Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

For Examiner's Use

General Certificate of Education
January 2008
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 9 January 2008 9.00 am to 10.30 am

For this paper you must have:
- a ruler with millimetre measurements.

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.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

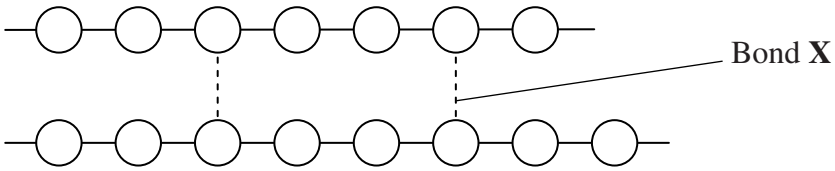
Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You will be marked on your ability to use good English, to organise information clearly and to use accurate scientific terminology where appropriate.

For Examiner's Use			
Question	Mark	Question	Mark
1			
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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

1 The diagram shows part of a cellulose molecule.



(a) (i) What type of bond is bond **X**?

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(1 mark)

(ii) Cellulose is found in plant cell walls. Bond **X** has an important role in the function of cellulose. Explain this role.

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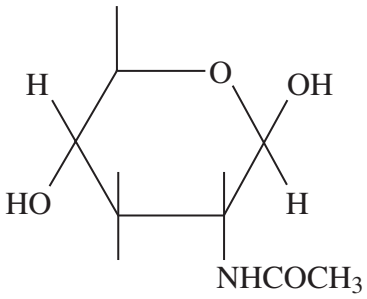
(2 marks)

(b) Chitin is a special kind of polysaccharide found in insect skeletons. The diagram shows a molecule of the monomer that makes up a molecule of chitin.



(i) A chemical element found in the monomer shown in the diagram is not found in the monomer that makes up a molecule of cellulose. Name this element.

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(1 mark)

(ii) What is the name of the chemical reaction in which molecules of this monomer join together to form chitin?

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(1 mark)

(c) Cellulose and chitin are structural polysaccharides. Other polysaccharides are storage polysaccharides. Name a storage polysaccharide found in

(i) animal cells

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(1 mark)

(ii) plant cells.

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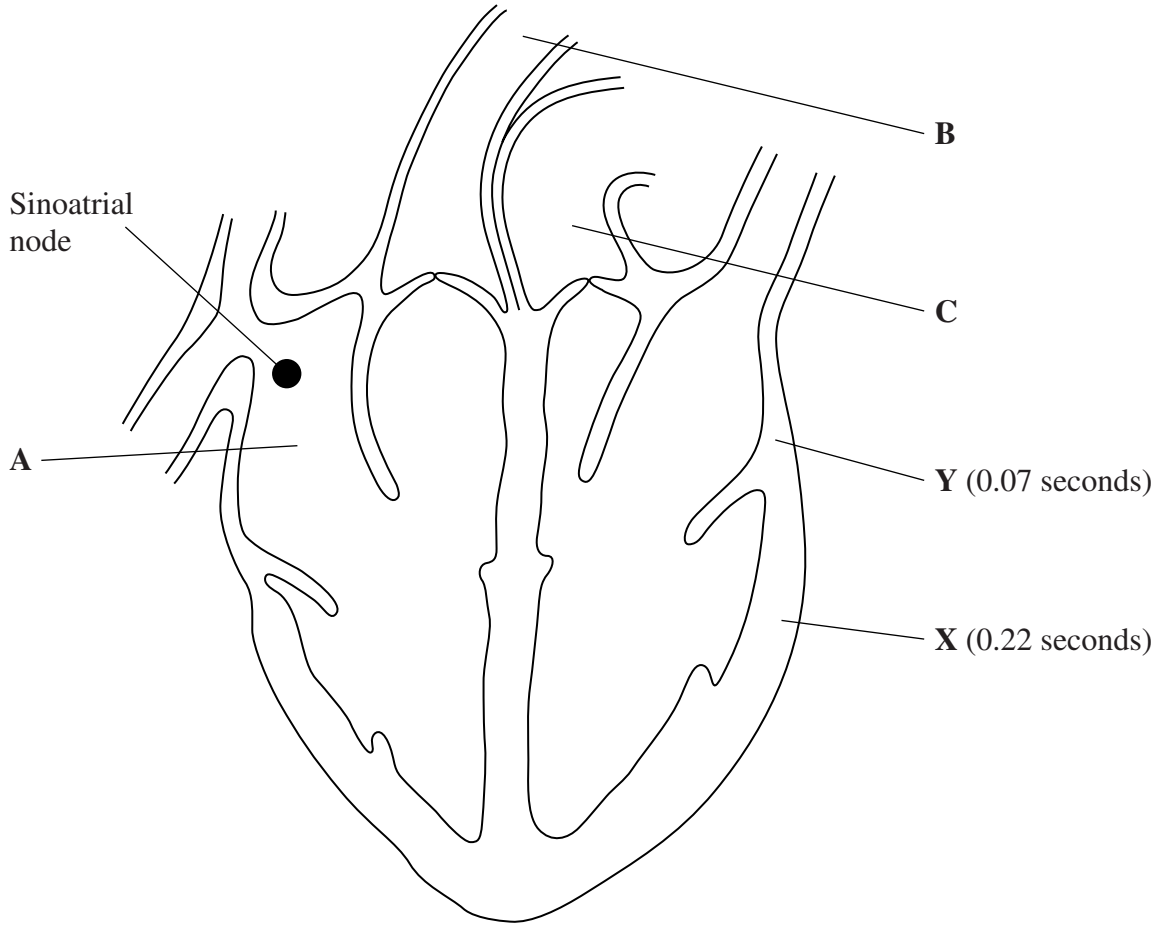
(1 mark)

7

2 The diagram shows a section through a human heart.



(a) Name

(i) the chamber of the heart labelled **A**

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(1 mark)

(ii) the blood vessel labelled **B**.

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(1 mark)

(b) Blood leaving the heart through vessel **C** is at a higher pressure than blood leaving through vessel **B**. Explain what causes this higher pressure.

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(2 marks)

(c) The figures on the diagram give the time taken for electrical activity to spread from the sinoatrial node to the point shown.
The electrical activity takes much longer to reach point **X** than it takes to reach point **Y**. Explain why it takes much longer to reach point **X**.

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(2 marks)

(d) In an investigation, scientists stimulated one of the nerves going to the sinoatrial node. This caused a fall in cardiac output.

(i) Which nerve did the scientists stimulate?

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(1 mark)

(ii) Explain how stimulation of this nerve caused a fall in cardiac output.

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(2 marks)

9

3 (a) Blood is an example of a tissue.
Explain what is meant by a tissue.

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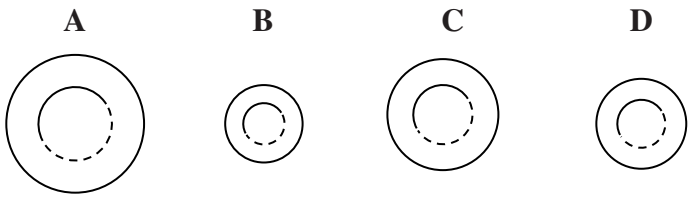
(1 mark)

(b) Students used an optical microscope to estimate the diameter of some red blood cells. They estimated the diameter of the field of view as 450 µm. They also estimated that there were 60 red blood cells side by side across the field of view.
Calculate the approximate diameter of these red blood cells.

Diameter ..... µm *(1 mark)*

(c) Mammalian red blood cells are disc-shaped. The diagram shows red blood cells from four different mammals. They have been drawn to the same scale.



(i) Which of cells **A** to **D** would have the greatest surface area to volume ratio?

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(1 mark)

(ii) A large surface area to volume ratio affects the uptake of oxygen by a red blood cell. Explain how.

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(1 mark)

(d) The students mixed some red blood cells with a concentrated solution of sucrose. They examined the cells under a microscope.
The cells were small and wrinkled. Explain why.

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(2 marks)

(e) The students mixed more red blood cells with a solution of detergent. Detergent dissolves lipids. When they examined a drop of the mixture with a microscope, no cells could be seen but the liquid was red in colour.
Explain why no cells were seen and the liquid was red in colour.

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(2 marks)

8

Turn over for the next question

4 Sucrose is a non-reducing sugar. When it is hydrolysed, a molecule of sucrose is broken down to give a molecule of glucose and a molecule of fructose.
Glucose and fructose are reducing sugars.
Three test tubes were prepared.

- Test tube **P** contained sucrose.
- Test tube **Q** contained partly hydrolysed sucrose.
- Test tube **R** contained fully hydrolysed sucrose.

(a) Test tube **P** did not contain glucose or fructose. Describe how you could use Benedict's solution to confirm this.

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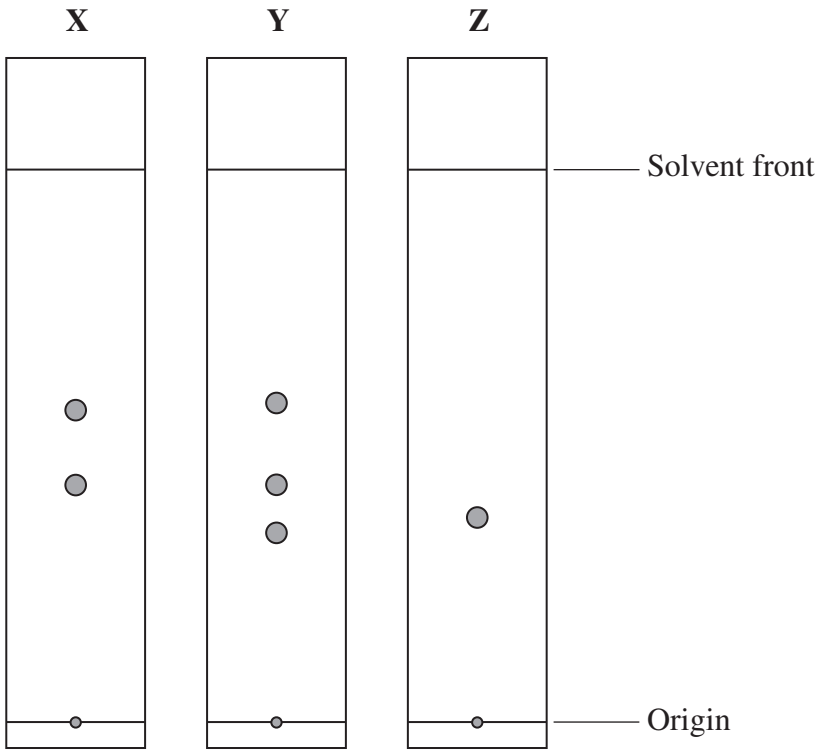
(2 marks)

The contents of these three test tubes were analysed by chromatography. The diagram shows the three chromatograms produced.



(b) Which of chromatograms **X**, **Y** or **Z** was produced from test tube **Q**? Give the reason for your answer.

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(2 marks)

(c) You could use a solution of fructose and your knowledge of R_f values to identify the spot that is fructose on chromatogram **Y**. Describe how.

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(3 marks)

7

5 (a) The table shows features of some blood vessels from a mammal.

Blood vessel	Diameter of lumen / mm	Thickness of wall / mm	Blood pressure / kPa
Artery	4.000	1.000	12.0
Arteriole	0.030	0.020	8.0
Capillary	0.008	0.001	4.0
Vein	4.000		

Use the figures in the table to estimate the thickness of the wall and the blood pressure in the vein. For each estimate, explain how you arrived at your answer.

(i) Thickness of vein wall = ... mm

Explanation .....

.....

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(1 mark)

(ii) Blood pressure in vein = ... kPa

Explanation .....

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(1 mark)

(b) Explain the part played by leg muscles and valves in allowing blood in the leg veins to flow only towards the heart.

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(3 marks)

5

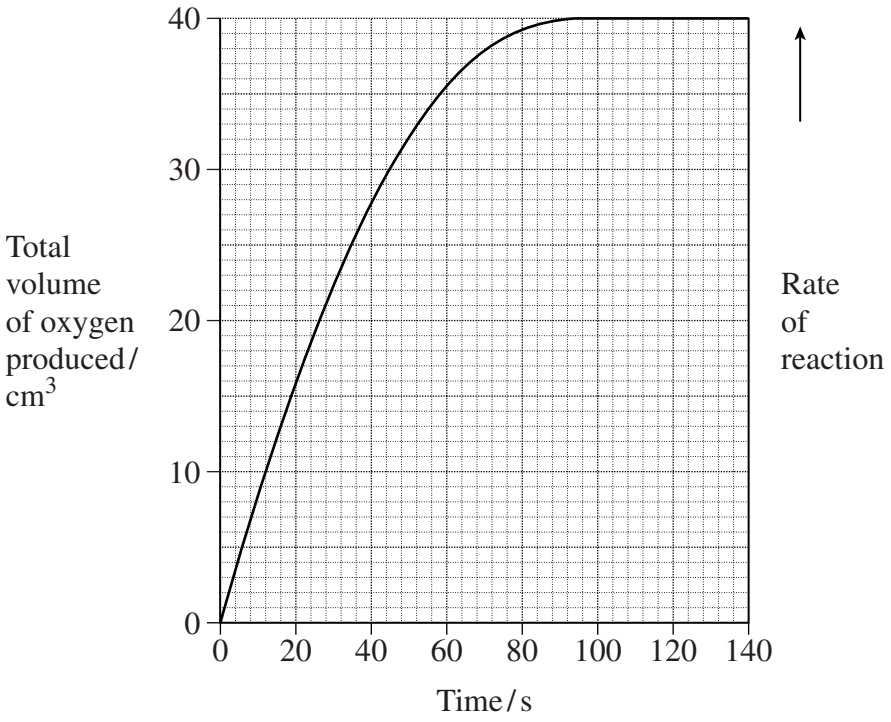
Turn over for the next question

6 Catalase is an enzyme. It catalyses the following reaction.

hydrogen peroxide → water + oxygen

Catalase can be obtained from potato tissue. A student ground potato tissue with water and sand, and then filtered the mixture. The liquid contained catalase.

In an investigation, the student mixed this liquid with hydrogen peroxide and measured the volume of oxygen produced at 10-second intervals. The results are shown in the graph.



(a) (i) How much oxygen was produced between 120 and 130 seconds?

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(1 mark)

(ii) Less oxygen was produced between 80 and 90 seconds than between 10 and 20 seconds. Use your knowledge of the way enzymes work to explain why.

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(2 marks)

(b) Sketch a curve on the graph to show how the rate of reaction changed over the time shown.

(2 marks)

(c) Describe how you could test the catalase preparation to show that it contained protein.

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(2 marks)

(d) When scientists measure the activity of an enzyme, they make sure that the enzyme is at its optimum pH. Explain why.

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(2 marks)

9

Turn over for the next question

7 Read the following passage.

Bats are the only mammals that can fly. Flight is a very rapid method of locomotion but it requires much more energy than walking or running. The gas exchange and blood systems of bats have many adaptations. These adaptations enable them to supply large amounts of oxygen to the flight muscles.

The alveoli in a bat's lungs are much smaller than the alveoli in the lungs of other mammals of a similar size. The lumen of each alveolus is separated from the blood by only two layers of cells. Together these two layers are less than 2 μm thick. Each alveolus is surrounded by many capillaries.

Three seconds after taking off and starting to fly, a bat's tidal volume may have increased by 15 times. This enormous increase is partly due to a five-fold increase in breathing rate.

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

(a) (i) The alveoli in a bat's lung are very small (line 6). Explain the advantage to a bat of having large numbers of very small alveoli.

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(2 marks)

(ii) Two layers of cells separate the lumen of an alveolus from the blood (lines 7–8). Name these two layers.

1. .....

2. .....

(2 marks)

(iii) It is an advantage to a bat to have many capillaries surrounding each alveolus (line 9). Use Fick's law to explain this advantage.

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(2 marks)

(b) The pulmonary ventilation of a bat increases after it takes off and starts to fly. By how many times would you expect it to have increased three seconds after taking off? Explain how you reached your answer.

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(2 marks)

(c) List the blood vessels through which oxygen travels from the lungs to the artery that supplies the flight muscles of a bat.

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(1 mark)

(d) Describe the parts played in breathing by the medulla, and the diaphragm and intercostal muscles.

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(6 marks)

15

8 The table shows the percentages of different membranes in two animal cells.

Type of membrane	**Percentage of total membrane in**	
	Cell R	**Cell S**
Plasma membrane surrounding cell	3	5
Rough endoplasmic reticulum	38	60
Outer membrane of mitochondria	11	4
Inner membrane of mitochondria	34	17
Lysosome membrane	3	3
Other membranes	11	11

(a) The main function of one of these cells is to make enzymes. Suggest which cell has this main function and explain the evidence for your answer.

Cell .....

Evidence .....

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(2 marks)

(b) (i) In both cells the figure for the inner membrane of the mitochondria is different from the figure for the outer membrane. Explain this difference.

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(1 mark)

(ii) The appearance of the mitochondria in Cell **R** is different from the appearance of the mitochondria in Cell **S**. Use the figures in the table to suggest how they are different in appearance.

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(1 mark)

(c) Cell **R** is a eukaryotic cell. Describe **two** ways in which the distribution of membranes in cell **R** is different from the distribution of membranes in a prokaryotic cell.

1. .....

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2. .....

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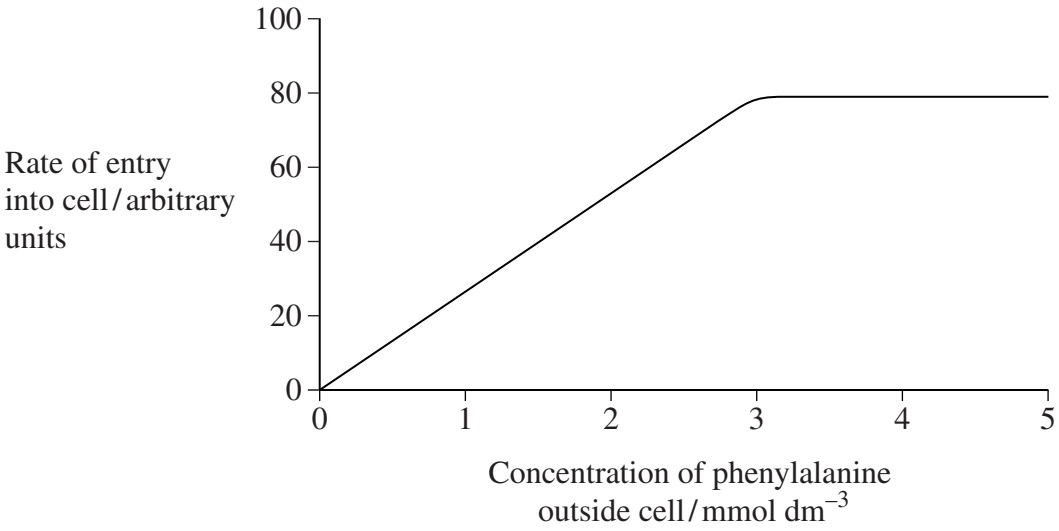
(2 marks)

Phenylalanine is an amino acid. Scientists investigated the rate of uptake of phenylalanine by a cell. They changed the concentration of phenylalanine outside the cell and measured the rate at which it entered the cell. The graph shows the results.



(d) The concentration of phenylalanine outside the cell affects the rate at which it enters the cell. Describe how.

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(2 marks)

(e) Phenylalanine enters the cell by facilitated diffusion. Increasing phenylalanine concentration from 4 mmol dm^{-3} to 5 mmol dm^{-3} does not increase the rate at which it enters the cell. Explain why.

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(1 mark)

Question 8 continues on the next page

(f) A centrifuge may be used to obtain a sample of chloroplasts from leaves. Starting with some lettuce leaves, describe how.

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(6 marks)

15

END OF QUESTIONS

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