Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

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General Certificate of Education
June 2002
Advanced Level Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Monday 17 June 2002 Morning Session

No additional materials are required.
You may use a calculator.

Time allowed: 1 hour 30 minutes

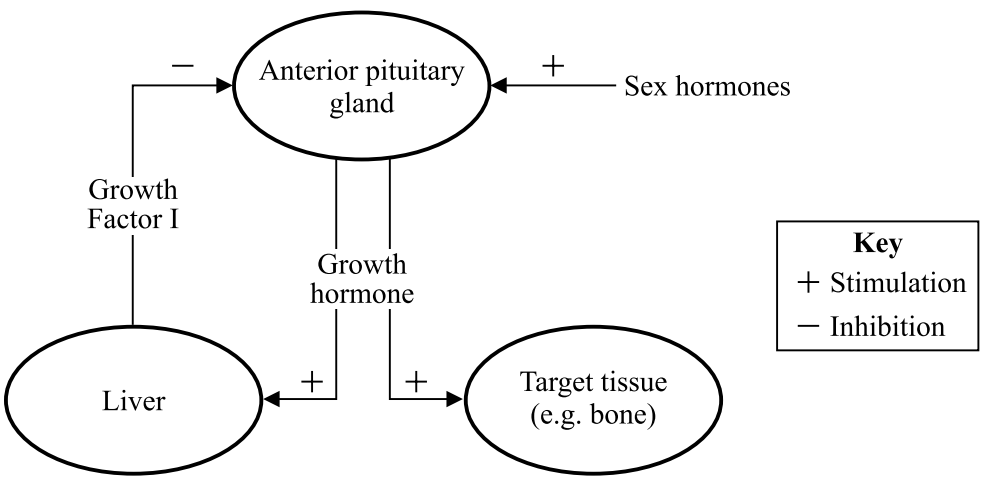
Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

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			
4			
5			
6			
7			
8			
9			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 (a) The diagram shows some of the ways in which the secretion of growth hormone is controlled.



(i) How does *growth rate* differ from *absolute growth*?

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(1 mark)

(ii) Explain the evidence in the diagram which suggests that the secretion of growth hormone is controlled by a negative feedback mechanism.

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(1 mark)

(iii) Suggest how the adolescent growth spurt is caused.

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(1 mark)

S (b) Human growth hormone can be obtained from genetically engineered bacteria. Explain why the growth hormone produced in this way has the same effect on growth as normal human growth hormone.

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(2 marks)

5

2 The beating of the heart is affected by nerves and by the hormone adrenaline.

(a) Explain how the sympathetic and parasympathetic branches of the autonomic nervous system affect heart rate.

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(3 marks)

S (b) Explain how beta blockers affect the beating of the heart.

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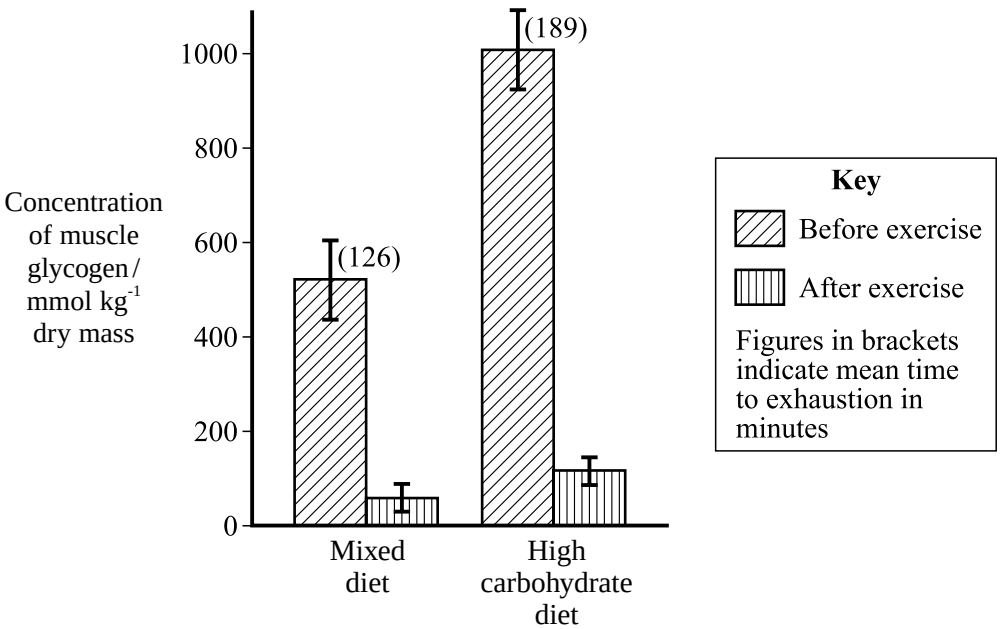
(2 marks)

5

3 Many athletes practise glycogen loading. They eat food high in carbohydrates for 3 – 4 days before an event. This produces an increase in the amount of glycogen stored in the liver and muscles.

In an investigation into the effects of glycogen loading on performance, two groups of athletes followed different diets before exercising. All the athletes exercised at the same rate until they were exhausted. This time was recorded. The concentration of muscle glycogen was measured before and after exercise. Some results are shown in the graph.



(a) (i) Calculate the percentage increase in mean time to exhaustion of the athletes following a high carbohydrate diet compared with those following a mixed diet. Show your working.

Answer .....

(2 marks)

(ii) Explain this increase in mean time to exhaustion.

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(2 marks)

S (b) What do the bars (I) on the graph indicate about the values?

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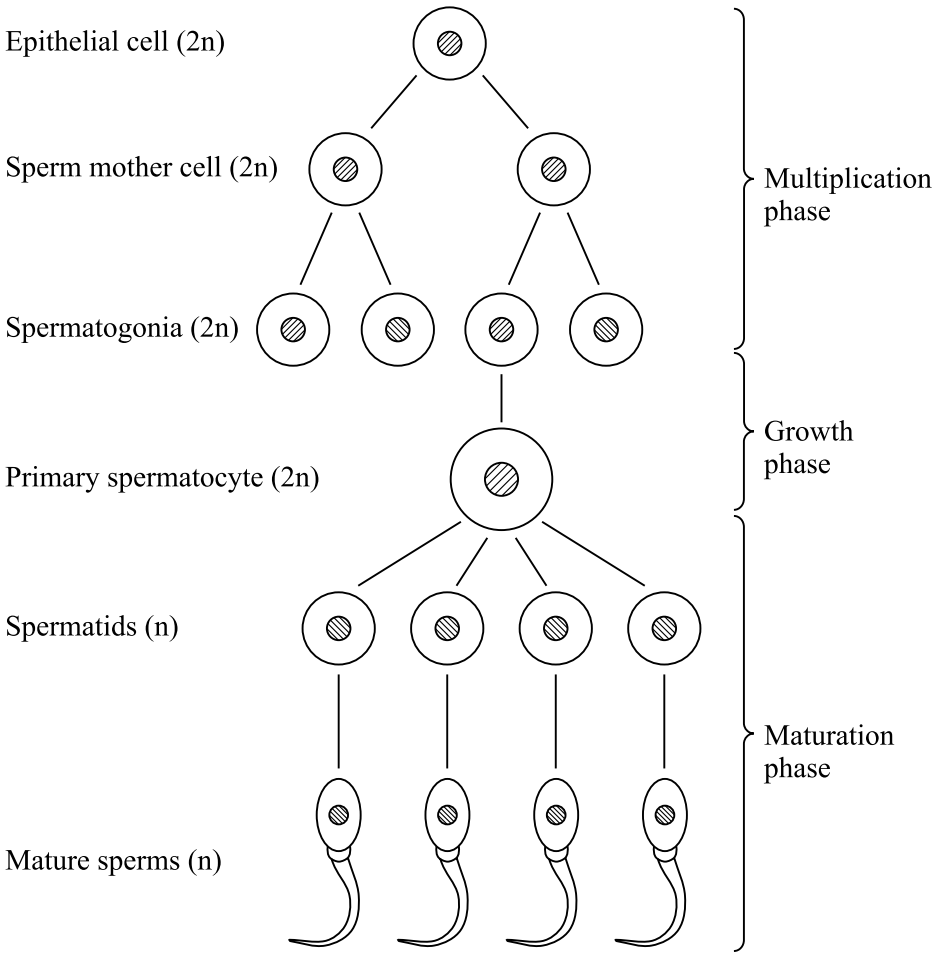
(1 mark)

4 The diagram shows the main stages in the production of mature sperms.



S (a) Explain why all the spermatogonia produced from a single sperm mother cell have identical DNA.

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(3 marks)

(b) Mature ova are produced by a similar process but there are important differences. Describe **two** of these differences.

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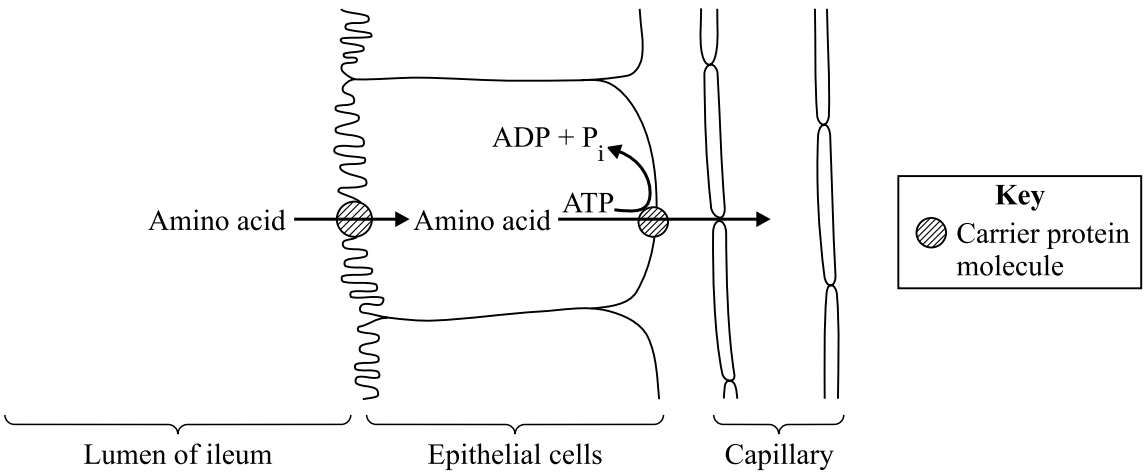
(2 marks)

5 (a) The diagram shows how amino acids are absorbed from the lumen of the ileum.



S Describe how the processes shown in the diagram enable the epithelial cells to absorb amino acids continuously.

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(3 marks)

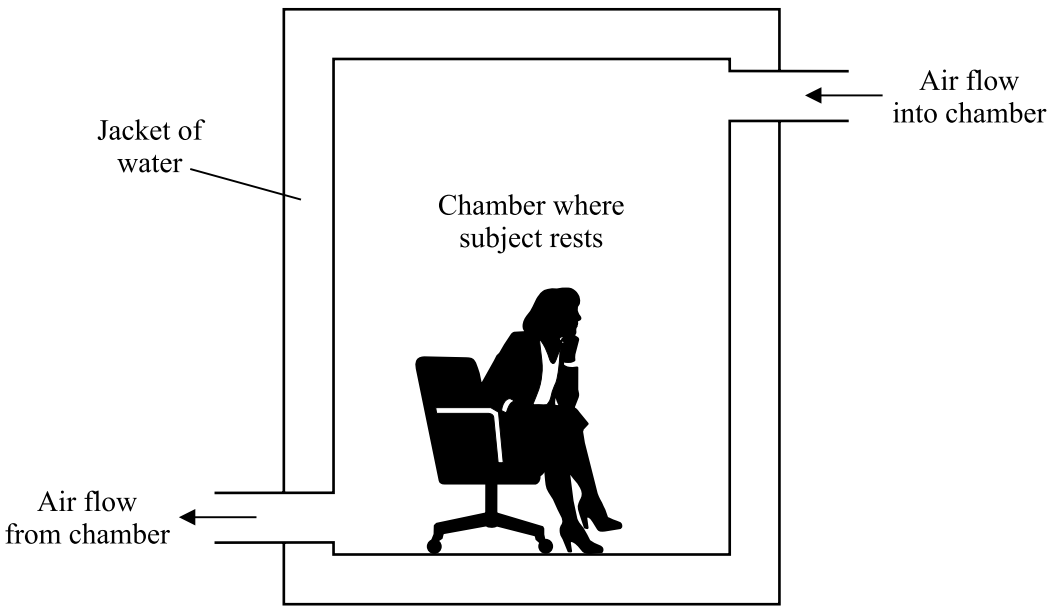
(b) 90% of the protein we eat is digested into amino acids. 80% of these amino acids are absorbed from the ileum and incorporated (as protein) into tissue.

A man needs to incorporate into tissue 0.54g of protein per kg body mass per day. How much protein should a man with a body mass of 75 kg eat per day? Show your working.

Answer.....

(2 marks)

6 (a) Basal metabolic rate (BMR) can be calculated from measurements taken from direct calorimetry. The diagram shows how this technique operates.



(i) In what units is BMR usually given?

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(1 mark)

(ii) Why must the mass of water and the change in temperature of the water over the period of the investigation be known?

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(1 mark)

(iii) Why must the rate of air flow and temperature of air entering and leaving the chamber be known?

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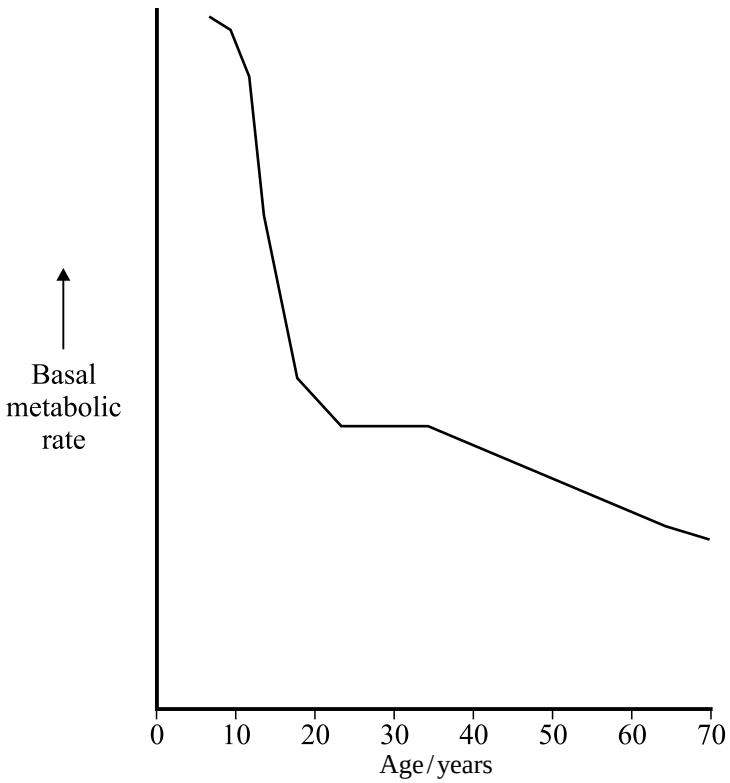
(1 mark)

QUESTION 6 CONTINUES ON THE NEXT PAGE

(b) The graph shows the changes in BMR in males between the ages of 10 and 70.



Explain the changes in BMR of males over this age span.

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(2 marks)

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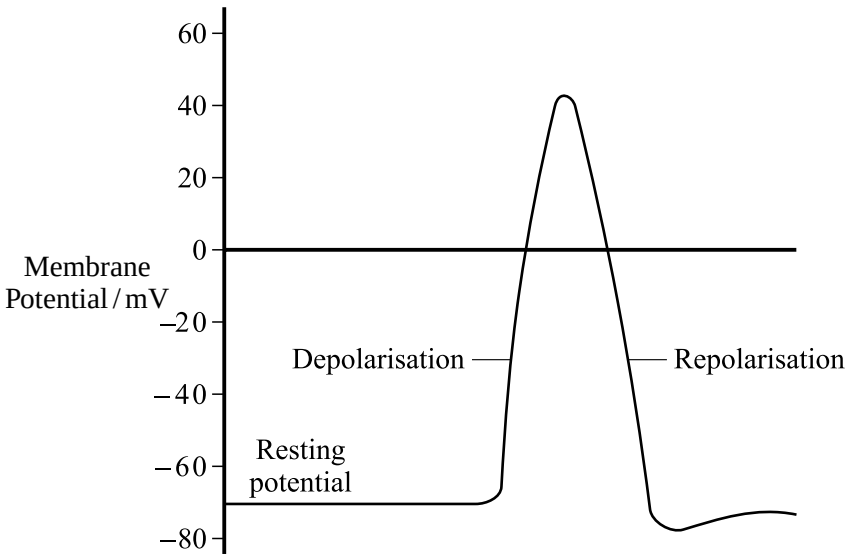
7 (a) The diagram shows the changes in the membrane potential at one point on an axon when an action potential is generated.



(i) Explain how

A the resting potential of –70 mV is maintained;

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(3 marks)

B depolarisation takes place.

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(1 mark)

(ii) Explain why another action potential cannot be generated during repolarisation.

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(2 marks)

QUESTION 7 CONTINUES ON THE NEXT PAGE

Turn over ▶

S (b) (i) Explain why a neurotransmitter (e.g. acetylcholine) can only bind with one type of receptor protein in the postsynaptic membrane.

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(2 marks)

(ii) What is the role of calcium ions (Ca^{2+}) in synaptic transmission?

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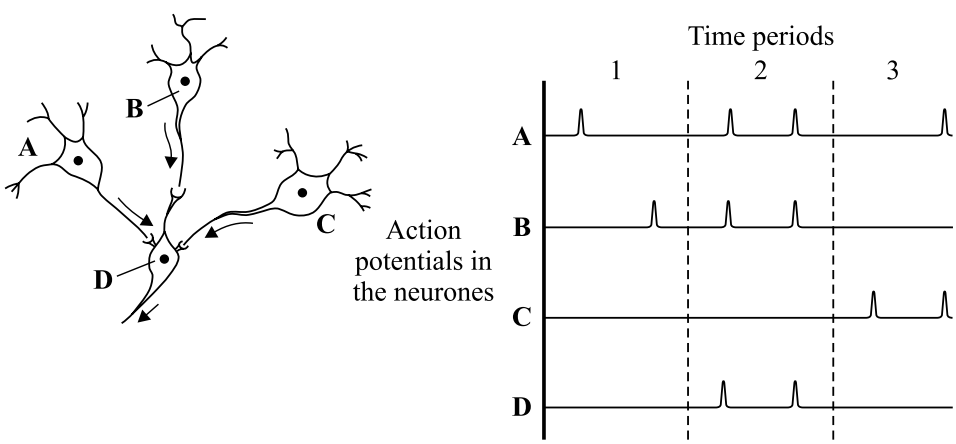
(1 mark)

(c) The diagram shows part of a nerve network. The graphs show action potentials in neurones **A**, **B** and **C** and those which result in neurone **D**.



(i) In terms of summation, explain why an action potential is generated in neurone **D** in time period 2.

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(2 marks)

(ii) Explain why no action potential is generated in neurone **D** during time period 1.

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(2 marks)

(iii) From the results in time period 3, deduce the nature of the synapse between neurones **C** and **D**. Explain your answer.

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(2 marks)

15

TURN OVER FOR THE NEXT QUESTION

8 In humans, the zygote formed by fertilisation develops into a blastocyst, which implants into the lining of the uterus. Some cells of the blastocyst form a membrane which develops into the placenta. Oxygen diffuses from maternal blood to fetal blood at the placenta.

(a) (i) Describe a blastocyst.

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(2 marks)

S (ii) Use Fick's law to explain how the structure of the placenta makes it an efficient gas exchange surface.

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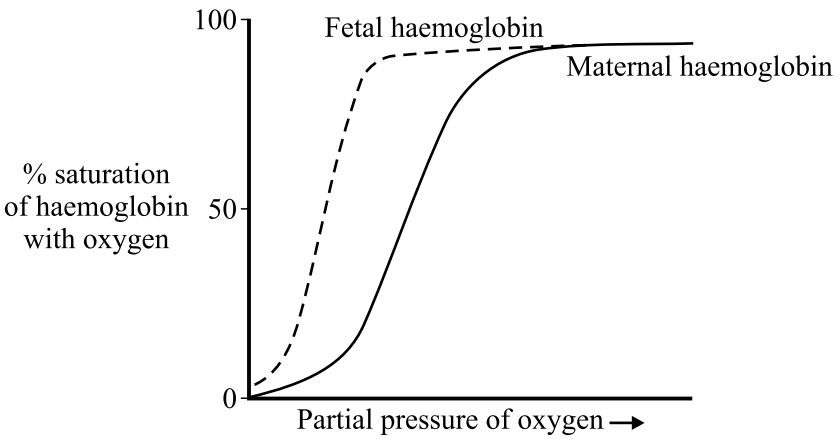
(4 marks)

(b) The graph shows the dissociation curves for fetal and maternal haemoglobin.



(i) Use evidence from the graph to explain how maternal haemoglobin can load oxygen in the lungs and unload oxygen in the placenta.

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(3 marks)

(ii) Use evidence from the graph to explain how fetal haemoglobin makes it possible for the fetus to obtain oxygen from the mother's blood.

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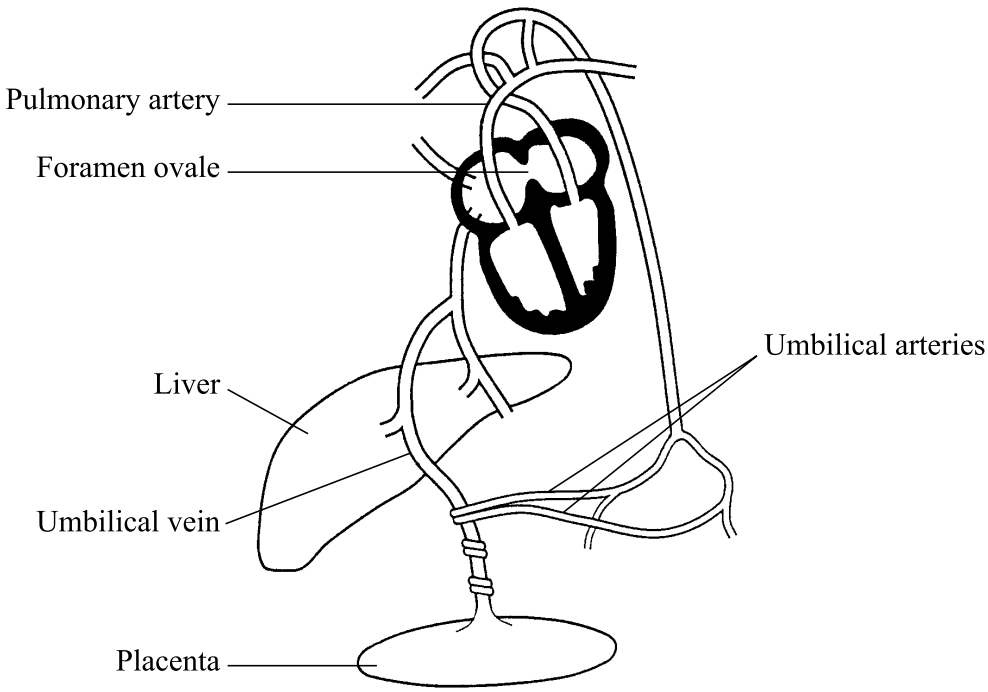
(2 marks)

QUESTION 8 CONTINUES ON THE NEXT PAGE

(c) The diagram shows the main features of the fetal circulatory system.



(i) Explain the importance of the pulmonary circulation in the fetus before birth.

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(2 marks)

(ii) Explain the benefits of the following events that take place at birth.

A The umbilical vein constricts.

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B The foramen ovale closes.

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(2 marks)

9 Skeletal muscle is made of bundles of fibres.

(a) Describe the roles of calcium ions, ATP and phosphocreatine in producing contraction of a muscle fibre.

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(4 marks)

S (b) The table shows some properties of slow and fast muscle fibres.

Property of fibre	Type I (slow fibres)	Type II (fast fibres)
Number of mitochondria per fibre	Many	Few
Concentration of enzymes regulating glycolysis	Moderate	High
Resistance to fatigue	High	Low

Endurance athletes, such as marathon runners, nearly always have a high proportion of slow fibres in their muscles. Explain the benefit of this.

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(6 marks)

QUESTION 9 CONTINUES ON THE NEXT PAGE

(c) During exercise, much heat is generated. Describe the homeostatic mechanisms that restore normal body temperature following vigorous exercise.

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(5 marks)

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END OF QUESTIONS