2018 Eukaryotic Cell Structure and Cell Membrane STQ

2018 / H2 / ACJC PRELIM / P2 Q1

1 Cholesterol is synthesised in the smooth endoplasmic reticulum (SER) in liver cells by a series of enzyme-catalysed reactions. Cholesterol is then transported to the Golgi apparatus where they are packaged into vesicles and subsequently released into a membrane-bound duct of the liver.

Fig. 1.1 is an electron micrograph of a section of a liver tissue.

Fig. 1.1

(a) Name structure **T** in Fig. 1.1 and describe its role in liver cells.

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..... [2]

(b) Both prokaryotes and structure **T** have membrane proteins to help them perform the role described in (a). Suggest how prokaryotes perform this role.

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[3]

(c) Describe the role of cholesterol in the cell surface membrane.

[1]

(d) Suggest how cholesterol is transported from the Golgi apparatus to the membrane-bound duct of the liver.

[2]

[Total: 8]

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2 Fig. 1.1 shows an electron micrograph of a pancreatic cell that secretes large amounts of insulin that helps to regulate blood glucose level.

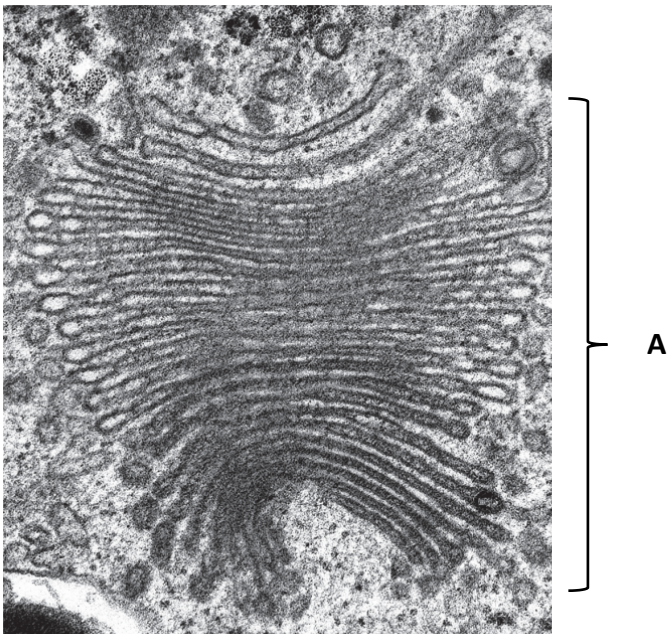

Fig. 1.1

(a) With reference to Fig. 1.1,

(i) identify organelle **A**;

[1]

(ii) describe **two** identifying features of organelle **A** that allows its identification in **(a)(i)**.

[2]

Fig. 1.2 shows a diagram of the molecular structures of tristearin (a triglyceride) and phosphatidylcholine (a phospholipid).

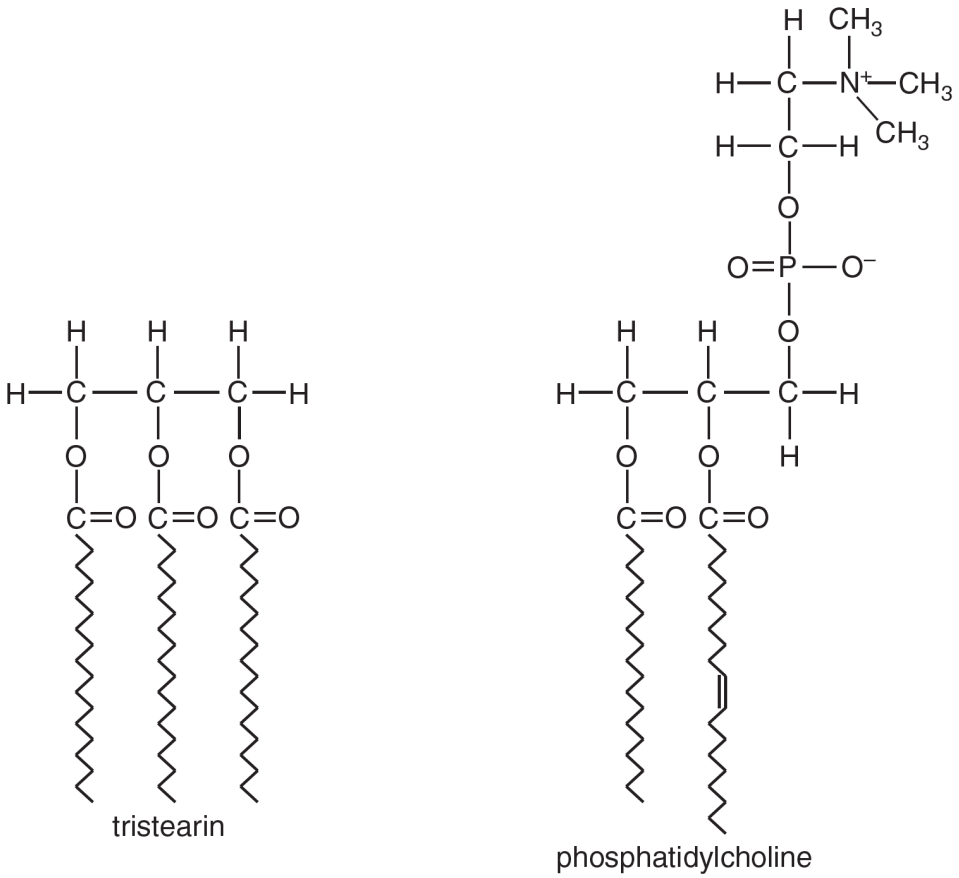

Fig. 1.2

(b) Table 1 shows a structural difference between the two molecules shown in Fig. 1.2.

Complete Table 1 with two further **structural** differences **other than** in numbers of different types of atoms.

Table 1

structural feature	tristearin	phosphotidylcholine
length of fatty acid chain	all same length	different lengths

[2]

(c) Triglyceride is used as energy storage while phospholipids are membrane components. Explain why phospholipids are suitable membrane components but not triglyceride.

[2]

Cells in the pancreas secrete enzymes, such as amylase and trypsin, into a duct. The enzymes are packaged in vesicles so that they can be exported from these cells as shown in Fig. 1.3.

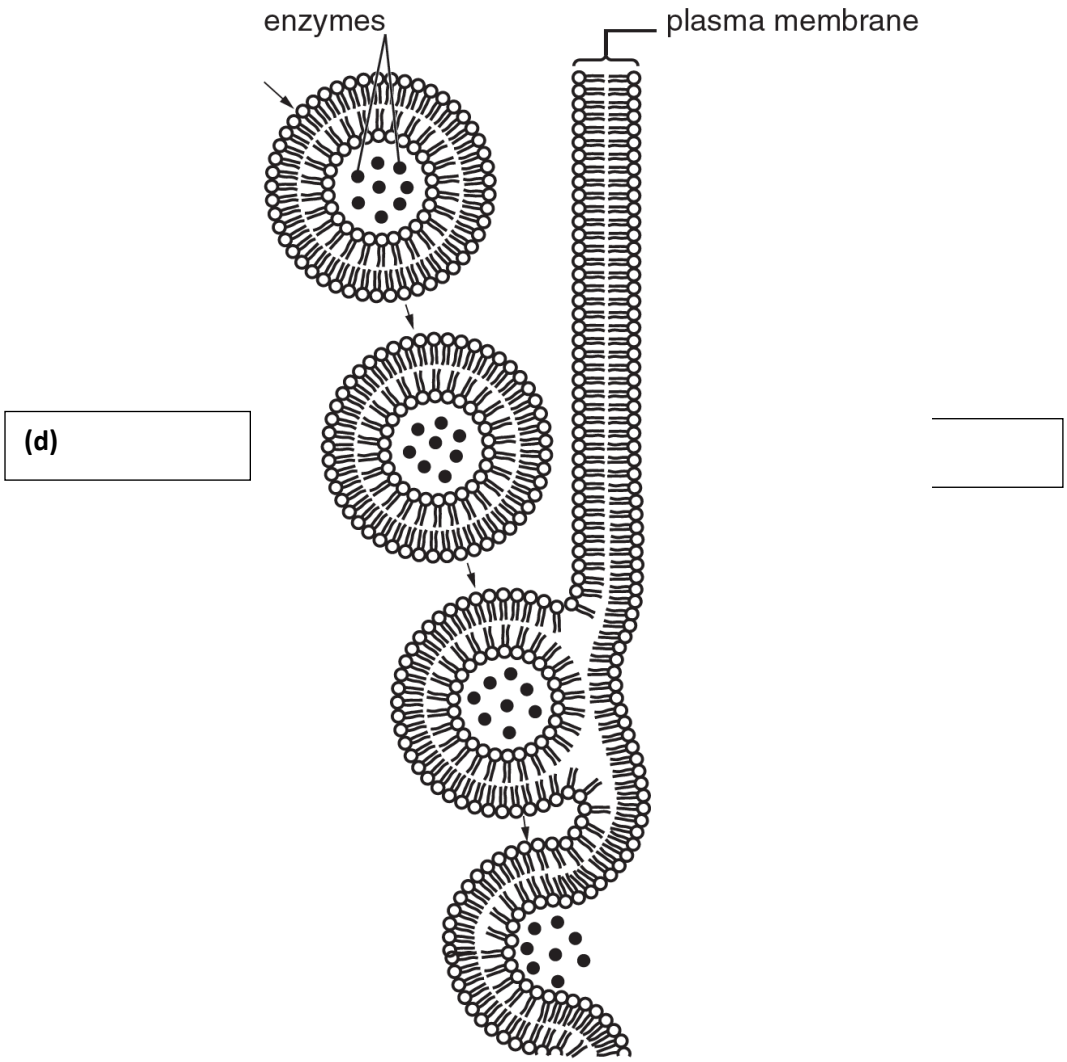

Fig. 1.3

(d) On Fig. 1.3, label the cytoplasm of the cell as '**cytoplasm**' and extracellular fluid as '**extracellular**'. [1]

(e) With reference to Fig. 1.3,

(i) explain how enzymes that are secreted by cells in the pancreas are packaged into vesicles and exported, after their synthesis at the endoplasmic reticulum.

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[6]

(ii) explain **one** property of the plasma membrane that allows vesicle formation.

[2]

(f) Describe **two** advantages of having plasma membranes **within** the cell.

[2]

[Total: 18]

QUESTION 3

Fig. 1.1 is an electron micrograph of part of a eukaryotic cell.

Fig. 1.1

(a) Identify the structures **J** and **K**. [2]

J ……..

K ……..

(b) Describe two structural features shown in Fig. 1.1 that identify **G** as the Golgi apparatus and **not** the rough endoplasmic reticulum. [2]

1. ……..……

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2. ……..……

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The Golgi apparatus is an organelle that is important for many functions. One example is the formation of lysosomes.

Before lysosomal hydrolases can function in the lysosome, they must be sorted from other proteins. Fig. 1.2 shows how a glycosylated lysosomal hydrolase is sorted at the trans face of the Golgi apparatus.

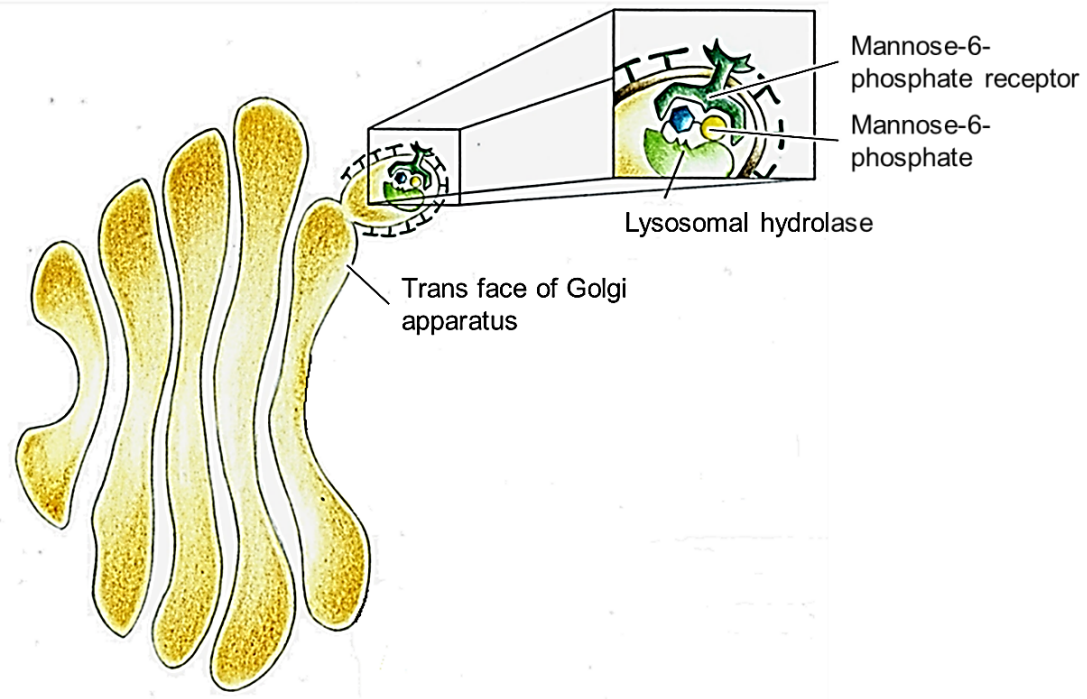

Fig. 1.2

(c) Outline the pathway taken by the lysosomal hydrolase from its site of synthesis to the trans face of the Golgi apparatus. [3]

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(d) With reference to Fig. 1.2, suggest how the Golgi apparatus is able to specifically sort the lysosomal hydrolase from other proteins. [2]

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[Total: 9]

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QUESTION 4

(a) Contrast the processes of facilitated diffusion and active transport. [3]

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(b) A group of students investigated the uptake of chloride ions in barley plants. They divided the plants into two groups and placed their roots in solutions containing radioactive chloride ions.

- Group **A** plants had a substance that inhibited respiration added to the solution.
- Group **B** did not have the substance added to the solution.

The students calculated the total amount of chloride ions absorbed by the plants every 15 minutes. Their results are shown in Fig. 2.1.

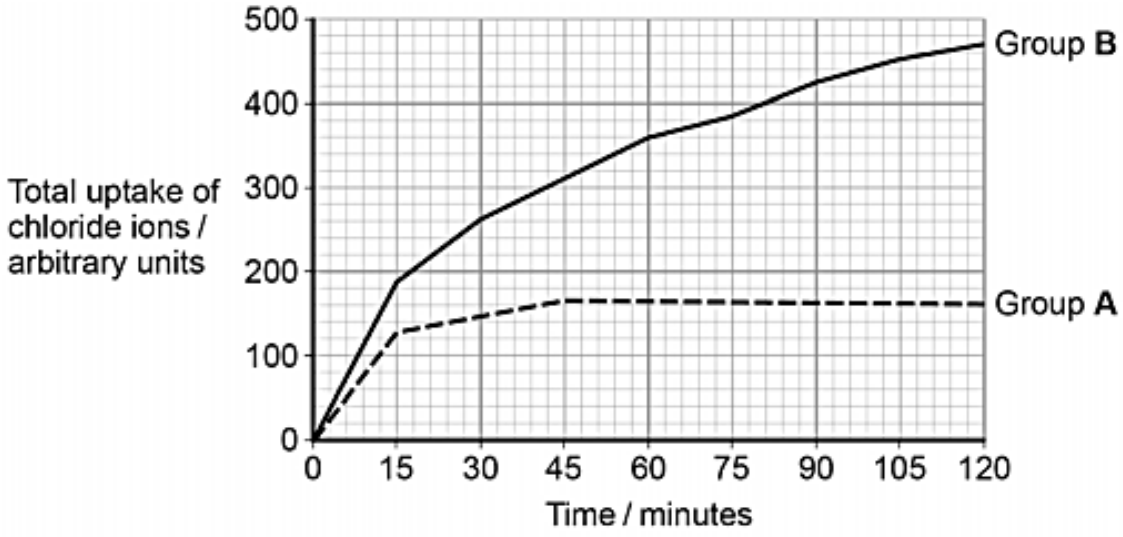

Fig. 2.1

(i) Calculate the ratio of the **rate** of uptake of chloride ions in the first hour to the **rate** of uptake of chloride ions in the second hour for group **B** plants. [2]

Ratio: ……..

(ii) Explain the results shown in Fig. 2.1. [4]

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[Total: 9]

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5 Fig. 1.1 shows a section of a cell surface membrane.

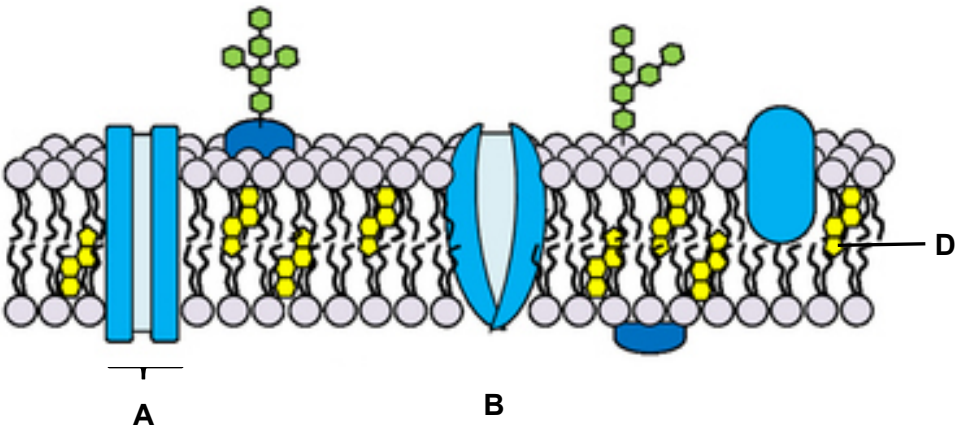

Fig. 1.1

(a) Name the structures labelled **A**, **B**, **C** and **D**.

A ……

B ……

C ……

D …… [2]

(b) Describe how structures **A** and **B** are held in the membrane.

[2]

(c) For hydrophilic molecules to enter a cell, they require the help of either structure **A** or **B**.

State and explain which of the two structures allows a faster entry into the cell.

[3]

(d) State **two** possible functions of structure **C**.

[2]

(e) Suggest why there seems to be a greater diversity in the molecular structures of **A** and **B** than that of **C**.

[2]

(f) The fluid mosaic model was first proposed by S.J. Singer and Garth L. Nicolson in 1972 to explain the structure of the cell surface membrane.

Explain why it is called fluid mosaic.

[2]

(g) Comment on the significance of structure **D** in the cell surface membrane.

[1]

[Total: 14]

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6 Fig.1.1 shows a cell undergoing telophase and process **X** simultaneously.

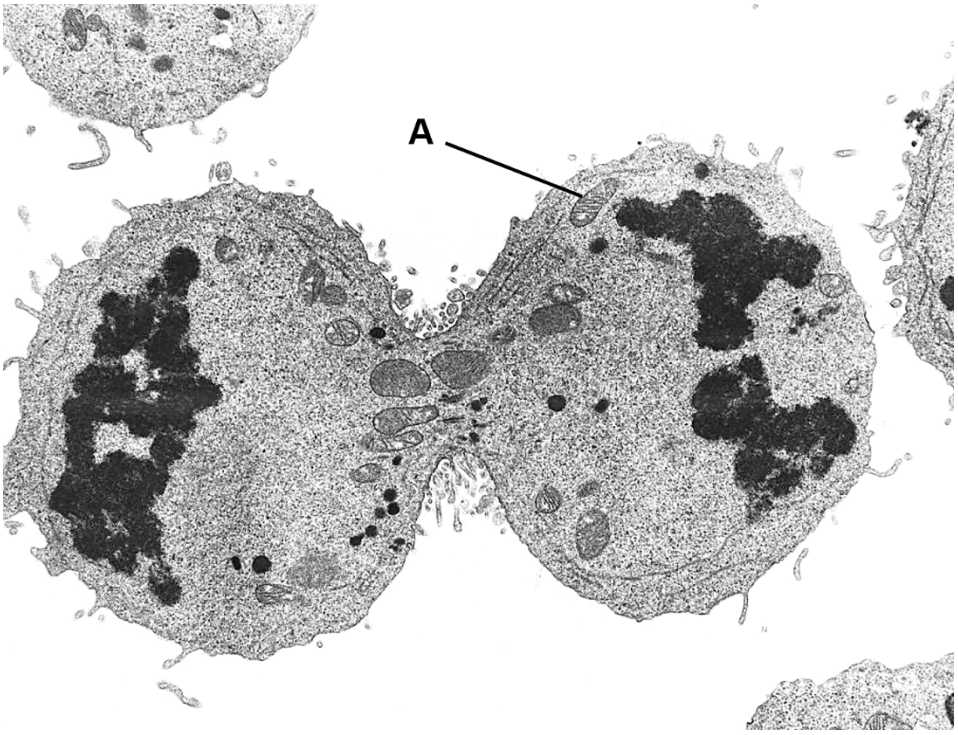

Fig. 1.1

Source: David M. Phillips, 2014

(a) Name structure **A**. [1]

(b) Name process **X** and explain how it supports the cell theory. [2]

(c) Outline the role of **A** and explain its significance to process **X**. [3]

[Total: 6]

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7 Plants vary greatly in terms of size.

(a) Explain whether the cell theory is applicable to plants.

[2]

Sugar molecules enter cells through transport proteins.

(b) Explain why transport proteins are required for the movement of sugar molecules, such as glucose and fructose, into cells.

[2]

Some plant cells convert fructose and glucose into sucrose for transport from the leaves to the roots. Sucrose is moved into phloem sieve tubes as shown in Fig. 1.1.

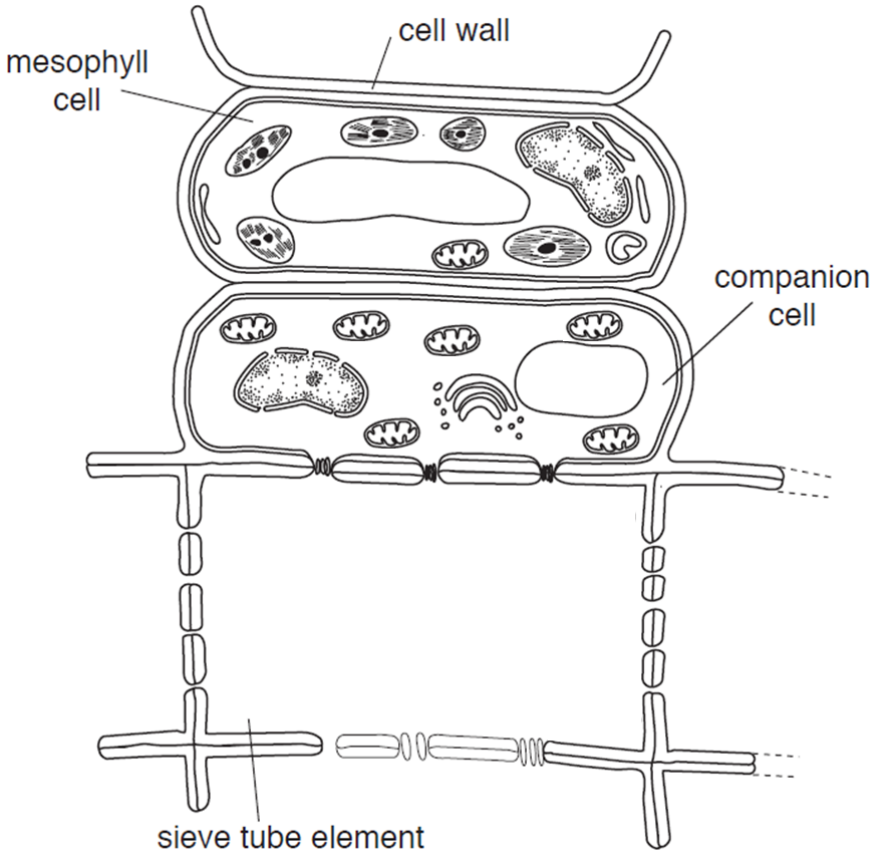

Fig. 1.1

Each cell has a specialized function.

(c) With reference to Fig. 1.1 and the information provided, state **one** difference between a mesophyll cell and companion cell.

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_____ [1]

Fig. 1.2 shows how sucrose is transported into the companion cell from the mesophyll cell.

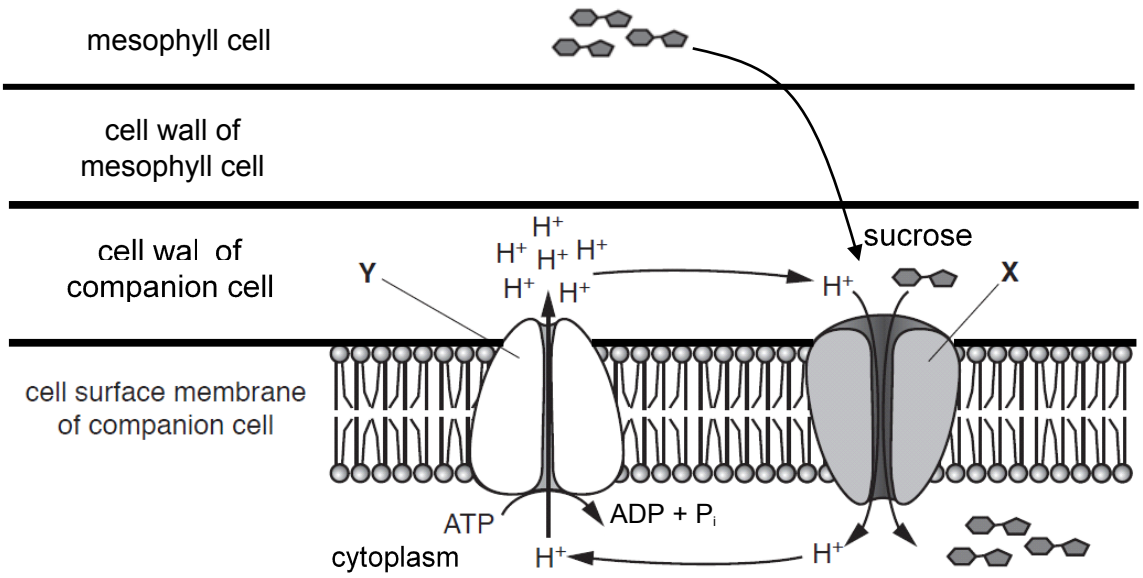

Fig. 1.2

(d) Using the information in Fig. 1.1 and Fig. 1.2, explain how sucrose moves into the companion cell.

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_____ [3]

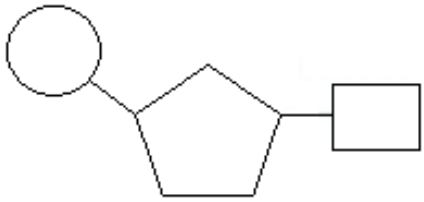
[Total: 8]

8 In eukaryotic cells, the degradation of mRNA is an essential part of the regulation of gene expression. It can be controlled in response to developmental, environmental, and metabolic signals. mRNA hydrolysis is catalysed by numerous types of nucleases, such as the endonuclease Ribonuclease A (RNAse A), shown in Fig. 1.1.

(A) Space-filling model (B) Ribbon diagram

Fig. 1.1

(a) Using a labelled and annotated diagram, illustrate the hydrolysis of the bond catalysed by RNAase.
(A monomer has been drawn for you.)



[3]

Fig. 1.1 B shows two important catalytic residues within the active site of RNAse A, which are His12 and His119.

(b) Explain how these two histidines, which are in position 12 and 119 of the 124 amino acid sequence, are brought together in the active site of the enzyme.

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…… [3]

Fig. 1.2 shows the structure of histidine and phenylalanine.

(A) Histidine (B) Phenylalanine

Fig. 1.2

(c) Predict how the catalytic activity of RNAse would be affected if both histidines were replaced by phenylalanines.

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…… [2]

[Total: 8]

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