BIOLOGY

Paper 5090/11
Multiple Choice

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

General comments

Overall, the paper discriminated well between candidates while still remaining accessible. It was pleasing to see that most candidates coped well with interpreting experimental data, including in situations where the context was unfamiliar.

Comments on specific questions

Questions 2, 4, 8, 10 and 12

These questions proved to be relatively easy, but they nevertheless worked well in discriminating between candidates of differing abilities.

Question 7

The weaker candidates confused the graph for rate of photosynthesis versus temperature with that versus light intensity.

Question 9

A large number of candidates thought that the liver secretes insulin.

Question 11

Many candidates did not recognise that osmosis can only occur through a partially permeable membrane.

Question 14

A common error was the belief that the blood pressure is higher in the veins than in the capillaries.

Question 15

The comparison of plasma and tissue fluid was not well known.

Question 17

A high proportion of candidates thought that anaerobic respiration in muscles produces carbon dioxide.

Question 23

This proved to be the hardest question on the paper. Most candidates did not appreciate that the reflex action requires no input from the brain.

Question 25

A common error was the belief that malaria is treated with antibiotics.

Question 26

The key to interpreting this question was to realise that viruses do not have a cellular structure.

Question 27

A majority of candidates thought that it is necessary to keep bacteria in (rather than out) during alcoholic fermentation.

Question 36

The signs and symptoms of syphilis were not well known.

Questions 38 and 39

Both these questions proved harder than expected, perhaps because they dealt with familiar topics in less familiar contexts.

Question 40

Most candidates dealt confidently with this genetics problem.

BIOLOGY

Paper 5090/12
Multiple Choice

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

General comments

Overall, the paper discriminated well between candidates while still remaining accessible. It was pleasing to see that most candidates coped well in interpreting experimental data, including in situations where the context was unfamiliar.

Comments on specific questions

Questions 8, 14, 17, 22, 25, 35, 36 and 38

These questions proved to be relatively easy, but they nevertheless worked well in discriminating between candidates of differing abilities.

Question 2

Many candidates did not appreciate that diffusion occurs through a partially permeable membrane.

Question 7

The weaker candidates confused the graph for rate of photosynthesis versus temperature with that versus light intensity.

Question 13

Some candidates did not realise that pulse rate will have no effect on ventilation of the lungs.

Question 15

The comparison of plasma and tissue fluid was not well known.

Question 27

Less than a third of candidates recognised the diagram of a yeast cell.

Question 31

Weaker candidates thought of mosquitoes as being malarial parasites.

Question 33

The diagram here required candidates to recognise which parts of a fruit are composed of parent tissues and which are the offspring. Many candidates found his challenging.

BIOLOGY

Paper 5090/21
Theory

Key messages

Many candidates gave general accounts in their answers, rather than responding to the specific aspect of a topic as required by specific questions. As a result, marks were lost. Candidates are advised to read the question *before*, *during* and *after* answering it to ensure that they produce a full and relevant answer.

General comments

Some very competent work was seen from the better candidates. However, details on the hormone oestrogen (**Question 3**) were often inaccurate and a significant number were unable to produce a full genetic diagram (**Question 4**).

Comments on specific questions

Section A

Question 1

(a) (i) It was not uncommon for answers to be given that described features that are **not** found in bacteria e.g. they have a nucleus and they have no cell wall. No references to the dimensions of a bacterial cell were seen.

(b) (i) This was usually correct, though 'chloroplast' was a common response (the question asked for a *chemical*).

(ii) Candidates who opted to supply an equation in symbols were required to make it balance correctly. Unfortunately many were unable to do so, whilst a few offered the equation for photosynthesis instead.

(c) It was common to read (incorrectly) that iron is necessary for bones. Some candidates failed to score the iron mark by saying that it was 'for blood' and not specifically mentioning either red blood cells or haemoglobin.

Question 2

(a) This was a high-scoring question. The only real problem was distinguishing between sepal and petal.

(b) Many immediately recognised that this was a question on transpiration, and thus an account of the transpiration stream was given – beginning with the root hairs and root, that were clearly **not** present in the diagram. The question asked specifically for a description of the *pathway*, but many, albeit accurate, descriptions of the mechanisms governing transpiration were given. Candidates need to read the question carefully before responding.

(c) (i) A simple calculation that most candidates completed successfully.

(ii) The majority of candidates realised that the bubble would slow down. Most suggested that this would be due either to a reduced rate of photosynthesis or transpiration – very rarely to both. Only a few referred to stomata being closed or to the rate of diffusion from the leaf being slowed.

Question 3

(a) Apart from the very occasional reference to the heart or kidney, **X** was usually correct. However, naming the blood vessels proved to be much more of a challenge. The hepatic vein and the hepatic portal vein were often confused, and both renal and pulmonary blood vessels were popular choices.

(b) The diagram should have helped candidates with this part since the blood vessels concerned were labelled as carrying blood from the heart (**R**) and to the heart (**P**). This information did not prevent a significant number of candidates describing their structure incorrectly.

(c) (i) Named hormones or named enzymes were relatively common, incorrect answers.

(ii) This question was rarely tackled with any real confidence or accuracy. Oestrogen was most commonly thought to be produced by the pituitary gland. Many unlikely organs were suggested as possible target organs (e.g. stomach), and it was not uncommon for the boxes to be left blank.

Question 4

(a) (i) References to genes being able to be copied were almost completely absent from candidates' answers.

(ii) The vast majority gave the correct answer here.

(b) Many candidates failed to produce an accurate genetic diagram, and showed confusion over which stages in such a diagram indicate the genotype, phenotype and gametes. However, a number of correct diagrams were seen, with a mark sometimes being lost for failing to identify which of the offspring would be white.

(c) This proved to be a demanding question. Only a few candidates realised that dark stripes and colour of fur are controlled by different genes. There was then a failure by all but a very few candidates to realise that the varying pattern of stripes could be due to allele mutations or to different allele combinations. Many repeated the question by saying that all individuals are different, or made a reference to continuous variation.

Question 5

This question successfully probed candidates' knowledge of the processes of sexual and asexual reproduction. A few had difficulty in tying the correct word to the process and this could have accounted for a number who managed no more than a couple of marks. **H** (the fusion of nuclei) and **J** (the formation of a diploid zygote) were the two processes that were most commonly incorrectly assigned, with a significant number of candidates believing them to be relevant to both sexual and asexual reproduction, whilst **F** most regularly appeared in this, its correct, box.

Section B

Question 6

(a) There is some confusion over the function of cilia. It was not uncommon to read that they are involved in moving air into and out of the lungs or that they filter dust or bacteria from the air. However, most correctly stated that they pass mucus, with bacteria, up towards the throat. 'Germs' is not considered to be a scientifically accurate term at this level.

(b) The question stated that 'you should make reference to **named** structures in your answer'. However, some answers referred only to 'it', thus failing to indicate precisely which structures were being described. Although the moist surface of alveoli was often mentioned, it was rare for candidates to explain that this allowed gases to dissolve. Capillaries and alveoli were said to be 'one cell thick', when it is their *walls* that are one cell thick – not the complete structure. A few only referred to the plasma in the capillaries. Despite these shortcomings, this was a relatively high-scoring question.

Question 7

(a) Only the better candidates expanded the fact that the bacteria round disc **N** had not been killed, by explaining that gene mutation had allowed them to survive and then breed offspring with the same resistance. Occasionally, candidates referred to the resistance of the antibiotic indicating a slender grasp of the principles of natural selection.

(b) This part exposed misunderstanding amongst a number of candidates who believed that vegetative propagation, where a person selects the plants they wish to grow, is an example of artificial selection. Some believed that genetic engineering is also an example of artificial selection. However, many scored well, failing only to say that the process is repeated over many generations.

Section C

Question 8

(a) This part was well answered. There was the occasional confusion over cell wall and cell membrane, and there were few references to the fact that (because of the presence of the central vacuole) the nucleus of a plant cell is generally less central than that of an animal cell.

(b) This was answered well. Confusion between xylem and phloem was extremely rare; one possible exception to this was the occasional reference to xylem carrying 'food'. All functional and structural features of xylem vessels were mentioned. As with xylem, all the structural and functional features of red blood cells were well known and were regularly described.

Question 9

(a) General differences only were required, but it was not uncommon for full descriptions of anaerobic respiration in yeast and in muscles to be described. By so doing, candidates did not refer to the comparative amounts of energy that are released in aerobic and anaerobic respiration. A significant number of candidates believe that energy is produced, rather than released, by the process of respiration.

(b) Most candidates accurately described the differences between the two anaerobic forms of respiration. However, it was not unusual to see references to carbon dioxide being evolved by anaerobic respiration in muscles, and references to oxygen debt in muscles were rare.

(c) This part was, in the main, answered well, though there is the mistaken belief amongst some candidates that water moves by active transport. That a living membrane is required for active transport was rarely seen in candidates' responses.

BIOLOGY

Paper 5090/22
Theory

Key messages

Many candidates read the question only sufficiently thoroughly to determine the topic being examined, but then gave a general account of it, rather than restricting their answer to the specific aspect of that topic as required by the question. As a result, marks were lost. Candidates are advised to read the question *before*, *during* and *after* answering it to ensure that they produce a full and relevant answer. Centres are reminded that candidates should be guided in the length of each of their responses by the number of lines provided and by the number of marks available.

General comments

Some excellent work was seen from the more highly attaining candidates. Production of the seed and fruit wall (**Question 7**) resulting in genetic differences, and questions requiring tailoring and application of knowledge to a previously unseen context, provided more challenge for even the best candidates.

Comments on specific questions

Section A

Question 1

(a) This proved to be a challenging first question even for otherwise able candidates. Whilst many candidates drew the diaphragm in an acceptable vertical position, a significant number did not show it joining the body wall on both sides. Few candidates were able to correctly show the position of the heart, despite any circle drawn either on or touching the sternum being accepted by examiners. The liver, too, was frequently shown in an incorrect location, most often above the drawn diaphragm.

(b) (i) Correct reference to a direction of movement quite commonly enabled candidates to gain credit here. Frequent incorrect reference to the 'diaphragm' was seen and did not gain credit. Contradictory reference to both 'up' and 'down' or to both 'out' and 'in' was also frequently seen. Centres are advised that where numbered response lines are provided, only **one** mark is available per numbered line.

(b) (ii) Frequent correct reference was made to the involvement of the ribs and the intercostal muscles in the movement of a person's chest, and to the resulting changes in volume and pressure. Direct comparison with the movement of the handle was less frequently seen. Incorrect reference to the diaphragm was frequent. There was a tendency for candidates to write at length about their knowledge of the process of breathing, rather than to relate this knowledge to the question asked.

Question 2

(a) (i) This was well answered by most candidates. The most common incorrect answer was 'excretion'.

(a) (ii) This was well answered by most candidates. It was not uncommon for **A** to be indicated too high on the diagram to gain credit, as the label was in that case indicating the rectum rather than the anus.

(b) This was well answered by most candidates and a range of correct alternatives such as ileum, small intestine, villi and capillaries were accepted in the second part. Incorrect reference to 'amino acids' was seen in the first part and to the 'duodenum' in the second part.

(c) This question was a good discriminator. Credit was awarded for answering the question asked about the effect on digestion of removing the gall bladder, rather than for providing a description of the usual function of bile. Many candidates were able to make correct reference to 'bile' however a much smaller proportion were able to go on to identify that bile would not be stored if the gall bladder had been removed. Candidates who did identify this often went on to incorrectly suggest that emulsification and/or digestion of fats would **stop** rather than **reduce/slow** as a result. Candidates were often unclear about the significant difference between **physical** digestion (by bile) and **chemical** digestion (by enzymes). A small number of candidates confused the gall bladder with the urinary bladder.

Question 3

(a) This was well answered by most candidates. Correct label lines were accepted on either one or on both diagrams. The sepal was the most commonly correctly identified part. A small number of candidates did not gain credit for their labelling of the carpel due to the use of insufficiently clear label lines. Examiners accepted a label line correctly drawn to **any** part of the carpel. Centres are reminded that label lines should touch the part being identified by candidates.

(b) Most candidates demonstrated a good understanding of cross-pollination in the context of the question set. Insufficient reference to **named** parts of the flower was seen in some responses. A common error was for candidates to suggest that the anthers of **E** were not yet mature, rather than withered post-maturity.

(c) This was very well answered by most candidates. A common error was to refer to the size and/or colour of the 'flower' rather than to specifically that of the 'petals'. Adaptations such as the presence of nectar, nectar guides, scent and a petal that provides a landing platform for the insect, were known by the majority of candidates. Occasionally candidates made reference to the absence of adaptations specific to wind-pollination. Such references did not answer the question asked, and as such did not gain credit.

Question 4

(a) This was correctly deduced by almost all candidates.

(b) (i) This question was a good discriminator. Many candidates gave often full and correct details of the **environmental factors** that influence the loss of water vapour. These factors were, however, identified in the stem of the question as being the **same** for both plants. Candidates who answered successfully were able to identify the factors relating to plants **F** and **G** that might have influenced their respective losses of water vapour. A number of candidates quoted data provided in Fig. 4.1 in order to identify a difference in the amount of water vapour lost by the two plants. Such data quotes did not gain credit as the question required a **suggested reason for** such a difference.

(b) (ii) Reference to environmental factors such as 'light', 'temperature' and 'humidity' did not gain credit unless in **comparative** terms (e.g. **more** light). Reference to stomata opening in response to a named environmental factor was commonly seen and did gain credit without the need for a comparative reference. Reference to the 'sun rising' was made by a number of candidates and was insufficient to gain credit.

(c) This was well answered by most candidates. The concept of transpiration causing a cooling effect for the leaves was clearly well known by many. Reference to **most** transpiration/water loss occurring at 12.00 hours was also commonly made. A small number of candidates incorrectly interpreted '12.00 hours' to be midnight and suggested that a decrease in the surrounding temperature at that time would result in a lower temperature of the leaves.

Question 5

(a) This question successfully tested candidates' knowledge of cell structure. Many candidates were able to correctly draw and label the position of a single nucleus in each cell, however incorrect

positioning of the nucleus in the vacuole of cells **H** and **J** was not uncommon. Fewer candidates were able to correctly draw and label the position of one or more chloroplasts in **only** cell **H**, with a significant number incorrectly adding chloroplasts also to cell **J**. A small number of candidates did not add any labels to the diagram, as instructed in the question, to identify the structures that they had drawn. Such unlabelled responses did not gain credit.

(b) This was well answered by most candidates. Incorrect reference to 'sperm duct' was sometimes made in the second part.

(c) This was well answered by many candidates. It should be noted that the question asked specifically for an explanation of 'how energy plays an important part in the function of each cell' rather than simply for an account of the function of each cell. For cell **H** a significant proportion of candidates did not specifically make reference to 'light' energy and some made incorrect reference to energy being used **for** respiration. Cell **H** was often sometimes incorrectly identified, for example as a red blood cell, which therefore limited candidates' ability to gain credit. For cell **J** a significant number of candidates incorrectly linked an energy requirement to the uptake of both water **and** mineral ions. For cell **K** most candidates gained credit for correct reference to the concept of 'movement', however many did not also make reference to action of the cell's 'tail' or 'flagellum'.

SECTION B

Question 6

(a) The majority of candidates gave very full and correctly detailed accounts, however few candidates made reference to the cytoplasm of the origin cell. Occasionally, details of the passage through the heart were incorrect (e.g. reference to the left side rather than the right) and sometimes such details were omitted.

(b) Many candidates gave full accounts of the passage of blood **both** from the heart to the foot **and** from the foot to the heart. Only the latter was required by the question. The role of veins and of venous valves was well known by many candidates. Reference was less often made to the role of skeletal muscles. Reference was commonly made to the blood being under pressure. It was not always clear though whether it was the candidate's intention to imply that this pressure was important in keeping the blood flowing specifically from the foot to the heart as required by the question.

Question 7

(a) This question proved to be challenging for the majority of candidates. The responses of many candidates revealed an often confused and superficial knowledge and understanding of this part of the syllabus. There was frequent confusion between the terms 'seed' and 'fruit' and between 'meiosis' and 'mitosis'. The process of mitosis in the production of genetically identical cells in the fruit wall was better known than the process of meiosis in the production of gametes. Many candidates incorrectly attributed the formation of the seed to the process of meiosis. Many candidates did not appear to realise that the fruit wall was specifically mentioned in the question, and consequently based their answers incorrectly upon the complete fruit. Mutation and genetic modification were concepts referred to by some candidates, neither of which were relevant to the question asked.

(b) Most candidates gave answers which were characterised by much correct detail and many candidates gained either full or nearly full credit. Reference to both mechanisms of animal dispersal were commonly seen by examiners. Occasional incorrect reference to seeds being 'excreted' by an animal was seen. Centres are reminded that inaccurate use by candidates of the term 'excretion' is common in a number of areas of the syllabus and will not gain credit. A small proportion of candidates made specific incorrect reference to 'pollen' in their response, which left examiners unable to award credit for the particular mechanism of seed dispersal where this error occurred. Centres are advised that candidates do often confuse the mechanisms of pollen transmission with those of seed dispersal. It was sometimes the case that candidates did not make specific reference to 'pollen' but aspects of their answers (e.g. mention of colour of leaves and/or to the presence of nectar) suggested an element of confusion.

SECTION C

Question 8

(a) Whilst most candidates placed the named organisms in the correct sequence, a significant number did not draw a pyramid of the correct shape. As the question required candidates to label a pyramid of biomass for the specific food chain provided, reference to named trophic levels (e.g. producer) was ignored by examiners and did not gain credit.

(b) This question proved to be challenging for many candidates. As in some previous questions on this paper, candidates often did not tailor their response to the specific question asked. Unnecessary reference was therefore often made to energy transfer from the tree to the insect as well as from the insect to the bird. Some candidates made incorrect reference to loss of energy in the faeces of the insect rather than of the bird. Many candidates made incorrect reference to energy being **used in** respiration rather than to it being **released by** respiration. Reference was often made to energy being lost in 'metabolic processes' rather than during named processes. The processes of 'growth' and 'mitosis' will result in an increase in biomass and will **not** contribute to the loss of energy between trophic levels.

(c) This was very well answered by most candidates with many attaining full credit. The only frequently seen error was the box for 'tree' being drawn too large. A small number of candidates provided labels for a food chain unrelated to the question.

Question 9

(a) This was well answered by most candidates who were, almost universally, able to correctly name several measures to be taken. Candidates did not though always link each measure with a valid explanation as to why that measure should be taken. Such candidates did therefore not respond in full to the question asked and were not awarded full credit. Often there was uncertainty concerning which stage of the mosquito life cycle was the target of each individual measure. A number of candidates made correct reference to the use of 'nets' but did not identify the **location** (e.g. on doors/windows or around beds) of such netting. Such specificity was required to gain credit for that particular measure.

(b) Many candidates were unsure of the target of the drugs used to protect against malaria. Many candidates did not either specifically name the pathogen *'Plasmodium*' or make reference to the term 'parasite'. Incorrect reference to 'virus' or 'bacterium' was common. A significant number of candidates made incorrect reference to the development of 'immunity' rather than 'resistance' to the drugs, with some candidates conferring this resistance on the mosquito vector rather than on the malarial pathogen. Correct reference to either 'mutation' or to the process of 'natural selection' was infrequent, although reference to 'cost effectiveness' and to 'increased effectiveness' of more recently-discovered drugs was more common.

BIOLOGY

Paper 5090/31
Practical Test

Key messages

Candidates should apply their knowledge and experience of practical work, as well as using the skills and techniques that they have acquired in planning and carrying out practical exercises. They should ensure that they make careful observations and recordings and are able to interpret data that they have obtained for themselves, or has been provided to them.

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

General comments

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

Comments on specific questions

Question 1

(a) (i) This question required candidates to carefully cut two identical strips of potato tissue without skin. One was placed in solution S1, the other in solution S2, for 20 minutes. The solutions contained different concentrations of sucrose. After 20 minutes, the candidates were instructed to pin one end of each strip on the cork of the apparatus provided and mark the position of the unpinned end on the graph paper provided. Most candidates performed the experiment successfully but on occasion omitted to label their results with an X and/or S1 and S2.

(ii) Most candidates were able to describe how flexible the potato strips had become after soaking.

(iii) The candidates were asked to identify two variables which were controlled in the experiment. Most candidates were able to identify one variable correctly: time for soaking (the potato strips) and the same size of potato strip were the most common correct answers.

(iv) The strongest answers showed an understanding of osmosis and how potato strips were affected by the movement of water due to osmosis.

(b) (i) Counting of plasmolysed and non-plasmolysed cells from the diagram was very well done by most candidates.

(ii) Most candidates were able to calculate the percentage of plasmolysed cells from the total number of cells.

(c) (i) Table 1.3 compared the percentage of plasmolysed cells in different concentrations of sucrose solutions. Candidates were asked to construct a line graph from the data. To score highly, candidates needed to ensure that there were linear scales on each axis. The axes should have been fully labelled with appropriate units. A zero at the origin of each axis was expected. Points given in the data should have been plotted correctly and joined by a ruled straight line, as instructed. A line of best fit or a curve did not gain credit.

(ii) The completed graph from **(c)(i)** was used to calculate the concentration of sucrose in which 50% of the cells were plasmolysed. This value was to be indicated on the graph and correct units (mol per dm^3) were to be given in the answer. Many candidates showed their working but many did not give the correct units.

Question 2

(a) Candidates were presented with a magnified photograph of a plant cell in Fig. 2.1 from which they were asked to make a drawing. The stronger answers produced large, clear drawings indicating the cell wall by a double line and showing an acceptable number of chloroplasts with complete outlines. Some candidates spent time labelling the cell which was not required.

(b) Using the magnification given for the photograph of the cell, candidates were asked to calculate the length of the actual cell. Most candidates accurately measured the length of the cell in the photograph and used this value correctly to obtain their answer. Correct units were required for full marks.

(c) Many candidates were able to identify two structures seen in cell P which are only found in plant cells.

Question 3

(a) (i) Most candidates were able to describe the test for the presence of starch in a food sample. It should be noted that this test does not require the iodine solution to be heated.

(ii) Similarly, most candidates correctly described the test for reducing sugars in a food sample. Full marks were given when the correct reagent was heated and the initial and end colours described.

(b) (i) From Table 3.1, which gave information about the composition of some foods, candidates were asked to describe the relationship between the fat content and the energy content. Most candidates described the direct relationship correctly but it should be noted that such a relationship is not necessarily proportional nor directly proportional.

(ii) Most candidates correctly calculated the protein content of 250 g of cooked chicken. Some candidates used inappropriate figures from the table which led to an incorrect answer.

(iii) Most candidates were able to make a correct calculation using data from the table.

BIOLOGY

Paper 5090/32
Practical Test

Key messages

Candidates should apply their knowledge and experience of practical work, as well as using the skills and techniques that they have acquired in planning and carrying out practical exercises. They should ensure that they make careful observations and recordings and are able to interpret data that they have obtained for themselves, or has been provided to them.

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

General comments

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

Comments on specific questions

Question 1

(a) (i) This question required candidates to carefully cut two identical strips of potato tissue without skin. One was placed in solution S1, the other in solution S2, for 20 minutes. The solutions contained different concentrations of sucrose. After 20 minutes, the candidates were instructed to pin one end of each strip on the cork of the apparatus provided and mark the position of the unpinned end on the graph paper provided. Most candidates performed the experiment successfully but on occasion omitted to label their results with an X and/or S1 and S2.

(ii) Most candidates were able to describe how flexible the potato strips had become after soaking.

(iii) The candidates were asked to identify two variables which were controlled in the experiment. Most candidates were able to identify one variable correctly: time for soaking (the potato strips) and the same size of potato strip were the most common correct answers.

(iv) The strongest answers showed an understanding of osmosis and how potato strips were affected by the movement of water due to osmosis.

(b) (i) Counting of plasmolysed and non-plasmolysed cells from the diagram was very well done by most candidates.

(ii) Most candidates were able to calculate the percentage of plasmolysed cells from the total number of cells.

(c) (i) Table 1.3 compared the percentage of plasmolysed cells in different concentrations of sucrose solutions. Candidates were asked to construct a line graph from the data. To score highly, candidates needed to ensure that there were linear scales on each axis. The axes should have been fully labelled with appropriate units. A zero at the origin of each axis was expected. Points given in the data should have been plotted correctly and joined by a ruled straight line, as instructed. A line of best fit or a curve did not gain credit.

(ii) The completed graph from **(c)(i)** was used to calculate the concentration of sucrose in which 50% of the cells were plasmolysed. This value was to be indicated on the graph and correct units (mol per dm^3) were to be given in the answer. Many candidates showed their working but many did not give the correct units.

Question 2

(a) Candidates were presented with a magnified photograph of a plant cell in Fig. 2.1 from which they were asked to make a drawing. The stronger answers produced large, clear drawings indicating the cell wall by a double line and showing an acceptable number of chloroplasts with complete outlines. Some candidates spent time labelling the cell which was not required.

(b) Using the magnification given for the photograph of the cell, candidates were asked to calculate the length of the actual cell. Most candidates accurately measured the length of the cell in the photograph and used this value correctly to obtain their answer. Correct units were required for full marks.

(c) Many candidates were able to identify two structures seen in cell P which are only found in plant cells.

Question 3

(a) (i) Most candidates were able to describe the test for the presence of starch in a food sample. It should be noted that this test does not require the iodine solution to be heated.

(ii) Similarly, most candidates correctly described the test for reducing sugars in a food sample. Full marks were given when the correct reagent was heated and the initial and end colours described.

(b) (i) From Table 3.1, which gave information about the composition of some foods, candidates were asked to describe the relationship between the fat content and the energy content. Most candidates described the direct relationship correctly but it should be noted that such a relationship is not necessarily proportional nor directly proportional.

(ii) Most candidates correctly calculated the protein content of 250 g of cooked chicken. Some candidates used inappropriate figures from the table which led to an incorrect answer.

(iii) Most candidates were able to make a correct calculation using data from the table.

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. It is important that candidates read the questions carefully to ensure that they answer what is being asked. All the information provided with each question should be read thoroughly as this information may be necessary for answering the questions that follow.

General comments

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

There has been continued improvement in the responses to questions relating to experimental design and more candidates are using precise terminology such as *mass* and *volume*, rather than *amount* or *quantity* when describing measurements or listing variables to be controlled. To improve further, consideration should be given to the range of values chosen for the independent variable and candidates need to understand the difference between the terms *accuracy* and *reliability*.

When asked to draw a graph candidates should ensure that instructions are followed when joining the points. If ruled lines are asked for, curves and lines of best fit are not creditworthy. The graph should make full use of the space provided and scales should be linear. Candidates should appreciate that unless a value for each axis is entered at the origin, it cannot be determined that the scales chosen are linear. Any description of the trend shown should have full and clear references to the data from the graph.

Comments on specific questions

Question 1

(a) (i) Candidates were asked to plot a line graph showing the effect of pH on the activity of catalase. Almost all followed instructions to construct a line graph and the majority of candidates correctly plotted the dependent variable on the x-axis. Where candidates reversed the axes, often the points were later joined incorrectly. Many chose scales that did not make full use of the grid and in some cases values were not correctly indicated at the origin for both axes (the x-axis in particular), meaning that scales were not linear. Most candidates plotted the given values clearly and accurately with only a few being too faint to be seen. A small number of candidates disregarded instructions and joined the points with a curve rather than ruled lines. A few did use a ruler but drew a line of best fit that omitted some of the points.

(a) (ii) There were some good answers describing an increase in the production of oxygen as pH increased up to a maximum at pH7, then a gradual decrease as the pH increased further. Some candidates were not specific about the peak of activity and others only mentioned the volume of oxygen produced at this point without reference to the pH. A few identified the peak of activity but just stated that other pHs produced less oxygen than this, thus not clearly describing the trend.

(a) (iii) A few candidates were able to state two variables. The most frequent correct answers related to the concentration and/or volume of the hydrogen peroxide solution. Some answers were too vague, e.g. volume, whilst others thought that the independent variable (pH) should be kept constant.

(a) (iv) Candidates were asked to describe how they could investigate the effect of temperature on the activity of catalase using the apparatus shown. A few candidates answered this well. Many, however, described using one flask that was then heated to continuously varying temperatures over a Bunsen burner, and gave no details of specific temperatures to be used. The best answers explained how the temperature might be controlled, e.g. by means of a water bath, and suggested a range of temperatures within which one might reasonably expect enzymes to be active. Some candidates thought that a suitable range would include temperatures such as 0 °C and 100 °C. Most candidates were able to state that the volume of oxygen produced should be measured, but many omitted a suitable time period over which to collect the oxygen.

(a) (v) There were many good answers here relating to standard laboratory safety procedures such as wearing goggles to prevent damage from chemicals splashing in eyes. Some suggested a suitable precaution, and then did not explain the reason for the precaution. Some candidates misunderstood the question and incorrectly wrote about improving the method or the accuracy of measurements e.g. use a stopwatch for better timing.

(b) (i) Nearly all candidates read the optimum temperature correctly. A small number read from the wrong axis and answered 7.5.

(b) (ii) Candidates were asked to suggest why Savinase® is added to biological detergents. This question was generally not well answered. Of those candidates scoring marks, most mentioned that the enzyme breaks down protein (stains) and/or gave a suitable example of a stain that might be removed. The majority simply wrote that stains would be removed and others wrote about the removal of bacteria. Many described Savinase® as a catalyst and therefore suggested that it would speed up the reaction of the detergent or lower the activation energy. Very few used the information provided in the graph to comment on the ability of Savinase® to work at a higher than usual temperature for enzymes.

Question 2

(a) The candidates were asked to make a drawing of the cell labelled **Q** twice the size of the one shown in Fig. 2.1, but many drawings were larger. Most drawn cells were approximately circular but often the nucleus was shown out of proportion to the rest of the cell. Observation of the nucleus should have revealed that it was formed of two lobes that were joined, but often this was not shown. The technique for drawing a continuous smooth outline freehand was good but those that drew the outline with compasses could not be credited. It should be noted that shading or stippling should not be used on biological drawings.

(b) (i) The majority of candidates correctly identified the blood cells shown. A few put red and white cells the wrong way round.

(b) (ii) Many candidates were able to state that **Q** was larger than **P**, or had a nucleus (unlike **P**). A few referred to **Q** as having granular cytoplasm.

(c) The majority of candidates recorded the absence or presence of a cell wall correctly and a few recorded the difference in the shape of the nuclei. Most answers stated that either a nucleus was present in both cells or that a nucleus was present in one but not in the other. Some commented on the relative size of the nuclei despite no information about magnification being given.

Question 3

(a) (i) Candidates were asked to measure and record the maximum width of leaf **A**. Most measurements were accurate and included the correct units. There were a few cases where the ruler was read incorrectly, e.g. 20.2 mm for 22 mm.

(a) (ii) Having measured the leaf, candidates were asked to calculate the actual maximum width. The most common error was to multiply their measurement by 0.5 instead of dividing by 0.5. Most gave the correct units, although some made errors when converting measurements made in centimetres into millimetres.

(b) (i) Most means were correctly calculated. A few correctly totalled the 10 measurements but did not then proceed to divide by 10 in order to calculate the mean.

(b) (ii) The majority of candidates correctly stated that leaves from a shady position were wider than those found in the sun. Very few observed that the variation in widths was greater in the leaves from sunny positions than from those in the shade.

(b) (iii) Candidates were asked to suggest a way in which the reliability of the results could be improved. Many suggested that the experiment should be repeated but this response did not necessarily indicate that more leaves would be tested. A number suggested using a different species which was not creditworthy.

(c) Here candidates were asked to suggest how the different sized leaves in shady and sunny positions might be an advantage to the plant. There were some good answers either in terms of photosynthesis (in the shady areas) or transpiration (in the sunny areas). The best responses referred to the larger/smaller surface area of the leaves rather than just the large and small leaves and this was related to the increased absorption of light/decreased water loss. Most candidates were able to state that the size of the leaf would have some effect on either photosynthesis or transpiration.

BIOLOGY

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Alternative to Practical

Key Messages

Candidates should read questions carefully in order to ensure that they are giving full, relevant answers. Following instructions is an important part of practical work; candidates should ensure that they do as instructed in a question.

Candidates should be aware of the differences between accuracy, reliability and validity in practical work.

Candidates should show their working when requested, as even if the answer arrived at is not creditworthy, some credit may be gained for correct methods of working.

Units should be given when measurements are made.

General Comments

There were candidates who scored maximum credit throughout the paper, and the number of questions to which candidates attempted no response was very low. Candidates appeared to have sufficient time to complete their answers. The vast majority of scripts were clearly legible; difficulties in reading answers may arise when candidates write a draft answer and then write their final answer on top of it.

Comments on Specific Questions

Question 1

(a) (i) Most candidates were able to calculate the four changes in mass of the potato strips correctly. In both of the strips **C** and **D** the change was a loss in mass which should have been recorded with a negative sign or the word 'decreased'. A significant number of candidates, whose answers to **Question 1(a)(ii)** indicated that they had recognised these losses, omitted the negative sign or word in this table.

A few candidates misplaced the decimal point in their answers recording, for example, 3 g instead of 0.3 g.

(ii) There were many very good explanations of the results in **A** and **D**, though a few candidates did not read the question sufficiently carefully and referred to **A** and **B** so their answers could not gain full credit. Good answers explained that the gain in mass in **A** was due to water moving into the strip from the solution and the loss in mass in **D** was due to water moving out into the solution. There were candidates who correctly gave these explanations but did not mention that the water movement was due to osmosis. There were candidates who incorrectly suggested that the solution had either entered or left the strip or that active transport had taken place. A few candidates simply repeated what was in the table, stating by how much masses had increased or decreased without giving the required explanation.

(iii) Many candidates correctly recognised that the blotting of the strip removed any solution remaining on the surface of the strip so that it would not be included in the second weighing of the strip. A few candidates suggested that the purpose was so that the dry mass of the strip could be obtained, not appreciating that the term 'dry mass' has a specific meaning not relevant to this investigation.

(iv) A few candidates answered this well. They recognised that there should be only one variable in an investigation which, in this case, was the concentration of the sucrose solution, so the surface area of the potato strips needed to be kept constant. Had it not been, the investigation would not have been assessing what it was designed to assess and so would not have been valid. Cutting all the strips to the same dimensions increased the validity of the investigation.

(v) Many candidates correctly described that adding 50 cm^3 of water to the given 50 cm^3 of 0.8 mol per dm^3 sucrose solution would produce 100 cm^3 of 0.4 mol per dm^3 sucrose solution. Others correctly expressed this as making the given 50 cm^3 of 0.8 mol per dm^3 sucrose solution up to 100 cm^3 with water. Credit could not be given to candidates who simply stated 'add water' without stating a volume. Statements such as 'increase the volume and decrease the moles' without details of how this could be achieved could not be credited.

There were some candidates who erroneously answered in terms of adding potato strips to the solution, perhaps confusing what was asked for with osmosis investigations they had previously carried out.

(b) (i) Almost all candidates were able to interpret **Fig.1.1** and count the numbers of plasmolysed and non-plasmolysed cells correctly. Very few either miscounted or identified non-plasmolysed cells as plasmolysed.

(ii) The vast majority of candidates used the correct method and calculated the percentage of plasmolysed cells correctly. The most common error was not calculating the percentage in relation to the total number of cells (28) as asked, but in relation to the number of non-plasmolysed cells, (21).

(c) (i) There were some excellent graphs drawn, with fully-labelled and correctly orientated axes, linear scales making good use of the grid provided, clear and precise plotting and plots joined with ruled lines as asked for in the question. Candidates should appreciate that, unless a value for each axis is entered at the origin, it cannot be determined whether the scales chosen are linear. When the question asks for plots to be joined with ruled lines, free-hand or curved lines cannot be credited. Candidates who ruled a line of best fit could not be credited because their one line did not go through all their plotted points. A few candidates omitted joining the plot at 0,0.

(ii) There were a significant number of candidates who did not show their working on the graph as asked and thus could not be credited for it. Many candidates were able to read the correct value from their graph but did not include units in their answer. As no units were printed on the answer line, they should have been given. A few candidates recorded values with an excessive number of decimal places; such a degree of accuracy in measurement is impossible using this method.

Question 2

(a) (i) The majority of candidates knew that iodine solution should be used for testing for the presence of starch. Some included irrelevant details of removing chlorophyll prior to testing a leaf for starch. Some considered, incorrectly, that it is necessary to heat the iodine and food material mixture. When recording expected colour changes, it should be noted that the original colour of the iodine solution should be given as well as the final colour that indicates the presence of starch.

(ii) Most candidates knew that Benedict's solution should be used to test for reducing sugars but the occasional incorrect use of the biuret test was seen. However, the fact that after the Benedict's solution has been added to the food material, the mixture should be heated, was often omitted. If heating is done using a water bath, then it should be stated that the water should be hot or at a stated temperature. The expected colours indicating the presence of reducing sugars were generally well-known but the original blue colour of the Benedict's solution was often omitted. At no point in a reducing sugar test does the Benedict's solution turn blue – it is blue at the start and remains blue if no reducing sugar is present.

(b) (i) The most common error in answering this question was the use of the term 'directly proportional'. As the fat content increased or decreased so the energy content of the food increased or decreased, which many candidates described well. However, as one increased or decreased the other did not increase or decrease by the same percentage, so they were not directly proportional. Answers that simply quoted data from the table without identifying a relationship could not be credited.

(ii) A good number of candidates were able to use the table to find that the protein content of 100 g of chicken was 25 g and then to calculate correctly that 250 g of chicken would contain 62.5 g of protein. Some did not show their working which may have been creditworthy even if the final mass calculated was incorrect.

(iii) This proved to be a more challenging calculation for many candidates. Again, there may have been those whose working, if not their answer, may have been creditworthy had they shown it.

Question 3

(a) Drawing a biological specimen involves good observation and application of techniques. There were some drawings which followed instructions and were of a good size, showing excellent observation of the proportion of the length to the width of the cell, the thickness of the cell wall and the position and arrangement of the chloroplasts. Clear, clean, continuous lines were drawn with a sharp pencil and there was no shading or stippling. Each of the chloroplasts was represented by a continuous line with no breaks in it. Some drawings, however, were too small or did not accurately represent the shape of the cell. The lines drawn by some candidates were not continuous, having breaks in them, or were too sketchy or drawn with a blunt pencil. There should be no ruled lines in such a drawing. Occasionally the cell wall was represented by a single instead of a double line. Although there were a number of chloroplasts to be drawn, each should have been represented with care; in many cases the 'circles' were incomplete. As a drawing of cell **P** was required, no detail of chloroplasts in the surrounding cells should have been shown.

(b) Many candidates measured the maximum length accurately. Some measured the maximum length of their drawing instead of the cell in **Fig. 3.1** as asked and could not be credited. A few measured the cell vertically instead of the maximum length; length is the longest dimension. A good number of candidates calculated the actual length of cell **P** well, dividing its maximum length by the given magnification of **Fig. 3.1** and including correct units with their answer. Those candidates who incorrectly multiplied the maximum length of the cell and the given magnification should have realised their error when the actual size of the cell derived was totally unrealistic, sometimes in excess of 10 000 mm.

(c) The majority of candidates correctly stated two visible features of cell **P** that are found only in plant cells – chloroplasts and a cell wall. Chlorophyll, as stated by some, is not a structure.