Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
January 2003
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

HUMAN BIOLOGY (SPECIFICATION A) BYA7
Unit 7 The Human Life-span

Thursday 23 January 2003 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, 3, 4 and 5 as well as Module 7 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 **Figure 1** shows a human sperm.

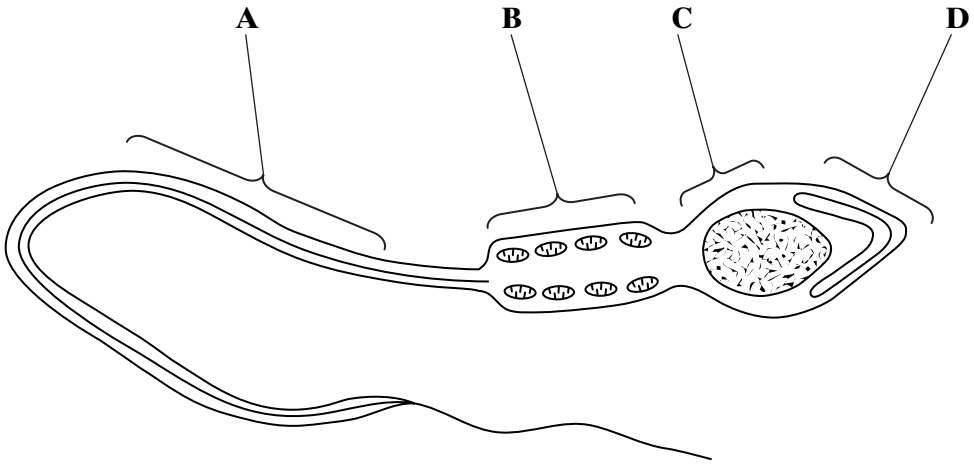

Figure 1

(a) Which region, **A**, **B**, **C** or **D**, contains

(i) organelles supplying energy for locomotion; .....

(ii) enzymes required for penetrating the membranes surrounding an egg cell?

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(2 marks)

(b) **Figure 2** shows the circulatory system of a fetus.

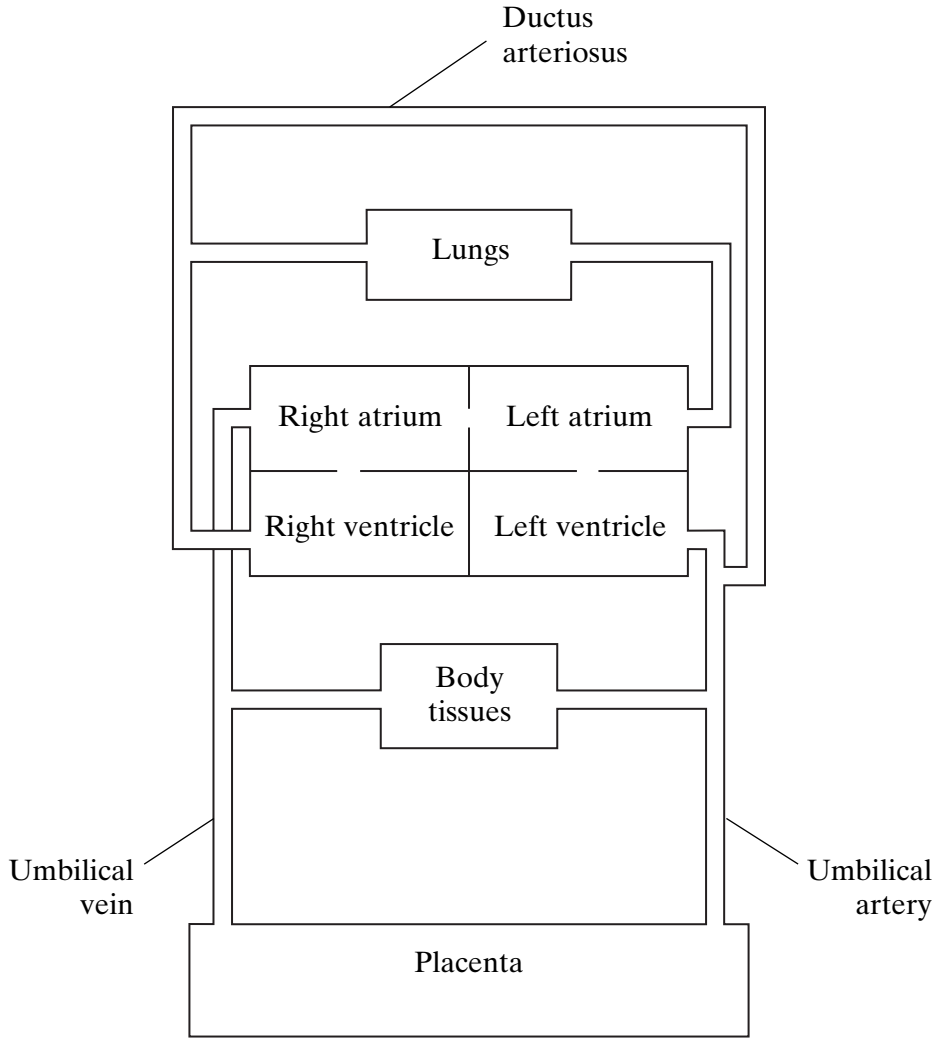

Figure 2

(i) Only a small amount of blood passes through the lungs of a fetus. Draw arrows on **Figure 2** to show **one** pathway which transports carbon dioxide from the body tissues to the placenta and which does **not** pass through the lungs.

(2 marks)

S (ii) Explain why a vein such as the umbilical vein can be described as an organ.

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(1 mark)

5

2 (a) When pressure is applied to a Pacinian corpuscle, an impulse is produced in its sensory neurone. Explain how.

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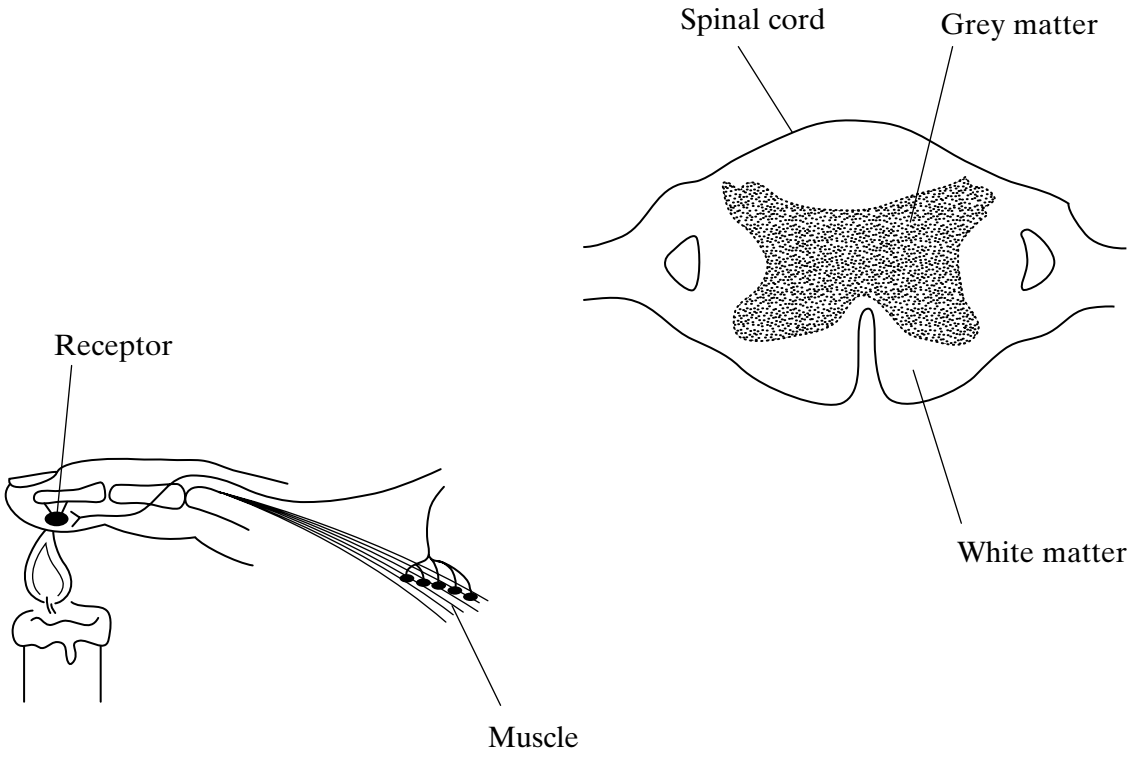
(2 marks)

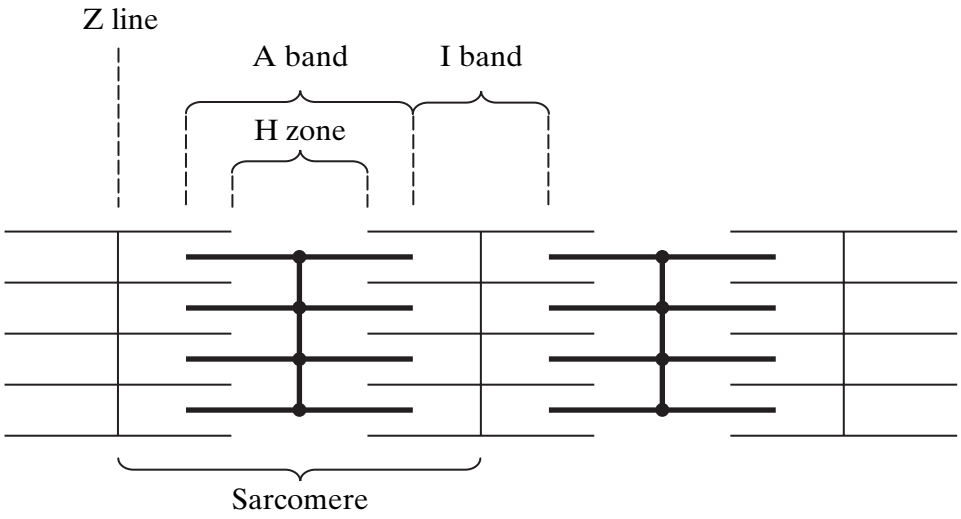
(b) The diagram shows part of a simple reflex arc containing three neurones.



Complete the diagram by drawing in and labelling the structures that conduct impulses into, through, and out of the spinal cord. *(3 marks)*

5

3 The diagram shows the arrangement of some of the proteins in a myofibril from a skeletal muscle. The myofibril is shown in the relaxed state.



(a) Name the protein found in the H zone.

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(1 mark)

(b) When the muscle contracts, what happens to the width of

(i) the A band; .....

(ii) the I band? .....

(2 marks)

S (c) The distance between two Z lines in a myofibril is 1.6 μm. Calculate the magnification of the diagram. Show your working.

Answer .....

(2 marks)

5

4 (a) Humans are able to maintain a constant core temperature when exposed to cold external temperatures.

S Suggest

(i) **one** advantage of this;

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(1 mark)

(ii) **one** disadvantage of this.

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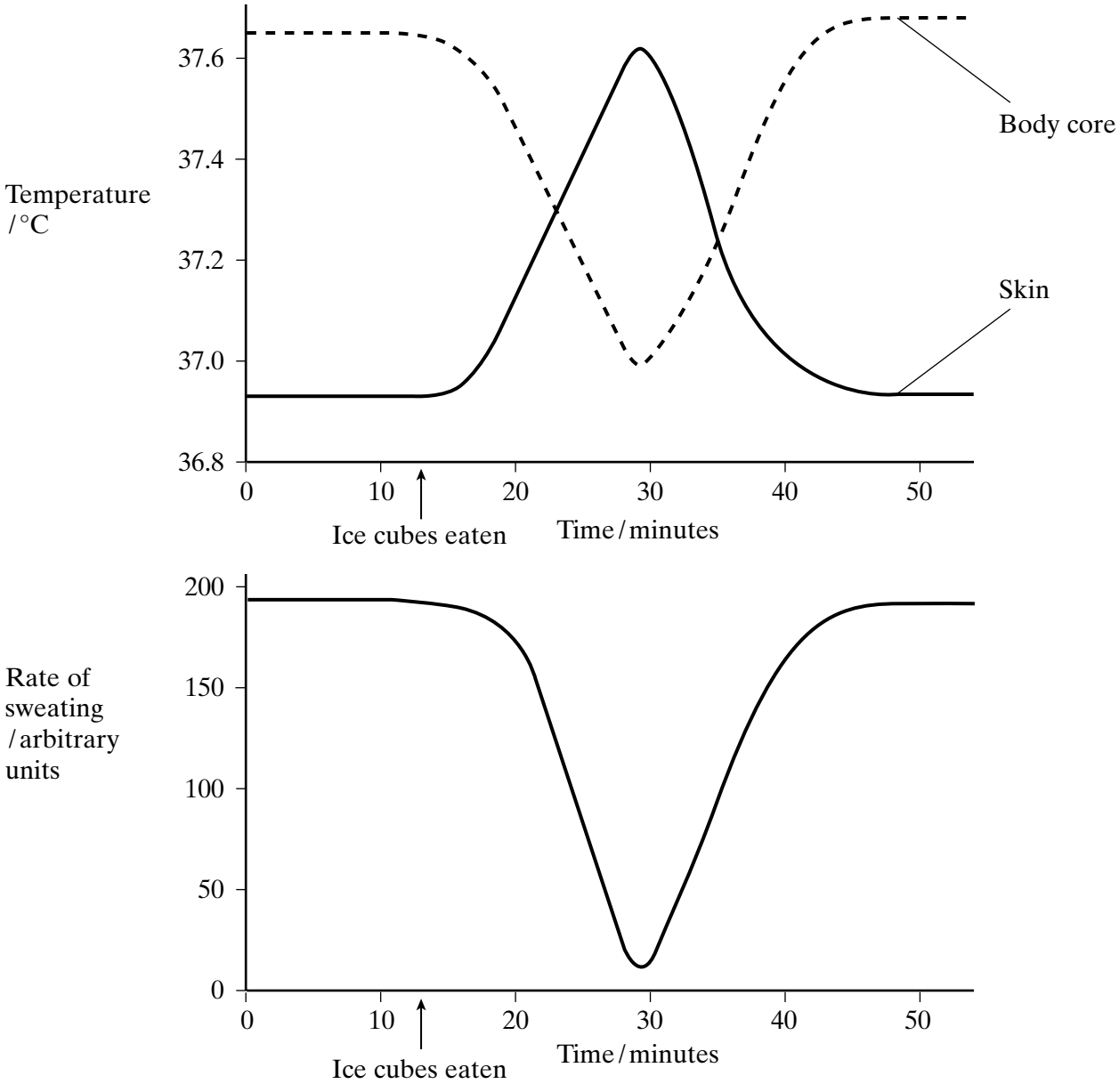
(1 mark)

(b) The graphs show data collected from a volunteer who ate several ice cubes.



(i) Explain the relationship between the rate of sweating and the temperature of the skin.

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(2 marks)

(ii) Use information in the graphs to explain the part played by negative feedback in the control of core temperature.

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(2 marks)

6

TURN OVER FOR THE NEXT QUESTION

5 (a) Describe how haemoglobin acts as a buffer to prevent changes in blood pH.

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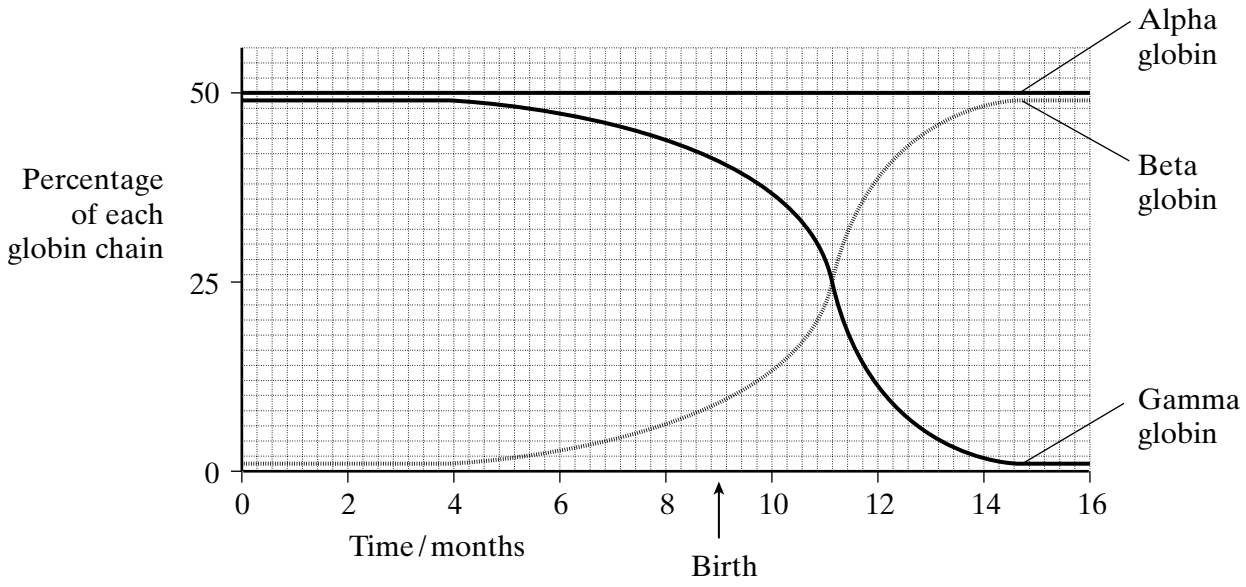
(1 mark)

(b) Globin chains are polypeptides. The globin chains in adult haemoglobin differ from those in fetal haemoglobin. The graph shows the percentage of the different globin chains present in haemoglobin molecules of a human before and after birth.



(i) At birth, the red blood cells of a baby contain a mixture of adult haemoglobin and fetal haemoglobin. Using information in the graph, calculate the percentage of the total haemoglobin molecules at birth that are adult haemoglobin molecules. Explain how you arrived at your answer.

Percentage = ...

Explanation

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(2 marks)

S (ii) Suggest how the cells that become red blood cells are able to produce different forms of haemoglobin at different stages in development.

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(2 marks)

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6 (a) What is meant by *basal metabolic rate?*

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(2 marks)

(b) A tall, thin man has a higher basal metabolic rate than a shorter, broader man of similar mass and age. Explain why.

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(2 marks)

4

7 **Figures 1** and **2** show data collected from a longitudinal study of the growth of a large number of children. The bars show standard deviation.

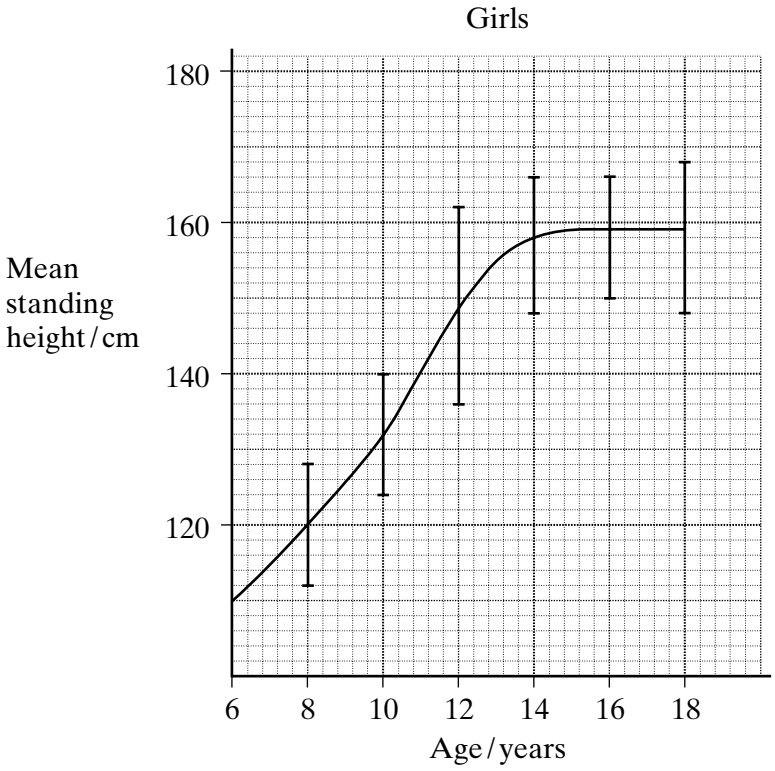

Figure 1

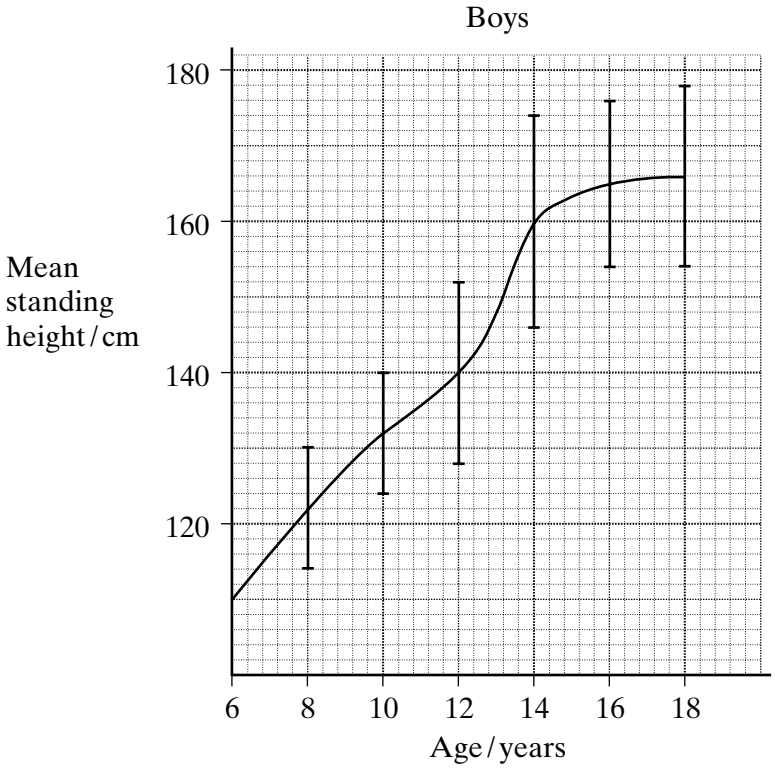

Figure 2

(a) (i) Explain what is meant by a *longitudinal study.*

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(1 mark)

(ii) Give **one** disadvantage of a longitudinal study of growth rate.

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(1 mark)

S (b) At which of the ages shown did the girls show the greatest variation in height? Give the evidence for your answer.

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(2 marks)

(c) Data from **Figure 1** have been used to plot the growth rate for girls in **Figure 3**. Use data from **Figure 2** to sketch a curve showing the growth rate for boys on **Figure 3**.

(2 marks)

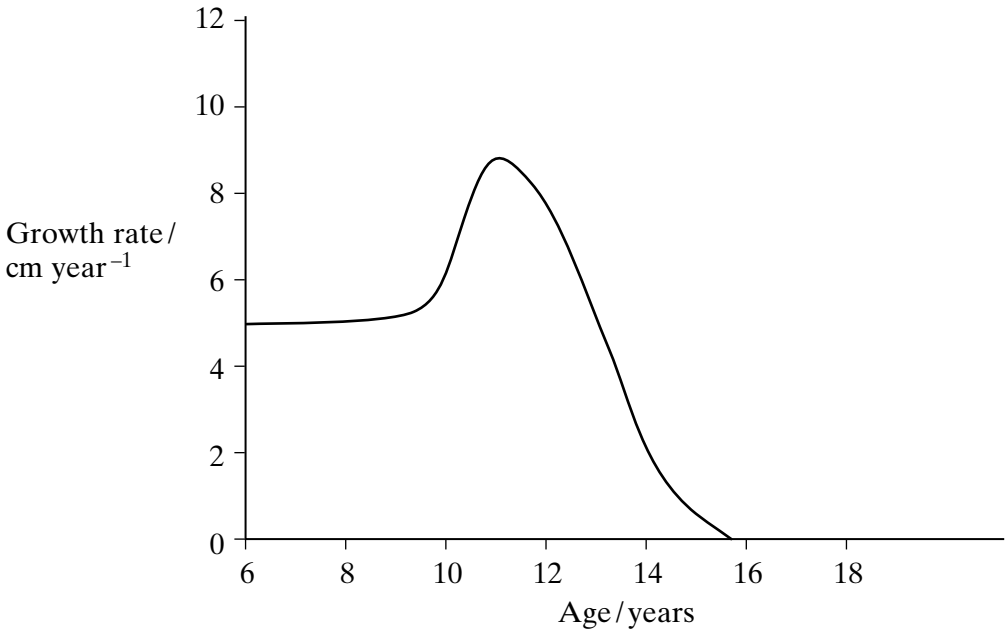

Figure 3

QUESTION 7 CONTINUES ON THE NEXT PAGE

(d) During the course of this study the girls' requirements for iron increased. Explain why.

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(3 marks)

(e) The table shows additional data collected from the sample of girls during the course of the study.

Age /years	**Mean circumference of head /cm**
6	49.0
8	50.6
10	51.9
12	52.6
14	53.0
16	53.3
18	53.3

Describe and explain any difference between the pattern of growth of the head and the pattern of growth for height between the ages of 6 years and 18 years (**Figure 1**).

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(2 marks)

S (f) In some children, growth is limited by a deficiency of growth hormone, which is a protein. Such children can be treated with injections of human growth hormone. Explain how bacteria could be used to obtain sufficient quantities of human growth hormone for such treatment.

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(4 marks)

15

TURN OVER FOR THE NEXT QUESTION

8 (a) **Figure 1** shows part of a nerve cell. The numbers show the membrane potential, in millivolts, at various points along the axon.

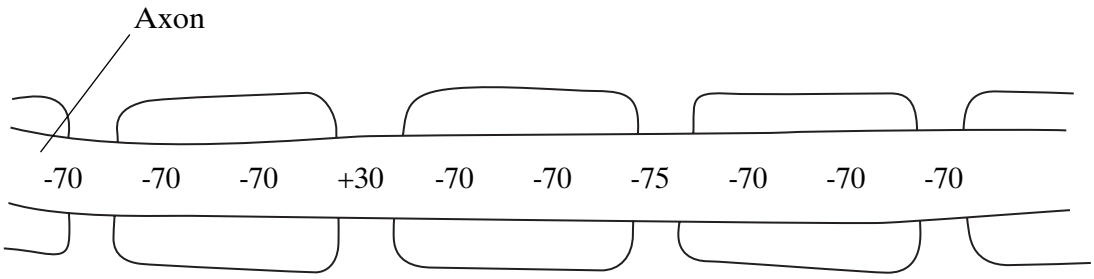

Figure 1

(i) Draw a circle on **Figure 1** to show the region of axon membrane which is most permeable to potassium ions. Explain your answer.

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(2 marks)

(ii) Draw an arrow on **Figure 1** to indicate the direction in which the nerve impulse is being conducted. Explain your answer.

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(2 marks)

S (b) The rate of oxygen consumption of a neurone increases when it conducts a high frequency of impulses. Explain why.

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(4 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(c) **Figure 2** shows the positions of two electrodes on the arm of a 20-year-old volunteer.

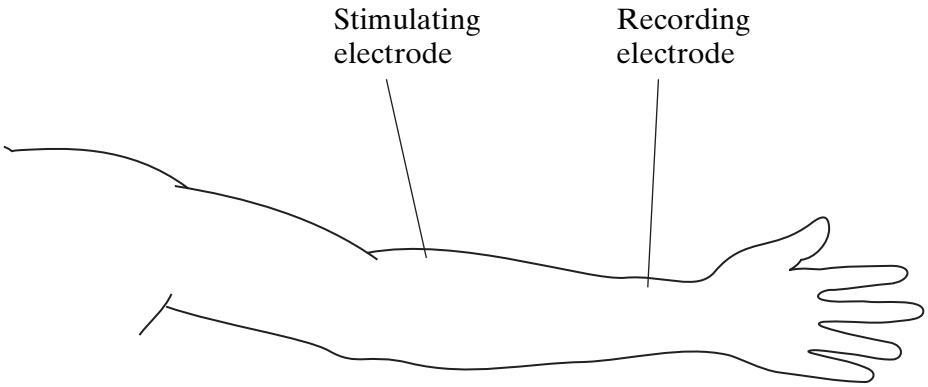

Figure 2

The first electrode was used to stimulate motor neurones in the ulnar nerve at different positions along the arm. Impulses were produced in motor neurones as a result of the stimulation and travelled along the arm, producing contraction in a muscle near the wrist. As the muscle started to contract, it produced electrical impulses which were recorded by the second electrode. The time delay between the stimulation of the nerve and the start of the muscle contraction was recorded. The results of this investigation have been plotted on **Figure 3**.

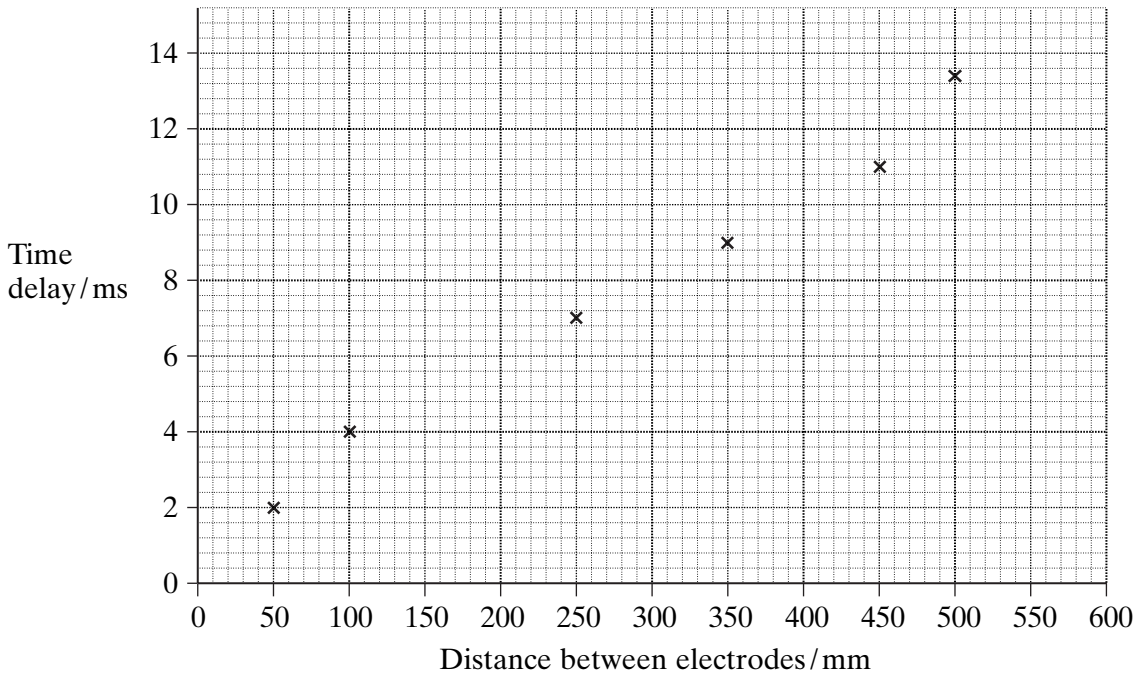

Figure 3

Draw a line of best fit on **Figure 3**. Use this line to calculate the speed of an impulse along the motor neurones in the ulnar nerve of this volunteer. Show your working.

Answer .....

(3 marks)

(d) The speed of conduction of nervous impulses and cardiac output are two physiological processes which decline with increasing age.

(i) With increasing age, a smaller proportion of each neurone is covered by a myelin sheath and the width of synapses between neurones is increased. Explain how these changes can result in a decrease in the speed of conduction of nervous impulses.

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(3 marks)

(ii) Explain how cardiac output can decline with increasing age, even though heart rate does not decline with age.

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(1 mark)

15

9 (a) Describe how enzymes are involved in the digestion of proteins in the human gut.

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(6 marks)

(b) Describe the role of the hormones secretin and cholecystokinin-pancreozymin in controlling digestive secretions.

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(4 marks)

S (c) The teeth of some mammals are specialised for either a carnivorous or a herbivorous diet, but human teeth are adapted for an omnivorous diet. Explain how stabilising selection might maintain the adaptations shown by human teeth.

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(5 marks)

15

END OF QUESTIONS