

Surname						Other Names					
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General Certificate of Education
January 2005
Advanced Level Examination



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

BYA7

Monday 24 January 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, 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			
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7			
8			
9			
Total (Column 1)		→	
Total (Column 2)		→	
TOTAL			
Examiner's Initials			

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

- 1 (a) Human growth can be investigated either by a cross-sectional study or by a longitudinal study. Give **one** advantage of

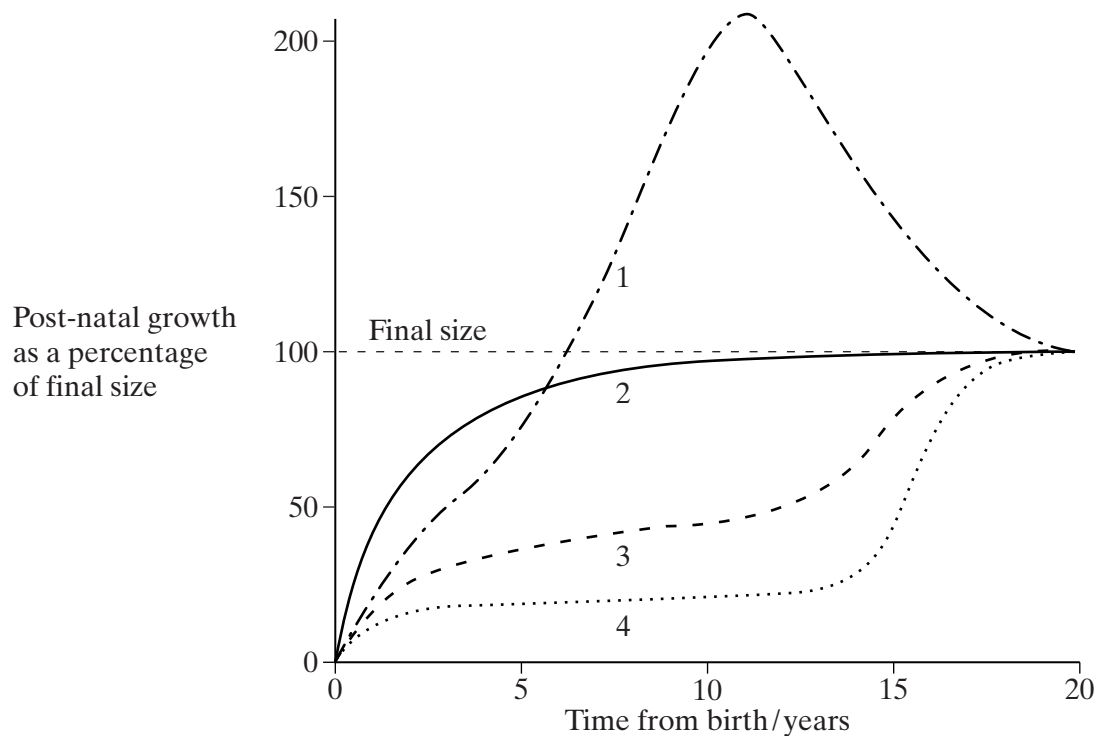
(i) a cross-sectional study;

(1 mark)

(ii) a longitudinal study.

(1 mark)

- (b) The graph shows changes in four different aspects of human growth from birth to the age of 20 years.



Complete the table to show which aspect of growth each curve represents. Write **one** number in each box.

Aspect of growth	Curve number
Brain and head	
Lymph tissue	
Reproductive organs	
Total height	

(2 marks)

4

- 2 **Figure 1** shows part of a single myofibril from a skeletal muscle fibre as it appears under an optical microscope.

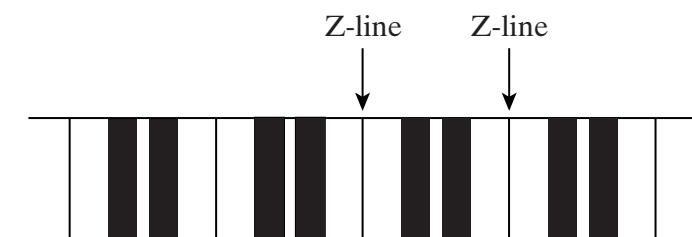


Figure 1

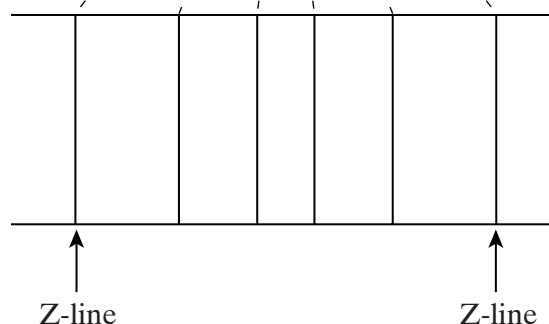


Figure 2

- (a) (i) Complete **Figure 2** to show the arrangement of actin and myosin filaments in this part of the myofibril as they would appear under an electron microscope. Label the actin and myosin filaments.

(2 marks)

- S (ii) Why are the details you have drawn in **Figure 2** visible under the electron microscope but not under the optical microscope?

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(1 mark)

- (b) The myofibril in **Figure 1** is magnified $\times 8000$. A muscle fibre is $40\text{ }\mu\text{m}$ in diameter. Calculate the number of myofibrils which would fit side by side across the diameter of the muscle fibre. Show your working.

Answer myofibrils
(2 marks)

Turn over

5

- 3 The diagram shows the digestion and absorption of fat in the small intestine.

The diagram is not reproduced here due to third-party restrictions.

- S Using information in the diagram, explain the importance of each of the following in the digestion and absorption of fat.

(a) Concentration gradient

(1 mark)

(b) Emulsification

(1 mark)

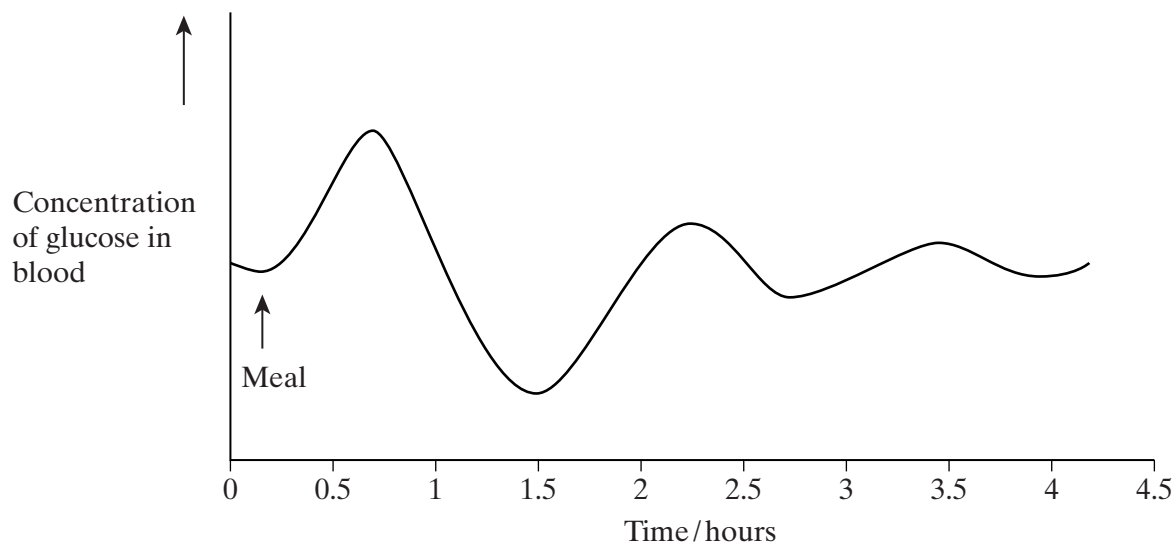
(c) Exocytosis

(1 mark)

(d) Solubility in lipids

(1 mark)

- 4 (a) The graph shows changes in the concentration of glucose in a person's blood following a meal.



Changes in the concentration of glucose are controlled by the hormones glucagon and insulin. Write the letters **X** and **Y** on the graph to show

X a time when glucagon secretion would be high;

Y a time when insulin secretion would be high.

(1 mark)

- S (b) Many diabetics require regular injections of insulin. Describe how bacteria can be genetically modified to produce human insulin.

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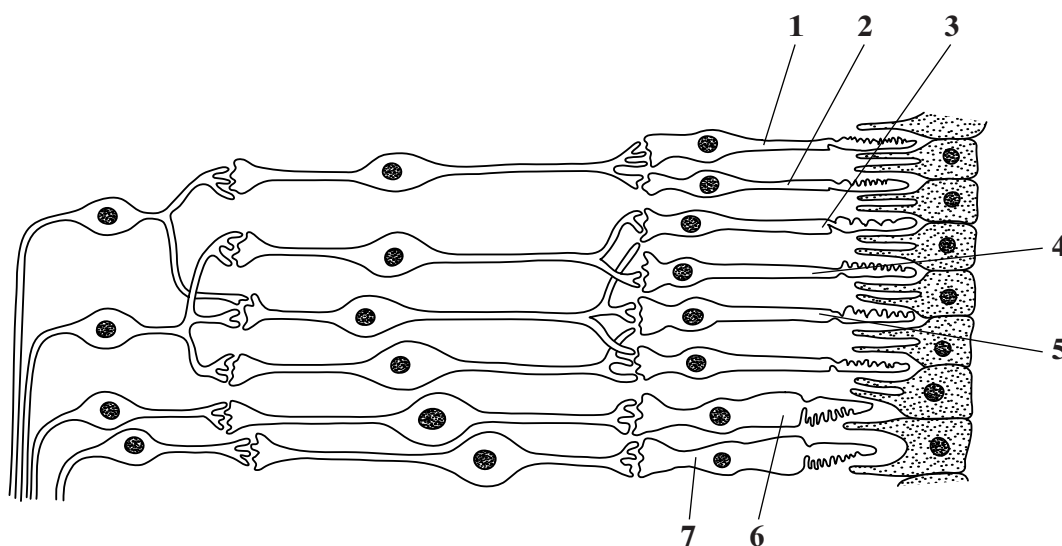
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(4 marks)

Turn over ►

5 The diagram shows part of the retina in a human eye.



(a) Explain each of the following observations.

- (i) When light falls on cells **1** and **2**, only one spot of light is seen. But, when light falls on cells **2** and **3**, two spots of light are seen.

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(1 mark)

- (ii) When one unit of light energy falls on cell **3**, no light is seen. But, when one unit of light energy falls on cell **3**, one unit falls on cell **4** and one unit falls on cell **5**, light is seen.

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(3 marks)

- (b) Cells of the same type as cells **6** and **7** are found in large numbers at the fovea. This results in colour vision with high visual acuity.

Explain what causes vision using the fovea

- (i) to be in colour;

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.....

(1 mark)

- (ii) to have high visual acuity.

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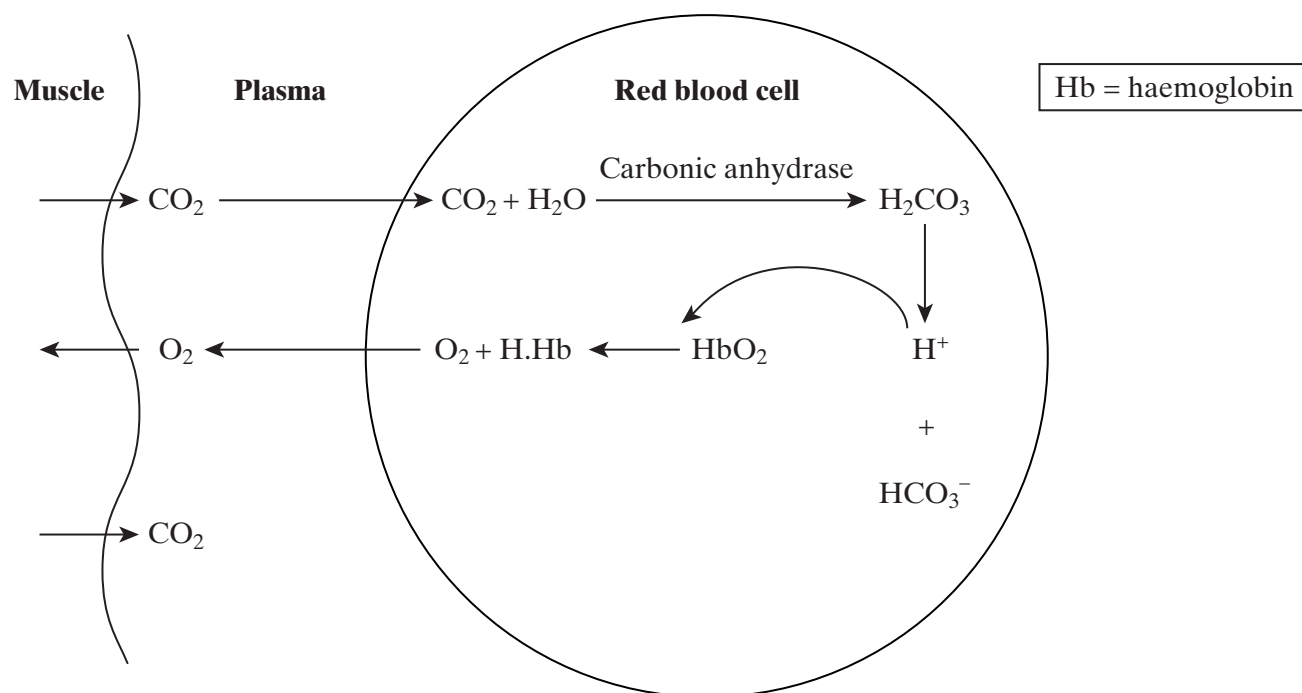
(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 6 The diagram shows some aspects of the exchange of carbon dioxide and oxygen between a red blood cell and muscle tissue.



- S (a) Increased muscle activity increases the amount of oxygen released from a red blood cell during exercise. Using information in the diagram, explain how.

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(3 marks)

- (b) The blood in a vein leaving a muscle has a pH only slightly lower than that in the artery entering it. This is partly due to haemoglobin in the red cells acting as a buffer.

- (i) Explain why the pH in the vein is lower than that in the artery.

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(2 marks)

- (ii) Explain how haemoglobin acts as a buffer.

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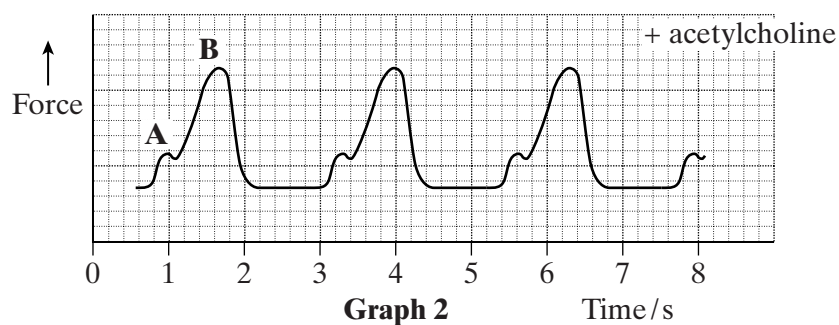
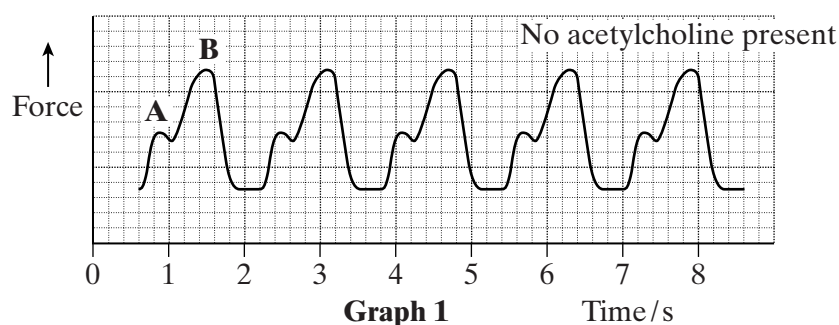
(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 7 A frog's heart was attached to an instrument which measured the force produced as the heart contracted. **Graph 1** shows the changes in force when the heart was bathed in a solution of salts at 20°C. **Graph 2** shows the results when the heart was bathed in the same solution at the same temperature, but including acetylcholine.



- S (a) Points **A** and **B** show when the atria and ventricle were contracting. Which point, **A** or **B**, shows contraction of the ventricle? Give **two** reasons for your answer.

Point

Reason 1

.....

Reason 2

.....

(2 marks)

- (b) Calculate the frog's heart rate when acetylcholine was **not** present. Show your working.

Heart rate = beats per minute
(2 marks)

- (c) (i) From the graphs, what can you conclude about the effect of acetylcholine on heart rate;
stroke volume?
(2 marks)

- S (ii) Use your answer to part (i) to explain the effect of acetylcholine on cardiac output.
.....
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(1 mark)

- (iii) Addition of acetylcholine in the experiment mimics the effect of one branch of the autonomic nervous system. Which branch is this?
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(1 mark)

- S (d) (i) Explain how nervous control in a human can cause increased cardiac output during exercise.
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(4 marks)

- (ii) Explain why increased cardiac output is an advantage during exercise.
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(3 marks)

Turn over ►

8 **Table 1** shows some data about two moderately active 22-year-old women.

	Woman A	Woman B
Height/cm	160	170
Mass/kg	55	55
Basal metabolic rate (BMR)/kJ day ⁻¹	4 970	5 800
Total energy requirement/kJ day ⁻¹	7 700	8 990

Table 1

- (a) (i) For each woman, the total energy requirement per day was greater than the BMR. Suggest **two** reasons for this.

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(2 marks)

- (ii) Use the data about height and mass to suggest why the BMR was greater in woman **B** than in woman **A**.

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(2 marks)

- (iii) During senescence, the BMR usually decreases. Give **two** reasons for this.

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(2 marks)

- (b) Woman **B** was a vegetarian.

- (i) Give **two** problems that might arise from eating only vegetable foods.

1

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2

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(2 marks)

- (ii) Explain how eating a wide range of vegetables would help to overcome these problems.

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(1 mark)

In another study, the iron content of the diets of men and women in their early 20s was investigated. The results are given in **Table 2**.

	Males	Females
Sample size	22	29
Mean iron intake / mg day ⁻¹	15.1	13.8
Standard deviation	5.1	2.8

Table 2

- S** (c) Which sample, males or females, showed the greater variation? Give evidence from **Table 2** for your answer.

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(1 mark)

- S** (d) A statistical test was carried out on the results.

- (i) Suggest the null hypothesis that was tested.

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(1 mark)

- (ii) The result of the statistical test gave a probability greater than 0.05. What conclusion can be drawn from this?

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(2 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ➡

- (e) The mean value for daily iron intake in the females was significantly less than the recommended amount, whereas the mean value for the male intake was more than sufficient. Why do females have a higher iron requirement than males of the same age?

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(2 marks)

15

- 9 (a) Describe how the structure of the placenta allows efficient exchange of materials between mother and fetus.

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(6 marks)

- (b) Describe and explain the role of the ductus arteriosus and the foramen ovale in the circulatory system of the developing fetus.

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(3 marks)

- (c) Describe how hormones control human pregnancy, birth and lactation.

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(6 marks)

END OF QUESTIONS

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