OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

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Candidate signature _____

I declare this is my own work.

INTERNATIONAL A-LEVEL

BIOLOGY (9610)

Unit 3 Populations and Genes

Tuesday 3 January 2023 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions

- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

Answer **all** questions in the spaces provided.

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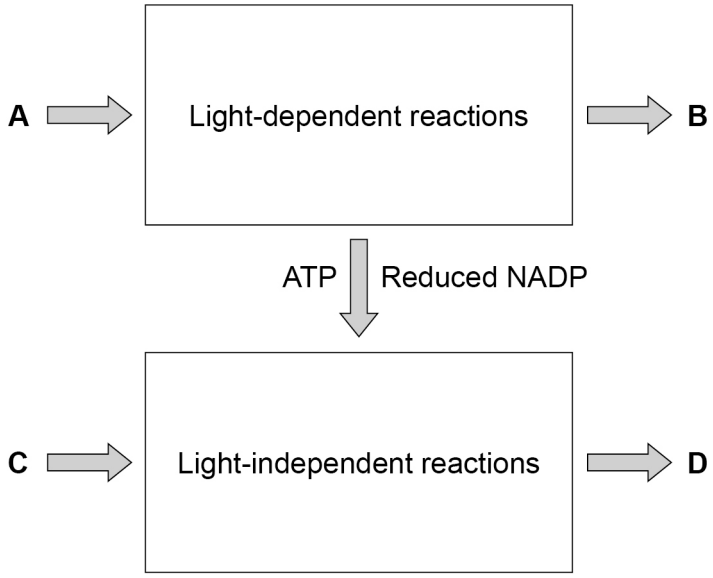
0 1 Photosynthesis occurs inside chloroplasts.

Figure 1 shows a summary of photosynthesis. **A** and **C** are substances that enter the chloroplast, **B** and **D** are substances that leave the chloroplast.

Figure 1



0 1 . 1 Name the substances labelled **A**, **B**, **C** and **D** shown in **Figure 1**.

[2 marks]

Substance **A** _____

Substance **B** _____

Substance **C** _____

Substance **D** _____

0 1 . 2 State the precise locations of the light-dependent and the light-independent reactions in the chloroplast.

[2 marks]

Light-dependent reaction _____

Light-independent reaction _____

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0 1 . 3 Describe how reduced NADP is produced in the light-dependent reactions of photosynthesis.

[4 marks]

Question 1 continues on the next page

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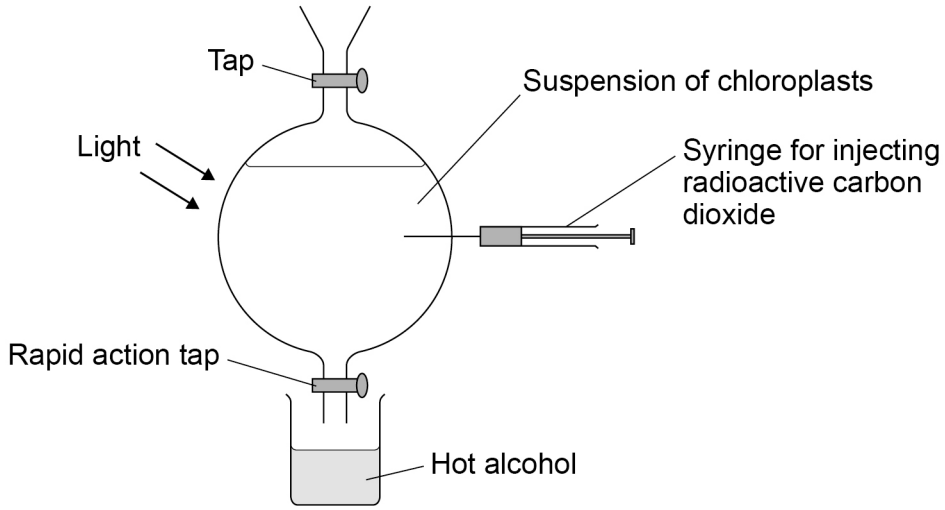
Scientists use the apparatus shown in **Figure 2** to investigate photosynthesis.

The scientists:

- add radioactive carbon dioxide ($^{14}CO_2$) to a suspension of chloroplasts
- shine light at the chloroplasts so that the chloroplasts photosynthesise
- open the rapid action tap after 5 seconds to allow the chloroplasts to fall into the hot alcohol which immediately stops chemical reactions
- analyse the chloroplasts for different radioactively labelled compounds
- repeat the experiment allowing the chloroplasts to photosynthesise for 30 seconds before opening the tap.

Figure 2



0 1 . 4 Explain how the sequence of chemical reactions in photosynthesis can be determined using radioactive carbon dioxide**.**

[2 marks]

0 1 . 5 Suggest **two** advantages of using a suspension of chloroplasts, rather than a green plant in this investigation.

[2 marks]

Advantage 1 _____

Advantage 2 _____

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Question 1 continues on the next page

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ANSWER IN THE SPACES PROVIDED

The scientists separate the compounds in the chloroplasts by paper chromatography.

The chromatograms are placed on photographic film.

Dark patches are produced where there are radioactive compounds.

The size of the dark patches indicates the amount of radioactive compound present.

Figure 3 and **Figure 4** show the results after 5 and 30 seconds of photosynthesis.

Figure 3

After 5 seconds photosynthesis with $^{14}CO_2$

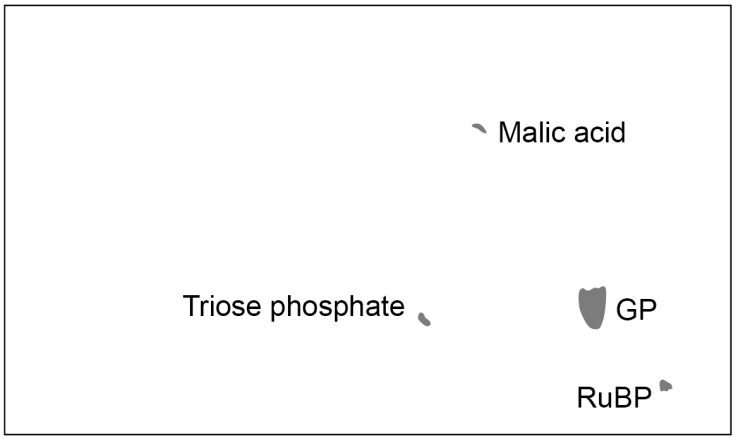
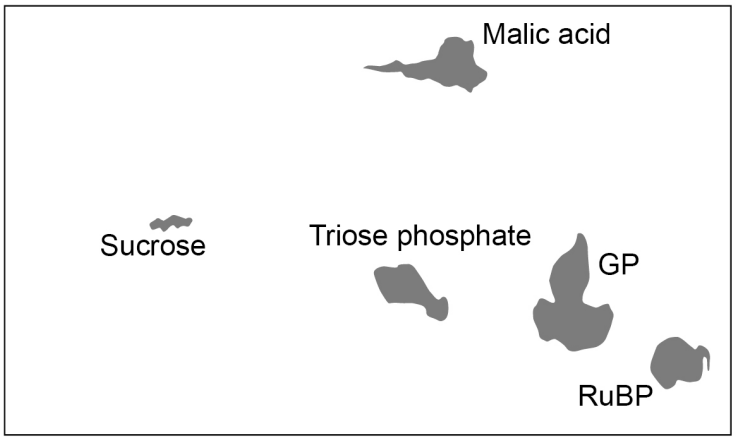


Figure 4

After 30 seconds photosynthesis with $^{14}CO_2$



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0 1 . 6 Identify which compound is produced first, using information from **Figure 3**.

[1 mark]

0 1 . 7 Explain why the amount of radioactive RuBP increases between 5 seconds and 30 seconds.

[2 marks]

15

Turn over for the next question

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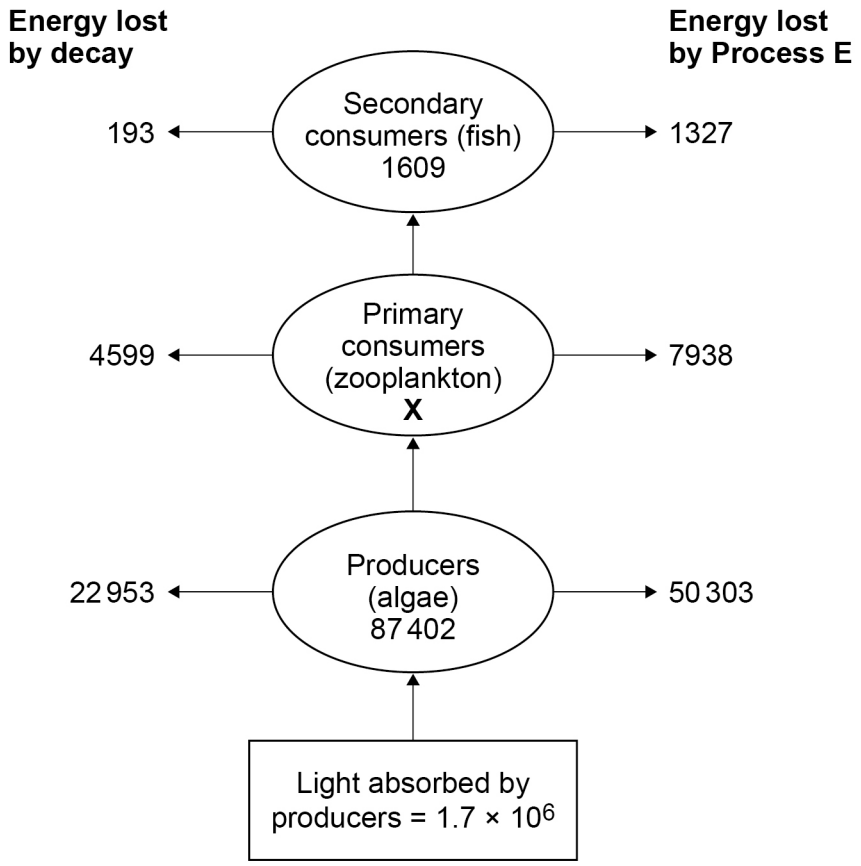
0 2 **Figure 5** shows the energy flow through a freshwater ecosystem in a lake. Algae are single-celled photosynthetic organisms and zooplankton are tiny animals that feed on algae.

Figure 5



0 2 . 1 Suggest suitable units for the numbers shown in **Figure 5**.

[2 marks]

_____

0 2 . 2 Name process **E** shown on **Figure 5**.

[1 mark]

Process **E** _____

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0 2 . 3 Calculate the gross primary production (GPP) of the producers as a percentage of the light energy they absorb.

Give your answer to 3 significant figures.

[2 marks]

Answer = _____ %

0 2 . 4 Value **X** in **Figure 5** is the gross production by the primary consumers.

Calculate the value of **X** and use this value to determine the efficiency of energy transfer between the producers and the primary consumers.

[2 marks]

Value **X** = _____

Efficiency of energy transfer = _____ %

0 2 . 5 A typical value for the efficiency of energy transfer between producers and primary consumers in terrestrial ecosystems is approximately 10%.

Suggest a reason for the efficiency transfer being higher than 10% in the ecosystem shown in **Figure 5** where single-celled algae are the producers.

[1 mark]

_____

_____

_____

Question 2 continues on the next page

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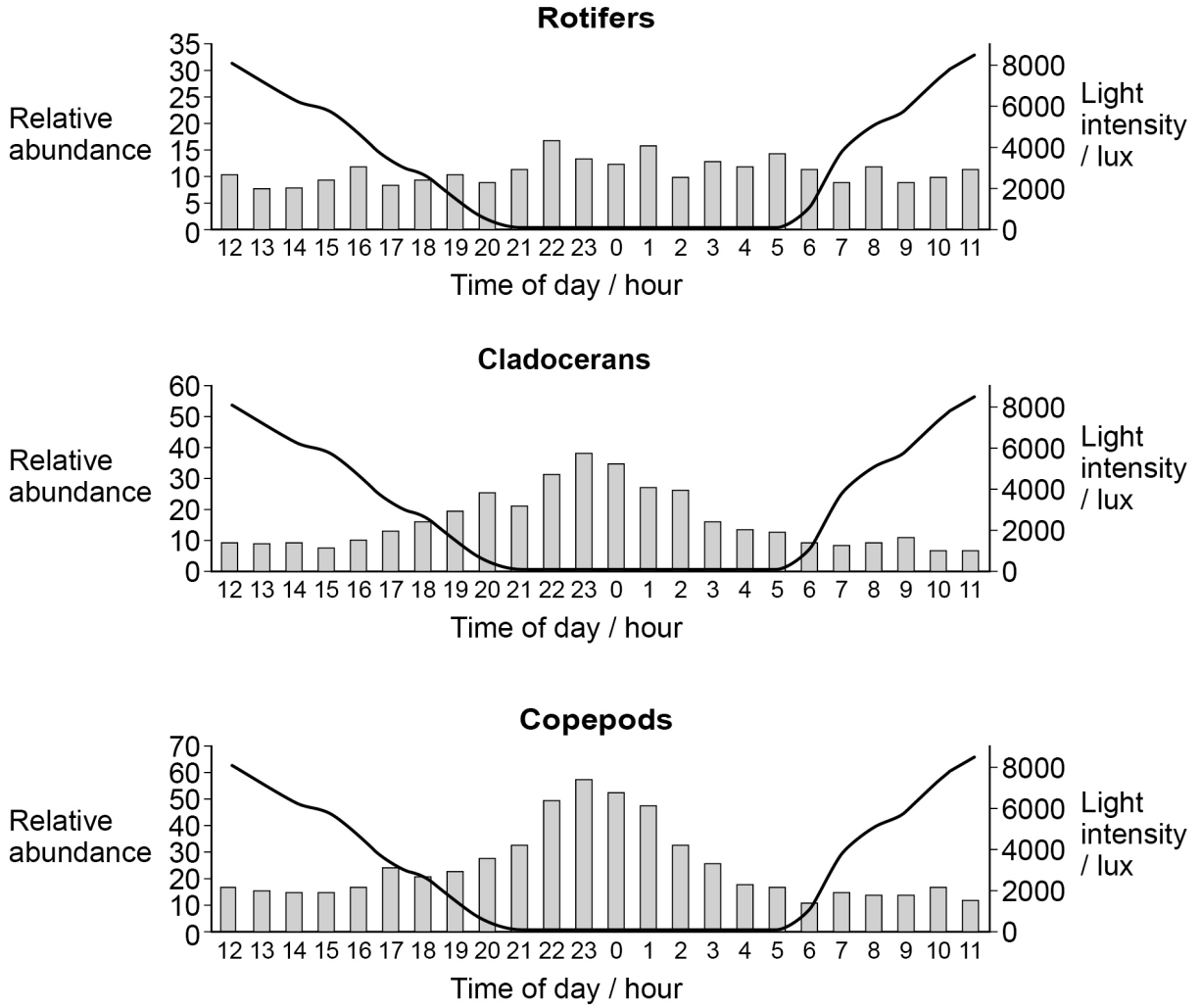
Zooplankton are tiny animals that eat the producers in the freshwater ecosystem.

Figure 6 shows the abundance of three types of zooplankton at different times of the day and the relative light intensity. All samples were taken at the surface of the lake.

Figure 6



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0 2 . 6 Compare the relative abundance of rotifers with the relative abundance of copepods during the 24 hours shown in **Figure 6**.

[2 marks]

0 2 . 7 Predatory fish also live in the lake.

The fish:

- feed on zooplankton
- hunt by sight.

Some types of zooplankton show vertical migratory patterns (move to different depths) over a 24-hour period.

Suggest how the differences in behaviour of the zooplankton may have evolved.

[6 marks]

16

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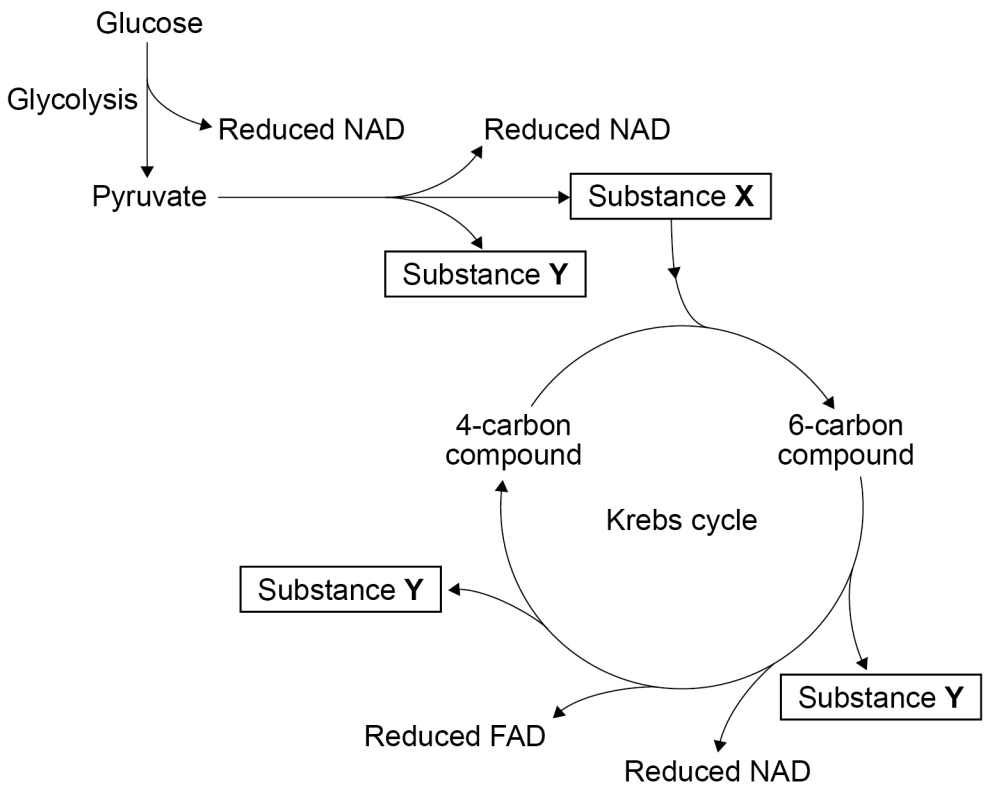
0 3 **Figure 7** shows some of the reactions in respiration.

Figure 7



0 3 . 1 Name:

[2 marks]

Substance **X** _____

Substance **Y** _____

0 3 . 2 State where in the cell the Krebs cycle occurs.

[1 mark]

_____

0 3 . 3 Give the number of carbon atoms that substance **X** adds to the Krebs cycle.

Use information from **Figure 7**.

[1 mark]

_____

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0 3 . 4 The reduced FAD and reduced NAD are passed to the electron transfer chain.

Explain how the reduced FAD and reduced NAD are used to synthesise ATP.

[4 marks]

0 3 . 5 Anaerobic respiration in animals produces lactate.

Explain how the production of lactate allows glycolysis to continue.

Use **Figure 7** and your own knowledge.

[2 marks]

10

Turn over for the next question

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0 4 Light intensity and wavelength can affect the rate of photosynthesis.

0 4 . 1 Describe an experiment to determine the effect of light intensity on the rate of photosynthesis.

[5 marks]

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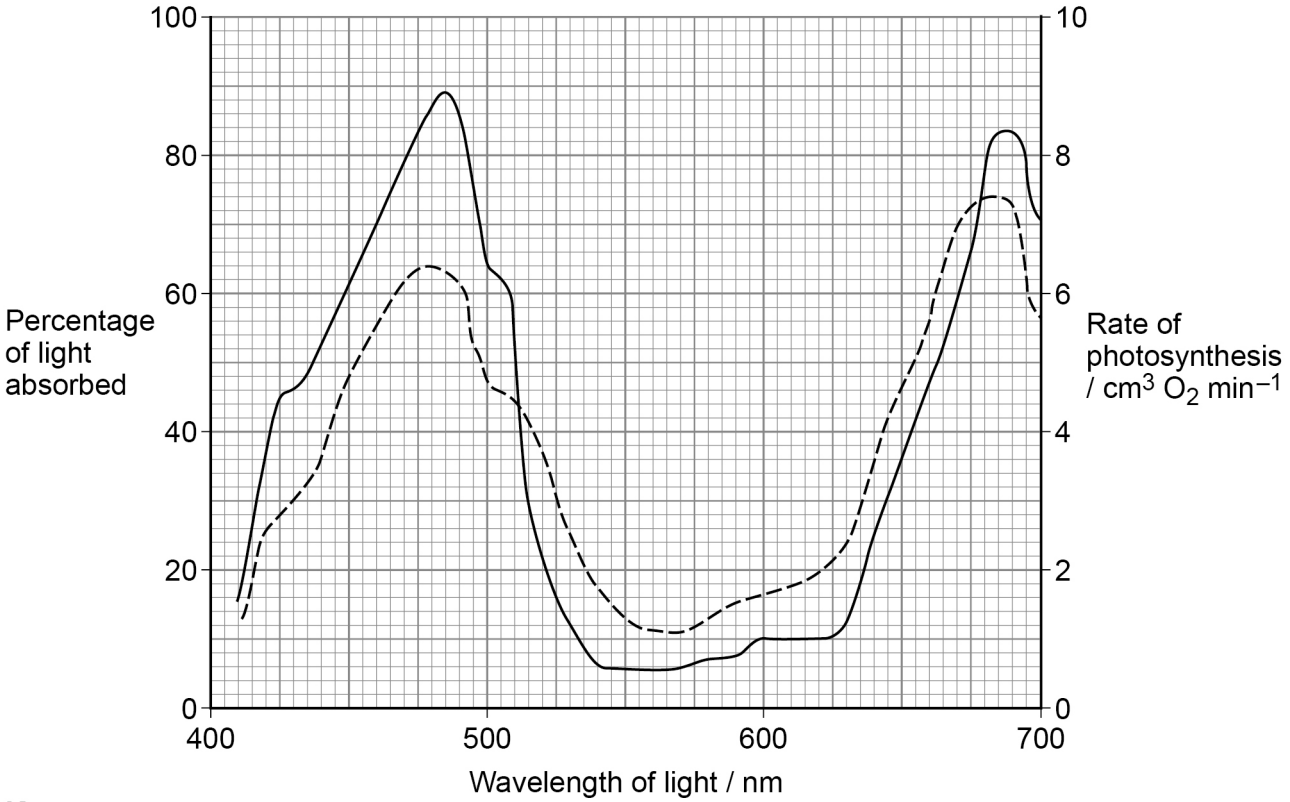
The rate of photosynthesis can also be measured when a plant is exposed to different wavelengths of light.

Figure 8 shows the rate of photosynthesis and the percentage of light absorbed when a plant is exposed to different wavelengths of light.

Figure 8



Key

——— Percentage of light absorbed

– – – – Rate of photosynthesis

0 4 . 2 Describe the pattern in the percentage of light absorbed shown in **Figure 8**.

Use data from **Figure 8**.

[2 marks]

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0 4 . 3 Give **one** reason a plant can absorb a range of different wavelengths of light.

[1 mark]

0 4 . 4 Give the reason why the two curves shown in **Figure 8** follow a similar pattern.

[1 mark]

0 4 . 5 State the range of wavelengths on **Figure 8** which correspond to green light.

Give a reason for your answer.

[2 marks]

Range of wavelengths = _____ nm

Reason: _____

As light passes through water some wavelengths are absorbed. Seaweeds are photosynthetic organisms found on sea shores. Seaweeds that are covered with water for most of the time appear red in colour because they contain a red pigment called phycoerythrin.

0 4 . 6 Suggest the advantage to these seaweeds of containing phycoerythrin.

[2 marks]

13

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0 5 Some alleles are described as being recessive.
Some genes are described as being sex-linked.

0 5 . 1 Define the terms:

- recessive
- sex-linked.

[2 marks]

Recessive _____

_____

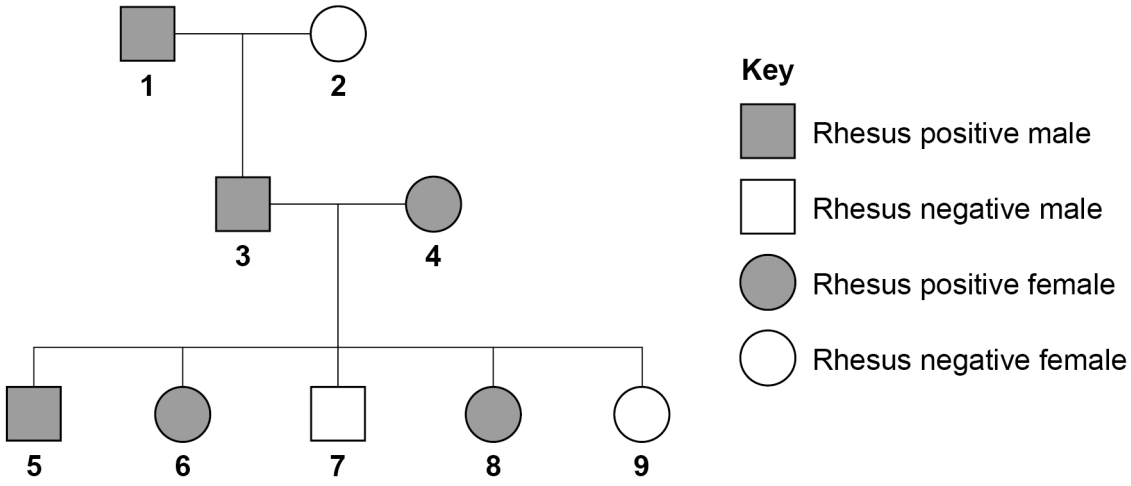
Sex-linked _____

_____

The Rhesus blood group is genetically controlled.
The gene for the Rhesus blood group has two alleles.
The allele for Rhesus positive is dominant to the allele for Rhesus negative.

Figure 9 shows the inheritance of the Rhesus blood group in a family.

Figure 9



0 5 . 2 Explain how **Figure 9** shows that the allele for Rhesus positive is **not** sex-linked.

[2 marks]

_____

_____

_____

_____

_____

_____

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0 5 . 3 In Asia, 3% of the population are Rhesus negative.

Calculate the percentage of the population expected to be heterozygous for the Rhesus gene. Use the Hardy–Weinberg equation.

[2 marks]

Answer = _____ %

6

Turn over for the next question

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0 6 . 1 Nitrogen is an essential element in all living organisms.

Describe how nitrogen in the organic compounds of dead organisms is made available to plants.

Include the role of microorganisms in this process.

[5 marks]

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0 6 . 2 Describe how plants can use the nitrogen found in the substances they absorb from the soil to make useful organic compounds.

Give specific examples of organic compounds that contain nitrogen.

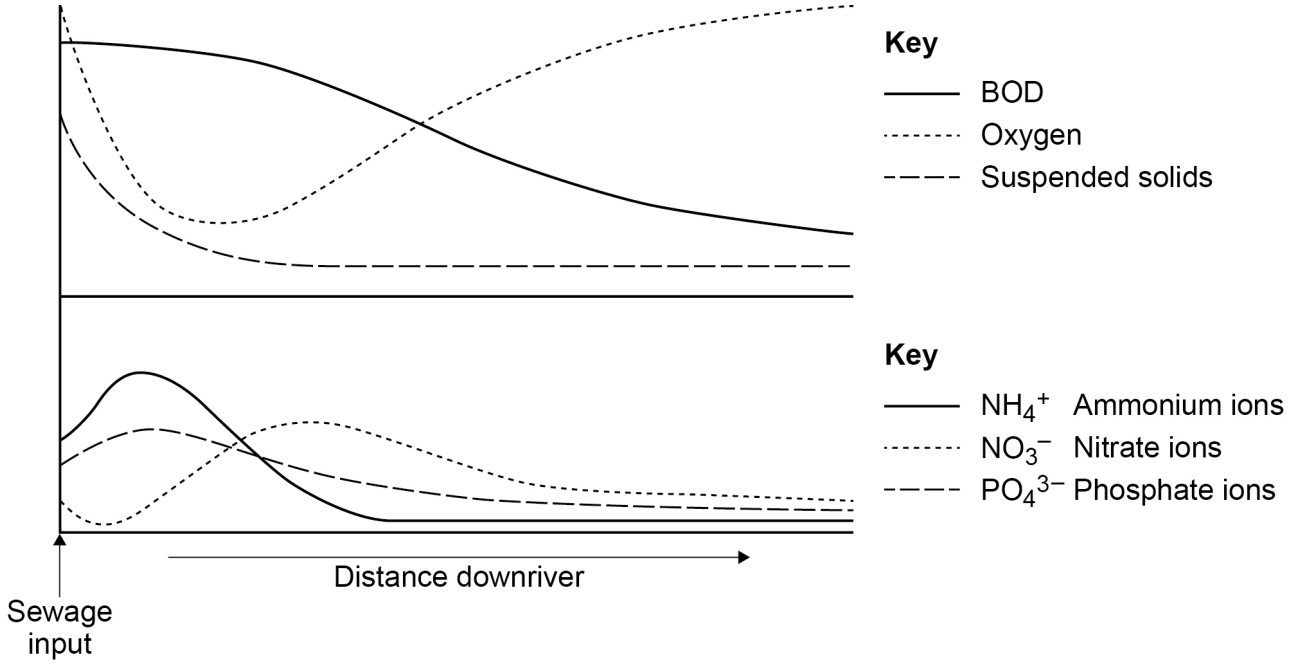
[4 marks]

Sometimes sewage from human homes drains into rivers.

Figure 10 shows the amounts of different substances in a river downstream from a sewage input.

The **Biochemical oxygen demand** (**BOD**) is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in the water.

Figure 10



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0 6 . 3 Explain the changes shown in **Figure 10**.

[6 marks]

END OF QUESTIONS

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