Surname		Other Names	
Centre Number			Candidate Number	
Candidate Signature			

For Examiner's Use

General Certificate of Education
January 2007
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

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

Wednesday 10 January 2007 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 (a) Avocados are fruit that contain large amounts of lipid. Describe how you would use a biochemical test to show that an avocado contains lipid.

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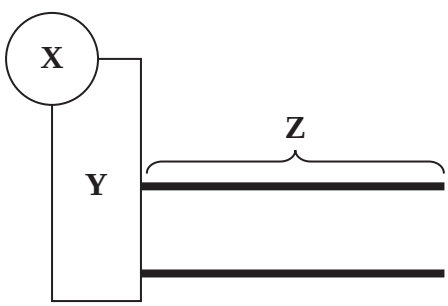
(2 marks)

(b) The diagram shows the structure of a saturated phospholipid molecule.



(i) What does the part of the molecule labelled **Y** represent?

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(1 mark)

(ii) Describe how the molecule shown in the diagram is different from a triglyceride molecule.

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(1 mark)

(iii) Part **Z** consists of carbon and hydrogen atoms arranged in a chain. Draw a diagram to show the arrangement of the hydrogen atoms on the last three carbon atoms in this chain.

(1 mark)

(iv) Phospholipids are arranged in a bilayer in a plasma membrane. Explain how the properties of part **Z** help explain this arrangement.

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(2 marks)

7

Turn over for the next question

2 (a) The pressure inside the lungs changes when a person breathes in.

(i) Describe the pressure changes in the lungs during one complete inspiration.

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(1 mark)

(ii) The movement of the ribs helps bring about the change in pressure at the start of inspiration. Explain how.

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(2 marks)

(b) Give a simple word equation to state Fick's law.

(2 marks)

(c) Use Fick's law to explain the following observations.

(i) In emphysema, the walls between some of the alveoli break down and enlarge the air spaces in the lungs. The absorption of oxygen from the lungs is not very efficient in a person with emphysema.

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(2 marks)

(ii) When a person's breathing rate increases, the concentration of carbon dioxide in their blood decreases.

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(2 marks)

9

Turn over for the next question

3 (a) The list shows methods by which substances may enter or leave cells.

A simple diffusion
B facilitated diffusion
C osmosis
D active transport
E exocytosis

Choose the correct method, **A** to **E**, to give the most likely reason for

(i) the secretion of large droplets of fat from milk-producing cells in a mammary gland

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(1 mark)

(ii) the swelling and bursting of red blood cells in a very dilute salt solution

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(1 mark)

(iii) the increase in the rate of loss of sodium ions from a cell that occurred when the energy source, ATP, was injected into the cell.

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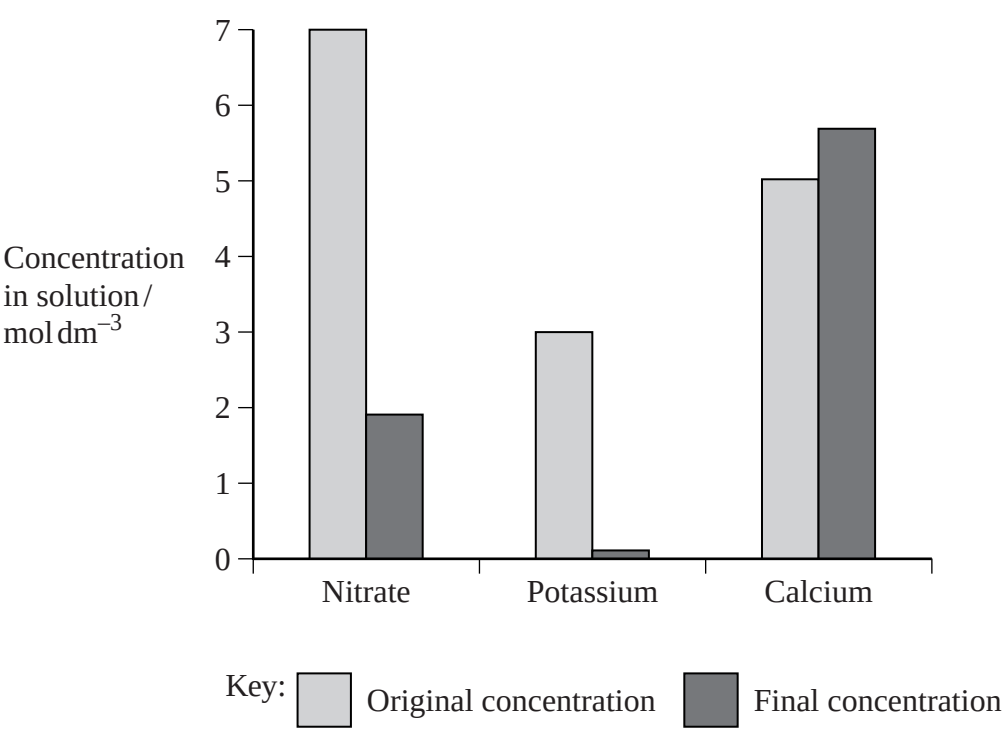
(1 mark)

Barley plants were grown in a solution that contained various ions. As the plants grew, they absorbed both ions and water from the solution. The bar chart shows the original and final concentrations of some of these ions in the solution.



(b) The potassium ions were absorbed by active transport.

(i) How do the data on potassium ion concentration support this?

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(2 marks)

(ii) The experiment was repeated. This time, the solution in which the barley plants were growing did not contain oxygen. How would you expect the final concentration of potassium ions in the solution to be affected by the lack of oxygen? Explain your answer.

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(3 marks)

(c) Calcium ions were absorbed by the plants. Explain the difference between the original and final concentrations of calcium ions in the solution.

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(1 mark)

9

4 (a) (i) Which chamber of the heart of a mammal has the thickest wall?

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(1 mark)

(ii) Explain why this thick wall is important in the circulation of blood.

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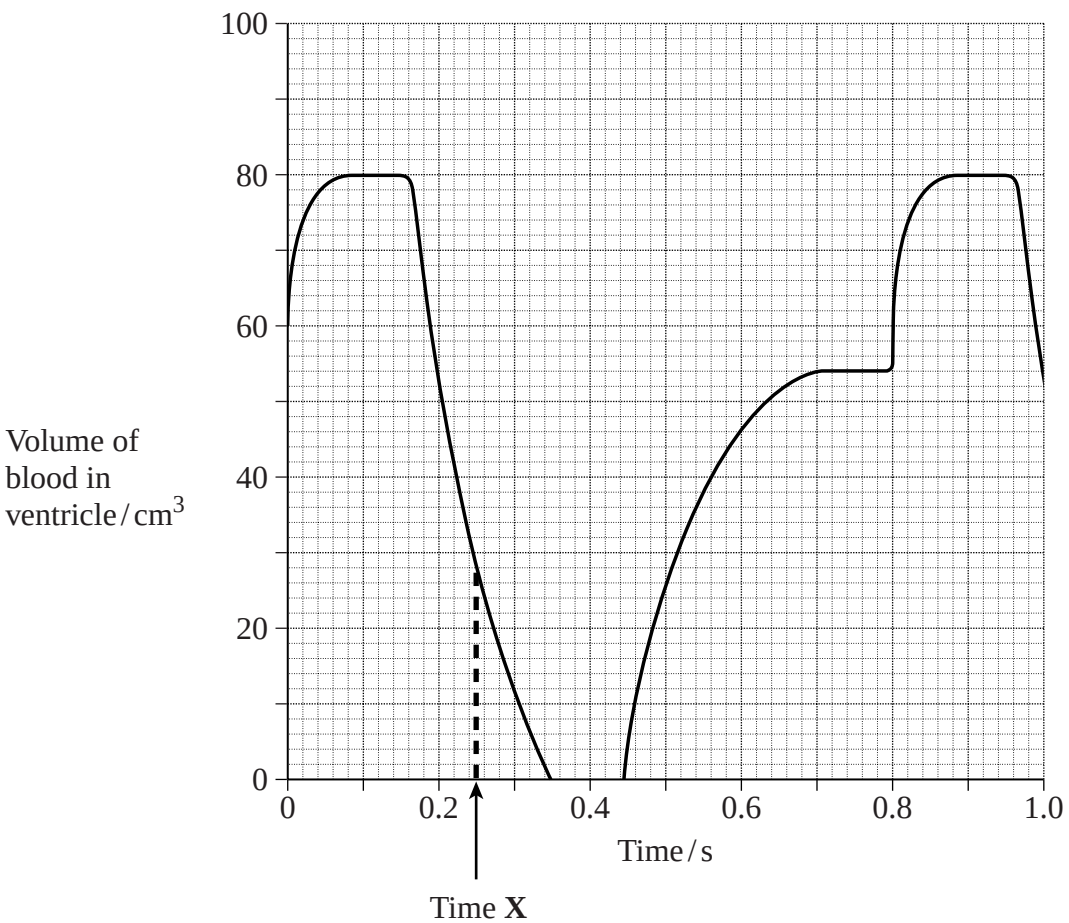
(1 mark)

(b) The graph shows changes in the volume of blood in the left ventricle in one second in a person at rest.



(i) Which of the heart valves would be open and which would be closed at the time marked **X**?

Open	Closed

(1 mark)

(ii) Describe **two** ways in which the curve shown on the graph would differ during a period of strenuous activity.

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2 .....

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(2 marks)

(iii) Use the data in the graph to calculate this person's cardiac output. Show your working.

Cardiac output = ... *(3 marks)*

8

5 (a) The table shows some of the features present in three different cells. Complete the table with a tick if the feature is present or a cross if it is absent.

Feature	Leaf cell	Red blood cell	Bacterial cell
Plasma membrane			
Mitochondrion			
Chromosomes containing both DNA and protein			

(3 marks)

(b) It is not possible to see the detailed structure of a mitochondrion with an optical microscope. Explain why.

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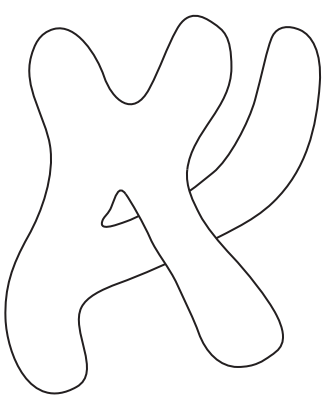
(2 marks)

(c) Some mitochondria are branched. The diagram shows the shape of a branched mitochondrion.



A transmission electron microscope may not show that this mitochondrion is branched. Use this diagram to explain why.

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(2 marks)

6 Hydrogen peroxide breaks down slowly at room temperature to produce oxygen and water.

$$2H_2O_2 \longrightarrow 2\ H_2O + O_2$$

Catalase is an enzyme that catalyses this reaction.

(a) Explain why adding catalase to hydrogen peroxide makes the reaction go faster.

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(2 marks)

(b) Students investigated the effect of substrate concentration on the rate of reaction of catalase. They used sand to grind a potato. This broke open the potato cells. The mixture of potato and sand was used as a source of catalase. The students measured the amount of oxygen produced to find the rate of reaction.

(i) Suggest a suitable control for this investigation and explain why it was necessary.

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(2 marks)

(ii) The temperature was kept constant with a water bath. Give **one** reason why allowing the temperature to fluctuate would lead to unreliable results.

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(1 mark)

5

7 Read the following passage.

Starch is an important storage substance found in many plants. Starch obtained from corn is very cheap, especially in the USA. It can be hydrolysed by enzymes to glucose. The glucose is then converted to fructose. Fructose can be used to replace sucrose in soft drinks. Glucose has only 70% of the sweetness of sucrose but fructose is twice as sweet as glucose.

In the process, starch is first heated to 105 °C and made into a paste. Bacterial amylase is then added. This hydrolyses the starch, breaking it down to smaller dextrin molecules. Hydrolysis continues for two hours at 90 °C. The next step is to hydrolyse the dextrins to glucose. The enzyme involved here is amyloglucosidase. This enzyme works at a temperature of 55 °C to 60 °C and a pH of 4.5. The final step is the conversion of glucose to fructose by glucose isomerase.

There is a demand for low-energy sweeteners, and enzymes are also involved in their production. The dipeptide aspartame is very useful here. The sweetness ratio of aspartame to sucrose is 180 : 1. Because of this, only very small amounts of aspartame are needed to sweeten drinks. Aspartame is formed from the amino acids aspartic acid and phenylalanine. The aspartic acid is produced by an enzyme using fumaric acid as a substrate.

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

(a) Use information from the second paragraph to produce a flowchart showing the production of fructose from starch. Only show the substances and enzymes involved.

(2 marks)

(b) Glucose and fructose both have the same chemical formula, $C_6H_{12}O_6$. Explain how two different monosaccharides can both have the same chemical formula.

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(1 mark)

(c) Bacterial amylase catalyses the hydrolysis of starch, but it does not catalyse the hydrolysis of other substances. Explain why.

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(2 marks)

(d) (i) Suggest what type of chemical reaction would produce aspartame from aspartic acid and phenylalanine (lines 15–16).

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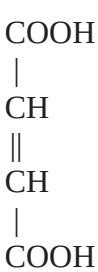
(1 mark)

(ii) The diagram shows a molecule of fumaric acid (lines 15–16).



Name a chemical element present in aspartic acid but not present in fumaric acid.

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(1 mark)

Question 7 continues on the next page

(e) Sucrose is only added to soft drinks as a sweetener.

(i) How much fructose must be added to replace 10 g of sucrose?

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(1 mark)

(ii) How much aspartame must be added to replace 10 g of sucrose?

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(1 mark)

(f) Describe the structure of starch and explain how its structure is related to its function as a storage molecule.

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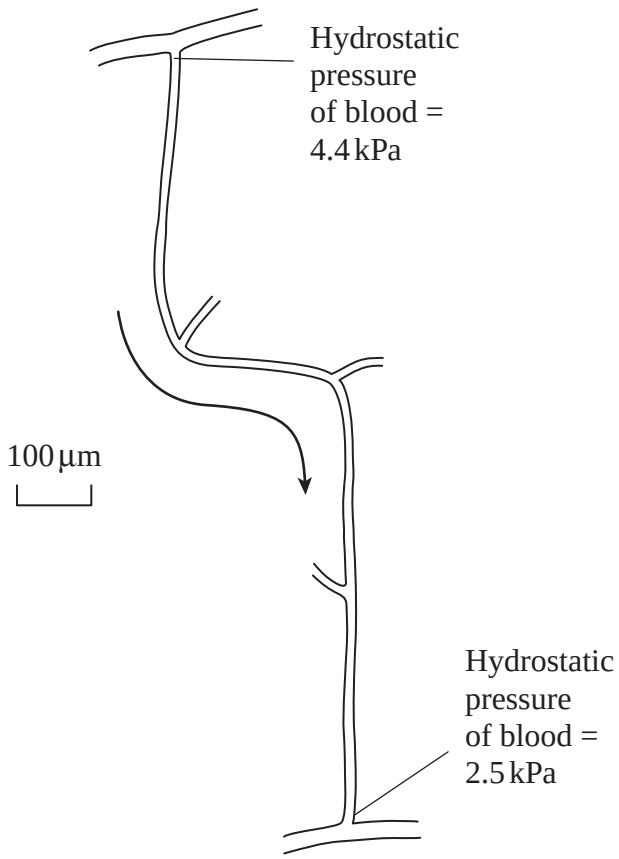
(6 marks)

Turn over for the next question

8 The drawing shows a capillary going from an arteriole to a venule.



(a) Blood flows through the capillary in the direction shown by the arrow. Explain the evidence for this from the drawing.

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(1 mark)

(b) (i) Calculate the actual length of this capillary. Show your working and give your answer in millimetres.

Answer ..... mm *(2 marks)*

(ii) A red blood cell takes 1.3 seconds to pass along this capillary from the arteriole to the venule. Explain how you would use this information and your answer to part (b)(i) to calculate the rate of blood flow through this capillary.

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(1 mark)

(iii) A slow rate of blood flow allows more efficient exchange of substances between the blood and the tissues surrounding the capillary. Explain how.

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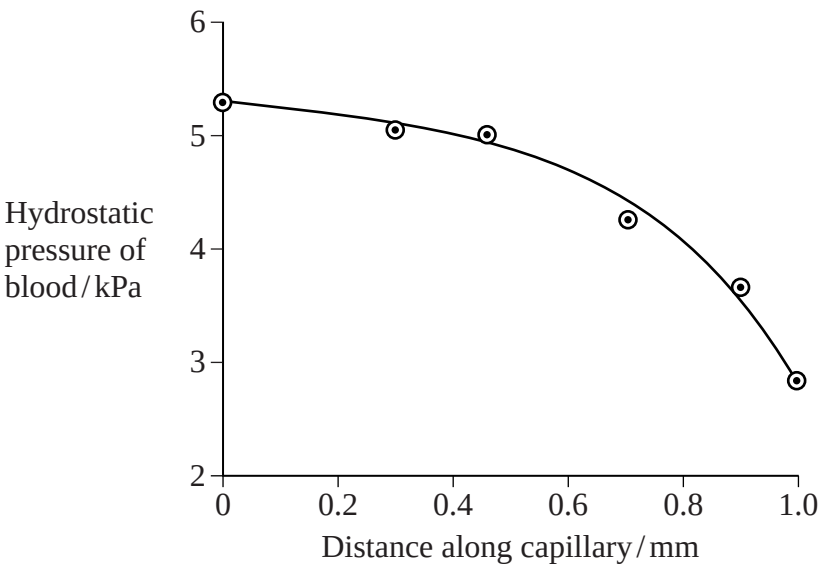
(1 mark)

Question 8 continues on the next page

The graph shows how the hydrostatic pressure of the blood changes with distance along another capillary.



(c) (i) Describe how the hydrostatic pressure of the blood changes with distance along the capillary.

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(2 marks)

(ii) Explain this change.

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(2 marks)

(d) Describe the role of the hydrostatic pressure of blood and of osmosis in the formation and reabsorption of tissue fluid.

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(6 marks)

15

END OF QUESTIONS

There are no questions printed on this page