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General Certificate of Education
 June 2005
 Advanced Subsidiary Examination



BIOLOGY (SPECIFICATION B)
Unit 3 Physiology and Transport

BYB3/W

Monday 6 June 2005 Morning Session

In addition to this paper you will require:

- a ruler with millimetre measurements.

You may use a calculator.

| For Examiner's Use | | | |
|---------------------|------|--------|------|
| Number | Mark | Number | Mark |
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Time allowed: 1 hour

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 54.
- Mark allocations are shown in brackets.
- Answers for **Questions 1 to 6** are expected to be short and precise.
- **Question 7** should be answered in continuous prose. Quality of Written Communication will be assessed in the answer. You will be awarded up to 1 mark for 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 legibility of your handwriting and the accuracy of your spelling, punctuation and grammar will also be taken into account.

NO QUESTIONS APPEAR ON THIS PAGE

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

1 (a) Receptors are involved in the control of breathing. Name the type of receptor located in

(i) bronchioles;

(ii) carotid bodies.

(2 marks)

(b) Describe how stimulation of receptors in the medulla results in an increase in the volume of the lungs during breathing.

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(2 marks)

(c) As a small aircraft takes off and climbs, the partial pressure of the oxygen in the aircraft decreases rapidly. Explain why the pilot's rate of breathing is not immediately affected by the reduction in oxygen.

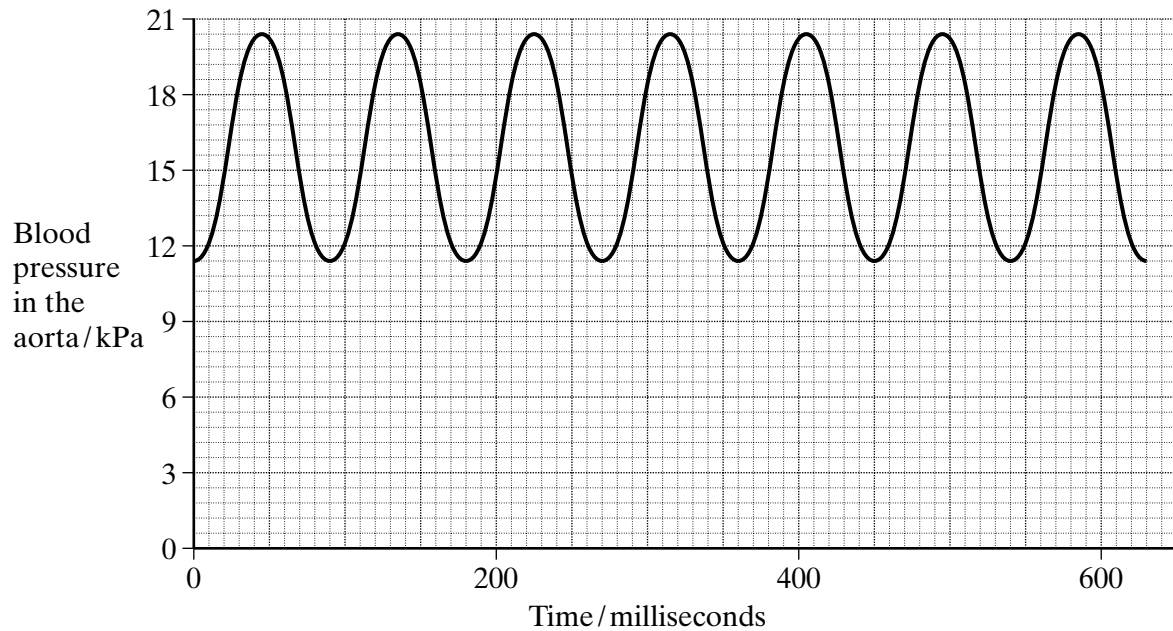
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(2 marks)

6

Turn over 

- 2 The graph shows the changes in pressure which take place in the aorta of a mouse during several heartbeats.



- (a) Which chamber of the heart produces the increase in pressure recorded in the aorta?

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(1 mark)

- (b) The pressure of blood in the aorta decreases during each heartbeat but does not fall below 10 kPa. Explain what causes the pressure of blood to

- (i) decrease during each heartbeat;

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(1 mark)

- (ii) stay above 10 kPa.

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(2 marks)

- (c) The heart rate of a mouse is much higher than the heart rate of a human. Use the graph to calculate the heart rate of the mouse. Show your working.

Heart rate = beats per minute
(2 marks)

- (d) The cardiac output is the volume of blood pumped by a heart in one minute. The stroke volume is the volume of blood pumped by a heart in a single heartbeat.

$$\text{cardiac output} = \text{stroke volume} \times \text{heart rate}$$

The cardiac output for a mouse with a heart rate of 550 beats per minute is 16.6 cm^3 per minute. Calculate the stroke volume for this mouse. Show your working.

Stroke volume = cm^3
(2 marks)

8

TURN OVER FOR THE NEXT QUESTION

Turn over 

3 (a) Describe how water is absorbed from the soil into a root and moves towards the endodermis.

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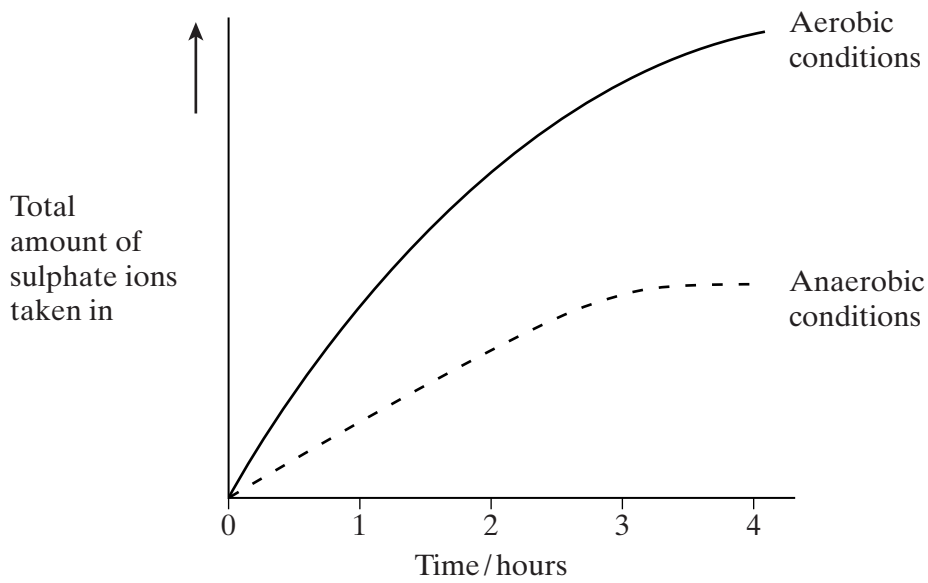
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(3 marks)

(b) An investigation was carried out to compare the uptake of sulphate ions by barley roots in aerobic and in anaerobic conditions. The results are shown in the graph.



- (i) Explain the evidence from the graph that active transport is involved in the uptake of sulphate ions.

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(2 marks)

- (ii) Suggest why the uptake of sulphate ions by the roots in anaerobic conditions stopped after 3 hours.

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(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ▶

4 (a) Explain how each of the following is related to the function of xylem tissue.

(i) Xylem tissue contains hollow tubes.

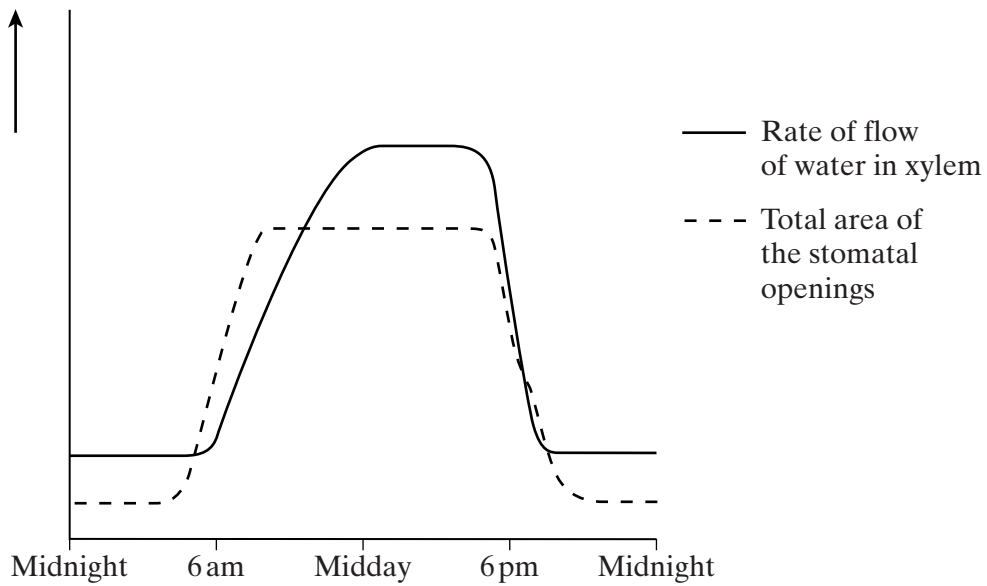
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(ii) Lignin is present in xylem cell walls.

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(2 marks)

(b) In an investigation the total area of the stomatal openings and the rate of flow of water through xylem were measured in a plant over a period of 24 hours. The results are shown in the graph.



- (i) Describe the relationship between the rate of flow of water and the total area of the stomatal openings for the period of time between midday and midnight.

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(1 mark)

- (ii) Between 8 am and midday the rate of flow of water continues to rise although the total area of the stomatal openings remains constant. Explain why the rate of flow of water rises.

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(1 mark)

- (iii) How would the curve showing the total area of the stomatal openings differ if the investigation was repeated on a dull day?

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(1 mark)

- (c) Some xerophytic plants have sunken stomata. Explain the advantage of this adaptation.

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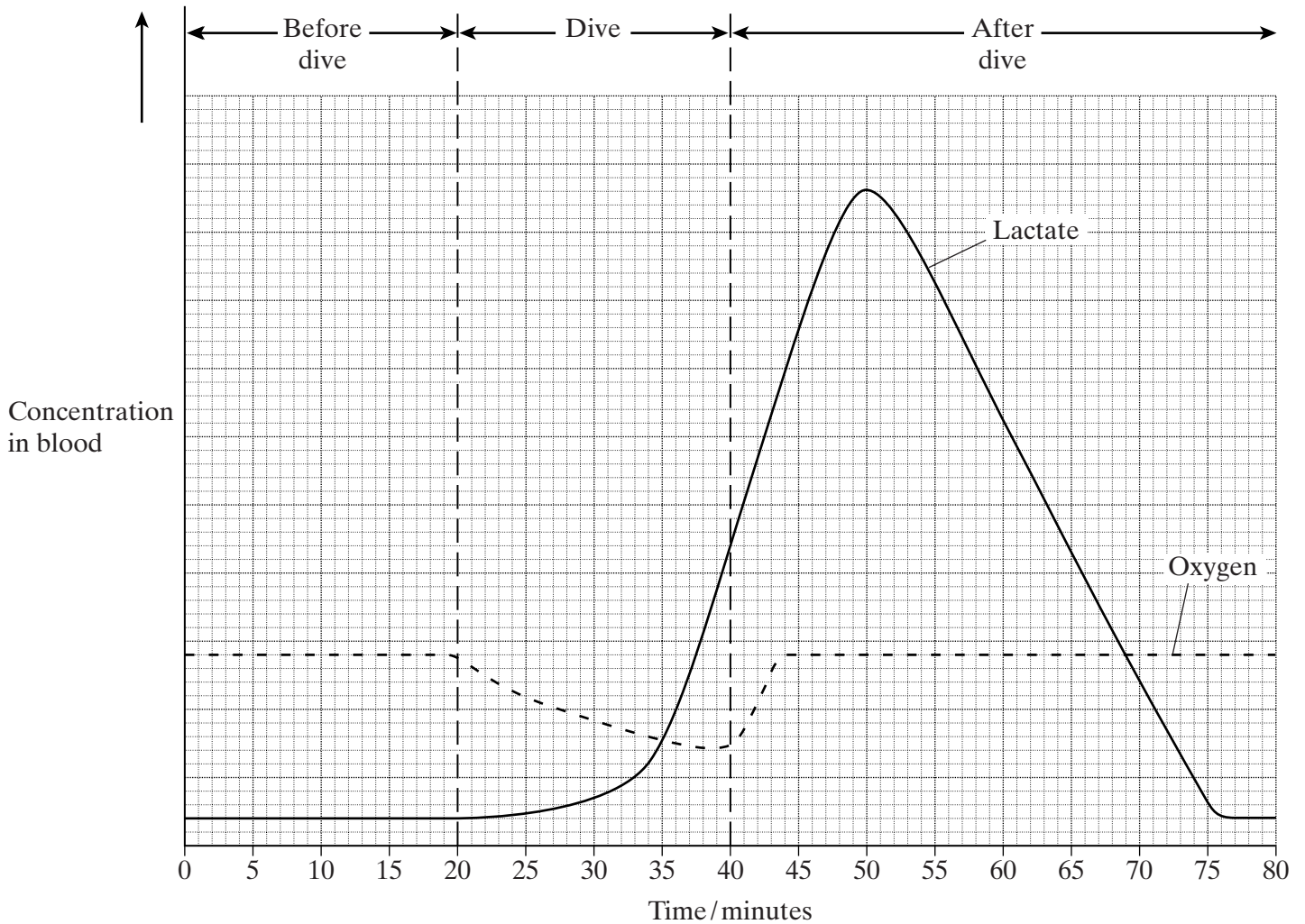
(2 marks)



Turn over 

- 5 Seals are aquatic mammals. They use lungs as organs of gas exchange so they do not breathe when they are under water during a dive.

The graph shows changes in oxygen and lactate concentration in the blood of a seal before, during and after a dive.



- (a) The concentration of oxygen in the blood fell during the dive. Explain why.

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(1 mark)

- (b) Use information in the graph to calculate how long it took from the end of the dive for the seal to recover fully.

Answer minutes
 (1 mark)

(c) Explain what causes the concentration of blood lactate to fall after a dive.

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(2 marks)

(d) Reducing the volume of blood pumped out by the heart reduces the rate of blood flow to the diaphragm muscles.

(i) Give **one** other way in which blood flow into the diaphragm muscles may be reduced.

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(1 mark)

(ii) During a dive, blood flow to the diaphragm muscles of a seal is reduced. Suggest the advantage to the seal of maintaining some blood supply to the diaphragm muscles during a dive.

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(2 marks)

(e) The heart rate of a seal is higher immediately after a dive than it is before the dive. Describe how the heart rate is increased.

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(2 marks)

6 A decrease in the pH of blood plasma reduces the affinity of haemoglobin for oxygen.

(a) (i) Explain how aerobic respiration in cells leads to a change in the pH of blood plasma.

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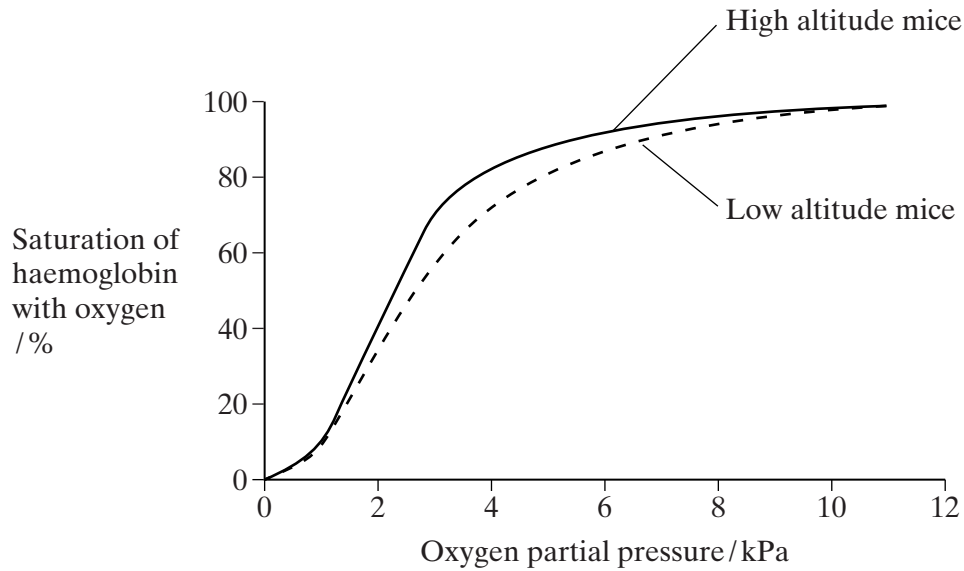
(2 marks)

(ii) What is the advantage to tissue cells of a reduction in the affinity of haemoglobin for oxygen when the plasma pH decreases?

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(2 marks)

- (b) Deer mice are small mammals which live in North America. One population lives at high altitude and another at low altitude. Less oxygen is available at high altitude. The graph shows the oxygen haemoglobin dissociation curves for the two populations of deer mice.



- (i) Explain the advantage for mice living at high altitude in having a dissociation curve which is to the left of the curve for mice living at low altitude.

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(2 marks)

- (ii) Suggest why it would be a disadvantage for the curve to be much further to the left.

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(1 mark)

Answers to **Question 7** should be written in continuous prose, where appropriate.
Quality of Written Communication will be assessed in the answers.

7 (a) How is root pressure produced?

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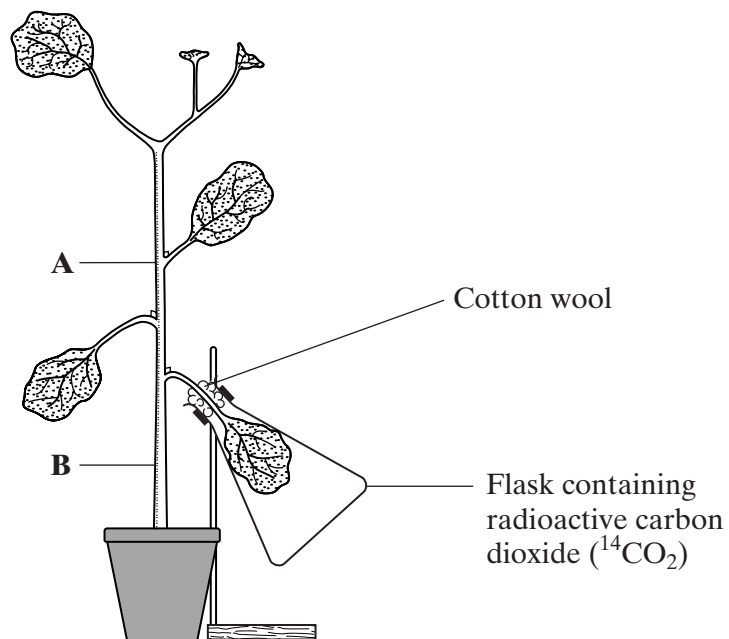
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(3 marks)

(b) A leaf on a growing plant was exposed to radioactive carbon dioxide, $^{14}\text{CO}_2$, as shown in the diagram. After a few hours, radioactivity was detected in the phloem at two positions, **A** and **B**, in the stem.



Explain how radioactive substances had reached positions **A** and **B**.

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(7 marks)

END OF QUESTIONS

QWC

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