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General Certificate of Education
 June 2006
 Advanced Subsidiary Examination



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

Monday 5 June 2006 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 marked.

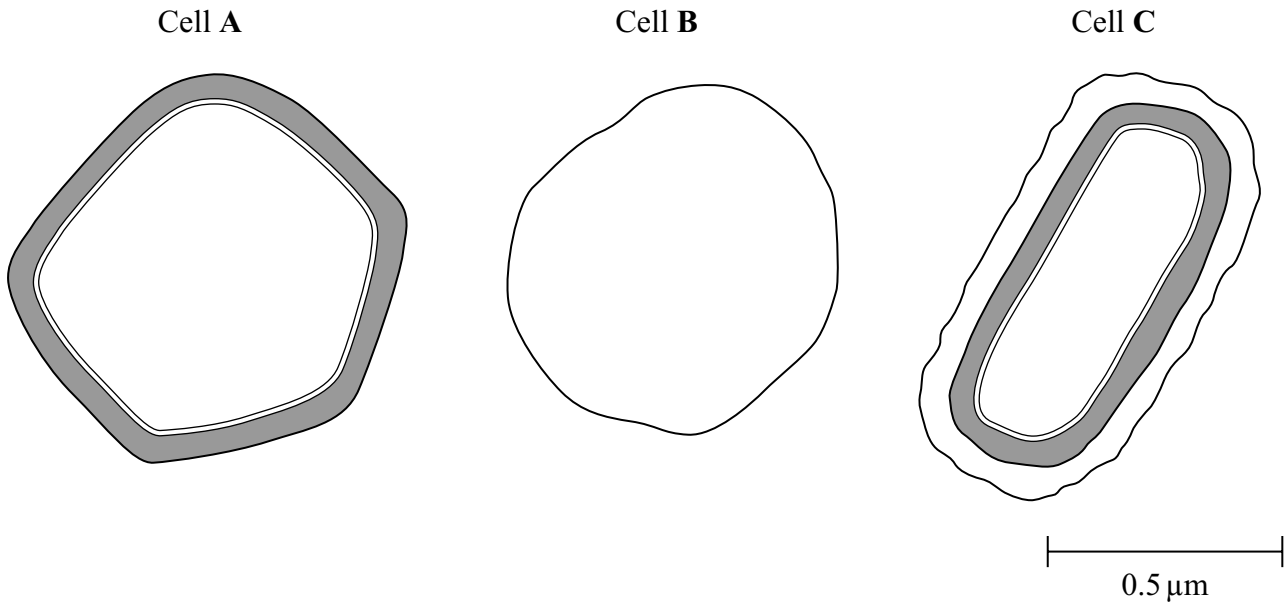
Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in your answers.

| For Examiner's Use | | | |
|---------------------|------|--------|------|
| Number | Mark | Number | Mark |
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Answer **all** questions in the spaces provided.

1 The diagram shows the outer layers of three different cells, **A**, **B** and **C**.



(a) What is the evidence from the diagram that

(i) cell **B** is an animal cell,

.....

 (1 mark)

(ii) cell **C** is a prokaryotic cell?

.....

 (1 mark)

(b) Explain how you would calculate the magnification of cell **C**.

.....

 (1 mark)

(c) Cell A is a plant cell. Name a polysaccharide which may be found in cell A but would not be found in the animal cell.

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(1 mark)

(d) Penicillin is an antibiotic. It prevents the formation of bacterial cell walls. As a result, bacterial cells that have been treated with penicillin swell and burst as water enters.

(i) Explain how water enters a bacterial cell.

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(2 marks)

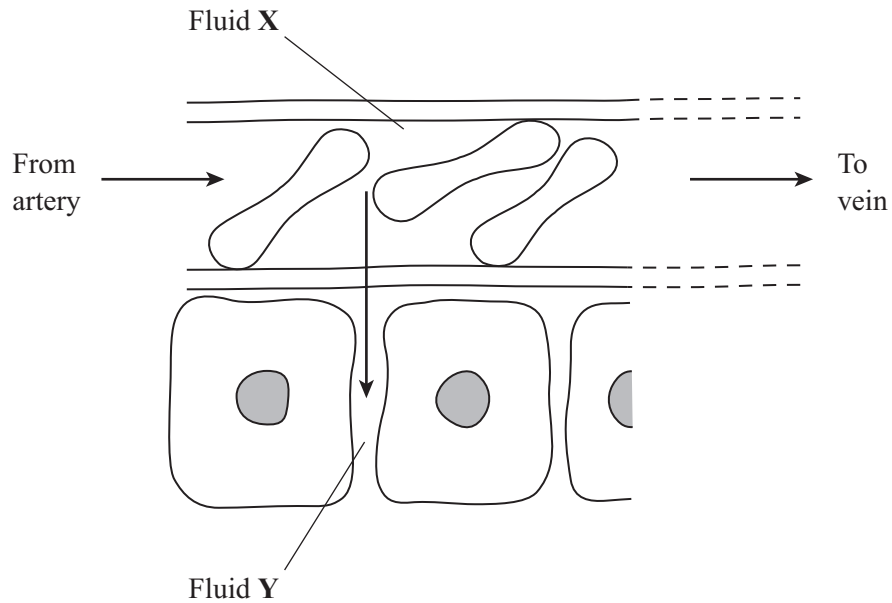
(ii) Suggest why penicillin has no effect on plant cells.

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(1 mark)

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Turn over for the next question

2 The diagram shows part of a capillary and some of the cells surrounding it.



(a) Name

(i) fluid X, (1 mark)

(ii) fluid Y. (1 mark)

(b) Describe and explain **one** way in which the composition of fluid Y differs from that of fluid X.

.....

 (2 marks)

(c) Explain how fluid leaves the capillary at the arterial end.

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(2 marks)

(d) Oxygen moves from fluid **Y** into active muscle cells faster than it does into resting muscle cells. Use Fick's law to explain why.

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(3 marks)

Turn over for the next question

- 3 Tradescantia is a house plant. There are small hairs on its flowers. These hairs are made of cells. **Figure 1** shows the appearance of cells from one of these hairs after 20 minutes in distilled water. **Figure 2** shows cells from another hair after 20 minutes in a solution of potassium nitrate.

Figure 1 (in distilled water)

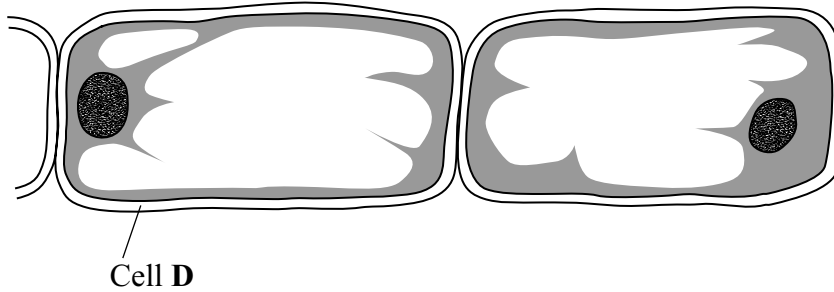
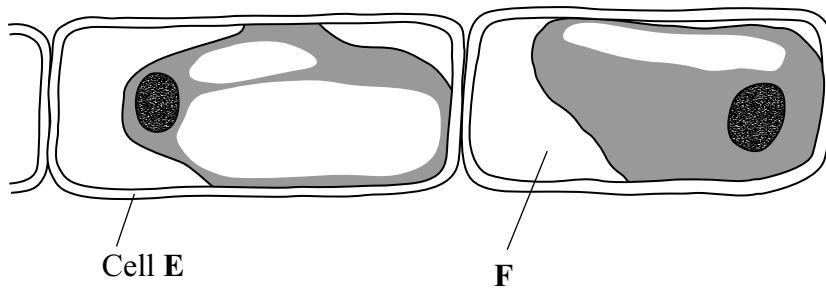


Figure 2 (in potassium nitrate solution)



- (a) What does **Figure 2** suggest about the permeability of the plasma membranes surrounding these cells?

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(1 mark)

(b) What is present in the space labelled **F**? Explain your answer.

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(2 marks)

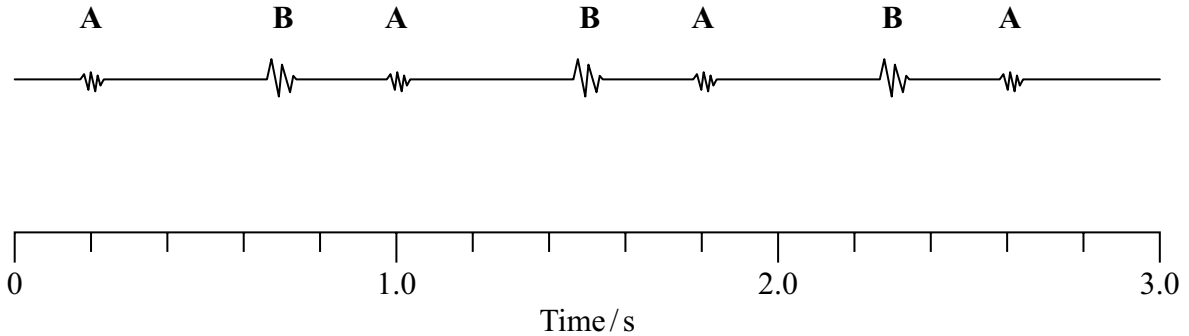
(c) How would the water potential of the sap in the vacuole of cell **E** differ from the water potential of the sap in the vacuole of cell **D**? Explain your answer.

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(3 marks)

Turn over for the next question

- 4 When a stethoscope is placed on the chest wall, sounds are heard as the heart beats. These heart sounds are caused by valves shutting. The diagram shows the heart sounds from a resting person.



- (a) (i) The sounds labelled **A** on the diagram are made by the closing of the valves at the entrance to the arteries. What makes the sounds labelled **B**?

.....

 (1 mark)

- (ii) Explain what causes the valve to shut when sound **A** is heard.

.....

 (1 mark)

- (b) In this person, the stroke volume is 70 cm^3 . Calculate the cardiac output. Show your working.

Cardiac output cm^3 per minute (3 marks)

- (c) During exercise, the heart sounds increase in rate as the heart beats faster. Describe the part played by nerves going to the heart in increasing the rate at which the heart beats.

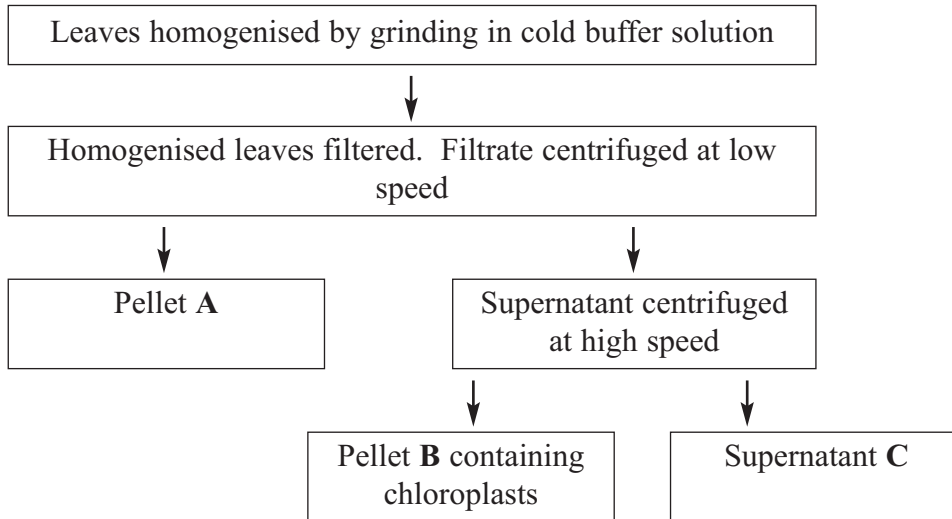
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(3 marks)

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Turn over for the next question

5 The flowchart shows how chloroplasts may be obtained from leaves.



(a) In the first step in this procedure, the leaves were homogenised by grinding in cold buffer solution. Explain why

(i) the leaves were homogenised,

.....

.....

(1 mark)

(ii) a buffer solution was used.

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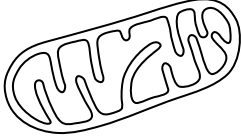
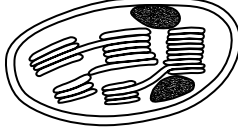
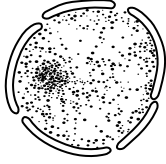
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(2 marks)

(b) The table shows some of the organelles present in the leaf cells.

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|-------------------------------|---|--|---|
| Organelle | X  | Y  | Z  |
| Fraction containing organelle | | | |

- (i) Complete the table to show in which of pellet **A**, pellet **B** or supernatant **C** you would expect to find each of these organelles. (2 marks)
- (ii) Organelle **X** is found in large numbers in cells which take up substances by active transport. Explain why.

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(2 marks)

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Turn over for the next question

- 6 (a) Describe a biochemical test which could be used to show that a sample of fruit juice contained reducing sugars.

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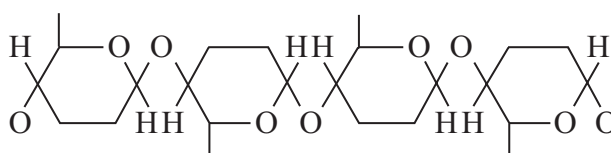
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(2 marks)

The diagram shows part of a cellulose molecule.



- (b) (i) Draw a diagram in the space below to show a molecule of the monomer from which cellulose is formed.

(1 mark)

- (ii) Describe how this molecule differs from a molecule of α -glucose.

.....

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(1 mark)

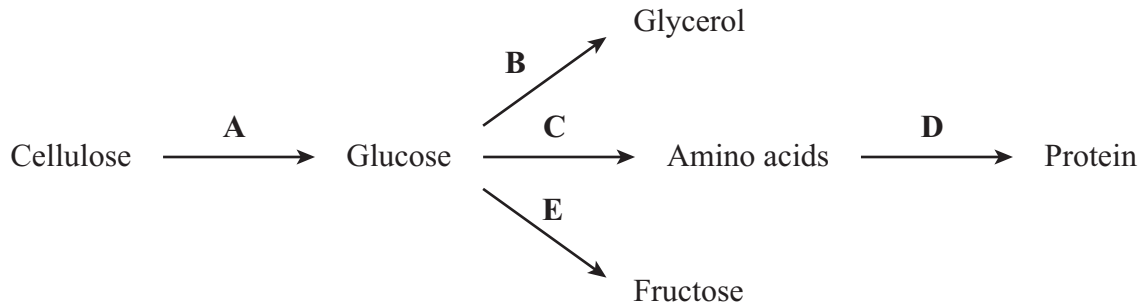
- (c) Describe the importance of hydrogen bonds in the structure of cellulose.

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(1 mark)

Research has been carried out into the possibility of using cellulose to produce other substances. The flow chart shows possible pathways for producing some of these substances.



- (d) Which chemical element would it be necessary to add to glucose to produce an amino acid?

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(1 mark)

- (e) Isomers are substances which have the same chemical formula but have different molecular structures. An enzyme which catalyses a reaction in which one isomer is converted to another is an isomerase.

- (i) Which of reactions A – E would be catalysed by an isomerase?

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(1 mark)

- (ii) Which of reactions A – E would be catalysed by a hydrolase?

.....
(1 mark)

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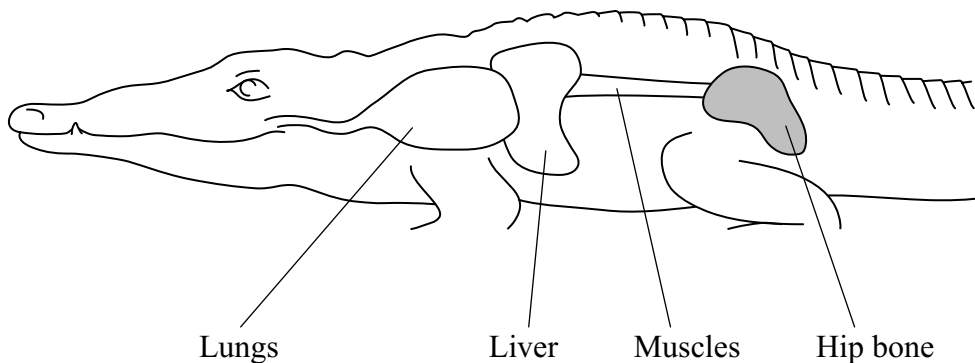
Turn over for the next question

7 Read the following passage.

When a person breathes in, the diaphragm muscle contracts and the diaphragm flattens. This, together with movement of the ribs, leads to air being drawn into the lungs. Breathing out is generally passive and results from the relaxation of the diaphragm muscle and the elastic recoil of the lung tissue.

- 5 Two sets of intercostal muscles also play an important part in breathing in humans. Contraction of the external intercostal muscles is associated with breathing in. During strenuous exercise, contraction of the internal intercostal muscles helps force air out of the lungs. In this case, breathing out is active.

- 10 Crocodiles also have lungs and breathe air. They have well developed intercostal muscles but do not appear to use these during breathing. They also lack a diaphragm. Breathing in, in crocodiles, is brought about by contraction of muscles attaching the liver to the hip bones (see diagram). This pulls the liver back and causes air to enter the lungs. Breathing out results from the contraction of abdominal muscles which move the liver forwards.



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

- (a) Describe the movement of the ribs when a person breathes in (line 2).

.....

(1 mark)

(b) (i) Explain what is meant by passive (line 3).

.....
.....
(1 mark)

(ii) Is breathing out in crocodiles active or passive? Explain your answer.

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.....
(1 mark)

(c) Describe the part played by the phrenic nerve in bringing about changes in the shape of the diaphragm when a person breathes in and out.

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(3 marks)

(d) Explain how movement of the liver causes air to enter a crocodile's lungs.

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(3 marks)

Question 7 continues on the next page

- 8 Some enzymes digest protein. They hydrolyse the peptide bonds between amino acids. The extent to which a protein is digested is called the degree of hydrolysis (DH). The DH value may be calculated from the equation:

$$\text{DH} = \frac{100 \times \text{Number of peptide bonds hydrolysed}}{\text{Total number of peptide bonds present}}$$

- (a) (i) A protein molecule contains 151 amino acids. What is the total number of peptide bonds in this molecule?

.....
(1 mark)

- (ii) A molecule of this protein is digested. The DH value of the digested protein is 18. Calculate the number of peptide bonds that have been hydrolysed.

Answer (1 mark)

- (b) What would be the DH value of a protein if it were completely hydrolysed to amino acids? Explain how you arrived at your answer.

DH value

Explanation

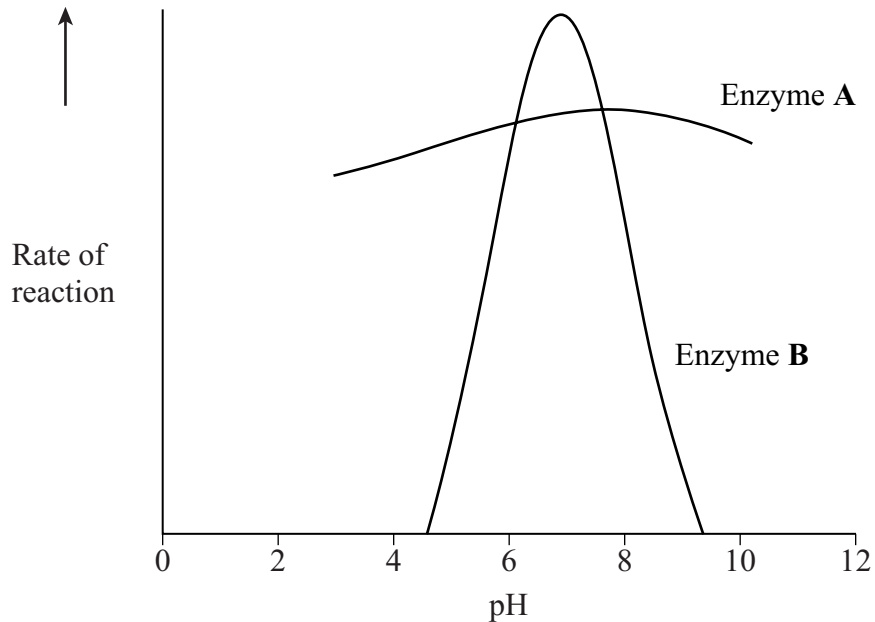
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(2 marks)

Question 8 continues on the next page

Enzymes **A** and **B** digest protein. The graph shows the effect of pH on the rates of reaction of these enzymes.



- (c) Pepsin is a protein-digesting enzyme found in the stomach. It has an optimum pH of 2 and is fully denatured at pH 6. Sketch a curve on the graph to show the effect of pH on the rate of reaction of pepsin.

(1 mark)

- (d) Explain why the rate of reaction of enzyme **B** is low at pH 5.

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(3 marks)

There are no questions printed on this page