Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination

Biology

For this paper you must have:
- a ruler with millimetre measurements.
- a calculator.

Time allowed
- 1 hour 45 minutes

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.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- 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 85.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

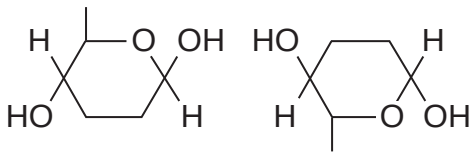
Answer **all** questions in the spaces provided.

1 (a) The table shows some substances found in cells. Complete the table to show the properties of these substances. Put a tick in the box if the statement is correct.

Statement	Substance			
	Starch	Glycogen	Deoxyribose	DNA helicase
Substance contains only the elements carbon, hydrogen and oxygen				
Substance is made from amino acid monomers				
Substance is found in both animal cells and plant cells				

(4 marks)

1 (b) The diagram shows two molecules of β-glucose.



On the diagram, draw a box around the atoms that are removed when the two β-glucose molecules are joined by condensation.

(2 marks)

Do not write outside the box

1 (c) (i) Hydrogen bonds are important in cellulose molecules. Explain why.

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(2 marks)

1 (c) (ii) A starch molecule has a spiral shape. Explain why this shape is important to its function in cells.

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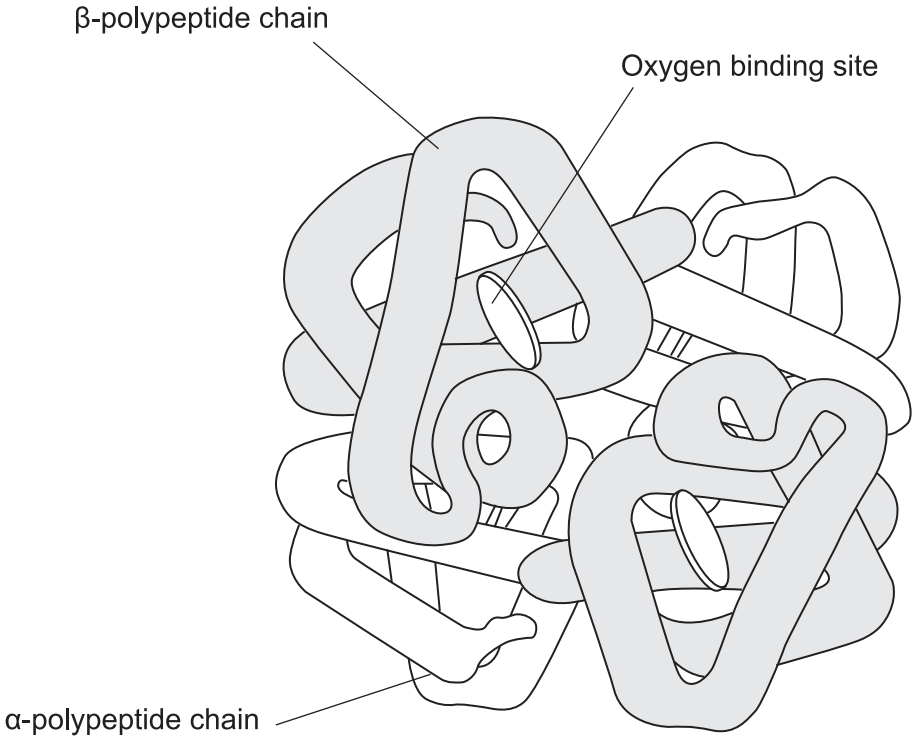
(1 mark)

9

Turn over for the next question

Do not write outside the box

2 The diagram shows a molecule of haemoglobin.



2 (a) What is the evidence from the diagram that haemoglobin has a quaternary structure?

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(1 mark)

2 (b) (i) A gene codes for the α-polypeptide chain. There are 423 bases in this gene that code for amino acids. How many amino acids are there in the α-polypeptide chain?

(1 mark)

2 (b) (ii) The total number of bases in the DNA of the α-polypeptide gene is more than 423. Give **two** reasons why there are more than 423 bases.

1 .....

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(2 marks)

Do not write outside the box

2 (c) The haemoglobin in one organism may have a different chemical structure from the haemoglobin in another organism. Describe how.

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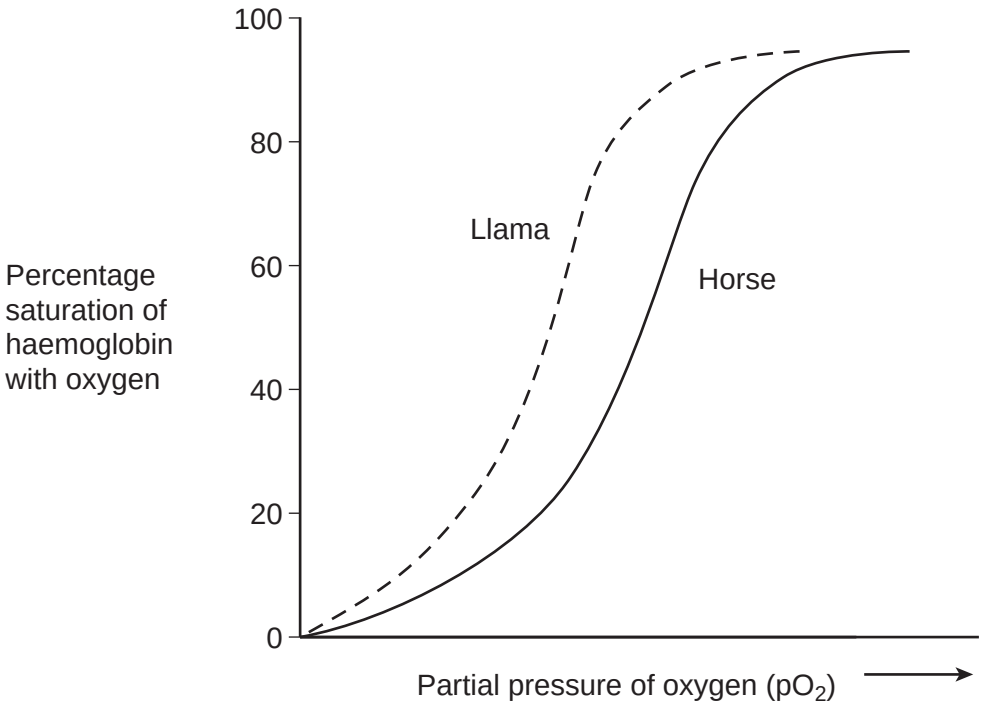
(1 mark)

2 (d) The graph shows oxygen dissociation curves for horse haemoglobin and for llama haemoglobin. Horses are adapted to live at sea level and llamas are adapted to live in high mountains.



Use the graph to explain why llamas are better adapted to live in high mountains than horses.

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(3 marks)

(Extra space) .....

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8

Turn over ▶

6

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3 (a) An order is a taxonomic group. Fruit flies and mosquitoes belong to the same order of insects. Name the other **three** taxonomic groups to which fruit flies and mosquitoes both belong.

1 .....

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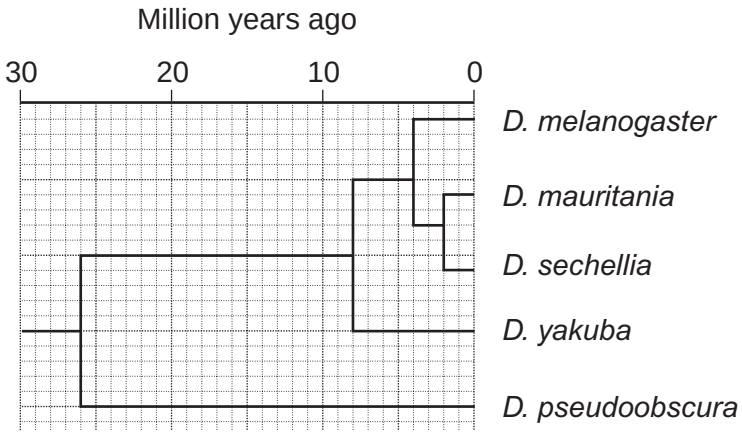
(2 marks)

The diagram shows the phylogenetic relationship between five species of fruit fly that belong to the genus *Drosophila.*



3 (b) (i) Explain what is meant by a phylogenetic relationship.

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(1 mark)

3 (b) (ii) How many million years ago did *D. melanogaster* and *D. pseudoobscura* last share a common ancestor?

(1 mark)

Do not write outside the box

3 (c) Scientists used DNA hybridisation to confirm the relationship between *D. mauritania, D. sechellia* and *D. yakuba.*

3 (c) (i) They made samples of hybrid DNA using a gene that was found in all three species. Explain why it was important that they made samples of hybrid DNA from the same gene.

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(2 marks)

3 (c) (ii) The hybrid DNA formed between *D. mauritania* and *D. sechellia* separated at a higher temperature than the hybrid DNA formed between *D. mauritania* and *D. yakuba.* Explain what caused the DNA to separate at a higher temperature.

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(2 marks)

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Turn over for the next question

Do not write outside the box

4 The table shows some differences between three varieties of banana plant.

	Variety **A**	Variety **B**	Variety **C**
Number of chromosomes in a leaf cell	22	33	44
Growth rate of fruit / cm^3 $week^{-1}$	2.9	6.9	7.2
Breaking strength of leaf / arbitrary units	10.8	9.4	7.8

4 (a) (i) How many chromosomes are there in a male gamete from variety **C**?

(1 mark)

4 (a) (ii) Variety **B** cannot produce fertile gametes. Use information in the table to explain why.

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(2 marks)

Do not write outside the box

In some countries very strong winds may occur. Banana growers in these countries choose to grow variety **B**.

4 (b) (i) Use the data in the table to explain why banana growers in these countries choose to grow variety **B** rather than variety **A**.

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(1 mark)

4 (b) (ii) Use the data in the table to explain why banana growers in these countries choose to grow variety **B** rather than variety **C**.

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(1 mark)

4 (c) Banana growers can only grow new variety **B** plants from suckers. Suckers grow from cells at the base of the stem of the parent plant.

Use your knowledge of cell division to explain how growing variety **B** on a large scale will affect the genetic diversity of bananas.

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(2 marks)

7

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5 (a) What information is required to calculate an index of diversity for a particular community?

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(1 mark)

5 (b) Farmers clear tropical forest and grow crops instead. Explain how this causes the diversity of insects in the area to decrease.

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(3 marks)

(Extra space) .....

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Question 5 continues on the next page

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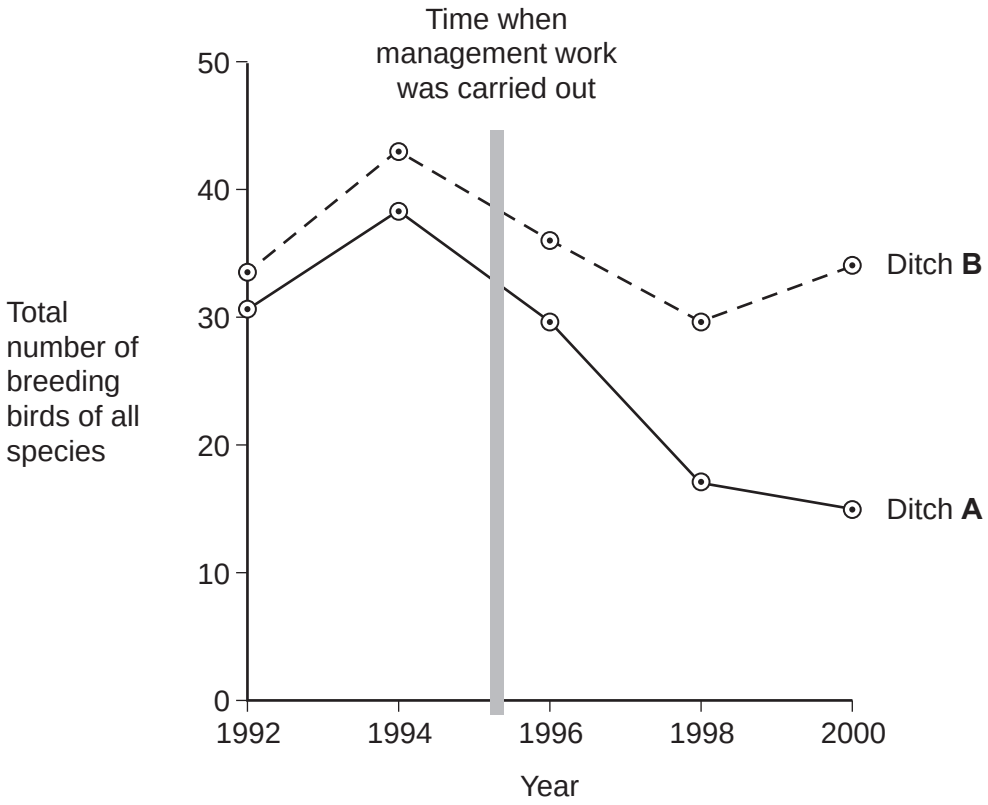
Farmers manage the ditches that drain water from their fields. If they do not, the ditches will become blocked by plants. Biologists investigated the effects of two different ways of managing ditches on farmland birds.

- Ditch **A** was cleared of plants on both banks
- Ditch **B** was cleared of plants on one bank.

The graph shows the number of breeding birds of all species along the two ditches, before and after management.



5 (c) (i) The points on the graph have been joined with straight lines rather than with a smooth curve. Explain why they have been joined with straight lines.

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(1 mark)

5 (c) (ii) It would have been useful to have had a control ditch in this investigation. Explain why.

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(1 mark)

Do not write outside the box

5 (d) A farmer who wanted to increase the diversity of birds on his land read about this investigation.
He concluded that clearing the plants from one bank would not decrease diversity as much as clearing the plants from both banks. Evaluate this conclusion.

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(3 marks)

(Extra space) .....

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Turn over for the next question

Do not write outside the box

6 Penicillins are antibiotics. Some bacteria produce an enzyme that breaks down one sort of penicillin.

6 (a) The gene that codes for this enzyme may be passed from one species of bacteria to another species. Describe how.

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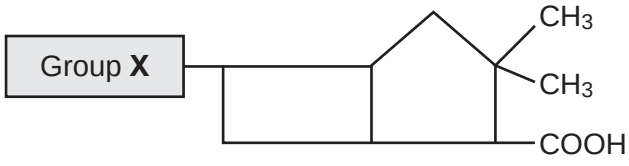
(2 marks)

6 (b) There are different sorts of penicillin. All of these have the same basic chemical structure shown in the diagram but group **X** is different.



A bacterial infection that cannot be treated with one sort of penicillin can be treated with a different sort. Use your knowledge of enzyme action to explain why the different sort of penicillin is effective in treating the infection.

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(3 marks)

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6 (c) Farmers often keep large numbers of cattle together. Farmers used to give cattle food which had antibiotics added to it.

6 (c) (i) Suggest how adding antibiotics to the food of the cattle increased profit for the farmers.

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(2 marks)

6 (c) (ii) Adding antibiotics to the food of cattle is now banned in many countries. Use your knowledge of selection to explain why adding antibiotics was banned.

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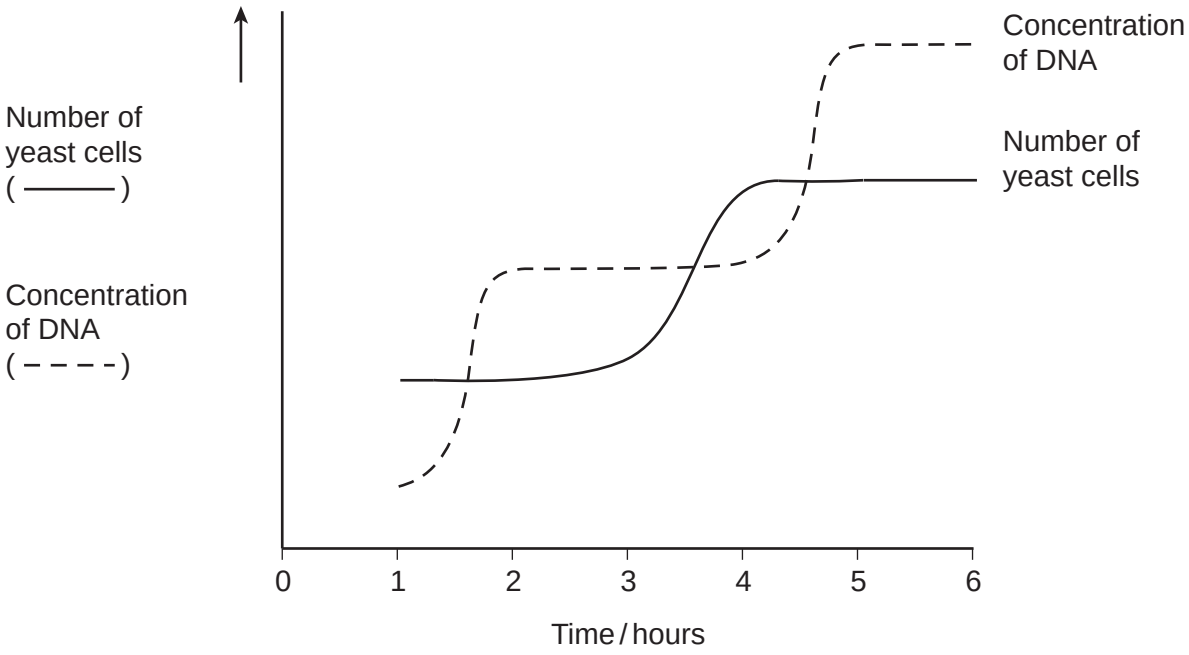
(2 marks)

9

Turn over for the next question

7 Yeast is a single-celled eukaryotic organism. When yeast cells are grown, each cell forms a bud. This bud grows into a new cell. This allows yeast to multiply because the parent cell is still alive and the new cell has been formed.

Scientists grew yeast cells in a culture. They counted the number of cells present and measured the total concentration of DNA in the culture over a period of 6 hours. Their results are shown in the graph.



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7 (a) Use your knowledge of the cell cycle to explain the shape of the curve for the number of yeast cells

7 (a) (i) between 1 and 2 hours

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(1 mark)

7 (a) (ii) between 3 and 4 hours.

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(1 mark)

7 (b) Use the curve for the concentration of DNA to find the length of a cell cycle in these yeast cells. Explain how you arrived at your answer.

Length of cell cycle .....

Explanation .....

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(3 marks)

5

Turn over ▶

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ANSWER IN THE SPACES PROVIDED

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8 (a) Students measured the rate of transpiration of a plant growing in a pot under different environmental conditions. Their results are shown in the table.

Conditions			Transpiration rate / g h^{-1}
A	Still air	15 °C	1.2
B	Moving air	15 °C	1.7
C	Still air	25 °C	2.3

During transpiration, water diffuses from cells to the air surrounding a leaf.

8 (a) (i) Suggest an explanation for the difference in transpiration rate between conditions **A** and **B.**

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(2 marks)

8 (a) (ii) Suggest an explanation for the difference in transpiration rate between conditions **A** and **C.**

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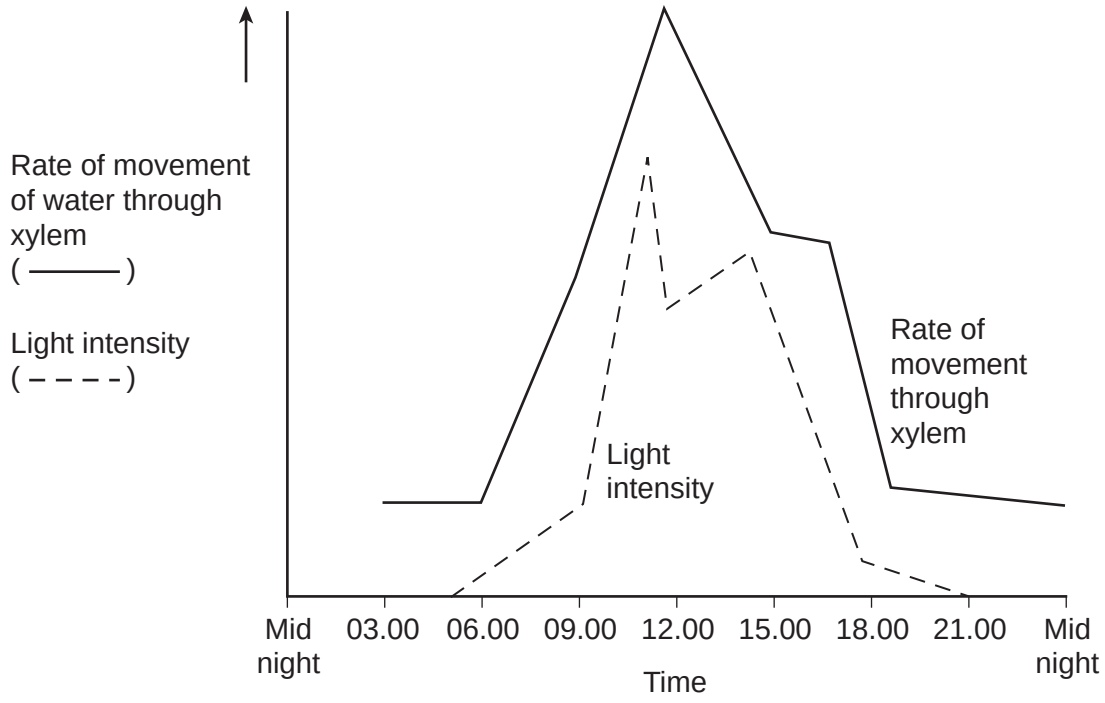
(2 marks)

Question 8 continues on the next page

8 (b) Scientists investigated the rate of water movement through the xylem of a twig from a tree over 24 hours. The graph shows their results. It also shows the light intensity for the same period of time.



8 (b) (i) Describe the relationship between the rate of water movement through the xylem and the light intensity.

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(1 mark)

8 (b) (ii) Explain the change in the rate of water movement through the xylem between 06.00 and 12.00 hours.

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(2 marks)

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8 (b) (iii) The scientists also measured the diameter of the trunk of the tree on which the twig had been growing. The diameter was less at 12.00 than it was at 03.00 hours. Explain why the diameter was less at 12.00 hours.

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(2 marks)

Question 8 continues on the next page

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8 (c) Arteries and arterioles take blood away from the heart.
Explain how the structures of the walls of arteries and arterioles are related to their functions.

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(6 marks)

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Question 9 starts on page 24

Turn over for the next question

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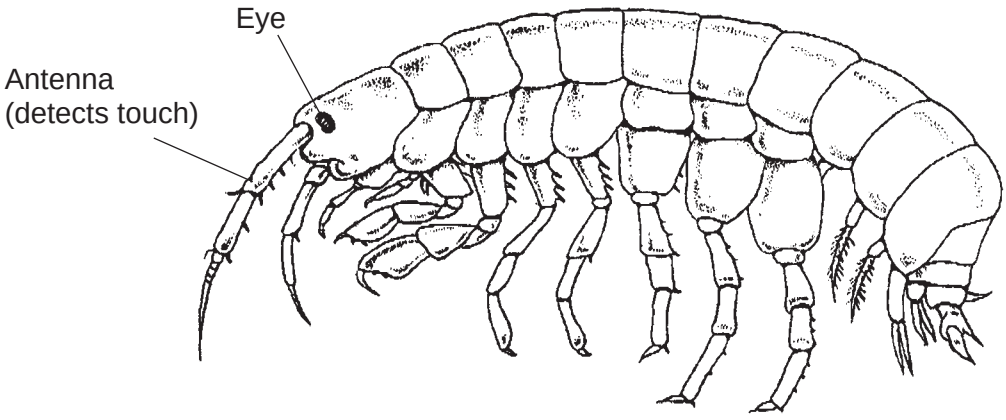
9 **Figure 1** shows a fresh-water shrimp.

Figure 1



Biologists collected shrimps from a stream inside a cave and from the same stream when it was in the open.
They measured the maximum diameter of each shrimp's eye. They also measured the length of its antenna. From these measurements they calculated the mean values for each site. **Figure 2** shows their results.

Figure 2

	Shrimps from the stream	
	inside the cave	**in the open**
Mean diameter of eye / mm	0.09	0.24
Mean length of antenna / mm	8.46	5.81

9 (a) The biologists measured the maximum diameter of each shrimp's eye.
Explain why they measured the **maximum** diameter.

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(1 mark)

Do not write outside the box

9 (b) A scientist working many years earlier suggested that animals which live in caves had similar adaptations. These adaptations included

- smaller eyes
- greater use of sense organs such as those involved in detecting touch.

9 (b) (i) Do the data in **Figure 2** support this scientist's suggestion? Explain your answer.

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(2 marks)

9 (b) (ii) The data in **Figure 2** are mean values. Explain how standard deviations of these mean values would help you to interpret the data in **Figure 2.**

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(2 marks)

Question 9 continues on the next page

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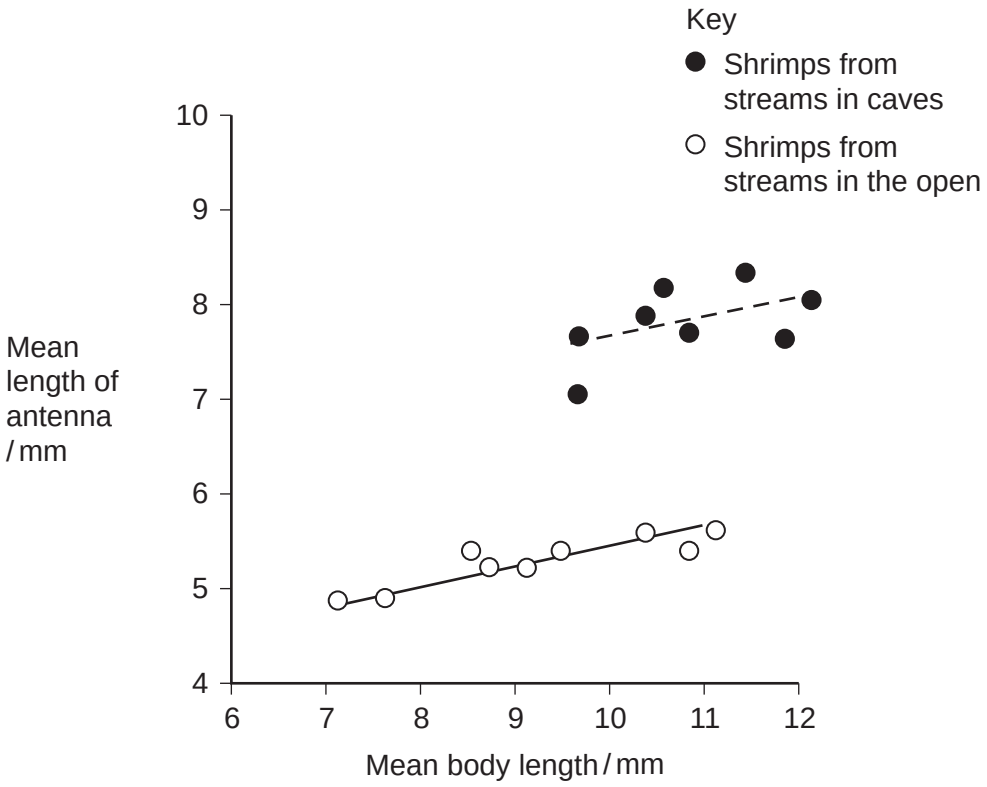
9 (c) The biologists investigated shrimps living in other streams. They measured the length of the antennae of these shrimps. They also measured their body length. **Figure 3** shows the mean antenna length plotted against mean body length for each site.

Figure 3



9 (c) (i) What does the information in the graph suggest about the body lengths of shrimps living in caves and living in the open?

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(2 marks)

9 (c) (ii) Do the data in the graph support the conclusion that shrimps with longer bodies have longer antennae? Give the reason for your answer.

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(1 mark)

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Other biologists investigated the genetic diversity of these shrimps.
Figure 4 shows some of the data they collected.

Figure 4

Gene	Allele	Percentage of shrimps with this allele in stream	
		inside a cave	in the open
PGI	**A**	0.9	2.5
	B	0.0	3.3
	C	98.2	66.4
	D	0.9	6.6
	E	0.0	21.3
ACO2	**J**	0.0	5.6
	K	0.0	76.7
	L	100.0	17.8

9 (d) The biologists concluded that the shrimps in the open had a higher genetic diversity than those in the cave. Explain how the data in **Figure 4** support this conclusion.

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(1 mark)

9 (e) The percentage of shrimps with allele **L** in the cave is different from the percentage of shrimps with allele **L** in the open. Use your knowledge of the founder effect to suggest a reason for this difference.

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(3 marks)

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Question 9 continues on the next page

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9 (f) The biologists who studied these shrimps wanted to know if the shrimps living in the cave were the same species as those living in the open. They used breeding experiments to investigate this.

9 (f) (i) Describe how the biologists should carry out these breeding experiments.

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9 (f) (ii) The results of breeding experiments would help the biologists to decide whether the shrimps were the same species. Explain how.

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(3 marks)

15

END OF QUESTIONS