BIOLOGY

Paper 5090/1
Multiple Choice

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

General

Candidates had no particular difficulties with correctly answering **Questions 1, 2, 6, 7, 8, 10, 17, 20, 22, 25, 28** and **34**. However, candidates should always read the questions carefully before selecting their answer. This was particularly apparent in **Question 9**, **15** and **37**. Further comments on these are given below.

Comments on individual items.

3 Yellow-brown is the negative result with iodine, so the question is asking in which tubes is the starch hydrolysed. 75°C and pH 2.5 will denature salivary amylase.

4 The 'lock' is the active site on the enzyme lipase and the 'key' is the shape of the lipid substrate.

5 So many enzymes are involved in photosynthesis that only exceptional plants can photosynthesise successfully above 50°C. Option **B** shows the rate increasing above 70°C. Options **A** and **C** can be dismissed since they show a high rate even at 0° which then decreases.

9 Reading the wording of the options carefully shows the goblet cell, labelled 3, producing enzymes and the secretory villi and associated part of the cell, labelled 4, producing mucus, rather than the other way round.

11 Mineral ions will only pass from soil water to root hair cells if their concentration in the soil water exceeds that in the cells, in which case water will leave the cells so the plant will dehydrate and die.

12 A complex question, in which candidates must first identify X as a xylem element and Y as a phloem sieve tube. Testing their contents will show no reducing sugar or starch in the xylem or the phloem, since sucrose (a non-reducing sugar) in the phloem will give a negative Benedict's test unless previously hydrolysed and then neutralised.

13 This well known graph continues to present problems to some. When the pressure in the ventricle rises above the pressure in the atrium, the valve between them is forced closed, causing the heart beat at point **B**. The same valve opens again at **D** when the pressure difference is reversed.

14 Urea is synthesised from excess amino acids in the liver and passes into the blood capillaries. Option **A** incorrectly shows oxygen passing out of the blood in the lungs. Option **B** correctly shows CO_2 entering the blood, but also urea, which, in the kidneys, will pass <u>from</u> capillaries.

15 Option **C** does carry oxygenated blood, but it is an artery – the aorta. **D** is the pulmonary vein.

16 The stem refers to yeast. Lactic acid and CO_2 (Option **C**) are produced by anaerobic respiration, but in animal tissue.

18 The seeds absorb O_2 and release CO_2, which is then absorbed by the NaOH, so the overall volume decreases and the bubble moves left towards the tube.

19 The ball and socket joint is at the shoulder. Option **A** was far too popular.

21 A homeostatic system does vary, but changes are opposed and the system remains constant over a period of time. Options **B** and **C** would never restore a system to normal.

23 When the body is shocked, the pupils dilate, glucose release increases, peristalsis and urine production slow or stop.

24 The brain receives pain impulses, but none reach the effector, so the block must be in the motor nerve – Y.

26 The virus must be **A**, because all the others are multicellular.

28 The statement aims to explain the data, which show the feeding effects of the plankton.

29 Option **B** shows too many tertiary consumers, whereas Options **C** and **D** show too many trees.

30 Option **D** was too popular. Nitrogen fixation refers to forming NH_4^+ of NO_3^- from atmospheric nitrogen.

31 Options **A**, **C** and **D** all either kill larvae or prevent eggs from being laid. Only **C** (insecticides) will kill adults as well.

32 Option **D** was popular. Nitrates will probably increase plant growth, but will not produce acid gasses such as SO_2 or SO_3.

33 Meiosis occurs at **A** and produces haploid cells. Options **C** and **D** are mitotic and **B** shows fusion at fertilisation.

35 The statements in options **A** and **B** are correct, but do not answer the question, which refers to bottled milk.

36 Option **C** shows menstruation and option **A** shows the development of the new uterine wall, so **B** will be a fertile time, also indicated by the date – just after the 14^{th} day after menstruation.

37 The question tells candidates that roan cows are the result of a cross between pure red coat and pure white coats, so roan cows must be heterozygous. Hence crossing them with the homozygous dominant must give a 1:1 ratio, and not the 3:1 ratio that is expected from crossing two heterozygotes.

39 Options **A** and **C** do not involve bacteria. **B** shows cloning before the gene is inserted into the bacteria.

40 **A** and **B** are heterozygous and **D** is recessive.

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Paper 5090/02

Theory

General comments

Marks for ***Section A*** were generally not quite as high as has been the case in previous years. Although high marks for each individual question were seen, few candidates managed to sustain the standard throughout the Section. In ***Section B***, many candidates suffered as a result of only a hazy knowledge of continuous and discontinuous variation. Nevertheless, full marks for each of the ***Section B*** questions were by no means uncommon.

Comments on individual questions

Section A

Question 1

(a) There was often confusion between plumule and radicle and several may have thought that the testa is part of the cotyledon, as cotyledon was a reasonably popular inaccurate answer.

(b) (i) This was more often correct than not, but several candidates did not think before answering, and suggested a soluble food store. Fat or oil were rarely seen. When protein was given, which was very rarely, candidates usually scored better in **(iv)**.

(ii) Some referred to how storage food is made (i.e. by photosynthesis) rather than how the food is made available for germination, but they were not penalised if they then went on to talk of the breakdown of stored food in the cotyledon. Though this process is digestion, the word was rarely mentioned.

(iii) Although some pinned their faith on diffusion, and there were a few references to xylem, phloem was commonly correctly mentioned. Only the very best candidates thought to mention the loading and unloading of the phloem by active transport.

(iv) A reference to growth rather than to energy release as a use of carbohydrate was the only relatively common unacceptable answer. It was felt that, although the energy may be used for growth, the use of the carbohydrate was to release the energy.

(c) Only a few spoke of a named gas, with many referring to two gases, or to one gas, usually carbon dioxide, both entering and leaving the plant during the daylight.

Question 2

(a) Several suggested the small intestine for **G** and the kidney (or gall bladder) for **I**. Otherwise, answers were usually correct.

(b) Although there were many good answers, confusions were revealed over where insulin is produced (many thought it was the liver), and whether it is insulin or glucagon that is responsible for the conversion. (In fact, glucagon is not mentioned in the syllabus - and there was often confusion also between glycogen and glucagon). Few thought to explain how insulin from the pancreas is carried to the liver, and many believed insulin to be an enzyme.

(c) It was rare to see answers referring to **F** carrying blood and **H** carrying urine. An appreciable number of candidates wrote answers that related to patients with diabetes rather than to the healthy person mentioned in the question. Perhaps this was the result of misreading the question

leading them to compare a healthy with an unhealthy person. Many omitted to refer to *differences* in the composition of the contents of **F** and **I**.

Question 3

(a) (i) **J** was often identified as the (upper) epidermis, and **K** as unqualified mesophyll.

(b) (i) Many candidates showed water passing from the xylem through the phloem, then squeezing between mesophyll cells rather than entering and leaving them. Some showed water entering the stoma and passing up through the leaf and leaving through the upper cuticle. It was the extreme exception to see a candidate showing accurately in **(ii)** exactly where the water evaporates. The great majority showed the evaporation occurring through the stoma rather than from the surface of a mesophyll cell.

(c) Although this was no problem for the candidates who thought carefully about the process that was occurring, many offered various inaccurate pairings of stomata (**M** and **N** being common).

(d) It was hoped that candidates would have appreciated the rapid increase in transpiration shown in Fig. 3.2a at the time that the atmospheric temperature rises to its highest. Only a few made the link between transpiration and evaporation, and then between evaporation and its cooling effect.

Question 4

(a) (i) Tissue fluid, blood and lymph were not uncommon inaccurate answers, and in **(ii)** several failed to notice, or understand the reference to mineral ions in the question, and suggested glucose and amino acids and oxygen as well as several elements. Perhaps the term 'ion' is not as familiar to some as should be the case. There was a common confusion with plants since many thought that proteins are made from nitrates in the blood.

(b) This was, generally, correct, but there were a few who revealed confusion between the two types of cell, and between the infected and uninfected red cell.

(c) Candidates are to be congratulated on producing such a high standard of answers for this part. All three marking points were regularly and accurately made.

Question 5

This question fell short of the quality of answers offered in other questions in ***Section A***.

(a) **R** was often incorrectly identified as the uterus wall, and there were indications that candidates were confused by the relatively traditional diagram, offering suggestions including 'ovulation' and 'fertilisation'.

(b) This suspicion was reinforced by the very few who managed to add 14 + days to the time of menstruation in order to arrive at the likely time for fertilisation, or to subtract a few days from the time the uterus lining begins to break down in order to arrive at a plausible time for implantation.

(c) High blood pressure and an incompatibility of blood groups were often mentioned, but 'disease' rather than pathogens being able to pass to the fetus was a common inaccuracy.

(d) (i) The data were usually handled competently, though a few forgot that units are important, and others did not supply a 'range' as asked for in the question

(ii) This was intended to test the candidates' knowledge of human reproduction, but, if sex chromosomes were mentioned at all, it was just as likely to be a reference to X rather than Y chromosomes. Many said humans do not hatch, but they did not go on to say that the embryo develops inside the mother thus their answers did not attract credit. Some spoke of sex being determined by genes, or reproduction in reptiles was thought to be asexual, but references to temperature were often accurately made.

Section B

Question 6

(a) There were some almost faultless answers to this section, though there were also many who failed to remember the basic examination advice – to read the question. Many lost sight altogether of *energy* flow through the part of the carbon cycle illustrated and gave answers related to the flow of carbon. Others overlooked the reference on the diagram to 'millions of years' and spoke of wood being buried then, on reclamation, being sawn-up or turned into charcoal. Despite the heaps shown in Fig. 6.1, several spoke only of oil or gas as the fossil fuels. Quite often fossils were mentioned, but the word 'fuels' was omitted.

(b) The major fault here, amongst many excellent answers, was a failure to tie the environmental effect described to a specific activity depicted in Fig. 6.1. Nevertheless, knowledge of the effects of pollution was generally sound.

Question 7

(a) This was by far the most poorly answered question on the paper. Apart from the predictable confusion between the two terms, it was clear that many candidates had no tangible concept of the two forms of variation. One belief was that discontinuous variation is not affected by time or age whereas continuous variation is. From the better candidates, the importance of genes was often appreciated in **(i)** but overlooked in **(ii)**, whereas inheritance was not mentioned as often with reference to discontinuous variation as might have been expected.

(b) (i) A fairly common misconception here was to state that the genes in red blood cells had undergone mutation, but most candidates seemed comfortable with the effect of a gene mutation. Some, however, referred to iron deficiency in the diet.

(ii) It was not uncommon to read that Down's syndrome is the result of a gene mutation, though the fact that chromosomes are involved was often evident in the use of the phrase 'the genes on a chromosome'. Other fairly common errors included reference to one too few chromosomes, or to an extra pair of chromosomes. In both **(i)** and **(ii)** graphs, if given, were rarely sufficiently well annotated to gain credit.

Question 8 Either

(a) Respiration was usually clearly defined, though several spoke of oxygen and had clearly forgotten about anaerobic respiration (and **(b)** did not jog the memory). Reference to the process occurring in cells was often, indeed usually, omitted and many still believe that respiration either 'produces' or 'uses' energy. A few weaker candidates described breathing.

(b) Other than those any already flagged-up in **(a)**, there were no problems here at all.

(c) There were several acceptable processes to choose from, and most selected one that was relevant. Few referred to the process being fermentation, and the importance of a suitable temperature was often overlooked. Some believed that antibiotic production employs anaerobic respiration – not appreciating the need for oxygen to be bubbled into the fermenter (a misleading term, in this context), and others, again not reading the question, wrote about lactic acid build-up in muscles.

Question 8 Or

This question was generally less popular than **8 Either**, but it offered ample opportunity to score well.

(a) Examiners felt that to say that the cell wall lets 'anything' through was a little too imprecise to score, but otherwise candidates confidently spoke of its preventing the cell from bursting, and referred to the part it plays in turgor, cell shape and plant support. Some candidates, confused by the term, described it as semi-permeable, whilst others called it a permeable *membrane* – which was not accepted.

(b) This part was generally less well answered than **(a)**. It was surprising to read so few accurate references to water passing through the membrane by osmosis, or to mineral ions passing by active transport. The importance of water entry to the turgidity of the cell was also overlooked. A significant number of candidates, not reading the question carefully enough, gave an account of the cell membrane in animal cells, though still managed to score some marks where appropriate.

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Paper 5090/03

Practical Test

General comments

Candidates continue to lose marks quite unnecessarily by not following the instructions set out in the questions, especially on this occasion in making the comparisons in **Question 2**.

Comments on specific questions

Question 1

(a) Only a very small percentage of candidates followed the instruction to record the temperatures at alternate minute intervals but, provided that the table was fully completed, they were not seriously penalised. Some instances were noted when the temperature rose somewhere during the experiment! Initial temperatures of the cups, and room temperature were sometimes omitted or left incomplete, without units.

(i) The graph was generally well constructed with the axes accurately labelled, clear plots, good curves or ruled connections and the two curves identified. Mistakes included confusion in the origin of the *y* axis when it was not at zero and drawing a wavy curve, when ruled connections would have been better, if there was no obvious curve of best fit.

(ii) Many answered this by saying how the temperature would fall, rather than by referring to the appearance of the graph. Usually one mark was awarded because they did not go on to say that the graphs would level off or that curve **B** would always be above curve **A**.

(b) (i) The main point to make here was evaporation, preferably followed by reference to latent heat, or that heat was lost by the cup or the water. Heat and temperature were not well distinguished.

(ii) Following on was the effect of sweat glands producing sweat that evaporated, with similar loss of heat. It was frequently stated that heat escaped, or evaporated, from sweat glands or pores.

(iii) Reference might have been made to variable sweating in humans, sweating is under physiological control or is in response to stimuli. Credit was also given for vasodilation or insulation.

(c) Successful suggestions included: the use of two thermometers; constant volumes of water initially in cups; stirring; some standardisation of the wetting of the tissue and, inevitably, replication. It was important to stick to the apparatus that was provided rather than to replace it more or less completely, as many said.

Question 2

Labels were not required in the drawings in ***section (a)***. The standard of drawing as a means of recording observations was almost invariably disappointing, however. Candidates did not notice even the more obvious features and were unable to make effective use of the hand lens. Excessive shading often occurred, sometimes obscuring features that should have been shown. Perhaps these aspects of practical work should receive more attention.

(a) (i) Often the characteristic tripartite structure was not shown and there were very few reasonable attempts to draw any vascular bundles in the pericarp.

(ii) A longitudinal drawing frequently appeared here; equally frequently the whole of the transverse section was repeated – with no extra detail. Of those who correctly drew a portion of the outside

layer hardly anyone presented a fair representation of the rows of bundles and the fact that the inner bundles were larger was not noticed with any degree of accuracy. In fact the pattern of large vessels in the bundles is also visible with a lens such as those provided.

(iii) Candidates were much more comfortable with the exercise of calculating the magnification of a drawing. Nearly everyone showed where they had measured, but sometimes on the wrong drawing! The actual measurement, with units, was usually given where the measurement was taken; ideally this should have been repeated where the calculation was made. Magnifications were well expressed, with only a few answers spoiled by the addition of units, excessive and unrealistic numbers of decimal places or too much rounding up or down.

(b) (i) Structural similarity with **W2**, a slice of cucumber, might simply have been the presence of a pericarp, tripartite structure and presence of vascular bundles. Reference to seeds in both was not realistic.

(ii) Careful reading would have shown that this section referred to the two pericarps alone. Generally the colour was strikingly different, (though often confused or interchanged), as was the relatively much thicker pericarp of the banana. Reference to the outer texture, or distribution of vascular bundles was also acceptable.

(iii) Here, internal differences were needed. Absence of seeds – some said very small seeds – in the banana, as opposed to presence of seeds (or larger seeds) in the cucumber was the favourite point. Seed colour, brown compared with green or white, was accepted. Some described the firmness or relative juiciness of the fruits. Those who attempted to describe the colour often described that of the pericarp. However, in both **(ii)** and **(iii)**, candidates who confined their attention to the correct region scored well.

(c) This came down to a few simple points.

- less ripe and ripe banana, or the same fruit as it matured, being tested
- the iodine test for starch
- difference between the two results
- Benedict's test for reducing sugar
- difference between the results
- attempts to standardise the procedures, e.g. uniformity of amounts of material
- replication.

For candidates who followed the correct approach it was not difficult to make four points.
A significant number applied the tests, or only a single test, to just one sample of banana; others gave purely theoretical accounts of what they thought the changes would be. Another shortcoming was to describe the tests without mentioning the results and hence allowing no conclusion to be drawn.

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Paper 5090/06
Alternative to Practical

General comments

It is pleasing to note that some candidates were awarded full marks for this paper. However, 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. This was noticed in **Question 3** where some candidates merely produced a list of components for **(a) (ii)** or made no attempt to label their drawing of cell **A**.

Comments on specific questions

Question 1

This question was the best discriminator on the paper; it touched on a variety of different physiological processes.

(a) Watering the wilted plant was the usual answer but not many candidates added an acceptable second suggestion. Many unwisely added fertiliser, or some kind of solute such as nitrate. Shading or covering were the expected responses.

(b) There were many references to seeds in this section, either in terms of their germination or as being synonymous with 'seedlings'. This was not penalised, as far as possible.

(i) The time lag of three days was the clue to the seedling having absorbed all the water in its pot with most of the water being lost through transpiration, (and by photosynthesis, according to many!). The cells would then have become flaccid, causing wilting.

(ii) and **(iii)** By contrast the more rapid wilting of seedling E would have been caused by damage to the delicate root hairs during the transplanting process. Overnight a new growth of root hairs would occur, enabling the seedling to absorb water as usual. Damage to the root as a whole was accepted as a partial answer when it was on the right lines but with no mention of root hairs. It was often thought that the watering had been excessive, making the soil waterlogged and preventing active transport.

(iv) The majority of candidates adequately explained the wilting in terms of water potential, realising that the cells of the root, having a higher water potential than the surrounding soil, would suffer a net loss of water by exosmosis. Those who referred to concentrations (of what?) tended to become confused, as did others who referred to pH.

(v) It was generally realised that watering was again the answer for the plant's recovery though fertiliser or other solutes were often mentioned.

(c) Many weaker candidates described an incorrect experiment concerning seed germination or water culture. Others planted seedlings in garden beds, treating them rather indiscriminately.

The points that were expected in a good answer included a range of concentrations of a fertiliser solution applied to seedlings, as uniform as possible, growing in pots, or similar containers, in uniform conditions. A suitable time scale was required before any results could be measured; three days was the minimum that was accepted though longer would have been better. It was surprising how many answers referred to a few hours, or even minutes for the necessary period. Obtaining, recording and presentation of results and experimental replication were also good points.

Numerous candidates applied their range of solutions to seedlings (sometimes the same seedling over a period), and judged the result by the degree of wilting that took place. Others measured the growth with the help of a stopwatch.

A significant minority described experiments with visking tubing, or microscopic observation of cells (from the seedlings) undergoing plasmolysis. These were not acceptable.

Question 2

For those who knew their food tests, marks were readily available. Most of the mistakes that were seen in this section were the result of carelessness and might have been avoided by careful checking.

(i) Because of the rapid response to the addition of iodine solution, the mark for A2 was awarded to those who said the contents would be (blue)black as well as those who described the initial colour of the iodine solution.

(ii) The conclusions in table 2.1 were sometimes spoiled by referring to unqualified 'sugar' or non-reducing sugar. Either reducing sugar or glucose was accepted. A few referred to the presence of iodine in A2.

(iii) Table 2.2 was generally interpreted correctly though a few said that the cloudiness in B2 indicated the presence of carbon dioxide.

(iv) This was the discriminating section of the question. Reference to the sample being cut up, so increasing the surface area for reaction, or allowing cell contents to escape, was the point most often made. A second mark was for realising that the cloudiness would have occurred prematurely or for saying that the fat would normally be dissolved in ethanol before the addition of water during the ethanol emulsion test.

Question 3

(a) (i) Most candidates identified the tissue in Fig. 3.1 as blood, though a few referred to a blood cell or cells. There were also a number of unrealistic answers like bone, epithelium, liver or blood vessel.

(ii) Red and white blood cells were usually correctly labelled. Platelets were noted by many, but sometimes thought to be bacteria or waste products. Plasma was labelled less often, but sometimes called tissue fluid. The name of a specific leucocyte was accepted once, in place of the general label, but the main components already mentioned were required for the marks.

(iii) The quality of the drawing was very variable. Messy and excessive shading often obscured detail such as the shape of the nucleus. The characteristic shape of the nucleus was often well represented but sometimes completely unrealistic or like a diagram of a generalised animal cell.

A significant proportion did not label their drawing, a few labelled a cell wall but generally cytoplasm, cell membrane and nucleus were picked out.

(iv) The requirement to show on the drawing where the measurement was taken was completed in most cases. This was generally, quite appropriately, the longest distance across the drawing. The actual measurement, with units, was usually given where the measurement was taken; ideally this should have been repeated where the calculation was made. Not everyone allowed for the x750 enlargement of Fig. 3.1, so losing a mark. Magnifications were well expressed, with only a few answers spoiled by the addition of units, excessive and unrealistic numbers of decimal places or too much rounding up or down. When the x750 was taken into account it was not realistic to add decimal places to a figure of the order of x3000 or more. Answers like 'x 10887.1' were seen!

(b) The simple answer, transport of oxygen, was all that was required here. Some answers were spoiled by over-elaboration, like saying that the purpose was transport of oxyhaemoglobin, or transport of an additional substance as well as oxygen. A few said that blood was transported, others that the function was the production of haemoglobin. However, on the whole this was an easy mark.