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

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

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, 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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9			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

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

TEE (total energy expenditure)	=	BMR (basal metabolic rate)	×	PAL (physical activity level)

(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)

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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)

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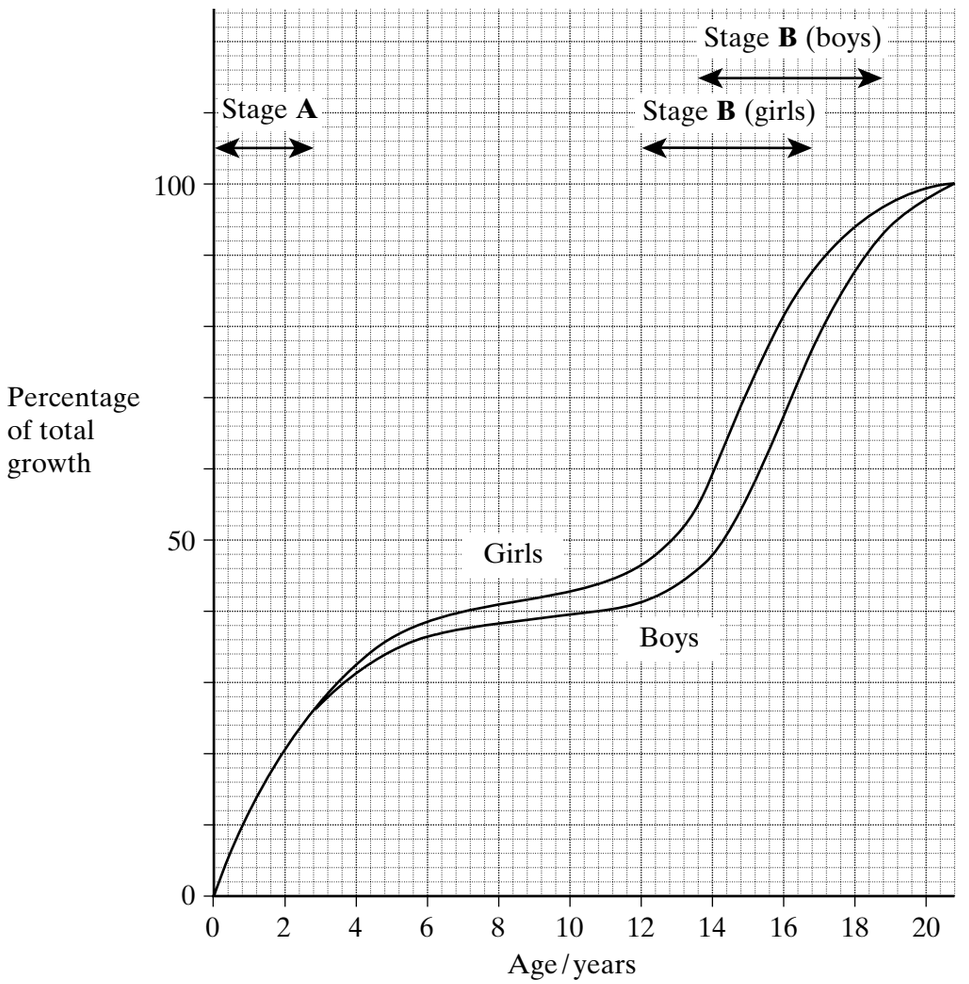
TURN OVER FOR THE NEXT QUESTION

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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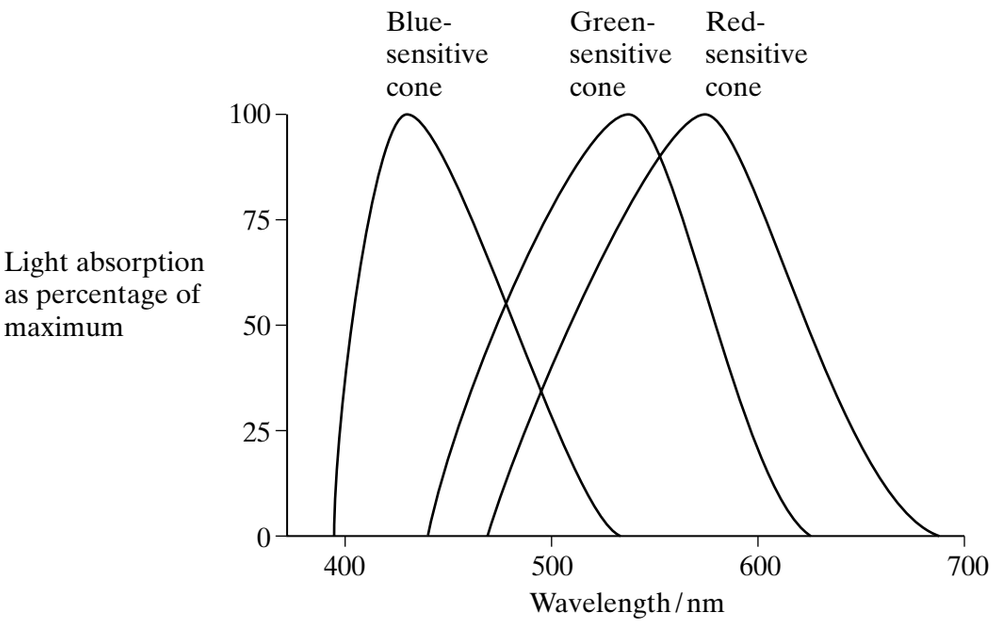
TURN OVER FOR THE NEXT QUESTION

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)

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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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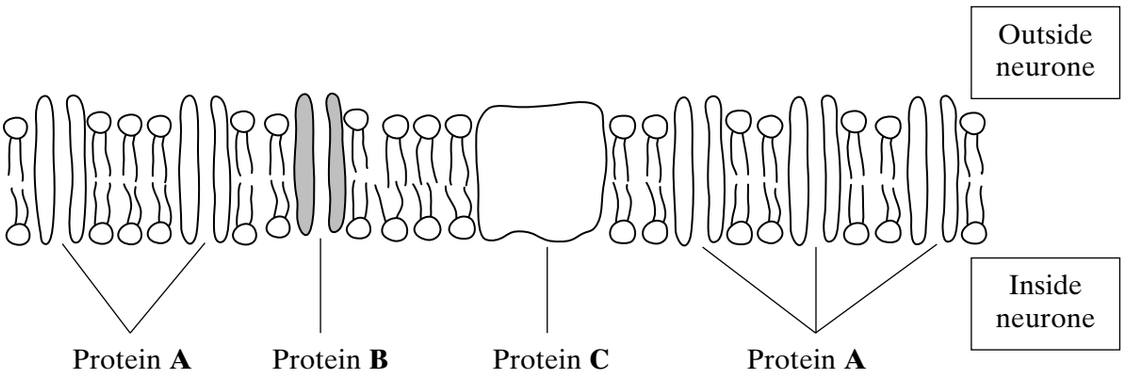
TURN OVER FOR THE NEXT QUESTION

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.

$$CO_2 + H_2O \xrightleftharpoons{\text{Carbonic anhydrase}} H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$$

(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

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

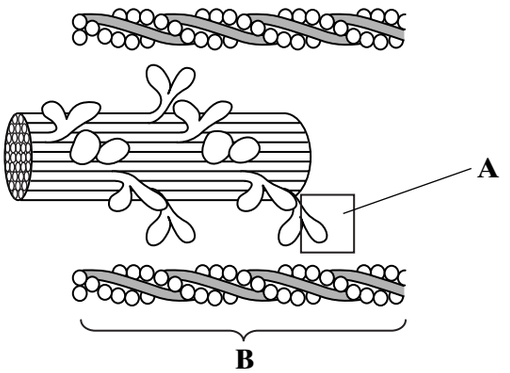

Figure 1

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

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(1 mark)

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

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(1 mark)

(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.

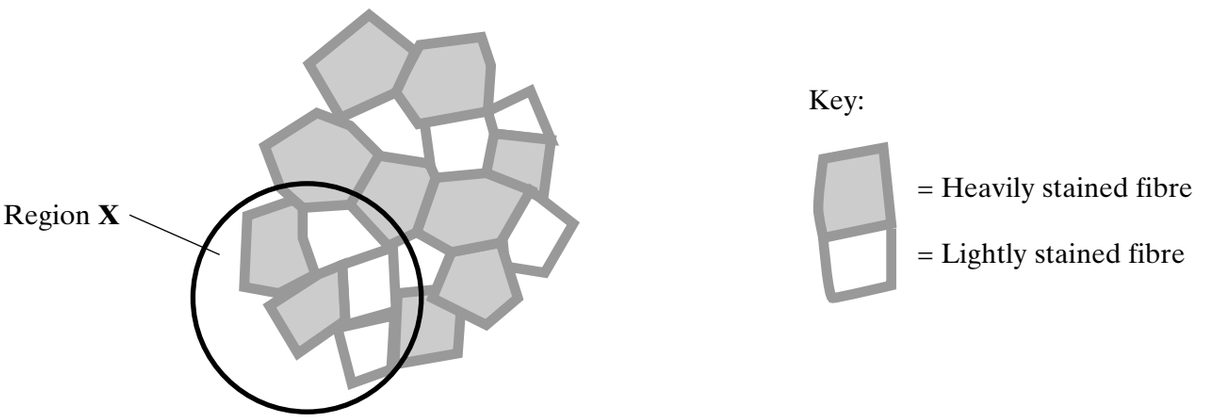

Figure 2

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.

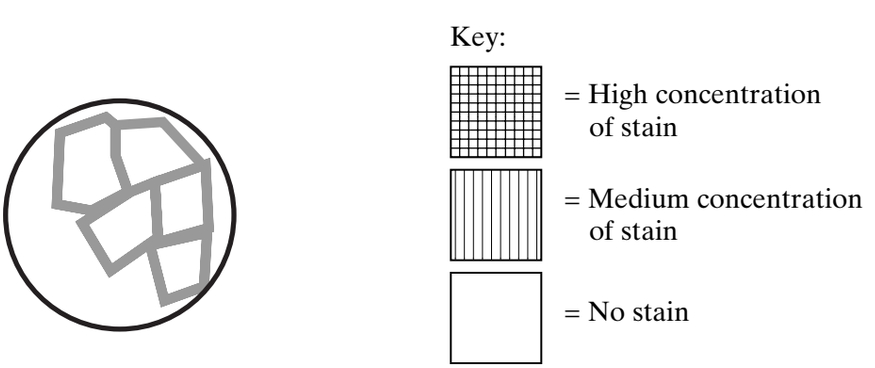

Figure 3

(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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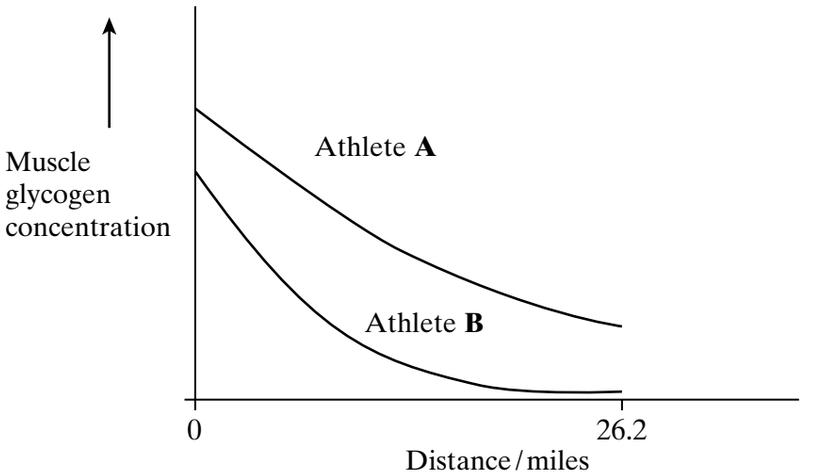
(4 marks)

15

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)

LEAVE MARGIN BLANK

(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)

15

END OF QUESTIONS