Q1.

4 Fig. 4.1 shows transverse sections of a root and a stem.

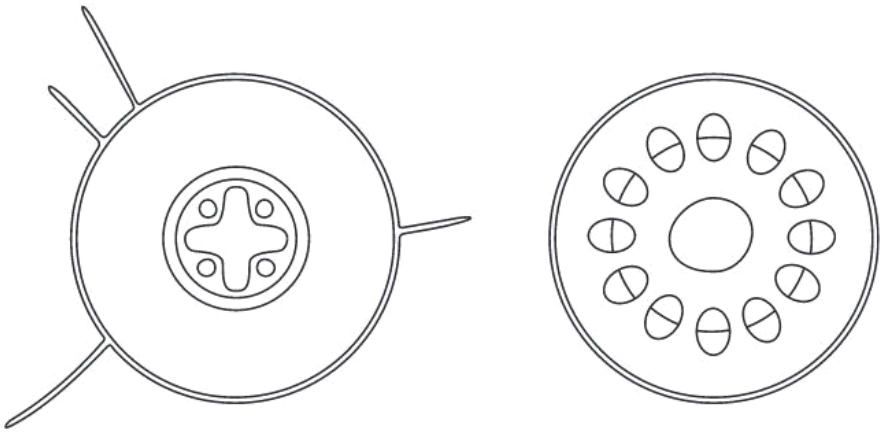

Fig. 4.1

(a) (i) Shade in an area in the transverse section of the root where there are cells specialised for the transport of water. [1]

(ii) Shade in an area in the transverse section of the stem where there are cells specialised for the transport of sucrose. [1]

(b) Suggest why the vascular bundles in the stem are situated towards the outside.

.....

.....[1]

(c) Describe the process by which water passes from the soil into the root hairs.

.....

.....

.....

.....[2]

(d) Explain how water passes from the stem to the air surrounding a leaf.

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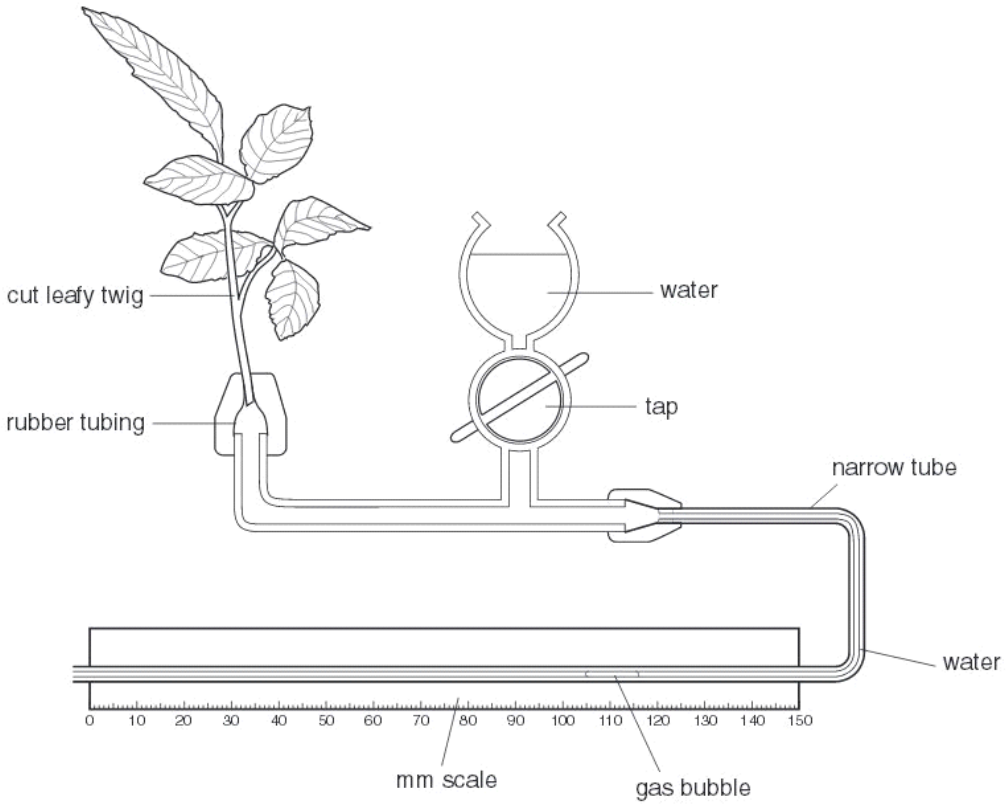
.....[4]

[Total : 9]

Q2.

Fig. 3.1 shows a potometer that is used for measuring rates of water uptake by leafy shoots.



A student used the potometer shown in Fig. 3.1 to investigate the rate of water uptake of a leafy shoot under six different sets of conditions. The student changed two environmental conditions around the plant:

- temperature
- wind speed.

For each experiment, the apparatus was left in the conditions until the rate of water uptake by the leafy shoot became constant. The student took several measurements during each experiment and calculated the mean rate of movement of the gas bubble. The results are recorded in Table 3.1.

Table 3.1

experiment	temperature / °C	wind speed	mean rate of movement of gas bubble / mm h^{-1}
1	15	low	12
2	15	high	22
3	25	low	24
4	25	high	45
5	35	low	64
6	35	high	120

(b) Using the data in Table 3.1, describe and explain the effect of the two conditions that the student changed during the investigation on the rate of water uptake.

temperature .....

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wind speed .....

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.....[4]

The rate of water movement up the leafy shoot was measured before it was cut from the plant. The rate was found to be less than the rate of water uptake from the potometer when kept in the same temperature and windspeed conditions.

(c) Suggest why the rate of water movement in an intact shoot is less than that measured in the potometer.

.....

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.....[2]

[Total: 11]

Q3.

2 **Fig. 2.1 is a drawing of a transverse section of a leaf.**

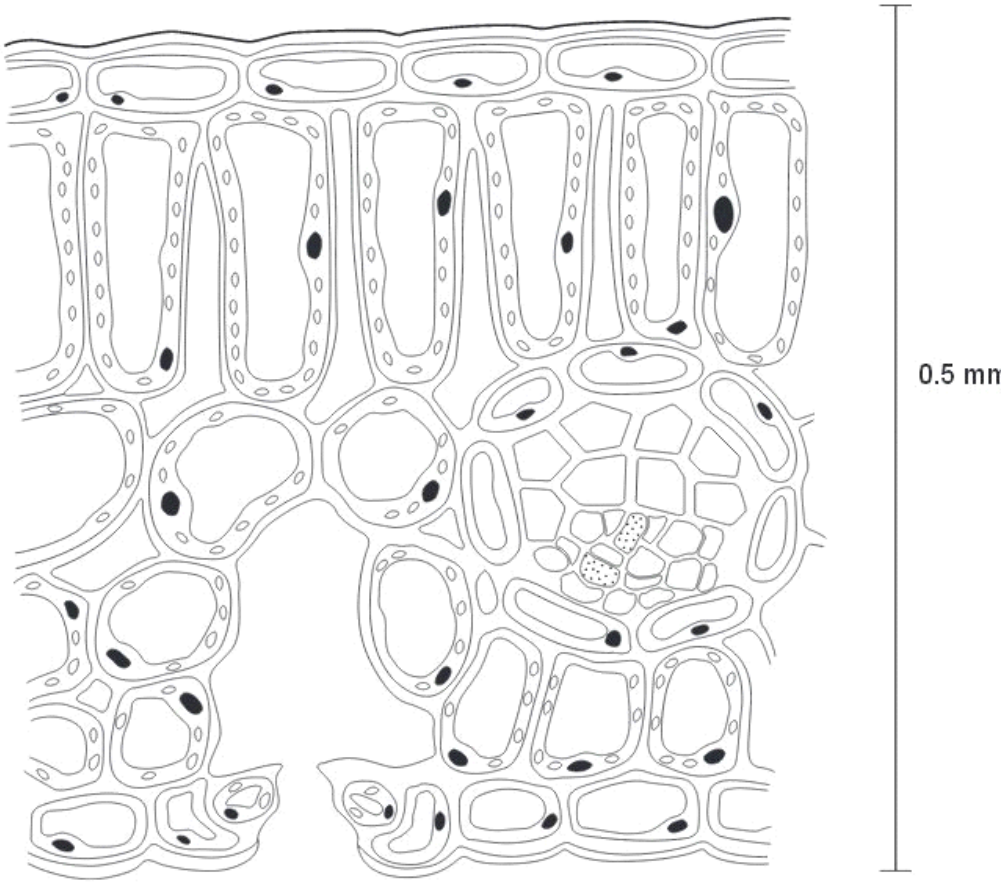

Fig. 2.1

(a) (i) Use label lines and the letters **X**, **S**, **E** and **D** to indicate the following on Fig. 2.1:

X – a xylem vessel
S – a phloem sieve tube
E – a lower epidermal cell
D – a palisade mesophyll cell [4]

(ii) Calculate the magnification of Fig. 2.1. Show your working and express your answer to the nearest whole number.

Answer ..... [2]

(b) Name **two** assimilates that move from the palisade mesophyll cells to the vascular tissue to be exported from the leaf.

1 .....

2 ..... [2]

(c) Explain, using the term **water potential**, how water moves from the vascular tissue to the atmosphere.

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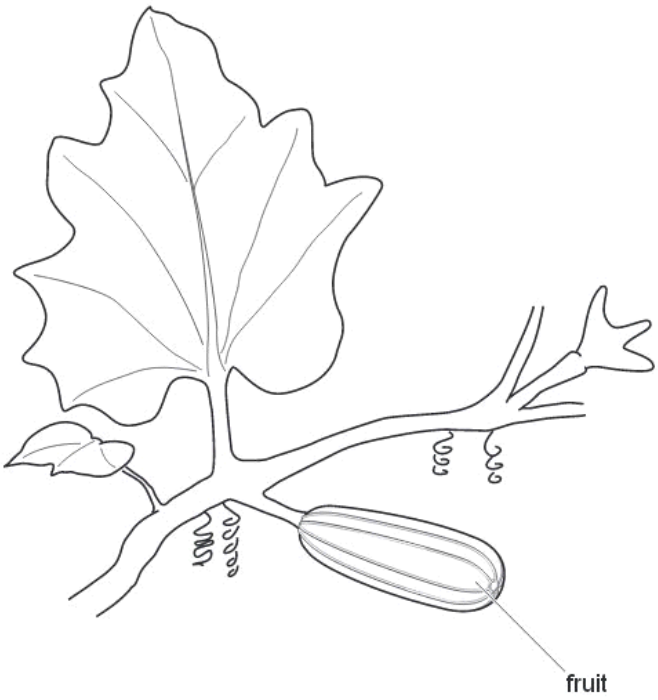
..... [4]

[Total: 12]

Q4.

2 Fig. 2.1 shows part of a summer squash, *Cucurbita pepo*. Fig. 2.2 is a high power drawing of an area of phloem from a transverse section of the stem of *C. pepo*.



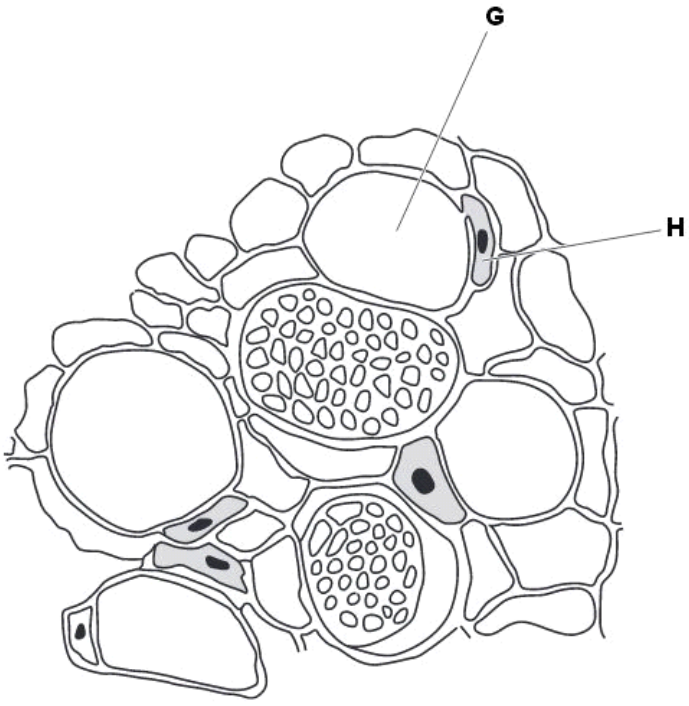


Fig. 2.2

(a) (i) Name **G** and **H**.

G .....

H .....[1]

(ii) Describe three ways in which the **structure** of a xylem vessel differs from the structure of cell **G**.

1. .....

2. .....

3. .....[3]

(b) The liquid extracted from the phloem of *C. pepo* contains sucrose.

Explain how sucrose is transported in the phloem along the stem from the leaf to the fruit.

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.....[4]

(c) Most of the sucrose transported in the phloem enters the fruit.

Suggest why summer squash fruits are not sweet.

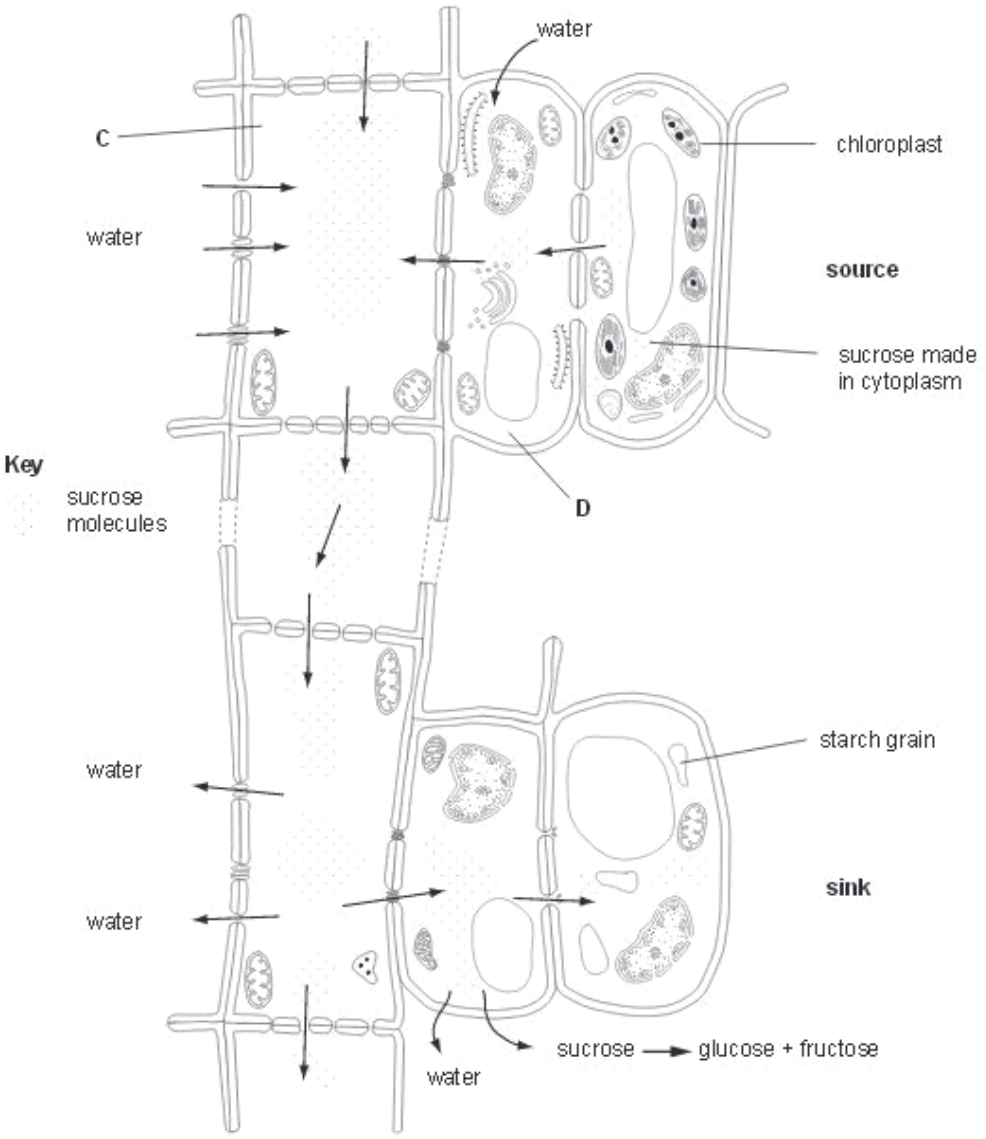
.....

.....[1]

[Total: 9]

Q5.

4 Fig. 4.1 shows the movement of sucrose from source to sink through the phloem in a plant.



(a) With reference to Fig. 4.1,

(i) name an example of a source and a sink

source .....

sink .....[1]

(ii) name cells **C** and **D**.

C .....

D .....[1]

(b) With reference to Fig. 4.1, explain how sucrose travels from,

the source to cell **C** .....

.....

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cell **C** to the sink. .....

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.....[4]

(c) Explain why multicellular plants require transport systems for substances, such as water and sucrose.

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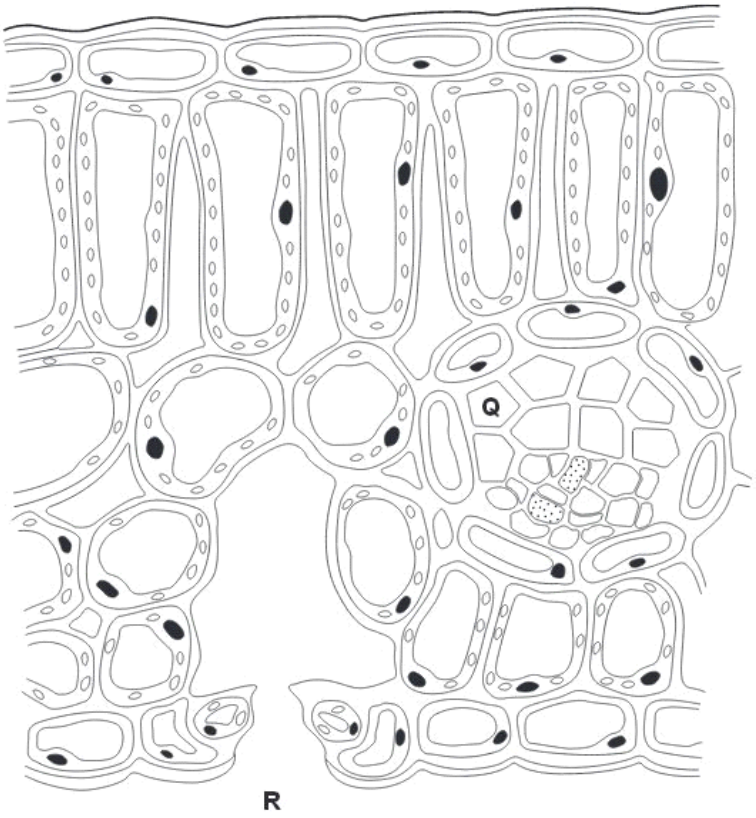
.....[2]

[Total: 8]

Q6.

5 Fig. 5.1 shows part of a transverse section of a leaf.



(a) Explain, in terms of **water potential**, how water moves from **Q** to **R**.

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.....[4]

(b) State and explain three ways in which the **structure** of xylem vessels is adapted to transport water.

1. .....

explanation .....

.....

2. .....

explanation .....

.....

3. .....

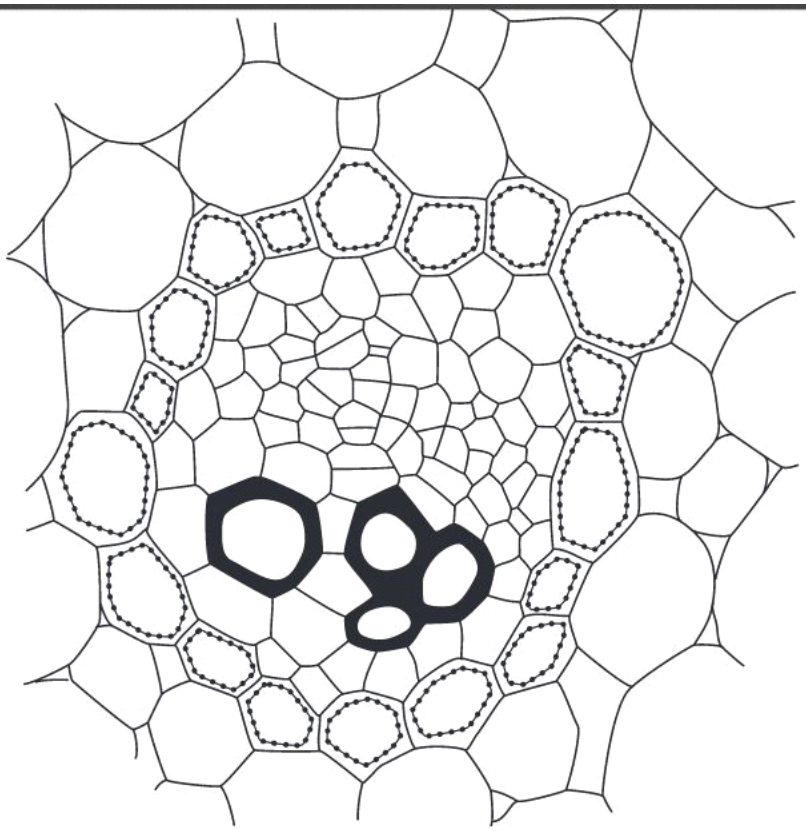
explanation .....

.....[6]

[Total: 10]

Q7.

5 Fig. 5.1 shows a vascular bundle from the stem of *Peperomia dahlstedtii*, a plant from Brazil. The vascular bundles in the stems of *P. dahlstedtii* are unusual because they are surrounded by an endodermis with a Casparian strip.



(a) Use label lines and the letters **P**, **Q** and **R** to identify the following in the vascular bundle.

P an endodermal cell with a Casparian strip

Q a cell wall strengthened with lignin

R a tissue that transports assimilates [3]

(b) Vascular tissue in roots is surrounded by an endodermis.

Describe the function of the endodermis in roots.

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.....

.....[3]

(c) State and explain two ways in which the **structure** of a phloem sieve tube is adapted for the transport of assimilates.

1. .....

explanation .....

.....

2. .....

explanation .....

.....[4]

[Total: 10]

Q8.

3 **(a)** Plants take in mineral ions through their root hair cells. This may happen by a process which moves the ions from a low concentration in the soil to a higher concentration in the root hair cell.

(i) Name and describe this process by which mineral ions are taken in.

name .....

description .....

.....

.....

..... [3]

(ii) Phosphate is an example of an ion transported in this way. State **one** use for this ion in plant cells.

.....

..... [1]

Fig. 3.1 is a plan diagram of a transverse section of a plant root.

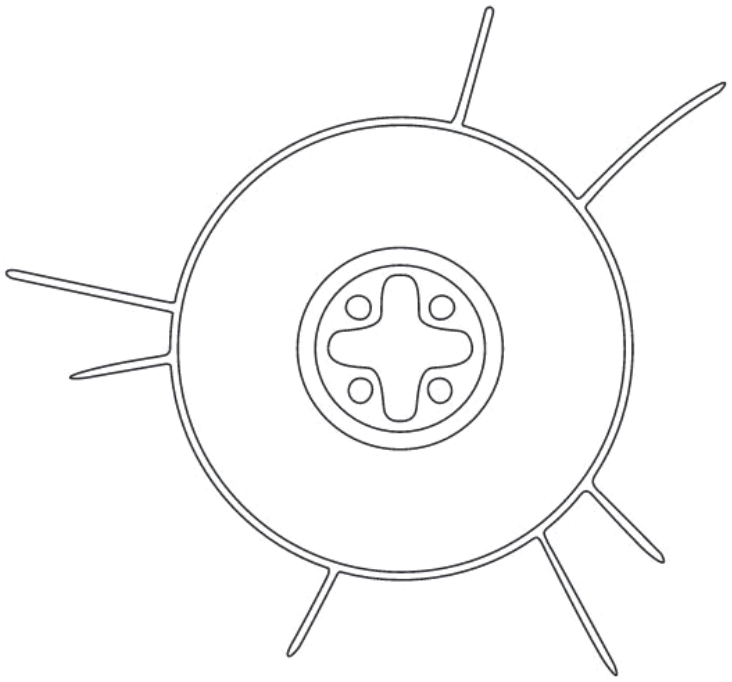

Fig. 3.1

(b) **(i)** Write the letter **W** on Fig. 3.1 in the area where cells are specialised for the transport of water and mineral ions. [1]

F Exam U

(ii) Water is also absorbed from the soil by the root hair cells.

Outline the mechanism by which this occurs.

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..... [2]

(iii) Describe the pathway taken by water as it passes from the root hair cells into the cells which are specialised for transport of water and mineral ions.

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..... [4]

[Total: 11]

Q9.

3 **(a)** With reference to the structure of a leaf, explain the difference between evaporation and transpiration.

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.....[4]

(b) Apple, *Pyrus malus*, sour cherry, *Prunus cerasus*, and peach, *Prunus persica*, are dicotyledonous trees that are of importance to commercial growers for the fruit that they produce.

A student chose a small area of land where all three species of fruit tree were growing. Leaf samples were removed and, using a microscope, the mean number of stomata per square millimetre was estimated for each species.

The rate of transpiration of each species was then measured on each of three separate occasions. The student performed the investigation outside where the trees were located and recorded the weather conditions on each day.

The mean transpiration rate was calculated per unit area of leaf.

The results are shown in Table 3.1.

Table 3.1

fruit tree	mean number of stomata / mm^{-2}	mean transpiration rate / $cm^3\ h^{-1}$		
		hot dry day	warm dry day	warm rainy day
apple	266	0.19	0.35	0.21
sour cherry	284	0.09	0.28	0.25
peach	190	0.03	0.08	0.07

(i) With reference to Table 3.1, describe **and** explain the results of the investigation.

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Exam
U

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.....[4]

(ii) The mean transpiration rate of each species was calculated over a 24 hour period.

Describe how the transpiration rate during the night would differ from the transpiration rate during the day.

Explain your answer.

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.....[3]

(iii) Suggest which of the three species of fruit tree has been described as 'drought-resistant' and would be economical to grow in areas where water is scarce.

..... [1]

(ii) A diet rich in peaches can help reduce inflammation of the bronchi and bronchioles.

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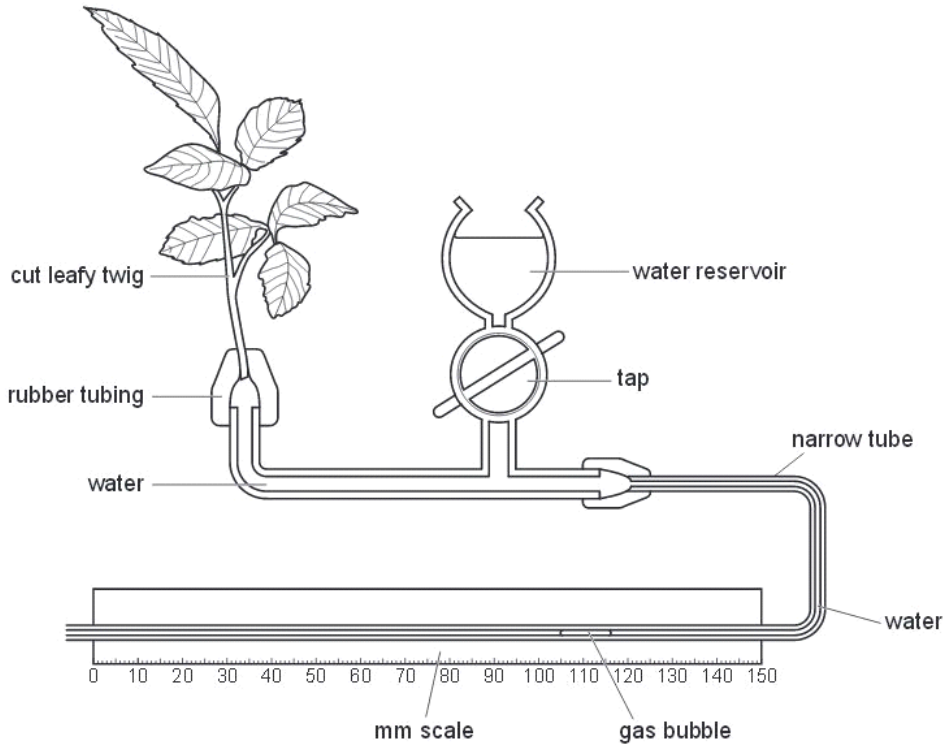
..... [2]

[Total: 16]

Q10.

2 Fig. 2.1 shows an apparatus used to measure the rate of water uptake by leafy parts of plants.



(a) State the name of this apparatus.

.....[1]

(b) Explain why the rate of water uptake by the leafy part of the plant shown in Fig. 2.1 will **not** be the same as the rate of transpiration.

.....

.....

.....

.....[2]

(c) Using the apparatus as shown in Fig. 2.1, the rate of water uptake at 25 °C was found to be greater than at 20 °C.

For Examiner's Use

(i) Explain the effect of increasing the temperature on the rate of water uptake.

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.....[3]

(ii) State two environmental conditions, **other than temperature**, which will affect the rate of water uptake of a leafy twig as shown in Fig. 2.1.

1. .....

2. .....[2]

(d) Transpiration is sometimes described as an 'inevitable consequence of gas exchange' in plants.

Explain this statement.

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.....[3]

[Total: 11]

Q11.

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

For Examiner Use

Explain what is meant by this statement.

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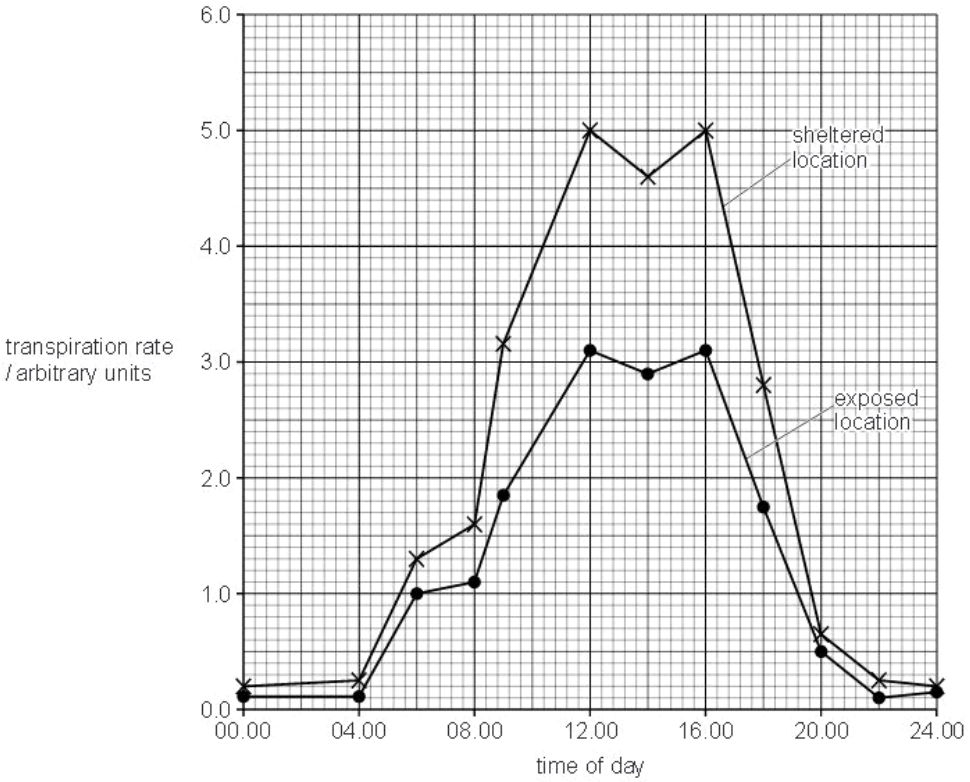
.....[3]

The buttonwood tree, *Conocarpus erectus*, grows in coastal areas of the Americas. A study was carried out on its ability to survive on Socorro Island off the Pacific coast of Mexico. The island is exposed to high winds, which can lead to high rates of transpiration.

The transpiration rates of trees at sheltered and exposed locations at the same altitude on Socorro Island were compared. The results are shown in Fig. 3.1.



(b) Describe the results shown in Fig. 3.1.

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..... [5]

(c) The leaves of the buttonwood trees at the exposed site were significantly smaller than those at the sheltered site.

Describe three ways, **other than small size**, in which leaves are adapted to reduce the rate of transpiration.

1. .....

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2. .....

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3. .....

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..... [3]

[Total: 11]

Q12.

2 **Fig. 2.1 shows xylem tissue in a longitudinal section through the stem of a dicotyledonous plant.**

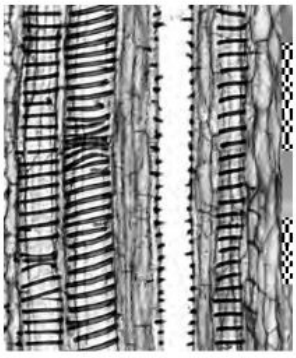

Fig. 2.1

(a) Describe and explain how the structure of xylem vessels is suited to their function.

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..... [5]

(b) It is possible to obtain images, such as Fig. 2.1, at the same magnification with both the light microscope and the electron microscope.

State the advantages of using the light microscope, rather than using the electron microscope, in studies of tissues.

.....

.....

.....

.....

..... [2]

[Total: 7]

Q13.

(d) Palisade mesophyll cells have very large vacuoles.

Explain how water moves from the xylem in the leaf into these vacuoles.

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..... **[3]**

Q14.

3 **(a)** Explain why transpiration is the inevitable consequence of gaseous exchange in land plants.

Us

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.....[3]

Fig. 3.1 shows some of the cells from the lower part and under surface of a leaf. The water potentials of three cells, **A**, **B** and **C**, are shown.

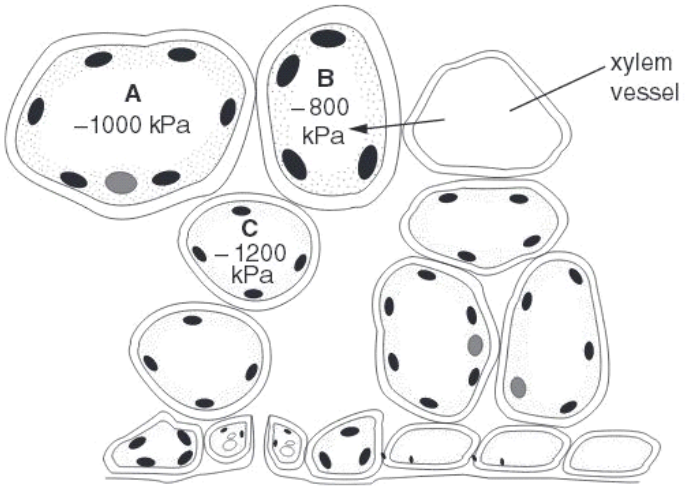

Fig. 3.1

(b) Explain how water moves from the xylem vessel to cell **B**.

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.....[3]

(c) Draw labelled arrows on Fig. 3.1 to show the direction in which

(i) water flows between the cells **A**, **B** and **C**; [2]

(ii) water vapour diffuses. [1]

(d) State two features of xerophytic plants that help to reduce the loss of water by transpiration from their leaves.

1. .....

.....

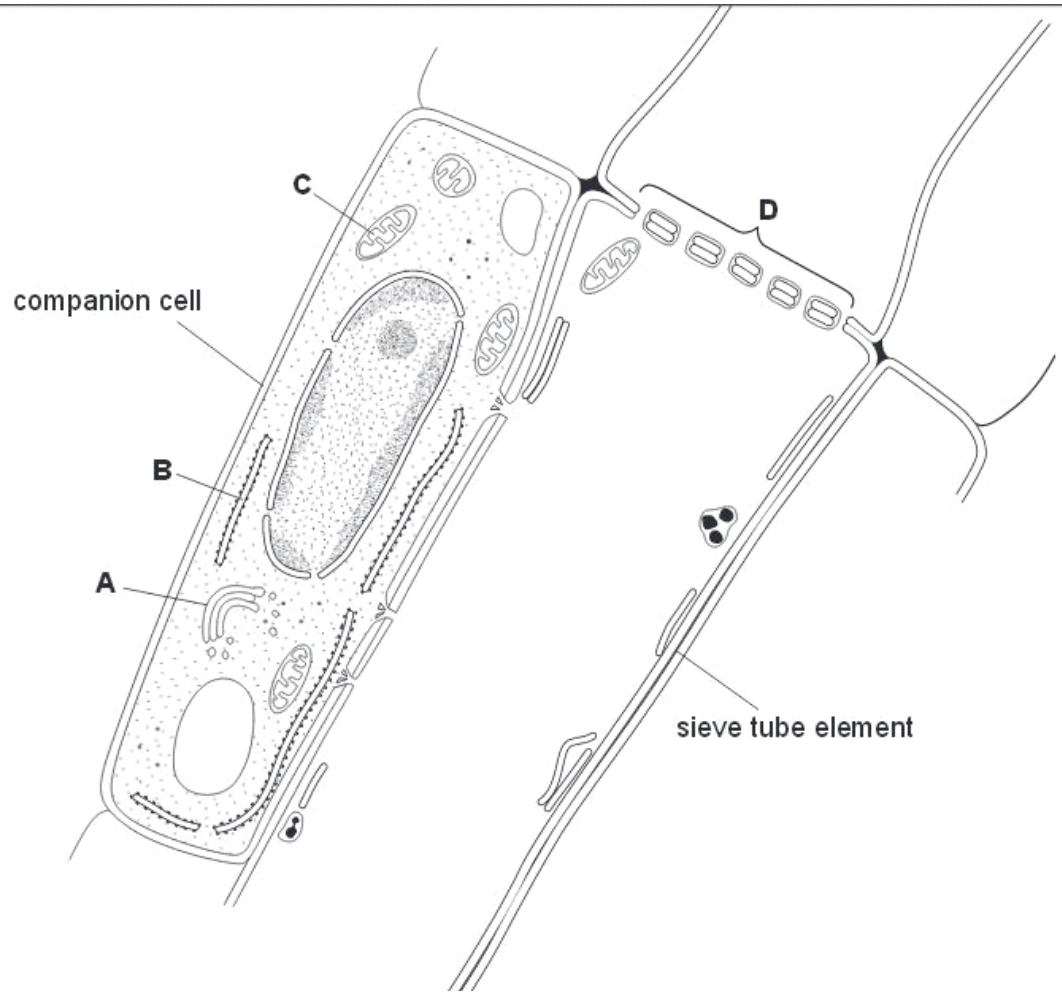
2. .....

.....[2]

[Total : 11]

Q15.

1 Fig. 1.1 is a drawing made from an electron micrograph. It shows a longitudinal section through a sieve tube element and a companion cell in the phloem of a flowering plant.



(a) Refer to Fig. 1.1.

(i) Name structures **A** to **C**.

A .....

B .....

C .....[3]

(ii) State the name given to the region labelled **D** that separates the two sieve tube elements.

.....[1]

(iii) Name **one assimilate** that is transported in the phloem.

.....[1]

(b) Explain how the structure of sieve tube elements helps the translocation of substances in the phloem.

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.....[3]

(c) Describe the role of companion cells in translocation in the phloem.

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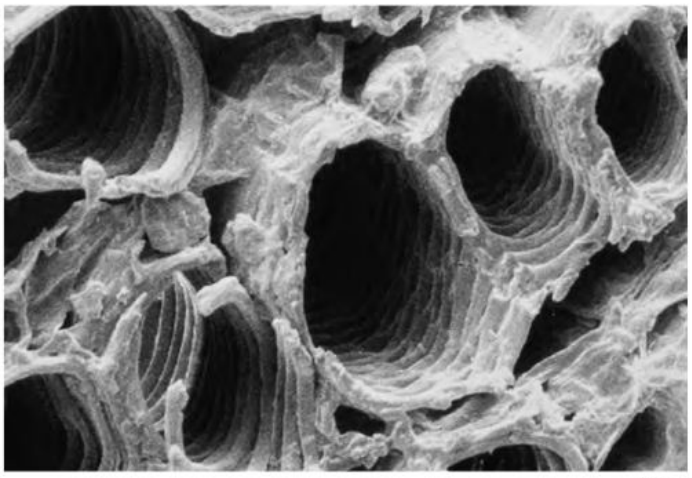
.....[2]

[Total : 10]

Q16.

3 Fig. 3.1 shows an electron micrograph of some xylem vessels in tobacco leaf fragments in a cigarette.



magnification = ×395

Fig. 3.1

(a) (i) Describe **and** explain two features of the xylem vessels, **visible** in Fig. 3.1, that are adaptations for the transport of water in a plant.

feature .....

explanation .....

.....

feature .....

explanation .....

.....[2]

(ii) Explain the mechanisms that cause movement of water in xylem vessels.

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.....[4]

o

(b) When tobacco leaf fragments in cigarettes are burnt, substances that are hazardous to health are released.

Name three of these hazardous substances and for each describe **one** effect on the body.

substance .....

effect .....

.....

substance .....

effect .....

.....

substance .....

effect .....

.....[3]

[Total: 9]

Q17.

2 **(a)** Plants absorb water from the soil.

Describe the pathways taken by water as it moves from the soil into the xylem of the root.

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..... **[4]**

Fig. 2.1 is a plan diagram of a transverse section of a leaf from *Nerium oleander*, a plant that is adapted to survive in dry areas.

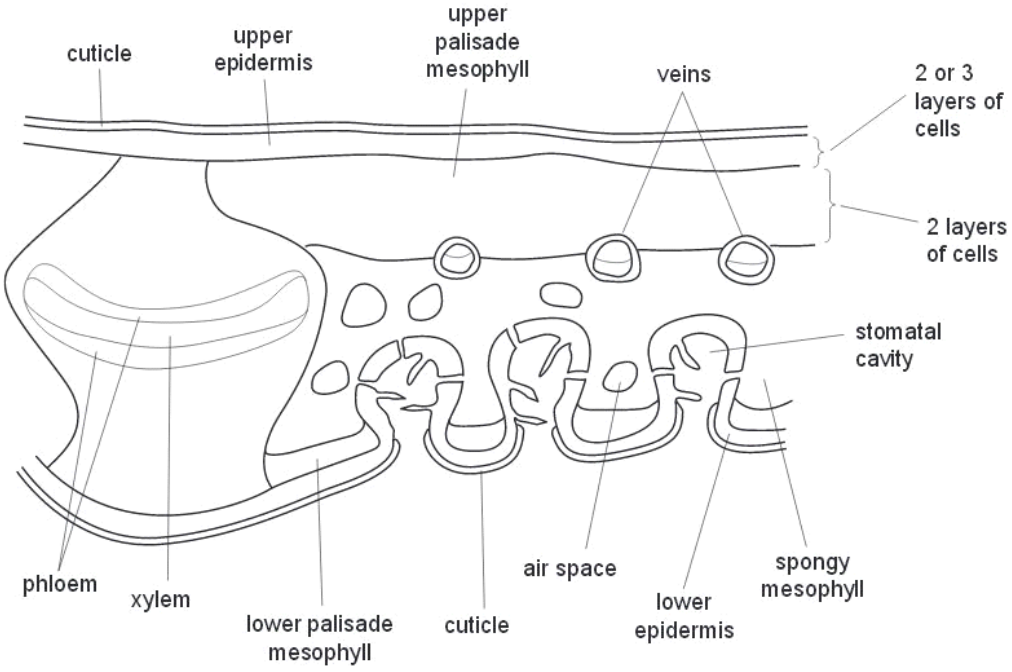

Fig. 2.2 shows detail of the lower epidermis that lines the stomatal cavities of *N. oleander*.

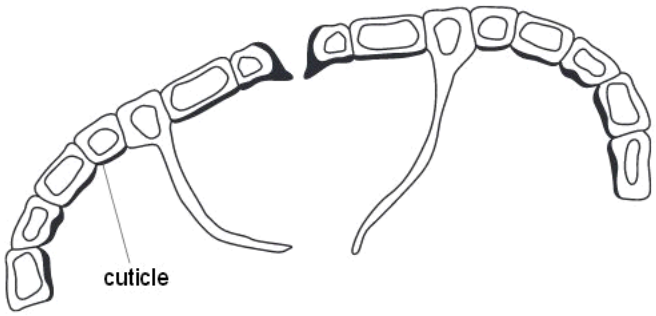

Fig. 2.2

(b) Using information in Fig. 2.1 and Fig. 2.2,

(i) explain why transpiration is considered to be an "inevitable consequence of gas exchange" in plants, such as *N. oleander*

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..... [3]

(ii) explain how the leaves of *N. oleander* are adapted to reduce water loss.

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..... [3]

[Total: 10]

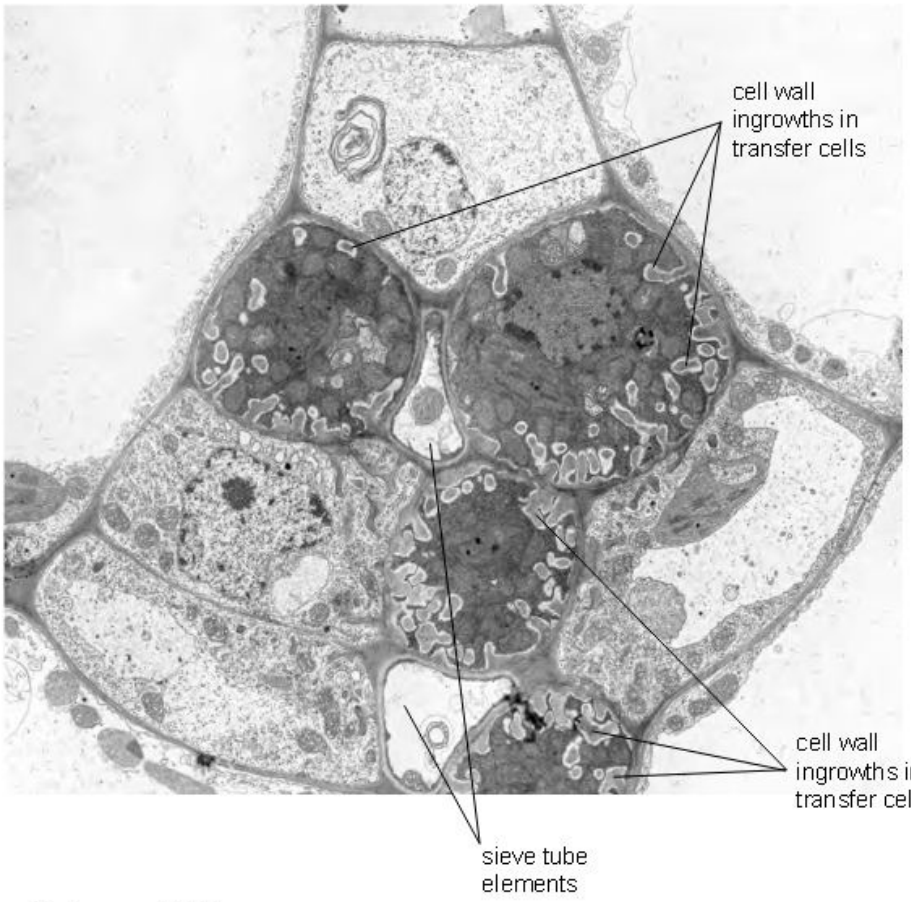
Q18.

4 Phloem transfer cells are specialised companion cells that load sucrose into sieve tube elements.

Ex

Fig. 4.1 is an electron micrograph of a transverse section showing phloem tissue from a leaf of *Senecio vulgaris*. The section shows two sieve tube elements and four phloem transfer cells. The sieve tube elements are small in this section because it is taken at the end of a vein in the leaf.

It is thought that the many ingrowths of the cell walls visible in Fig. 4.1 are related to the movement of large quantities of sucrose.



magnification = ×10,000

(a) Describe how companion cells load sucrose into phloem sieve tubes.

B

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.....

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..... [4]

(b) Transfer cells move large quantities of sucrose into phloem sieve tubes.

Suggest why these cells have cell wall ingrowths as shown in Fig. 4.1.

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..... [2]

(c) **(i)** Explain the advantage of studying cells, such as transfer cells, with the electron microscope rather than the light microscope.

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..... [2]

(ii) Describe the appearance of the phloem sieve tubes when viewed in longitudinal section.

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..... [2]

[Total: 10]

Q19.

4 **(a)** **Explain what is meant by the term transpiration.**

.....

.....

.....**[2]**

The rates of transpiration of plants of two species, **A** and **B**, were measured over a period of seven hours. The results are shown in Fig. 4.1.

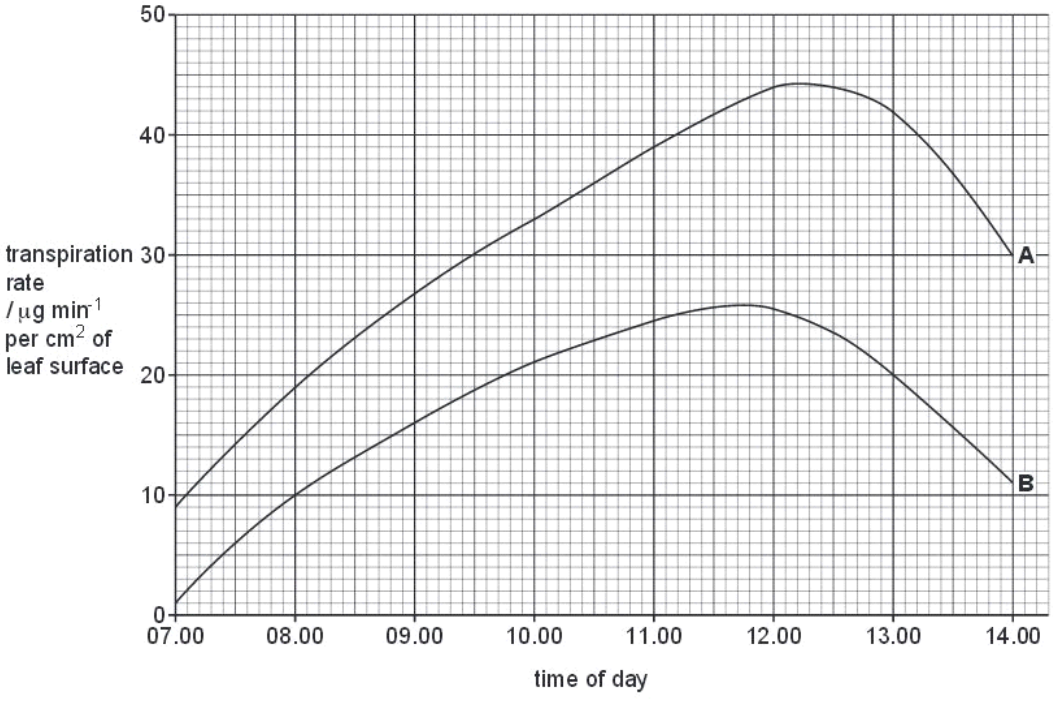

Fig. 4.1

(b) With reference to Fig. 4.1, compare the rates of transpiration of the two species over the seven hour period.

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.....[4]

(c) State two possible features of the **leaves** of species **B** that could explain the different rates of transpiration in comparison with species **A**.

Explain how each feature acts to reduce transpiration.

feature .....

explanation .....

.....

.....

feature .....

explanation .....

.....

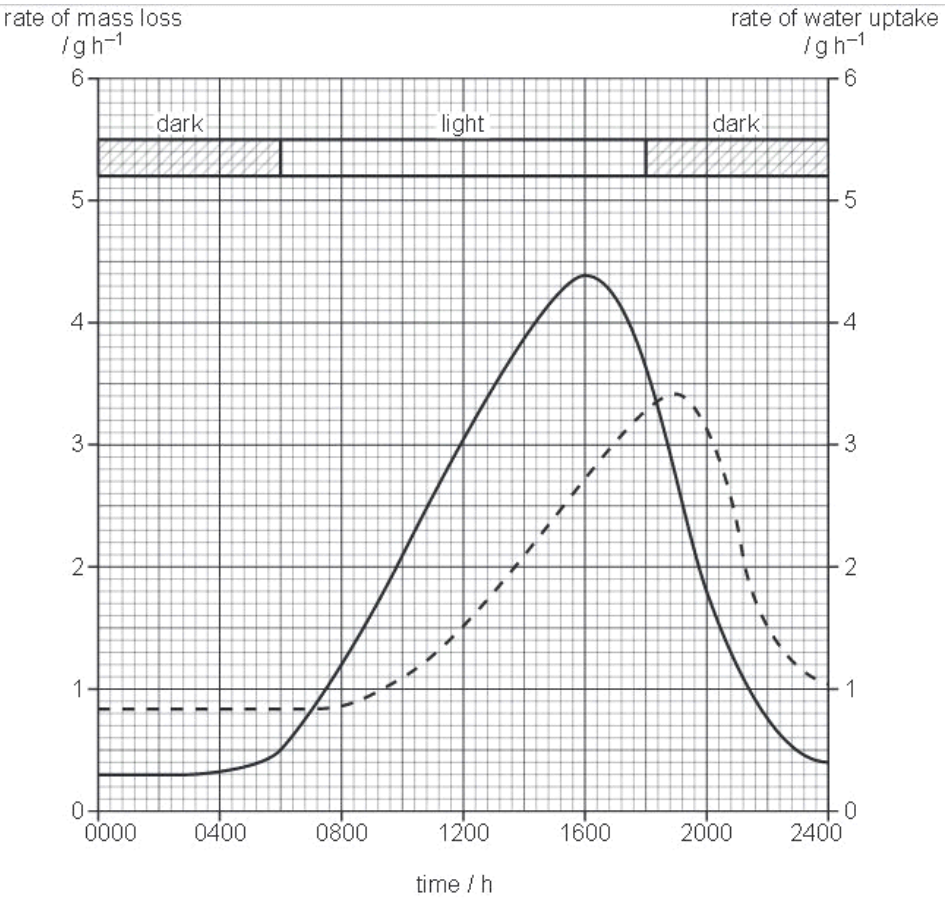
.....[4]

[Total: 10]

Q20.

4 A leafy twig was cut from a tree and the cut end immediately placed into water. The twig was then put into a potometer to measure the uptake of water. The potometer was placed on a balance to record changes in mass.

Fig. 4.1 shows the rate of water uptake and the rate of mass loss over a period of 24 hours. The graph also shows when it was light and when it was dark.



Key

——— rate of mass loss

– – – rate of water uptake

Fig. 4.1

(a) (i) Explain how water was lost from the leaves of the leafy twig.

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.....[3]

(ii) With reference to Fig. 4.1, describe how the rates of water uptake and water loss change during the 24 hour period.

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.....[4]

(b) Explain the mechanism by which water is transported in the xylem of the leafy twig while in the potometer.

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.....[3]

[Total: 10]

Q21.

5 **Phloem transfer cells are modified companion cells that move sucrose and other assimilates from mesophyll tissue into phloem sieve tube elements.**

Fig. 5.1 is an electron micrograph of a phloem transfer cell.

Fo
Exami
Us

magnification = ×10 000

(a) Calculate the actual distance across the transfer cell from **X** to **Y**.

Show your working and express your answer to the nearest micrometre.

answer ..... µm [2]

(b) With reference to Fig. 5.1, explain how phloem transfer cells help in the movement of sucrose from the mesophyll of a leaf into a phloem sieve tube element.

E

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(c) Explain how sucrose in the phloem sap is moved from sieve tube elements in leaves to cells in a sink, such as a root.

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.....[4]

[Total: 11]

Q22.

6 Fig. 6.1 shows a phloem sieve tube element, its companion cell and a mesophyll cell in the leaf of a photosynthesising plant.

For Examiner's Use

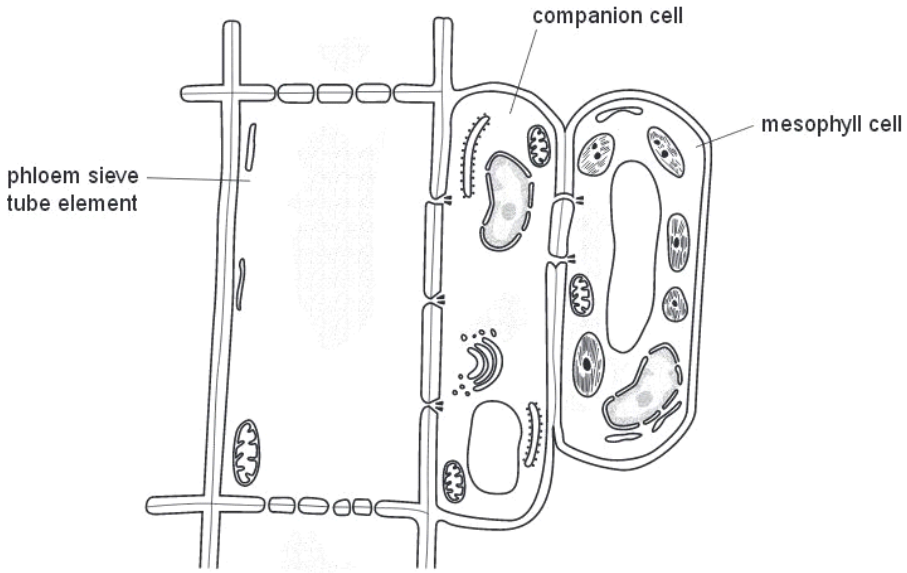

Fig. 6.1

(a) Use label lines and the letters **C** to **E** to identify the following on Fig. 6.1.

C – a structure involved in ribosome synthesis

D – an organelle that is involved in the modification and packaging of proteins

E – an organelle that is involved in aerobic respiration [3]

(b) The concentration of sucrose in the sap of the phloem sieve tube element is much higher than in the cytoplasm of the photosynthesising cell.

Describe **and** explain how sucrose is transported from the photosynthesising cell to the phloem sieve tube element.

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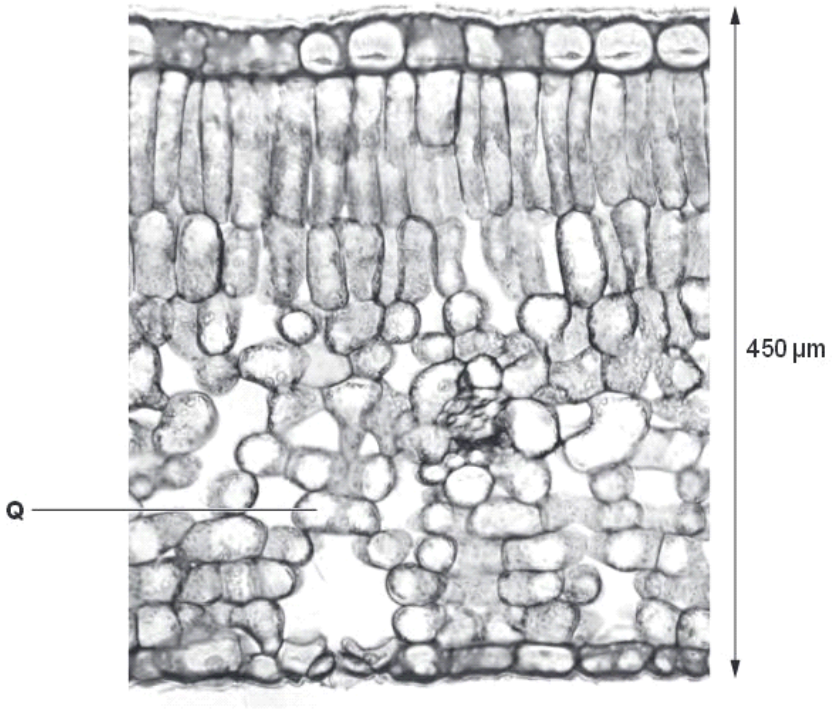
.....[4]

[Total: 7]

Q23.

3 Fig. 3.1 is a photomicrograph of a transverse section through a leaf from a tea plant, *Camellia sinensis*.



(a) Use label lines and the letters **X**, **Y** and **Z** to label the following features on Fig. 3.1.

X a cell of the upper epidermis

Y a palisade mesophyll cell

Z a guard cell

[3]

(b) Describe **and** explain how water moves from inside the leaf at point **Q** on Fig. 3.1 to the atmosphere outside the leaf during transpiration.

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..... **[4]**

(c) The leaf of *C. sinensis*, shown in Fig. 3.1, has developed in a sunny position.

State three features of the leaf, **visible in Fig. 3.1**, which show that it has developed in a sunny position.

1. .....

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2. .....

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3. .....

..... **[3]**

[Total: 10]

Q24.

2 Thale cress, *Arabidopsis thaliana*, is used to study the roles of genes and proteins in plants.

The cell membranes of the root hairs of *A. thaliana* contain proteins called aquaporins that allow the movement of water between the soil and the cytoplasm as shown in Fig. 2.1.

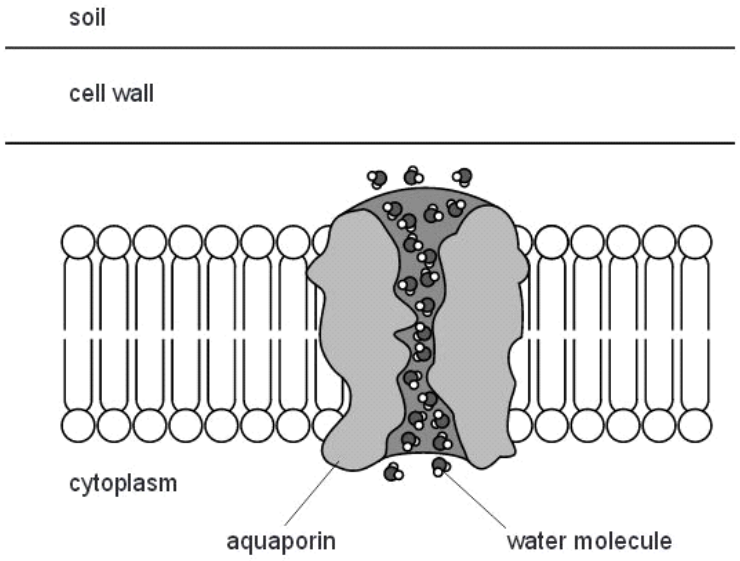

Fig. 2.1

(a) With reference to Fig. 2.1:

(i) explain how water is absorbed by root hairs of *A. thaliana*

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(ii) state why aquaporins are necessary in cell surface membranes.

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(b) Describe the pathway taken by water from the cytoplasm of the root hair cell to a xylem vessel in the centre of the root.

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An investigation was carried out to find the effect of an enzyme in *A. thaliana* on the composition of the cuticle. The enzyme is involved in the production of lipid that accumulates in the cuticle.

Plants were discovered with a mutation of the gene that codes for the enzyme.

Some of these mutant plants (Group **A**) were grown in pots and their rate of transpiration was determined over three days. They were compared with control plants (Group **B**) in which the gene was switched on and the enzyme present. The results are shown in Fig. 2.2.

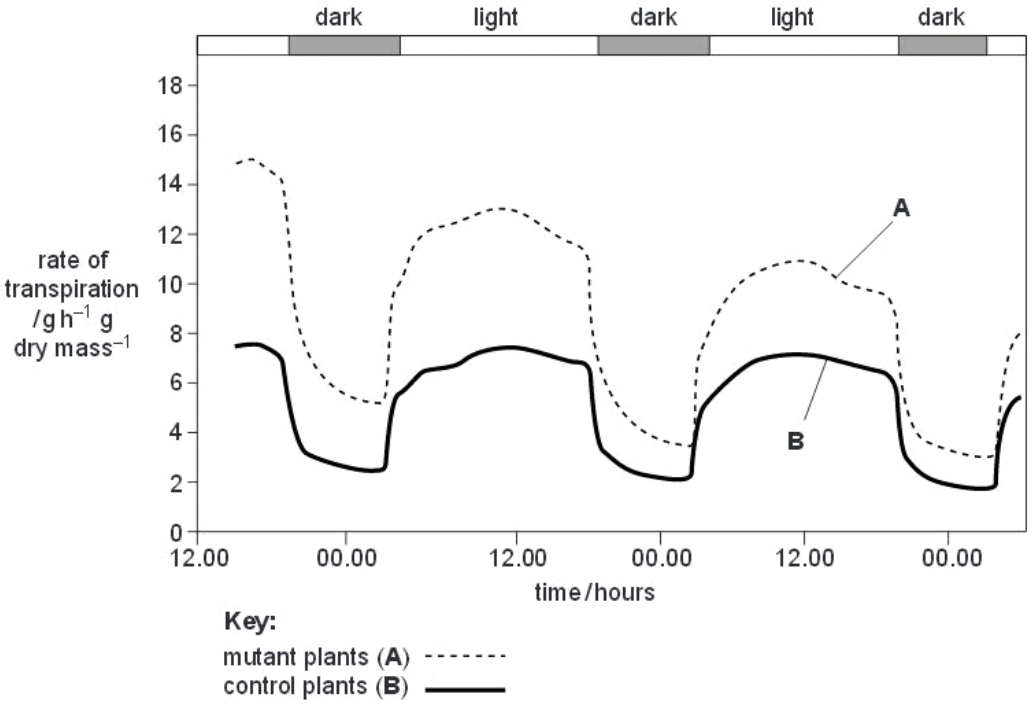

Fig. 2.2

(c) With reference to Fig. 2.2, explain:

(i) why the rate of transpiration is higher during the day than at night in both groups of plants

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(ii) how the results show that the cuticle is less effective in the mutant plants.

For Examiner Use

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[Total: 11]

Q25.

4 Fig. 4.1 is an electron micrograph of a transverse section through a plant stem. The xylem vessels are clearly visible.

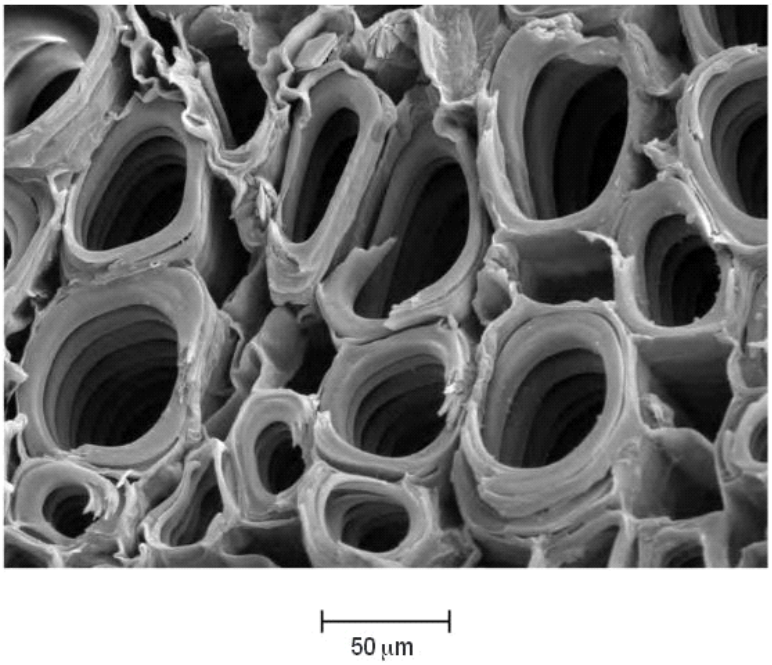

Fig. 4.1

(a) Calculate the magnification of the electron micrograph in Fig. 4.1.

Show your working and give your answer to the nearest 100.

answer .....[2]

(b) Describe how the structure of xylem vessels is adapted to their function.

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.....[3]

(c) Describe **and** explain how water moves from the xylem vessels in the leaves to the atmosphere surrounding the leaves of the plant.

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[Total: 10]

Q26.

3 **(a)** Explain the need for transport systems in plants.

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(b) Fig. 3.1 is a drawing of a transverse section through part of the stem of a dicotyledonous plant. Cell **A** and cell **B** are involved in the transport of dissolved organic molecules.

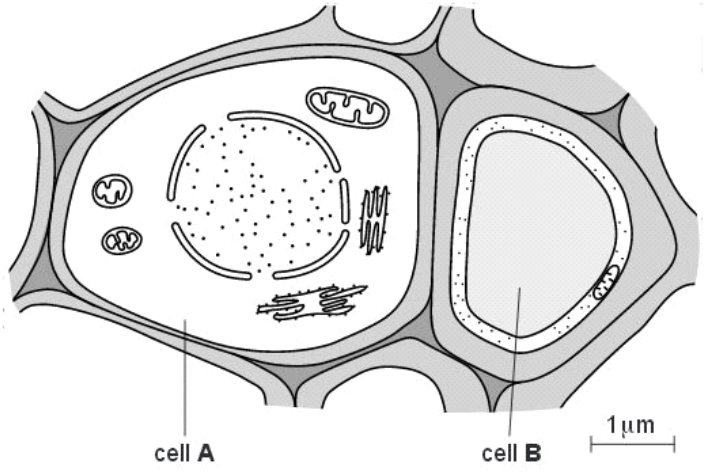

Fig. 3.1

(i) Name cell **A** and cell **B**.

cell A .....

cell B .....[1]

(ii) **With reference to Fig. 3.1, explain how the different structures of cell types A and B are related to their function.**

For Examiner's Use

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(c) Complete Table 3.1 to state four differences between transport systems in mammals and in plants.

Table 3.1

transport system in mammals	transport system in plants

[4]

Q27.

6 Fig. 6.1 is a photomicrograph of phloem sieve tubes from a plant stem.

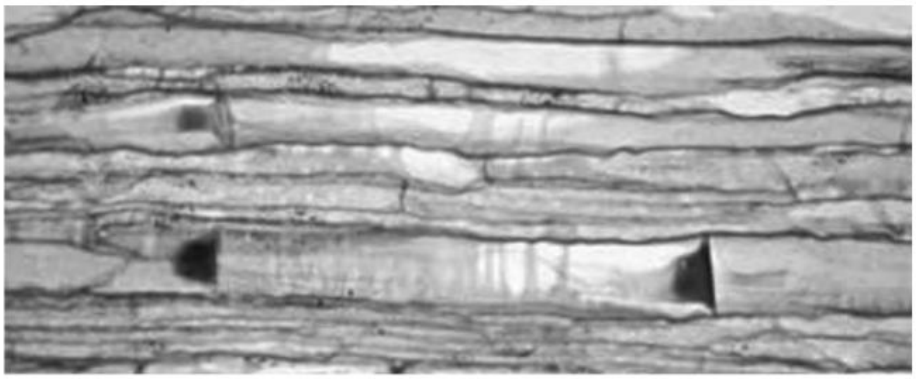

Fig. 6.1

(a) State two features, **visible in Fig. 6.1**, which distinguish sieve tubes from xylem vessels.

1. .....

2. .....

[2]

(b) Explain briefly how sucrose is **moved**, or translocated, **through** sieve tubes.

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(c) Some enzymes are found in phloem tissue.
Describe how enzymes catalyse reactions.

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[Total: 7]