Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME	

CENTRE NUMBER		CANDIDATE NUMBER	

4485788656

BIOLOGY **9700/21**

Paper 2 AS Level Structured Questions **May/June 2021**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

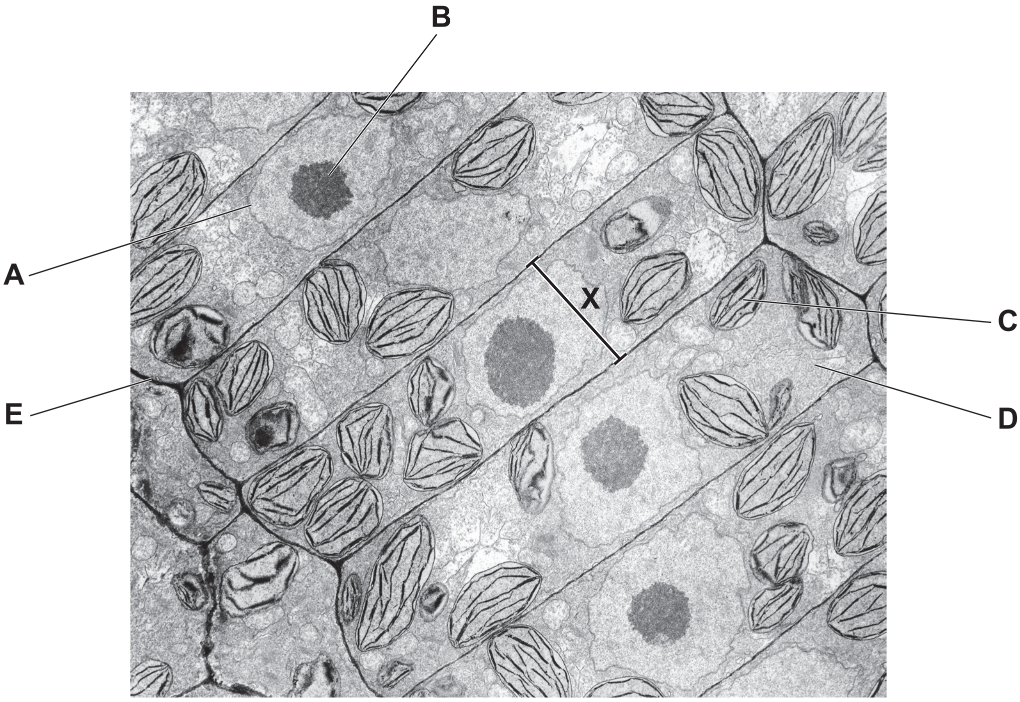
- The total mark for this paper is 60.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **16** pages.

DC (ST/CT) 203278/2

Answer **all** questions.

1 Fig. 1.1 is a transmission electron micrograph of cells from duckweed, *Spirodela oligorrhiza*.



magnification ×4275

Fig. 1.1

(a) Calculate the actual width of the cell labelled **X**.

Write down the formula you will use to make your calculation.

Show your working and give your answer in micrometres to one decimal place.

formula

.... μm [3]

(b) **(i)** Table 1.1 lists some biological molecules found in plant cells.

Complete Table 1.1 by choosing **one** letter from Fig. 1.1 that indicates a cell structure where each biological molecule is found.

Table 1.1

biological molecule	**letter from Fig. 1.1**
DNA	
cellulose	
phospholipid	
histone proteins	

[4]

(ii) State the name of a cell structure, **visible in Fig. 1.1**, where ATP is synthesised.

.... [1]

(iii) Name a cell structure that produces mRNA.

.... [1]

(c) Describe the evidence from Fig. 1.1 that shows that the image is a transmission electron micrograph.

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.... [2]

[Total: 11]

2 Fig. 2.1 shows three molecules of water.

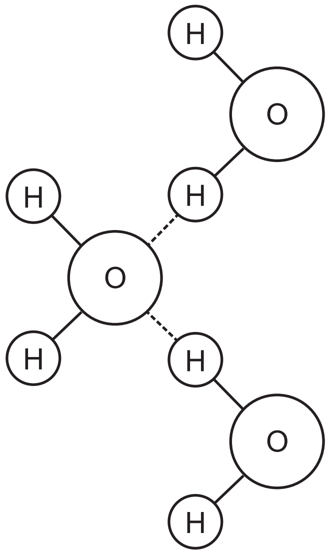

Fig. 2.1

(a) Describe the hydrogen bonding that occurs between the water molecules shown in Fig. 2.1.

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.... [3]

(b) The human enzyme, salivary amylase, is composed of one polypeptide. Fig. 2.2 represents the structure of a molecule of salivary amylase.

Fig. 2.2

(i) Explain the role of hydrogen bonding in maintaining the secondary structure of proteins, such as salivary amylase.

....

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.... [1]

(ii) Explain the role of hydrogen bonding in maintaining the tertiary structure of proteins such as salivary amylase.

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.... [2]

(c) Outline the importance of water as a solvent in **plants**.

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.... [3]

[Total: 9]

3 Visking tubing can be used to investigate the properties of cell membranes.

A student carried out an experiment to investigate osmosis using Visking tubing. An outline of the investigation is shown in Fig. 3.1.

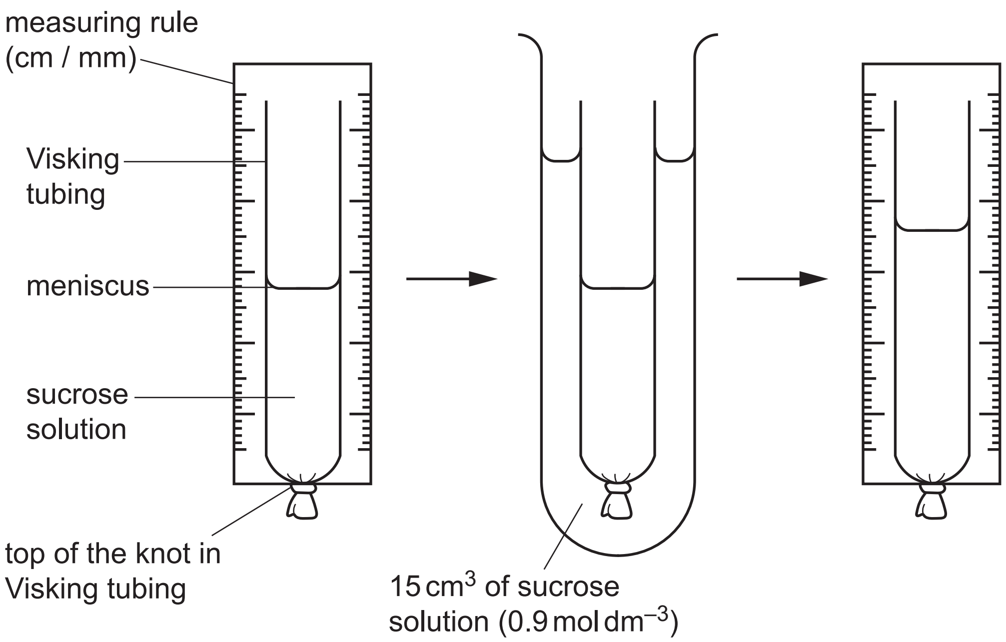

Fig. 3.1

- Six pieces of Visking tubing were filled with 10 cm^3 of different concentrations of sucrose solution: 0.0, 0.4, 0.8, 1.2, 1.6 and 2.0 mol dm^{-3}.
- The height of the meniscus of each solution in the Visking tubing was measured.
- The pieces of Visking tubing were put into test-tubes containing 15 cm^3 of 0.9 mol dm^{-3} sucrose solution.
- After 20 minutes, the pieces of Visking tubing were removed from the test-tubes and the height of the meniscus in each was measured.

The results are shown in Table 3.1.

Table 3.1

concentration of sucrose solution inside Visking tubing / mol dm^{-3}	**difference in height of meniscus after 20 minutes / mm**
0.0	–12
0.4	–4
0.8	–2
1.2	+1
1.6	+6
2.0	+11

(a) The Visking tubing used by the student was **not** permeable to sucrose.

Explain the results shown in Table 3.1.

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.... [3]

(b) When red blood cells are placed in water they are destroyed by bursting.

The student also investigated how red blood cells are affected by immersion in solutions of sodium chloride of different concentration. Blood samples of the same volume were added to solutions of sodium chloride in separate test-tubes.

After 10 minutes, the student took 0.1 cm^3 of the blood samples from the test-tubes and estimated the percentage of red blood cells that had burst in each blood sample.

Fig. 3.2 shows the student's results.

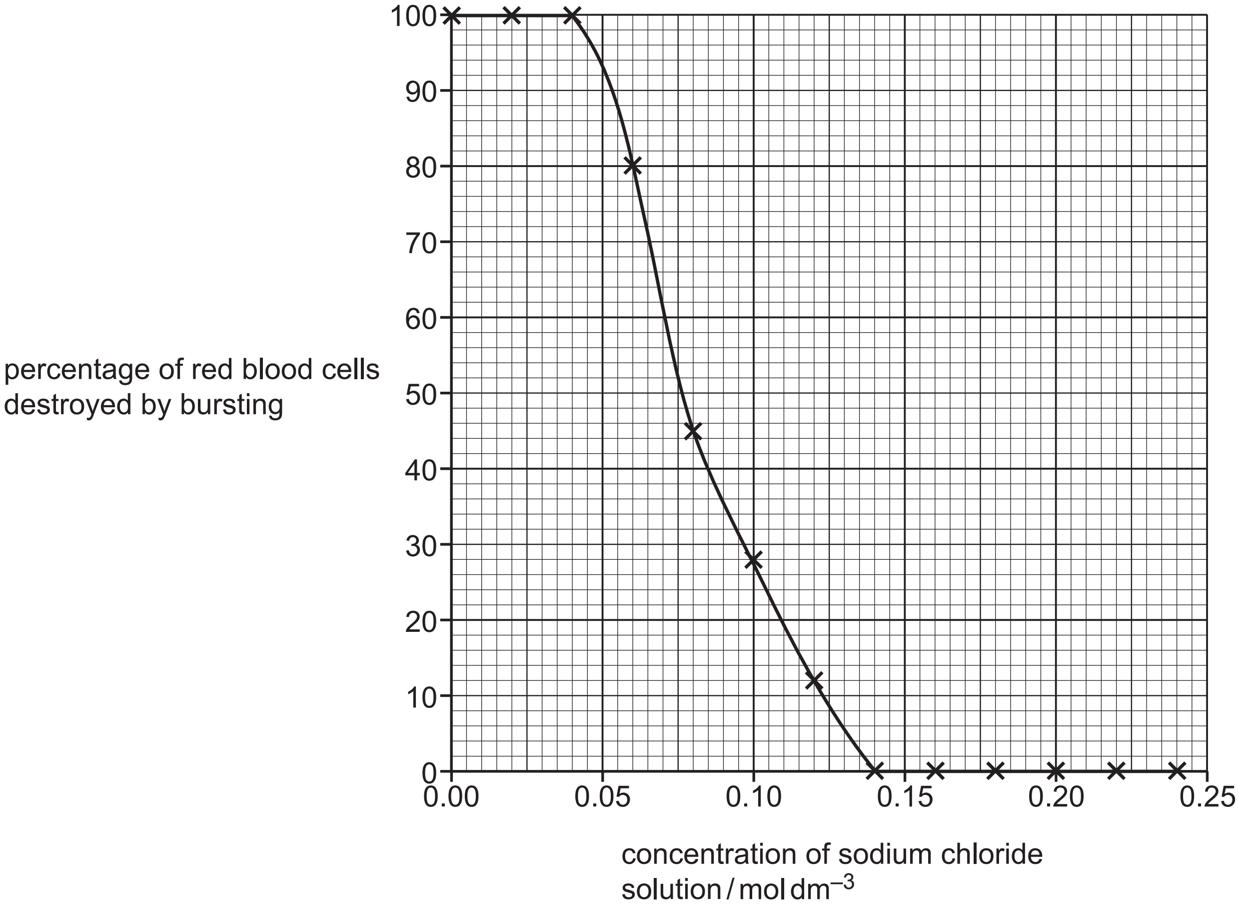

Fig. 3.2

Describe **and** explain the effects on red blood cells of immersion in different concentrations of sodium chloride as shown in Fig. 3.2.

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.... [4]

[Total: 7]

4 **(a)** The induced-fit hypothesis and the lock-and-key hypothesis are used to describe the mode of action of enzymes.

Explain the induced-fit hypothesis.

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.... [3]

(b) Radish plants contain the enzyme peroxidase that catalyses the breakdown of hydrogen peroxide.

Students investigated the effect of increasing the concentration of hydrogen peroxide on the activity of peroxidase extracted from radish.

The results of their investigation are shown in Fig. 4.1.

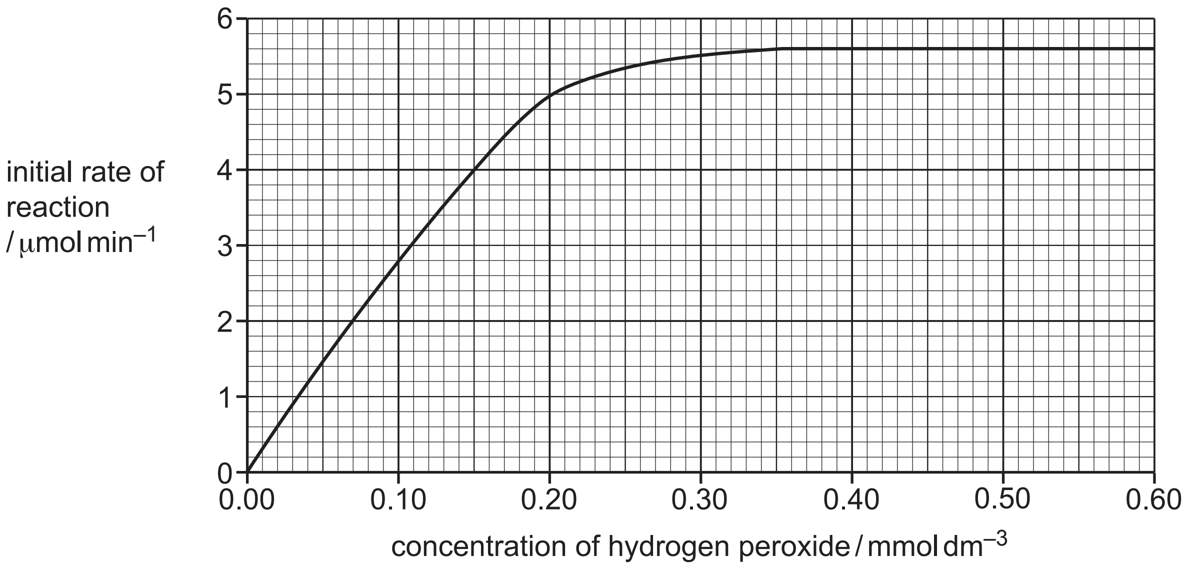

Fig. 4.1

(i) Explain the effect of increasing the concentration of hydrogen peroxide on the initial rate of reaction as shown in Fig. 4.1.

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.... [3]

(ii) The students determined the K_m for radish peroxidase as 0.10 mmol dm^{-3}.

With reference to Fig. 4.1, describe how they determined the K_m.

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.... [2]

(c) A further investigation found that the K_m for carbonic anhydrase is 12 mmol dm^{-3}.

Describe the role of carbonic anhydrase in the transport of carbon dioxide.

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.... [3]

[Total: 11]

5 Much success was made in reducing the number of cases of malaria between 2000 and 2015.

(a) Explain how malaria is transmitted.

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.... [2]

(b) Diagnostic test strips for malaria contain monoclonal antibodies. The test strips detect antigens produced by the pathogens that cause malaria.

Fig. 5.1 shows stages in the production of monoclonal antibodies. The information in three of these stages is incomplete.

Complete Fig. 5.1.

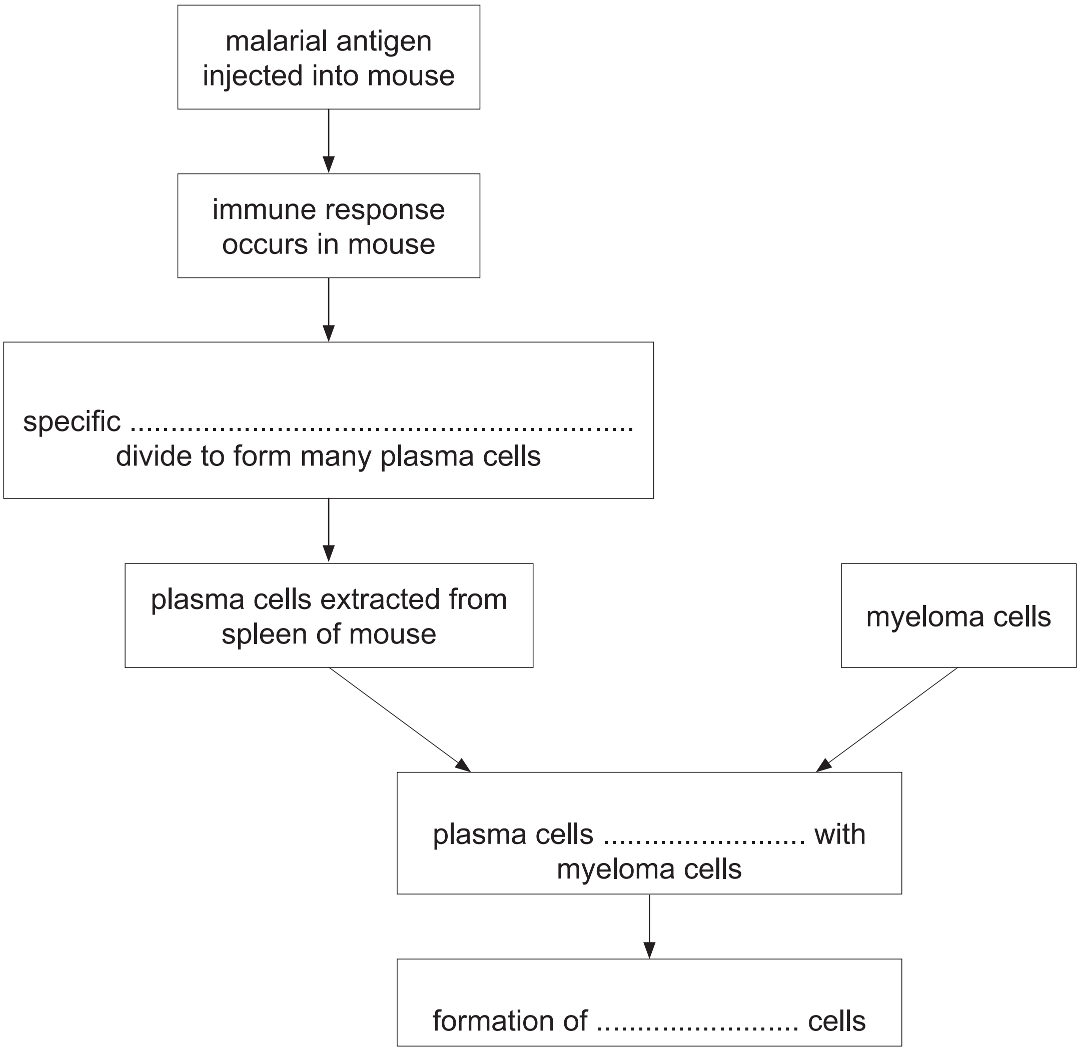
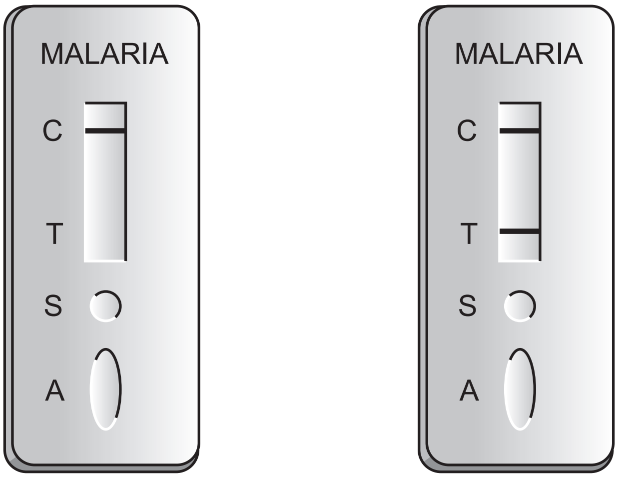


Fig. 5.1

[3]

(c) Fig. 5.2 shows two diagnostic test strips for malaria.



negative result　　　positive result

Fig. 5.2

- A sample of blood from a person suspected of having malaria is put into the well labelled **S**.
- A buffer solution is put into the well labelled **A**.
- The buffer solution moves the blood towards the results window.
- A line at position **C** indicates that the test is working correctly.
- A line at position **T** indicates a positive result for malaria.

State **three** advantages of using test strips for malaria, such as those shown in Fig. 5.2.

1 ....

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2 ....

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3 ....

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[3]

(d) The highest number of cases of malaria occur in sub-Saharan Africa and South-East Asia.

Discuss the factors that determine the global distribution of malaria.

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.... [5]

[Total: 13]

6 Lysosomes are cell structures that contain enzymes known as acid hydrolases.

Fig. 6.1 shows some processes that occur in animal cells.

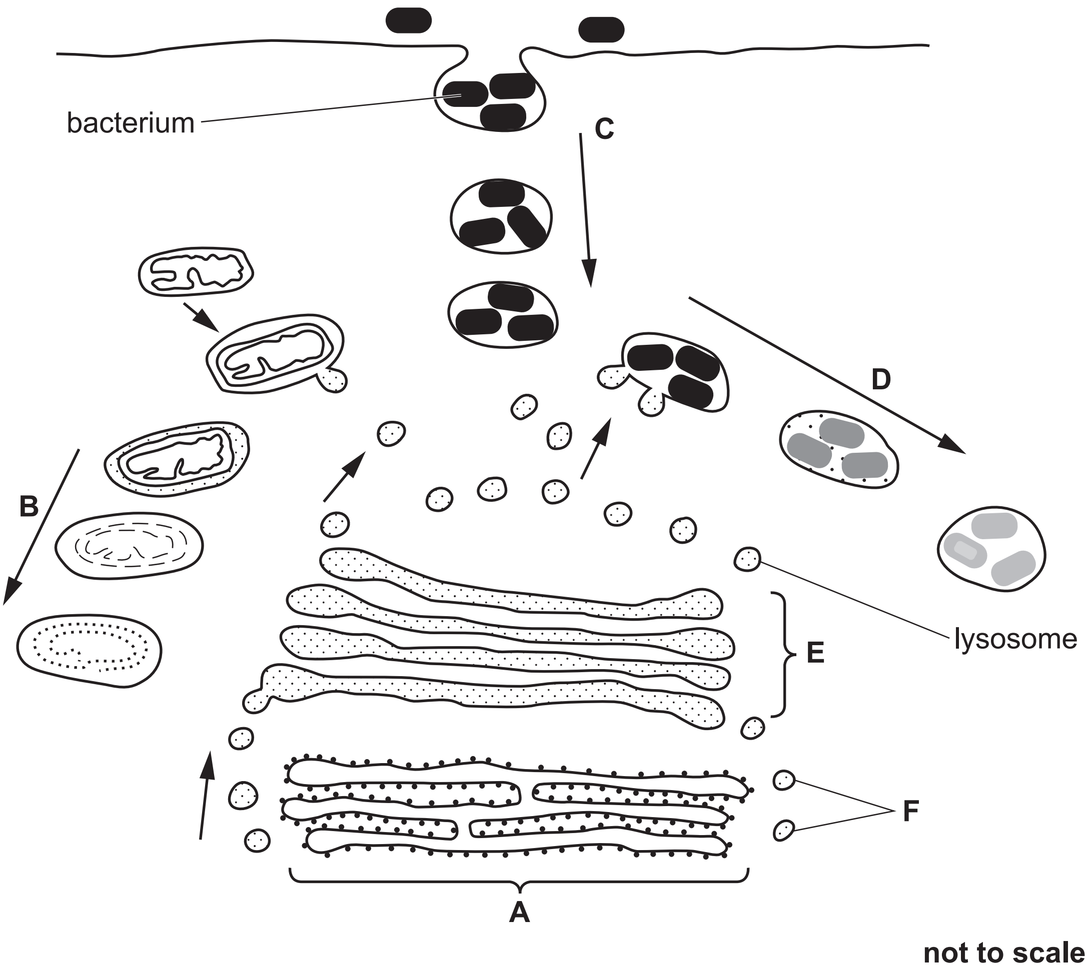

Fig. 6.1

(a) Name the cell structures labelled **A** and **E**.

A ....

E .... [2]

(b) State the function of the structures labelled **F**.

....

.... [1]

(c) Name the process by which bacteria are taken into the cell at **C**.

.... [1]

(d) With reference to the processes occurring at **B** and at **D** in Fig. 6.1, outline the role of acid hydrolases in lysosomes.

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.... [3]

(e) Carrier proteins in the membranes of lysosomes maintain a lower pH than the surrounding cytoplasm by moving hydrogen ions.

Suggest how the carrier proteins maintain the lower pH within the lysosomes.

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.... [2]

[Total: 9]