

BIOLOGY

Paper 5090/12
Multiple Choice

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

General comments

This paper discriminated well, producing a wide distribution of marks, with many candidates achieving high scores on a paper which contained some challenging questions.

Comments on specific questions

Question 3

Option **A** was a very strong distractor in this question. Candidates may have read the graph as a change in mass over time and so looked for a concentration that produced no change.

Question 8

Option **A** proved a popular distractor, with many candidates seeming to believe that a five-year-old boy will need more energy in the diet than an adult, active woman. This may reflect some misconceptions about the dietary requirements of children.

Question 12

Many candidates found this question challenging. It is clear that the mechanism for transpiration is not well understood.

Question 13

Many candidates found this question challenging and option **C** was the most popular answer, showing that they understood that urea is removed from the blood in the kidneys and that the concentration of urea in the blood would therefore be higher in the renal artery than in the renal vein. However, the concentration in the hepatic vein will be higher as the liver produces urea.

Question 16

This question proved to be difficult with many candidates opting for **D**. The equations for anaerobic respiration are perhaps not as well-known as those for aerobic respiration.

Question 19

Many candidates found this question challenging and all the options available were selected by significant numbers of candidates. This may show that candidates do not have a clear understanding of the relative sizes of the molecules concerned, or perhaps of the way in which dialysis works, or perhaps that insulin is a protein.

Question 39

This is a difficult question and it is encouraging to see that a good proportion of candidates correctly selected option **C**. From the left-hand side of the tree, it is clear that night-blindness is recessive, and therefore that individuals 5 and 6 must be heterozygous for the condition to produce individual 8. The probability of a night-blind child must therefore be 1 in 4 (0.25) and most candidates selected **B** as their answer, ignoring the gender of the child. When the chance of a male child is also considered (1 in 2, or 0.5) the outcome is 1 in 8 (Option **C**).

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Paper 5090/22
Theory

Key messages

Examiners noted that some candidates were able to respond to information presented in unfamiliar contexts. There is evidence again this session however that candidates sometimes did not understand the different requirements of a question requiring a description from one requiring an explanation. Centres are reminded that candidates should be guided in the length of each of their responses by the number of lines provided and by the number of marks available. A number of questions required the candidate to study carefully and to understand clearly a significant amount of information provided by the question. Examiners felt that a proportion of candidates may not have allocated sufficient time to this task prior to responding. Centres are reminded that credit will not be awarded for information re-stated by the candidate that was made available in the wording of the question.

General comments

Some very competent work was seen from the more highly attaining candidates. The structure and function of the cells in **Question 6** were well known. The comparison between the processes of cell division in **Question 5** and the provision of oxygen to a muscle cell in **Question 7** were less well known. Questions requiring tailoring and application of knowledge to a previously unseen context continued to provide more challenge for even some highly attaining candidates. A greater degree of specificity was required in some responses (e.g. reference to named chemicals rather than to 'nutrients' in **Questions 2(c)(ii), 4(b)** and **9(b)**).

Comments on specific questions

Section A

Question 1

- (a) Generally well answered, with a large majority of candidates scoring at least two of the available three marks and often all three. A correct size comparison was sometimes not given and a significant number of candidates incorrectly referred to the 'style' as the 'pollen tube'.
- (b) Most candidates made correct reference to 'cross' pollination. Common incorrect responses included reference to 'wind' or 'self' pollination. Reference to 'variation' was more common than reference to this variation being 'genetic'.
- (c) (i) The majority of candidates correctly identified the required genotypes. Some candidates confused the pin and thrum genotypes, whilst others incorrectly identified thrum as homozygous dominant.
(ii) More able candidates attained all three available marks without difficulty. Some candidates inverted the gametes for pin and thrum whilst others specified incorrect gametes. Very few candidates who gave incorrect offspring genotypes went on to provide a correct pin: thrum ratio for the genotypes that they had shown.

Question 2

- (a) (i) Most candidates correctly identified the 'chloroplast' as being the part of a plant cell where photosynthesis takes place. Reference to 'chlorophyll' was frequently seen but was not accepted due to its chemical nature rather than being a part of a plant cell. Some candidates incorrectly

named tissues or organs such as 'spongy mesophyll', 'palisade mesophyll' or 'leaf'. The required knowledge of sequential levels of organisation appeared to challenge many candidates here.

- (ii) Generally well answered with the majority of candidates scoring both available marks. Correct word equations and those using symbols were frequently seen. A common error was the inclusion of 'water' on both sides of the equation. Unbalanced equations and the equation for aerobic respiration were also quite commonly seen.
- (b) Very well answered with most candidates correctly identifying both the correct colour and the reason for this. Suggestion of the presence of 'chloroplasts' was not accepted as candidates should understand that these are not contained by bacteria as part of their cellular structure.
- (c) (i) Most candidates were familiar with the correct terminology of either 'genetic engineering' or 'genetic modification'. Either term was given credit.
(ii) The application of information provided in the question to the growth of crop plants provided challenge for some candidates. Many correctly identified that 'absorption of more light' would lead to 'increased photosynthesis'. Some candidates were not able to reach the further conclusion that there would be 'faster growth' or a 'higher yield'. Centres are reminded that the product of photosynthesis is specifically carbohydrate in nature and that reference instead to either 'food' or 'nutrient' production will not be credited.

Question 3

- (a) (i) The majority of candidates correctly identified the type of pathogen that causes syphilis as a 'bacterium'. Some candidates more specifically identified the bacterium by name. The most common error was to identify the type of pathogen as a 'virus'.
(ii) A large number of candidates correctly named the component of blood as the 'white blood cells' or 'lymphocytes'. The abbreviation 'WBC' was not accepted in place of a correctly named component. Commonly seen errors included reference to 'phagocytes' or to 'erythrocytes'.
(iii) Fewer candidates gained credit here than in the earlier parts of the question. Common errors included reference to 'blood' or to named types of blood cell.
- (b) (i) Many candidates did not make the required link to either 'antibody production' or to the action of an 'immune response'. Reference instead was common to either the spread of bacteria or to the time taken for symptoms to appear.
(ii) This question identified those candidates who were able to process the information provided. Candidates who did so, more often correctly identified the conclusion than they did the validity of the test. Some candidates did not respond by using **only** the words 'yes' or 'no' as instructed by the question.
(iii) The majority of candidates correctly identified 'antibiotics' or a correctly named antibiotic as the type of drug used to treat primary stage syphilis. The most common incorrect answers related to the use of 'painkillers' or of a named painkiller (e.g. paracetamol).
- (c) (i) The calculation proved challenging for many candidates. Relatively few scored both available marks, whilst others secured one mark for inclusion of an element of correct working out in their response.
(ii) A wide range of suggestions were accepted by Examiners and this enabled many candidates to gain credit for their response. Quite common however were responses that made incorrect reference to the frequency of sexual activity.
(iii) This was well answered. A large majority of candidates scored either one or both available marks. Some candidates did not mention 'condom' by name but referred instead to the use of 'protection' during sexual intercourse which was not sufficient to gain credit. Many candidates made incorrect reference to 'not sharing needles' which indicated apparent confusion with prevention strategies for HIV/AIDS.

Question 4

- (a) (i) Correctly answered by most candidates. A small number of candidates gave answers based on a 'use' (i.e. for growth) of protein rather than a 'source' of protein in the diet.
- (ii) This was well answered with many candidates gaining full credit. The exception was candidates who linked the action of a named protease enzyme to an incorrect location in the alimentary canal.
- (iii) Answered correctly by almost all candidates.
- (b) This part of the question presented more of a challenge to most candidates. Many could identify from the diagrams that there had been a reduction in either the size of the villi or the surface area. Many were not then able to specify that less absorption of a named product would occur by either 'diffusion' or 'active transport'. Instead, non-specific reference to the absorption of 'nutrients' was common and was not sufficient to gain credit. A small proportion of candidates incorrectly wrote about the effect of smoking and a reduction in the surface area of alveoli for gas exchange.

Question 5

More able candidates gained full credit. Some candidates appeared to have insufficient detailed knowledge of the types of cell division to process the information provided. Centres are encouraged to give candidates experience of representing information in a variety of formats in order to prepare them for questions such as this.

Section B

Question 6

Most candidates gave full and correct answers that gained credit in both **parts (a) and (b)**. The abbreviation 'RBC' was not accepted in place of correctly naming the 'red blood cell'. Centres are encouraged to guide candidates towards linking each structural adaptation of a specialised cell to a functional role. A small number of candidates made incorrect reference in **(a)** to active transport of water molecules.

Question 7

- (a) Almost all candidates correctly identified the type of respiration as 'aerobic'.
- (b) Examiners accepted responses that referred to either the advantages of aerobic respiration or the disadvantages of anaerobic respiration. This allowed many candidates to gain credit for correct reference to 'lactic acid' and to 'oxygen debt'. There were some references to incorrect products of anaerobic respiration in muscle cells (e.g. carbon dioxide). Correct reference to 'fatigue' was common, however many candidates did not then relate their answer specifically to the benefit of a person running a race. Centres are again reminded that credit will **not** be given for any indication that energy is 'produced' in the process of respiration.
- (c) This was moderately well answered. The question required reference to passage of air or oxygen from the exterior into the lung, followed by the passage of oxygen from the lung to the muscle cell. More able candidates gained full credit. Some candidates did not refer to any aspect of passage into the lung and gave answers solely based upon that from the lung to the muscle cell.

Section C

Question 8

This question was answered by the majority of candidates and when answered it often enabled candidates to gain significant credit.

- (a) Those candidates that were able to correctly identify 'deforestation' as a human activity and were then able to go on to describe the possible harmful effects of this, gained significant credit. Some responses did not refer specifically to the rainforest – with some candidates referring instead to melting of polar ice. References to 'acid rain' and its effects, and to the specific effects of human activity on the local human population of the rainforest, were less frequently seen. Some

candidates made incorrect reference to the ozone layer and others provided lengthy but irrelevant answers based upon pollution of water (e.g. eutrophication) or pollution in general.

- (b) This was well answered by some candidates. Incorrect reference to the Sun as the 'producer' was seen. A small number of candidates incorrectly stated the trophic level of plants to be 'primary consumers'. This often led to a contradiction (and hence no credit) when they later correctly referred to animals eating the plants as herbivores. Reference to non-cyclical energy flow was not common, however candidates did often appreciate the loss of energy through successive levels of a food chain.

Question 9

This question was answered by fewer candidates and responses were usually of a lower standard than those seen for **Question 8**.

- (a) This was quite well answered with most candidates scoring between half and full credit. Some candidates incorrectly implied that the zygote is multicellular. There was sometimes confusion in candidate responses when using the terms 'zygote' and 'embryo'. Many candidates gave a full and correct account of the cell division by mitosis of the zygote to form an embryo or blastocyst. Cell division was sometimes incorrectly referred to as being by 'meiosis'. Whilst most spelling errors in candidate responses are overlooked by Examiners, **only** the correct spelling of 'mitosis' and 'meiosis' will gain credit.
- (b) This part was less well answered. Candidates often did not make refer to specific named chemicals crossing the placenta or to their subsequent use. For example transfer of 'oxygen' and 'glucose' was often referenced but without a statement regarding their subsequent use in 'respiration'. This requirement was stated clearly in the question. Reference to 'nutrients' alone was insufficient to gain credit. Centres are reminded that structural details of the placenta are **not** required. Candidates are though expected to understand the transfer of named substances between the blood in two locations without the exchange of blood itself. The removal of named waste substances (e.g. 'urea' and/or 'carbon dioxide') appeared to be well known by most candidates.

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Paper 5090/62
Alternative to Practical

Key messages

Candidates should read questions carefully, ensure that they follow any given instructions and answer the questions fully and as set.

Candidates should be advised to read all the information provided about investigations carefully and to try to visualise what is actually happening.

Candidates should be familiar with the names and usage of standard laboratory equipment.

The demands of command words in questions should be understood e.g. describe, explain.

Controlling of variables in investigations should be understood.

The correct units should be included in appropriate answers.

General comments

Candidates appeared to have adequate time to complete the paper.

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.

Scientific terms such as mass or volume are becoming more widely and correctly used, rather than general words such as 'amount'.

The drawing of the graph was generally well done.

Comments on specific questions

Question 1

- (a) (i) The vast majority of candidates entered six values in the table and entered rounded values for the times taken in 3% hydrogen peroxide solution as instructed. Others did not round the values and therefore could not be credited, either because they had not read the instructions carefully or because they did not know what rounding meant. The three means were usually correctly calculated but a few candidates did not know how to calculate a mean and simply added the three values for each concentration together.
- (ii) Many candidates were able to identify two safety precautions that should be taken, having been told that hydrogen peroxide is a harmful or irritating substance. Answers in terms of either wearing protective clothing e.g. goggles, laboratory coats or gloves, or treating the substance with caution e.g. using test-tube holders, using forceps to place the potato discs in the hydrogen peroxide or washing off any spilt solution, were creditworthy. No credit could be given to answers related to hydrogen peroxide being flammable or poisonous as the only information given was that it was harmful and irritating.

- (iii) This question tested the familiarity of the candidates with the use of standard laboratory apparatus. Many candidates correctly identified that a measuring cylinder or syringe could be used for measuring 15 cm³ of liquid. Beakers, conical flasks, droppers and pipettes, unless graduated, cannot be used to measure a precise volume. Burettes would not normally be used for measuring volumes in an investigation of this nature.
- (iv) The vast majority of candidates interpreted the data correctly and stated that the time taken for the discs to float decreased with increased concentration of hydrogen peroxide. Even though they had correctly entered values in the table, there were some candidates who stated incorrectly that the time taken for the discs to float increased.
- (v) A mean result obtained from the results of several repetitions of the same investigation is far more reliable than the results of a single investigation. Thus explanations in terms of repeating the investigation and obtaining mean (average) results were expected here but not seen very frequently. There were many answers that did not answer the question but were instead about improving the method of the investigation e.g. measuring volumes more accurately or extending the investigation e.g. to test the effect on the potato of more concentrations of hydrogen peroxide.
- (vi) This proved a challenging question for many candidates, possibly because they had not actually carried out the investigation. However, a full description of the method used had been given. Candidates should be advised to read all information provided carefully and to try to visualise what is actually happening. This will help them to appreciate where errors might occur and how they might affect the outcomes.

In this method the only variable should have been the concentration of hydrogen peroxide. Introducing other variables into the investigation were sources of error and would have meant that the results would not have been valid. These sources of error included using potato discs of different sizes or masses; they should all have been the same at 1 mm thick. There were candidates who suggested this but not many who went on to explain the effect of the error in terms of varying enzyme content or the number of bubbles needed to cause floating. Some candidates correctly suggested that discs from different parts of a tuber or different tubers might not have the same enzyme content.

Accurately measuring the time taken for the discs to float was also a possible source of error, especially because the end point was not always clear. Using a stopwatch or digital timer as suggested by some candidates could not be credited because it was not a source of error but a means of trying to avoid error.

A few candidates correctly identified that the temperature not being controlled in this investigation was a possible source of error as enzyme action varies with temperature. Also, that adding the discs one by one to the same hydrogen peroxide may have changed its concentration as some was broken down and water produced as a by-product.

Rounding the times to the nearest second was done for all the discs and therefore was not a source of error.

Many answers referred vaguely to human error without enlarging on what the human error may have been e.g. not cutting discs precisely. Also frequently mentioned was parallax error that could not be credited as no reading off scales was done in this investigation.

- (vii) There were two stages in a full explanation and some candidates did well and included both. The discs did not float in water because no bubbles of oxygen were produced. Why was no oxygen produced? Because there was no hydrogen peroxide present and catalase does not act on water. Both a reference to the lack of bubbles and the reason for that lack were needed in the answer.

Too many candidates took this question out of the context of the investigation in **Question 1** and linked it to different experiments they may have carried out involving potatoes and osmosis, answering in terms of water entering the discs. These answers could not be credited.

- (b) This question asked for a description of a method that could be used to show that the bubbles in this investigation were the result of enzyme action. Answers given by some candidates that simply described how enzymes work could not be credited.

Creditworthy answers developed the method already described so that the only variable was that the enzyme in some discs had been denatured by boiling and therefore had been made inactive while the quantities of potato and hydrogen peroxide were controlled. If the discs with denatured enzyme did not float, that would be proof that active enzyme is needed to produce bubbles.

A few candidates referred to the 'killing' of enzymes by boiling which could not be credited while others erroneously thought that a temperature of 40 °C would denature the enzyme.

Neither repeating the investigation already described nor describing testing potato for the presence of protein (because enzymes are proteins) answered the question and therefore could not be credited.

- (c) (i) Some excellent graphs were drawn by many candidates, with the number of potato discs plotted on the x-axis as that was the independent variable in this investigation. The dependent variable, that which was being measured i.e. the time in seconds taken to produce 5 cm³ of oxygen, was plotted on the y-axis. Both axes were fully-labelled with what was being plotted and units and scales were chosen to make the best use of the grid provided. The scales were linear necessitating values at the origin of the axes; some candidates omitted these. The points on the vast majority of graphs were plotted correctly and joined with good, smooth curves. There were those who ignored the instruction given and joined their points with ruled lines that could not be credited. Lines extrapolated beyond the given plotted points were not creditworthy either.

The question asked for a graph to be plotted. It is good to be able to report that no attempts at drawing bar charts were seen.

- (ii) Many candidates correctly described the increasing rate of reaction as the enzyme concentration increased. Some confused rate of reaction with the time taken and incorrectly stated that it decreased. Very few descriptions of the rate of reaction then becoming constant, even when the enzyme concentration was increased, were seen.
- (iii) There were only a few good explanations given for the shape of the specified part of graph, i.e. why it had plateaued. Many candidates answered in terms of the reaction stopping although, in fact, it was continuing at the same rate. The enzyme had not been used up, as some suggested, as more had been added in the potato disc. Although more enzyme had been provided there was something preventing an increased rate. There was insufficient hydrogen peroxide available; hydrogen peroxide was the limiting factor.

Some correctly referred to the maximum rate of enzyme action having been reached but those who referred to optimum rate could not be credited.

Question 2

- (a) This is a paper based on practical skills, one of which is making good observations and trying to account for what has been seen. Candidates were required to describe any changes that had occurred in the two strips of plant tissue and to suggest what had happened to bring them about.

There were some good descriptions given, after observing that both strips had become curved but in different directions. Some correctly observed that the epidermis in both had remained unchanged so that it was changes in the length of the inner tissue that must have caused the curvature. Many correctly related these changes to osmosis having taken place, resulting in water entering the inner tissue of A and leaving the inner tissue of B.

Some correctly described the movement of water but did not mention osmosis.

A frequent misunderstanding was that sugar solution had either entered or left B.

- (b) (i) Most candidates followed the instruction to make a large drawing but some small drawings were seen. The vast majority of the drawings were of the pollen grain and pollen tube as shown in the photograph as asked for. However, a few candidates drew only the pollen grain or the pollen tube. Good drawings were made with a sharp pencil, with clear continuous lines and no shading of any sort. The pollen tube drawn was curved and of more or less the same width throughout its length. A common omission was the drawing of the two nuclei.

- (ii) The measuring of the pollen tube was generally well done but a few candidates were confused about units, recording measurements in centimetres, or even metres, although mm was given on the answer line.

Candidates were told that the magnification of the pollen tube in the photo was x600. The measurement recorded by the candidate divided by 600 resulted in the actual length of the pollen tube and many candidates did this, expressing their answer complete with correct units. A few calculated the size correctly but omitted units. Common errors included dividing the measurement of their drawing by 600 or dividing 600 by the length they had recorded. Candidates should check their answers by thinking of the actual size of pollen grains they have seen; this would help them to recognise that answers e.g. of 500 mm could not possibly be correct so their working must have been incorrect.

Question 3

- (a) Many candidates explained well that they would draw a line to complete the outline of the leaf and then count how many squares were missing from the area eaten by the leaf-cutter bee. As it was only that area that was required, there was no need to calculate the area of the whole leaf as some suggested.
- (b) The number of squares counted for the given area multiplied by 16, the given area of each square, resulted in the area of the missing part and many candidates did this, expressing their answers with the correct units, mm². A few omitted units or incorrectly used mm, a unit of linear measurement or mm³, a unit of volume, not area.