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Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
January 2004
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Thursday 22 January 2004 Morning Session

No additional materials are required.
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			

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

1 (a) The table contains information summarising the hormonal control of digestion in mammals. Complete the table.

Hormone	Site of hormone secretion	Action
	stomach	secretion of gastric juice
Cholecystokinin-pancreozymin		contraction of gallbladder and stimulation of pancreatic enzyme secretion
	duodenum	secretion of water and sodium hydrogencarbonate from the pancreas

(3 marks)

(b) A simple reflex can also initiate the secretion of gastric juice. How does the time taken to stimulate gastric juice secretion by a simple reflex differ from the time taken when stimulated by a hormone? Explain your answer.

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(2 marks)

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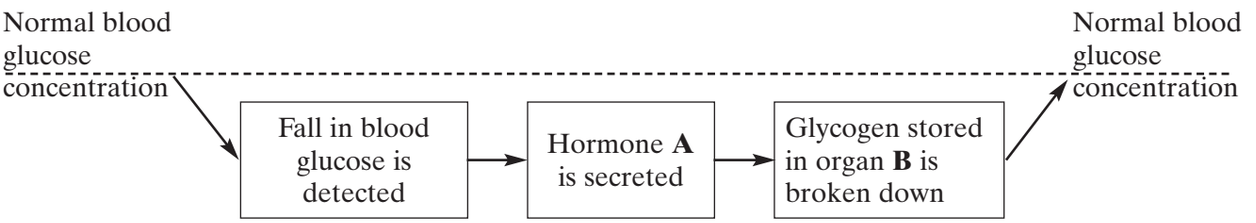
2 The diagram shows some of the events which maintain blood glucose concentration in a mammal.



(a) Name

(i) hormone **A**; .....

(ii) organ **B**. .....

(2 marks)

(b) Explain why the events shown in the diagram can be described as an example of negative feedback.

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(1 mark)

S (c) Explain how the structure of a glycogen molecule is related to its function in maintaining blood glucose concentration.

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(2 marks)

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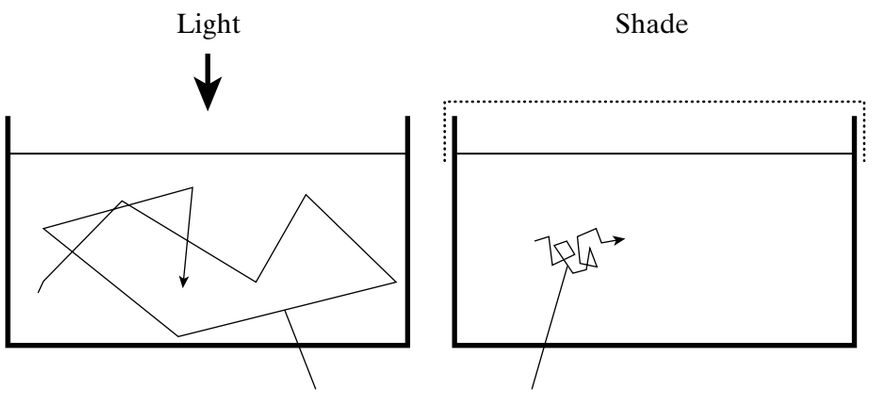
3 A flatworm is a simple soft-bodied animal. The diagram shows the movements of an aquatic flatworm in light and in shade. The path followed by the flatworm over a period of three minutes was traced on the side of a tank.



Path of flatworm moving on side of tank

(a) (i) Name the type of behaviour shown. Give a reason for your answer.

Type of behaviour .....

Reason .....

.....

(2 marks)

(ii) Suggest **one** advantage of the behaviour shown in the diagram.

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(1 mark)

S (b) The biomass of flatworms in aquatic ecosystems is always lower than the biomass of the species on which they prey. Explain why this is so.

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(2 marks)

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4 (a) Describe the features of fish gills that give them a large surface area.

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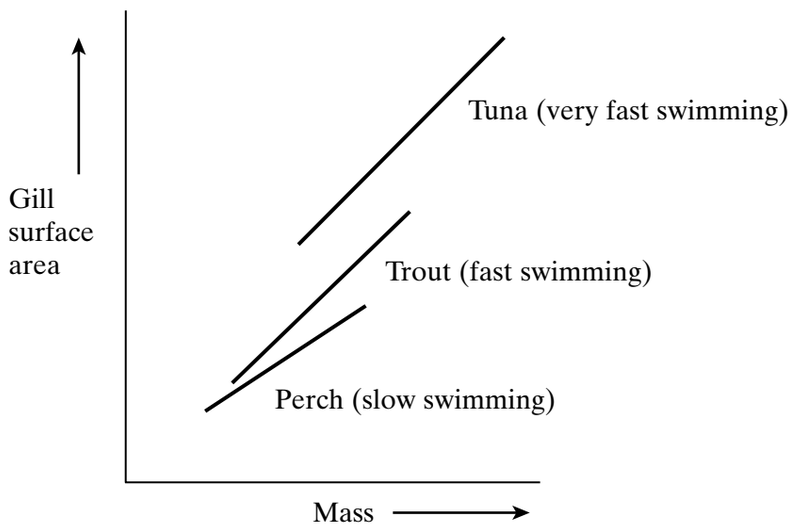
(2 marks)

The graph shows the relationship between gill surface area and body mass for three species of fish.



(b) (i) Describe the relationships between gill surface area, mass and swimming speed shown in the diagram.

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(1 mark)

(ii) Explain the relationship between gill surface area and swimming speed.

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(2 marks)

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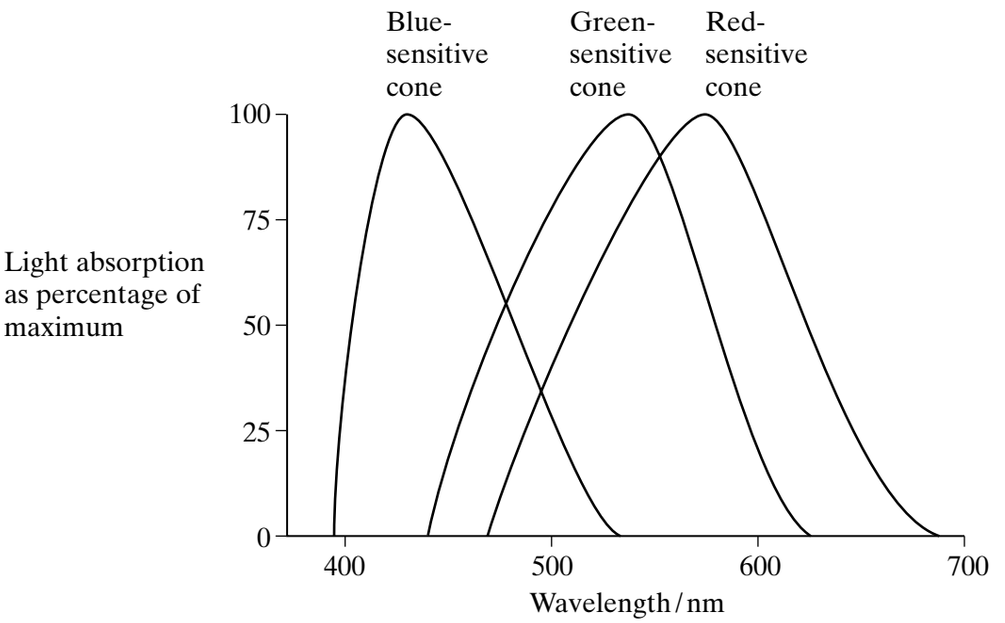
5 (a) The graph shows the percentage of light of different wavelengths absorbed by the three types of cone cell found in the retina of the human eye.



(i) What colour would the brain perceive when light of 420 nm was shone on the retina? Explain your answer.

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(1 mark)

(ii) Why would the brain perceive orange when light of 580 nm was shone on the retina?

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(1 mark)

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S (b) It is thought that primitive mammals had only one type of photosensitive pigment in their eyes and therefore had only monochromatic vision. Colour-sensitive pigments arose as a result of gene mutations. Explain how an allele for a pigment sensitive to colour might spread in a population of mammals.

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(3 marks)

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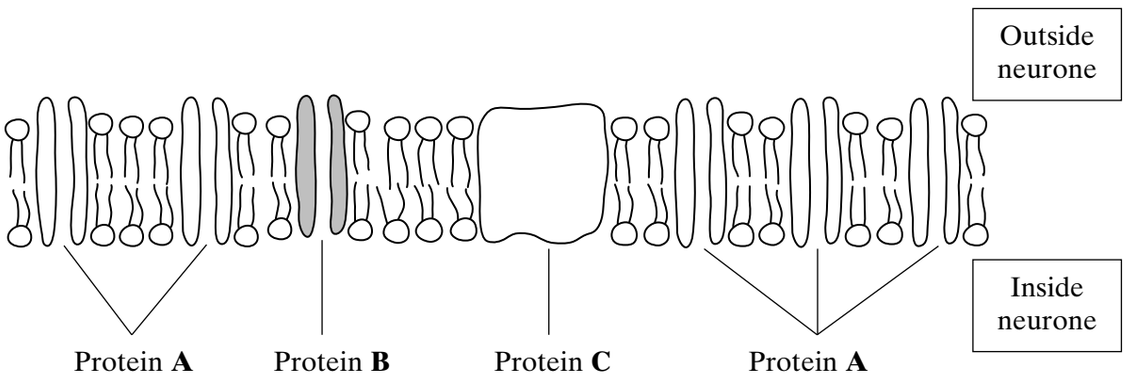
6 The resting potential of a neurone is maintained by the unequal distribution of ions inside and outside the plasma membrane. The diagram shows the plasma membrane of a neurone and the three different proteins that are involved in maintaining the resting potential.



(a) Protein **C** requires ATP to function. Describe the role of protein **C**.

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(2 marks)

S (b) (i) Proteins **A** and **B** differ from each other. Explain why different proteins are required for the diffusion of different ions through the membrane.

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(2 marks)

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(ii) The plasma membrane of the neurone is more permeable to potassium ions than to sodium ions. Give the evidence from the diagram that supports this observation.

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(1 mark)

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7 Mammals and fish remove nitrogenous waste from their bodies in different forms.

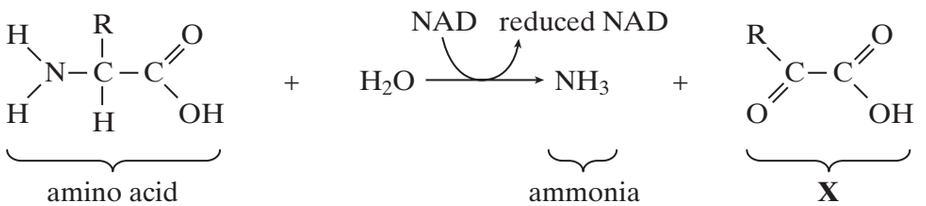
S (a) Name **two** polymers present in mammals and fish that contain nitrogen.

1 .....

2 .....

(2 marks)

(b) The diagram shows a reaction that occurs in the liver of both mammals and fish.



(i) Describe what may happen to molecule **X**.

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(1 mark)

(ii) In a mammal the ammonia is converted into urea. Give **one** advantage of this.

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(1 mark)

(iii) Describe how the ammonia is removed from the body of a fish.

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(1 mark)

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(c) In a mammal urea is removed from the blood by the kidneys and concentrated in the filtrate.

(i) Describe how urea is removed from the blood.

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(2 marks)

(ii) Explain how urea is concentrated in the filtrate.

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(4 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

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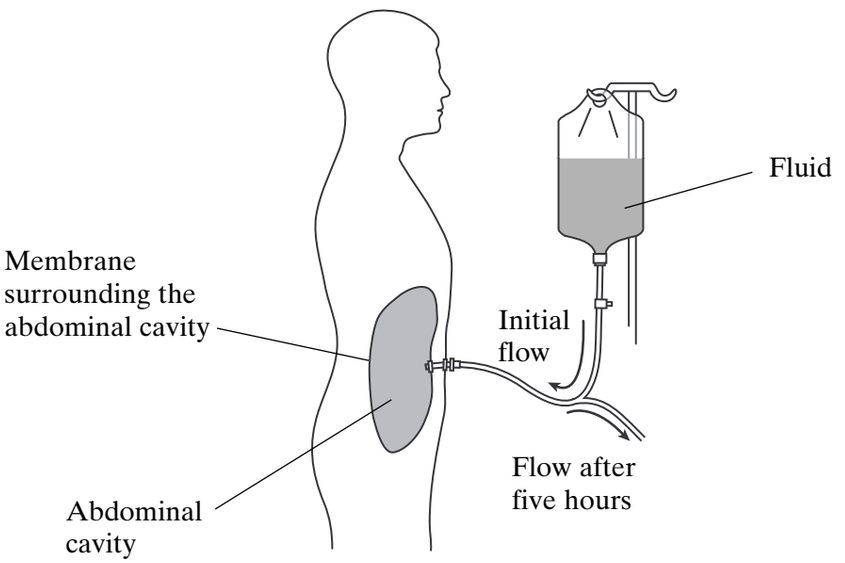
S (d) The diagram shows one way in which a person who has kidney disease can have the condition managed. In the process a fluid is put into the abdominal cavity. Exchange of materials takes place across the membrane that surrounds the abdominal cavity. This removes waste products from the blood. After five hours the fluid is drained out of the cavity and discarded. The cavity is then refilled with fresh fluid.



The table shows the concentration of solutes in the fresh fluid.

Solute	Concentration / mmol dm^{-3}
Sodium ions (Na^+)	132
Chloride ions (Cl^-)	96
Calcium ions (Ca^{2+})	1.25
Magnesium ions (Mg^{2+})	0.25
Glucose	76
Urea	0

(i) By what process does urea enter the fluid in the abdominal cavity from the blood?

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(1 mark)

(ii) Explain why the fluid is changed every five hours.

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(1 mark)

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(iii) Fluid of the composition shown in the table is used instead of distilled water. Explain why.

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(2 marks)

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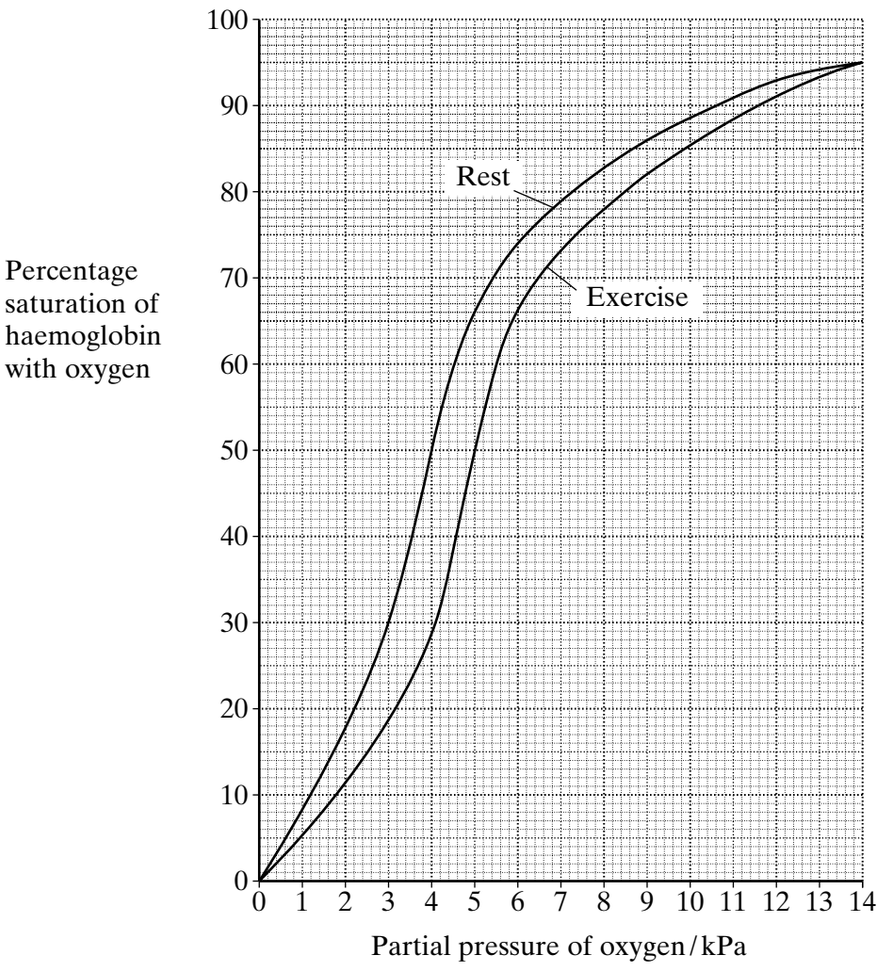
8 The graph shows dissociation curves for human oxyhaemoglobin at rest and during exercise. **Table 1** gives information about conditions in the body at rest and during exercise.



	Rest	Exercise
Plasma pH	7.4	7.2
Blood temperature / °C	37.0	39.0
Alveolar partial pressure of oxygen / kPa	13.3	13.3
Tissue partial pressure of oxygen / kPa	5.0	4.0

Table 1

(a) What is meant by the term *partial pressure*?

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(1 mark)

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(b) Use **Table 1** and the graph to calculate the difference in the percentage saturation of haemoglobin in the tissues between rest and exercise.

Answer ..... %
(1 mark)

(c) Explain the differences between the figures shown in **Table 1** for rest and exercise.

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(4 marks)

(d) Explain the advantage of the difference in position of the dissociation curve during exercise.

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(2 marks)

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Table 2 shows how the oxygen concentration in the blood going to and from a muscle changes from rest to heavy exercise.

		Oxygen concentration/cm^3 per 100 cm^3 blood	
		Blood in arteries	**Blood in veins**
At rest	**In solution**	0.3	0.2
	As oxyhaemoglobin	19.5	15.0
	Total oxygen	19.8	15.2
During heavy exercise	**In solution**	0.3	0.1
	As oxyhaemoglobin	20.9	5.3
	Total oxygen	21.2	5.4

Table 2

(e) By how many times is the volume of oxygen removed from the blood by the muscle in **Table 2** during heavy exercise greater than the volume removed at rest?
Show your working.

Answer ..... times
(2 marks)

(f) Does enriching inspired air with oxygen have any effect on the amount of oxygen reaching the tissues? Support your answer with evidence from the graph and **Table 2**.

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(3 marks)

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S (g) The change to the dissociation curve is one of a number of ways in which the total oxygen supplied to muscles is increased during exercise. Give **two** other ways in which the total oxygen supplied to muscles during exercise is increased.

1 .....

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2 .....

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(2 marks)

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9 (a) Explain how water enters a plant root from the soil and travels through to the endodermis.

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(5 marks)

(b) From the root, water is transported upwards through the stem. Explain how evaporation from the leaves can cause the water to move upwards.

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(4 marks)

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S (c) In daylight, most of the water evaporates from the leaves but some is used by the plant. Describe the ways in which this water could be used by the plant.

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(6 marks)

15

END OF QUESTIONS

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