BIOLOGY

Paper 5090/11
Multiple Choice

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

Comments on individual items

These questions were well known and posed few problems: 5, 11, 13, 19, 2, 24, 26, 34, 36 and 39.

1 "Leaf mesophyll" refers to the layer in the leaf, although there are individual mesophyll cells in it. The same applies to the leaf epidermis, so both columns refer to tissues rather than the individual cells.

2 Although it is normal to teach the active uptake of nitrate ions, both water and nitrate ions can pass both ways. A healthy plant put into distilled water will lose ions by diffusion.

3 Boiling will damage the membrane proteins, so they are no longer partially permeable. The unboiled tissue will allow osmosis, so the distilled water will enter, swelling the cells.

6 Option B was popular, but if the light intensity raised the temperature above its optimum, the rate of photosynthesis would fall, rather than continuing at its maximum.

7 The leaf will photosynthesise at mid day and lower the CO_2 content, raising the pH, while at midnight, continuing respiration will raise the CO_2 level and the pH drops.

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8 The liver maintains a constant blood glucose level. Blood from the body in the hepatic artery (Label 2) will have had glucose removed and used in the body's metabolism, so the hepatic vein (Label 1) will have had glucose added. After a meal it is most unlikely that glucose will be added to the blood from the hepatic portal vessel (Label 3), since a meal will normally contain foods which will be digested to produce carbohydrates including glucose.

9 Enzymes contain protein which is identified by the biuret test.

10 The signs and symptoms in the stem describe scurvy.

12 The leaf surfaces are labelled. Transpiration is mainly from the lower surface.

14 Option C was popular and although a renal portal system is found in frogs the question was aimed at the human body.

15 Both plasma and tissue fluid contain amino acids and protein, but transfer is not by osmosis, digestion or active transport.

16 The first change is the increase CO_2 production by muscles, followed by higher CO_2 in blood, higher breathing rate and more oxygen in blood (options C, B and A) in sequence.

18 Whilst options A and D are true, the experiment is aimed at demonstrating a temperature rise.

20 Blood flowing through the surface capillaries labelled X will lose heat.

21 Urea in the renal artery (labelled Y) will diffuse out into the urine in Z (the ureter) so the concentration in Y cannot always be higher than in Z.

23 When the pupil diameter increases at X, the light level must be lower. The radial muscles pull the edge of the pupil outwards.

25 As sewage is added, aerobic bacteria increase and the oxygen is therefore used.

27 As well as the bacteria in milk, fungi are found, but the important factor is the acids which reduce the pH.

29 Pyramid Z suggests that a small mass of herbivores can support a large mass of carnivores, which is unlikely.

31 *Vector* refers to the mosquito being a carrier of the parasite from one host to another. Laying many eggs is true, but not relevant in this case.

32 These data only support D, although A, B and C may well be true.

33 It would appear that many candidates had not experienced or were familiar with the simple practical showing pollen germination and the male nuclei moving down the pollen tube.

35 Pregnancy implies that the embryo has implanted in the uterus wall – many do not – so mitosis during pregnancy must take place in C.

37 The essential feature of DNA is that it is copied before mitosis. Hence asexual offspring must be identical.

38 The alleles T and t are alternate forms of the height gene.

40 The woman must be I^AI^A and the man must be I^BI^O so all their offspring must receive I^A and either I^B or I^O

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BIOLOGY

Paper 5090/12
Multiple Choice

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

Comments on individual items.

The questions which were well known and posed few problems: 4, 7, 13, 18, 24, 25, 28 and 37.

1 The liver maintains a constant blood glucose level. Blood from the body in the hepatic artery (Label 2) will have had glucose removed and used in the body's metabolism, so the hepatic vein (Label 1) will have had glucose added. After a meal it is most unlikely that glucose will be added to the blood from the hepatic portal vessel (Label 3), since a meal will normally contain foods which will be digested to produce carbohydrates including glucose.

2 The signs and symptoms in the stem describe scurvy.

3 Enzymes contain protein which is identified by the biuret test.

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9 The leaf will photosynthesise at mid day and lower the CO_2 content, raising the pH, while at midnight, continuing respiration will raise the CO_2 level and the pH drops

10 Option B was popular, but if the light intensity raised the temperature above its optimum, the rate of photosynthesis would fall, rather than continuing at its maximum.

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29 "Vector" refers to the mosquito being a carrier of the parasite from one host to another. Laying many eggs is true, but not relevant in this case.

30 As well as the bacteria in milk, fungi are found, but the important factor is the acids which reduce the pH.

31 Antibiotics have no effect on viruses.

33 Pyramid Z suggests that a small mass of herbivores can support a large mass of carnivores, which is unlikely.

34 These data only support D, although A, B and C may well be true. The clue is the label on the Y axis.

35 The woman must be I^AI^A and the man must be I^BI^O so all their offspring must receive I^A and either I^B or I^O

36 The alleles T and t are alternate forms of the height gene.

38 The essential feature of DNA is that it is copied before mitosis. Hence asexual offspring must be identical.

39 As sewage is added, aerobic bacteria increase and the oxygen is therefore used.

40 The elbow is a hinge joint only and does not rotate like the shoulder.

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BIOLOGY

Paper 5090/21

Theory

General comments

The work of the candidates in general was well presented and legible, the time available seemed adequate and though some attempted both **Question 8E** and **8O** the rubric was otherwise followed. The candidates were of a wide range of ability and most attempted to answer all the questions even though some answers were irrelevant. There were, however, those with little biological knowledge who had difficulty understanding what was required as an answer to a question. In ***Section A*** candidates gathered marks across the various questions but some of the ***Section B*** questions proved to be more challenging than others. It would benefit all candidates if they spent time reading the questions carefully before framing their answers so as to avoid missing vital information.

Comments on specific questions

Section A

Question 1

(a) A significant number of candidates failed to label either diagram. The style was frequently labelled as the filament and the lip of the petal as the sepal. Many candidates found the structure of this flower difficult to interpret.

(b) This part was answered well and most candidates gained both marks.

(c) (i) Only a few candidates, it seemed, read and made use of the information given at the start of the question with regard to the time interval between **Fig..1.1 (a)** and **Fig. 1.1 (b)**.

There were some references to the withered anthers but rarely was mention made of the longer style, while the stigma went unrecognised. In all parts of the answers to this question the names of the structures were confused. A common response was to explain that self-pollination did not occur because this flower is an insect-pollinated flower. There were some candidates who realised that pollen could not fall on the stigma, even if no reference was made to the different 'ripening' times.

(c) (ii) Most of the candidates understand the basic requirements of pollination, however, many of the answers were sketchy and were not especially applicable to this particular flower, e.g. the insect searched for nectar and collected pollen but did not make contact with the anther, or, sat on the stigma. It was not unusual for anthers to be transferred, or, for anthers and stigmas to have reversed functions.

Question 2

(a) Very few candidates correctly answered 'water'; many gave answers already in the 'pie' e.g. roughage.

(b) Generally, plants e.g. grass were named (but it was not undigested) though cellulose was not uncommon.

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(c) This topic was found to be difficult and the answers were very confused. The candidates who correctly identified protein as being the component in faeces required to increase the nitrates, usually scored better marks. It was not, however, uncommon for this protein to be digested / deaminated or changed to amino acids within the cow and then egested. The processes of decay, nitrification, and nitrogen fixation are not well understood; in some answers nitrification preceded decomposition. There was a tendency to describe either decay or nitrification, but not both, and the crucial link of ammonia/ammonium salts between the two processes was not widely realised. There were nonetheless, some candidates who presented accurate and fairly complete accounts.

(d) Most of the candidates scored one mark, usually for urea, with an occasional reference to salts and water.

Question 3

(a) The oesophagus (variously spelled) / gullet was usually correctly named; the rectum if incorrect, was named as the anus.

(b) (i) There were some (approximately 50%) correct answers, however many did not use a label line; incorrect sites of digestion named were the liver, stomach and mouth.

(ii) Many candidates answered this well scoring all the marks, gaining three for bile related points, however others were confused about the source and function of the secretions. It was unusual to find an explanation as to why fat digestion only started in the duodenum.

(c) Few candidates scored even one mark in this section. Firstly the information given in the question had to be evaluated, this most often resulted in this being rephrased and given as the answer. Some candidates stated that mucus production would increase under conditions of stress. The usual mark scored was for 'acid in contact with the stomach wall' though a few realised that the mucus was protective. The idea that the stomach wall, being made of protein, could be digested by the protease was not seen.

Question 4

(a) Less than half of the candidates understood what was required by 'describe the relationship between the alleles' Incorrect answers included genes / genotype / heterozygote.

(b) Many correctly identified Child 6, (otherwise child 2 was chosen) fewer gained the second mark since lack of 'blood group A' as opposed to 'allele A' in the genotype was cited as the cause.

(c) The majority of the candidates were able to make a reasonable attempt at this part, but lack of precision cost marks. There was a widespread failure to indicate both the genotype of the parents and the segregation of gametes. The wrong choice of parent genotype and failure to use the prefix ' I ' also limited the marks available. There was some confusion of phenotype / genotype e.g. phenotype shown as 'OO' candidates generally showed that they knew how a genetic diagram should be presented; there were some very good answers

Question 5

(a) There were some candidates who were unable to read the graph, others who gave the figure for water loss not uptake. Many, even some good candidates, omitted the units.

(b) (i) Root hair cells were usually correctly given, though reference to xylem was not uncommon.

(ii) Though many candidates correctly gave 'guard cells', stomatal cell was the most frequent answer.

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(c) (i) It was not enough to list three life processes, specific uses of water were required which should be different e.g. a reference to the transport of three different substances would gain only one 'transport' mark. Generally most candidates were able to score one or two marks here, though the use of water as a solvent was infrequent.

(ii) There were some candidates who failed to recognise the light / dark significance of the times given, here and in **(c)(i)**, although generally this part was done well.

(d) Well done, many candidates scored full marks here. There were references to 'more water loss than uptake', information derived from the graph, loss of turgor and wilting were frequently given but any reference to stomatal closure was rare.

Section B

Question 6

(a) The question was concise and should have given a lead as to the required answer. Those candidates who described a chromosome, knew it was made of DNA, and contained genes (which could be passed on to offspring) scored the most marks but they did not always pursue the other aspects. Many candidates were confused about the relationship of DNA and genes. The majority of candidates gave very inaccurate accounts of reproductive processes, meiosis followed fertilization, gametes had a variable number of chromosomes but the marks for reference to characteristics and offspring were usually scored.

(b) Although there were some odd ideas e.g. that relatives were less likely to be infected, most candidates gained one or two marks, usually for stating that it was more likely that the blood group would be the same or that there were common genes amongst relatives. There were comparatively few candidates who mentioned ' rejection' / proteins / antigen / antibodies.

Question 7

(a) There were many excellent answers with candidates scoring all the marks easily. There were also some poor answers where only an odd mark for an impulse or sensory neurone was scored. The main problem was the involvement of the brain in a spinal reflex action, sometimes there was just a passing reference, in others, the action became a voluntary action as a result of instructions received from the brain. There were errors in terminology e.g. nerves and neurones confused, and 'messages' transmitted. There were very few correct receptors.

(b) The majority of candidates scored two marks, adrenaline secretion and its effect being well known. There was some confusion of cause and effect with some thinking that more blood flowing caused the heart to beat faster. The adrenaline never travelled in the blood to the heart.

Question 8 Either

(a) **T**here were few correct explanations and candidates found it difficult to express their ideas, however, the three significant factors were recognised, if not called factors. Many knew that the rate of reaction would be affected in some way but did not understand the meaning of 'limit' in this connection.

(b) This question was low scoring, candidates are not confident dealing with respiration in plants. Most knew that photosynthesis released oxygen but did not say where this took place, so losing easy marks. Many 'switched' from photosynthesis to respiration at night. A surprising number failed to mention atmospheric oxygen as a source. Many 'extracted' oxygen from unlikely molecules such as carbon dioxide. There were good candidates who diffused oxygen in through the stomata, but few mentions of uptake from the soil via the roots.

Question 8 Or

(a) The majority of candidates gained a mark for a reference to a cell being a unit of life, unless they confused cell and organism. Many gave inadequate descriptions of cell contents (they named only two not three structures) and despite the wording of the question described plant cells; cells never divided or passed on genetic information.

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(b) Candidates did not answer this question in the way in which it was intended, instead, the usual answer was a description of the circulatory system including an explanation of the 'double circulation'. There were some candidates who attempted to relate the part played by tissues and organs. The usual marks scored were for: the heart as an organ; which pumped blood; blood and muscle named as tissues; and transport of oxygen with an occasional rare reference to other points. There were no references to an artery or vein being an organ, and rare reference to any involvement of nerve / nervous tissue.

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BIOLOGY

Paper 5090/22

Theory

General comments

Many candidates displayed sound interpretational skills in ***Section A***, and also showed that they were able to reproduce relevant knowledge where and when required in ***Section B***. There were several occasions where it appeared that just a little more thought before beginning their answers might have paid dividends.

Comments on Specific Questions

Section A

Question 1

(a) **B** was sometimes inaccurately identified as the pulmonary artery, but otherwise this part was well answered.

(b) This question proved to be quite challenging for many candidates The aortic valves were quite often overlooked completely, were often shown with flaps pointing in opposite directions or both pointing in completely the wrong direction. The atrio-ventricular valves were regularly shown bridging the walls on either side of each ventricle, and quite often with their flaps pointing up into the atria. Sometimes, valves were located in the venae cavae or pulmonary veins.

(c) There were some very inaccurate guesses in this part. Blood was shown travelling the correct way through one side of the heart, but in the reverse direction on the other side. It was not uncommon for the blood to be shown passing within the muscle tissue.

(d) Although some candidates mistakenly felt that the defect might lead to raised blood pressure in the circulatory system, most realised that there would be a mixing of oxygenated and deoxygenated blood. Insufficient oxygen being circulated and breathing problems were regularly mentioned.

Question 2

(a)

(i) Pollination and pest removal were commonly seen and several candidates incorrectly opted for the statement that they might eat bacteria.

(ii) The straightforward fact that the insects would damage the crops was appreciated by almost all candidates.

(b) The key to answering this question was to establish the link between the change in population and resistance in the insects. Once this was established, candidates usually scored well, but there was a widespread belief that resistance is the same as immunity, and also more than a hint that the question had not been carefully read when answers spoke of insecticide *not* being sprayed after year 1.

(c) This question afforded candidates the opportunity to use information from different areas of the syllabus, and they did so impressively. Answers ranged from the suggested use of high yield varieties of seeds, to watering, genetic engineering, the use of fertilisers and of biological control. Some optimistically suggested methods that would have required the control of climatic features.

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Question 3

(a)

(i) Around a half of the candidates did not make the connection between the green leaves, shown and labelled in the figure, and photosynthesis. Thus, the most common incorrect answer was digestion.

(ii) Those who then referred to the raw materials required for photosynthesis did not always supply sufficient scientific detail on how the carbon dioxide would be made available. A reference to respiration was required though water fleas were often thought to 'breathe it out'. 'Light' was often mentioned as a raw material, even sometimes in preference to carbon dioxide or water.

(b)

(i) Some otherwise competent candidates sometimes struggled to name an enzyme that would digest a nitrogen-containing nutrient. Carbohydrases and lipase were quite often suggested.

(ii) The significance of the wording of the question was not appreciated by the relatively large number of candidates who thought that proteins might be absorbed, or that the 'digested chemicals' might be nitrates.

(c) 'Nitrates' was the commonly suggested form.

Question 4

For a situation likely to be unfamiliar to many candidates, there was an admirable use of knowledge and of accurate interpretation in this question.

(a) Although **C** was often misidentified as the cotyledon, and **D** and **E** were occasionally reversed, this was quite well answered.

(b) There was a misunderstanding by some candidates of the word 'embryo' in this part leading them to believe that it was Fig. 4.1(b) that showed the embryo. Those who understood the term, or followed the lead given in **(a)(ii)**, gave some sound suggestions on how the requirements for germination are obtained. Light was a predictable inaccurate suggestion as a necessary condition for germination, and carbon dioxide was quite a common suggestion.

(c) This question proved taxing, even for some of the most able candidates. It was hoped that there was enough information on Fig. 4.1(a) to indicate that sexual reproduction had occurred, and thus that the seedling would not be genetically identical to the parent. Even when appreciating that the seed resulted from pollination, several still felt that the offspring would be genetically the same as the parent.

Question 5

(a) Many omitted to respond to this question, yet it was intended to examine the candidates' knowledge that, when lying on the back, and breathing in, the chest wall rises. Some who realised this then showed the chest wall as a long straight line above Fig. 5.1.

(b) Fig. 5.1 showed **F** and **G** as different positions in the same structure, and, since candidates at this level would not be expected to be expert at reading CT scans, any reasonable answer that indicated that this fact had been appreciated gained credit (irrespective of its total scientific accuracy). **H** was more often identified as intercostal muscles than as ribs, but it was felt that there were sufficient clues in Fig. 5.1, to insist on an accurate identification.

(c) There were some fine answers to this part, often gaining full credit. The commonest errors were to confuse the internal with the external intercostal muscles, and to state that it is the entry of the air that caused the increase in the volume of the lungs / thoracic cavity.

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Section B

Question 6

(a) This part enabled candidates to show just how well they were able to remember a definition. The result was a succession of careful and accurate descriptions of a hormone. Several candidates made it difficult for themselves by selecting a specific hormone and then describing its functions, which did not always answer the question with sufficient precision. Others confused hormone with enzyme.

(b) Those candidates who started their answers after reading only the first phrase of the question often went on to give a description of a hormone that is not involved in maintaining constant conditions within the human body. Some otherwise good answers stopped short of explaining *exactly* what it was that the hormone maintained. Surprisingly, use of the word 'homeostasis' was rare, despite something close to a definition of it appearing in the question. It was unfortunate that several candidates confused the words 'glycogen' and 'glucagon', especially in view of the fact that glucagon is not a term from the syllabus.

Question 7

(a) This was generally well answered, though several described a virus, whilst others gave the opposite of what was required ('bacteria do not have cells walls' and 'bacteria have a nucleus'). Accurate size references were rare.

(b) This part somewhat unexpectedly revealed an area of confusion. There were many accounts of biotechnological processes that involve fungi (e.g. penicillin production, brewing and bread making). Those who chose to describe insulin production usually mentioned only the name of the hormone and the fact that a human gene is inserted into a bacterial plasmid. Accounts of the need then to incubate the bacteria to produce an end-product were uncommon. It was rare in any account to see a description of the separation of the product from the substrate in the fermenter.

Question 8 Either

Candidates produced some most thorough answers to this question. It was sometimes unclear just what constituted the concentration gradient when describing osmosis - was it the concentration of water molecules or was it the concentration of the solution? Also, references to the semi-permeable nature of the cell membrane were often omitted. Some did not think beyond one example – usually osmosis or diffusion, and when active transport was described, the references omitted were those to the need for energy from respiration.

Question 8 Or

This was not quite as popular as the previous question, but it still produced some fine answers and full credit was not uncommon. Those who talked of the umbilical arteries and vein sometimes confused their functions and references to the importance of the spongy lining of the uterus were rare. It was, perhaps, this omission that sometimes led also to not mentioning the importance of diffusion in the process. Proteins, rather than amino acids, were sometimes said to pass from the mother, and it was relatively rare to read exactly what the various requirements are used for. Perhaps this was another example of the need to read the question carefully.

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BIOLOGY

Paper 5090/31

Practical Test

General comments

The objectives of this paper were to test not only biological knowledge but also knowledge and experience of practical work, together with the use and application of practical skills and techniques. The questions tested candidates' abilities to follow instructions, make and record accurate observations using written and drawing skills, take measurements and perform simple calculations. The use of techniques and apparatus in experiments and the ability to evaluate and apply data resulting from an investigation were also tested. Candidates appeared to have more than sufficient time to complete the paper.

Comments on Specific Questions

Question 1

(a)

(ii)(iii) When asked to suggest why two strips were used and to explain how their observations supported this suggestion, many candidates confused 'accuracy' with 'reliability' and mis-interpreted the term 'observations' in the question as 'descriptions' of turgidity /flaccidity in the potato strips. Some excellent responses on the other hand contained balanced arguments about avoiding errors in measurement and obtaining average /mean changes in the length of strips.

(iv) The majority of candidates successfully completed Table 1.1. Differences in the initial and final measurements were frequently and correctly stated except for the omission of positive and negative signs in the final column for changes in length and also for omitting to include final length measurements.

(b)

(i) The ability to read the results of an experiment and present them in a different way were tested by the construction of a graph from data in Table 1.1. The majority of candidates chose the correct *x* and *y* axes and produced accurate plots. Care was needed to improve the labelling of these axes together with an improvement in the quality of best fit / ruled connections to complete the graph.

(ii) Correct plotting of the change in length /mm on the *y* axis on the graph generally lead to many candidates determining the correct concentration of the solution at which there would be no change in the mean length of the potato strip.

(iii) Candidates needed to improve their understanding that equal water potential and no net exchange of water would result in no change in length in the strips of potato.

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(c) Responses of candidates were overall satisfactory. Correct references to replication or using more slices and improving the accuracy of measurement were frequently mentioned, but with little reference to measuring the mass/weight of strips. Repeating the experiment with different/more concentrations of solutions and extending the investigation over a longer period were valid replies, but the use of solutions with equal concentrations or testing plant slices at the same time or at the same temperature were invalid.

Question 2

(a)

(i) This is not a test of artistic ability but of observation and making an accurate and precise record of those observations. Many candidates produced drawings of a reasonable and realistic size, with a head and eyes shown and the correct arrangement of segmented parts, including jointed legs and a pair of wings with venation. The best drawings demonstrated all of these features and with clear and clean lines, whereas weaker answers showed sketchy and unrealistic drawings often lacking segmentation or with one wing (and no venation) and legs without joints. Most of the labelling was excellent and the majority referred to legs/wings, head /thorax/abdomen, eyes and segmentation and many very good responses also highlighted the proboscis and antenna.

(ii) The best answers made reference to the image of the specimen becoming clearer or that the outline had been improved. In addition, correct responses pointed out that the liquid helped to hold the specimen in place or that it was kept flat/spread out or words to that effect. Common errors indicated that the liquid magnified / softened the specimen or allowed the cover glass to stick to the slide.

(iii) Calculating the magnification of a drawing in relation to the size of a specimen is a standard biological procedure. In most responses measurements were undertaken accurately and indicated on the drawing itself. Some candidates gave no units and those measuring in cm omitted to record this to the nearest decimal place e.g. 5 cm instead of 5.0 cm. Also candidates needed to understand that the correct method for calculating magnification is by dividing the measurement given in their drawing by the measurement of the specimen and then expressing this with a 'X' or 'times' and also within 2 decimal places.

(b)

(i) Some responses were excellent with a clear indication of segments/ joints and that both showed legs/appendages and eyes. On the other hand there were frequent errors relating to body shape, a covering of hairs and in extreme cases the presence of 'arms and feet '.

(ii) Many candidates satisfactorily completed Table 2.1, with a clear understanding of differences in the external features of both specimens. These included differences in size and the presence of a smaller head /eyes, one pair of wings and longer legs in specimen **X** compared with the presence of a larger head/eyes, two pairs of wings and shorter legs in the dragonfly. Furthermore many excellent responses showed the presence of a proboscis, a rounded abdomen and long antennae in specimen **X** compared with the lack of a proboscis, a pointed abdomen and short antennae in the dragonfly. Weaker answers made references to 'hairy' legs, 'anther' for antenna and 'spike/needle' for the proboscis.

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BIOLOGY

Paper 5090/32

Practical Test

General comments

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(i) The ability to read the results of an experiment and present them in a different way were tested by the construction of a graph from data in Table 1.1. The majority of candidates chose the correct *x* and *y* axes and produced accurate plots. Care was needed to improve the labelling of these axes together with an improvement in the quality of best fit / ruled connections to complete the graph.

(ii) Correct plotting of the change in length /mm on the *y* axis on the graph generally led to many candidates determining the correct concentration of the solution at which there would be no change in the mean length of the potato strip.

(iii) Candidates needed to improve their understanding that equal water potential and no net exchange of water would result in no change in length in the strips of potato.

(c) Responses of candidates were overall satisfactory. Correct references to replication or using more slices and improving the accuracy of measurement were frequently mentioned, but with little reference to measuring the mass/weight of strips. Repeating the experiment with different/more concentrations of solutions and extending the investigation over a longer period were valid replies, but the use of solutions with equal concentrations or testing plant slices at the same time or at the same temperature were invalid.

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Question 2

(a)

(i) This was not a test of artistic ability but of observation and making an accurate and precise record of those observations. Many candidates produced drawings of a reasonable and realistic size, with a head and eyes shown and the correct arrangement of segmented parts, including jointed legs and a pair of wings with venation. The best drawings demonstrated all of these features and with clear and clean lines, whereas weaker answers showed sketchy and unrealistic drawings often lacking segmentation or with one wing (and no venation) and legs without joints. Most of the labelling was excellent and the majority referred to legs/wings, head /thorax/abdomen, eyes and segmentation and many very good responses also highlighted the proboscis and antenna.

(ii) The best answers made reference to the image of the specimen becoming clearer or that the outline had been improved. In addition, correct responses pointed out that the liquid helped to hold the specimen in place or that it was kept flat/spread out or words to that effect. Common errors indicated that the liquid magnified / softened the specimen or allowed the cover glass to stick to the slide.

(iii) Calculating the magnification of a drawing in relation to the size of a specimen is a standard biological procedure. In most responses measurements were undertaken accurately and indicated on the drawing itself. Some candidates gave no units and those measuring in cm omitted to record this to the nearest decimal place e.g. 5 cm instead of 5.0 cm. Also candidates needed to understand that the correct method for calculating magnification is by dividing the measurement given in their drawing by the measurement of the specimen and then expressing this with a 'X' or 'times' and also within 2 decimal places.

(b)

(i) Some responses were excellent with a clear indication of segments/ joints and that both showed legs/appendages and eyes. On the other hand there were frequent errors relating to body shape, a covering of hairs and in extreme cases the presence of 'arms and feet '.

(ii) Many candidates satisfactorily completed Table 2.1, with a clear understanding of differences in the external features of both specimens. These included differences in size and the presence of a smaller head /eyes, one pair of wings and longer legs in specimen **X** compared with the presence of a larger head/eyes, two pairs of wings and shorter legs in the dragonfly. Furthermore many excellent responses showed the presence of a proboscis, a rounded abdomen and long antennae in specimen **X** compared with the lack of a proboscis, a pointed abdomen and short antennae in the dragonfly. Weaker answers made references to 'hairy' legs, 'anther' for antenna and 'spike/needle' for the proboscis.

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BIOLOGY

Paper 5090/61
Alternative to Practical

General comments

Candidates showed, to a greater or lesser degree, that they had some knowledge and experience of practical work. They demonstrated this by following instructions, making accurate observations and recording them, taking measurements, performing simple calculations and presenting data in graphical form. Some also showed that they were able to apply biological knowledge to new situations.

Almost all scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written.

It appears that most candidates had sufficient time to complete the paper but a few candidates did not answer the final section. It is not possible to say whether this was due to lack of time or not.

Comments on Specific Questions

Question 1

(a)

(i) Almost all candidates attempted this and most drew line graphs as expected, with very few incorrectly drawing bar charts.

Many candidates correctly chose the *x*-axis for the known quantity, light intensity, and the *y*-axis for the quantity being measured, carbon dioxide intake. A similar number fully labelled both axes, to include units of measurement.

The more able candidates included the negative values for some of the readings for carbon dioxide intake in a linear scale. Although readings at different light intensities had not been taken at regular intervals, the scale on the 'light intensity axis' should have been linear and 10 should have been included.

Plotting of points was generally well done to the candidates' own scales. If candidates are using a dot rather than a cross for a plotting point, they should ensure that it is still clearly visible when the points are joined up.

Plotted points were usually well joined up with smooth, clear lines but there were a few candidates who drew very sketchy lines or needed to use a sharpened pencil.

(ii) This question demanded clear thinking and application of knowledge of photosynthesis. Initially as light intensity increased, so did carbon dioxide intake showing that light was a limiting factor. A point was reached after which, although the light intensity increased, carbon dioxide intake remained at a more or less constant rate showing that some other factor or factors were limiting the intake, More able candidates explained this, quoting figures from Table 1.1 to support their arguments. A good number of candidates did recognise the initial relationship between carbon dioxide intake and increasing light intensities.

There were those who wrote of carbon dioxide being released, not relating the data to photosynthesis. Others stated incorrectly that once the line, i.e. carbon dioxide intake, had levelled off photosynthesis had stopped.

(iii) This involved reading a value from their plotted graph which a number of candidates were able to do.

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(iv) Some candidates correctly stated that, at low light intensity, the rate of photosynthesis is low so little carbon dioxide is being taken in. As respiration goes on at all light intensities, carbon dioxide would have been produced. As there was no net movement of carbon dioxide, the rate of production (respiration) must have been the same as the rate of intake (photosynthesis). More able candidates expressed this clearly.

There are some candidates who think that light is necessary for respiration to take place which is not true.

Question 2

(a) The vast majority of candidates were able to identify four features in common, usually listing segments or joints, wings, veins, legs, head appendages of some sort, and eyes. A few candidates wrongly included features such as spiracles that were not visible on the drawings.

(b) This required candidates to see differences between comparable features. Again the vast majority of candidates were able to contrast e.g. wing numbers, thickness of legs, presence or absence of 'hairs' on legs and head appendages, size of eye, structure of the rear of the body, presence or absence of some kind of mouth part.

Some candidates did not contrast the same feature e.g. large eyes were alongside thin legs in their table. Some candidates made comparison of size not noticing that the specimens had not been drawn to the same scale.

(c) Calculating the magnification of a drawing in relation to the size of an actual specimen is a standard biological procedure with which candidates are expected to be familiar.

Here they were expected to measure the drawn wing, and to use the information that this length in the actual specimen was 40 mm in order to calculate the magnification of the drawing. Many candidates correctly recorded the two measurements in the correct expression to calculate the magnification of their drawing.

Some common errors made were:

- measuring inaccurately,
- inverting the expression for calculating magnification,
- omitting x or times in expressing the magnification,
- giving an answer to an impractical number of decimal places,
- including units of measurement in the expression of magnification.

Question 3

(a)

(i) Most candidates were familiar with the iodine test for the presence of starch giving a positive (blue-) black colour. Some included a description of how they would prepare a green leaf for the starch test which was not relevant to this question.

(ii) Many candidates described the biuret test and its positive purple/ mauve result. Some incorrectly described tests for food materials other than protein e.g. Benedicts or emulsion test.

(b)

(i) The more able candidates identified the need for protein to be made into soluble amino acids by enzyme action in order to be translocated through the phloem. The majority did not recognise this and wrote, incorrectly, of proteins being moved, often by diffusion or osmosis or active transport.

(ii) A few candidates failed to draw anything on Fig. 3.1 but whether this was because they did not know how to answer or they had overlooked the question is not known. There were many good answers, arrows clearly drawn from the cotyledon to radicle and/or plumule. Some candidates showed a movement from outside the seed into the radical. Presumably they thought, incorrectly, that proteins are absorbed from the soil.

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(c) Candidates were not expected to have knowledge of the plant shown in Fig. 3.2 but to be able to use the information provided in the drawing and within the question.

Many candidates recognised that the enzymes produced by the leaves would break down the protein in the trapped insect. Some recorded that the amino acids produced would then be absorbed by the leaves for use in the plant. Some candidates did not make use of the information provided, answering in terms of bacteria decomposing the insects' bodies or of the plant 'sucking the goodness' out of the insects.

There were candidates for whom the words 'plant' and 'insect' triggered 'pollination' which was not relevant to the question.

(d)

(i) The role of nitrates in plants was well known and usually given in terms of protein synthesis, growth and repair, and chlorophyll production.

(ii) There were good answers to this question where candidates recognised that they were being asked to design an experiment. They recognised the need for 'constants' e.g. environmental conditions, size/species of specimen, time period as well as for a control experiment. They recorded the expected outcomes in terms of growth or leaf colour. A number of candidates simply repeated their answers to **(d)(i)**.

A few candidates did not answer this section. It is not possible to tell whether this was because of lack of time.

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BIOLOGY

Paper 5090/62
Alternative to Practical

General comments

Candidates showed, to a greater or lesser degree, that they had some knowledge and experience of practical work. They demonstrated this by following instructions, making accurate observations and recording them in word and drawing, taking measurements, performing simple calculations and presenting data in graphical form. Some also showed that they were able to apply biological knowledge to new situations.

Almost all scripts were clearly legible, with answers written in the spaces provided or, if not, with clear indications of where they had been written.

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

Comments on Specific Questions

Question 1

(a)

(i) The more able candidates looked at Fig. 1.1 and thought through how the apparatus worked. They were able to complete the Table 1.1, as asked, with a correct reading of 6 – 8. Many candidates recorded incorrect readings that were far in excess of this. Some candidates did not answer this question, either because they overlooked it or did not know how to, and left the Table 1.1 incomplete.

(ii) Many candidates worked out that by pushing the plunger of the syringe down, water would be forced into the capillary tube to refill it and set it to 0. This would not have happened if the plant had been removed as some suggested.

(iii) The ability to read the results of an investigation and to present them in a different way was tested by asking for the construction of a graph from the figures in Table 1.1. Many candidates constructed good graphs; only a few drew bar charts instead of graphs. Most correctly chose the *x*-axis for the known quantity, time, and the *y*-axis for the quantity being measured, distance. Not all candidates fully labelled the axes, often omitting units of measurement. There were those who did not recognise that 'time of day' relates to a 24 hour period and used a scale that included 25 and above.

Many candidates produced non-linear scales e.g. the distance between 0 and 08.00 was the same as for that between 08.00 and 10.00, 10.00 and 12.00 etc. without indicating that it was shortened.

Most candidates were able to plot the points accurately and clearly. Candidates were expected to plot their answer to **(a)(i)**. If candidates are using a dot rather than a cross for a plotting point, they should ensure that it is still clearly visible when the points are joined up.

Many candidates joined up their plots with good ruled lines or good smooth curves of best fit.

(iv) Some candidates were able to state correctly, in their own words, three environmental factors that affect the rate of transpiration – humidity, temperature, air movement or light.

Some made incorrect statements e.g. pH, pressure or carbon dioxide concentration.

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(v) More able candidates correctly answered in terms of either some appropriate environmental change or of experimental error. There were those who thought, incorrectly, that the rate of transpiration was higher at that time than might have been expected instead of lower.

(b) This question differentiated well between candidates.

(i) Many candidates' answers showed that they recognised the cellular structure of a leaf. Some were able to draw on Fig. 1.2 a correct route taken by water through the leaf, entering the leaf through the xylem and leaving through the stoma. Some candidates did not recognise the xylem and, incorrectly, drew xylem elsewhere on Fig. 1.2.

As most transpiration takes place through the stomata and a cuticle was drawn on the upper epidermis, water loss from the upper leaf surface was not acceptable.

Other errors were to show water entering the upper surface of the leaf via the cuticle and through the stoma.

Some candidates also indicated clearly by labels where the physical processes of evaporation, diffusion and osmosis take place but many omitted to do this.

(ii) The question asked for the route taken by carbon dioxide in photosynthesis to be shown so it was expected that a pathway going in through the stoma and into a mesophyll cell would be drawn. The more able candidates did this well.

Common errors were carbon dioxide entering the leaf through its upper surface and the drawing of a pathway relating to carbon dioxide movement during respiration.

Some indicated that photosynthesis takes place in the upper epidermal cells which is incorrect as they contain no chloroplasts.

The need for the route taken by water and that taken by carbon dioxide to be clearly identified in some way was recognised by some but, by no means, all candidates.

There were candidates who drew only one route, sometimes without a label, and those who drew nothing.

(iii) It was expected that candidates would know which cells in a leaf are important in water movement and photosynthesis and be able to identify them by their position and shape on a diagram.

Many identified guard cells correctly. Stoma(ta) are not cells. Mesophyll cells, sometimes qualified as spongy or palisade, were often correctly labelled. Xylem was less frequently labelled correctly, some confusing xylem and phloem and others leaving it unlabelled.

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Question 2

(a)

(i) Candidates were expected to produce a biological rather than artistic drawing of the specimen in Fig. 2.1. or a relevant part of it, so shading was not necessary.

Many drawings were of an acceptable size drawn with the expected clear, clean lines rather than sketchy ones. Sometimes the proportions of the various parts of the specimen were not well portrayed.

Some candidates drew 'text book' diagrams of general seed structure that were not asked for.

The more able candidates correctly labelled the plumule and radicle and knew that these grow to become stem and root respectively.

(ii) Many candidates correctly recorded two measurements with units and used the correct expression i.e. $\frac{\text{drawing size}}{\text{specimen size}}$ to calculate the magnification of their drawing.

Some correctly made allowance for the image of the specimen in Fig. 2.1 being at a magnification of 0.75 to reach their final answer but often this was overlooked.

Common errors made were:

- omitting to record units of measurement,
- inverting the expression for calculating magnification,
- omitting x or times in expressing the magnification,
- omitting to take the 0.75 magnification of the specimen into account,
- giving an answer to an impractical number of decimal places,
- including units of measurement in the expression of magnification.

Calculating the magnification of a drawing in relation to the size of an actual specimen is a standard biological procedure with which some candidates seemed to be unfamiliar.

Question 3

There was sufficient information given, either in words or in Fig. 3.1, even for candidates who had no experience of an investigation like the one described to be able to answer this question which involved applying knowledge of photosynthesis and respiration.

(a)

(i) Most candidates were able to correctly suggest the colour of the indicator in each tube after 2 hours in bright sunlight.

(ii) A good number of candidates were able to name respiration and photosynthesis as the processes responsible for the colour changes. Some incorrectly stated excretion, osmosis and diffusion or referred to transpiration instead of respiration. It should be noted that 'breathing' is not an acceptable alternative term for 'respiration' as some candidates think.

(iii) Explanations of how the colour changes were brought about were correctly given by referring to carbon dioxide. Carbon dioxide, produced during respiration and absorbed during photosynthesis, dissolves in water to produce an acidic solution.

Common errors were stating that carbon dioxide produces an alkaline solution, or that the oxygen given off during photosynthesis produces an alkaline solution.

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(iv) More able candidates correctly suggested that the indicator would be yellow. As light could not reach the plant, no photosynthesis could occur but respiration would still go on, releasing carbon dioxide to produce a more acidic solution.

Some candidates think, incorrectly, that plants respire only in darkness, not understanding that respiration takes place at all times.

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