

Surname						Other Names					
Centre Number						Candidate Number					
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General Certificate of Education
June 2003
Advanced Subsidiary Examination



BIOLOGY/HUMAN BIOLOGY (SPECIFICATION A) BYA1
Unit 1 Molecules, Cells and Systems

Monday 2 June 2003 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** the 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.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
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5			
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7			
8			
Total (Column 1)			
Total (Column 2)			
TOTAL			
Examiner's Initials			

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

- 1** (a) Describe the route taken by a red blood cell from leaving the right ventricle of the heart to entering the left atrium.

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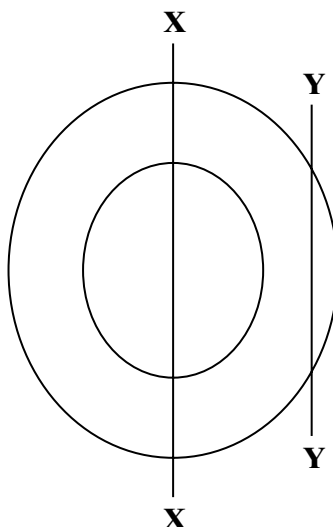
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(2 marks)

- (b) The drawing shows a red blood cell.



- (i) The centre of this cell appears light in colour when seen with an optical microscope. Explain why.

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(1 mark)

- (ii) Draw diagrams in the space below to show the appearance of this cell along

Section **X-X**

Section **Y-Y**

(2 marks)

- (c) There are no nuclei or other cell organelles in the cytoplasm of red blood cells. Describe **one** way in which the structure of a red blood cell

- (i) is similar to the structure of a lymphocyte;

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(1 mark)

- (ii) is different from the structure of a prokaryotic cell such as a bacterium.

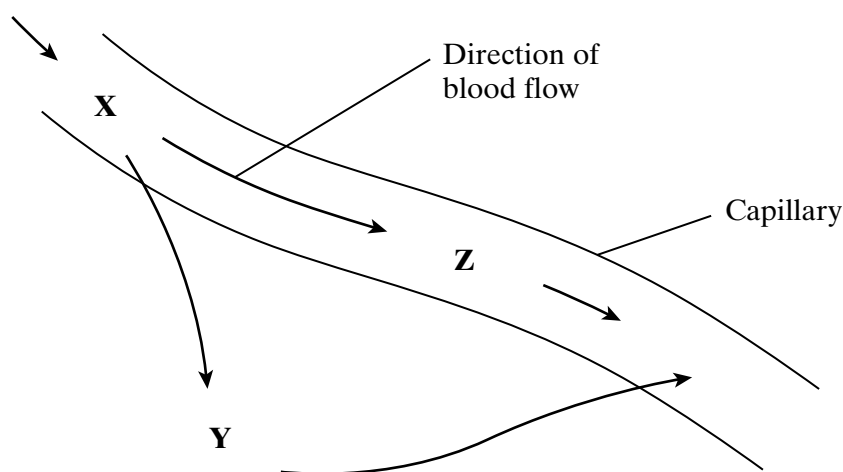
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(1 mark)

7

TURN OVER FOR THE NEXT QUESTION

Turn over ►

2 The diagram shows the formation of tissue fluid and its return to a capillary.



- (a) (i) Describe how the concentration of protein in the tissue fluid at **Y** differs from that in the plasma at **X**. Explain what causes this difference.

Difference

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Explanation

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(2 marks)

- (ii) Describe how the concentration of protein in the plasma at **Z** differs from that in the plasma at **X**. Explain what causes this difference.

Difference

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Explanation

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(2 marks)

- (b) Describe the part played by proteins in the plasma in returning tissue fluid to the capillary.

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(3 marks)

- (c) The tissues of people who are starving often swell because of the accumulation of tissue fluid. Explain what causes this accumulation of tissue fluid.

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(2 marks)

9

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 3 (a) Describe how muscles in the thorax (chest) cause air to enter the lungs during breathing.

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(3 marks)

- (b) An athlete exercised at different rates on an exercise bicycle. The table shows the effects of exercise rate on his breathing rate and tidal volume.

Exercise rate / arbitrary units	Breathing rate / breaths minute ⁻¹	Tidal volume / dm ³
0	14.0	0.74
30	15.1	1.43
60	15.3	1.86
90	14.5	2.34
120	15.1	2.76
150	14.8	3.25
180	21.5	3.21
210	25.7	3.23

- (i) The athlete cycled at the particular exercise rate for 5 minutes before the relevant readings were taken. Explain why the readings were taken only after the athlete had been cycling for 5 minutes.

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(1 mark)

- (ii) Calculate the total volume of air taken into the lungs in one minute at an exercise rate of 120 arbitrary units.

Volume of air =
(1 mark)

- (iii) Give **two** conclusions that can be drawn from the figures in the table.

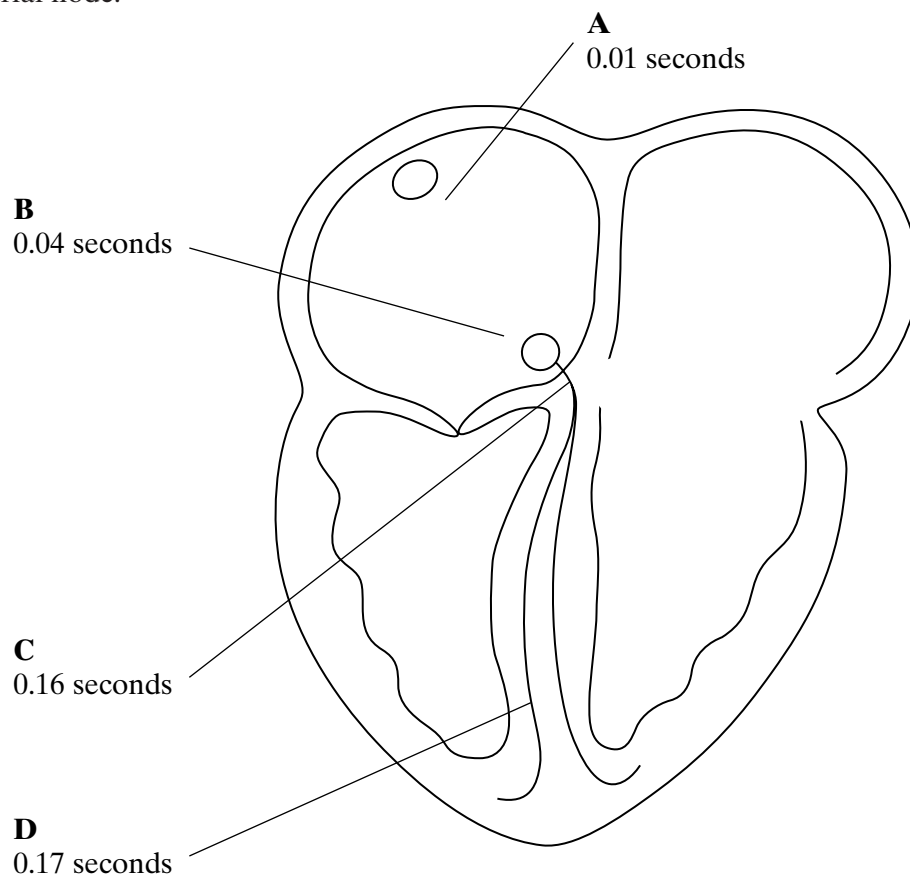
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(2 marks)

$\frac{\quad}{7}$

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 4 The diagram shows the heart and the tissues which control the heart beat. The figures on the diagram show the time in seconds taken for a wave of electrical activity to spread from the sinoatrial node.



- (a) (i) The diagram shows that the valve between the right atrium and the right ventricle is closed. What does this indicate about the relative pressures in the right atrium and the right ventricle?

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(1 mark)

- (ii) Complete the diagram to show whether the valve between the left atrium and the left ventricle is open or closed.

(1 mark)

- (b) The rate at which the electrical activity passes from **B** to **C** is important in controlling the heart beat. Explain why.

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(2 marks)

- (c) The heart rate of a sleeping person is low. Explain how nerves supplying the heart may produce a low heart rate in a sleeping person.

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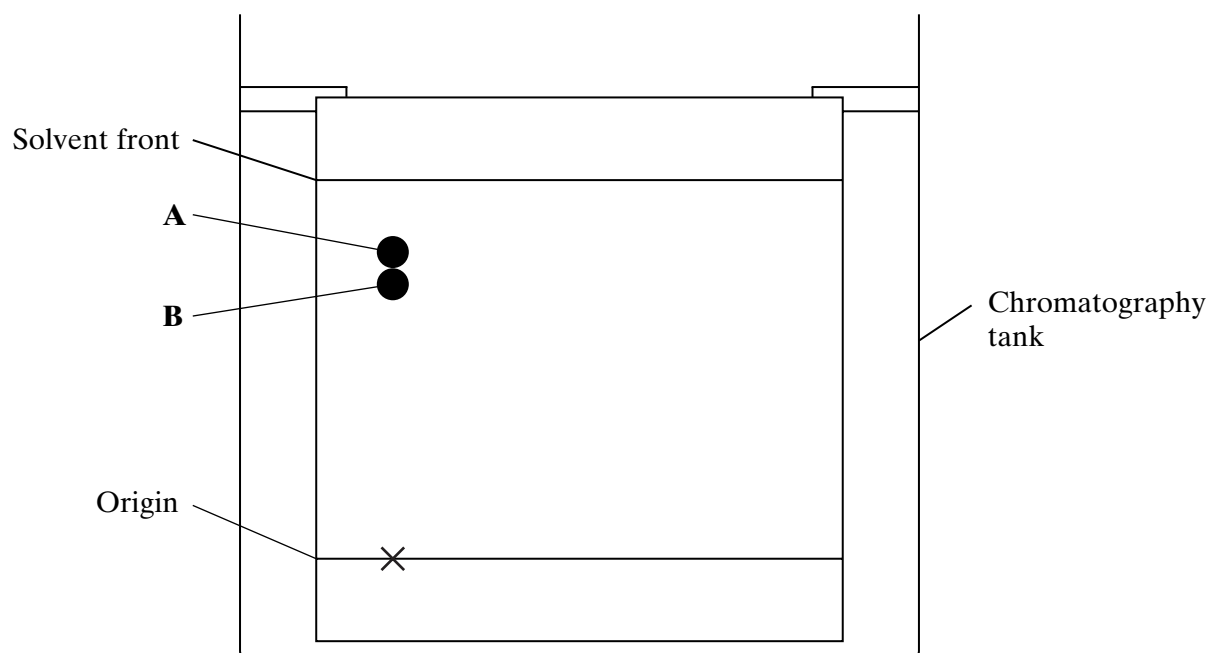
(3 marks)

$\frac{\quad}{7}$

TURN OVER FOR THE NEXT QUESTION

Turn over ►

- 5 A trisaccharide is a sugar made from three monosaccharide units. A particular trisaccharide was completely hydrolysed. The resulting solution was placed on a piece of chromatography paper and left to run. The diagram shows the resulting chromatogram.



- (a) (i) Draw a line on the diagram to show the depth of the solvent in the chromatography tank. (1 mark)

- (ii) Describe how you could produce a concentrated spot on the origin before the paper was put into the tank.

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(1 mark)

- (b) Spots **A** and **B** are close together on the chromatogram. Describe what you could do to separate these spots so that they would be farther apart.

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(2 marks)

- (c) (i) Calculate the R_f value of the sugar in spot **A**.

Answer =
(1 mark)

- (ii) What does this chromatogram tell us about the monosaccharides in the original trisaccharide?

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(1 mark)

- (d) The monosaccharides in the original trisaccharide were hexose sugars. They each contained 6 carbon atoms. How many oxygen atoms would the trisaccharide contain? Explain your answer.

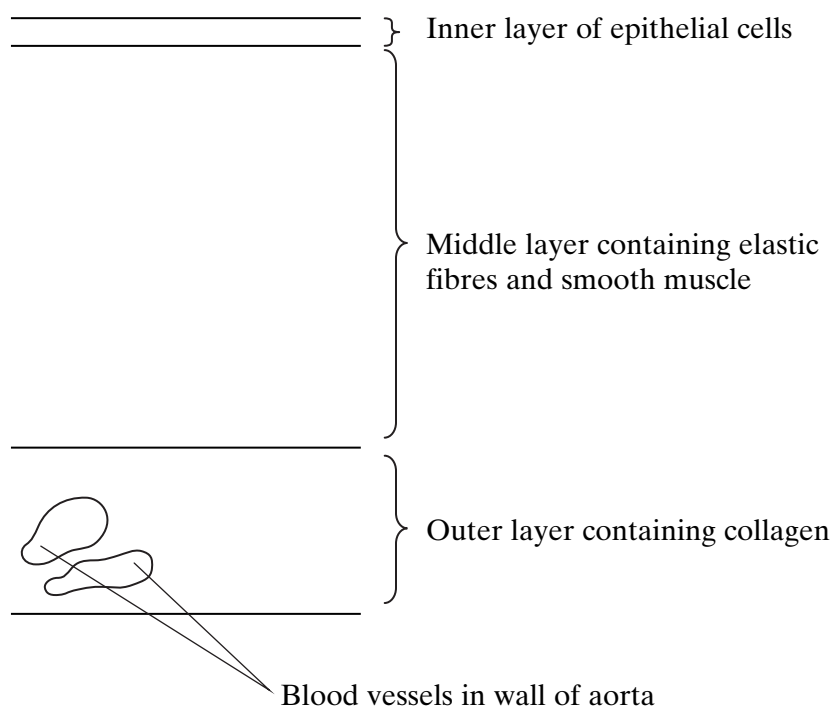
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(3 marks)

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TURN OVER FOR THE NEXT QUESTION

Turn over ►

6 The diagram shows a section through the wall of the aorta.



(a) Explain why the aorta is an organ.

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(1 mark)

(b) Explain how cells in the outer layer of the wall of the aorta get oxygen for respiration.

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(2 marks)

(c) (i) The wall of the aorta helps to smooth out blood pressure in the aorta. Explain how.

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(2 marks)

- (ii) The changes in the pressure of blood in the aorta can be measured. Explain why this information would enable you to measure the heart rate.

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(1 mark)

6

TURN OVER FOR THE NEXT QUESTION

Turn over ►

7 Read the following passage.

Bananas go through a series of changes as they ripen. The skin goes from green through yellow to brown. Biochemical changes take place in the fruit pulp. In an unripe banana, the main carbohydrate in the fruit pulp is starch. As the fruit ripens, this starch is largely replaced by reducing sugars such as glucose. The mass of cellulose in the fruit pulp, however, does not change and remains more or less constant at between 1 and 2%.

Bananas are picked when they are green and transported in refrigerated ships. A major problem with shipping bananas in this way is “chilling”. Chilling results from exposing fruit to temperatures below a critical low value for longer than a critical time. In general, the longer the voyage, the higher the temperature bananas must be kept at to avoid chilling. Chilled bananas are poor in quality. They are not as sweet as usual because starch hydrolysis is slow.

Use information from the passage and your own knowledge to answer the questions.

- (a) Suggest how you could use Benedict’s solution to show that a ripe banana contained more reducing sugar than an unripe banana.

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(3 marks)

- (b) Explain what causes the water potential of the banana pulp to decrease as the fruit ripens.

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(2 marks)

- (c) (i) Explain what causes starch hydrolysis to be slow in chilled bananas (line 10).

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(3 marks)

- (ii) Explain why “In general, the longer the voyage, the higher the temperature bananas must be kept at to avoid chilling.” (lines 8 - 9).

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(1 mark)

- (d) Describe how the structure and properties of starch and cellulose molecules are related to their functions in plant cells.

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(6 marks)

- 8 A plasma membrane surrounds an animal cell. Cell membranes are also found in the cytoplasm. The table shows the distribution of membranes around and in the cytoplasm of two different types of animal cell.

Type of membrane	Percentage of total cell membrane	
	Cell A	Cell B
Plasma membrane surrounding cell	2	5
Rough endoplasmic reticulum	35	60
Golgi apparatus	7	10
Outer mitochondrial membrane	7	4
Inner mitochondrial membrane	32	17

- (a) (i) Explain why the figures for cell **A** do not add up to 100%.

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 (1 mark)

- (ii) The figures for the inner mitochondrial membrane are greater than the figures for the outer mitochondrial membrane. Use your knowledge of the structure of mitochondria to explain why.

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 (1 mark)

- (b) (i) The total area of the membranes in and surrounding cell **B** is 13 000 μm^2 . Calculate the area of the plasma membrane of cell **B**.

Area = μm^2
 (1 mark)

- (ii) Some cells whose main function is absorption of small molecules have structural features on the plasma membrane which increase its surface area. Name these features.

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 (1 mark)

- (c) (i) Cell **A** takes up large amounts of substances by active transport. Explain the evidence from the table which supports this statement.

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(2 marks)

- (ii) Cell **B** synthesises large amounts of enzymes. Explain the evidence from the table which supports this statement.

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(3 marks)

- (d) Describe the structure of a phospholipid molecule and explain how phospholipids are arranged in a plasma membrane.

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QUESTION 8 CONTINUES ON THE NEXT PAGE

Turn over ►

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(6 marks)

15

END OF QUESTIONS