

QUESTION 1: N/A

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A biologist investigated the behaviour of a species of worm that lives in soil.

He cultured three samples of worms in three separate trays of soil for many days. Each culture:

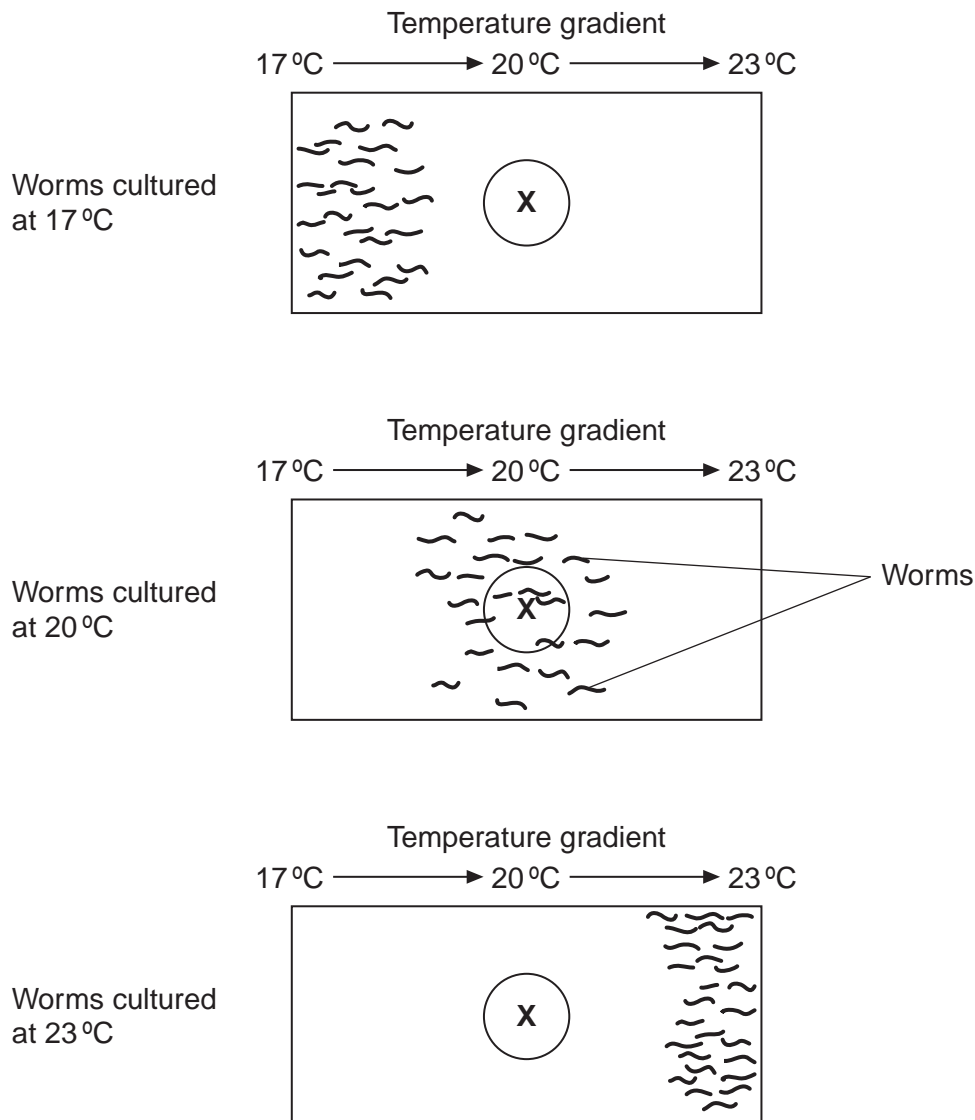
- contained a food supply
- was kept at a different temperature.

The temperatures of the cultures were 17 °C, 20 °C and 23 °C.

The biologist then removed food from the trays for several hours. Then he transferred each sample of worms onto a glass surface where there was **no food**. Each surface had a temperature gradient across it. After 1 hour, the biologist recorded the position of each worm.

Figure 2 shows his results. On each diagram, (X) marks where he released the worms onto the glass surface.

Figure 2



- 2 (a)** The biologist concluded that the worms' behaviour demonstrated taxis. How do these results support this conclusion?

[2 marks]

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- 2 (b)** Using the information provided, suggest an explanation for the worms' behaviour on the glass surfaces in the absence of food.

[3 marks]

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- 2 (c)** In each experiment, the biologist exposed the surfaces to light that was dim and even, so he could see where the worms went.

Apart from seeing where the worms went, suggest **two** reasons why it was important that the light was dim and even.

[2 marks]

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- 3 (a)** A myelinated axon conducts impulses faster than a non-myelinated axon.
Explain this difference.

[3 marks]

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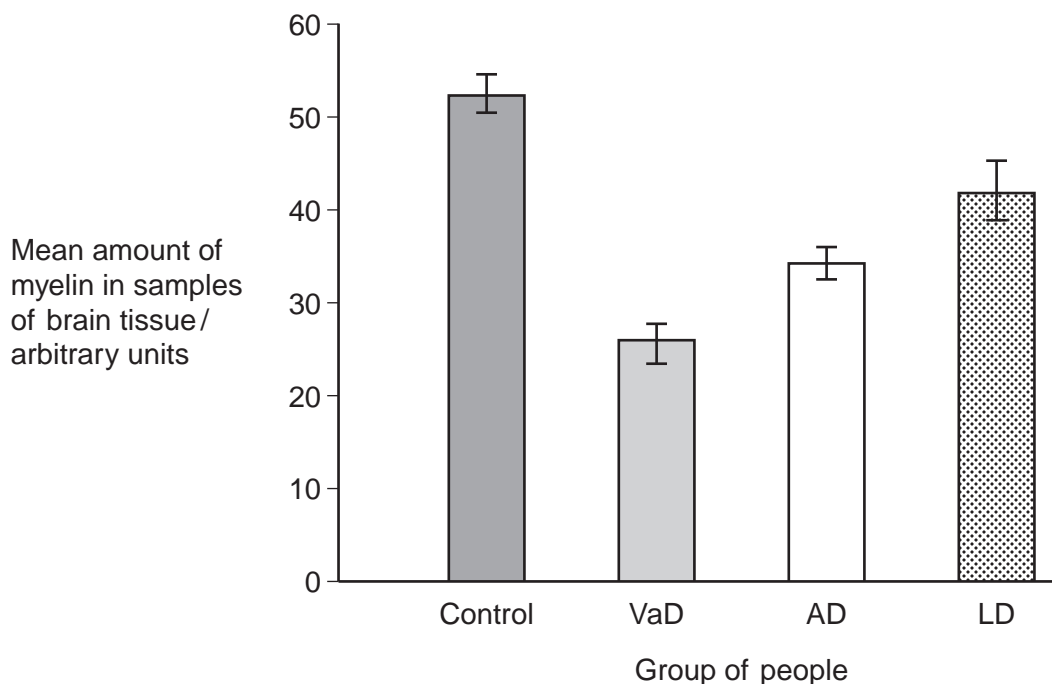
Doctors investigated the relationship between myelin in brain tissue and different types of dementia. All types of dementia involve loss of mental ability.

The doctors measured the mean amount of myelin in samples of brain tissue from:

- a control group of 12 people without dementia
- 20 people with vascular dementia (VaD)
- 19 people with Alzheimer's dementia (AD)
- 31 people with Lewy body dementia (LD).

The doctors' results are shown in **Figure 3**. The vertical bars show standard errors.

Figure 3



- 3 (b)** The doctors used a statistical test to compare the results for AD and LD. They obtained a value for P of 0.047.

What does this result show about the difference between the means for AD and LD?

Use the words **probability** and **chance** in your answer.

[2 marks]

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- 3 (c)** A student who read this investigation concluded that there was a relationship between the amount of myelin in a person's brain and whether or not they had dementia.

Do these data support this conclusion? Give reasons for your answer.

[4 marks]

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QUESTION 4: N/A

5 Hodgkin's lymphoma (HL) is a type of cancer. It is usually treated using chemotherapy.

In young female patients with HL, chemotherapy can reduce their ability to have children in later life. This is because some of the drugs used in chemotherapy destroy developing follicles in their ovaries.

5 (a) Destruction of developing follicles during chemotherapy can lead to a much higher concentration of FSH in the young female patients' bodies than normal.

Use your knowledge of hormonal interactions to explain why.

[2 marks]

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5 (b) Some young female patients with HL are given an artificial hormone during chemotherapy. This artificial hormone **reduces** the release of FSH.

5 (b) (i) Suggest how the artificial hormone helps to prevent a reduction in their ability to have children in later life.

[3 marks]

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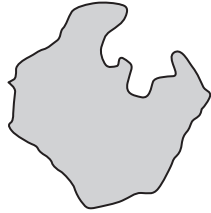
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- 5 (b) (ii) **Figure 4** shows the structures of the artificial hormone and the hormone that normally causes the release of FSH.

Figure 4



Artificial hormone



Hormone that normally
causes the release of FSH

Suggest how the artificial hormone reduces the release of FSH.

[2 marks]

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Turn over for the next question

- 6 (a)** What is the role of phosphocreatine (PC) in providing energy during muscle contraction?

[2 marks]

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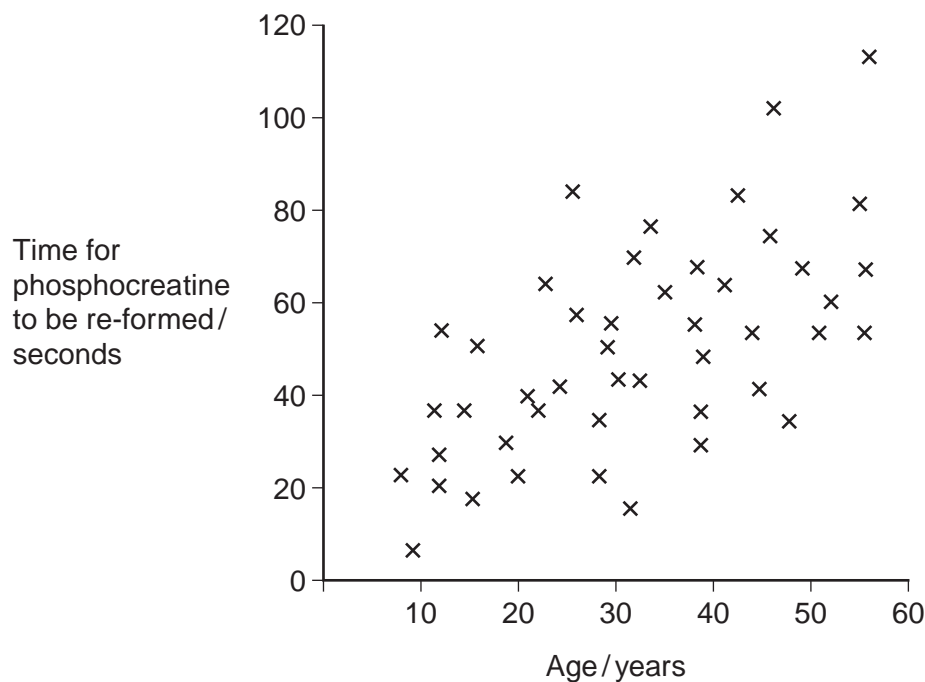
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Scientists investigated the time for phosphocreatine (PC) to be re-formed in arm muscles after the same exercise in healthy people of different ages. The exercise involved brief, rapid contractions of arm muscles.

Figure 5 shows the scientists' results. Each cross is the result for one person.

Figure 5



- 6 (b)** There is a lot of variation in the time taken for PC to be re-formed in people of a very similar age.

Suggest **one** reason for this variation.

[1 mark]

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6 (c) Use your knowledge of fast muscle fibres to explain the data in **Figure 5**.

[4 marks]

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Turn over for the next question

7 Upwelling is a process where water moves from deeper parts of the sea to the surface. This water contains a lot of nutrients from the remains of dead organisms.

- (a) (i) Nitrates and phosphates are two of these nutrients. They provide a source of nitrogen and phosphorus for cells.

Give a biological molecule that contains:

[2 marks]

1. nitrogen

2. phosphorus.....

- (a) (ii) Describe the role of microorganisms in producing nitrates from the remains of dead organisms.

[3 marks]

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- (b) Upwelling often results in high primary productivity in coastal waters.
Explain why some of the most productive fishing areas are found in coastal waters.

[2 marks]

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- 8 Farmland previously used for growing crops was left for 30 years and developed into woodland. During this period, ecologists recorded an increase in the diversity of birds in the area.

(a) Name the process that resulted in the development of woodland from farmland. **[1 mark]**

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(b) Explain the increase in the diversity of birds as the woodland developed. **[3 marks]**

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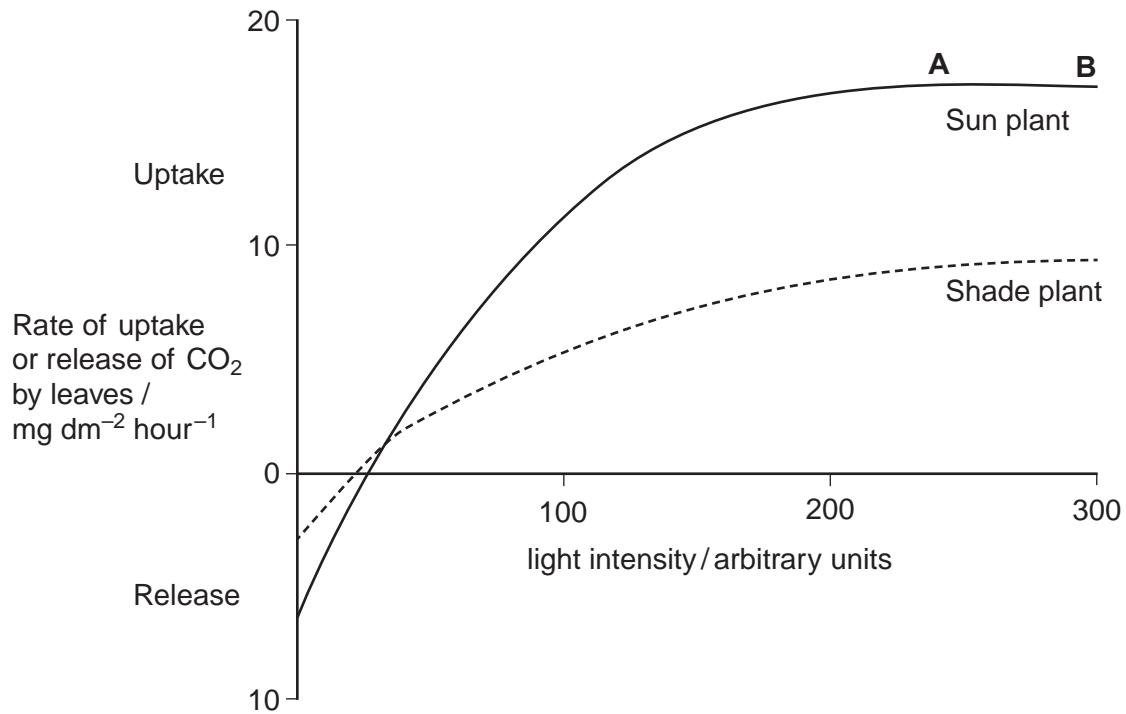
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- 8 (c) The ecologists also investigated photosynthesis in two species of plant found in the woodland. One of the species was adapted to growing in bright sunlight (sun plant) and the other was adapted to growing in the shade (shade plant). The ecologists' results are shown in **Figure 2**.

Figure 2



- 8 (c) (i) Give **two** factors which could be limiting the rate of photosynthesis in the sun plant between points **A** and **B** on **Figure 2**.

[1 mark]

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- (c) (ii) Explain why CO₂ uptake is a measure of net productivity.

[1 mark]

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- (c) (iii) Use the information in **Figure 2** to explain how the shade plant is better adapted than the sun plant to growing at low light intensities.

[2 marks]

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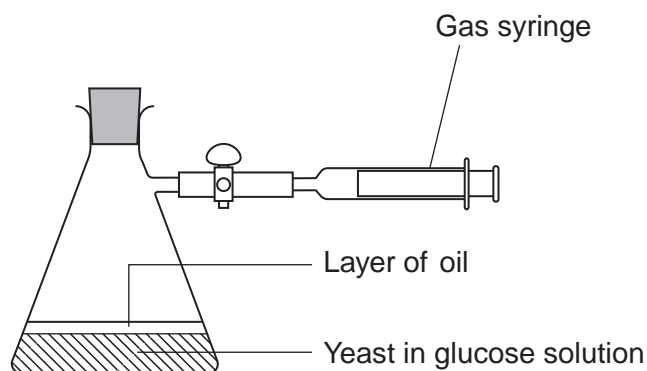
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A student investigated the rate of anaerobic respiration in yeast. She put 5 g of yeast into a glucose solution and placed this mixture in the apparatus shown in **Figure 4**. She then recorded the total volume of gas collected every 10 minutes for 1 hour.

Figure 4

- (a) Explain why a layer of oil is required in this investigation.

[1 mark]

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- (b) The student's results are shown in **Table 3**.

Table 3

Time / minutes	Total volume of gas collected / cm ³
10	0.3
20	0.9
30	1.9
40	3.1
50	5.0
60	5.2

- 9 (b) (i) Calculate the rate of gas production in $\text{cm}^3 \text{g}^{-1} \text{min}^{-1}$ during the first 40 minutes of this investigation. Show your working.

[2 marks]

Answer = $\text{cm}^3 \text{g}^{-1} \text{min}^{-1}$

- (b) (ii) Suggest why the rate of gas production decreased between 50 and 60 minutes.

[1 mark]

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- (b) (iii) Yeast can also respire aerobically. The student repeated the investigation with a fresh sample of yeast in glucose solution, but without the oil. All other conditions remained the same.

Explain what would happen to the volume of gas in the syringe if the yeast were only respiring aerobically.

[2 marks]

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- (c) Respiration produces more ATP per molecule of glucose in the presence of oxygen than it does when oxygen is absent. Explain why.

[2 marks]

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- 10 (a) During the light-independent reaction of photosynthesis, carbon dioxide is converted into organic substances. Describe how.

[6 marks]

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Question 8 continues on the next page

10 (b) Explain how human activities have contributed to global warming.

[4 marks]

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- 10 (c) The bluebell is a flowering plant found in woodlands. Global warming has been associated with a change in the population of bluebells. Describe how you could estimate the number of bluebells in a small woodland.

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END OF QUESTIONS