

BIOLOGY

Paper 5090/01
Multiple Choice

General comments

This paper achieved a good spread of the candidates. Knowledge continues to be good, but there were some surprises, such as in **Questions 18** and **19**, which seemed to be straightforward, but caused some problems. Candidates should appreciate that the longer questions need to be read carefully. As ever, the most important instruction must be to “read the question”. Examples include **Question 3** and **Question 6**.

Comments on specific questions

Questions 1, 4, 5, 9, 10, 11, 12, 14, 20, 21, 25, 26, 27, 28, 31, 32 and **35** were well known and presented few difficulties.

Question 1 Option B was surprisingly popular. The cellulose wall is completely permeable.

Question 2 Water will move down the water potential gradient, so cell 1 must be higher than cell 2 and 2 higher than 3. The mineral concentration in the cells must be higher in the cells than in the soil, since water enters by osmosis, so mineral uptake must be by active transport.

Question 3 The question refers to the sucrose solution in the test tube and as water enters the potato cells, the sucrose must become more concentrated. In the potato cells the sucrose is polymerised to starch.

Question 6 This question was not well understood. Both tubes are illuminated, but the black paper around tube 1 will prevent photosynthesis, so the CO₂ will rise and the pH fall, turning the indicator yellow. In tube 2, photosynthesis will take place using CO₂ and the pH will be neutral, turning the indicator orange.

Question 7 At low light intensities only, as the light gets brighter, the photosynthesis rate increases. Therefore, light is the limiting factor. In brighter light, the CO₂ is limiting.

Question 8 Lettuce will provide fibre and vitamin C, so options A and D are wrong. There is very little fat in lettuce, so the fat soluble vitamins A and D will be limited or even absent.

Question 13 This graph should be well understood by now, especially as **Question 14** gives a useful diagram of the heart. Valves can only be forced open or closed by a pressure difference. Hence during period A, the atrial pressure is higher than the ventricle, and the atrio-ventricular valves must be open. They close when the ventricles begin to contract at the start of the B period, but the semi-lunar valves are still closed until the pressure in the ventricles exceeds that in the aorta, at the start of period C.

Question 15 Since CO₂ is lost from the lungs, the pulmonary vein from the lungs will have the lowest CO₂ content. “Lowest” is in bold type, but this question was not as easy as expected.

Question 16 Breathing at rest in adults may not use the diaphragm muscles, but deep inhalations use both diaphragm and intercostals muscles, as musicians and athletes will know well.

Question 17 The question is about the function of the cilia, so moving mucus up and out of the system is obvious, but cilia do not trap bacteria, due to the layer of mucus.

Question 20 Dialysis is fine in the artificial kidney, but the definition of excretion includes the removal of urea by the kidneys.

- Question 22** The man can move his leg in response to a pinprick. This is a reflex, so block Z must not in place. He cannot feel the pinprick, so the block must be at X.
- Question 23** Option D was unexpectedly popular, since taking up glucose by the liver is due to insulin, not adrenalin.
- Question 24** As the ring of ciliary muscle contracts, its diameter will be less, so the ligaments that suspend the lens will slacken.
- Question 29** Only inorganic materials are required by the tree for photosynthesis.
Fungi may be saprophytes or parasites, but do require organic nutrients.
- Question 30** The process labelled S must be feeding and only the key, A, does not include S.
P is denitrification, Q is nitrogen fixation and R is synthesis of amino acids.
- Question 33** The anther, labelled 1 and the ovule, labelled 3, will contain haploid nuclei. The stigma, 2, may receive pollen grains, but if pollen tubes grow into the stigma, their nuclei will be produced by mitosis, since the pollen grain is already haploid.
- Question 34** Since the seeds store starch, they must contain amylases which are used in germination. Boiling the seeds will denature the enzymes, so no hydrolysis occurs round them.
- Question 36** B is not true, since sperm will still be made (and reabsorbed). Similarly, (option D) the interstitial cells of the testes will still synthesise hormones and they will pass out of the testes in the blood as usual.
- Question 37** The I^A allele and the I^B allele are codominant, while the allele I^O is recessive, so if the phenotype is blood group A, only $I^A I^A$ or $I^A I^O$ genotypes are possible.
- Question 38** Dominant alleles may be disadvantageous and will be selected against, so option B is not acceptable.
- Question 40** If both parents are homozygous, the F_1 all have the same heterozygous genotype and hence the same phenotype. E.g. AA x aa will give all Aa.

BIOLOGY

Paper 5090/02

Theory

General comments

This year's paper succeeded in spreading the candidates across the mark range, with several scoring in the very high 70s out of 80. **Sections A** and **B** were answered equally well by most candidates.

Comments on specific questions

Section A

Question 1

Sections (c) and **(d)** proved far more demanding than **(a)** and **(b)**.

- (a) Almost all of those who attempted to shade the xylem did so correctly. Relatively few candidates thought that the dye would pass up the stem in the phloem.
- (b) A significant feature, missed by several candidates, was that it is the solution that moves up the stem as a result of transpiration pull, not simply the dye. Some candidates, however, answered solely in terms of water and failed to mention the dye at all. 'Suction' was not considered to be a scientifically sound notion.
- (c) This part was very poorly answered. Often, the dye was incorrectly thought to move by osmosis, or to be taken up by active transport. In the latter case, reference was regularly made to 'against a concentration gradient' – a belief that was not in line with the information provided in the question.
- (d) Better candidates had few problems in realising that water would pass from the plant by osmosis, but a large number felt that the salt solution would move into the plant, thus missing altogether the significance of the *concentrated* salt solution in which the plant had been immersed.

Question 2

- (a) There were few problems here, though the term 'product' did not seem to be familiar to a small number of candidates.
- (b) Several gave enzymes not found in the stomach and also referred to the enzymatic breakdown of non-protein substances. Otherwise, full marks were common for this section.
- (c) Again, this was a section competently answered by the great majority of candidates, though a few, carelessly in some cases, failed to continue the graph until it cut the zero line.

Question 3

- (a) All the major differences likely to exist were mentioned, though a few did say that the jar would contain 'only' carbon dioxide, 'a lot of carbon dioxide', or 'very little oxygen'. All these answers were not considered sufficiently accurate to gain credit.
- (b) There was some confusion over muscular action during breathing in and breathing out, but some entirely accurate answers were seen.

- (c) Candidates found difficulty in interpreting the requirements of this section of the question. Many did not understand that it is the metabolic process of respiration that causes the change in pH. Answers often centred on the alveoli rather than the cells of the student's body as required. Those who did realise that the question was about cellular respiration had no difficulties. Those who, acceptably, referred to red blood cells removing oxygen from the air in the lungs.

Question 4

- (a) Generally, this was correctly answered. Haemoglobin was, by far, the most common inaccurate suggestion, with magnesium also sometimes mentioned.
- (b) Examiners looked here for matching differences between bird and mammal red blood cells. Good candidates regularly scored all three marks available. Amongst the unacceptable answers were references to cytoplasm and to haemoglobin.
- (c)(i) Occasionally artery was suggested, but usually this part was correctly answered. Commonly, reference was made to the thinness of the walls, to blood cells passing singly and to the branching nature of the capillaries passing between body cells. Those who failed to score well did so as a result of omission rather than inaccuracy.
- (ii) Just occasionally, 'blood', or 'water' were mentioned, but, from a range of acceptable alternatives, candidates usually found an acceptable suggestion.
- (iii) The major fault here was to repeat the words in the question ('blood flowing in pulses' or 'smoothly') without explaining why that is the case. It should be understood that marks are never awarded for repeating information provided in the question.

Question 5

- (a) The terms 'pericarp' or 'ovary wall' did not appear as often as might have been hoped. 'Flesh' was fairly common, and several opted not to attempt the section.
- (b) It was surprising how few failed to realise that seeds and fruits are the product of sexual reproduction, especially as a considerable number felt that one of them was, whilst the other, they thought, was a product of asexual reproduction. Potato tubers were often correctly thought to be examples of asexual reproduction, but even those who understood the principles, then went on to explain what happens to the seed, fruit or tuber rather than to explain any of the processes involved in their production.
- (c) The significance of root nodules in leguminous plants was not well known by many candidates. Even so, full marks were available for candidates who thought to describe decomposition and release of nitrates into the soil and the importance of these ions for the growth of future crops.

Section B

Question 6

- (a)(i) Although this section was often very fully and accurately answered, there was a great deal of imprecision over what was actually being filtered and where anything being 'absorbed' was actually being absorbed into. The term 'excretion' was often a costly oversight, and homeostasis was mentioned, but no precise detail was often then given on just how this was being achieved by the kidney. References were being made to 'the body', when credit was more readily available if the explanations had related to the blood. The importance of excess water being removed was often overlooked, and the kidney was sometimes said to produce or store urea.
- (ii) There was considerable confusion between 'urethra' and 'ureter'. The urethra was often said to 'store' urine, and, surprisingly, it was not uncommonly said to pour its contents (which were often urea rather than urine) into the alimentary canal. Some confused the urinary bladder with the gall bladder.

- (b) The dialysis machine was well understood by many candidates. Others were not sure on exactly where the blood was flowing (it was relatively rare to have a clear statement in the dialysis tube, and it often seemed to flow directly into the bathing fluid), or, indeed, what materials are removed from the blood. Some thought that urine is removed. Nevertheless, marks were quite common.

Question 7

- (a) Some candidates described a reflex arc rather than emphasising the part played by each particular neurone. Others felt that sensory neurones 'detect' stimuli, or that they are receptors. Those who knew their neurones provided faultless answers, but common errors were to say that sensory neurones detect stimuli or are receptors, to omit any reference to effectors when describing the distribution of a motor neurone, and to fail to mention the CNS (or acceptable part thereof) in any of the descriptions. Several answers completely confused the three types of neurone.
- (b) Candidates found it difficult to articulate their knowledge, though in many cases, this stemmed from confusion between the two different types of action and the differing roles of the brain in the two actions. Only occasionally was the protective nature of reflex actions mentioned. The term 'voluntary' was sometimes used instead of 'involuntary', and vice versa.

Question 8 Either

There were some truly excellent answers to this question. There were also, however, many that exposed faulty understanding of the principles involved. There were few problems with the part dealing with photosynthesis, which was generally well answered. However, some candidates then followed the story of oxygen release and its value to humans rather than the nutrition path. Some talked of the energy loss through food chains, and even, occasionally, vitamin D production and energy absorption as a result of sunlight falling on the skin. Those who mentioned humans eating plants often omitted any reference to digestion, or that it is in the muscle cells that the respiration occurs to release (NOT 'produce') the energy that is then used for muscle contraction.

Question 8 Or

This was, by far, the less popular of the optional questions, but those who attempted it often produced answers of a high quality. The major shortcoming was a failure to mention the importance of procedures or structural features mentioned. Penicillin was commonly the example mentioned, but several thought that *Penicillium* is a bacterium. A few of the weaker candidates produced answers which related to the use rather than to the production of an antibiotic and a significant number of weaker candidates confined their answers to a description of yoghurt production.

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Paper 5090/03

Practical Test

General comments

A number of marks were readily accessible in both questions with **Question 1** particularly reflecting candidates' familiarity with the Benedict food test. Thus, a total mark below 10 was very unusual and there were a good number of scores in the middle thirties. It should again be stressed that the ability to follow instructions very carefully is always rewarded by a few marks that might otherwise have been thrown away. It was vitally important that the major drawing required in **Question 1 (a)** was thoroughly labelled, yet a few completely unlabelled answers were presented.

Comments on specific questions

Question 1

It was intended that the seedling should preferably have been a cereal, probably maize, but many Centres provided seedlings of a bean, or other dicotyledonous plant. The mark scheme was adapted accordingly.

- (a) (i) Drawings were generally of good size and reflected the detail of the specimen provided. Because of the wide range of possible specimens, labelling was relatively undemanding, to encompass any features that appeared. The radical and plumule were frequently confused, however. The majority of candidates remembered to indicate on the drawing precisely where their measurement was taken.
- (ii) The exercise in determining magnification was well carried out. Those who elected to measure in mm did not suffer the problems that occurred in the use of cm, where incorrect conversions were made. The final expression of the magnification was only very rarely invalidated by the addition of units, such as 'x 2.3 cm'.
- (b) (i) Those who followed the instruction to *describe* the results of the two tests, (both here and in **part (c)**), readily gained the marks. However, many candidates elected to state their conclusions, often simply as 'negative', or 'not present'.
- (ii) This test was well known, and well described.
- (c) From the descriptions given, it appeared that many candidates took portions of the seedlings from the visking tubing and crushed them before carrying out the tests, when all that was required for each test was a sample of the solution taken from the apparatus by means of a syringe.
- (d) Many answers were based on the assumption that osmosis was occurring. Those who answered in terms of digestion and diffusion readily obtained the marks. Some mentioned food tests again – including a grease spot test in one case!
- (e) Only a very small minority described how the same experiment could be carried out using rice seedlings as well as the maize (or other material) that was provided. The concept of germinating rice grains appeared to be strange to many. A lot of candidates did not get beyond the idea of repeating the food tests that had been carried out on the maize, on the rice. In a number of cases the biuret test for proteins was also mentioned.

Question 2

- (a) (i) This was generally carried out adequately. Mistakes occurred during attempts to take measurements and calculations between mm and cm, sometimes resulting in ridiculous figures. Many overlooked the fact that the squares on the graph paper are 2 mm x 2 mm rather than 1 mm x 1 mm as suggested.
- (ii) Generally less well done. Drawing the outline of the leaf was no problem but only a minority presented a reasonable way to count the squares while many more measured their drawing and applied the same method from **part (i)**, which was not at all the idea. Evidence of systematic counting, or tallying, by marking the squares, for example, was looked for. And some form of allowance for part squares, was expected. Again, many results that were unrealistically high or low were noted. For both parts of **Section (a)** units were sometimes omitted, or incorrect.
- (iii) The majority gained the two marks here, though thinking of an advantage proved difficult for some. 'Quick' was accepted, but not 'easy', which often replaced it.
- (b) (i) Some confused breadth with thickness, or height, as it was frequently expressed.
- (ii) Large surface area and short diffusion pathway, associated with light and carbon dioxide absorption, respectively, provided ready sources for the two points required.
- (c) Comparing and contrasting were generally not well carried out, especially with regard to the requirement that the features should be visible. Valid features were often quoted in the wrong section.
- (i) Most were able to state that both specimens were green (or contained chlorophyll). Other acceptable features were venation, large surface area or flatness.
- (ii) The table required contrasting pairs of characters such as dicotyledon against monocotyledon, net veined or parallel veined, stalked or sessile, jagged margin or smooth – not necessarily expressed in these terms. Others stated colour difference or differential hairiness that they observed.

BIOLOGY

Paper 5090/06

Alternative to Practical

General comments

Our intention, as always with this paper, was to enable candidates to show that they had experience of practical work, preferably by participation or, at least from observation.

Marks were lost carelessly by failure to follow simple instructions – drawing no guide line to show where the measurement was taken in **Question 2 (a)**, or stating conclusions rather than results (observations) in Table 3.1.

In those Centres where candidates' scores were low, in single figures or just above, the marks for drawing the graph, the specimen in **Question 2** and the calculation of magnification, were the main and sometimes the only source. In general, however, there was a good spread and a significant number were between 35 and 39.

Comments on specific questions

Question 1

- (a)(i) The graph was well drawn by many candidates. Axes were well labelled and plots clearly shown. Care was needed to allow for the fact that the readings were taken at irregular intervals of light intensity. Joining the points by means of ruled lines, or drawing a line of best fit was sometimes carried out indecisively and a significant minority were correct in every respect except that the names and labelling of the axes were interchanged. Others reversed axes and plotted accordingly. A very few produced bar charts. These variations each incurred a degree of penalisation.
- (ii) Many recognised that light was no longer the limiting factor and suggested that carbon dioxide was now limiting. Some merely stated that photosynthesis was at an optimal rate, or was being stopped, while some associated the high light intensity with excessive heat and denaturing of enzymes. The compensation point was mentioned as well – but to no avail!
- (b)(i) Surprisingly few candidates actually mentioned that the light bulb would give off heat and that the heat would affect the rate of photosynthesis.
- (ii) The idea of the pond weed, or the apparatus, adjusting to the changed conditions was well understood.
- (iii) Most candidates scored one mark, either for saying that the light source was brought closer to the pond weed or that a more powerful light was used. Many lost marks by saying that the light was moved or the bulb was changed, without specifying how.
- (iv) Few were able to suggest more than two acceptable improvements. The most common correct response was to state that the experiment should be repeated and an average taken. Others commented that more pond weed might be used and suggested improved methods of counting the bubbles or measuring the volume of gas produced. References to keeping a stated factor, temperature for example, constant, were rarely seen.

Question 2

- (a)(i) Drawings of this quite difficult subject were very creditably done though some were impressions that took little account of the number and shape of spores. Clean, clear lines were expected and shading was not required. Many candidates omitted to draw a line to show where their measurement was taken.
- (ii) Often, even when a line was drawn, no units of measurement were given and when the chosen unit was cm rather than mm, the first decimal place was not recorded. The expression 'length of drawing over equivalent length of specimen', was sometimes inverted and the final statement of the magnification was spoiled by giving a unit, e.g. 'x 1100 mm'. A minority failed to make an allowance for the fact that Fig. 2.1 was 'x 1000'. Candidates might also appreciate that an answer like 'x 1193.02' is not realistic and might well have been rounded to x 1200.
- (iii) This section was probably the most poorly answered part of the whole paper. Many candidates did not appear to understand the question and either gave an account of the fermentation methods used in penicillin production, or did not understand that penicillin was the antibiotic. Others merely recounted what they had been given in the stem of the question. Good answers described how different concentrations of the antibiotic could be applied to a range of Petri dishes for a suitable time, in uniform conditions of temperature for instance, before the results were assessed. Concentration was often confused with volume.

Question 3

- (a)(i) The table was frequently completed inadequately despite the clear instruction that the observed results of the tests were required. Series of ticks and crosses, or plus and minus signs, or a statement that 'nothing happens', were often seen. The key results were those for 0 minutes and 10 minutes, with some tolerance being allowed for the intermediate periods.
- (ii) Many candidates were unable to suggest how to determine the end point of the reaction between starch and amylase. Some believed that the presence of reducing sugar would signify the end of the reaction while others stated that the test should be performed but gave no further detail.
- (iii) It was usually appreciated that the model represented the digestion of starch by amylase. Many just gave a general statement on this process without trying to relate the various components. Of those who did associate the visking tube with the gut, and absorption, very few went on to mention the water representing blood.
- (b)(i) The majority referred to a change in the level of the meniscus but did not always indicate the direction. Others mentioned increase in the volume or turgor of the visking tubing, but neither is obviously visible.
- (ii) Those who answered in terms of water potential had no difficulty with this section. There were however a number of references to solutes moving by osmosis and some attempts to answer in terms of diffusion and solute concentrations.
- (c) Most had the idea of molecules of different sizes behaving in distinct ways relative to the tubing, but there was some confusion when examples from the experiment were quoted; sucrose – quite unnecessarily – was often mentioned and described as a small molecule. 'Particles' rather than molecules were cited in many cases.