

Surname						Other Names					
Centre Number						Candidate Number					
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General Certificate of Education
 January 2004
 Advanced Level Examination



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

BYA7

Thursday 22 January 2004 Morning Session

<p>No additional materials are required. You may use a calculator.</p>
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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			
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Total (Column 1)	→		
Total (Column 2)	→		
TOTAL			
Examiner's Initials			

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

- 1 The equation is used to calculate a person's total energy expenditure.

$$\begin{array}{ccccc} \text{TEE} & = & \text{BMR} & \times & \text{PAL} \\ \text{(total energy} & & \text{(basal metabolic rate)} & & \text{(physical activity} \\ \text{expenditure)} & & & & \text{level)} \end{array}$$

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

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(2 marks)

- (b) Complete the table with ticks to show the effect of senescence on the components of the equation above.

Component	Increases	Remains the same	Decreases
BMR			
PAL			
TEE			

(1 mark)

- (c) Two men have the same body mass and age but their heights differ. The shorter man has a lower BMR. Explain why this is so.

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(2 marks)

- 2 (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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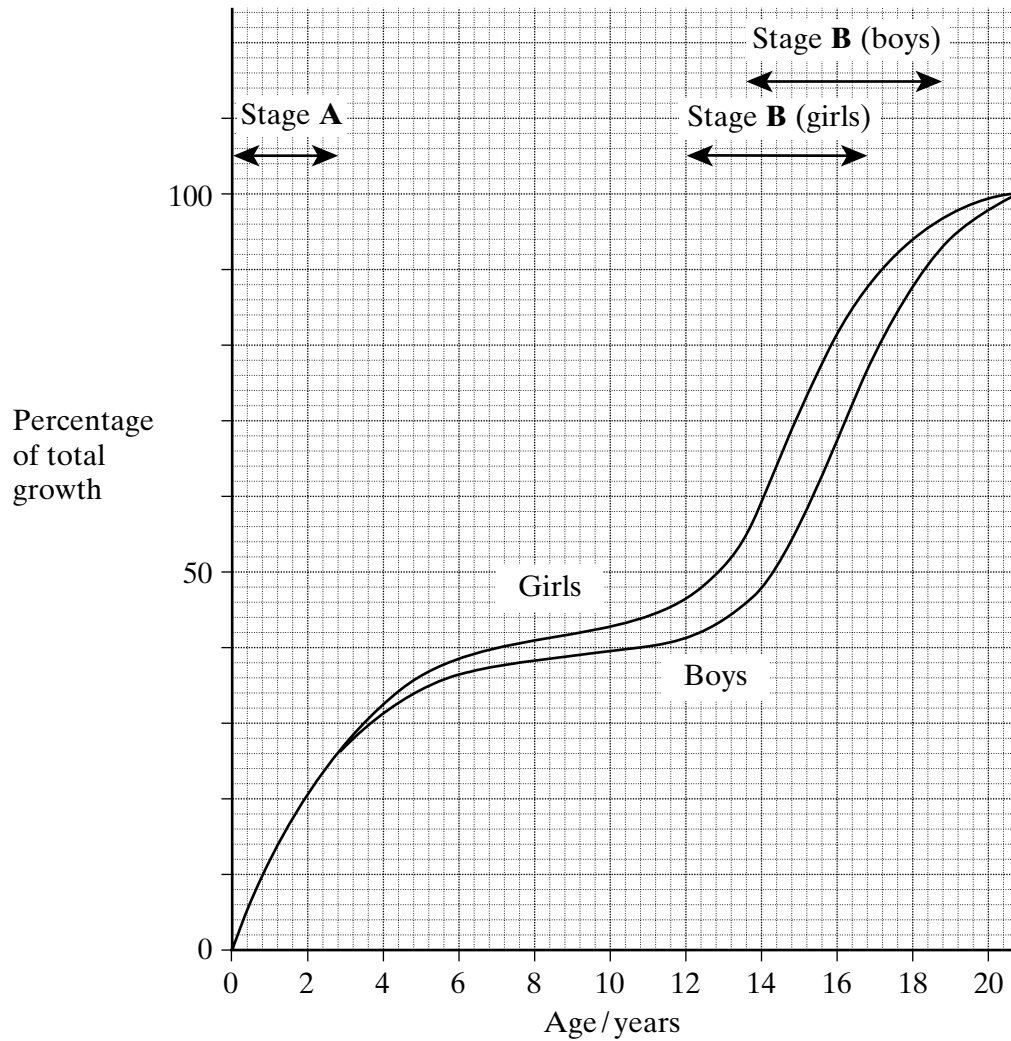
(2 marks)

5

TURN OVER FOR THE NEXT QUESTION

Turn over 

3 The graph shows growth curves.



- (a) During stage **A** one of the hormones controlling growth is growth hormone. Name **one** other hormone involved in controlling growth at this stage.

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(1 mark)

- (b) Boys and girls differ in the percentage of their total growth which occurs during the pubertal growth spurt labelled stage **B**. Use the graph to calculate this difference. Show your working.

Answer %
(2 marks)

(c) Explain why, during stage **B**, boys need more iron than when they are younger.

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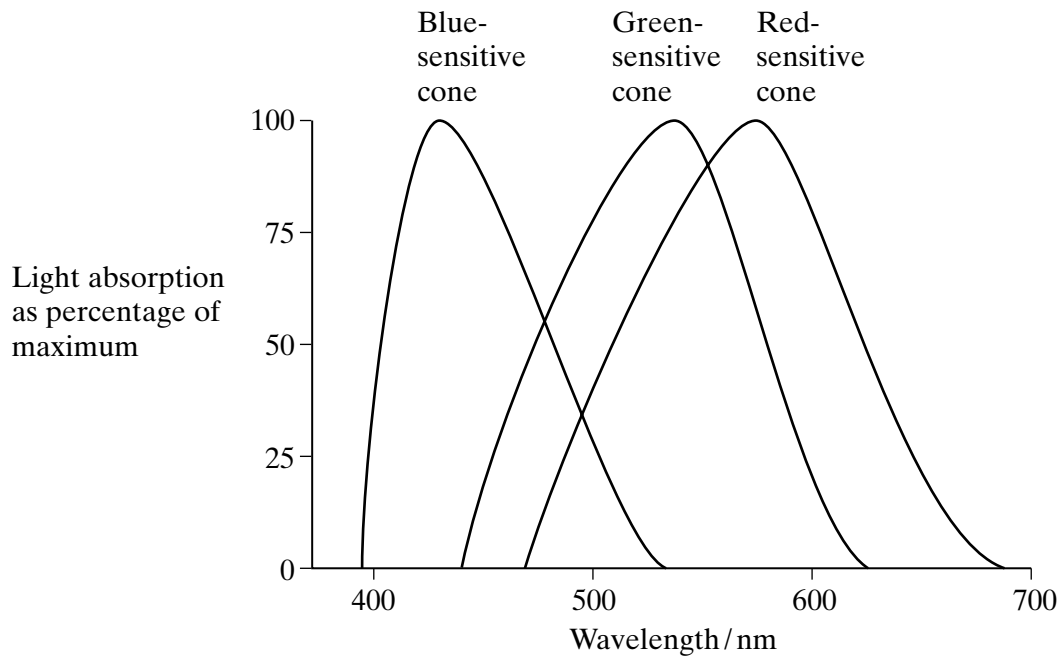
(2 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over ▶

- 4 (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)

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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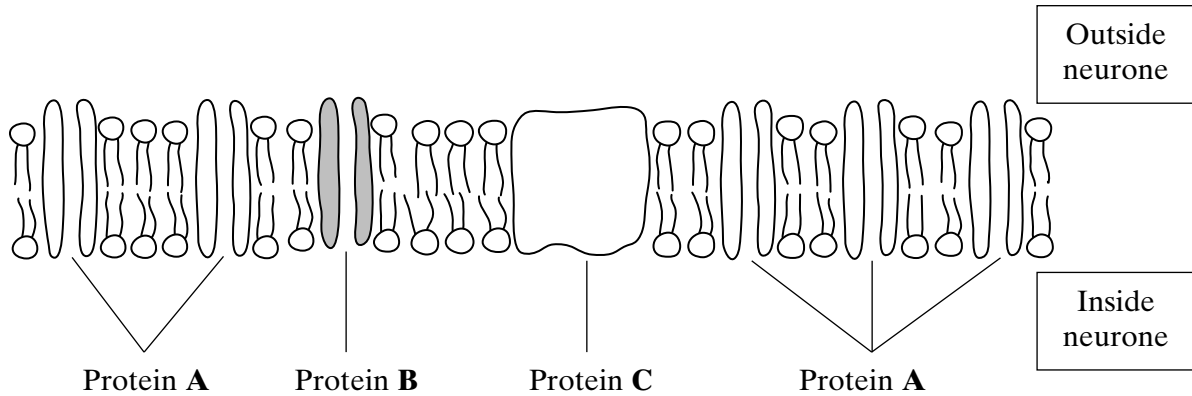
(3 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over ▶

5 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)

(b) Proteins A and B differ from each other.

S (i) Explain why different proteins are required for the diffusion of different ions through the membrane.

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(2 marks)

(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.

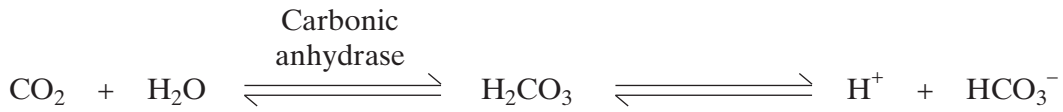
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(1 mark)

6 The equation shows chemical changes which take place in red blood cells.



(a) Explain what causes the concentration of hydrogen ions inside red blood cells to remain stable.

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(1 mark)

S (b) What effect would an increase in hydrogen ion concentration have on carbonic anhydrase? Explain your answer.

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(2 marks)

S (c) Carbonic anhydrase cannot be synthesised by mature red blood cells. Explain why.

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(2 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over 

7 **Figure 1** shows part of a sarcomere.

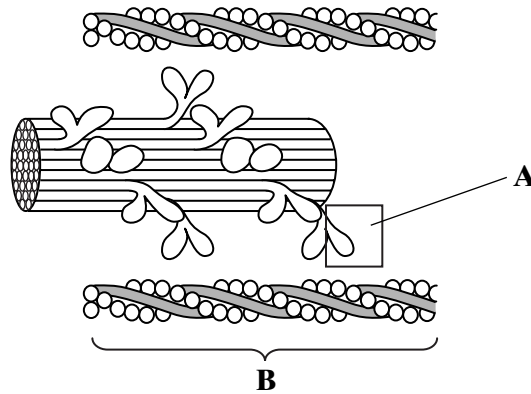


Figure 1

(a) (i) Name the main protein in structure **B**.

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(ii) Name the structure in box **A**.

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(b) (i) Describe how calcium ions cause the myofibril to start contracting.

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 (2 marks)

(ii) Describe the events that occur within a myofibril which enable it to contract.

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 (3 marks)

Slow and fast skeletal muscle fibres differ in a number of ways. Slow fibres get their ATP from aerobic respiration while anaerobic respiration provides fast fibres with their ATP. **Figure 2** shows a bundle of fast and slow fibres seen through an optical microscope. The fibres have been stained with a stain that binds to the enzymes which operate in the electron transport chain.

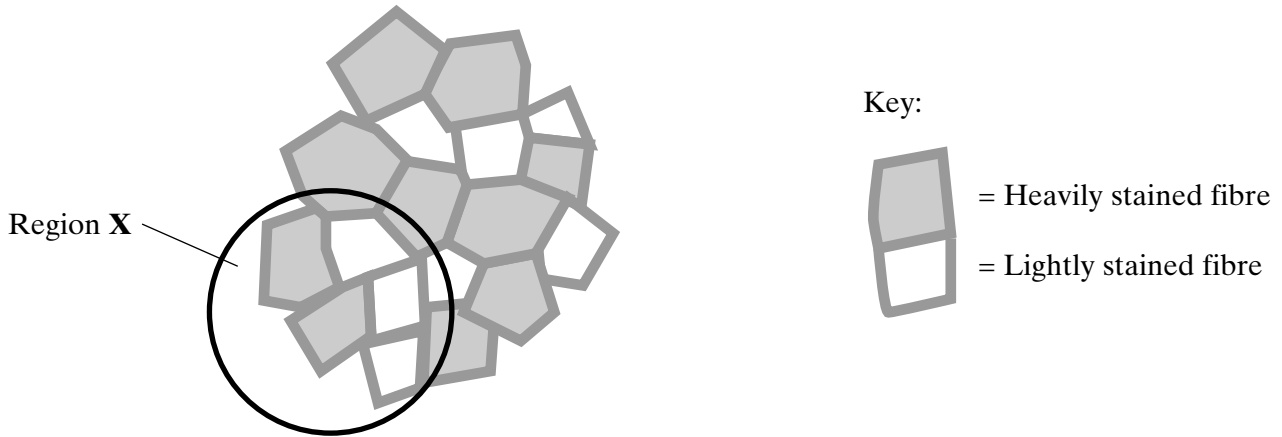


Figure 2

S (c) (i) Describe how you could calculate the percentage of fast fibres in this bundle.

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 (1 mark)

(ii) The figure calculated by the method in part (c)(i) may not be true for the muscle as a whole. Explain why.

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 (1 mark)

(d) The fibres in **Figure 3** correspond to those in region **X** of **Figure 2**. They were stained with a substance that binds to enzymes involved in glycolysis. Shade **Figure 3** to show the appearance of the fibres. Use the shading shown in the key.

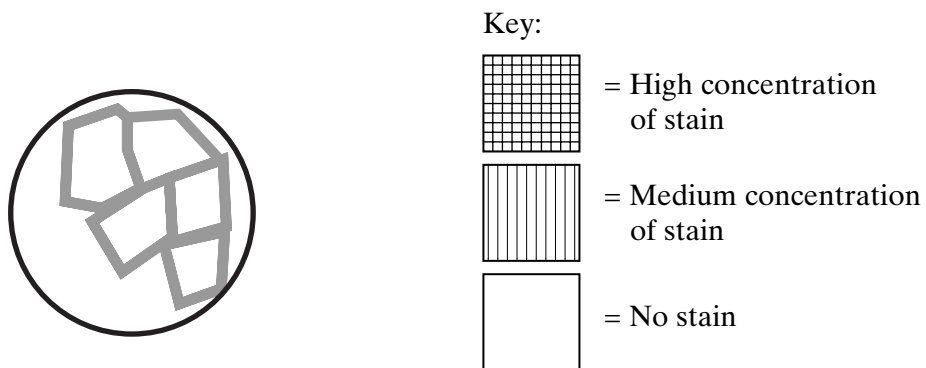


Figure 3

(2 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

Turn over ►

S (e) Recent research has shown that the difference in fibre types is due in part to the presence of different forms of the protein myosin with different molecular shapes. Explain how a new form of myosin with different properties could have been produced as a result of mutation.

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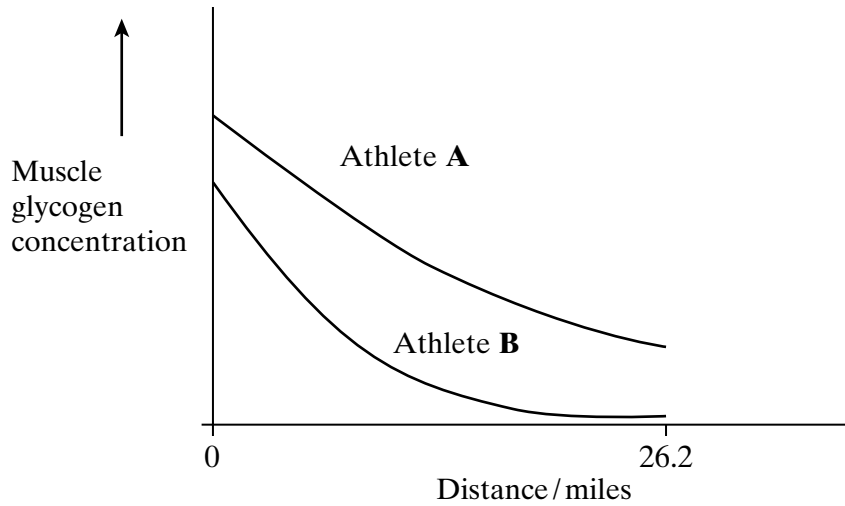
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(4 marks)

- 8 A marathon is a race where athletes run a distance of 26.2 miles. Club-level athletes can complete a marathon in about three hours.

An investigation was carried out into muscle glycogen concentration, exercise and diet. The investigation involved two club-level athletes running a marathon. Athlete **A** had prepared for the race by glycogen loading, athlete **B** had not. The graph shows the results.



- S (a) The RQ for athlete **B** changed during the marathon. Using information from the graph

(i) describe how the RQ value changed;

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(1 mark)

(ii) give an explanation for the change.

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(2 marks)

- (b) Athlete **A** ate a diet rich in pasta and potatoes for four days prior to the marathon.

(i) Describe how this led to glycogen loading.

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(2 marks)

(ii) Explain the fall in muscle glycogen concentration during the marathon.

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(2 marks)

(c) The core body temperature of the athletes increased slightly during the marathon.

S (i) Explain what caused their core body temperature to increase.

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(1 mark)

(ii) Explain what caused the increase to be only slight.

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(4 marks)

(iii) The athletes' muscles respired at a lower rate when the external temperature was 25 °C than when the external temperature was 10 °C. In terms of blood flow, explain what caused this difference.

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(3 marks)

Turn over ▶

- 9 (a) Explain how the structural features of a sperm cell enable it to travel through the female reproductive tract and fertilise a secondary oocyte.

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(4 marks)

- S (b) In a zygote, DNA is present both in the nucleus and in the mitochondria. The table shows an analysis of the DNA present in a zygote.

Source	Kilobase-pairs of DNA present
Ovum	4 656 900
Sperm	3 000 000

Describe and explain the origins of the DNA present in the zygote.

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(5 marks)

- (c) The placenta is the site of exchange between the fetus and its mother. Describe and explain **three** ways in which the placenta is adapted for the exchange of substances.

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(6 marks)

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END OF QUESTIONS