Cambridge Assessment International Education

Example Responses – Paper 2

Cambridge O Level
Biology 5090

For examination from 2023

Cambridge Pathway

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge O Level Biology 5090.

This booklet contains responses to all questions from June 2023 Paper 22, which have been written by a Cambridge examiner. Responses are accompanied by a brief commentary highlighting common errors and misconceptions where they are relevant.

The question papers and mark schemes are available to download from the School Support Hub

5090 June 2023 Question Paper 22

5090 June 2023 Mark Scheme 22

Past exam resources and other teaching and learning resources are available from the School Support Hub

Question 1

1 Table 1.1 lists three of the gases present in the atmosphere.

Table 1.1

gas	percentage
oxygen	21
carbon dioxide	0.04
nitrogen	78

(a) Complete Table 1.1 to state the percentage of each gas in the atmosphere. [3]

Examiner comment

- The syllabus content section of the syllabus indicates that candidates should be able to state the percentages of the gases in atmospheric air (statement 9.1.2). The values given in the example response are the expected rounded values for oxygen, carbon dioxide and nitrogen. Some older textbooks give a figure of 0.03 % for carbon dioxide, but since carbon dioxide has increased over time the value of 0.04 % should be quoted nowadays.
- In general, candidates knew that nitrogen is a greater percentage of the atmosphere than oxygen and remembered the relative percentages. The carbon dioxide percentage was trickier and candidates quite often gave 0.4 % rather than 0.04 % as their answer. Some candidates were confused and quoted percentages for exhaled air, giving 16 % for oxygen and 4 % for carbon dioxide.

(b) Some foods are packaged in a sealed container that contains a mixture of the same gases, with percentages that are different from those found in atmospheric air.

Fig. 1.1 shows a diagram of food packaged in this way.

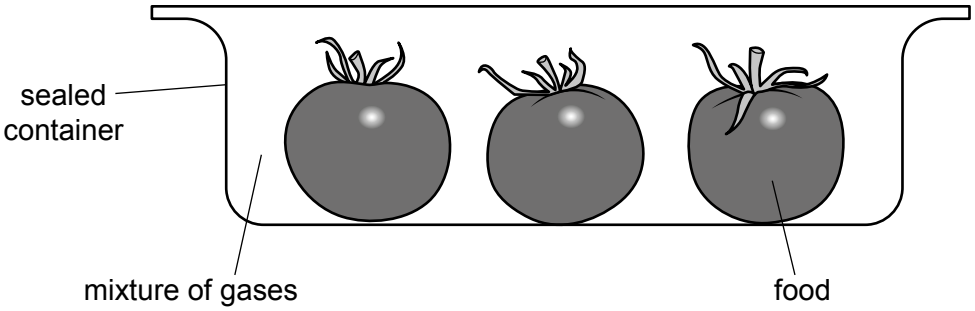


Fig. 1.1

This method of food packaging slows down decomposition of the food.

(i) Suggest how the percentage of **one** gas named in Table 1.1 is changed when used to package food in this way.

oxygen is reduced ..... [1]

Examiner comment

Candidates could select any one of the three gases mentioned in the table, but they did need to provide a description of how the percentage had been changed to slow down decomposition. Candidates should always check the command words in the question to make sure they are providing the required information.

(ii) Explain how this change will slow down decomposition of the food.

Bacteria and fungi decompose food. When there is a lower percentage of oxygen in the food packaging the rate of their aerobic respiration decreases. This results in less energy being released for their growth and reproduction so food decomposition will be slower.

..... [3]

Examiner comment

- This question assessed candidates' knowledge of the decomposition process. The majority of candidates tackling this question understood that decomposition is carried out by microorganisms and that these organisms respire.
- Some candidates were unable to link decomposition to decomposers and when answering this question described the tomatoes in the packages as respiring. The relationship between the lower rate of respiration and its effect on energy release, growth and reproduction of the decomposers was rarely explored in the answers, suggesting that a more in-depth study of decomposition would benefit candidates.

(iii) Suggest **two** advantages of slowing down decomposition of packaged food.

1 the food will last for longer before it needs to be eaten

2 a farmer can sell more of their crop over a longer period of time and therefore make a greater profit

[2]

[Total: 9]

Examiner comment

- There were also other valid suggestions such as 'there will be less food wastage' and 'there is less risk of food poisoning'.
- This question appeared to be quite simple and this may be the reason for candidates giving only partial explanations like 'farmers will get more money', 'it is better for the environment' or 'it is healthier'. Candidates should show examiners as much relevant biological knowledge and understanding as possible when constructing their answers, even when they are short answers.

Question 2

2 **(a)** Describe physical digestion in humans and explain its importance.

Physical digestion is the breakdown of food into smaller pieces without chemical change to the food molecules. It starts in the mouth where teeth chew food into smaller pieces making it easier to swallow and travel down the oesophagus. Stomach muscles contract and relax to churn food in the stomach and mix it with digestive enzymes. The physical digestion increases the surface area of the food to assist enzyme action.

..... [4]

Examiner comment

When describing physical digestion, candidates should make sure that they don't describe food 'molecules' being broken down. Molecules will only be broken down by chemical changes, such as those catalysed by enzymes. It was important for candidates to read the question carefully so that the focus of their answers was correct. If a candidate missed the word 'physical' before the word digestion and wrote in general about digestion, they may miss out salient details about physical digestion.

(b) **(i)** State the name of the chemical present in the stomach that kills many ingested bacteria.

hydrochloric acid [1]

Examiner comment

- Candidates were asked to 'name' a chemical, so they were expected to give a written name rather than the chemical symbols.
- It was important for candidates to be as specific as possible. Gastric juice is a mixture of chemicals, including hydrochloric acid, so on its own was an insufficient answer.

(ii) Bacteria that are not killed in the stomach may cause disease.

State the term used to describe:

- organisms that cause disease.

  pathogens

- the type of immunity gained after infection by organisms that cause disease.

  active

[2]

Examiner comment

Candidates needed to restrict their answer to a single term when asked to 'State the term used to describe'.

Some candidates who were uncertain about which was the relevant term recorded several possible terms in their answer, e.g. virus / bacteria / pathogen, in the hope that the examiner would select the correct term from their list and award them the marks. This would not be the case, and where candidates wrote either 'bacteria' or 'virus' as their answer, they would not be awarded marks for incorrect responses.

(c) Disease can be caused by viruses.

Yellow fever is an example of a disease caused by a virus.

Outline how a weakened form of the virus that causes yellow fever can be used to give a person long-term immunity against the disease.

The weakened form of the virus can be injected into a person as a vaccination. The lymphocytes in the blood detect the antigens on the surface of the virus and produce antibodies. These antibodies bring about the destruction of the virus. The lymphocytes will divide to form memory cells so that if the same virus (in a non-weakened form) enters the body again the immune response will be more rapid. [3]

Examiner comment

- In general this was a very accessible question for the majority of candidates.
- There were, however, a minority who were confused about the whole process, particularly about the difference between antigens and antibodies and how memory cells are formed. It was quite common to see answers containing the misconception that antibodies turn into memory cells suggesting that candidates don't fully understand that antibodies are chemicals rather than cells.
- Asking candidates to develop a visual representation of the immune response, for example creating a comic book story / computer game scenario with the lymphocytes as the heroes with their antibody weapons, is one way of bringing these terms to life.

Question 3

3 The nervous system coordinates and regulates body functions.

Fig. 3.1 shows two diagrams, each showing parts of the nervous system in a human.

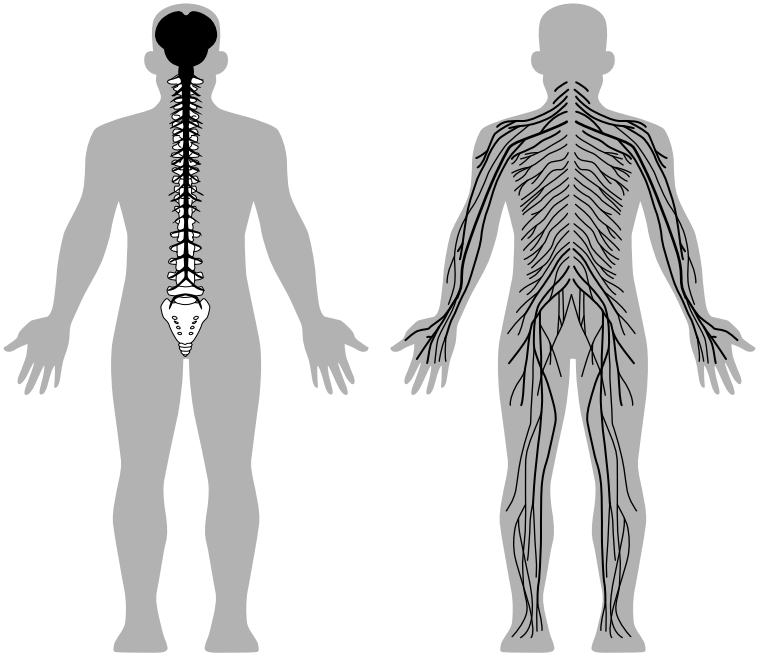


diagram **A** diagram **B**

Fig. 3.1

(a) Describe the parts of the nervous system shown in each diagram.

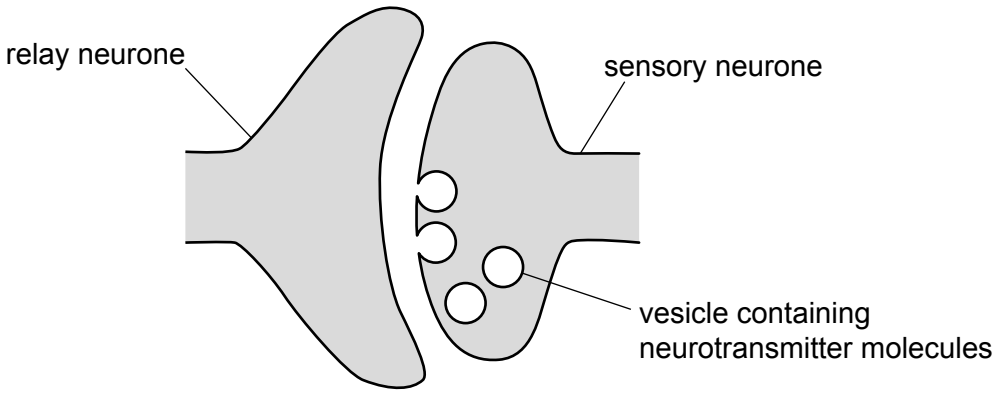
diagram **A** the central nervous system (CNS) which is made up of the brain and spinal cord

diagram **B** the peripheral nervous system (PNS) which is made up of all the nerves outside the central nervous system (the cranial and spinal nerves) [4]

Examiner comment

- Candidates found it straightforward to define the central nervous system, but providing a clear and accurate definition of the peripheral nervous system was more challenging and spellings of the word 'peripheral' were very varied. Discussing the use of the word 'peripheral' in contexts other than biological ones might help candidates to remember this term.
- A common mistake was to describe the lines on diagram **B** as blood vessels, rather than nerves. It is unlikely that candidates thought that blood vessels are part of the nervous system, but very possible that they had not retained the information in the stem of the question. Careful reading of the stem of the question would help candidates to keep their minds focused on the topic being assessed.
- The difference between the terms 'neurone' and 'nerve' was also not clear to many candidates and they were likely to use them as interchangeable words in their answers.

(b) Fig. 3.2 shows the junction between two neurones.



not to scale

Fig. 3.2

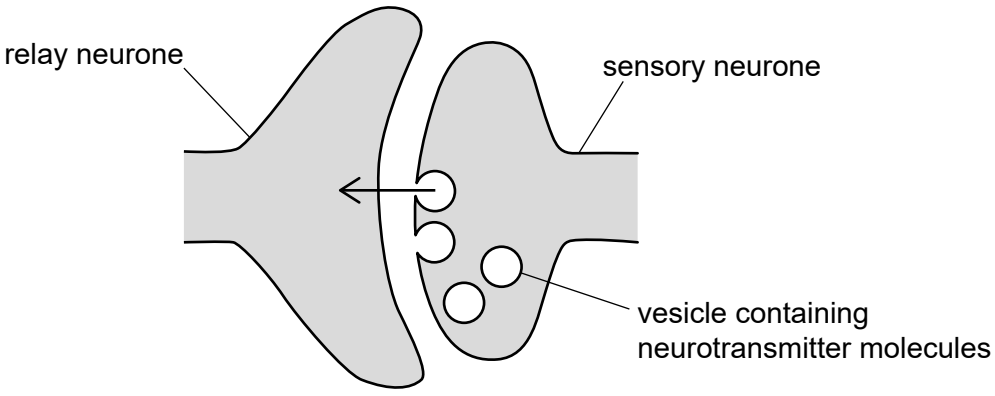
(i) Name the junction shown in Fig. 3.2.

synapse ..... [1]

Examiner comment

Synaptic cleft and synaptic gap were also correct answers.

(ii) Draw an arrow on Fig. 3.2 to show the direction that an impulse will travel. [1]



not to scale

Examiner comment

This diagram is often shown in text books with the two neurones vertically placed, so candidates needed to be able to use the labels of the neurones and the presence of vesicles in the sensory neurone to work out that the direction of nerve impulse travel was from right to left. The majority of candidates had no difficulty with this question although some drew the arrow from left to right and some up or down in the synaptic gap.

(iii) The distance between the two neurones shown in Fig. 3.2 is 0.00003 mm.

State this distance in units of μm.

Space for working.

0.00003 × 1000 = 0.03

.....0.03..... μm [1]

Examiner comment

The mathematical requirements for biology are set out on page 35 of the syllabus and this question addressed the following statement in the geometry section: 'convert between metric units, including μm, mm, cm and m; cm^3 and dm^3 ; mg, g and kg'. The micrometre is the unit frequently used for cell measurements. Candidates should be given practice in converting millimetres to micrometres and micrometres to millimetres and be able to remember that there are a thousand micrometres in a millimetre.

(c) Nicotine is a chemical found in cigarette smoke.

A molecule of nicotine has a similar shape to a molecule of neurotransmitter.

Suggest and explain the effect of nicotine at the junctions between neurones.

The nicotine molecules diffuse across the synaptic gap. Because nicotine molecules are the same shape as the neurotransmitter molecules they bind with the protein receptors on the membrane of the relay neurone. This results in nerve impulses being generated in the relay neurone.

..... [3]

Examiner comment

This question required candidates to apply their knowledge of how a synapse works to suggest what effect nicotine molecules would have on this junction. Candidates were given a significant prompt that nicotine has a similar shape to a molecule of neurotransmitter. Unfortunately, instead of concentrating on the role of neurotransmitters, some candidates focused on their knowledge of nicotine and wrote about addiction in general terms.

Some candidates were able to give detailed answers about the nicotine binding to or blocking the protein receptors of the relay neurone and either increasing or decreasing nerve impulse transmission. The command word 'suggest' generally indicates that the question requires application of recalled knowledge rather than straightforward recall. Additionally, since the candidates were not expected to know if nicotine triggers or blocks impulses, either suggestion could be awarded marks.

Question 4

4 Lake Washington in the United States of America is a large fresh water lake.

Between 1941 and 1963 an increasing amount of untreated sewage polluted the lake.

(a) Suggest and explain the effect of this untreated sewage on the lake ecosystem.

Untreated sewage will contain nitrates and phosphates and these will cause eutrophication in Lake Washington. The rate of growth of algae will increase causing an algal bloom on the surface of the lake. These algae and other plants will then die and their remains will be fed on by decomposers which use up oxygen for respiration. This causes the oxygen concentration in the freshwater to decrease so that there is not enough for the freshwater animals so they die.

..... [5]

Examiner comment

- Candidates who realised that the untreated sewage would contain nitrates and phosphates had access to all the marks available for a correct description of eutrophication.
- Most candidates had a good understanding about the algae growing rapidly and then the algae and other plants dying and being fed on by decomposers. Many remembered that oxygen was involved but they tended to be too vague here. Since photosynthesis generates oxygen and aerobic respiration requires oxygen they needed to be really clear that when eutrophication is occurring the balance between oxygen release and uptake is disturbed so that overall the oxygen concentration in the lake water declines.
- Some candidates' answers were too vague when they described the impact on the organisms in the lake. Many answers said something like ‘the living organisms died’ which suggested that they had forgotten that decomposers are living organisms.
- There was a widespread misunderstanding about the word ‘marine’ with many candidates appearing to think it is synonymous with the word ‘aquatic’. The stem of the question clearly states that this is a freshwater lake ecosystem rather than a sea / ocean / marine ecosystem. Since marine organisms cannot live in freshwater, they will not be impacted by the untreated sewage.

Between 1963 and 1968 new sewage treatment facilities were constructed.

By 1968 the amount of untreated sewage entering Lake Washington was reduced to zero.

Fig. 4.1 shows how the transparency of water in the lake has changed over time.

Water transparency is a measure of how far light travels through water.

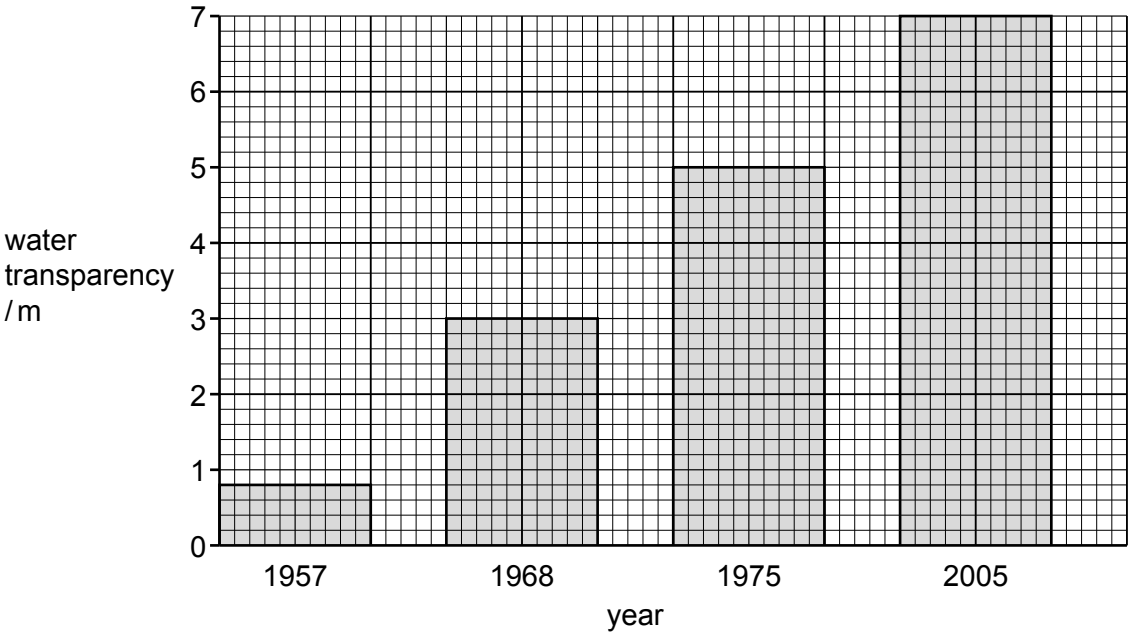


Fig. 4.1

(b) Calculate the percentage increase in water transparency between 1957 and 1968.

Space for working.

water transparency in 1957 = 0.8 m

water transparency in 1968 = 3.0 m

change in transparency is: 3.0 – 0.8 = 2.2

percentage increase: $\frac{2.2}{0.8} \times 100$

.....275.....% [2]

Examiner comment

- Calculating percentage change is one of the mathematical requirements listed in the syllabus under the number section on page 35.
- Most candidates were able to read the bar chart correctly to get the values of 0.8 m and 3.0 m for the depths of transparency in 1957 and 1968 respectively and were able to subtract 0.8 from 3.0 to get a figure of 2.2. When they didn't get the correct final percentage increase, they could be awarded 1 mark for stating these correct values and knowing they had to subtract one from the other.
- Candidates found it difficult to remember that they needed to then divide this number by the initial value and multiply by 100 to get the percentage change. Often they divided by 3 to get a change of 73.3 % or they forgot to multiply by 100 and gave the change as 2.75 %. If candidates were uncertain about which figure to divide by which they should be encouraged to make a rough estimate of the answer first. Here, it was clear from the bar chart that the difference in transparency was more than double the original figure, so the percentage increase was going to be greater than 100 %.

(c) One species of fish that lives in Lake Washington is the Three Spined Stickleback.

Fig. 4.2 shows three different distribution patterns of armour plates on the skin of these fish.

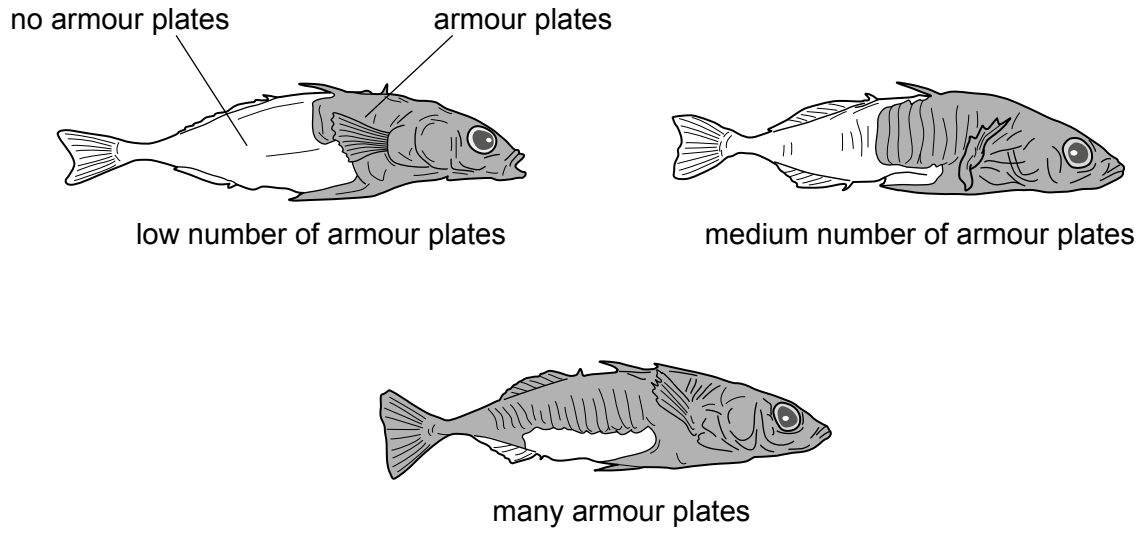


Fig. 4.2

Table 4.1 shows how the distribution patterns of armour plates on the skin of Three Spined Sticklebacks have changed over time.

Table 4.1

year	percentage of fish with each distribution		
	low number of armour plates	**medium number of armour plates**	**many armour plates**
1957	91	9	0
1968	69	25	6
1975	25	35	40
2005	16	35	49

(i) Use data from Table 4.1 to describe how the distribution patterns of armour plates have changed over time.

Between 1957 and 2005 the percentage of fish in the population with a low number of armour plates decreased and the percentage with many armour plates increased.

Between 1957 and 1975 the percentage of fish in the population with a medium number of armour plates increased but from 1975 to 2005 the population remained constant.

..... [4]

Examiner comment

- Page 8 of the syllabus lists the assessment objectives that may be assessed on the question paper. Some of these relate to knowledge and understanding but others are skills that should be developed while teaching biology topics. Two of the skills listed, which are relevant to this question are:
  - translate information from one form to another
  - use information to identify patterns, report trends and form conclusions.
- When translating information from a table to a written description, candidates needed to ensure that their written answer contains all the relevant details and units so that it gives a complete picture when read separately from the table. The table provided gave information about the percentages of stickleback fish with either low, medium or many armour plates but many candidates simply referred to the number fish rather than the percentage; this would only be correct if the total number in the whole population remained at 100 fish from 1957 to 2005.
- When asked to describe the changes observed, candidates should be looking at patterns and trends in the tabulated result. Too often candidates took the data from the table and repeated it in written form, for example 'In 1957 the percentage with low armour plates was 91, the percentage with medium armour plates was 9 and the percentage with many armour plates was 0.' Although correct, this did not answer the question which asked about changes over time.

(ii) Armour plates on the skin of a Three Spined Stickleback protect it from predators.

Describe how the process of natural selection may have caused these changes in the distribution of plates over time.

There is variation in the number of armour plates on the Three Spined Stickleback fish which is caused by mutation. Water transparency has increased making it easier for predators to see the fish. The more armour plates the fish have the better they are protected from the predators and the more likely they are to survive to reproduce. They will then pass on the beneficial allele for more armour plates to their offspring and this will be repeated over many generations.

..... [5]

Examiner comment

- This was the final part of Question 4, a 16-mark question in total. Candidates were expected to assimilate all the preceding information fully and analyse the data presented in both graphical and tabular form in order to produce a comprehensive answer to this question. Only a few candidates were able to connect the environmental change of increasing water transparency to changes in predation and to realise that this was driving the natural selection process. When presented with a long and complex question such as Question 4, candidates should read through the entirety of the question to gain an overview and to synthesise the information before starting on their answers.
- Marks were most frequently awarded for explaining that fish with many armour plates were better protected from predation than those with a low number of plates, allowing them to survive long enough to reproduce. There was a scattering of the terms ‘variation’ and ‘mutation’ and in general these were used in the correct context.
- Candidates found it difficult to explain that the beneficial allele for more armour plates is passed on to the next generation. The correct use of ‘allele’ rather than ‘gene’ was important here since it is the version of the gene being passed on that is critical. An analogy may be helpful for candidates. For example, to gain success in a science examination they may be given two science books (genes). If they are given a biology book (allele) and a chemistry book (allele) then that gives them an advantage over candidates given a physics and a chemistry book, if the science examination is Biology O Level.
- Some candidates wrote about natural selection in the general terms given in the syllabus without attempting to apply their knowledge and link it to the scenario in Lake Washington. Others gave answers that suggested that the fish had ‘decided’ to adapt and so had developed extra plates during their lifetimes. Yet others seemed to forget that it was the number of plates that would put the fish at a relative advantage or disadvantage and simply repeated the first sentence of the question stem as an explanation.

Question 5

5 Fig. 5.1 is a photomicrograph of the centre of a plant root.

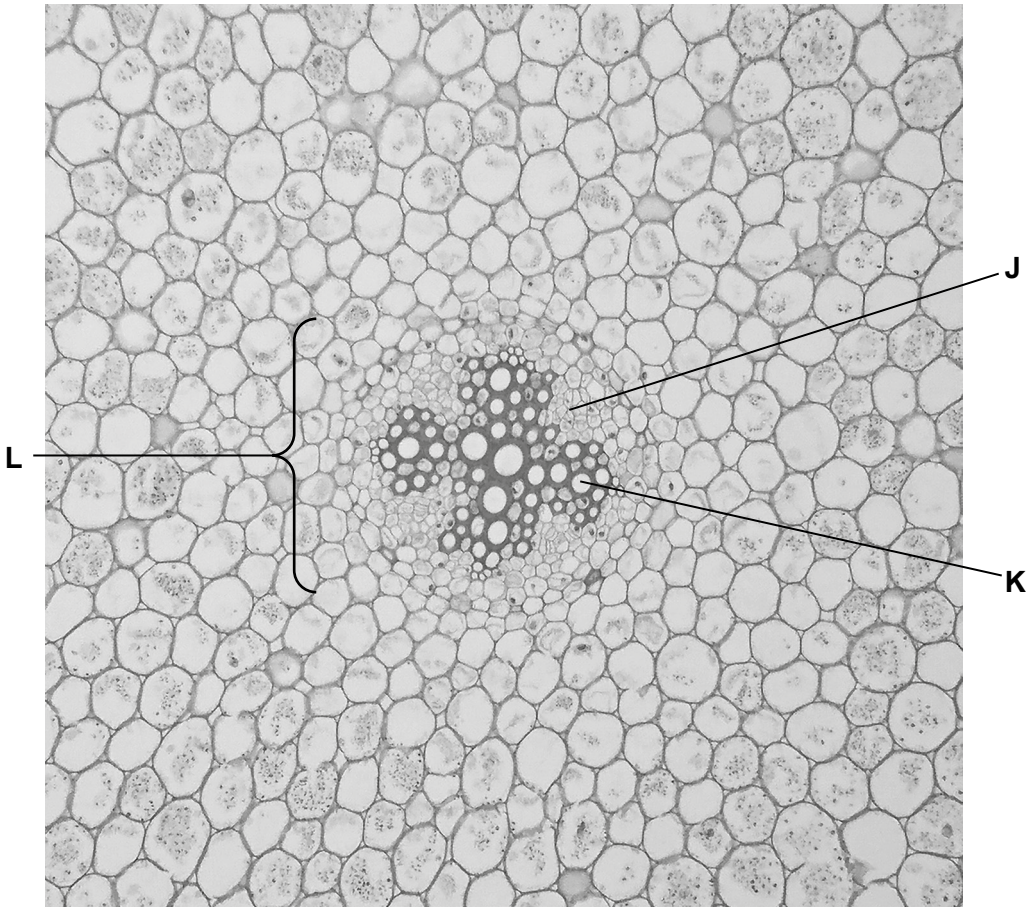


Fig. 5.1

(a) (i) Identify each of the tissues labelled **J** and **K**.

J phloem

K xylem

[2]

Examiner comment

Most candidates knew that the centre of the root contained xylem and phloem but, judging by the number of crossings out, a significant number struggled to identify which was which. Candidates should be advised to observe diagrams carefully and apply their knowledge. In fig. 5.1 they were shown a cross section through the root of a dicotyledonous plant. The cell walls of K are much thicker than elsewhere and candidates who know that the cell walls of xylem vessels are thickened with lignin will then be confident in labelling K as xylem. Alternatively a simple, non-biological way to remember that xylem is located in the centre of the root is to link the cross shape formed by the xylem vessels to the initial letter ‘x’ of xylem.

(ii) State the term used to describe the group of tissues labelled **L**.

vascular bundle [1]

Examiner comment

Since the question asked candidates to state the term of 'the group of tissues' rather than 'a group of tissues' the most appropriate answer here was 'vascular bundle' which many candidates gave. Those who knew that a group of tissues is known as an organ were also awarded marks for correct biology.

(iii) State **two** ways in which the structure of a cell in tissue **K** will differ from a cell in tissue **J**.

1 K has cell walls which are thickened with lignin and the cell walls of J do not contain lignin

2 the cells of K do not contain cytoplasm or other cell contents but the cells of J do have cell contents

[2]

Examiner comment

The key word here was 'structure'. Candidates needed to make sure that their answers outlined structural differences between xylem and phloem. Functional differences such as what is transported and how it is transported were not relevant to the question.

(iv) Outline the function of tissue **J**.

The function of J is translocation. Sucrose and amino acids are moved from where they are manufactured or released (source, e.g. leaf) to where they are used or stored (sink, e.g. root). This means that the movement of sucrose and amino acids is bidirectional.

[4]

Examiner comment

- Some candidates gave insufficient or inaccurate details about what is transported in phloem. In response to most biological questions, candidates should avoid the generic term 'food' and to search for a more specific description.
- When candidates did give a specific answer they quite often incorrectly mentioned glucose being transported rather than sucrose. Although not on the syllabus, some candidates gave explanations about why sucrose rather than glucose is transported, demonstrating that where teaching extends beyond the syllabus it can help candidates retain important facts.

(b) (i) Name the type of response shown by a plant root when it grows down into soil after the seed has germinated.

positive gravitropism ..... [2]

Examiner comment

Candidates should always check how many marks are available for each question. Here there were two marks, suggesting that more than two words were required for a complete answer. Many candidates simply gave gravitropism / geotropism, but forgot to indicate the direction of the tropism. Alternative answers such as negative phototropism or positive hydrotropism were available.

(ii) Explain how this response shown by the plant root is necessary for the leaves to grow and to appear green.

When the root grows downwards it will be able to absorb water and mineral ions from the soil. The water is necessary for leaf cell elongation which enables leaves to grow. Any magnesium absorbed can be used in the manufacture of chlorophyll which makes the leaves green and is required for photosynthesis to make glucose. This glucose can be combined with the nitrates absorbed from the soil to make proteins for growth.

..... [4]

[Total: 15]

Examiner comment

- The term 'absorb' is very useful in biology to describe molecules or light entering and being used by a living organism and candidates should try to remember this term so that their descriptions are accurate. The term 'nutrient', however, is one to avoid in most contexts as it is too general; it can be defined as 'any substance that plants and animals need to live and grow' so candidates needed to specify that it was water and minerals that were absorbed from the soil.
- Many candidates could remember that magnesium is required for chlorophyll synthesis. Many also mentioned nitrates, although answers were less confident, here with many only linking nitrates to growth rather than stating that they were required to make proteins for growth.
- Very few candidates commented on the role of water in growth. Opportunities to explore how plant growth involves cell elongation exist when covering the topics of coordination and responses in plants and germination.

Question 6

6 Fig. 6.1 shows the pattern of results from an investigation into the effect of increasing light intensity on the rate of photosynthesis.

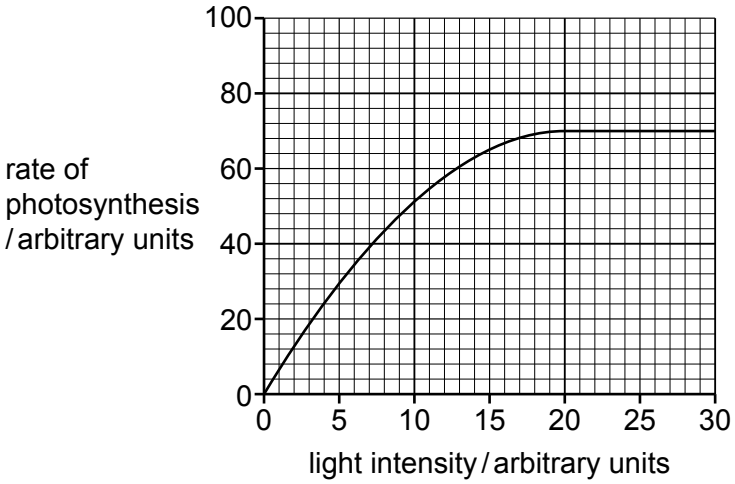


Fig. 6.1

(a) Describe and explain the pattern of results between a light intensity of 20 and 30 arbitrary units.

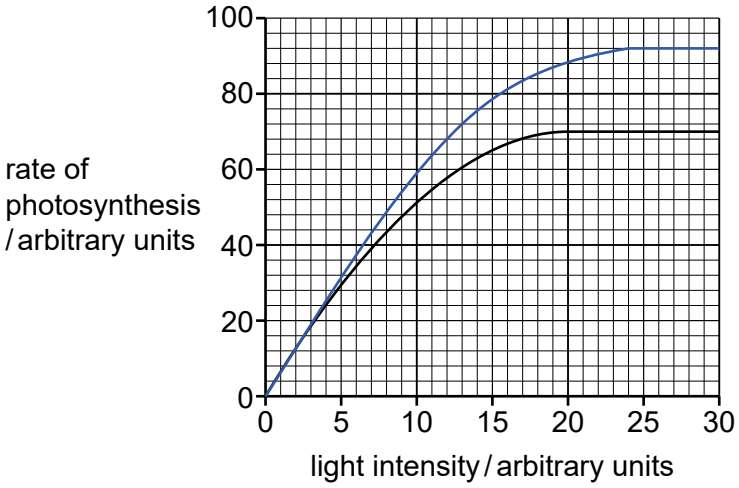
The rate of photosynthesis is constant between a light intensity of 20 and 30 arbitrary units. This indicates that light intensity is not a limiting factor for photosynthesis beyond a light intensity of 20 arbitrary units. Carbon dioxide or temperature may be the factor that limits photosynthesis beyond a light intensity of 20 arbitrary units. [2]

Examiner comment

- Interpreting graphs remains a challenge for many candidates. More practice interpreting a variety of graphs may help candidates to deal with information provided in a graphical format. A few candidates mistakenly interpreted the horizontal line as photosynthesis having stopped, suggesting that they hadn't understood that the graph shows how fast photosynthesis is happening at different intensities of light. Some interpreted the straight line as showing that the light intensity was constant, indicating they hadn't appreciated that this is the independent variable in the investigation which has been increased from 0 to 30 arbitrary units.
- Most candidates who wrote about limiting factors understood that if the rate of photosynthesis is constant between 20 and 30 arbitrary units, then light intensity is not the limiting factor and some other factor must be limiting at this light intensity.
- The idea of different factors limiting the rate of a process can be straightforward to understand, especially if analogies like manufacturing a product in industry are used when teaching the topic. Some candidates struggle when the information is presented in the form of a graph which needs to be interpreted and then described in writing or, as in this case, when written information needed to be interpreted in order to draw a graph. This was a topic which would benefit from revisiting throughout the course and the discusion of limiting factors does not need to be restricted to the topic of photosynthesis.

(b) The investigation was repeated with an increased concentration of carbon dioxide in the atmosphere.

(i) Draw a curve on Fig. 6.1 to show the pattern of results that would be expected from this second investigation. [2]



Examiner comment

- Candidates found this a very challenging question and many were not able to draw all parts of the curve correctly. They were most likely to understand that the curve should start at (0,0) and that it should end at 30 arbitrary units of light intensity at a higher rate of photosynthesis than the original curve.
- The most common mistake was for candidates to draw the gradient of the curve from (0,0) steeper than the original, forgetting that at low light intensities light was the limiting factor so it didn't matter how much carbon dioxide was available. The curve should have been drawn with the same gradient as that of the original investigation for the lower light intensities.
- Many candidates who drew the curve with a steeper gradient at the start, then drew the curve so that it became horizontal before a light intensity of 19 arbitrary units had been reached. This suggests that they hadn't fully understood that with a higher concentration of carbon dioxide the maximum rate of photosynthesis would not only be higher, but would continue increasing after a light intensity of 19 arbitrary units.

(ii) State the name of the product of photosynthesis that contains carbon atoms.

glucose [1]

Examiner comment

Most candidates understood the term 'product' so selected glucose as their answer, but a few incorrectly gave the name of the reactant, carbon dioxide. Some were undecided between glucose and starch and gave both names, possibly because testing for starch is the method used to investigate whether or not photosynthesis has occurred. Once again, supplying two answers did not benefit the candidate and they needed to choose just one answer.

(iii) Outline the uses made by a plant of named carbohydrates.

The glucose produced by photosynthesis has many uses. It can be converted to the carbohydrate starch which is then stored until needed. Alternatively the glucose may be used in respiration to provide energy for plant cell activities, e.g. cell division, active transport. Some glucose may be used in the manufacture of amino acids and lipids. Sucrose is the carbohydrate that is transported around the plant. Cellulose is another carbohydrate that is used to form cell walls.

..... [5]

[Total: 10]

Examiner comment

- This question asked candidates to link named carbohydrates to their uses in the plant for 5 marks. This proved straightforward for those who had learned the information and had read the question carefully, but others forgot to name the different carbohydrates and some described the uses of carbohydrates to humans rather than to the plants. Quite a few recalled glycogen as a storage carbohydrate either instead of starch or as well as it.
- Some candidates stated the misconception that energy is 'produced' by respiration, and this should be addressed whenever spotted.
- The command word of the question was 'outline'. The question was well suited to a bulleted list approach for the answer; creating a list may have helped candidates reach the five separate marking points they needed.

Question 7

7 DNA carries genetic information in the form of genes.

(a) The paragraph below describes the structure of a DNA molecule.

Complete the paragraph by writing the most appropriate word or letter in each space.

DNA contains the chemical elements carbon, hydrogen, oxygen, ...nitrogen..... and .....phosphorus..... . Two strands of DNA coil together to form a double .....helix..... . Each strand is made up of a chain of .....nucleotides..... . Bonds between pairs of bases hold the strands together. These bases always pair up in the same way: T with .....T..... and .....C..... with .....G..... .

[5]

Examiner comment

- Most candidates knew that nitrogen is an element in DNA, but phosphorus was less likely to be remembered. Section 4.1 of the syllabus states that candidates should be able to list the elements of DNA. Some may have remembered this list, and others may have been helped because they had learned that the bases are nitrogenous and that DNA has a sugar-phosphate backbone. This second point may be the reason why a common incorrect answer was the compound phosphate.
- Many candidates knew the term double helix although 'bond' was a common mistake triggered by the word 'double' preceding the answer space. Candidates also knew that nucleotides are joined together to form a strand of DNA and could generally pair T with A and list G and C as the other two bases for the final mark. A few gave three 'T's as their answer and U, X and Y sometimes featured.

(b) Explain how genetic modification can be used to change the function of an enzyme so that it acts on a different substrate.

Genes code for proteins and enzymes are proteins. Genetic modification can be used to change the sequence of bases in the gene that codes for the enzyme. This will result in the enzyme having a different sequence of amino acids so its shape will change. The active site will have a changed shape which will now be complementary to a different substrate so they can fit together to form an enzyme-substrate complex. [5]

[Total: 10]

Examiner comment

- Candidates needed to synthesise information from different parts of the syllabus in order to produce a clear, logical explanation.
- Many picked up on the term ‘genetic modification’ and wanted to explain details of how a gene is modified rather than how modifying a gene can change an enzyme’s function.
- Candidates were most likely to be awarded marks for explaining that an enzyme has an active site that is complementary in shape to its substrate and that by changing the shape of the active site the enzyme can become complementary to a different substrate. It was rare for candidates to correctly link the active site’s shape to its sequence of amino acids and the sequence of amino acids to the sequence of DNA bases. Some stated that an enzyme is a protein and others were able to give a correct description of genetic modification as a change in genetic material.
- This would be a good question to use for practice in writing about the links between genes, proteins and protein function.

Cambridge Assessment International Education
The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA, United Kingdom
t: +44 1223 553554
e: info@cambridgeinternational.org www.cambridgeinternational.org