BIOLOGY (US)

> **Paper 0438/11**
>
> **Multiple Choice**

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

General Comments

There was a good spread of marks on this paper, with no question proving so easy that it failed to make a significant contribution to the process of discriminating between candidates of differing ability. There were a few questions, however, at the other end of the facility range that posed problems, particularly so for the weaker candidates.

Comments on Specific Questions

Question 3

No candidate believed that the animal was not spotted in appearance. In making that judgement, they showed that they were fully competent when using an identification key.

Question 5

It is unlikely that a significant number of the candidates really believe that all cells in the roots of plants contain chloroplasts, as the results suggest. It is much more likely that they did not read the question carefully and failed to appreciate the significance of the word 'all' being emboldened.

Question 6

In theory papers, candidates regularly offer suggestions on the functions of root hairs that are wide of the mark. Some of those suggestions were included in this question but, when presented alongside the correct function, the majority of candidates were able to ignore these distractors.

Question 7

The spread of responses seen to this question indicates that candidates were unaware that xylem vessels are hollow tubes with their cytoplasm removed.

Question 13

Candidates had a sound grasp of the structure of food molecules.

Question 17

This was a testing question as it required candidates first to know the individual functions of xylem and phloem and then apply that knowledge to the described scenario.

Question 22

With a significant proportion of the candidates selecting option **C**, it would appear that many candidates did not appreciate the fact that the question was asking about liver function. The liver is the site of deamination of amino acids, and thus urea will be leaving the liver. Glucose will be removed from the blood for storage.

Question 30

A large proportion of candidates failed to realise that human sperm cells contain only one sex chromosome and thus selected **A** rather than **B** as their answer.

Question 35

Curiously, by far the majority felt that the loss of water to the atmosphere by animals is the result of transpiration. Much in the same way that the term 'excretion' is often used in a way that is biologically inaccurate, so, too, may be the word 'transpiration'. Examination questions test the *biological* knowledge that is required by the syllabus.

BIOLOGY (US)

| Paper 0438/21 |
| Core Theory |

Key Messages

Candidates should revise the syllabus thoroughly so that they are prepared to answer questions on any section. It is important that candidates read instructions carefully and study any diagrams fully before writing their answers. Candidates would also find it helpful to look at the credit allowance for each part of a question as this can be a guide to how many distinct points are required.

General Comments

Overall candidates struggled to answer much of this paper and many sections were left unanswered. The candidates did not appear to have been short of time, but rather that there were sections of the syllabus that they did not know.

Comments on Specific Questions

Question 1

(a) Most candidates could state the two characteristics of life, but the definition of reproduction caused more problems.

(b) Those candidates who described structural differences mostly did so correctly and were awarded credit. However, those who attempted to differentiate in terms of habitat or the ability to swim were less successful.

Question 2

(a) The diagram appeared to be unfamiliar to most candidates. Many gave names as if they were identifying structures in a cell. The structure most frequently identified correctly was the palisade / mesophyll layer.

(b)(i) The more able candidates could interpret the graph and state the differences for the two selected months. It would have been helpful if they had also used the figures in a constructive way, for example, "in May, there is four times as much carbohydrate in the leaves as in the tubers". An explanation for the differences proved difficult for candidates of all abilities. Few mentioned the fact that leaves would be photosynthesising to produce the carbohydrate, or that the carbohydrate would later be stored in the tubers. Many weaker candidates thought that the tubers would start photosynthesising to account for their increased carbohydrate level in September.

(ii) The fact that carbohydrate was stored as starch was not well known. Less able candidates performed better here than the ones who were more proficient overall. Many of the more able candidates gave glucose as their answer.

(iii) The most commonly given responses were respiration, energy release and growth. A considerable number gave respiration and energy release as two separate uses, but this could only gain credit once. Few referred to the possible uses of the released energy such as active transport, translocation or the synthesis of new chemicals.

Question 3

(a) About half the candidates across the whole ability range answered this correctly.

(b)(i) Very few candidates gave the correct answer. They appeared not to have read the information in the central box and so gave answers using the names of different neurones involved in a reflex action.

(ii) Most candidates gained credit here, with the most common answers centred round the need to keep the eye surface moist or to remove dust particles.

(c)(i) The definition of *drug* was not well known. Those who attempted to explain in their own words gave muddled and inaccurate statements.

(ii) Although many candidates knew that heroin is a depressant drug, credit was often lost for giving statements such as "reaction times are lower".

(iii) A wide variety of problems are caused by the use of heroin, and so most candidates managed to gain at least partial credit for this section.

(d) The function of an antibiotic drug needs more emphasis. Many candidates thought that an antibiotic could be used to kill any type of micro-organism. Phrases such as "fight bacteria" or "defend the body" are unscientific and should be avoided. Many weaker candidates thought that antibiotics induced the white blood cells to release antibodies, or that they reduced pain.

Question 4

(a)(i) There were two common incorrect answers seen. One was to place a Y chromosome in the ovum and an X chromosome in the sperm. The other was to make both gametes diploid, each with two sex chromosomes.

(ii) The majority of candidates responded with embryo or fetus. Zygote appeared infrequently.

(b) This question was the least well answered on the paper. Most candidates gave a circular argument such as "equal numbers of male and female babies are born as there is a 50% chance of a boy and a 50% chance of a girl". Very few candidates referred to the sex chromosomes or attempted to explain random fertilisation. No Punnett squares were seen.

(c)(i) This was fairly well answered. A few stated that the alleles would be "equal", which was not precise enough to be awarded credit.

(ii) Almost all correctly stated blood group, and slightly fewer also gave sex.

Question 5

(a) This was answered well by most. There was some confusion between the site where pollen landed and the site of fertilisation.

(b)(i) Some candidates gained partial credit. This is possibly because they had not realised that a word from the list could be used more than once.

(ii) This posed no problem for more able candidates. Those less able either did not understand the instructions or answered with a ratio that they had met previously in genetics.

Question 6

(a)(i), (ii) Many knew that bile is produced by the liver and stored in the gall bladder. Some candidates thought that the functions of these organs were reversed.

(iii) The role of bile in emulsifying fats is an area in which candidates of all abilities struggle. Common misconceptions are that bile contains enzymes to digest fat, that blockage of the bile duct means that fats are not digested and that people then become obese, and that fat causes an intestinal

blockage leading to constipation. It should be noted that it is insufficient for a candidate to say "bile breaks down fats" as this could infer that a chemical breakdown occurs. It is important for candidates to realise that the action of bile on fats is a physical one.

(b)(i) Most correctly identified the stomach and the small intestine.

(ii) This was a challenging question for all candidates. There was a tendency to give answers that were too vague for credit such as "the pH is not right" instead of "the pH is too low / too acidic".

(c)(i) Very few candidates understood the function of the colon in the absorption of water. The function of the colon needs to be reinforced.

(ii),(iii) Some candidates correctly named fibre or roughage as being the necessary component. Many candidates stated macro-nutrient. Few could state a disorder that might arise from the lack of fibre. Those who were awarded credit all gave constipation as the disorder. No one referred to cancer or diverticulitis.

Question 7

(a)(i) Almost all answered this correctly.

(ii) Most candidates completed the boxes correctly, although some weaker candidates reversed the order of the food chain

(b) Answers for which credit was not awarded referred to stopping the crops being eaten by animals rather than by insects. Most of the rest gave an acceptable reason, although in some cases the wording was muddled.

(c)(i) Many were credited for stating that the trout had eaten insects affected by insecticide. The majority thought that the algae would be covered in insecticide and that the insects ate the algae. A few lost credit by referring to the trout eating water fleas; as water fleas are crustaceans, they would be unaffected by the insecticide. A large number of responses centred around the gills of the trout becoming "clogged with insecticide" or stated that the trout were directly poisoned by the presence of insecticide in the water.

(ii) Most candidates who attempted the question appeared to have misread it and simply explained why the number of kingfishers decreased.

(d) The most able candidates could answer this with a coherent explanation. The majority thought that the fish were poisoned by the fertiliser. No candidates used the term "eutrophication".

Question 8

(a)(i) Weaker candidates struggled to answer this correctly, with many giving cattle, some type of arthropod or a detritivore as being responsible for the decay. Decomposer was the most frequently given correct answer, followed by bacteria and fungi.

(ii) Some candidates gave water and temperature, with relatively few referring to the surrounding pH or the oxygen concentration. Less able candidates incorrectly stated that wind, the amount of light or the amount of dead grass present would affect the rate of decay.

(b)(i) The calculation posed little problem for the more able candidates, although many others were confused and used the available figures in a variety of ways. Those who just wrote down an answer with no calculation shown may have missed gaining credit for a procedure that was correct.

(ii) Very few candidates gained any credit for their answer. Some candidates seemed to think that the energy would be recycled and could be used in photosynthesis.

(c) There were many imprecise and incorrect answers given here by candidates of all abilities. Good candidates were able to state global warming (or give a description.) Imprecise answers gave "pollution" or "it smells" whilst inaccurate ones said that methane destroys the ozone layer or that it causes acid rain.

(d) Most candidates managed to give at least one harmful effect of deforestation. The less able candidates described what occurs in deforestation rather than its effects.

Question 9

(a) Many candidates knew that cell **D** transports oxygen. Fewer could identify cell **B** with the removal of bacteria from the blood. The fact that urea is transported in the plasma needs to be emphasised, as does the role of the platelets in blood clotting. Alternatively it could be that the platelets and the plasma were not identified correctly from the diagram.

(b) Some able candidates answered correctly, but many others who attempted a response gave the name of a blood cell.

(c) This was well answered with calcium being the mineral most frequently suggested mineral. Weaker candidates suggested iron.

BIOLOGY

> **Paper 0438/31**
>
> **Extended Theory**

Key Messages

- Candidates should be encouraged to answer all the questions and to use the credit allocation as a guide to the number of points required. Ideally the paper should be finished with sufficient time to check answers for clarity or to add points that may have been omitted. Candidates should also be encouraged to use this time to look for any careless errors such as giving the labels for a diagram in the wrong order or misspelling a key term.

- Candidates should make sure that the points that they make are sufficiently different from each other. Some candidates gave very similar points that were likely to be accepted by the Examiners as alternatives rather than as separate creditworthy points.

- The command terms 'describe' and 'explain' are often confused. When questions ask for descriptions of data in the form of tables or graphs, any explanations of the data, however accurate, are not awarded any credit. Occasionally it is necessary to describe some or all of the data before offering interpretations in response to the command word 'explain'. However, most of such an answer should deal with the relevant biological principle(s), not a description of the data.

- Candidates should use information in graphs and tables to support their answers where appropriate. Data must always be quoted with the relevant units.

- Candidates need to be encouraged to use the correct scientific vocabulary. Vague terms rarely gain credit and hence words such as 'affect', 'change' and 'differ' without any further detail should be avoided. Better answers that gain credit use words such as stimulate, increase and decrease.

- Candidates should be encouraged to write their extended responses in continuous prose. Lists and phrases that show no links to appropriate scientific concepts rarely gain credit.

- Answers that are continued or rewritten in blank spaces or on additional paper must be clearly numbered. If an answer is crossed out and rewritten, candidates should always indicate where the rewritten answer is to be found.

- Candidates should avoid writing initial answers in pencil and then overwriting in pen. Any pencil markings that were missed during this process are unlikely to be sufficiently clear to gain credit. Candidates should also not use thick felt tip pens as the ink can affect the clarity of the answer overleaf. Incorrect answers must be clearly crossed out and the correct answer should be written alongside or just above the first answer.

General Comments

The best answered questions on the paper were **Questions 3(c)(i)**, **4(a)(i)**, **4(d)** and **5(c)**. Candidates found the last four parts of **Question 6** on decomposition, enzyme activity and the nitrogen cycle much more challenging than the rest of the paper.

There were several questions in this paper that required knowledge of biological processes. It was clear from the answers that many candidates were unsure of the stages of these processes and the sequence in which they occur. Processes from this paper are the entry and conduction of water in a plant (**Question 4**) and the nitrogen cycle (**Question 6**).

There was evidence that some candidates had not checked their answers carefully. For example, in **Question 5(d)** some wrote 'binary fusion', which is more likely to have been a slip rather than a genuine error.

On many scripts the last few parts of **Question 6** were left unanswered. It was not clear whether this indicated that candidates were short of time or whether they did not have the knowledge to answer these questions.

Comments on Specific Questions

Question 1

(a)	Most candidates showed a good understanding of the functions of the nucleus and the cell membrane. Answers referring to the nucleus as 'the brain of the cell' that 'tells the cell what to do' were not awarded credit as they were considered too superficial for this level. These answers missed the central idea of control. Answers suggesting that the nucleus is 'where reactions happen' were not given credit either as reactions also occur in the cytoplasm. Answers describing the cell membrane functions as providing protection, shape and support were not credited, but answers involving keeping the cell contents inside or keeping the cytoplasm intact were awarded credit.

(b)	Any definition of the term *tissue* should include the ideas of a group of cells in the same place doing the *same* function or being of the *same* type. The word 'similar' instead of 'same' is not precise enough for this definition.

(c)	Confusion frequently occurred between the functions of cilia and mucus; for example, many candidates stated that cilia trap particles in the air that enters the trachea. Some candidates referred to cilia 'filtering' particles presumably confusing them with the much larger nasal hairs. Mucus was often described as aiding the passage of food, even though the question specifically referred to the trachea. Few candidates described the motion of the cilia by referring to the wave motion or saying that cilia beat or waft mucus.

Question 2

Candidates often showed a good understanding of how to construct genetic diagrams, but found it more difficult to explain the ideas involved in **(a)** and **(b)(ii)**. Credit was awarded for answers to these parts that conveyed the right ideas, even if the use of terminology was not precise.

(a)	Candidates usually gave good definitions of the dominant allele. References to the allele being more 'powerful' were ignored. The most common error was that dominant alleles are more likely to be expressed when they are always expressed if present. Candidates often used the word 'dominant' in their definition; the word or phrase being defined should not be used in the definition.

(b)(i)	Many candidates gave good, complete genetic diagrams showing the inheritance of flecks on tulip petals. It is important that the letters used for the dominant and recessive alleles are written in a different way for upper and lower case rather than just written larger or smaller. This helps to avoid any confusion. Credit was sometimes lost by candidates who did not use a suitable way of showing the fusion of gametes. Using a Punnett square is the best way to do this as it is much less prone to errors than drawing criss-cross lines. Some candidates lost credit by omitting 'Ff' in the offspring genotypes.

(ii)	Most candidates gave correct genotypes, but sometimes did not add a suitable explanation about the parents. The question was asking about how to obtain all fleckless offspring, but answers explaining how to get fleckless offspring at all (with flecked siblings) were accepted.

Question 3

(a)	Most candidates gave the correct directions of movement between fetal and maternal circulations for each of the four substances. The reasons given for the movement were less accurate. 'Breathing' was sometimes given for oxygen instead of 'respiration', showing a lack of understanding of the two different processes, despite the clue in the second row for carbon dioxide. 'Waste' was sometimes written instead of 'for excretion' or 'metabolic waste', and was not credited; 'waste from deamination' was accepted.

(b) While there were many correct answers for both iron and vitamin D, there were many superficial responses that failed to gain credit. For example, credit was not given for 'iron for strong blood' and 'iron is needed for blood cells'.

(c) (i) Most candidates named the cells that produce antibodies as lymphocytes. White blood cells and leucocytes were also accepted, but 'white cells' was not. 'Phagocytes' was a common error.

(ii) Many candidates did not take full advantage of the credit available for this question; most made no mention of the provision of immunity or of a function of antibodies. However, most candidates referred to defence against infection or protection from infection. 'Fighting against infection' was credited, but not 'against disease' without further qualification or elaboration.

(iii) Many candidates gained partial credit for their answers about the advantages of breast-feeding. However, most did not give the four advantages that were necessary to gain full credit. Many wrote about the idea that breast milk is 'free' or 'cheap' expressed in a variety of ways. Similarly, they wrote about mother and infant forming a closer bond than might happen if formula milk was used. Some candidates did not develop the nutrient point adequately, suggesting that formula milk may have essential components that are actually missing. Better answers stated that breast milk has the nutrients in the exact proportions that the baby requires, and that the proportions of these components change to meet the changing requirements as the baby develops.

Question 4

(a) (i) Most candidates identified xylem as the water-conducting tissue.

(ii) Many candidates gave a correct feature of xylem vessels within xylem tissue, such as long, hollow and with no end walls. However, few candidates stated how the structure they had described was adapted for the function of water transport.

(b) Candidates frequently provided unnecessary detail about how water gets into plant roots by osmosis. Many did not develop their answers beyond a description of transpiration and many who mentioned the words cohesion and adhesion did not go on to give any further details. The idea of root pressure was credited despite its negligible contribution in large plants. This is a topic where candidates should be able to describe and explain the full sequence of events from the soil to the outside air, and then decide which parts of the sequence are relevant to different potential questions.

(c) (i) There were many successful descriptions of the data shown in Fig. 4.2, but candidates who omitted units from their data quotes did not gain credit. Key points from the results for tree **A**, such as the two peaks, the slow increase in rate of water conduction in the period after 4 hours and the maximum rate, went unnoticed by some. The question tested the skill of understanding and using data taken from a graph. This involved reading the points accurately and transcribing the units correctly. Many candidates did not read the rates of conduction from the graph correctly.

(ii) This part was poorly answered. Candidates confused volumes with rates of water conduction. There are two ways to calculate the total volume of water used by a tree in 24 hours: adding together the volumes for each hour, and calculating the area under the curve.

(iii) This part was rarely answered correctly. Most candidates restated the differences between tall, medium and short trees, but made no mention of the factors affecting the differences. There were several ways in which candidates could gain credit: they could identify differences in exposure to environmental factors, such as humidity, light intensity, wind speed and temperature that all vary with height in a forest. Other potential responses included differences in the surface areas of the leaves giving rise to different rates of transpiration. The information given about the trees was limited to their different heights; the trees could be different species.

(d) This question on the consequences of cutting down trees was generally well answered. Some candidates wrote about the loss of animals' 'homes' or 'places to live' rather than about habitat loss. They also wrote about organisms dying rather than dying out as happens when a species becomes locally extinct. The use of these technical terms demonstrates a firm grasp of the issues involved in deforestation. References to global warming, the greenhouse effect and desertification were ignored, being beyond the scope of the question.

Question 5

(a)   Few candidates identified two features that distinguish bacteria from other groups of organisms. A common error was to say what processes the bacteria could or could not do rather than giving distinguishing features. Many gave features that are shared with other organisms, such as being microscopic or unicellular.

(b) (i)   The population stages in Fig. 5.2 were usually named correctly. Some candidates described what happens in each stage rather than giving the name of each stage. It was sometimes not clear whether candidates had written 'lag' or 'log' for the first two stages. It may be better to learn the second stage as the exponential stage to avoid this confusion.

(ii)   The best way to explain why the population of *Lactobacillus bulgaricus* does not continue to increase is to refer to the action of limiting factors. An explanation that was sometimes seen, but did not go far enough, was that there was 'no or less food'. The Examiners did not accept 'food' in this context and were looking for nutrients, or better, certain named nutrients. A common explanation that was not accepted was that the reaction had finished. Better answers included the idea that the pH had *changed* to be unsuitable for the growth of *L. bulgaricus*. Similarly, the idea of the bacteria dying was not enough; candidates gained credit if they stated that the death rate is equivalent to the 'birth' rate or that reproduction had stopped.

(c)   Definitions of growth were very often correct. Candidates who stated that growth involves an increase in dry mass gained full credit. References to reproduction and development did not gain any credit. Few candidates stated that the increase in a parameter, such as dry mass, is permanent.

(d)   This part was answered correctly on the whole, but a significant number of candidates gave 'mitosis', which is incorrect. Asexual reproduction or binary fission were the only acceptable answers. 'Binary fusion' was also seen.

(e)   More correct advantages were given than disadvantages. A common error was to say that extra nutrients are added. Food additives are not nutrients. Disadvantages that did not gain credit included 'not natural' and 'cause illness'; these ideas should have been developed further. It was surprising that the disadvantages of additives were not as well known as the advantages.

Question 6

This question covered topics from **Sections II** and **IV** of the syllabus. The action of enzymes was explored in the context of decomposition. The final parts, about the nitrogen cycle, proved very challenging and some candidates did not offer any answers to **(d)**, **(e)(i)** and **(e)(ii)**.

(a)   Many candidates wrote about the properties of enzymes, such as 'speeding up the reaction', and their peak activity at an optimum pH and an optimum temperature. In this question, candidates should have considered a diagram showing how a substrate with a shape complementary to the active site fits into the enzyme, breaks and is then released as two product molecules. At least one candidate answered this question with such a diagram, but added no text. The candidates who described this mechanism as the lock and key mechanism were credited and they usually gained more credit because they described how it works.

(b)   Many candidates wrote that cellulase digests cellulose instead of the (cellulose) cell wall. The question asked for the *part* of the dead leaf cells, which implies a structure. This shows the importance of reading the question carefully.

(c) (i)   Credit was available for general statements that applied to both types of enzyme and for specific statements about the activity of each enzyme. Units were required for any data quotes that were given. Explanations were not needed in this part, just observations, so references to the effects of pH and the soil water content on the activity of the enzymes were not relevant.

(ii)   Explanations for the differences in the enzyme activity at the two locations were required in this part. Candidates often appeared unsure about how to respond to this question and did not always make best use of the information in Table 6.1. Successful answers centred on the effect of pH to the exclusion of ideas about the presence of water and the type and composition of the leaves.

Several candidates speculated about the effects of different temperatures, despite there being no data about this aspect.

(d) This part was not well answered. Many candidates gained only partial credit for identifying the involvement of decomposers or types of decomposers. Many candidates were unsure of the sequence of events so did not make the connection from decomposition to ammonia so that they could write about nitrification to form nitrate ions. There were references to nitrogen fixing and denitrifying bacteria, showing the extent of confusion with this topic. Some candidates thought that proteins are liberated into the soil from dead organisms for direct re-use by plants. Many candidates did not answer this part.

(e) (i) The only answer to this question was nitrogen fixation, although nitrogen fixing was also credited. A common error was 'nitrification'. In questions on the nitrogen cycle, there is often confusion between nitrogen fixing, nitrification and denitrifying.

(ii) This part was poorly answered as a result of the poor answers to **(e)(i)**. Candidates were expected to write about nitrogen-fixing bacteria in the root nodule of legumes, but any appropriate comments about free living nitrogen-fixing bacteria were accepted.