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For Examiner's Use
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General Certificate of Education  
June 2008  
Advanced Level Examination



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

**BYA6**

Friday 13 June 2008 1.30 pm to 3.00 pm

**For this paper you must have:**

- a ruler with millimetre measurements.
- You may use a calculator.

Time allowed: 1 hour 30 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. **Answers written in margins or on blank pages will not be marked.**
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Use accurate scientific terminology in all your answers.

**Information**

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- 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			
Question	Mark	Question	Mark
1		9	
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7			
8			
Total (Column 1) →			
Total (Column 2) →			
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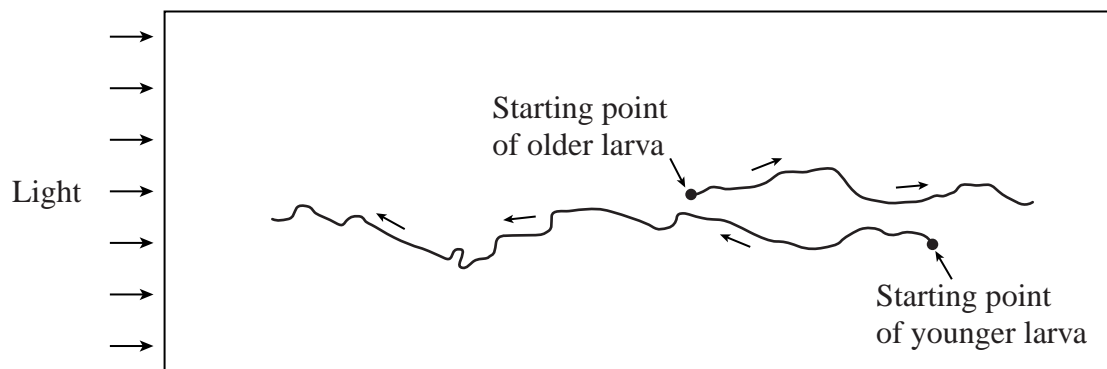


Answer **all** questions **in the spaces provided**.

- 1** The sea squirt is an animal that lives in the sea. The adults live attached to rocks.

During reproduction, the adult releases many larvae. The larvae can swim. After about an hour of swimming, the larvae settle on rocks and start to develop into adults.

Two larvae were placed in a tank of sea water. One had been released from an adult 15 minutes earlier, the other 45 minutes earlier. The diagram shows the swimming patterns of the larvae when the tank was lit from one side only.



- 1** (a) Name the type of behavioural response shown by the sea squirt larvae.  
Give evidence for your answer.

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(2 marks)

**1** (b) The swimming behaviour changed with the age of the larvae.

**1** (b) (i) Describe how the pattern of swimming behaviour changed.

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 (1 mark)

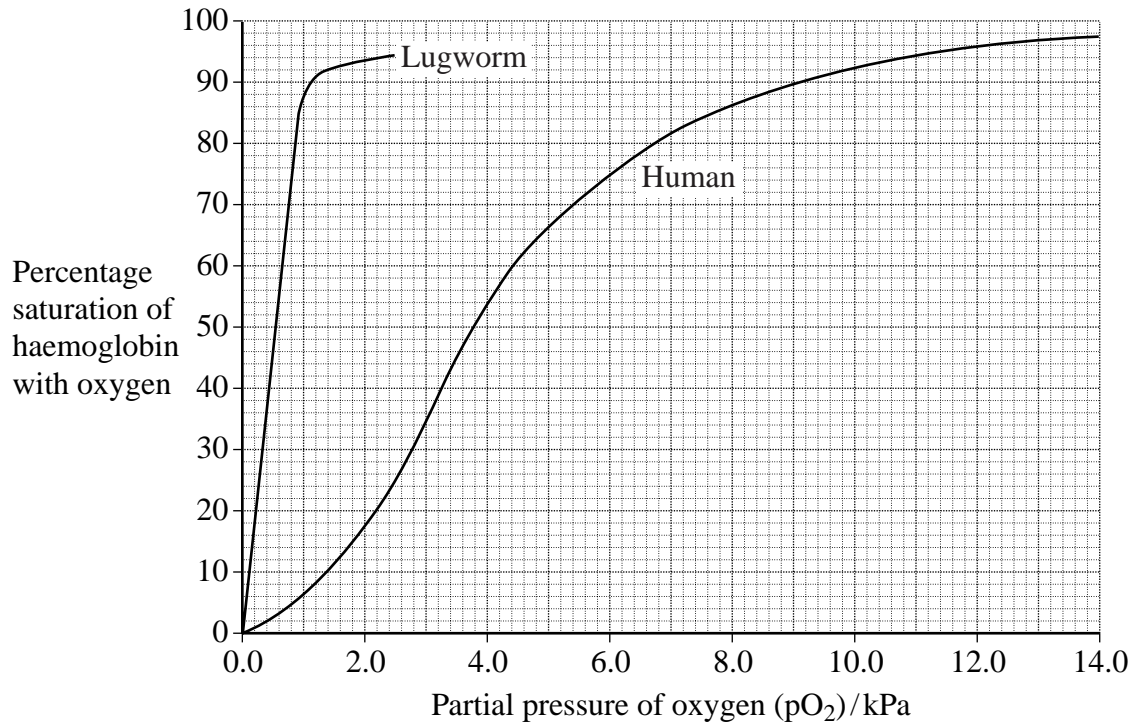
**S 1** (b) (ii) Suggest the advantage of this change in behaviour to the sea squirt in its natural habitat.

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 (2 marks)

**Turn over for the next question**



2 The graph shows the oxyhaemoglobin dissociation curves of a lugworm and a human.



- 2 (a) The saturation of haemoglobin with oxygen falls as the partial pressure of oxygen falls. Between which partial pressures of oxygen does the saturation fall from 80 % to 40 % in the lugworm?

From ..... kPa to ..... kPa (1 mark)

- 2 (b) The shape and position of the lugworm's dissociation curve adapt the lugworm for living in mud on the sea shore. Suggest how.

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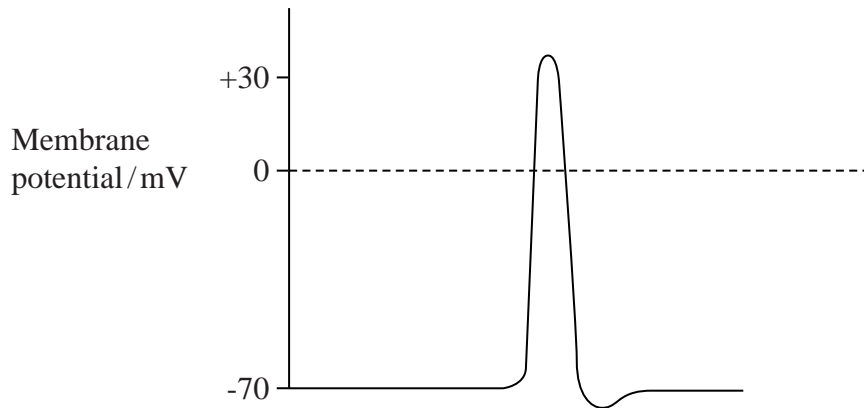
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(3 marks)

- 3 (a) The diagram shows an action potential.



Label the diagram with the letter **X** to show where the rate of diffusion of sodium ions is fastest.

(1 mark)

- S 3 (b) As a neurone transmits an impulse, its rate of oxygen consumption increases. Explain why.

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(Extra space) .....  
(3 marks)

- 3 (c) Myelination affects the rate of conduction of a nerve impulse. Explain how.

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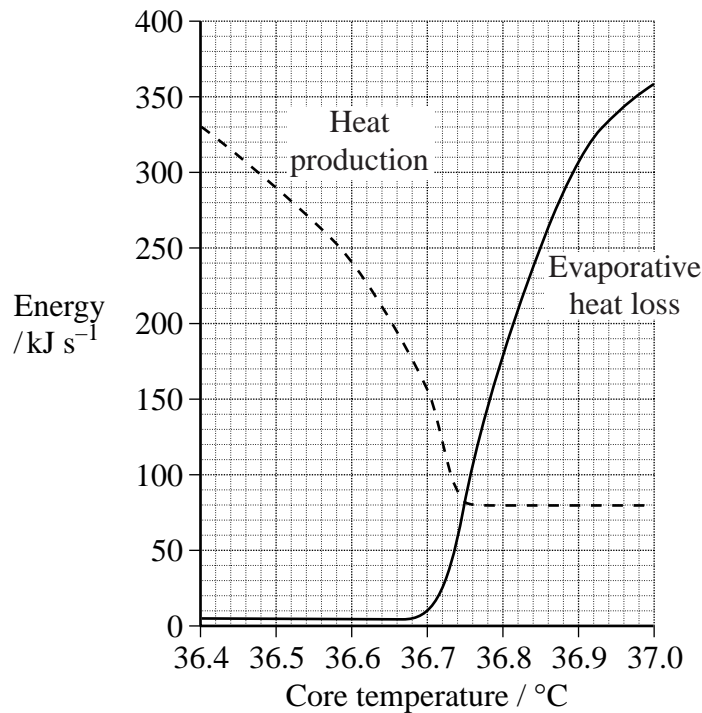
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(2 marks)

- 4 Scientists studied heat production and evaporative heat loss in a person who was at rest. The results are shown in the graph.



- 4 (a) The person's core temperature was monitored using a sensor in contact with one eardrum. The eardrum is very close to the hypothalamus. What is the advantage of recording the core temperature close to the hypothalamus?

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 (1 mark)

- 4 (b) (i) What is evaporative heat loss?

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 (1 mark)

- 4 (b) (ii) Describe and explain **one** other way in which the body increases heat loss as core temperature rises.

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(2 marks)

- 4 (c) Use the graph to give the range of temperatures over which the rate of respiration remained constant.

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(1 mark)

5

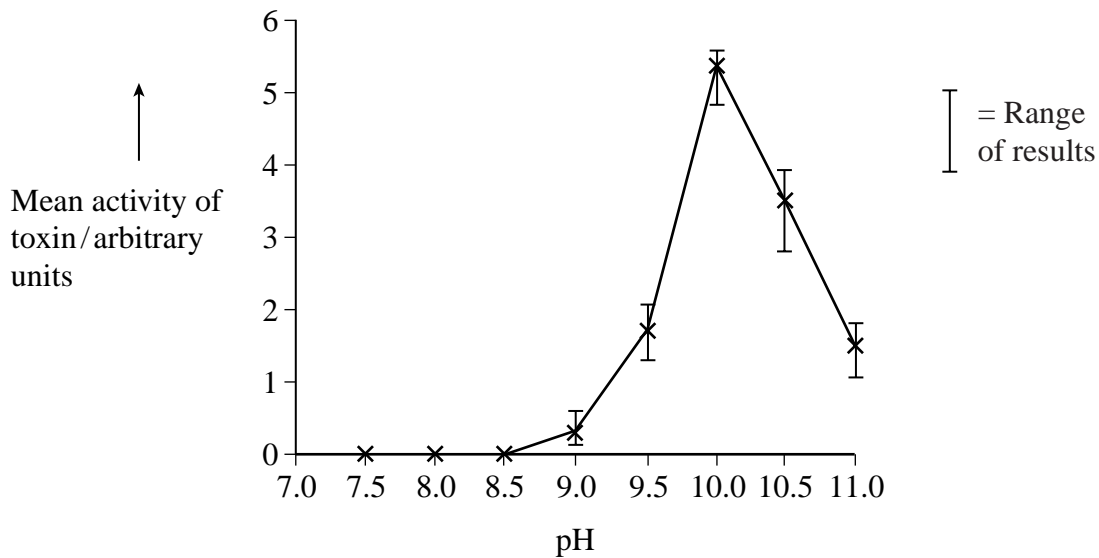
**Turn over for the next question**



- 5** Blackflies bite humans and suck blood. Blackfly larvae live in rivers and feed by filtering particles out of the water. A method of controlling blackfly is to add particles of an inactivated toxin to the water upstream of where the larvae are feeding. The toxin is a protein.

A protease in the larva's digestive system activates the toxin. The active toxin then joins to a receptor molecule on the gut epithelial cell membranes. This damages the epithelial cells and kills the larva.

The graph shows the results of an experiment to determine the optimum pH for activation of the toxin.



- 5** (a) Each vertical bar on the graph shows the range of results at the given pH.

- S 5** (a) (i) The mean is not necessarily found in the middle of each range. Explain why.

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 (1 mark)

- S 5** (a) (ii) Use of the standard deviation to show variation around the mean might have been more representative. Explain why.

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 (1 mark)





**S 5** (b) Part of the blackfly larva's gut has a pH of 10 to 10.5. All other animals living in the river have gut pH values below 8.5. Use information given earlier in the question to suggest **two** reasons why the toxin can be used for selective biological control of the blackfly.

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(2 marks)

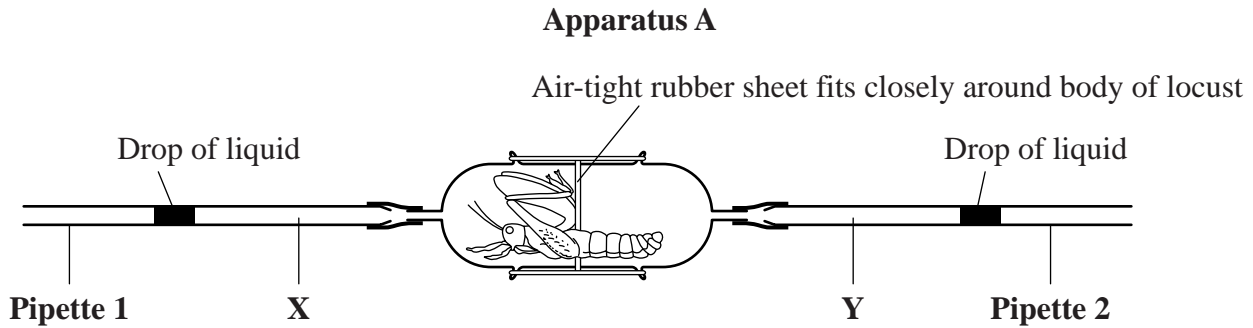
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**Turn over for the next question**

**Turn over ►**



- 6 Some students investigated gas exchange in a locust. They put the locust in **Apparatus A**.



The drop of liquid in **pipette 1** moved towards the locust. It moved from the  $1.0\text{ cm}^3$  mark to the  $7.7\text{ cm}^3$  mark, in 5 minutes. The drop of liquid in **pipette 2** moved the same distance away from the locust.

- 6 (a) (i) What does the direction of movement of the drops of liquid in **Apparatus A** suggest about the ventilation of the tracheal system of the locust?

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- 6 (a) (ii) The carbon dioxide concentration in the air at points **X** and **Y** would be different. Explain why.

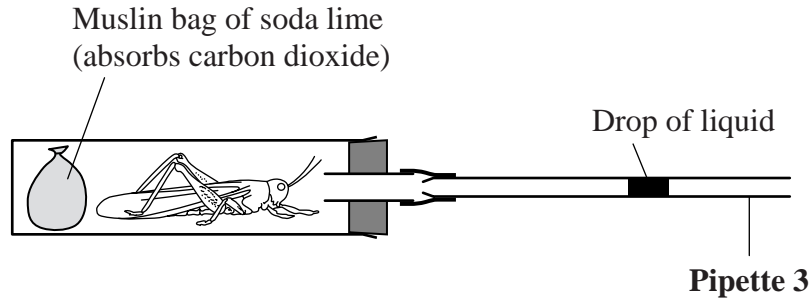
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- S 6** (b) The students then put the locust into **Apparatus B**. The liquid in **pipette 3** moved towards the locust from the  $0.20\text{ cm}^3$  mark to the  $0.42\text{ cm}^3$  mark in 5 minutes.

**Apparatus B**



- S 6** (b) (i) The air contains 21 % oxygen. Calculate what proportion of the oxygen pumped through the locust is absorbed by it for its respiration. Use information from **both** experiments and show your working.

Answer ..... (2 marks)

- S 6** (b) (ii) The experiment was repeated. This time glass beads were placed in the muslin bag in **Apparatus B** instead of soda lime. The liquid in **pipette 3** did not move. Calculate the respiratory quotient (RQ) of the locust. Show your working.

Answer ..... (2 marks)

- 7 (a) A diabetic person and a non-diabetic person each ate the same amount of glucose. One hour later, the glucose concentration in the blood of the diabetic person was higher than that of the non-diabetic person. Explain why.

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(3 marks)

- 7 (b) (i) The urine of a non-diabetic person does **not** contain glucose. Explain why.

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(2 marks)

- 7 (b) (ii) A high blood glucose concentration could cause glucose to be present in the urine of a diabetic person. Suggest how.

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(2 marks)



- S 7** (c) A test for glucose in urine uses immobilised enzymes on a plastic test strip. One of these enzymes is glucose oxidase. Explain why the test strip detects glucose and no other substance.

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(2 marks)

- S 7** (d) If the glomerular filtrate of a diabetic person contains a high concentration of glucose, he produces a larger volume of urine. Explain why.

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(3 marks)

- 7** (e) In some forms of kidney disease, proteins from the blood plasma are found in the urine. Which part of the nephron would have been damaged by the disease to cause proteins from blood plasma to be present in the urine? Explain your answer.

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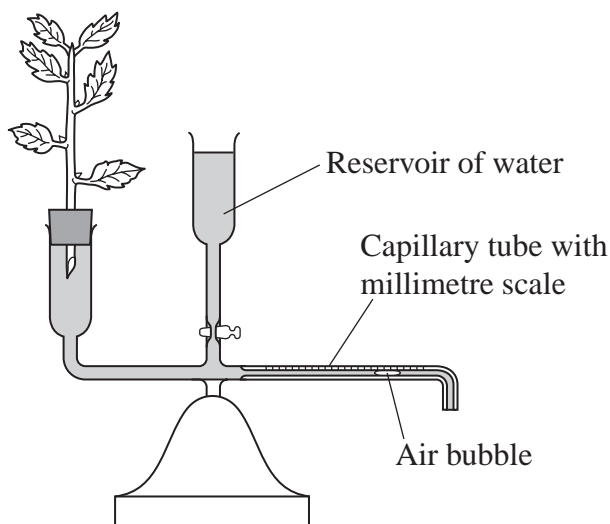
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(3 marks)



- 8 (a) A student put a leafy shoot from a laurel plant into a potometer, as shown in the diagram. The student put a second leafy shoot into another potometer.



The student smeared the leaves of each shoot with petroleum jelly. Petroleum jelly is a waterproofing agent. A different sequence of treatments was used for each shoot, as described in **Table 1**. In each experiment the student recorded the distance moved by the air bubble in 2 minutes. The results are also given in **Table 1**.

**Table 1**

Shoot 1		Shoot 2	
Surface covered with petroleum jelly	Distance moved by air bubble / mm	Surface covered with petroleum jelly	Distance moved by air bubble / mm
1 <sup>st</sup> Neither	83	1 <sup>st</sup> Neither	95
2 <sup>nd</sup> Upper	65	2 <sup>nd</sup> Lower	18
3 <sup>rd</sup> Upper and lower	4	3 <sup>rd</sup> Upper and lower	5

The leaves of the laurel have stomata only in the lower epidermis. There are no stomata in the upper epidermis.

What evidence in the table shows that water loss occurs

- 8** (a) (i) mainly through the stomata of the leaves

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(2 marks)

- 8** (a) (ii) partly through the cuticle of the leaves

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(Extra space) ..... (1 mark)

- 8** (a) (iii) partly through regions of the shoot other than the leaves?

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(Extra space) ..... (1 mark)

**Question 8 continues on the next page**

- 8 (b) **Table 2** shows the rate of flow in the xylem of a tree measured in one of the small branches at the top of the tree and in the trunk. The measurements were made at intervals throughout one day in the summer.

**Table 2**

Time of day	Rate of flow / $\text{m h}^{-1}$	
	Branch	Trunk
02:00	1.3	1.0
04:00	1.4	1.1
06:00	1.5	1.2
08:00	1.6	1.3
10:00	5.0	1.4
12:00	7.7	2.6
14:00	6.0	3.3
16:00	4.0	2.9
18:00	2.0	2.4
20:00	0.2	0.7

- 8 (b) (i) Explain how the table provides evidence for the cohesion-tension theory of water movement through a plant.

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(4 marks)



- 8** (b) (ii) Measurements of the diameter of the trunk were also made over the same time period. The maximum diameter was at 04:00 and the minimum at 16:00. Explain what caused this variation in trunk diameter.

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(Extra space) .....

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(3 marks)

- 8** (c) Describe and explain **two** adaptations which help xerophytic plants to survive in dry climates.

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(4 marks)



- 9** (a) Describe and explain the part played by enzymes in the digestion of protein in the human digestive system.

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*(Extra space)* .....

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- 9** (b) Describe the nervous and hormonal control of the digestion of protein in the human digestive system.

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*(Extra space)* .....

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**S 9** (c) The photograph shows the structure of the epithelium lining the small intestine.

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Structures **A** and **B** assist in the absorption of the products of protein digestion.  
Explain how.

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(5 marks)

**END OF QUESTIONS**

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