# BIOLOGY

**Paper 5090/01**
**Multiple Choice**

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

**General Comments**

This paper highlighted areas that were less well known, such as basic knowledge of the nitrogen cycle and the heart pressure graph. It was surprising to see that many candidates could not apply their knowledge of definitions, such as in **Question 11**, where understanding the definition of translocation is fundamental. As always it is important to remind candidates that every word of the stem must be read before jumping to a conclusion, e.g. missing the word “left” in the stem of **Question 13**. The last two questions were not difficult, but some candidates seem to have lost concentration by the end.

Items that were easy and / or caused no problems were **Questions 8**, **10**, **12**, **17**, **19**, **22**, **23**, **24**, **25**, **29** and **32**.

**Comments on individual Questions**

**Question 1**
Active transport requires energy, so an oxygen supply is necessary. Diffusion and osmosis are physical processes and occur without any energy input from the organism.

**Question 2**
The cell cannot be a bacterium since there are mitochondria as well as a clear nucleus, although no chromosomes are visible.

**Question 3**
Both mineral concentrations are higher in the cell than in the soil, so active transport must be involved in the uptake of both.

**Question 4**
As a key enters a lock, the substrate molecule (protein) enters the active site on the enzyme. The amino acids are the product

**Question 5**
This proved to be very taxing. Only the best candidates realised that nitrate is a raw material in producing amino acids from sugars (stage 2).

**Question 6**
Chloroplasts are in spongy and palisade mesophyll cells and the stomatal guard cells.

**Question 7**
The clue is the effect of temperature, leading to the sudden fall in photosynthesises.

**Question 9**
In tube three, the salivary amylase will digest the starch and the maltose product will give the positive Benedict's test as it does in tube 2.

**Question 11**
Translocation refers to sugars. Options **C** and **D** refer to the movement of water.

**Questions 13 and 14**
Despite the diagram for **Question 14** many did not realise that blood enters the left side of the heart only from the lungs.

**Question 15**
Valves are pushed open and closed when the pressure on one side is greater than on the other. When the ventricle pressure rises above that in the aorta, the semi-lunar valve must open. This definitive diagram is not nearly well enough known.

**Question 16**
The rising ribs will increase the thoracic volume and reduce its pressure, so **C** must be the key.

**Question 18**
When breathing in the diaphragm is pulled down, increasing the thoracic volume and the ribs rise.

**Question 20**
To imitate a kidney, the machine must lose excess salt, urea and water. Glucose must be kept constant to avoid osmotic problems.

**Question 21**
The first event must be reception of the stimuli, so **C** has to be the key.

**Question 26**
The stem states bacteria and yoghurt. Yoghurt does not contain alcohol!

**Question 27**
After 80 hours, both fungus and yield continue to rise, but not beyond 108 hours, so **C** is the key.

**Question 28**
When the stem is negative, the word **not** is emphasised. Only energy is a one way commodity.

**Question 30**
Ammonia is oxidised to nitrate by nitrifying bacteria – fundamental to life on earth.

**Question 31**
Pathogens cause disease. The mosquito merely carries the parasite and is therefore the vector.

**Question 33**
When gametes come from two different parents, male and female, the offspring must be different.

**Question 34**
Plant Q must have 7 chromosomes from its parent, P, but if P is self pollinated, then all 14 of Q's chromosomes must come from the one parent, P.

**Question 35**
Fertilisation normally occurs in the fallopian tubes, so sperm must pass through the vagina and the uterus to reach it.

**Question 36**
The enlarged diagram shows the blood in the larger vessel going to the foetus, so the blood returning through vessel X must contain more $CO_2$ and urea, so at Y, there will be more glucose and oxygen.

**Question 37**
Variation is discontinuous because there are two different types and no intermediate forms.

**Question 38**
Option **D** allows for possible B blood groups as well as A and AB.

**Question 39**
To show a recessive phenotype, both alleles must be recessive., whereas a single dominant allele will cause the organism to look like the dominant form.

**Question 40**
Both P and Q must be either Tt or TT. Unless they are both TT, the possibility exists that their offspring could be tt and be affected, since P's and Q's partners must both be tt.

# BIOLOGY

**Paper 5090/02**

**Theory**

## General comments

The Paper was accessible to candidates over a wide ability range and some very creditable work was seen. However, an extremely small percentage of candidates attempted **Question 8 Or**. This was not an especially demanding question, and it gives cause for speculation that candidates may be simply attempting the first option, **Question 8 Either**, rather than reading both through and then deciding which option to answer.

## Comments on specific questions

***Section A***

**Question 1**

This was a question that fell within the scope of most candidates.

**(a)** Answers to this question were usually correct, although there were some references to specific methods of propagation, which were usually inappropriate for this example and also an occasional mention of sexual reproduction.

**(b)** The lack of variation and possible overcrowding were the points most usually made.

**(c)** Few mentioned that plants would be well established before separating from their parent, but references to profitability and to inheritance of desirable qualities were commonly mentioned.

**(d)** Structure **D** was almost invariably recognised as being photosynthetic, but there were relatively few who went on to name the materials manufactured and supplied to plant **C**. Structure **E** posed few problems, with water and salts being regularly cited. Structure **F**, however, rarely attracted a full description for its function. Vague references to 'food' were common, and those who thought to mention xylem or phloem rarely made it clear exactly which material each was responsible for carrying.

**Question 2**

**(a)** **J** was usually correctly positioned, but **K** was quite often located in the vacuole.

**(b)** This part regularly scored full marks. As a straight forward example of osmosis, most appreciated that, in a solution with higher water potential than its cell sap, a cell takes in water and becomes turgid. Occasionally, it was the solution rather than water that was absorbed.

**(c)(i)(ii)** This was usually poorly answered. The cell wall (only), the cytoplasm and the vacuole were all, at times, shaded. Even those who correctly shaded the space between cell wall and cytoplasm, then usually described plasmolysis. Few appreciated that the cell membrane prevents the solution from passing further into the cell.

**Question 3**

**(a)** It was evident that candidates were unfamiliar with the external appearance of the heart. Some thought that **L** was fat, and often those who realised that is was an atrium forgot that, in a ventral view of the heart, the right atrium would appear on the left of the diagram. Although several believed that **M** was the pulmonary artery or a vena cava, pulmonary vein was a reasonably common answer.

**(b)** This question discriminated well. A reassuring number realised that oxygen and glucose would need to be added so that heart muscle cells could respire. Several thoughtful candidates suggested an anticoagulant. If hormones were suggested, it was rare, indeed, to see a valid reason for adding them.

**(c)** Answers to this part were disappointing. The question referred to 'knowledge of the structure of the heart', but very few based their answers on heart structure at all. Most answers related to the need to supply heart muscle with blood. Those who realised the significance of valves often mentioned an atrio-ventricular valve. Rarely was it mentioned that the blood flow would cause the valve to close, and references to coronary arteries were extremely infrequent.

**Question 4**

**(a)** Of the incorrect responses, ovule was the most common, with cotyledon a clear second-favourite.

**(b)** Wind dispersal was usually correctly suggested, though sometimes failed to say that the structure would help to delay the descent of the fruit to allow the wind the opportunity of carrying it away. Just to say that the wind would carry the fruits was to repeat that they were wind-dispersed. Some offered water dispersal (not in the syllabus) and a few suggested self-dispersal.

**(c)** Although all correct answers were seen, it was not particularly common to see two correct answers together. The main problem was to believe that the temperature was *not* optimum for all seeds– even though the question stated otherwise, and proceed to talk about the possible denaturing of enzymes. Too many gave light and carbon dioxide as their answers.

**(d)** All points were regularly made but often candidates were not sufficiently precise, and spoke of 'conditions' or 'the environment' not being favourable.

**Question 5**

**(a)** Photosynthesis was almost always correct, with just a few references to 'transpiration' and to 'respiration'.

**(b) (i)** Again, this was usually correct, though the occasional reference to 12.00 and 24.00 may have been the result of those two times appearing below '0's on the vertical axis.

**(ii)** This part differentiated well. Only the better candidates appreciated that photosynthesis would be slowing down then stopping and then carbon dioxide would be released from the plant as a result of respiration. Some did not make it clear that it would be *the plant* that would be releasing carbon dioxide (rather than the process of respiration), and many indicated that they believed respiration would begin when photosynthesis stopped.

**(c)** The only answer to this part was temperature – a factor that would affect both photosynthesis and respiration. Many suggested light, and several offered carbon dioxide.

**(d)** Candidates generally coped very well with a question that required considerable thought. Their greatest problem was carelessness over the drawing of the curve, failing to make it start at 12.00 and finish at 24.00, or not making it pass close enough to the 0/20.00 hrs intersection.

***Section B***

**Question 6**

**(a)** Many said that a hormone is a 'substance' without describing it as a chemical. Some said that hormones are secreted by both endocrine and exocrine glands, and many omitted to say that, once in the blood, it is the blood that carries the hormone to its target organ. References to destruction in the liver were not common. Many failed to appreciate that, when asked to give a *definition* of a hormone, a description of the action of a *specific* hormone will not reap many marks.

**(b)** Although scores were often high for this section, they masked a basic misunderstanding amongst a significant number of candidates. There is a common belief that, even in a spinal reflex action, the brain plays a controlling role. Otherwise, stimulus and impulse were often confused and neurones were said to generate impulses. Weaker candidates believed that nerves, rather than neurones, conducted the 'messages'.

**Question 7**

**(a)** Some perfect answers were seen for this part, though there is confusion over the relationship between chromosomes and genes. 'Chromosomes are found in genes' was only too common a statement. References to DNA and protein production were not common, and several seemed to believe that DNA is found only in blood or that its importance is associated with establishing paternity.

**(b)** Weaker answers suggested that sickle cell anaemia and Down's syndrome are the result of nutritional deficiencies**.** Those who knew that they were the result of mutations sometimes omitted to use that technical term and then confused gene with chromosome. Chromosome 23, rather than 21, was often thought to be responsible for Down's syndrome.

**(c)** It was relatively easy to score full marks for this part, but several failed to do so, either by omitting to mention what the blood groups of the parents were, or believing that blood group and genotype are the same thing. Those who produced an accurate answer often, unwisely, left it to the Examiner to work out which of the offspring was of a different blood group from either parent.

**Question 8 Either**

**(a)** This part was well answered. All marking points were seen indicating that candidates have a sound grasp of the hazards associated with deforestation. Surprisingly, perhaps, the effect of deforestation on human populations was less often mentioned than its effect on wildlife, and there is an erroneous belief that, somehow, trees 'attract' rainfall.

**(b)** This was disappointingly answered, since many were able to identify the types of pollution but were unable to back up their knowledge with details on the effects of the examples they gave. Apart from this lack of detail, there were also some serious misunderstandings. CFCs were blamed for global warming rather than depletion of the ozone layer; pesticides were said to be the cause of eutrophication and industrial wastes were often not specified, neither was any accurate account given of their effect on the environment. References to insecticides killing useful insects were surprisingly rare.

**Question 8 Or**

This question was so rarely answered that it is difficult to report on any sort of trend in the answers. Those who did answer it were usually able to give a very acceptable response.

**(a)** The story of energy flow begins with sunlight being absorbed by plants. The point was usually made, though several referred more generally to 'solar energy'. That all organisms then either use or lose energy was rarely mentioned, though there was sometimes an attempt to indicate that the energy never returns to its original source.

**(b)** Almost all candidates who attempted this question realised the connection between food chains and food webs.

**(c)** Of the marks available for this part of the question, several were awarded for a straightforward account of the roles of organisms in a food web, and most candidates were able to qualify for them. Some however forget to mention that producers are plants. The more demanding part of the answer was a requirement for candidates to describe, in some way, the interaction of the various trophic levels, and how numbers at one level will affect the numbers at another. This understanding was rarely expressed.

# BIOLOGY

**Paper 5090/03**

**Practical Test**

## General comments

Candidates continue to lose marks quite unnecessarily by not following the instructions set out on the question paper, for instance by completely omitting labels when instructed to produce a labelled drawing. But the principal weakness on this paper lay in the inability of many candidates to cope with the experimental investigation plan in **Question 1 (b)**.

Many Centres found it necessary to provide bean seeds that were smaller in size than those of the Runner bean that were recommended. This meant that there was a smaller margin for error when carrying out the instructions given in the question.

It was surprising to find that, in some Centres, the 'grease spot' test for fat or oil was still in use. This was removed from the syllabus some years ago. Other out-of-date tests have been seen from time to time. It is important that Centres are familiar with the up-to-date syllabus. It was not easy to understand why such a high proportion of the candidates performed so disappointingly, with many low marks achieved. Perhaps a more rigorous approach would be beneficial.

## Comments on specific questions

### Question 1

**(a) (i)** The grid was generally completed satisfactorily although some candidates did not state the units of measurement, or confused cm and mm. Wrongly placed decimal points resulted in answers such as 90 or 100 mm for the length of a seed.

**(ii)** The Examiners expected to see a 'tally' system of some sort as a practical aid in the compilation of the size groups, but such an answer was very rare. The total number of seeds measured and grouped together should have been twenty, but this was not always checked by candidates.

**(iii)** Care was needed in labelling the axes, especially in ensuring that the *x*-axis was horizontal, with the group sizes centrally placed beneath the columns. The columns should have been equally wide. A common weakness was in not clearly delimiting the outline of each ruled block, i.e. the pencil line not standing out sufficiently clearly from the background grid of graph paper.

**(b)** The vast majority of candidates did not realise that they should have planned to grow seeds from different size groups in uniform conditions, so that the resultant plants could mature. The resultant crop of seeds could then be measured, as the originals were, with the results being analysed and comparisons made. This would show whether the statement was justified. Marks were allocated for mentioning the uniformity of the conditions, two of which, such as provision of water, light or nutrients, could have been stated. An idea of the time scale, in months, rather than days, or even hours as was sometimes stated, could have been given and the collection of fruit, measurement of seeds and tabulation of results were all points that gained marks. Thus, variation within the same genotype might have been shown. Answers that were based on seeds of the same size being grown in different conditions were also accepted.

Many candidates based their answers on the idea of genetic diagrams intending to show dominant and recessive characters. The height of the plants that grew was often measured as the basis for analysis.

Most of the answers of this type were entirely theoretical with no experimental plan.

**(c) (i)** Many candidates did not follow the instruction to omit the cotyledon from their drawing and consequently the remainder of the embryo was drawn to too small a scale, with details of plumule and venation not shown. Thus, a good exercise in the use of a hand lens was not achieved. A significant proportion of candidates left their drawing unlabelled, forfeiting some of the available marks.

**(ii)** Despite the requirement being stressed in the question, many candidates did not rule the line to show where the measurement was made. This made it difficult to check the candidate's calculation. The value for the magnification was spoiled in a minority of answers by the inclusion of units of length, or by unrealistic inclusion of too many decimal places. Other answers suffered from excessive rounding, up or down.

**(d) (i) and (ii)** There was an unexpectedly large number of negative results recorded. The results varied within as well as between Centres, suggesting limitation of technique, perhaps in not comparing critically the test result with that of the drop of reagent on its own as instructed in the question.

**(iii)** This was satisfactorily answered. The link between protein and growth was well known and many went on to mention growth or enzyme formation. A minority did, however, say that protein provided energy.

**Question 2**

**(a) (i)** The majority of answers started appropriately, with the specimens being cut or crushed, but a significant number followed this by adding water at this stage, before the introduction of ethanol and so lost the effect of forming the milky emulsion from the prepared solution of fat in ethanol.

**(ii)** Table 2.1 was generally well completed, with full marks being gained. Errors included the transposition of the specimens, or the results. There was also some limitation in observing and expressing more, or less, intense results.

**(b)** Those candidates who approached this problem in the expected way, readily scored most, if not all of the marks that were allocated. This was by outlining a plan to investigate the energy content by burning each specimen in turn under a test-tube containing water, and noting the increase in temperature. Points that scored marks included how the specimen was held, (probably on a mounted needle), complete combustion, and uniform volumes of water. Many candidates merely repeated the ethanol test, quite often adding to it tests for reducing sugar, starch and protein, but they did not achieve much by way of comparison.

**(c)** Very few candidates made the observation that if **W3** and **W4** had the same starch content, as the question stated, any difference in energy content must have been caused by some other factor. In view of the earlier part of this question, this was most likely to be fat. Many candidates knew that fat is a rich source of energy and so, having established that **W4** showed a more positive result in the test recorded in Table 2.1, this indicated that **W4** had the higher energy content. Many answers scored some credit for this section but far fewer presented adequate reasoning for full marks to be awarded.

# BIOLOGY

**Paper 5090/06**
**Alternative to Practical**

## General comments

Candidates continue to lose marks quite unnecessarily by not following the instructions set out on the question paper, for instance by completely omitting labels when instructed to produce a labelled drawing. But the principal weakness on this paper lay in the inability of many candidates to cope with the experimental investigation plans at the ends of **Question 1 (b)** and **Question 3**.

## Comments on specific questions

### Question 1

**(a)** The label lines, **A** and **B**, to a stoma and a guard cell, clearly indicated that the dark surroundings of each stoma were there in addition to the guard cells. Failure to appreciate this caused confusion later in the question. Many candidates readily identified the structures correctly, although a significant minority suggested that they were phloem and xylem. The terms *stoma* and *stomata* were freely interchanged, but inaccurate distinction between singular and plural was not penalised.

**(b) (i) and (ii)** The vast majority knew that carbon dioxide enters a leaf in daylight while oxygen and water vapour emerge. However, many just said 'water'.

**(iii)** Instead of simply stating that stomata are closed in darkness, many chose to explain that photosynthesis would not be taking place, for a variety of reasons, which was not quite the right approach.

**(iv)** The use of cobalt chloride paper was often correctly described although a few were vague about the colour change, from blue to pink. Others described the enclosure of a plant in a bell-jar, or plastic bag, so that water droplets condensed on the inner surface. Restoring anhydrous copper sulfate to blue was accepted as a confirmatory test. The collection of a gas from submerged water-weed, the gas being confirmed as oxygen by its ability to ignite a glowing splint, was also widely described. Some, less familiar with practical work, gave theoretical accounts of transpiration or photosynthesis. It was not acceptable to hold a glowing splint under a leaf and expect it to ignite, or to enclose an animal with a plant.

**(c) (i)** Only rarely were full marks awarded for the calculation of magnification. Measurements were taken in the wrong places, units were omitted or confused, the calculation expression was inverted or the final statement of the answer included units, (mm or cm), or decimal places. A number of candidates measured the two drawings, Fig. 1.2 and 1.3, making no use of Fig. 1.1. Some latitude was allowed for those who attempted the correct procedure, however.

**(ii)** Examiners expected a reference to the feature, well illustrated in the diagrams, that the inner walls of the guard cells, bordering each stoma, were considerably thicker than the remainder of the walls. This was seen only infrequently. Hence the bending of the turgid cells, causing the stomata to open, was not explained. There was frequent mention of the elastic or even 'muscular' walls. It was often stated, confusingly, that water 'entered the cell walls'.

**(iii)** The structures labelled **F** were generally correctly identified as chloroplasts. Iodine solution was the favourite reagent, with methylene blue as an alternative. There were a few doubtful mentions of various indicators. Alcohol and Benedict's solution were also suggested.

**(iv)** Candidates were expected to link the chloroplasts with the ability to carry out photosynthesis in daylight, producing soluble carbohydrate which would lower the water potential of the guard cells, allowing them to absorb water osmotically, and open the stomata. Very few got beyond 'photosynthesis in light' and many said that stomata open because the cells 'need carbon dioxide' or that stomata react to light.

**Question 2**

**(a)** Very few full marks were awarded here, showing that the practicalities of food testing were not well known. A significant number of answers were spoiled by candidates changing of their minds, resulting in crossed ticks which were ambiguous and could not be accepted. Applying heat to the starch test was probably the most basic error. Many who correctly ticked starch as being a carbohydrate then went on to make a cross by reducing sugar.

**(b) (i) and (ii)** The majority of candidates recognised that the test for reducing sugar could give a green colour but relatively few realised that this indicated a low concentration of the sugar. Many said it was a negative result.

**(c)** Many answers to this section referred to the flammability of alcohol, either in decolourising a green leaf or in the ethanol emulsion test. These were not accepted. Examiners were looking for the hazards of contents spurting out during the reducing sugar test, or the test-tube breaking, or the substrate being altered. The positive advantage of even, or gentle, heating might also have been mentioned.

**Question 3**

**(a) (i)** The grid of measurements was nearly always completed, although some entries were in cm rather than mm (as instructed), and some measured the width rather than the length, which produced problems in Table 3.1.

**(ii)** There was space in the middle column of Table 3.1 for the construction of a tally, but this was only rarely seen. Quite frequently, however, there were marks on Fig. 3.1, suggesting an attempt to ensure that each of the beans received the correct attention. Some candidates numbered the beans, others divided them into groups, or crossed through each in turn. Such methods showed reflecting good technique. When the correct figures were used it was relatively straightforward to complete the table and a good series of figures was produced in the 'group' column, making the construction of the frequency diagram fairly simple.

**(iii)** Care was needed in labelling the axes, especially in ensuring that the *x*-axis was horizontal, with the group sizes centrally placed beneath the columns. The columns should have been equally wide. A common weakness was in not clearly delimiting the outline of each ruled block, i.e. the pencil line not standing out from the background grid of graph paper.

**(b)** The vast majority of candidates did not realise that they should have planned to grow seeds from different size groups in uniform conditions, so that the resultant plants could mature. The resultant crop of seeds could then be measured, as the originals were, with the results being analysed and comparisons made. This would show whether the statement was justified. Marks were allocated for selection of seeds, mentioning the uniformity of growing conditions, two of which, such as provision of water, light or nutrients, could have been stated. An idea of the time scale, in months, rather than days, as was often stated, could have been given and the collection of fruit, measurement of seeds and tabulation of results were all points that gained marks. Thus, variation within the same genotype might have been shown. Answers that were based on seeds of the same size being grown in different conditions were also accepted.

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