surprisingly, although most candidates could identify the advantages of growing crops in glasshouses in **b(i)** they found it much harder to identify disadvantages. Very few stated that crops grown under glass need to be watered.

(c) (i) Candidates were faced with two challenges when answering this question. Firstly they needed to interpret information presented in graphical form and secondly to describe the concept of limiting factors. Although some excellent answers were seen the majority struggled to express their ideas clearly.

(ii) Candidates had no difficulty with this question with most being able to name a factor other than light intensity which could limit photosynthesis.

Question 3

This question covered the topics of homeostasis, temperature regulation and excretion.

(a) (i) Some candidates gave a perfect definition of homeostasis to score the full two marks and others were able to gain full marks for an imperfect definition of homeostasis coupled with a correct description of sweat evaporating from the skin surface and removing excess heat energy.

(ii) Many candidates picked up two or more of the four marks available here. They were most likely to lose marks for imprecise descriptions of temperature regulation. For example, candidates referred to ‘messages’ or ‘signals’ being transferred to the brain rather than impulses. Often, candidates described blood vessels ‘moving near to the surface of the skin’ rather than correctly describing ‘arterioles widening and thus increasing the volume of blood flowing near the surface of the skin’. It is a very common and persistent misconception that blood vessels move and it is worth pointing out this error.

(b) The organ where most urea is produced is the liver but many candidates gave the answer ‘kidney’. This perhaps suggests that they are not clear about the difference between urea and urine.

(c) (i) For this question candidates were required to select information presented in a tabular form and translate it into a written comparison. Many were very successful and it was not unusual to find candidates scoring three of the four available marks. Most, however, did not quote any figures from the table and so they missed out on the final mark. Alternatively figures or units were inaccurately presented. The most common error was to quote ‘mol per dm^3’ instead of ‘mmol per dm^3’.

(ii) Candidates usually scored two marks for identifying that the patient with a kidney disease would have a higher concentration of urea in the sweat because their kidneys were not efficiently excreting it in urine. It was rare for candidates to mention that if the kidneys are not removing the urea then the concentration in the blood plasma will rise and therefore sweat will contain a higher urea concentration.

Question 4

This ecology question was set in the context of a tropical rainforest ecosystem.

(a) (i) Those candidates who were able to extract the relevant information from the stimulus material were generally able to produce a correct food chain for two marks. Those that did not gain full marks had not followed the instruction to produce a food chain of three organisms or they had selected incorrect organisms. Some had forgotten that the arrows used in food chains should always point in the direction of energy flow.

(ii) Candidates were asked to suggest the advantages, to the kapok tree, of being tall. Generally, a mark could be gained by recognising that one advantage is to gain light and a second mark was available for expanding on this to explain that the light would be used for photosynthesis. It was

much rarer for candidates to think about wind exposure and how this could aid plants in seed dispersal.

(iii) Generally, candidates were able to gain two of the three marks by explaining that bacteria and fungi from the forest floor were decomposers and for giving a partial description of either their relevance in the nitrogen or carbon cycle.

(b) (i) Cellulose and starch were the most common correct answers but some chose to mention chlorophyll.

(ii) The role of carbon dioxide in global warming and climate change is not well understood by candidates. Many candidates gave confused answers and incorrectly linked carbon dioxide to the destruction of the ozone layer rather than describing it as a greenhouse gas that traps heat energy resulting in global warming.

Question 5

Candidates were assessed on their ability to interpret an unfamiliar graph in this question about alcohol and its effects on the body.

(a) This question proved to be one of the most challenging on the question paper. Although candidates recognised that blood alcohol concentration increased and then decreased they found it very difficult to relate this to what was happening in the body. Marks were most generally obtained for mentioning the liver and for recognising that the decline in blood alcohol concentration was related to alcohol being broken down. It was unusual for candidates to describe the absorption of alcohol that results in the increase of blood alcohol concentration.

(b) Relatively few candidates scored two marks. Those that gained one of the two marks were most likely to suggest differences in liver efficiency or blood volume. Only a small number thought about gender or body mass differences.

(c) This proved to be the most accessible part of the question with many candidates able to provide at least one or two short-term effects of alcohol consumption.

Question 6

This question assessed candidates' knowledge and understanding of the lock and key hypothesis of enzyme action and the role of proteins in the human body.

(a) Most candidates were able to score marks on this question. Many remembered the instruction to include a named example of enzyme action but sometimes did not provide the name of the relevant substrate or product and occasionally answers confused the enzyme and substrate. Many mentioned that enzymes have an active site and some were able to describe how this meant that enzymes have specific substrates. It was unusual to find candidates mentioning the enzyme-substrate complex or the fact that enzymes remain unaltered by the reaction they catalyse; both creditworthy points.

(b) The majority of candidates remembered that proteins have an important role in growth and repair of body tissues and so they were able to score at least two of the five marks. Quite a few were then able to expand their answers to include details of different types of proteins such as antibodies and enzymes or they could name a specific protein such as haemoglobin or fibrinogen.

Question 7

Different aspects of inheritance were examined in this question.

(a) Marks were most frequently gained here by explaining that the nucleus has chromosomes which contain the genetic material DNA. Genes were also frequently mentioned but very few mentioned that genes code for proteins and therefore determine characteristics. The relevance of cell division is less well understood and many found it difficult to explain how meiosis results in gametes which are haploid cells. It is important that candidates learn how to spell meiosis and mitosis correctly so that the Examiner is sure which type of nuclear division the candidate is describing. Some made

correct references to fertilisation and a few went on to describe how the fusion of the nuclei of haploid gametes results in new combinations of alleles.

(b) Most realised that ionising radiation would result in an increased possibility of mutation to score at least one of the four marks available. The other marks could be obtained from accurate descriptions of gene and chromosome mutation. It was unusual to find candidates scoring full marks on this relatively straightforward, knowledge-based question suggesting that this topic requires plenty of reinforcement for the ideas to be retained.

Question 8

This optional question on the transport of water and the use of mineral ions in plants and animals proved slightly less popular than **Question 9**.

(a) Candidates were asked to compare the transport of water in humans and flowering plants. It was pleasing to see that some candidates did attempt to compare the similarities and differences and these candidates generally scored well here. Far too often, however, candidates were not comparing the transport systems so did not gain some of the available marks. For example, a candidate would explain that water is transported in xylem vessels in plants but not then explain that it is blood vessels that carry water in a human. Making comparisons, either in a tabular form or in writing, is a very useful scientific skill and many candidates would be helped to develop it if they are provided with plenty of opportunities to practice.

(b) This part of the question proved more difficult for many although some excellent answers were seen. Candidates who thought about this question carefully were able to use their knowledge of mineral requirements to explain that plants and animals have different structures and physiology so have different requirements. For example, plants photosynthesise so require magnesium to manufacture chlorophyll whereas humans have no need to synthesise chlorophyll.

Question 9

This question on sexual reproduction was attempted by a few more candidates than **Question 8** even though it proved to be slightly more challenging.

(a) As with **Question 8**, candidates were asked to make a comparison, this time between sperm cells and pollen grains. Once again, those candidates who thought about the similarities and differences in structure and function did much better than those who wrote about sperm cells and pollen grains separately. In general candidates tended to remember that a sperm cell has a tail for movement, that pollen grains are adapted for either wind or insect-pollination and that both are involved in fertilisation. It was less common for candidates to mention that they were both gametes and that they both contained a haploid nucleus.

(b) This proved to be a much more challenging question for many and usually only one or two marks were obtained here. Very few chose to mention the idea that sexual reproduction results in offspring that are genetically different from the parent whereas asexual reproduction results in clones or identical offspring, thus missing two relatively straightforward marks. Most did mention that sexual reproduction results in variation in a population. Explaining the significance of this variation for species survival was harder for candidates. Some, however, did use the example of disease resistance to good effect, explaining how genetic differences could allow some individuals to survive.

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. The use of specific vocabulary by candidates is important in order to express scientific content clearly and correctly. The necessity to link concepts between different areas of the syllabus is important when answering some questions. To gain full credit for a question, candidates will be expected to address all aspects of the question asked. Candidates are therefore advised to consider fully the scope of this requirement for each question before beginning to write a response. 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 were able to name and outline the role of hormones that control the menstrual cycle in **Question 6**. In the same question, specific details relating to the exchange of named substances between the mother and fetus at the placenta were less often understood. Questions that require tailoring and application of knowledge, such as in **Question 2** relating to the heart and circulation, continued to provide more challenge for even some highly attaining candidates. A greater degree of specificity was required in some other responses as noted for individual questions below. Centres are advised to instruct candidates to answer **either** Question 8 **or** Question 9 as clearly stated in the rubric.

Comments on specific questions

Section A

Question 1

(a) (i) This question was generally well answered. Most candidates correctly identified the 'guard cell' and the 'stomatal pore'. A minority of candidates incorrectly identified cell **A** as a 'mesophyll' cell, or incorrectly made reference to named cell organelles rather than to named types of cell.

(ii) This question was quite well answered, although full credit was often not awarded. Many candidates gave an account of photosynthesis rather than directing their answer to the question asked. Relatively few linked reduced light intake with reduced absorption of light by chlorophyll. The reduced production of glucose was often not stated.

(b) (i) A significant number of candidates drew arrows that pointed in the wrong direction or added an incomplete number of arrows to the diagram.

(ii) This question was well answered by many candidates, however it was common for species names rather than a number to be written as a response.

Question 2

(a) (i) Very few candidates gained full credit. Many were able to recognise that the heart of a human has four chambers, however some stated that the heart of a fish has only one chamber. Many answers made reference to 'single circulation' in comparison to 'double circulation', rather than to differences in the structure of the heart.

(ii) Most candidates answered correctly.

(b) (i) Most candidates answered correctly.

(ii) Many candidates found this question to be challenging with the majority attaining limited credit for answers that did not fully use the information provided. Reference was quite frequently seen to 'more blood being pumped around the body of the fish'. The intended link between a cold temperature and the effect of this on respiration as an enzyme-controlled reaction was rarely made.

Question 3

(a) (i) Many candidates gained full credit. Some did not give their answer to one decimal place, however separate credit was often awarded for correct identification of the appropriate unit.

(ii) Most candidates were able to give at least one use of protein in the diet. Some gave multiple alternative responses equivalent to 'growth' and therefore did not gain further credit.

(b) Many candidates gained full credit. Some did not make reference to either 'vitamin C' or to 'iron' at all; others mentioned both and gave their functions in the diet but did not go on to state that they are absent from milk. Most candidates scored at least two marks for recognising that 'vitamin D' and 'calcium' are each needed for 'bones'.

Question 4

(a) (i) Very few candidates answered correctly. The most common incorrect answer was 40 per cent, rather than stating that this is twice the probability.

(ii) There were some excellent answers to this question, with many candidates gaining full credit. There was also evidence of confusion in the case of some candidates who stated the roles of hormones incorrectly or who made errors when naming the hormones.

(b) Many candidates gained full credit here, however a significant number were imprecise when detailing the nature of the exchange between mother and fetus. Reference to the movement of 'nutrients' or of 'waste products' was not sufficiently detailed to gain credit. Reference to the movement by 'diffusion' was not always made. A noticeable proportion of candidates were not able to correctly identify the structure as the 'placenta' and incorrect references to it 'protecting the fetus from physical injury' were seen.

Question 5

(a) Most candidates were able to correctly name both enzymes.

(b) (i) Candidates generally scored well on this question, with many securing all three marks. Some did not use the information given, and many described the effect of pH either instead of, or as well as, the effect of temperature. There were some clear misconceptions about normal human body temperature. Some candidates did not gain full credit because they did not express the units of temperature correctly.

(ii) Most candidates gained one mark for understanding that Savinase has an optimum pH that is alkaline. A few recognised that the provision of an alkaline pH would prevent the enzyme being denatured. Very few candidates correctly linked the optimum pH with making the detergent more effective.

(iii) This was generally well answered, with many candidates gaining full credit. Most recognised that this would cause eutrophication and were able to go on to give an account of the process. Some candidates deduced that the phosphate ions would directly poison fish. Not all candidates appreciated the role of decomposers in reducing the oxygen content of the water, with many making an incorrect link between reduced oxygen content and the metabolism of aquatic plants.

Section B

Question 6

(a) This was generally well answered, with many candidates gaining full credit. Some candidates incorrectly named structure **P** as the 'stamen' rather than specifically as required the 'anther'. The functions of the three structures were well understood.

(b) (i) Most candidates were able to recognise that insect-pollinated flowers produce sticky pollen which can easily attach to insects. Some candidates seemingly misread the question and instead gave irrelevant accounts detailing adaptations of insect-pollinated flowers.

(ii) Most candidates gained full credit, however a minority described the structural adaptations of the flowers rather than of the pollen grains.

Question 7

(a) Many candidates gave lengthy descriptions of the data. A significant proportion of candidates did not recognise that the percentage of forest cover begins to increase in 1987, instead incorrectly stating that the increase begins in 1997. Most recognised that the percentage cover decreases until 1987. Some candidates did not make sufficient reference to specific data from the table. Attention had been drawn to the importance of this in the wording of the question.

(b) This question was often well answered, with many candidates easily gaining full credit. Some candidates seemingly misunderstood the question and gave accounts of possible reasons for the deforestation by relating this to an increased human population.

(c) Many candidates scored two marks for this question, recognising that environmental awareness has increased and stating that more trees have been planted. Some candidates simply described the change in cover or described the process of deforestation, rather than responding to the question asked. Only a small number of candidates made reference to the term 'conservation'.

Section C

Question 8

This was the most commonly answered question in this section.

(a) This was generally well answered with the majority of candidates quoting the syllabus definition to gain full credit. Reference to the effect of drugs on 'chemical reactions' or on 'metabolism' was not always expressed sufficiently well by candidates to gain credit for that point.

(b) Most candidates were able to secure at least four marks on this question, with many gaining full credit. A significant proportion of candidates named and wrote about several drugs, rather than limiting their response to one as required by the question. Most candidates described the adverse effects of alcohol, heroin or smoking (with most mentioning nicotine in their response). The adverse metabolic effects of drugs were well known, and most candidates referred to 'addiction', 'crime' and the 'social issues' associated with drug abuse. The specific reason for a person to take a drug and the concept of 'withdrawal' were less frequently seen.

Question 9

This was the least commonly answered question in this section.

(a) Very few candidates gained full credit, with most scoring the mark for reference to 'germination' alone. Reference to 'aerobic respiration' was infrequently seen.

(b) Candidates often limited their response to a superficial account of the role of water in plants. Such candidates most frequently made reference to 'transpiration' leading to a 'cooling effect', and to the role of water in maintenance of 'turgor' and the 'prevention of wilting'. Rarely did candidates make reference to either 'xylem' or 'phloem' and less frequently still to the role of water in the transport of

substances by these tissues. Surprisingly few candidates made reference to the use of water as a raw material in photosynthesis.

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, such as using basic scientific equipment including microscopes, biological tests and experimental design. Candidates should be able to identify problems in experimental design that could potentially make the conclusions unreliable.

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. More 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 read the question carefully to determine whether plotted points are to be joined by ruled lines, a curve or a line of best fit.

Comments on specific questions

Question 1

(a) (i) Most candidates gave times which agreed with the figures quoted, although a few left their experiment longer than instructed. A few candidates did not enter a start time.

(ii) The question asked what was done to ensure the strips could be identified after being removed from the test-tubes. The best answers mentioned the use of a labelled receptacle such as a Petri dish, test-tube or white tile. Some answers related to marking the actual strip which is not practical and so not creditworthy.

(iii) Most candidates correctly recorded start lengths of 80 and recorded the end lengths, although the end lengths did not always measure what was expected. Most were able to do the subtraction to calculate the change in length but some did not indicate negative values. A few candidates subtracted their measured values from 80, thus recording the positive and negative changes the wrong way round.

(iv) The majority of candidates followed instructions and used the flexibility key provided to identify the flexibility of each potato strip. In most cases strip **A** was the least flexible and strip **C** the most, as expected.

(v) Candidates were asked to describe and explain the changes in length and flexibility of the potato strip from solution **A**. There were many good answers referring only to strip **A** as required but a few candidates included superfluous information about other strips as well. Most identified a change in length and a decrease in flexibility correctly attributed to the uptake of water by osmosis.

References to increased turgor should have been related to cells rather than the whole strip.

(vi) This proved to be a demanding question but some good answers were seen. Only one potato strip being used in each solution was frequently given as a problem, with replicates/repeats suggested as an improvement. Many candidates noted that the potato strips had not been in the solutions for exactly the same length of time.

(b) (i) Most candidates seemed to understand the need to control variables and answers in terms of temperature and volume of solutions were often seen. There were a few responses of 'controlling the concentration of the sucrose solution' showing that these candidates had not understood the aim of the experiment.

(ii) Good answers in terms of the need to remove any surface solution so that it would not be included in the final mass of the strips were seen. Some answers seemed to imply that solution from within the strip was being removed and others that the external solution was removed so that any reaction would be stopped; these did not receive credit. A few candidates referred to dry mass which was not relevant in this investigation.

(iii) Many good graphs were seen with the independent variable plotted on the x-axis, fully labelled axes, good linear scales and with points plotted correctly and joined with ruled lines as requested. When asked to join points with ruled lines, lines of best fit, although ruled, are not acceptable.

(iv) Few candidates were able use their graph correctly to determine the concentration of sucrose solution in which no change in mass of the strip took place. Some of those who did give a correct value omitted units so could not be fully credited.

(v) Those who had given a correct value were usually able to explain that, if there had been no change, then the strip would still have a mass of 5 g. Drawing a line from 5 g on the y-axis to the graph line and then reading from there to the x-axis gave them the concentration at which there was no change.

Question 2

(a) (i) It was apparent that many candidates did not read the instructions carefully about what to draw. What was asked for was a drawing of the cell clearly labelled **E**, and the cells immediately to its outside and inside – just five cells in total. Many attempted to draw the whole root section, xylem vessels (not labelled **E**), or even textbook diagrams of transverse sections through a root.

Most drawings, of whatever was drawn, were of a good size. Those who attempted to draw cell **E** often showed good technique, using a sharp pencil and with no shading. Good attempts were often made to show that its inner and lateral cell walls were thicker than its outer wall.

It was often the case that more than the required number of surrounding cells was drawn.

(ii) Many candidates correctly measured the distance between **F** and **G**, which were clearly labelled on the xylem vessel, but there were those who measured a different cell and thus could not be credited.

(iii) The majority of candidates correctly divided their measurement by the x200 magnification to give the actual diameter of the vessel however some multiplied their figures resulting in the xylem vessel having an unrealistic diameter of 3400 mm.

(b) While many candidates knew that iodine solution should be used to test for the presence of starch and that blue-black indicates a positive result, very few were able to describe how to prepare a root section for viewing under the microscope. Few responses referred to the use of a (glass) slide and even fewer to a coverslip. Some did not use a microscope at all in their response.

A significant number of candidates applied their knowledge of testing leaves for starch to answer this question. As most roots do not contain chlorophyll, descriptions of removing chlorophyll were irrelevant. Others de-starched the root before applying iodine solution, not appreciating that the exercise was to discover whether starch was present, not to remove it.

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, such as using basic scientific equipment including microscopes, biological tests and experimental design. Candidates should be able to identify problems in experimental design that could potentially make the conclusions unreliable.

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. More 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 read the question carefully to determine whether plotted points are to be joined by ruled lines, a curve or a line of best fit.

Comments on specific questions

Question 1

(a) (i) There were many references to cutting and measuring without stating what would be used for cutting and measuring. Very few candidates referred to cutting on a flat surface such as a tile.

(ii) The question asked how the strips could be identified after being removed from the test-tubes. A number of responses correctly mentioned the use of a labelled receptacle such as a Petri dish, test-tube or white tile. Most incorrect answers related to marking the actual strip, feeling the strips to see which was the most flexible, or occasionally doing a Benedict's test.

(iii) Most, but not all candidates, entered 80 as the starting lengths and the majority of measurements were accurate. One or two candidates recorded measurements in centimetres instead of millimetres despite millimetres being indicated in the table heading. A few could not read the ruler properly – recording 85 mm as 80.5 mm.

The vast majority of candidates were able to do the subtraction to calculate the change in length but many did not indicate negative values. A small minority subtracted their measured values from 80, thus recording the positive and negative changes the wrong way round.

(iv) Most candidates followed instructions and used the flexibility key provided to correctly identify the flexibility of each potato strip. A few tried to write the descriptions in the results table which could not be credited.

(v) Candidates were asked to describe and explain the changes in length and flexibility of the potato strip from solution **A**. There were many good answers referring only to strip **A** as required but a few candidates included superfluous information about other strips as well. Most identified a change in

length and a decrease in flexibility correctly attributed to the uptake of water by osmosis. References to increased turgor should have been related to cells rather than the whole strip.

(vi) This proved to be a demanding question but some good answers were seen. Only one potato strip being used in each solution was frequently given as a problem with replicates/repeats suggested as an improvement. Answers such as 'not having the same concentration of sucrose in all the tubes' showed that some candidates had not taken note of the aim of the experiment.

(b) (i) Most candidates seemed to understand the need to control variables and answers in terms of temperature and volume of solutions were often seen. Again as in **(a)(vi)**, a few responses of 'controlling the concentration of the sucrose solution' showed that these candidates had not understood the aim of the experiment.

(ii) Good answers in terms of the need to remove any surface solution so that it would not be included in the final mass of the strips were seen. Some answers seemed to imply that solution from within the strip was being removed and others that the external solution was removed so that any reaction would be stopped; these could not receive credit. A few candidates referred to dry mass which was not relevant in this investigation.

(iii) Many good graphs were seen with the independent variable plotted on the x-axis, fully labelled axes, good linear scales and with points plotted correctly and joined with ruled lines as requested. When asked to join points with ruled lines, lines of best fit, although ruled, are not acceptable.

(iv) Few candidates were able use their graph correctly to determine the concentration of sucrose solution in which no change in mass of the strip took place. Some of those who did give a correct value omitted units so could not be fully credited.

(v) Those who had given a correct value were usually able to explain that, if there had been no change, then the strip would still have a mass of 5 g. Drawing a line from 5 g on the y-axis to the graph line and then reading from there to the x-axis gave them the concentration at which there was no change.

Question 2

(a) (i) It was apparent that many candidates did not read the instructions carefully about what to draw. What was asked for was a drawing of the cell clearly labelled **E**, and the cells immediately to its outside and inside – just five cells in total. Many attempted to draw the whole root section, xylem vessels (not labelled **E**), or even textbook diagrams of transverse sections through a root.

Most drawings, of whatever was drawn, were of a good size. Those who attempted to draw cell **E** often showed good technique, using a sharp pencil and not shading. Good attempts were often made to show that its inner and lateral cell walls were thicker than its outer wall.

It was often the case that more than the required number of surrounding cells was drawn.

(ii) Many candidates correctly measured the distance between **F** and **G**, which were clearly labelled on the xylem vessel, but there were those who measured a different cell and thus could not be credited.

(iii) The majority of candidates correctly divided their measurement by the x200 magnification to give the actual diameter of the vessel, however some multiplied their figures resulting in the xylem vessel having an unrealistic diameter of 3400 mm.

(b) While many candidates knew that iodine solution should be used to test for the presence of starch and that blue-black indicates a positive result, very few were able to describe how to prepare a root section for viewing under the microscope. Few responses referred to the use of a (glass) slide and even fewer to a coverslip. Some did not use a microscope at all in their response.

A significant number of candidates applied their knowledge of testing leaves for starch to answer this question. As most roots do not contain chlorophyll, descriptions of removing chlorophyll were irrelevant. Others de-starched the root before applying iodine solution, not appreciating that the exercise was to discover whether starch was present, not to remove it.

BIOLOGY

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Alternative to Practical

Key messages

Candidates should read the questions carefully and ensure that any instructions given are followed.

The requirements of different demand words used in questions should be appreciated e.g. the difference between being asked to 'Describe' and to 'Explain'.

In referring to variables that need to be controlled, more detail may be needed e.g. temperature alone would be an insufficient answer if it was the temperature of a water-bath that needed to be controlled.

General comments

Candidates appeared to have adequate time to complete the paper.

Almost all answers were clearly legible, written in the spaces provided or, if not, with clear indications of where they had been written. However, in a very few cases, answers were almost illegible.

Comments on specific questions

Question 1

(a) It was expected that candidates would have practical experience of carrying out food tests. Most candidates knew that the reagent used to test for glucose is Benedict's solution and for protein, biuret reagent. References to copper sulfate and sodium hydroxide solutions alone are insufficient. Care should be taken with names so that, for example, biuret is not confused with burette.

(b) (i) Candidates who read the question and information given carefully realised that some of the test-tubes being prepared would be used for Benedict's tests. These would involve the use of a water-bath. Hence any labelling would need to withstand possible contact with water. Sticky labels would not suffice and only permanent or wax markers would be suitable.

(ii) When candidates do practical work they appreciate that test-tubes do not provide a large surface on which to write identifying labels so those labels need to be short. Those labels also need to make clear exactly what is in each tube. Labelling these test-tubes 1, 2, 3 and 4 would not indicate what was in each test-tube. Labels such as AG (i.e. solution A being tested for glucose) and BP (i.e. solution B being tested for protein) would clearly identify the contents of test-tubes.

(iii) Candidates were required to transfer given observations into a table and to complete the table by drawing conclusions from those observations. Many candidates did this well, concluding from the results that neither glucose nor protein was present in solution A and that both were present in solution B. Almost all candidates entered something in all the cells of the table. When the given result was 'pale blue' then 'pale blue' should have been transferred into the table, not just 'blue', which could have implied that a change had occurred. Some candidates entered 'solution turned pale blue' implying that a change in colour had been seen, which was incorrect; it had remained pale blue when the test reagent had been added. A few candidates wrote conclusions in the 'observations' column which could not be credited.

(c) (i) Many candidates recognised that the apparatus used to measure 15 cm^3 would need to be graduated, so a syringe, measuring cylinder or graduated pipette would be suitable. It could be that

in a class practical individual candidates took 15 cm^3 each from one common burette so that too was a creditworthy answer. Pipettes, beakers and droppers (without 'graduated') could not be used to measure a known volume.

(ii) The surface of the Visking tubing filled with solution B was rinsed with water to wash off any of that solution B that may have been on the outside of the tubing. Many candidates did realise that, but answers in terms of getting rid of impurities, dust, bacteria etc. were too vague to be credited.

(d) (i) Stating two variables that should have been controlled in the investigation proved challenging for many candidates. Some referred to solution B although the question involved only solution A. Controlling variables such as time and temperature needed further explanation as it was only the time for which the Benedict's tests were heated that should be the same, as should the temperature of the water used for heating those tests. The volumes of reagents or solution used were often stated correctly but when 'amount' is used instead of 'volume' credit cannot be given.

(ii) There were many good answers to this question recognising that, as glucose had moved out of the Visking tubing but protein had not, the tubing must be partially permeable.

(e) (i) This question asked for a description of the changes in levels of solutions shown in the diagrams and not for an explanation of what had happened to bring about those changes. Candidates who gave only explanations could not be credited but many candidates gave good descriptions.

(ii) The majority of candidates correctly suggested that osmosis had brought about the changes.

Question 2

(a) (i) Many candidates did not appreciate the need to allow the plant to adjust to its new environment before beginning to use it in the investigation.

(ii) Most candidates observed that the reading for the bubble at 1 minute had been taken from the right-hand edge of the bubble and then correctly read 2.8 from the right-hand edge of the bubble in the diagram at 2 minutes. There were some who incorrectly read from the left-hand edge of the bubble at 2 minutes.

(iii) Some excellent graphs were seen, with the independent variable plotted on the x-axis, fully labelled axes and good linear scales. Points had been plotted correctly, joined with ruled lines as instructed and the lines clearly identified. Frequent reasons for not scoring higher marks were failing to label the axes, not plotting the points at zero and not making it clear which line related to which air movement condition. If ruled lines joining plotted points are asked for then a ruled line of best fit cannot be credited. Only a few candidates did not know how to plot two lines on the same axes of a graph.

(iv) If three marks are available for a question, answers giving only one piece of information cannot be fully credited. Many correct statements that the transpiration rate was higher in moving air or slower in still air scored one mark. Use of data was asked for. Those who were able to show how they had arrived at their answer using the data received further credit e.g. at 5 minutes with the plant in still air the bubble had moved only 5 cm whereas with the plant in moving air it had moved 7.6 cm.

(b) (i) Many candidates were able to use the information given for the plant in moving air at 5 minutes (7.6 cm) and 4 minutes (5.9 cm) to correctly calculate how far the bubble had moved in that minute (1.7 cm)

(ii) The area of the cross-section of the tube was given in mm^2. To calculate the volume of water transpired first involved changing the reading in **(b)(i)** which had been recorded in cm to mm i.e. 17 mm. To calculate the volume of water transpired, this value was then multiplied by the cross-section area given (0.085), which a good number of candidates did correctly. Some candidates did not convert the reading in cm to mm; a few divided their value in **(b)(i)** by 0.085. The question asked that the answer be given to 2 decimal places. A few candidates did not follow this instruction.

(c) This was generally well-answered. Candidates recognised that differences in results may have arisen because variables such as room temperature, humidity or light had not been controlled or speed of air movement or size/type of the plant were creditworthy answers.

Question 3

(a) Candidates were given clear instructions about which cells in the photomicrograph should be drawn. There were some excellent drawings showing good observational skills and technique and of a good size. Too many candidates read only the first part of these instructions and drew only the two guard cells and thus omitted to draw the cells touching them i.e. 6 cells in all. Some failed to delimit the two guard cells, drawing them as one oval cell with a stoma in the middle. Lines that were not drawn with a sharp pencil or were sketchy were seen, as was shading; these could not be credited. Most drew nuclei in the correct positions in the cells they had drawn.

(b) Most measurements of the guard cells were accurate. Many candidates were able to use the given actual length of the guard cell (0.07) to calculate the magnification of the photomicrograph correctly by dividing their measurement by that actual length. A few multiplied instead of dividing. Some, although the correct method had been used and credited, did not give their answer to the nearest whole number as asked for so were not able to receive full credit.