Cambridge International AS & A Level

BIOLOGY (9700) PAPER 2

Past Paper Questions By Topic
+ Answer Scheme

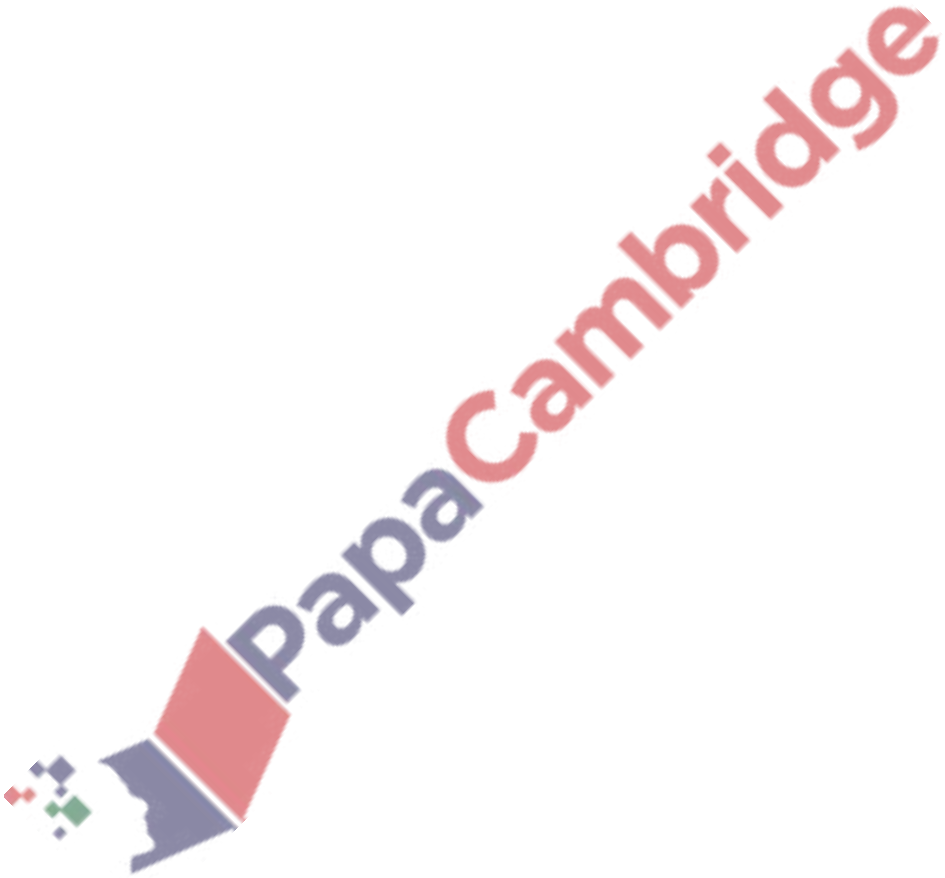
2015 - 2020

Complete Syllabus

PapaCambridge

Chapter 7

Transport in plants



7.1 Structure of transport tissues

87. 9700_s20_qp_22 Q: 5

In most plants, sucrose is the main sugar that is transported from sources to sinks.

(a) In the source, sucrose is transferred from a mesophyll cell to a phloem sieve tube through a companion cell.

Describe **and** explain how the transfer of sucrose into a phloem sieve tube from a companion cell can lead to the transport of the sugar to a sink.

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..... [4]

(b) Fig. 5.1 shows part of one pathway that is used in plant cells to synthesise sucrose. The enzyme sucrose synthase catalyses the transfer of glucose from UDPG (uridine diphosphate glucose) to fructose.

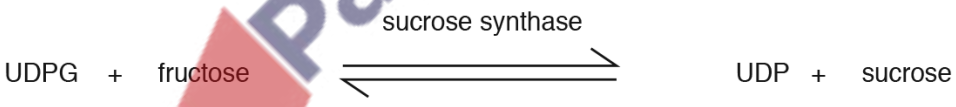

Fig. 5.1

The structure of UDPG is shown in Fig. 5.2.

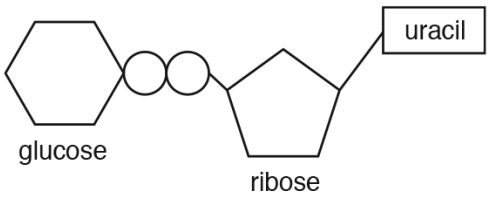

Fig. 5.2

(i) Name the type of bond formed when sucrose is synthesised.

..... [1]

(ii) Explain why UDP can be described as a phosphorylated nucleotide.

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..... [2]

(iii) Sucrose synthase acts by using an induced fit mechanism rather than a lock and key mechanism.

With reference to sucrose synthase and the **synthesis** of sucrose, outline the difference between the induced fit mechanism and lock and key mechanism of enzyme action.

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..... [4]

(c) UDPG is used in some algae (photosynthetic protoctists) to synthesise a storage compound known as floridean starch.

The molecular structure of floridean starch has been described as an intermediate between amylopectin and glycogen, with little or no amylose.

Describe the molecular structure of floridean starch by completing the passage.

Floridean starch is a polysaccharide composed of ..... monomers.

The monomers are joined by ..... and ..... linkages,

to give a branching structure that is less highly branched than

..... .

[4]

[Total: 15]

88. 9700_s18_qp_21 Q: 2

(a) Sucrose is a disaccharide.

Fig. 2.1 shows how sucrose is broken down in a reaction with hydrochloric acid.

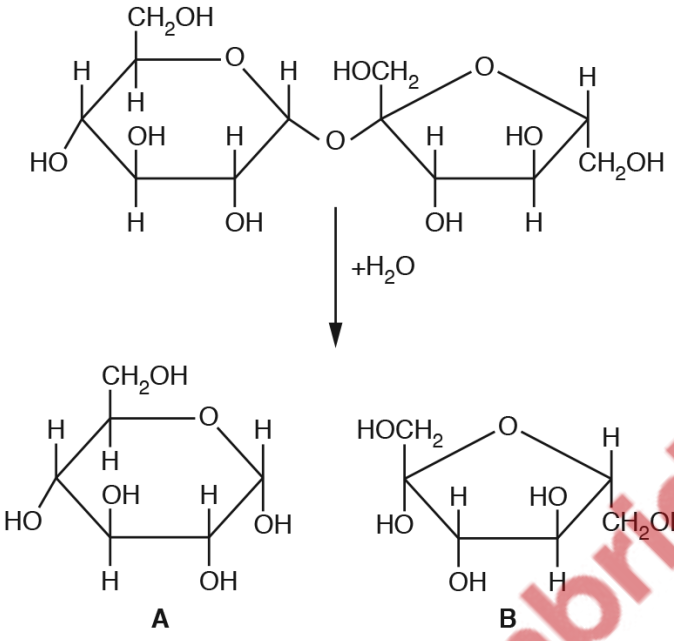

Fig. 2.1

(i) Name the products, **A** and **B**, of the reaction shown in Fig. 2.1.

A .....

B .....

[2]

(ii) Name the type of bond that is broken in the reaction shown in Fig. 2.1.

.....[1]

(iii) State the type of reaction shown in Fig. 2.1.

.....[1]

(b) When Benedict's solution is added to a sucrose solution and put into a boiling water-bath, no change in colour is observed.

State why no colour change is observed.

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.....[2]

(c) Sugar beet plants, *Beta vulgaris*, store sucrose in their roots.

Describe **and** explain how sucrose is transported from the phloem in the leaves of sugar beet to storage tissues in the root.

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.....[4]

[Total: 10]

89. 9700_w18_qp_21 Q: 5

(a) Fig. 5.1 shows the structure of a prokaryotic cell.

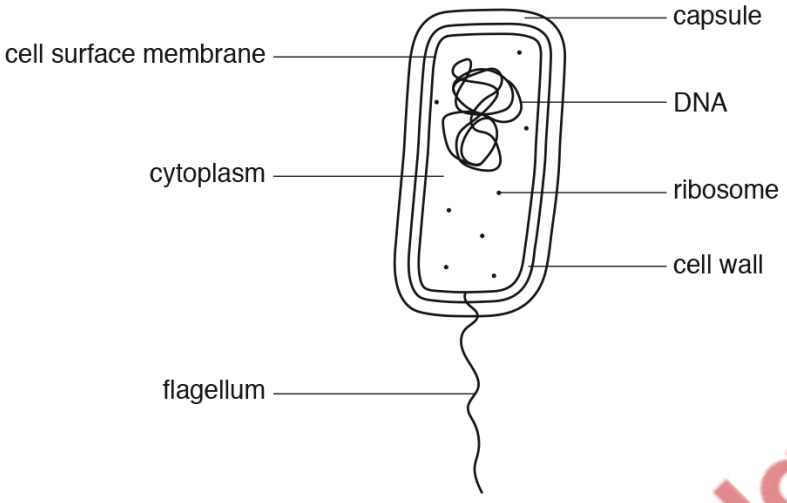

Fig. 5.1

Fig. 5.1 has **not** been fully labelled to confirm that the cell is prokaryotic.

State what **other** information could be added to **two** of the labels to confirm that this cell is prokaryotic and **not** eukaryotic.

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..... [2]

(b) Some prokaryotes are plant pathogens.

Liberibacter is a group of prokaryotic plant pathogens that causes severe damage to a variety of plant crops across the world.

Scientists made observations about plants infected with these pathogens compared to uninfected plants:

- starch accumulates in the leaves
- starch does not accumulate in roots and other storage organs
- fruits are smaller
- the pathogen is widely distributed throughout the plant and is found in a number of different organs including the root and leaf.

The scientists deduced that the pathogen infected the phloem tissue.

Suggest why the scientists were able to deduce that the pathogen infected the phloem tissue.

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..... [2]

(c) DNA and RNA both contain nucleotides with adenine.

Complete Table 5.1 to compare:

- a DNA nucleotide with adenine
- an RNA nucleotide with adenine
- ATP.

Table 5.1

feature	DNA nucleotide with adenine	RNA nucleotide with adenine	ATP
contains nitrogen (yes or no)			
contains a pyrimidine base (yes or no)			
number of phosphate groups			
name of the sugar component			

[5]

[Total: 9]

90. 9700_M16_qp_22 Q: 5

(a) Fig. 5.1 is a diagram of an ATP molecule.

Label Fig. 5.1 to show the structure of an ATP molecule.

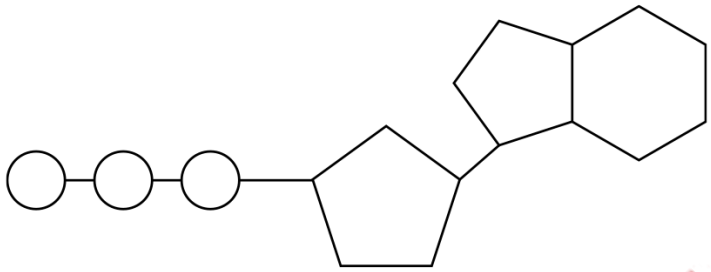

Fig. 5.1

[3]

(b) Statements **A**, **B**, **C** and **D** are part of the sequence of events that occur during the loading of sucrose into a phloem sieve tube.

A hydrogen ions bind to co-transporter protein
B diffusion of sucrose via plasmodesmata
C co-transport of hydrogen ions and sucrose
D hydrogen ions move out of companion cell

(i) State which event, **A**, **B**, **C** or **D**, requires ATP.

.....[1]

(ii) Place the letters **A** to **D** in the sequence that they would occur in the loading of sucrose into a phloem sieve tube.

.....[1]

(iii) State the name used to describe any area within a plant where sucrose is loaded into a phloem sieve tube.

.....[1]

(c) ATP is used during translation in amino acid activation, when an amino acid becomes attached to its specific tRNA molecule having a particular anticodon. The reaction requires an enzyme called aminoacyl tRNA synthetase.

(i) Explain why a particular amino acid needs to be linked to a specific tRNA molecule.

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.....[2]

(ii) The pH of the cytoplasm of most cells varies slightly around pH7. At extremes of pH, enzymes can become denatured.

Explain how the structure of an enzyme such as aminoacyl tRNA synthetase would be altered if the pH of the cytoplasm became too acidic.

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.....[2]

(iii) Aminoacyl tRNA synthetase uses the induced fit mechanism.

Explain the induced fit mechanism.

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.....[2]

[Total: 12]

91. 9700_s15_qp_23 Q: 5

Fig. 5.1 is a light micrograph of some unicellular photosynthetic organisms called *Chlamydomonas*.

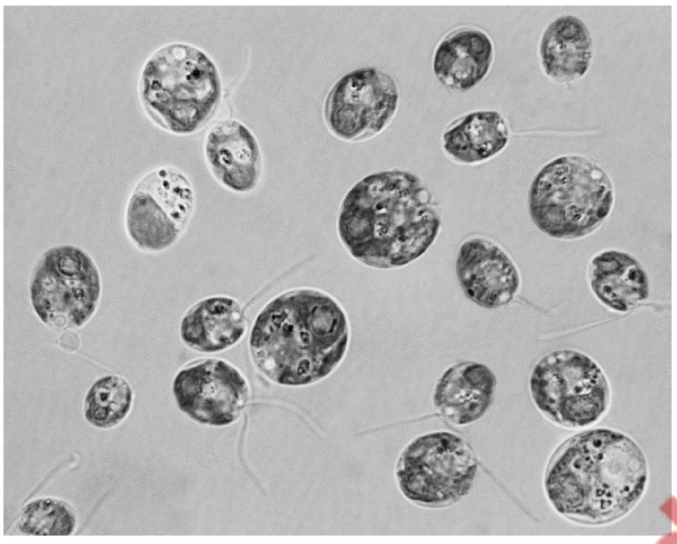

Fig. 5.1

(a) *Chlamydomonas* moves through water.

Explain why the light microscope rather than the electron microscope is used to observe the movement of *Chlamydomonas*.

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.....[2]

(b) *Chlamydomonas* live in water and obtain minerals, such as magnesium ions, from the water.

(i) State **one** role of magnesium ions in photosynthetic organisms.

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.....[1]

(ii) State two properties of water which make it possible for organisms such as *Chlamydomonas* to live in water.

1 .....

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2 .....

..... [2]

(c) Explain why multicellular organisms require transport systems while unicellular organisms, such as *Chlamydomonas*, do not.

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.....[4]

(d) Some plants, such as the banana plant, *Musa acuminata*, produce fruit. The banana fruit has a high content of carbohydrate.

Describe how sugars are transported in phloem sieve tubes from source to sink in plants such as *M. acuminata*.

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.....[5]

[Total: 14]

7.2 Transport mechanisms

92. 9700_m20_qp_22 Q: 1

Phloem sap is transported from sources to sinks in phloem sieve tubes. Each sieve tube is constructed from phloem sieve tube elements.

(a) The structure of a phloem sieve tube element is adapted to its function.

Each of explanations **A** to **F** describes how a particular structural feature of a phloem sieve tube element in a source is suited to the function of transporting phloem sap.

The matching structural feature for each explanation is listed in Table 1.1.

A for entry of sucrose and other organic compounds

B for rapid entry of water to create high hydrostatic pressure

C provides pores to allow the flow of phloem sap from one sieve tube element to the next

D to form very long tubular structures for the transport of phloem sap from source to sink

E decreases resistance to the flow of phloem sap within each sieve tube element, so the speed of flow is maintained

F provides more space to increase the volume of phloem sap transported per unit time

Complete Table 1.1 by writing the correct letter from **A** to **F** in the last column of each row, so that each structural feature is matched to the correct explanation.

Use each letter only **once**.

The first row has been completed for you.

Table 1.1

structural feature of phloem sieve tube element	explanation
There is no nucleus or large permanent vacuole.	**F**
The end walls are perforated to form sieve plates.	
There is only a thin layer of cytoplasm around the edge of the cell.	
The cell is elongated and arranged end to end with other cells.	
The cell has plasmodesmata connecting to a companion cell.	
There is a thin cellulose cell wall.	

[4]

(b) At the sink, sucrose and other organic compounds are unloaded from the phloem sieve tube element.

Explain why the process of unloading helps the mass flow of phloem sap from the source to the sink.

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..... [3]

[Total: 7]

93. 9700_m20_qp_22 Q: 6

Fig. 6.1 is a transmission electron micrograph of a plant parenchyma cell.

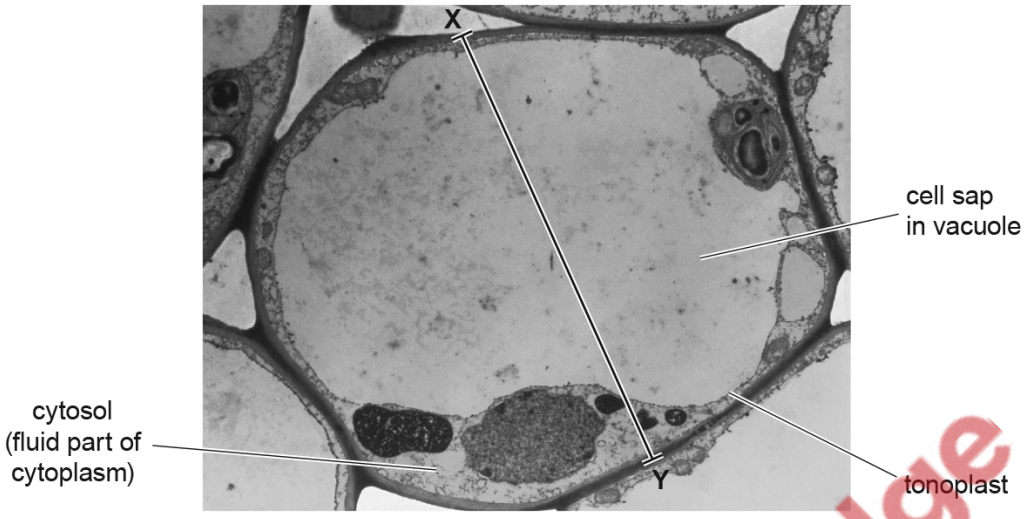

Fig. 6.1

(a) The external environment of the parenchyma cell has a higher water potential than the internal environment of the cell.

One function of parenchyma cells is to provide support to the plant.

With reference to Fig. 6.1, suggest how parenchyma cells provide support to the plant.

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..... [2]

(b) The image shown in Fig. 6.1 is at a higher magnification than can be obtained using a typical light microscope.

(i) Explain what is meant by the term *magnification*.

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..... [1]

(ii) The actual diameter of the parenchyma cell in Fig. 6.1 along the line **X—Y** is 35 μm.

Calculate the magnification of the image.

magnification = × .....
[2]

(c) The cell sap in the vacuole of the cell shown in Fig. 6.1 has a pH of 5.0. The cytosol has a pH of 7.2.

The tonoplast controls the passage of hydrogen ions from the cytosol into the vacuole. The low pH created by the entry of hydrogen ions is optimum for the action of acid hydrolase enzymes in the vacuole. Acid hydrolase enzymes are also found in lysosomes in animal cells.

(i) Suggest which transport mechanism is used to move hydrogen ions from the cytosol of the parenchyma cell into the vacuole.

Explain your choice.

transport mechanism .....

explanation .....

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[3]

(ii) Suggest how the structure of the tonoplast allows hydrogen ions to be transported into the vacuole, but does not allow the ions to leave the vacuole.

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..... [3]

(iii) The acid hydrolases in the vacuole cannot function in neutral conditions (pH 7.0) or alkaline conditions.

Explain the advantage to the plant cell of having acid hydrolases that cannot function in neutral, near neutral or alkaline conditions.

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..... [2]

[Total: 13]

94. 9700_s20_qp_23 Q: 1

Water and mineral ions are transported up the stem of a plant to the leaves within xylem vessels.

Some water and mineral ions can pass out of xylem vessel elements to supply parenchyma tissue in the stem.

(a) Fig. 1.1 is a plan diagram of a section through a stem.

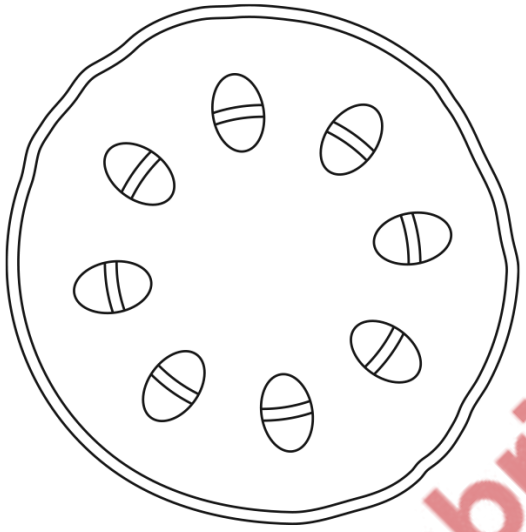

Fig. 1.1

Identify **one** location where xylem tissue occurs in the stem by drawing a label line and the letter **X** on Fig. 1.1. [1]

(b) Explain how hydrogen bonding between water molecules contributes to the movement of water within xylem vessels up the stem to the leaves.

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..... [3]

(c) Fig. 1.2 is a diagram of a photomicrograph showing three adjacent parenchyma cells in the stem. These parenchyma cells can be described as typical plant cells.

The arrows show the direction of movement of water between the cells.

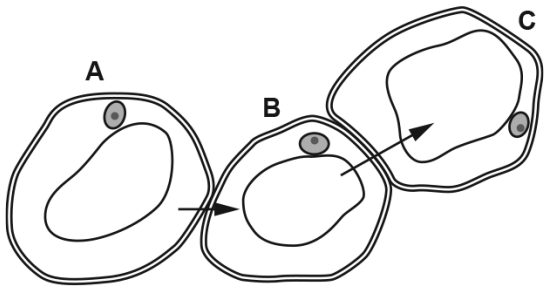

Fig. 1.2

(i) Describe **and** explain the movement of water shown in Fig. 1.2.

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..... [3]

(ii) Only some of the structures visible using the light microscope have been included in Fig. 1.2.

List the features that can be seen using the high power of a light microscope that help identify a parenchyma cell as a plant cell and **not** as an animal cell.

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..... [3]

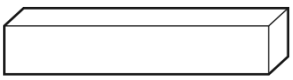
[Total: 10]

95. 9700_s20_qp_23 Q: 6

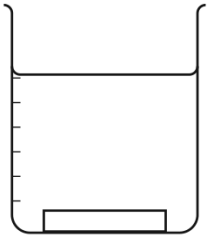
A student carried out an investigation to estimate the water potential of potato tissue. The main steps in the procedure and in the analysis of results are outlined in Fig. 6.1.

beaker	concentration of sucrose solution / mol dm^{-3}
1	0.0
2	0.1
3	0.2
4	0.3
5	0.4
6	0.5

Six different concentrations of sucrose solution were prepared and an equal volume of each was placed in a labelled beaker.



Six equal-sized blocks of potato tissue were cut out of the same potato, blotted dry and weighed.



One potato block was immersed in the solution in each beaker for 30 minutes.

After this time, the block was removed, blotted dry and reweighed.

The experiment was repeated twice.

The mean percentage change in mass of potato tissue was calculated for each concentration of sucrose used.

A graph was drawn of mean percentage change in the mass of potato tissue against concentration of sucrose.

Fig. 6.1

(a) Explain why the different concentrations of sucrose result in different mean percentage changes in mass of potato tissue.

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..... [3]

(b) State how the graph is used to estimate the water potential of the potato tissue.

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..... [1]

[Total: 4]

96. 9700_w20_qp_21 Q: 4

(a) Fig. 4.1 is a scanning electron micrograph of a section of a plant cell wall.

In living plant tissue cytoplasmic strands form part of structure **W**.

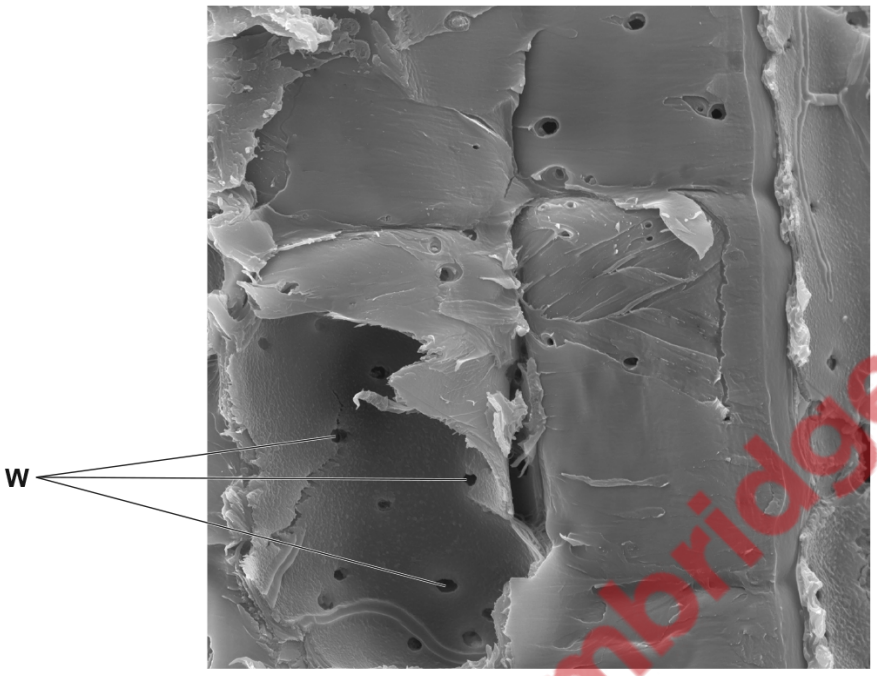

Fig. 4.1

(i) Identify the structures labelled **W** in Fig. 4.1.

..... [1]

(ii) Describe the function of structure **W**.

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..... [2]

(b) Viruses can infect plant cells.

(i) Outline the key structural features of a virus.

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..... [2]

(ii) Many plant viruses can travel through the plant to enter companion cells in the phloem tissue. The viruses then travel with assimilates in the phloem sap to other areas of the plant.

Explain the mechanism that allows assimilates and viruses to travel through phloem sieve tubes to other areas of the plant.

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..... [5]

[Total: 10]

97. 9700_w20_qp_22 Q: 1

Fig. 1.1 is a diagram drawn from a photomicrograph of a transverse section through part of a leaf.

The arrows in Fig. 1.1 show the movement of water through the cells of the leaf after it has left the xylem.

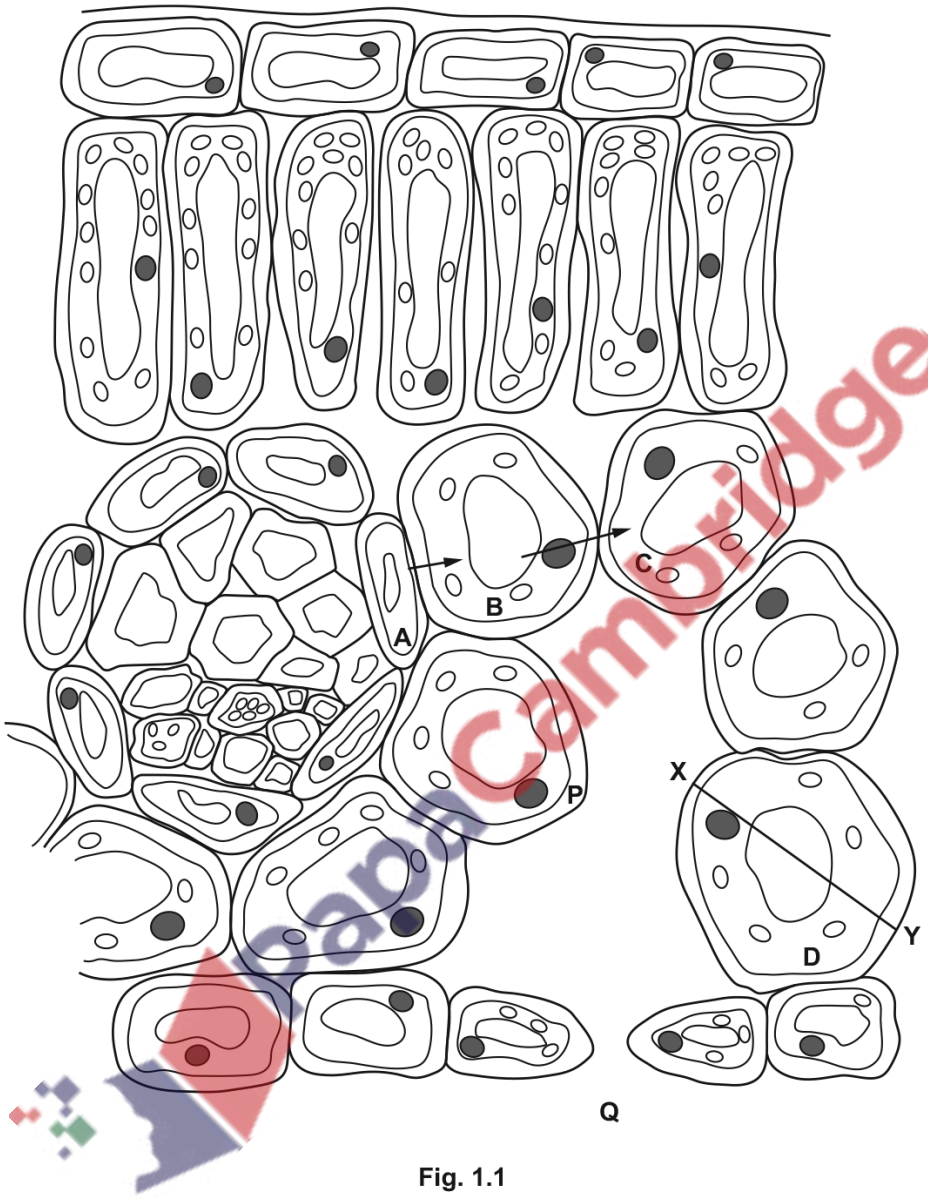

Fig. 1.1

(a) Water from the xylem can enter cell **A** and then moves to cells **B** and **C** without crossing their cell walls.

The cell structures through which water passes from cell **A** to cell **B** are **not** visible in Fig. 1.1.

(i) Name the cell structures through which water passes from cell **A** to cell **B** without crossing their cell walls.

..... [1]

(ii) Explain what causes water to move from cell **B** to cell **C**.

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..... [1]

(iii) Name the pathway taken by water between cell **A** and cell **C**.

..... [1]

(b) Most of the water that arrives at the leaf passes to the external atmosphere.

With reference to Fig. 1.1, describe **and** explain the sequence of events occurring between point **P** and point **Q**.

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..... [4]

(c) The actual diameter of cell **D** in Fig. 1.1 along the length **X**–**Y** is 25 μm.

Calculate the magnification of the image.

Write down the formula used to make your calculation. Show your working.

formula

answer = × ..... [3]

[Total: 10]

98. 9700_w20_qp_23 Q: 2

The veins of a leaf contain transport tissues. Fig. 2.1 is a drawing made from an electron micrograph showing a cross-section of the transport tissue in a leaf vein.

The cells labelled **A** are modified companion cells, known as phloem transfer cells. Transfer cells move sucrose and other assimilates from mesophyll cells, **B**, into the phloem sieve tube element, **C**.

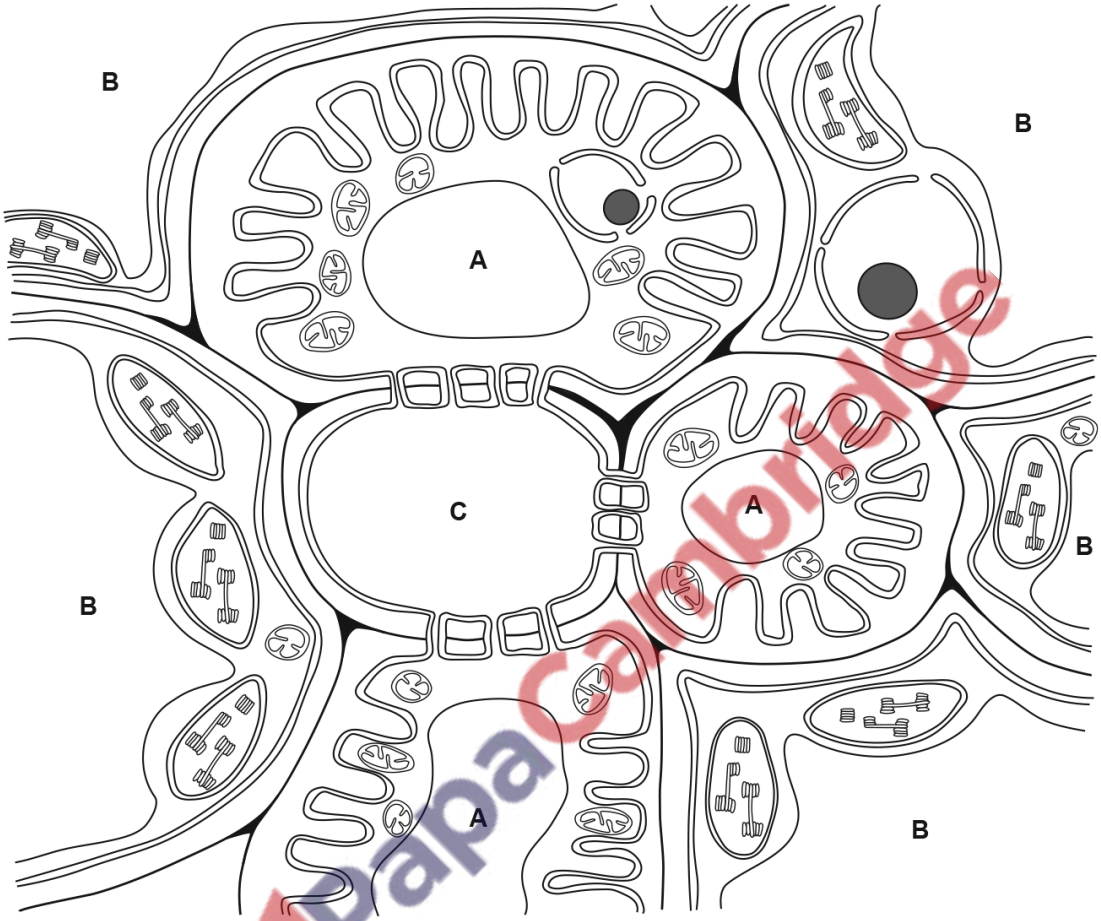

Fig. 2.1

(a) State the functions of the mesophyll cells, **B**, and sieve tube element, **C**, **and** explain how their structure is adapted for their function.

cell **B** – function .....

adaptation .....

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cell **C** – function .....

adaptation .....

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[5]

(b) The cell walls of the transfer cells, **A**, shown in Fig. 2.1, have infoldings.

Explain the advantages of these cell wall infoldings for the movement of sucrose from mesophyll cells to phloem sieve tubes.

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..... [3]

[Total: 8]

99. 9700_m19_qp_22 Q: 1

Fig. 1.1 and Fig. 1.2 are photomicrographs of sections through the leaves of two different plants.

Fig. 1.1 is a photomicrograph of a section through a leaf of Cornish heath, *Erica vagans*.

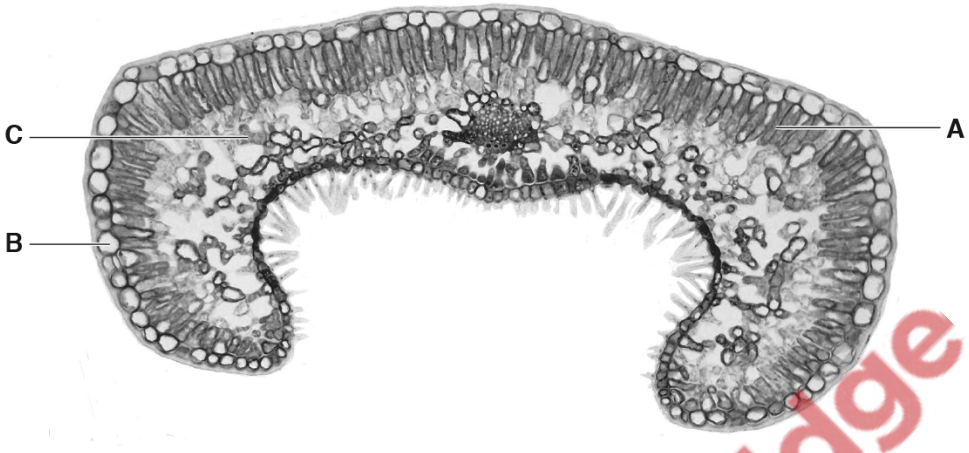

Fig. 1.1

Fig. 1.2 is a photomicrograph of a section through a leaf of Himalayan cedar, *Cedrus deodara*.

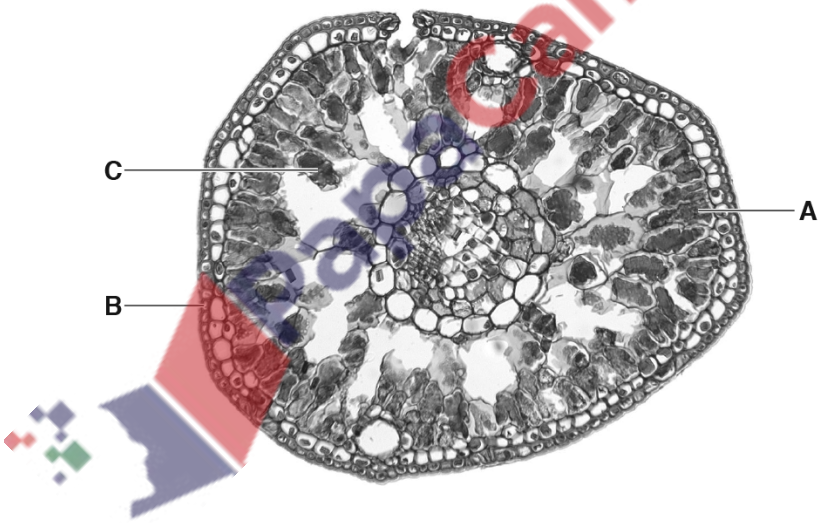

Fig. 1.2

Fig. 1.1 and Fig. 1.2 are not shown at the same magnification.

(a) Cells labelled **A**, **B** and **C** in Fig. 1.1 and Fig. 1.2 each form a different tissue.

Name each tissue formed.

tissue formed from **A** .....

tissue formed from **B** .....

tissue formed from **C** .....

[3]

(b) *Erica vagans* and *Cedrus deodara* are xerophytic plants.

With reference only to xerophytic features, describe the **differences** between the leaves of *E. vagans* and *C. deodara* **visible** in Fig. 1.1 and Fig. 1.2.

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..... [3]

(c) Transpiration is a consequence of gas exchange in leaves.

Explain why the rate of transpiration is greater during the day than during the night.

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..... [3]

[Total: 9]

100. 9700_s19_qp_21 Q: 4

Meristematic tissue is found in the growing regions of plants, such as shoot tips. Meristematic cells have a similar role to stem cells in animals.

Fig. 4.1 shows some of the stages in the formation of a mature phloem sieve tube element and companion cells from a meristematic cell.

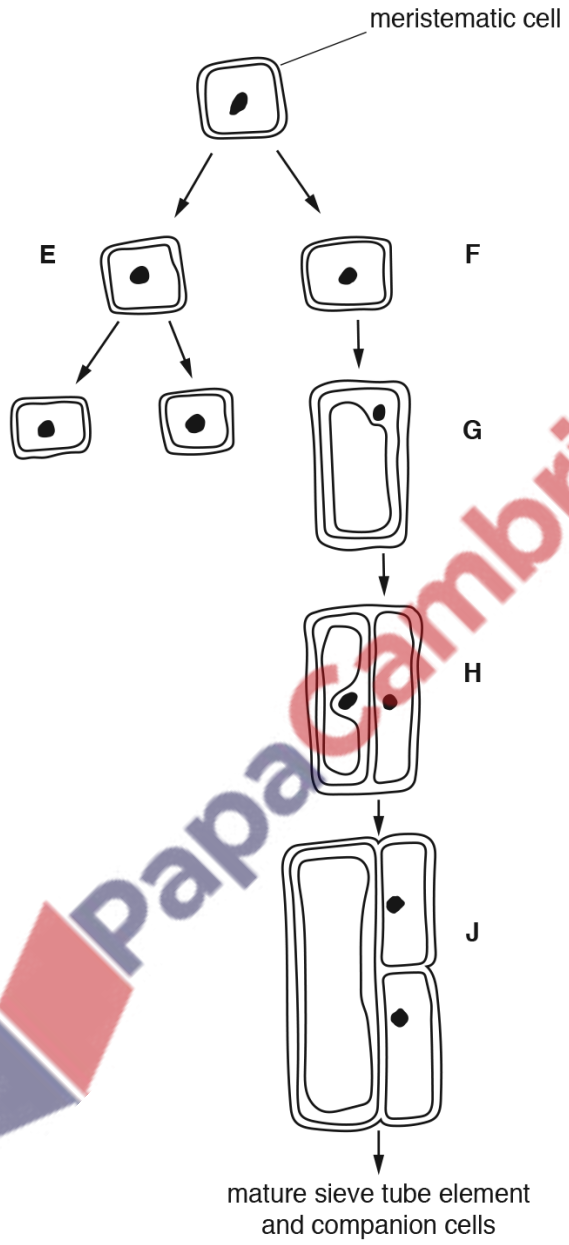

Fig. 4.1

(a) Cells **E** and **F** in Fig. 4.1 are daughter cells produced when the meristematic cell divides in the shoot tip.

Explain why it is important that one of the daughter cells (cell **E**) is a meristematic cell.

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..... [1]

(b) Complete Table 4.1 to describe the changes that are shown in Fig. 4.1 between stages:

- **F** and **G**
- **G** and **H**
- **H** and **J**.

Table 4.1

stages	description
F and **G**	
G and **H**	
H and **J**	

[3]

(c) Explain how the structure of a mature sieve tube element is related to its function.

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..... [4]

(d) Describe the functions of companion cells in transport in the phloem.

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..... [2]

[Total: 10]

101. 9700_s19_qp_22 Q: 1

Fig. 1.1 is a photomicrograph of a low power image of part of the common sunflower, *Helianthus annuus*. Fig. 1.1 is a transverse section.

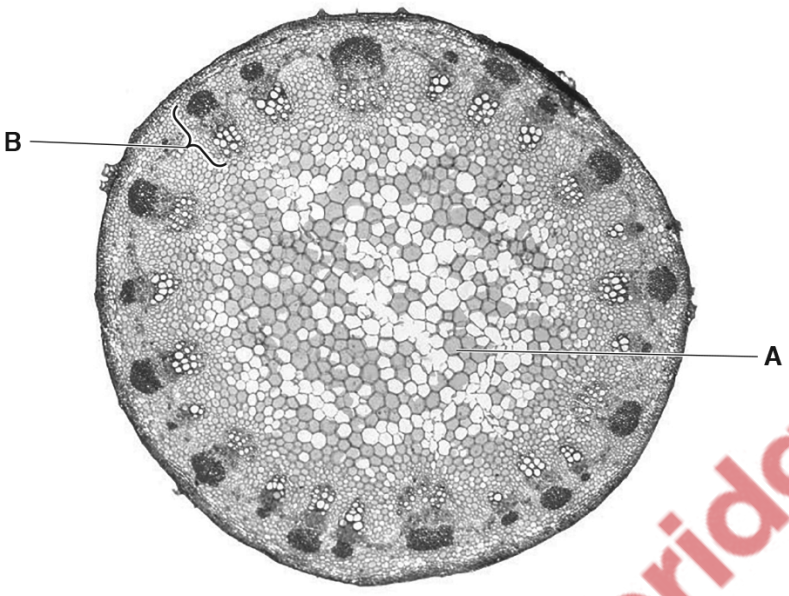

Fig. 1.1

(a) State, **with a reason**, whether Fig. 1.1 shows a section through the root or the stem of *H. annuus*.

.....

.....

..... [1]

(b) Cell type **A** in Fig. 1.1 has a large central vacuole.

Suggest, with reasons, the role of the tissue formed by this type of cell.

.....

.....

.....

..... [2]

(c) Structure **B** in Fig. 1.1 contains phloem tissue and xylem tissue and other tissues that provide support.

(i) Name structure **B**.

..... [1]

(ii) The actual length of structure **B** is 650 μm.

State the actual length of structure **B** in mm.

..... [1]

(d) When structure **B** is observed at a higher magnification, more detail of xylem vessel elements and phloem sieve tube elements can be seen.

Outline the differences in the structure of a xylem vessel element and a phloem sieve tube element.

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.....

.....

..... [3]

[Total: 8]

102. 9700_s19_qp_23 Q: 4

Phloem sieve tube elements and xylem vessel elements are cells that are involved with the transport of substances in plants.

(a) Describe **two** differences between the structure of a phloem sieve tube element and a xylem vessel element.

.....

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.....

..... [2]

(b) Sucrose is transported in phloem sieve tubes.

A student carried out a test to identify the presence of sucrose in a sample of sap taken from inside a phloem sieve tube. One of the steps in the procedure instructed the student to heat the phloem sap with hydrochloric acid.

Explain why it is necessary to carry out this step in the procedure.

.....

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.....

..... [2]

(c) The process of loading sucrose into a phloem sieve tube element involves a companion cell.

(i) Fig. 4.1 shows a stage in the process of loading sucrose into the phloem.

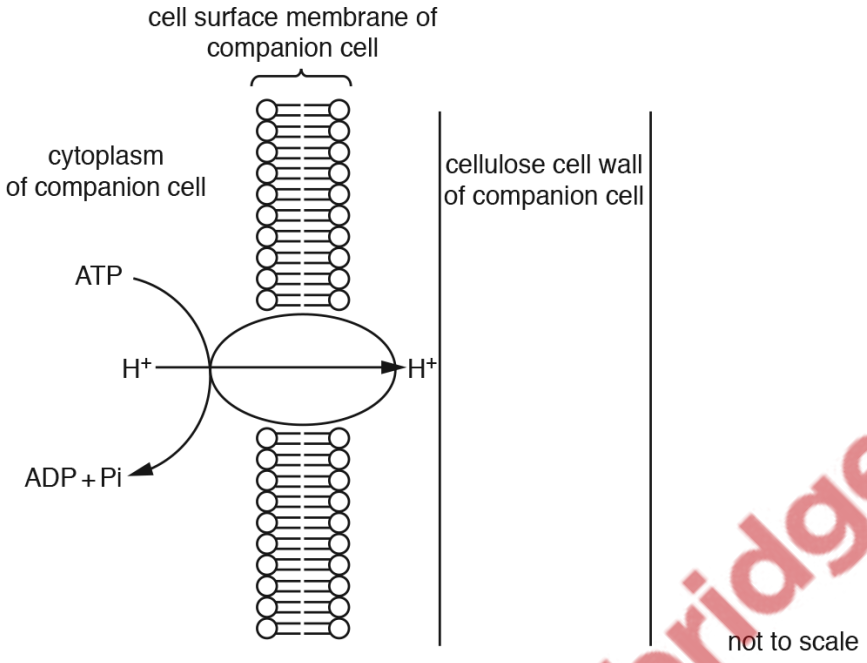

Fig. 4.1

Companion cells contain large numbers of mitochondria and ribosomes.

Explain the roles of mitochondria and ribosomes for the stage shown in Fig. 4.1.

.....

.....

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.....

..... [2]

(ii) Describe **and** explain how sucrose is transported from the cell wall of the companion cell into the cytoplasm.

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.....

.....

..... [3]

[Total: 9]

103. 9700_w19_qp_21 Q: 1

Fig. 1.1 shows the structure of the amino acid glycine.

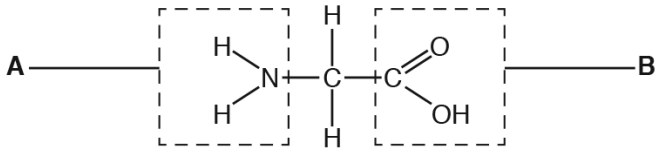


Fig. 1.1

(a) (i) Name the parts of the amino acid molecule labelled **A** and **B** in Fig. 1.1.

A .....

B .....

[2]

(ii) Amino acids are monomers used to build proteins.

Complete Fig. 1.2 by drawing a diagram to show the formation of a peptide bond between two molecules of glycine.

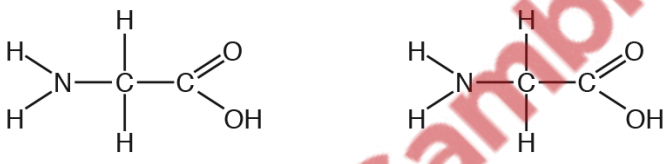
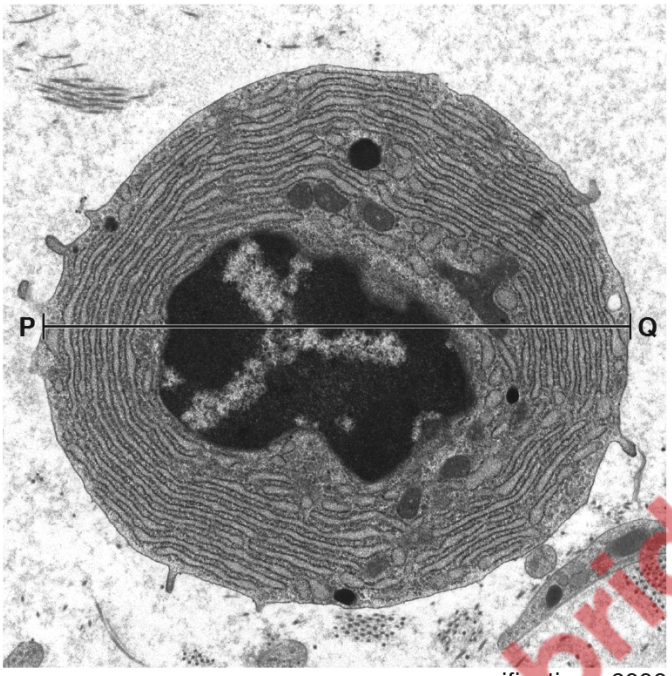


Fig. 1.2 [3]

(b) Plasma cells synthesise and secrete antibodies.

Fig. 1.3 is a transmission electron micrograph showing a plasma cell.



magnification ×6000

Fig. 1.3

(i) Use a label line and the label **T** on Fig. 1.3 to identify where the genes coding for the polypeptide chains of the antibodies are located. [1]

(ii) Calculate the actual diameter of the plasma cell shown by the line **P**–**Q**.

Write down the formula used to make your calculation.

Show your working and give your answer to the nearest micrometre (μm).

formula

actual diameter = ...μm [2]

(iii) The plasma cell in Fig. 1.3 is very metabolically active.

Suggest why there are very few mitochondria visible in the electron micrograph in Fig. 1.3.

.....

.....

..... [1]

(c) Sieve tube elements in plants have very few organelles such as mitochondria.

Explain how having very few organelles is an adaptation of the sieve tube element to its function.

.....

.....

.....

.....

..... [2]

[Total: 11]

104. 9700_w19_qp_21 Q: 3

A student carried out an experiment to investigate the effect of increasing the concentration of sucrose solution on the mass of potato tissue.

- Potato tissue was cut into cylinders of equal length and diameter.
- The mass of each cylinder was recorded.
- Each cylinder was put into a solution of sucrose, as shown in Fig. 3.1.

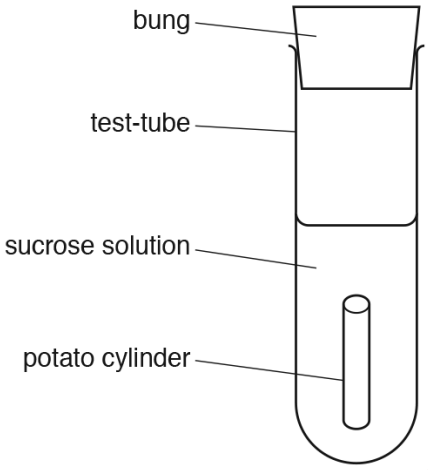


Fig. 3.1

- After one hour each cylinder was removed, blotted dry and reweighed.
- The percentage change in mass of each cylinder was calculated.
- The experiment was repeated three times.
- The mean percentage change in mass of the potato cylinders in each sucrose solution was calculated.

Fig. 3.2 shows the results of this investigation.

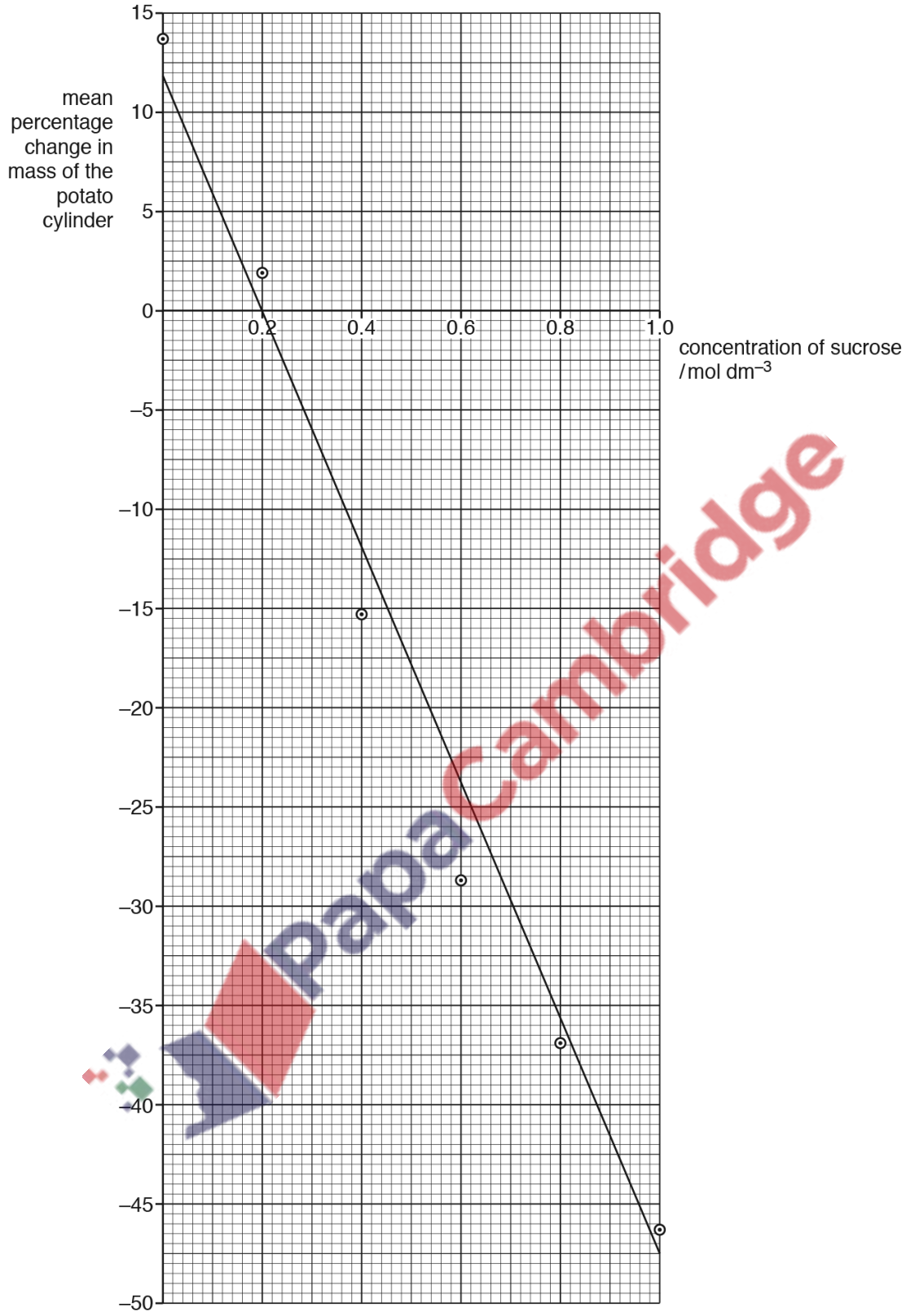


Fig. 3.2

(a) With reference to Fig. 3.2, describe the effect of increasing the concentration of sucrose solution on the mass of the potato cylinders.

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..... [3]

(b) Explain why there was a change in mass for the potato cylinders in 0.6 mol dm^{-3} sucrose solution.

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.....

..... [3]

[Total: 6]

105. 9700_w19_qp_22 Q: 1

Fig. 1.1 is a photomicrograph of a transverse section through the stem of creeping buttercup, *Ranunculus repens*.

Fig. 1.1

(a) Draw **one** label line on Fig. 1.1 to indicate **one** precise location where phloem sieve tubes occur. [1]

(b) State the role of phloem sieve tubes.

.....

.....

.....

.....

..... [2]

(c) A good quality plan diagram of Fig. 1.1 will show only the tissues in the stem in their correct location and in the correct proportions.

(i) State the name of the tissue that forms the outer layer of the stem section of *R. repens* in Fig. 1.1.

..... [1]

(ii) State the piece of equipment that can be used in the light microscope to work out the correct proportions of the tissues.

..... [1]

(d) Draw a diagram in the space provided to show the structure of a typical plant cell.

Label your diagram with the name of any structures that are found **only** in plant cells.

Do **not** label any structures that are also found in animal cells.

[5]

[Total: 10]

106. 9700_w19_qp_23 Q: 3

(a) The tomato plant, *Solanum lycopersicum*, does not tolerate periods of drought (water shortage). Researchers have produced a tomato plant that has an improved tolerance of drought.

The researchers measured the width and the length of open stomata in plants that are tolerant of drought and tomato plants that are not tolerant.

Fig. 3.1 is the formula used to calculate the size of an open stoma (stomatal aperture).

$$\text{stomatal aperture} = \frac{\text{width of open stoma}}{\text{length of open stoma}}$$

Fig. 3.1

Fig. 3.2 shows the mean stomatal aperture of the two groups of tomato plants.

Fig. 3.3 shows the rates of transpiration of the two groups of tomato plants when kept in identical conditions of drought.

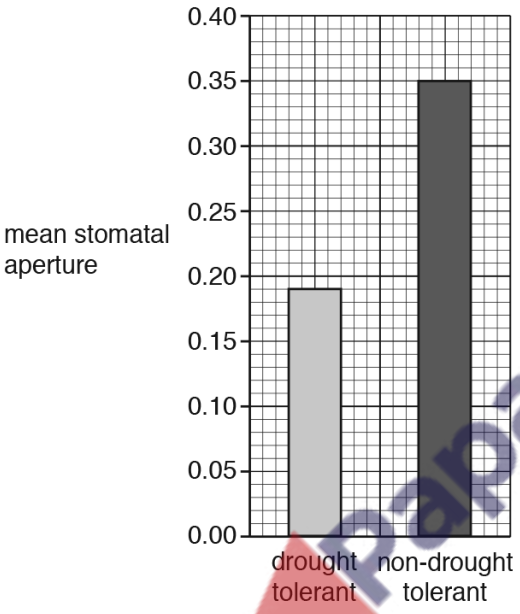

Fig. 3.2

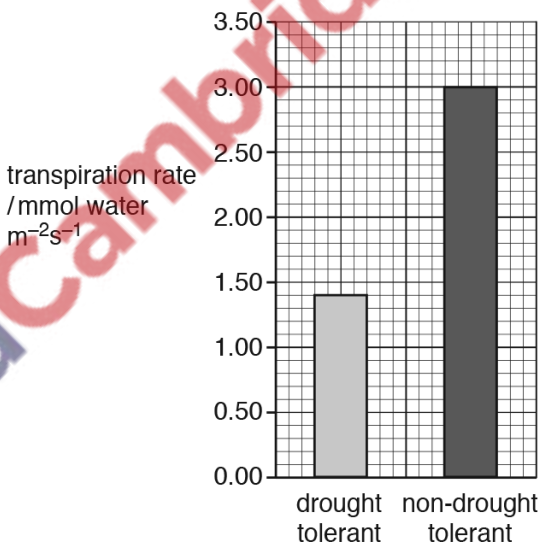

Fig. 3.3

The water uptake of leafy shoots taken from the two groups of tomato plants was measured using potometers. The leafy shoots were of similar mass and had the same number of leaves. The results are shown in Fig. 3.4.

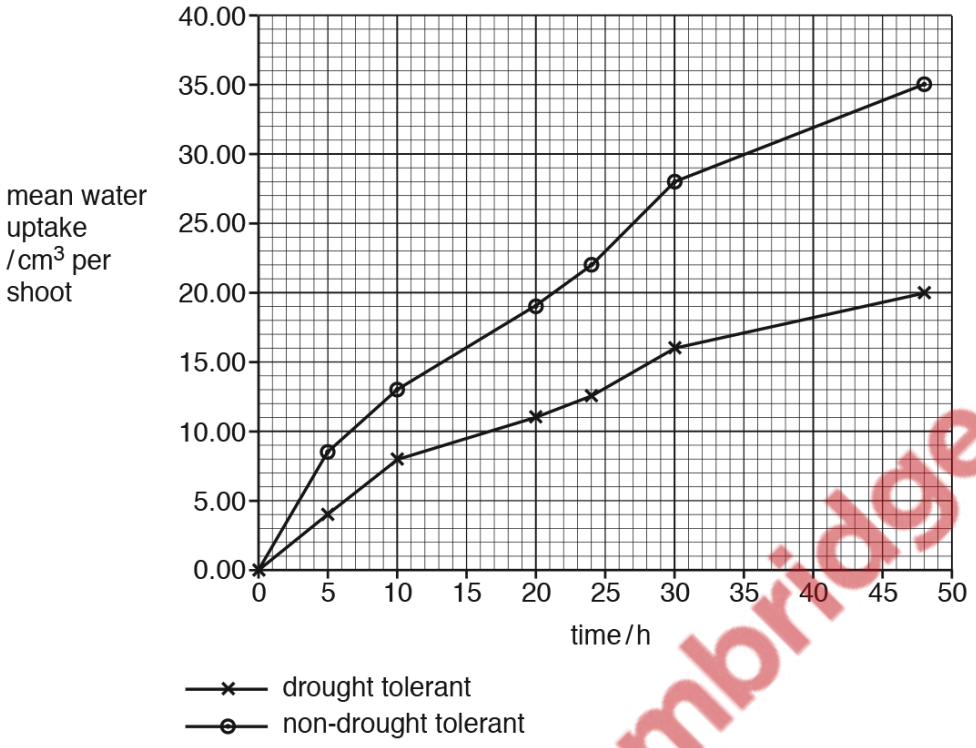

Fig. 3.4

With reference to Fig. 3.2, Fig. 3.3 **and** Fig. 3.4, describe **and** explain the differences between the plants that are drought tolerant and the plants that are non-drought tolerant.

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..... [5]

(b) The nuclei of plants produce small lengths of RNA known as microRNAs.

MicroRNAs in guard cells have been shown to prevent the synthesis of some proteins.

The guard cells of the drought-tolerant tomato plants produced more microRNA molecules than the guard cells of the non-tolerant plants.

MicroRNA molecules do **not** prevent transcription but interact with messenger RNA (mRNA).

Suggest how this microRNA can interact with mRNA to prevent the production of proteins in guard cells of *S. lycopersicum*.

.....

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.....

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..... [3]

[Total: 8]

107. 9700_s18_qp_21 Q: 6

Water absorbed by plant roots travels by different pathways from root hairs to the xylem.

Fig. 6.1 shows these pathways in the root of *Ranunculus acris*.

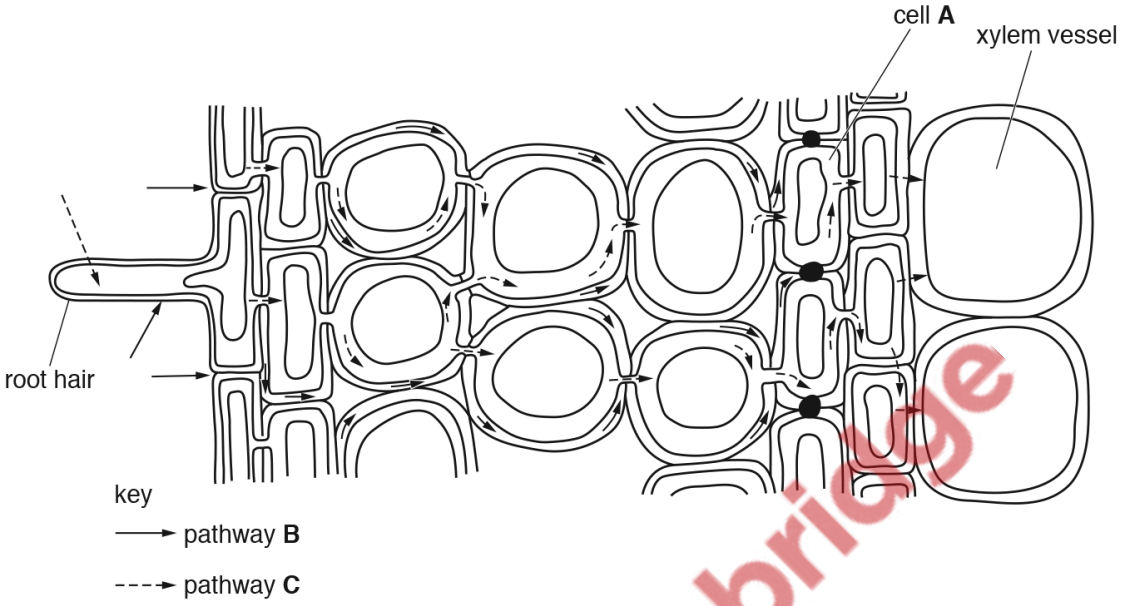

Fig. 6.1

(a) Name cell **A** and pathway **B** as shown in Fig. 6.1.

cell **A** .....

pathway **B** .....

[2]

(b) Transpiration occurring at the leaves is mainly responsible for movement of water across the root of *R. acris*.

Explain how transpiration is responsible for the movement of water across the root as shown in Fig. 6.1.

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.....[5]

(c) Explain why the movement of water in pathway **C** is slower than in pathway **B**.

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.....[2]

(d) Ions are taken up by root hair cells using active transport and facilitated diffusion.

Describe **two** ways in which facilitated diffusion differs from active transport.

1 .....

.....

.....

2 .....

.....

.....

[2]

[Total: 11]

108. 9700_s18_qp_22 Q: 1

Fig. 1.1 is a drawing of a photomicrograph of a spongy mesophyll cell from a leaf.

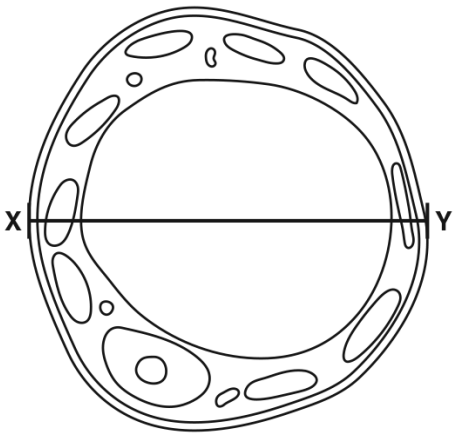

Fig. 1.1

(a) On Fig. 1.1, add a label line and the correct letter for each of the three cell structures listed.

- nucleolus = **N**
- tonoplast = **T**
- chloroplast = **C**

[3]

(b) The drawing in Fig. 1.1 is 2000 times larger than the actual size of the cell.

Describe the steps you would follow to determine the actual diameter of the cell in micrometres (μm), at **X**—**Y**.

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.....[2]

(c) The drawing in Fig. 1.1 was made using the high power objective lens of a light microscope. Some of the structures in Fig. 1.1 confirm that the cell is eukaryotic.

An electron micrograph of the same cell would reveal **additional** cell structures that are found in eukaryotes and not in prokaryotes.

List two examples of these additional cell structures.

1 .....

2 .....

[2]

(d) Some of the water that moves out of the xylem within the leaves takes an apoplastic pathway to the spongy mesophyll cells. There is a film of water on the external surfaces of these cells. This allows the intercellular air spaces to become saturated with water vapour.

(i) State, in terms of water movement from the xylem to the spongy mesophyll cells in the leaf, what is meant by the *apoplastic pathway*.

.....

.....

.....

.....

.....[2]

(ii) Outline the properties of water that contribute to the apoplastic movement of water to the spongy mesophyll cells **and** to the movement of water into the intercellular air spaces.

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.....

.....[4]

(iii) Describe what happens to the water vapour in the intercellular air spaces during the day **and** explain why this happens.

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.....

.....

.....

.....[2]

[Total: 15]

109. 9700_s17_qp_21 Q: 5

Sugar molecules enter cells through transport proteins.

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

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.....[2]

Some plant cells convert fructose and glucose into sucrose for transport from sources to sinks. Sucrose is moved into phloem sieve tubes as shown in Fig. 5.1.

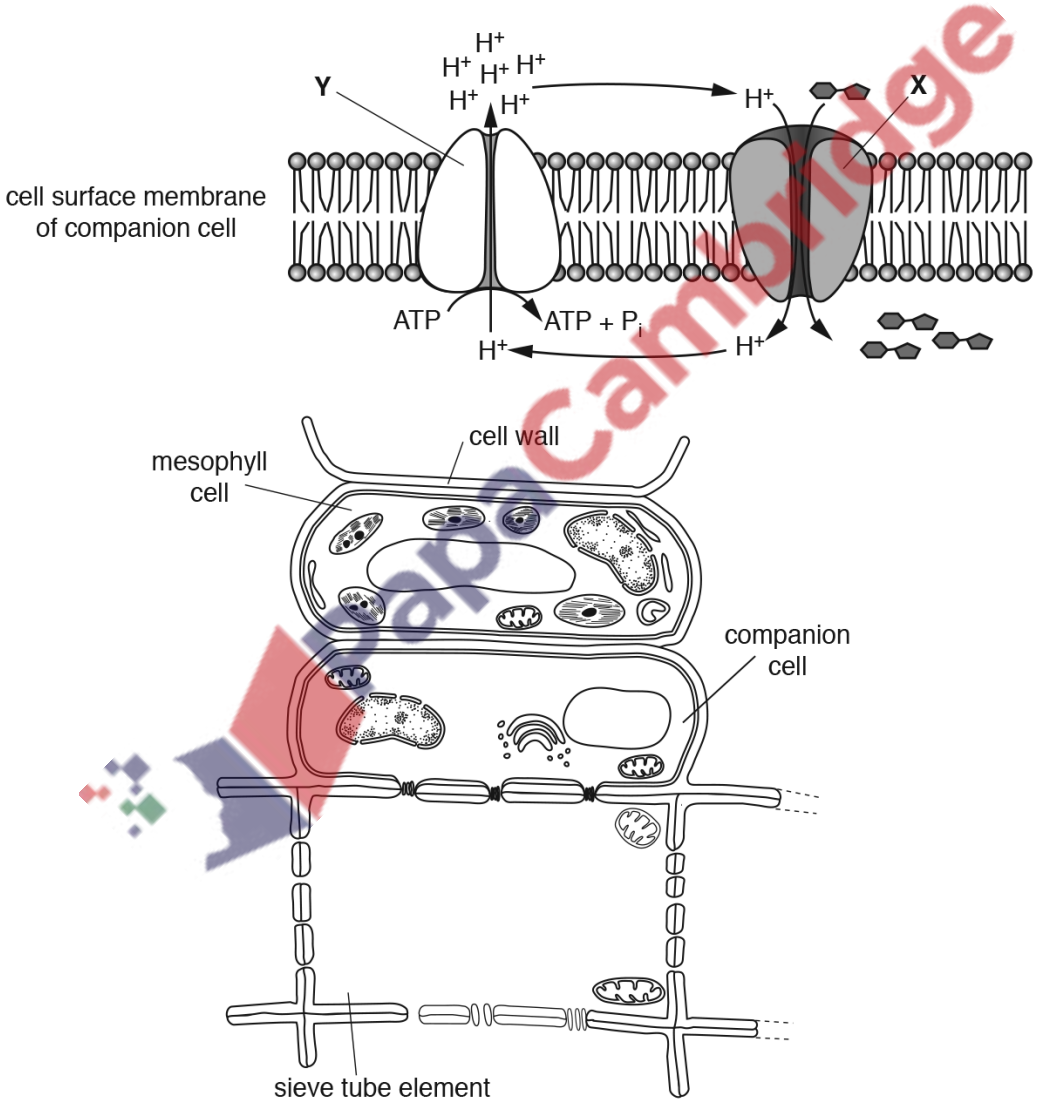

Fig. 5.1 not to scale

(b) Use the information in Fig. 5.1 to explain how sucrose:

- moves into the companion cell
- moves from the companion cell into the sieve tube element.

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.....[5]

(c) Sucrose travels in phloem sieve tubes to sinks.

State two examples of sinks.

1 .....

2 .....[1]

[Total: 8]

110. 9700_s17_qp_22 Q: 4

Meristematic tissue is found in the growing regions of plants, such as root tips.

(a) Fig. 4.1 summarises a cell cycle for a meristematic cell in the root tip. The two phases of this cell cycle are shown:

- interphase, which is divided into the G_1, S and G_2 stages
- cell division, which is divided into stages 1–5.

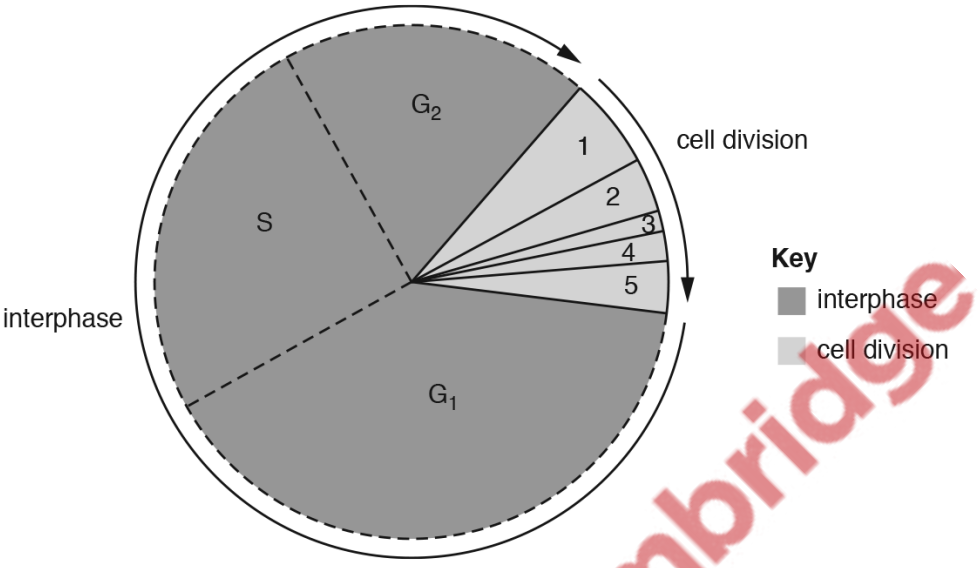

Fig. 4.1

(i) In Fig. 4.1, stage 2 is metaphase.

The stages shown in Fig. 4.1 are listed below. Draw a circle around the stage in the cell cycle that is cytokinesis **and** describe what happens in this stage in the root tip meristematic cell.

1 2 3 4 5 G_1 S G_2

.....

.....

.....

.....

.....

.....

.....[3]

(ii) The stages shown in Fig. 4.1 are listed below. Draw a circle around the stage in the cell cycle in which the semi-conservative replication of DNA occurs **and** state what is meant by semi-conservative replication.

1 2 3 4 5 G_1 S G_2

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.....[3]

(b) Meristematic cells have a similar role to stem cells found in animals.

Suggest the role of a meristematic cell **and** explain the features that help it to carry out its role.

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.....[3]

(c) Meristematic regions in the plant can sometimes be described as strong sinks.

(i) State what is meant by a *sink*.

.....

.....

.....[1]

(ii) Suggest what is meant by a **strong** sink.

.....

.....

.....[1]

(d) Describe **and** explain how sucrose is loaded into phloem sieve tubes.

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.....[4]

[Total: 15]

111. 9700_s17_qp_23 Q: 6

(a) In the space below, draw a diagram to show a hydrogen bond between two water molecules.

[3]

(b) **(i)** Movement of water in xylem depends on the force of attraction between water molecules as a result of hydrogen bonding.

State the name given to this force of attraction.

.....[1]

(ii) State the property of water that results in a cooling effect as water evaporates from the surface of organisms.

.....

.....[1]

[Total: 5]

112. 9700_w17_qp_21 Q: 6

Plants have two transport tissues, xylem and phloem.

(a) Describe **and** explain **two** ways in which the structure of xylem vessels is adapted to their function.

description 1 .....

.....

explanation 1 .....

.....

.....

description 2 .....

.....

explanation 2 .....

.....

.....[2]

(b) Describe **two** differences between the vessels that transport phloem sap in flowering plants and the vessels that transport blood in mammals.

.....

.....

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.....

.....

.....[2]

Fig. 6.1 shows root hair cells.

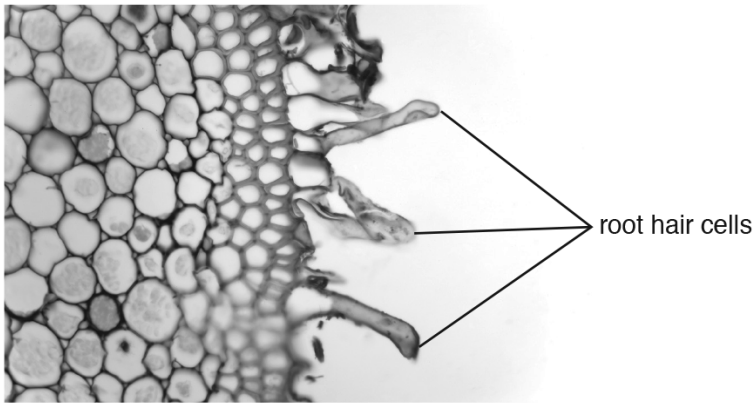

Fig. 6.1

(c) Explain why the root hair cells in Fig. 6.1 have more mitochondria than the other root cells shown.

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.....[3]

[Total: 7]

113. 9700_w17_qp_22 Q: 5

(a) Descriptions **A**, **B** and **C** relate to the movement of water from the soil to the xylem in roots.

State the correct term to match each of the descriptions **A**, **B** and **C**.

A The specialised root epidermal cell that provides a large surface area for the uptake of water from the soil.

.....

B The band of suberin in the cell walls of the endodermis that prevents the movement of water by the apoplastic pathway.

.....

C The cell structures that allow water to pass from one cell to the next as part of the symplastic pathway.

.....

[3]

(b) Explain, with reference to the structure of xylem vessel elements, why water does **not** take a symplastic pathway in the xylem to the leaves.

.....

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.....[2]

(c) Explain why the rate of movement of water in the xylem may slow down at night.

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.....

.....[3]

[Total: 8]

114. 9700_w17_qp_23 Q: 5

The tree species *Caryocar brasiliense* grows in areas where there is very little rainfall for five months of the year. During this long dry season the trees have mechanisms to reduce the rate of transpiration.

An investigation was carried out on *C. brasiliense* to find out how the rate of transpiration and the mean water potential of leaf cells changed over 12 hours in one day during the dry season.

The results are shown in Fig. 5.1 **A** and **B**.

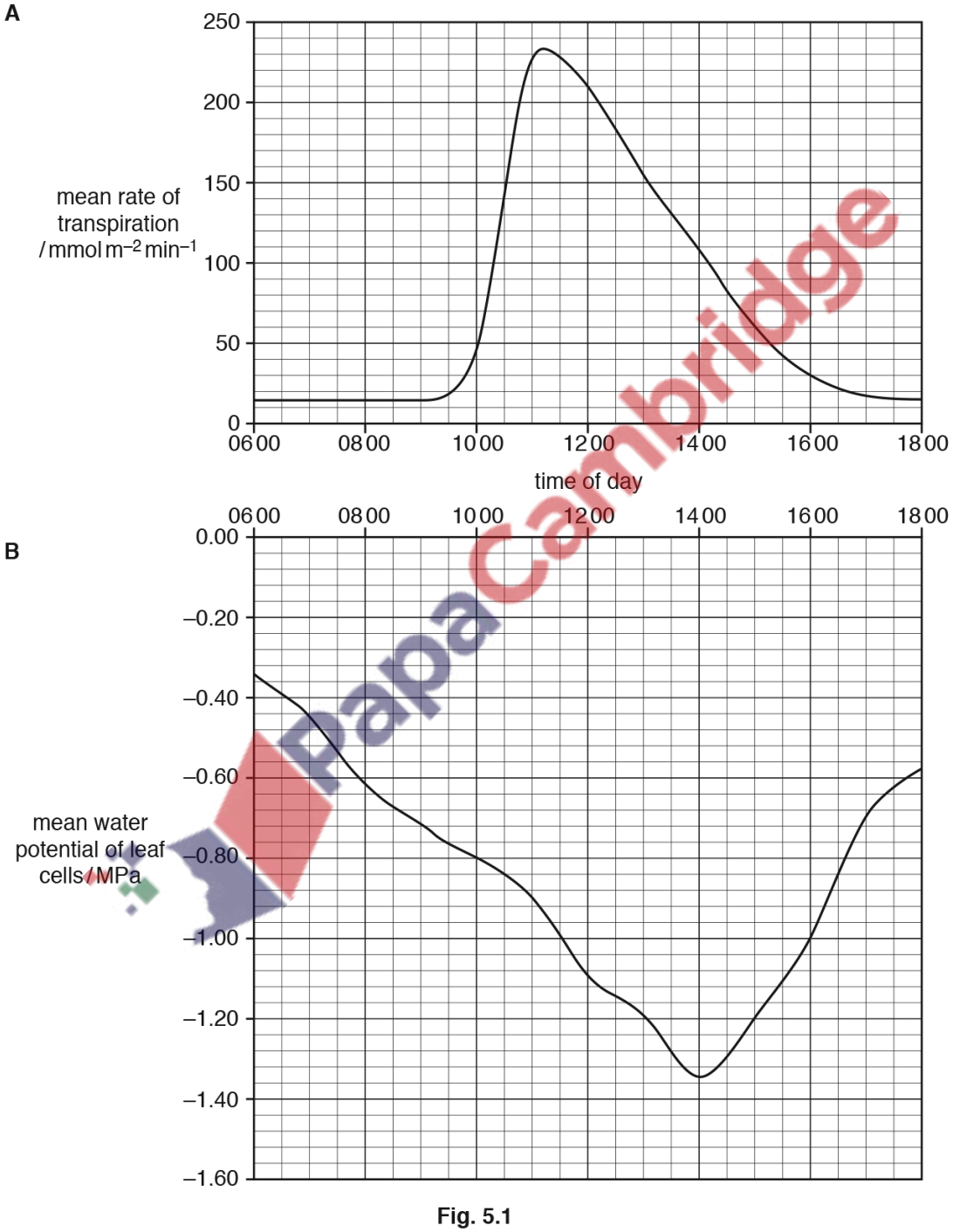

Fig. 5.1

(a) Define the term *transpiration*.

.....

.....

.....

.....[2]

(b) With reference to Fig. 5.1**A** and **B**, describe the changes recorded in the mean water potential of leaf cells over the 12 hour period. Suggest explanations for these changes.

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.....[4]

(c) The tree *C. brasiliense* is able to survive through long dry periods.

Many plant species that live in areas with little rainfall have features that reduce transpiration rates. Some adaptations reduce the water potential gradient for water vapour between the air spaces inside the leaves and the surrounding air.

Outline how leaves are adapted to reduce transpiration rates in this way.

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.....[3]

[Total: 9]

115. 9700_s16_qp_21 Q: 4

(a) Transpiration is often described as 'an inevitable consequence of gas exchange in leaves'.

Explain what is meant by this description.

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.....[3]

(b) Explain how hydrogen bonding is involved in the movement of water in the xylem.

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.....[3]

Southern beech trees of the genus *Nothofagus* grow in forests in the South Island of New Zealand. Fig. 4.1 shows a small part of a forest.

Most of the trees in the forests form a thick canopy of leaves. These are known as canopy trees. The tallest trees are known as emergent trees. Some trees do not reach the canopy and are known as suppressed trees.

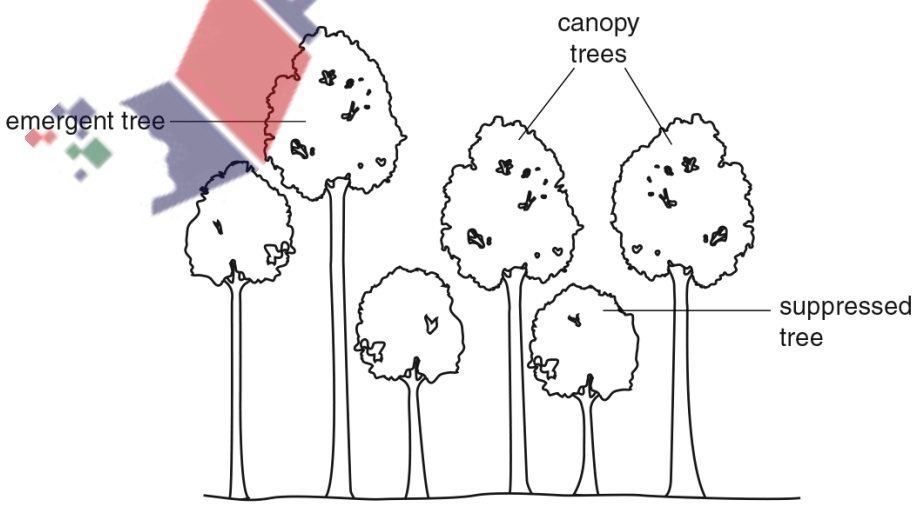

Fig. 4.1

Researchers determined the rates of transpiration of emergent, canopy and suppressed trees in a forest over a 14 hour period from 06.00 until 20.00 on one day in the summer. The results are shown in Fig. 4.2A. They also recorded changes in light intensity above the canopy over the same time period as shown in Fig. 4.2B.

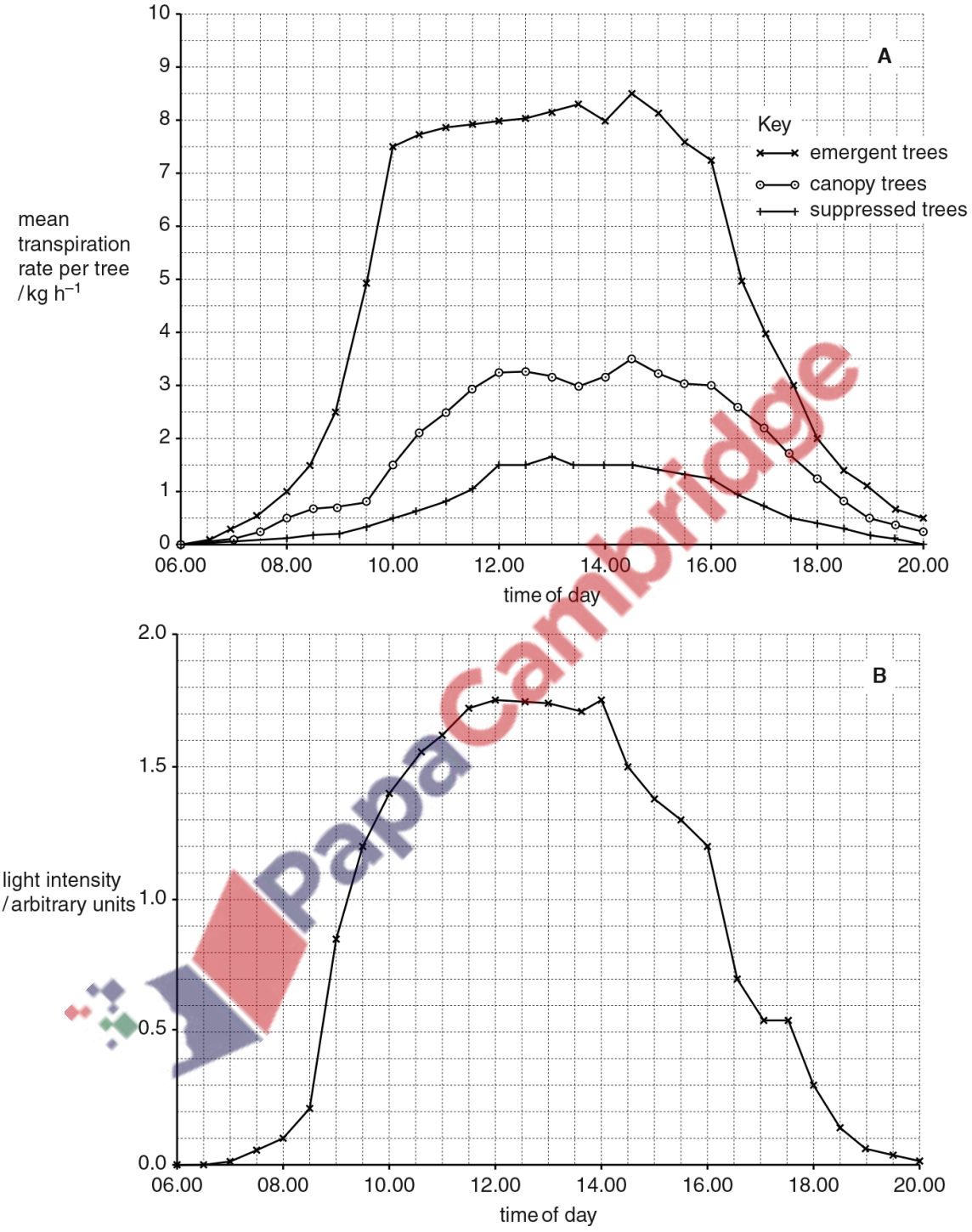

Fig. 4.2

(c) Use Fig. 4.2A to compare the transpiration rates of the emergent, canopy and suppressed trees in the forest over 14 hours.

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.....[4]

(d) The factors that affect transpiration rate vary considerably at different places inside forests.

Use the information in Fig. 4.1 and Fig. 4.2 to suggest reasons for the difference in the transpiration rates of the emergent and suppressed trees.

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.....[4]

[Total: 14]

116. 9700_s16_qp_22 Q: 2

Marram grass, *Ammophila arenaria*, is an important plant of sand dunes. Leaves of marram grass are well adapted to reduce water loss by transpiration.

Fig. 2.1 is a photomicrograph of a section though the leaf of marram grass.

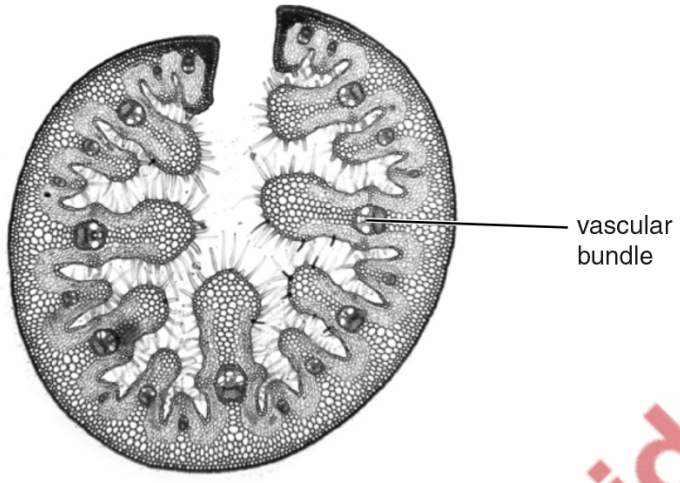

Fig. 2.1

(a) Examples of adaptations to reduce water loss by transpiration include a thick cuticle and no stomata on the outer surface, and stomata in pits on the inner surface.

(i) State **one** other adaptation, visible in Fig. 2.1, which reduces water loss by transpiration.

.....[1]

(ii) Explain how this adaptation reduces water loss.

.....

.....

.....

.....

.....

.....[2]

(b) State the term used to describe a plant type that has adaptations to reduce water loss by transpiration.

.....[1]

[Total: 4]

117. 9700_s16_qp_23 Q: 4

Fig. 4.1 is an electron micrograph showing a section through the stem of Asian rice, *Oryza sativa*.

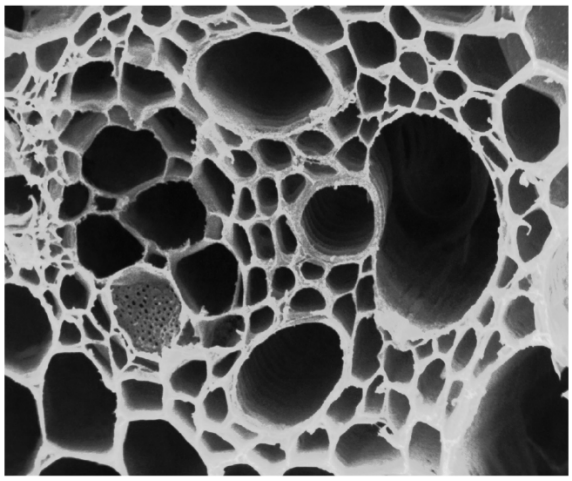

Fig. 4.1

(a) Draw a label line and label on Fig. 4.1 to show a phloem sieve tube. [1]

(b) Describe the function of phloem sieve tubes.

.....

.....

.....[2]

(c) In the root tip, some of the cells produced by mitosis differentiate into xylem vessel elements. During this differentiation, the structure of the cell wall changes.

Explain how the structure of the walls of xylem vessel elements are adapted to their functions.

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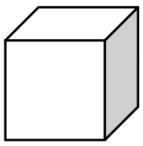
.....

.....[3]

(d) Organisms can be modelled as simple shapes for the calculation of surface area to volume ratios.

(i) Calculate the surface area to volume ratio of an animal modelled as a cube of side length 0.1 m.

Show your working.



surface area ..... m^2

volume ..... m^3

surface area to volume ratio .....
[3]

(ii) The surface area to volume ratio decreases as animals increase in size.

Use this fact to suggest why multicellular animals require transport systems.

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.....

.....[2]

[Total: 11]

118. 9700_w16_qp_21 Q: 2

(a) (i) Define *transpiration*.

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.....[1]

(ii) State **two** environmental factors that affect the rate of transpiration.

Explain how each factor affects the rate of transpiration.

factor 1 .....

explanation.....

.....

.....

factor 2 .....

explanation.....

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.....[4]

(b) Explain how hydrogen bonding is involved in the movement of water through the xylem.

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.....[3]

[Total: 8]

119. 9700_w16_qp_22 Q: 2

Phloem sap containing sucrose is transported in phloem sieve tubes from the source to the sink.

(a) A student carried out an experiment using Visking tubing to investigate osmosis. The student prepared a sucrose solution to represent phloem sap at the source. This was put into Visking tubing that was tied at one end, so that the tubing was approximately 75% full.

The rest of the procedure is summarised in Fig. 2.1. The tubing was removed after 20 minutes, dried and re-weighed.

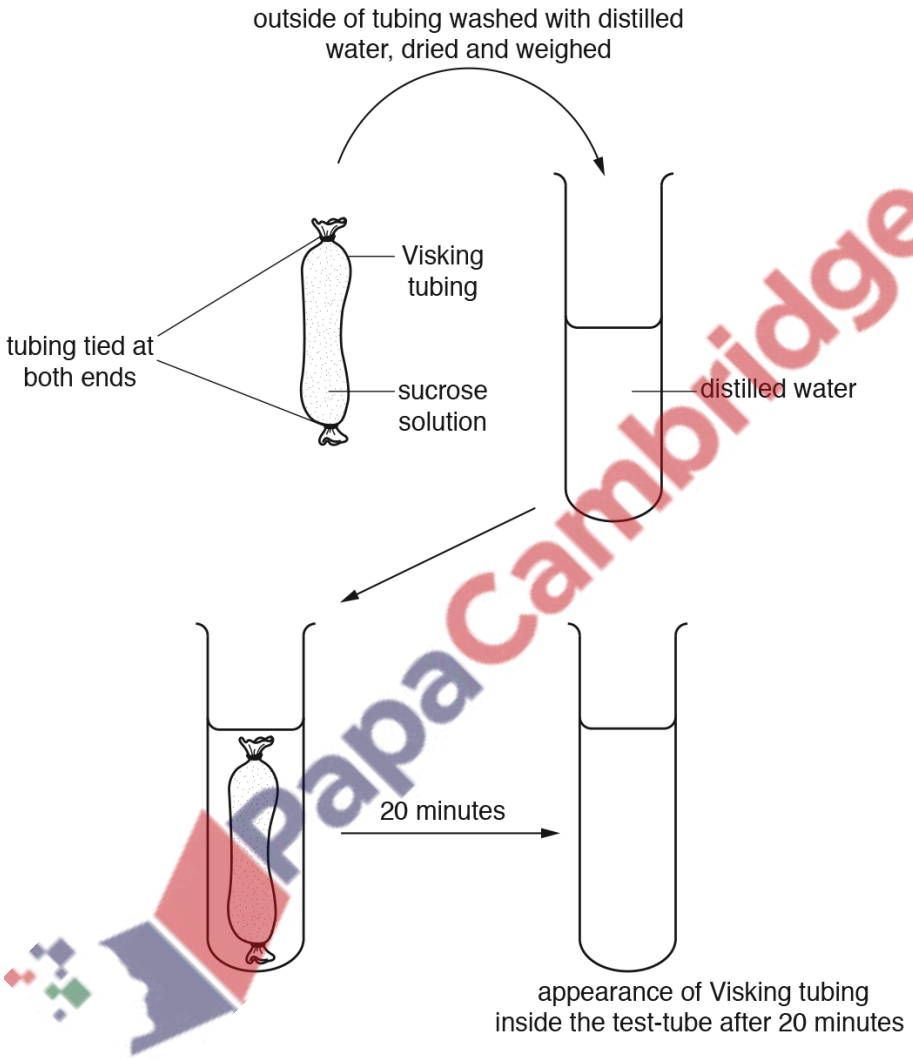

Fig. 2.1

(i) Complete Fig. 2.1 to show the appearance of the Visking tubing inside the test-tube after 20 minutes. [1]

(ii) State, **with reasons**, whether there would be a change in the mass of the Visking tubing containing the sucrose solution after 20 minutes.

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.....[3]

(b) Explain how osmosis is involved in the mass flow of phloem sap.

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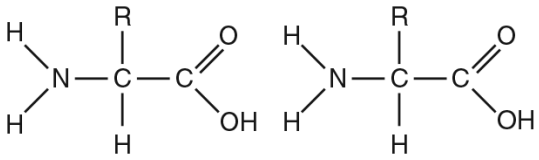
.....[3]

(c) Amino acids synthesised in the mesophyll cells of leaves are also transported in phloem sap to other locations where they are used to synthesise polypeptides.

Amino acids are joined by peptide bonds to form the polypeptides.

Two amino acids are shown below. Describe the formation of a peptide bond between these two amino acids. You may use the space below.



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.....[2]

[Total: 9]

120. 9700_w16_qp_23 Q: 3

Fig. 3.1 shows part of a transverse section of a root of *Ranunculus repens*.

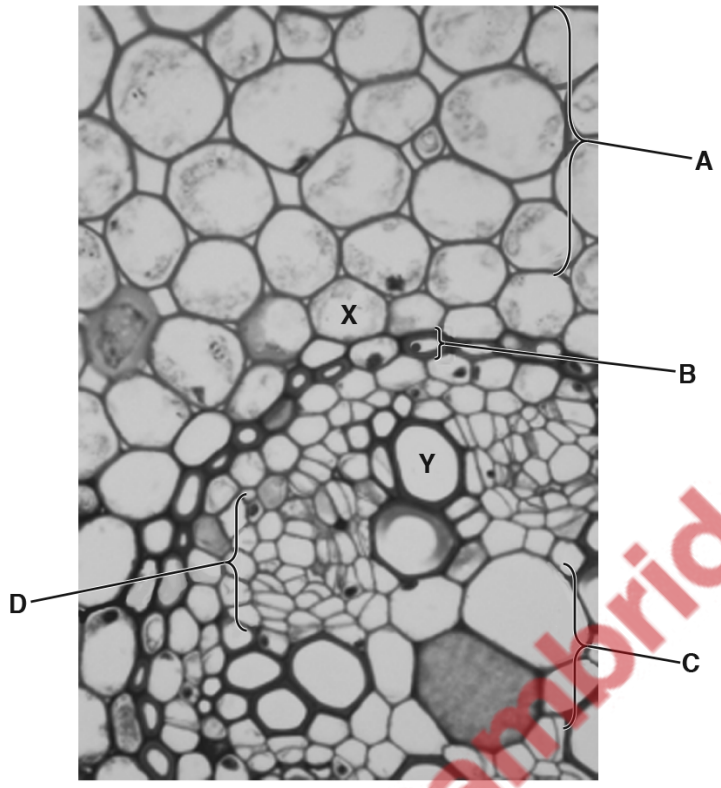

Fig. 3.1

(a) Name tissues **A** to **D**.

A .....

B .....

C .....

D .....[4]

(b) Explain how water moves from **X** to **Y**.

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.....

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.....[4]

[Total: 8]

121. 9700_s15_qp_21 Q: 3

When a leaf is first formed it is described as a sink for carbohydrate. As the leaf continues to grow, it starts to photosynthesise and becomes a source of carbohydrates and other assimilates.

Fig. 3.1 shows the changes that occur to the structure of plasmodesmata in the leaf as it grows.

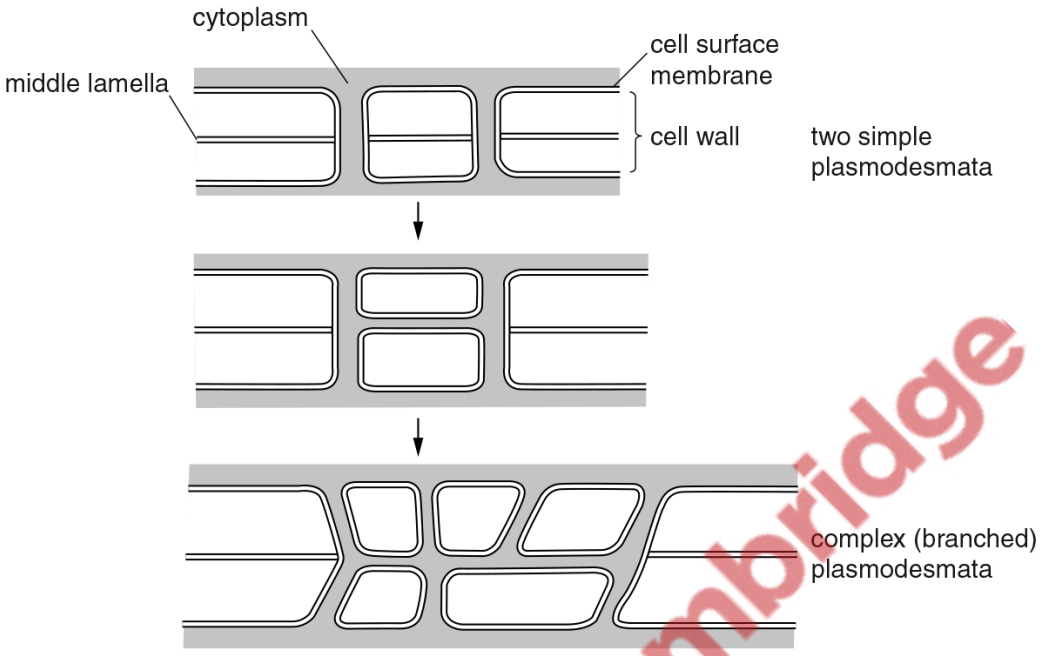

Fig. 3.1

(a) Suggest the advantage of complex plasmodesmata between cells in leaves.

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.....

.....[2]

(b) Assimilates are transported into phloem sieve tubes.

Explain how assimilates in phloem sieve tubes move from the veins in a mature leaf to sinks, such as flowers and fruits, in the rest of the plant.

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.....[4]

[Total: 6]

122. 9700_s15_qp_21 Q: 5

Fig. 5.1 shows a diagram of the molecular structures of tristearin (a triglyceride) and phosphatidylcholine (a phospholipid).

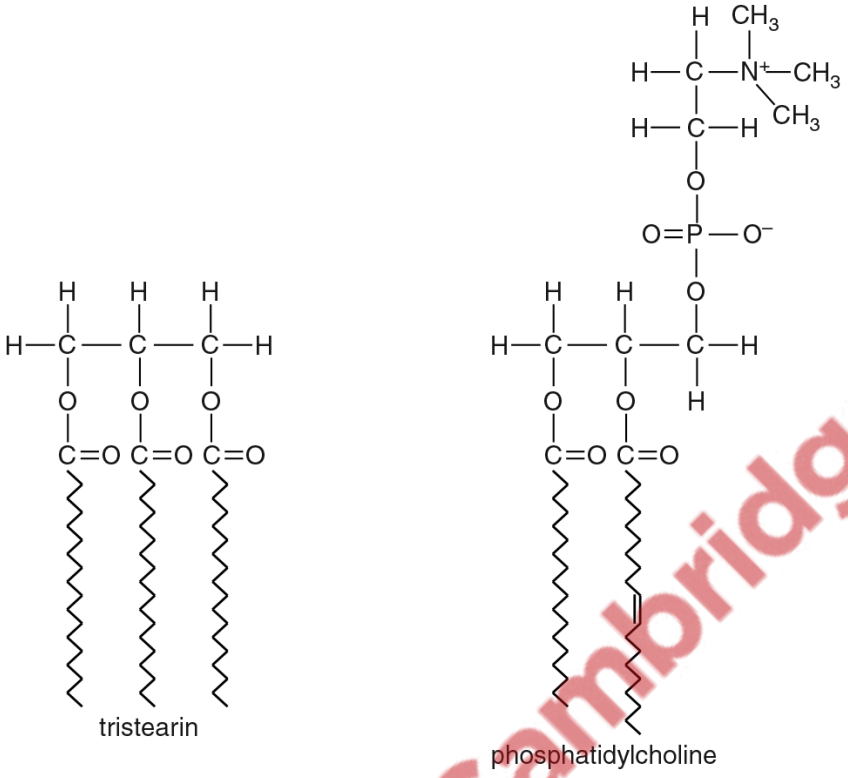

Fig. 5.1

(a) Table 5.1 shows a structural difference between the two molecules shown in Fig. 5.1.

Complete Table 5.1 with two further structural differences **other than** in numbers of different types of atoms.

Table 5.1

structural feature	tristearin	phosphatidylcholine
length of fatty acid chains	all the same length	different lengths

[2]

(b) 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. 5.2.

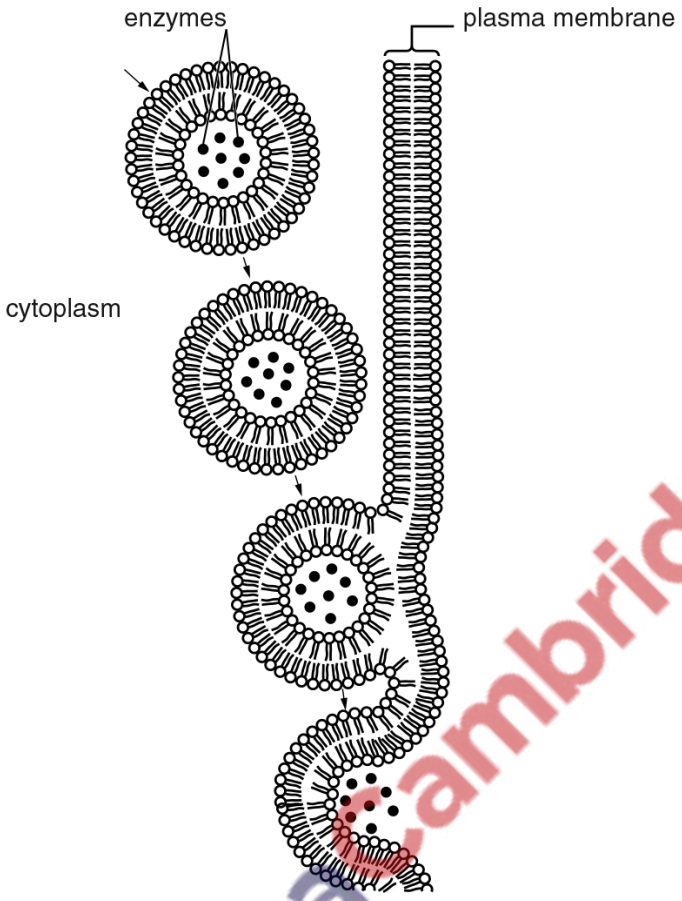

Fig. 5.2

With reference to Fig. 5.2, explain how enzymes that are secreted by cells in the pancreas are packaged into vesicles and exported.

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.....[4]

(c) Water has many significant roles to play in cells and living organisms.

Complete Table 5.2 below by stating the property of water that allows each of the following to take place.

Table 5.2

role of water	property of water
solvent for glucose and ions	
movement in xylem	
helps to decrease body temperature in mammals	

[3]

[Total: 9]

123. 9700_w15_qp_21 Q: 4

Marram grass, *Ammophila arenaria*, is a xerophyte adapted to grow in sandy soils in exposed locations.

Fig. 4.1 is a light micrograph of a section through a leaf of marram grass.

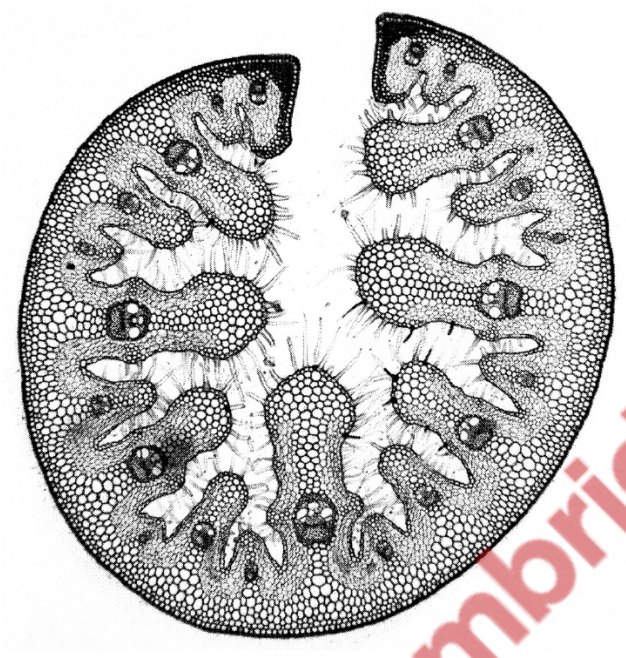

Fig. 4.1

(a) *A. arenaria* is adapted to reduce transpiration.

(i) State what is meant by the term *transpiration*.

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..... [3]

(ii) One adaptation of *A. arenaria* is the curled leaf.

Give **one** other adaptation, **visible in Fig. 4.1**, and explain how this reduces transpiration.

adaptation

.....

.....

explanation

.....

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..... [3]

(b) A student investigated the rates of transpiration and absorption of water by two species of plants, **P** and **Q**, over an 18 hour period between 0600 and 2400. The environmental conditions for the two species were the same.

The results are shown in Fig. 4.2.

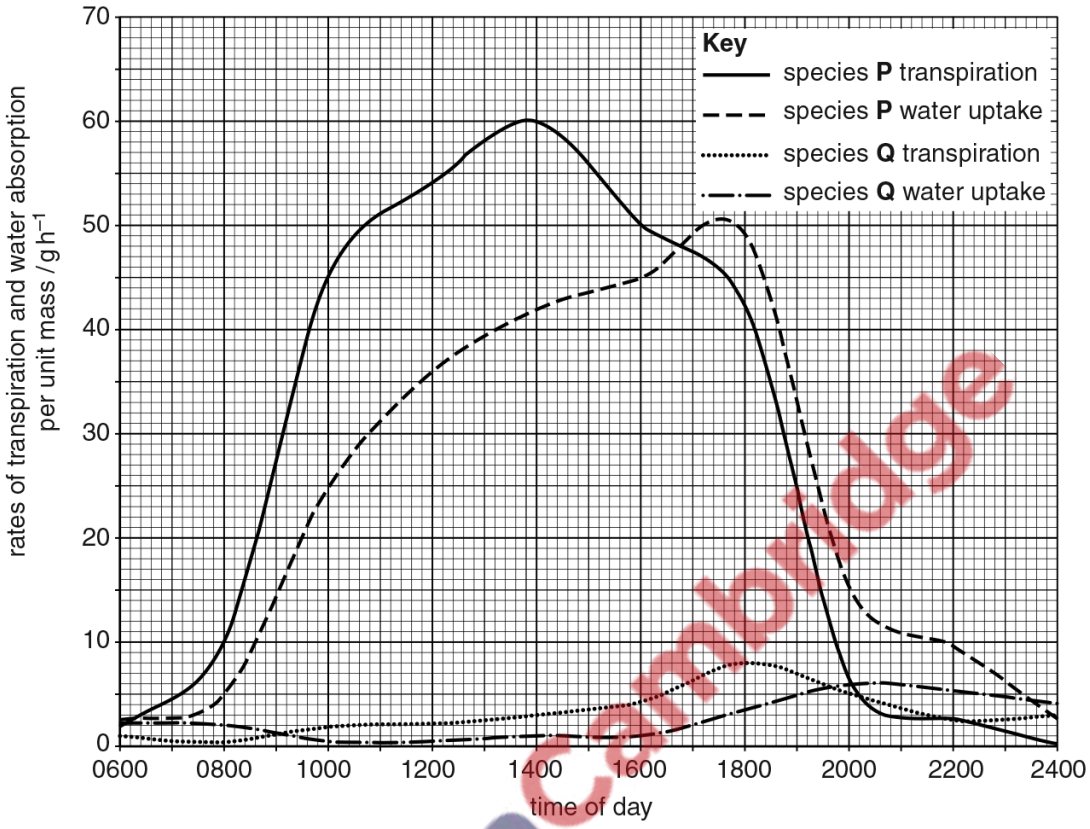

Fig. 4.2

(i) Use Fig. 4.2 to calculate the difference between the rates of transpiration and water absorption for species **P** at time 1400.

answer ..... [2]

(ii) Describe **and** explain the patterns of transpiration **and** water absorption for species **P**.

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..... [4]

(iii) Suggest why the pattern of transpiration for species **Q** is not the same as for species **P**.

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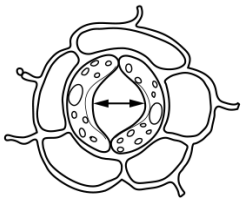
..... [2]

[Total: 14]

124. 9700_w15_qp_23 Q: 2

Most of the water lost from plants passes out through the stomata of leaves.

The distance between open guard cells is known as the stomatal aperture, as shown in Fig. 2.1.



↔ stomatal aperture

Fig. 2.1

Researchers investigated the effect of stomatal aperture on rates of transpiration in leaves of *Tradescantia zebrina* under two conditions:

- air kept moving by a fan (moving air)
- non-moving air.

The results are shown in Fig. 2.2.

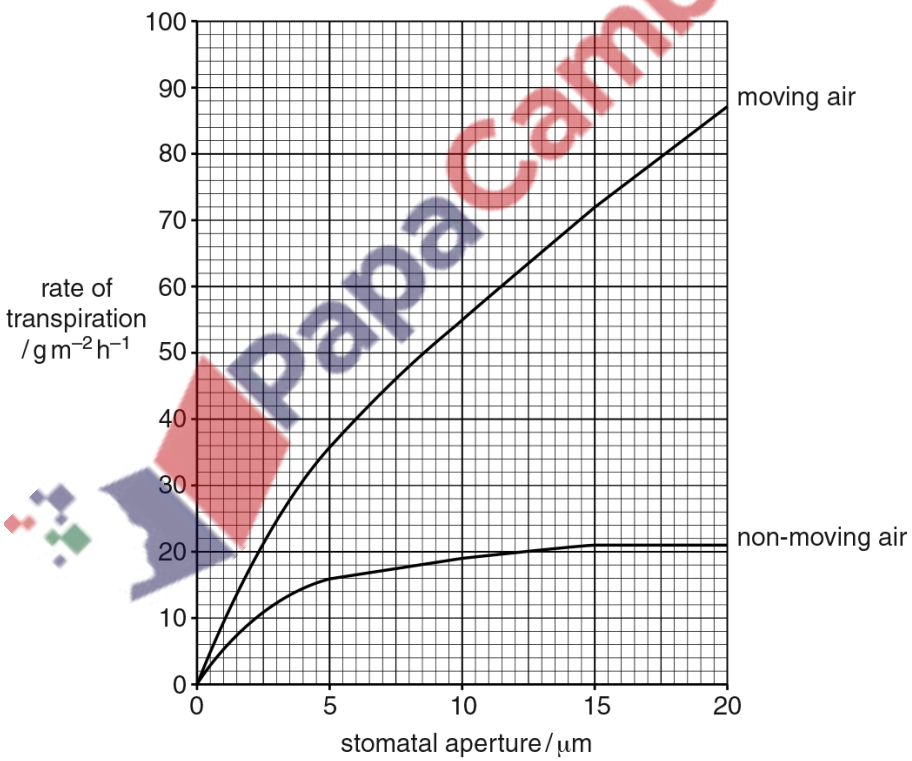


Fig. 2.2

(a) **(i)** Compare the effect of stomatal aperture on the rate of transpiration in *T. zebrina* in the two conditions.

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..... [3]

(ii) Explain the effect of stomatal aperture on rates of transpiration in non-moving and moving air.

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..... [3]

(b) Spruce trees and pine trees are adapted to dry conditions where water can be in limited supply.

Fig. 2.3 shows two stomata in a spruce leaf and Fig. 2.4 shows a vertical section through a stoma from a pine leaf.

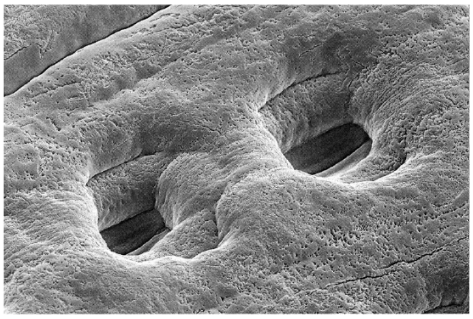

Fig. 2.3

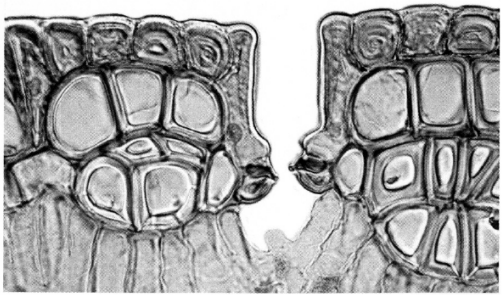

Fig. 2.4

(i) Explain how the stomatal features shown in Fig. 2.3 and Fig. 2.4 give an advantage to plants such as spruce and pine.

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.....

..... [2]

(ii) Some plants that live in very dry conditions close their stomata during the day and open them at night.

State **one** disadvantage of this for these plants.

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..... [1]

(iii) State **and** explain two adaptations that plant leaves have for survival in dry conditions **other** than those involving number or structure of stomata.

1. .....

.....

2. .....

..... [2]

[Total: 11]