Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2005
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY (SPECIFICATION A) BYA6
Unit 6 Physiology and the Environment

Tuesday 21 June 2005 Morning Session

In addition to this paper you will require:
- a ruler with millimetre measurements.

You may use a calculator.

Time allowed: 1 hour 30 minutes.

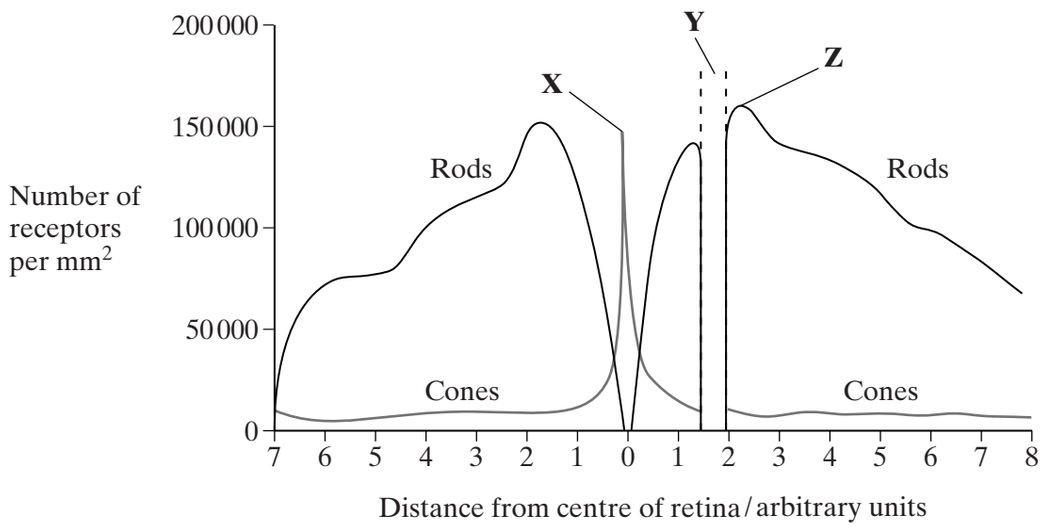
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 75.
- Mark allocations are shown in brackets.
- You will be assessed on your ability to use an appropriate form and style of writing, to organise relevant information clearly and coherently, and to use specialist vocabulary, where appropriate.
- The degree of legibility of your handwriting and the level of accuracy of your spelling, punctuation and grammar will also be taken into account.
- You are reminded that this test requires you to use your knowledge of Modules 1, 2, 4 and 5 as well as Module 6 in answering synoptic questions. These questions are indicated by the letter **S**.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
9			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 The graph shows the distribution of rod cells and cone cells across the retina of a human eye.



(a) Use the diagram to explain why

(i) no image is perceived when light is focused on the retina at **Y**;

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(1 mark)

(ii) an image formed at **X** is perceived in more detail than an image formed at **Z**.

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(2 marks)

(b) Describe how cone cells allow us to see different colours.

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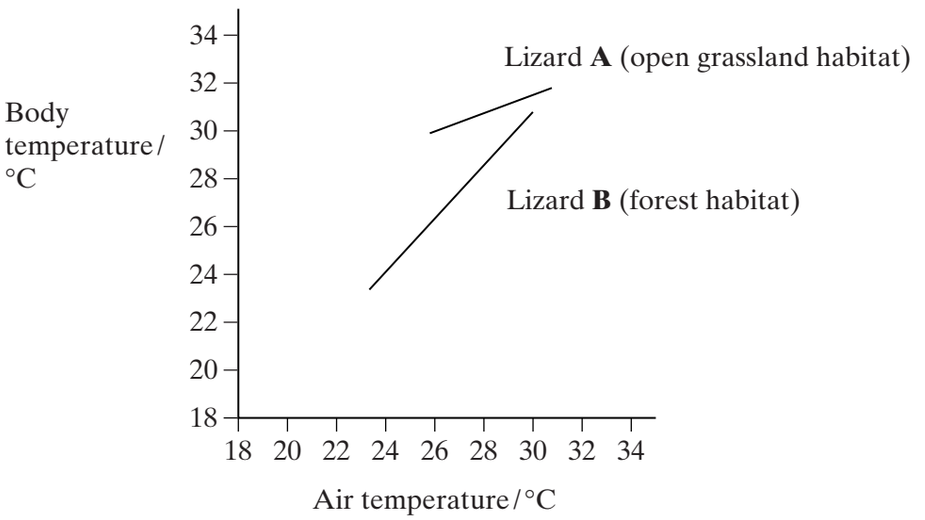
(2 marks)

5

2 Lizards are reptiles. The graph shows the results of an investigation into the relationship between air temperature and body temperature for two lizards living in different habitats. The investigation took place on a hot sunny day over a period of four hours.



(a) (i) Explain the relationship between the air temperature and the body temperature for lizard **B**.

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(1 mark)

(ii) Suggest an explanation for the different pattern shown by lizard **A**.

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(1 mark)

S (b) Lizard **B** moves more slowly when its body temperature is 24 °C than when it is 28 °C. Explain what causes the slower movements at the lower temperature.

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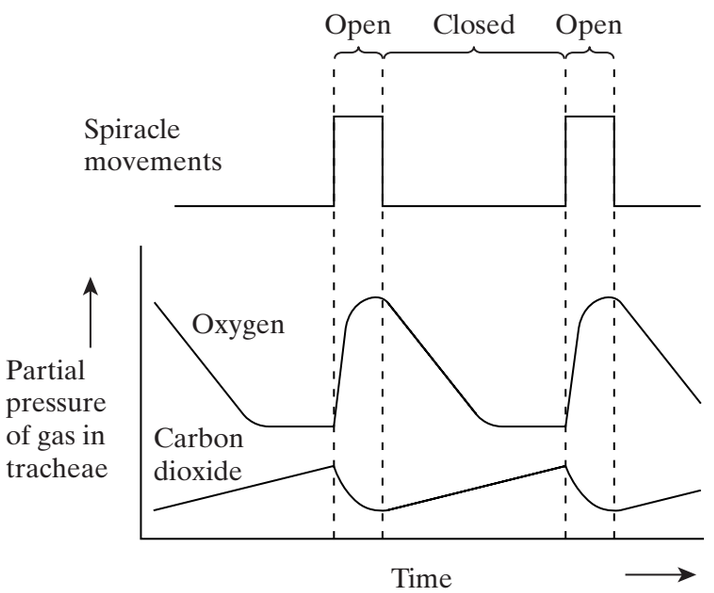
(2 marks)

4

Turn over ▶

3 Many insects release carbon dioxide in short bursts even though they produce it at a constant rate. The diagram shows how this is achieved in one particular insect.



(a) Using information from the diagram, suggest what stimulates the spiracles to open.

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(1 mark)

(b) Explain what causes the oxygen concentration in the tracheae to fall when the spiracles are closed.

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(2 marks)

(c) The insect lives in dry conditions. Suggest an advantage of the pattern of spiracle movements shown in the diagram.

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(2 marks)

5

4 (a) The table shows the membrane potential of an axon at rest and during the different phases of an action potential. Complete the table by writing in each box whether the sodium ion (Na^+) channels and potassium ion (K^+) channels are open or closed.

	Resting	**Starting to depolarise**	**Repolarising**
Membrane potential/mV	−70	−50	−20
Na^+ channels in axon membrane			
K^+ channels in axon membrane			

(2 marks)

(b) Describe how the resting potential is established in an axon by the movement of ions across the membrane.

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(2 marks)

S (c) Sodium and potassium ions can only cross the axon membrane through proteins. Explain why.

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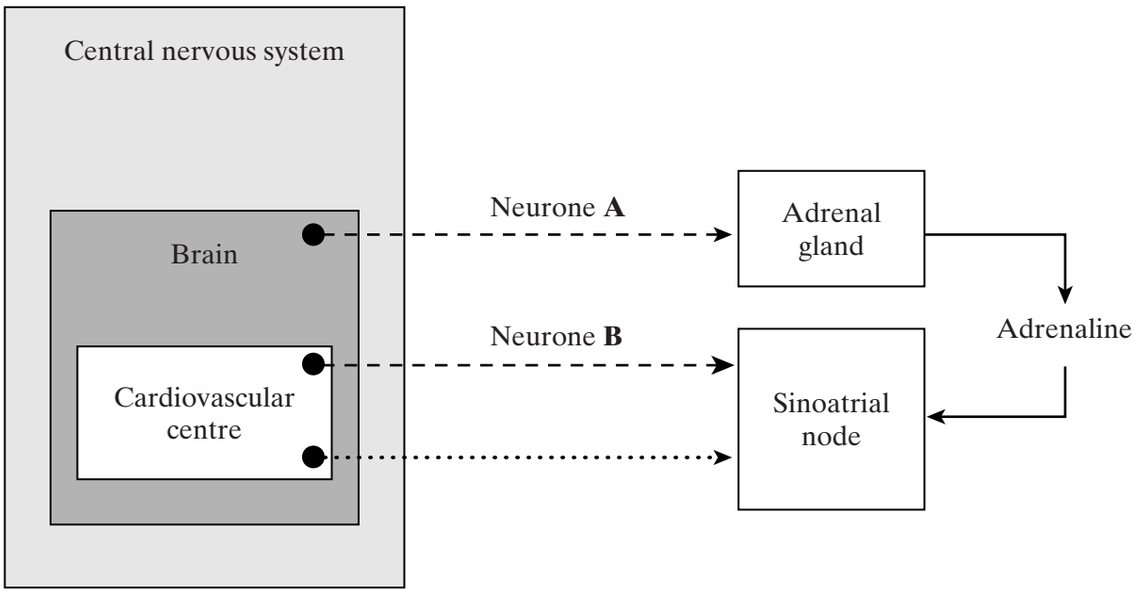
(2 marks)

6

5 The diagram shows the control of the heart rate by the autonomic nervous system.



Key:

●- - -➤ Sympathetic neurone

●·····➤ Parasympathetic neurone

(a) In which part of the brain is the cardiovascular centre located?

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(1 mark)

(b) What would be the effect on heart rate of stimulating

neurone **A**; .....

neurone **B**? .....

(1 mark)

LEAVE MARGIN BLANK

S (c) Describe how an impulse reaches the base of the ventricles of the heart from the sinoatrial node.

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(3 marks)

5

TURN OVER FOR THE NEXT QUESTION

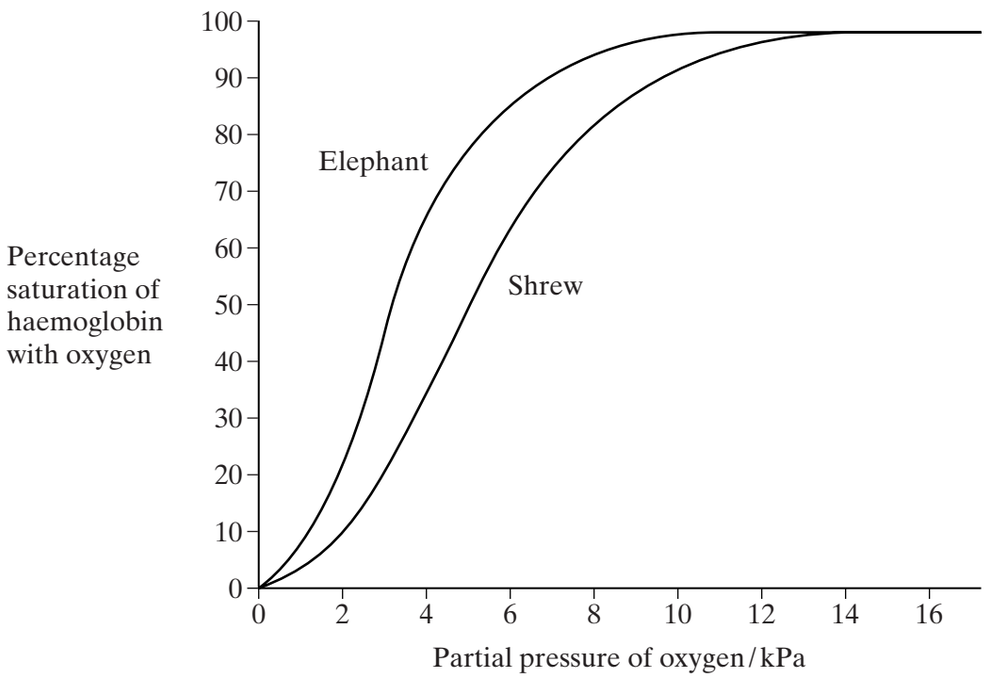
6 (a) The table shows some data for a shrew and an elephant.

	Shrew	**Elephant**
Body mass	10 g	5000 kg
Volume of oxygen taken up per hour	20 cm^3	52.5 dm^3

The rate of oxygen uptake for the shrew is 2 $cm^3 g^{-1} h^{-1}$. Calculate the volume of oxygen taken up per gram of body tissue per hour in the elephant. Show your working.

Answer ..... $cm^3 g^{-1} h^{-1}$
(2 marks)

(b) The graph shows the oxyhaemoglobin dissociation curves for these mammals.



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The tissues of the shrew have a higher rate of oxygen consumption per gram of body tissue than the elephant. There is an advantage to the shrew in having haemoglobin with a dissociation curve in the position shown. Explain this advantage.

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(3 marks)

5

TURN OVER FOR THE NEXT QUESTION

7 (a) Dietary recommendations are that lipid intake should make up 30% of energy intake. The recommended energy intake for most women aged 19 - 49 is 8100 kJ day^{-1}. The energy content of lipid is 37.8 kJ g^{-1}. Calculate the recommended lipid intake per day for these women. Show your working.

Answer ..... g

(2 marks)

In humans, triglycerides are the main form of dietary lipids. They are digested in the gut and the products of digestion are absorbed by the small intestine.

S (b) Describe a biochemical test that could be performed on a sample of food to determine whether it contained triglycerides.

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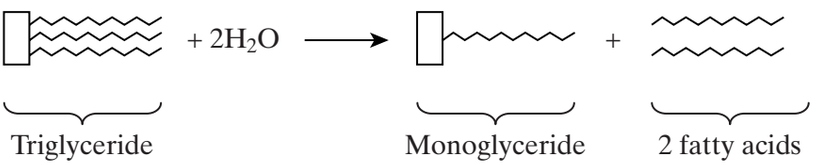
(2 marks)

(c) The diagram summarises a reaction involved in the digestion of triglycerides.



S (i) Name the type of reaction shown.

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(1 mark)

(ii) Describe the part played by bile in the digestion of lipids.

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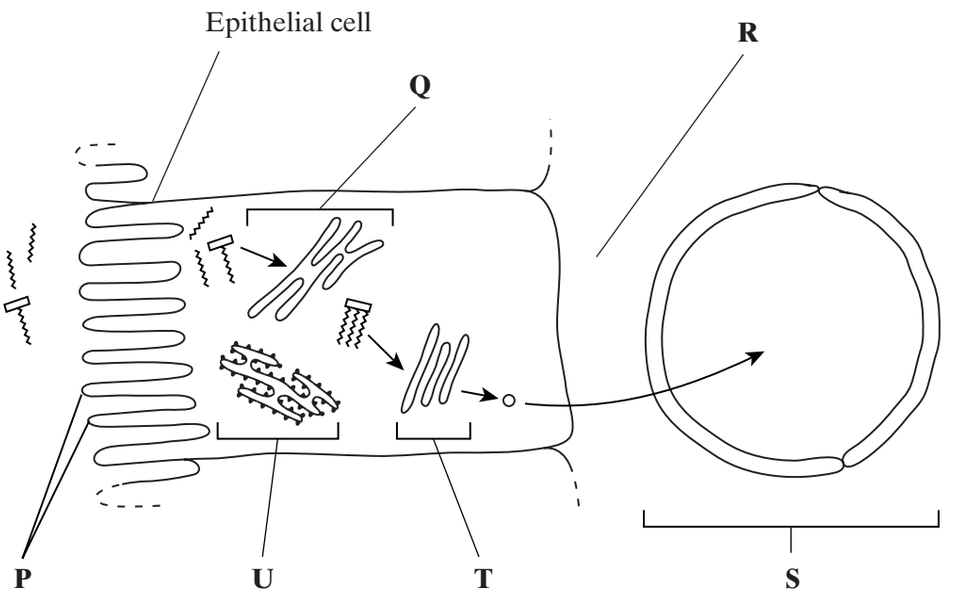
(3 marks)

(d) The diagram shows the events that occur in the absorption of monoglycerides and fatty acids. These molecules enter the epithelial cells of the small intestine by diffusion. Once inside they are reassembled into triglycerides in organelle **Q**. The triglyceride molecules are formed into chylomicrons in organelle **T**. Chylomicrons are made from many triglyceride molecules surrounded with protein molecules. The chylomicrons leave the cell and enter vessel **S**.



S (i) Explain the importance of the structures labelled **P**.

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(1 mark)

(ii) Name

R; .....

S. .....

(2 marks)

S (iii) Describe the role played by organelle **U** in the formation of chylomicrons.

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(2 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

Turn over ▶

S (iv) Suggest how the chylomicrons leave the epithelial cell. Give a reason for your answer.

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(2 marks)

15

8 (a) The control of water balance in the body involves negative feedback.

(i) Describe what is meant by *negative feedback*.

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(1 mark)

(ii) Water is removed from the body via the kidneys. Give **two** other ways in which water is removed from the body.

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2 .....

(2 marks)

(iii) Name the part of the brain which acts as the coordinator in the control of water balance.

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(1 mark)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(b) **Figure 1** shows the cells lining the collecting duct in a human kidney. ADH molecules bind to the receptor proteins and this triggers the vesicles containing aquaporins to bind with the plasma membrane next to the lumen. **Figure 2** shows an aquaporin which is a large channel protein.

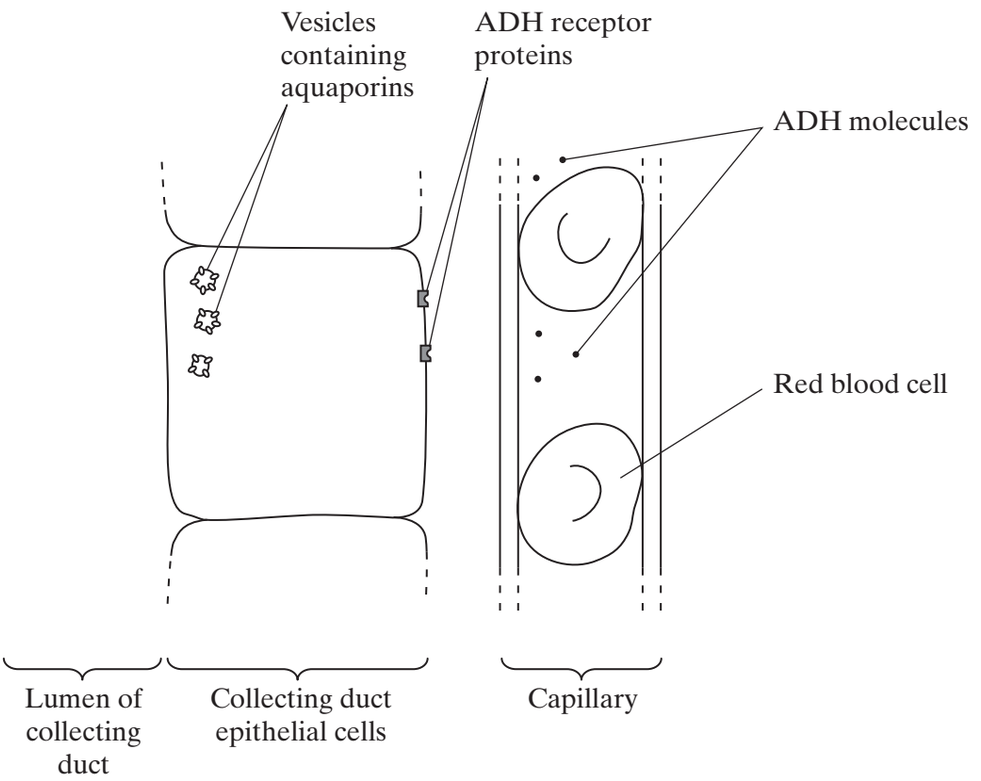

Figure 1

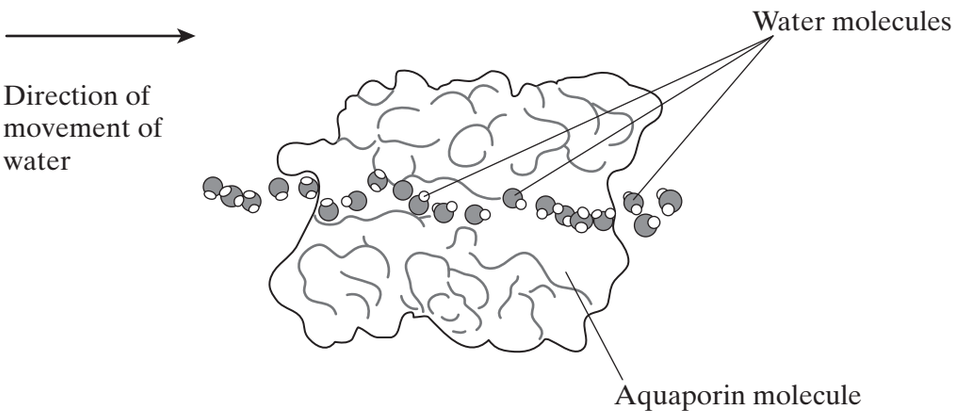

Figure 2

(i) From which gland is ADH released?

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(1 mark)

(ii) Use the information given to explain how ADH increases the movement of water from the lumen of the collecting duct into the blood.

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(4 marks)

(c) The gene for the ADH receptor proteins is found on the X chromosome. One allele of this gene causes a non-functioning receptor protein to be made. This allele is recessive and is one cause of the condition called diabetes insipidus.

(i) What would be the most obvious symptom of diabetes insipidus?

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(1 mark)

S (ii) Suggest why diabetes insipidus is more common in males.

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(2 marks)

S (iii) A recessive allele which has harmful effects is able to reach a higher frequency in a population than a harmful dominant allele. Explain how.

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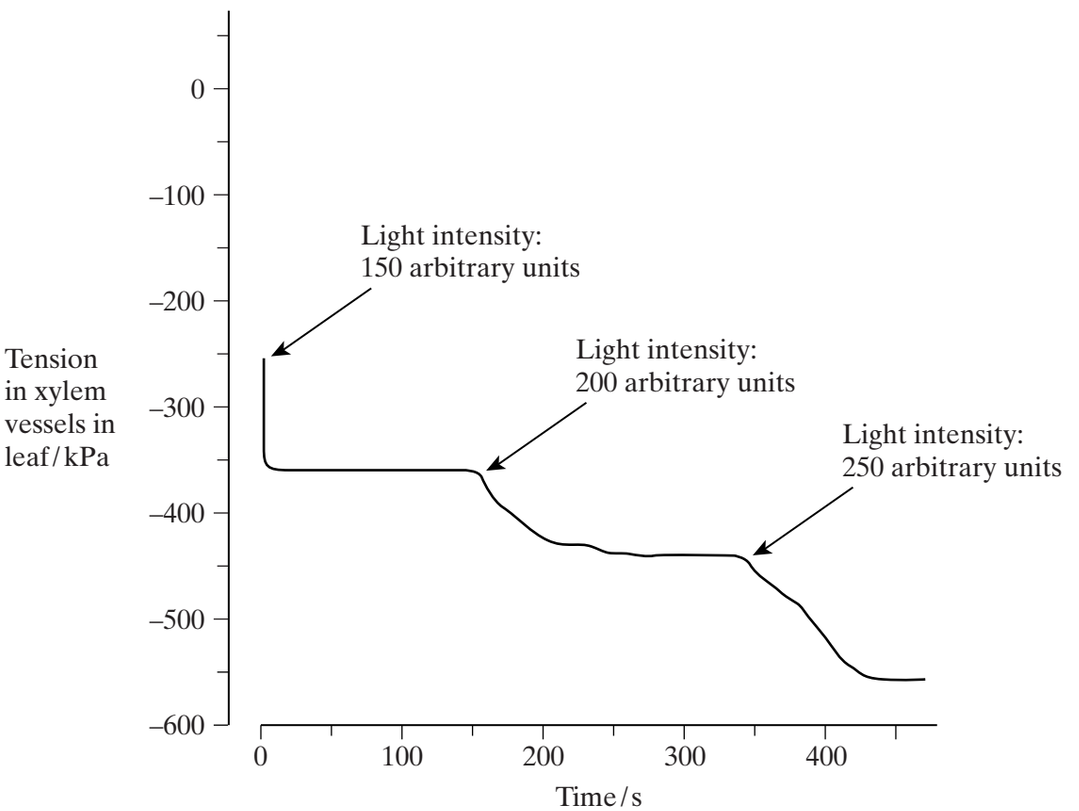
(3 marks)

15

Turn over ▶

9 The chart shows the results obtained from an investigation to determine the effect of light intensity on the tension in xylem vessels in the leaves of a plant.



(a) Describe and explain the effects of increasing light intensity on the tension in the xylem vessels in the leaves.

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(5 marks)

(b) Explain why it was important to keep the humidity constant during the investigation.

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(2 marks)

(c) Explain how the negative pressure in the xylem vessels of the leaves causes water to move up the plant from the xylem in the roots.

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(4 marks)

S (d) Many tropical plants have a specialised method of photosynthesis. Explain how this method adapts the plant to tropical conditions.

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(4 marks)

END OF QUESTIONS

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