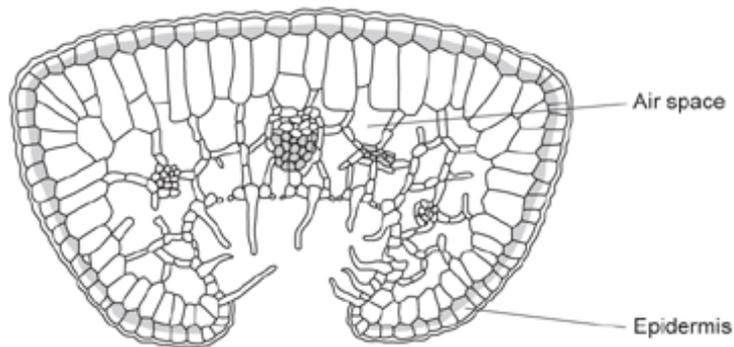


1(a). Many plants, such as *Erica cinerea* (bell heather), have evolved adaptations to limit water loss by transpiration.

This is a drawing of a leaf of *E. cinerea*.



State and explain how the leaf of *E. cinerea* is adapted to limit water loss by transpiration.

[2]

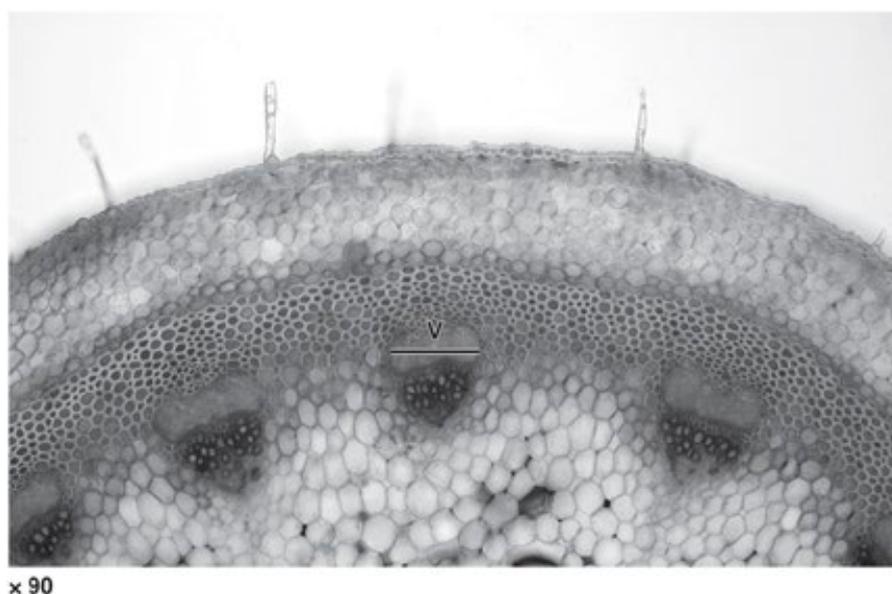
(b). Xylem vessels maintain the transpiration stream by transporting water up plant stems.

A pair of students dissect the vascular tissue of the primrose plant, *Primula vulgaris*.

- i. State **and** explain **one** safety precaution that the students should take when dissecting the vascular tissue.

[2]

- ii. This is a light micrograph of a transverse section through the stem of *P. vulgaris*.



The diameter of one of the vascular bundles is shown by the line labelled **V**.

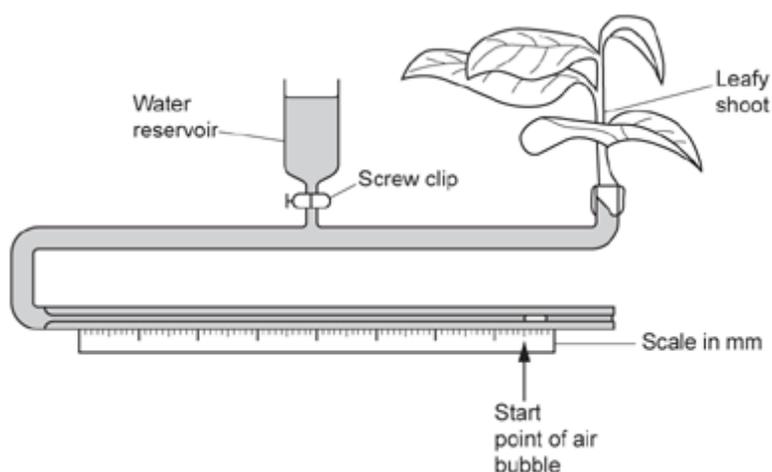
Calculate the actual diameter of the vascular bundle labelled **V**.

Give your answer in mm and to **2** significant figures.

Diameter of the vascular bundle **V** = mm **[2]**

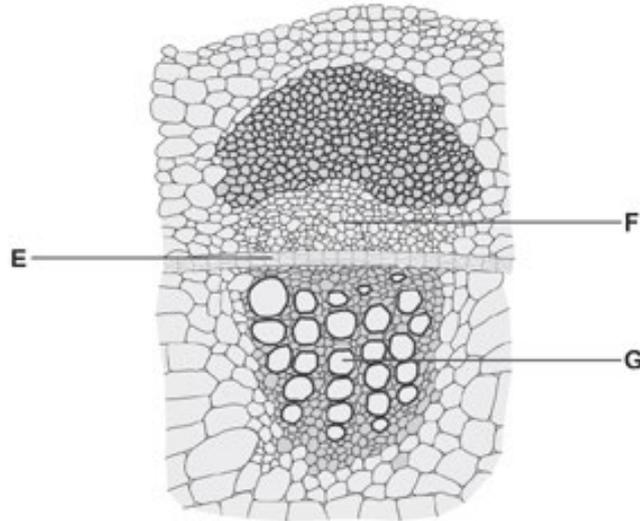
- (c). A scientist plans to investigate the effect of temperature on the rate of transpiration in the primrose plant, *P. vulgaris*.

The scientist uses a potometer in their investigation, as shown in the diagram below.



2(a). Living organisms are organised into tissues, organs, and organ systems.

A light microscope image from a transverse-section through the stem of a plant was used to produce the drawing shown.



i. Identify tissues **E** and **F**.

Tissue **E** _____

Tissue **F** _____ [2]

ii. Explain **two** ways tissue **G** is adapted for its function.

..... [2]

(b). The sentences are about the transport of water through a plant.

Complete the sentences using the most appropriate terms.

In the apoplast pathway, water moves through the of plant cells. When water reaches the endodermis, its movement is blocked by an impermeable barrier called the

Water is then forced into the symplast pathway. It moves between cells through channels called

[3]

(c). Xerophytes are plants that are adapted to living in dry environments.

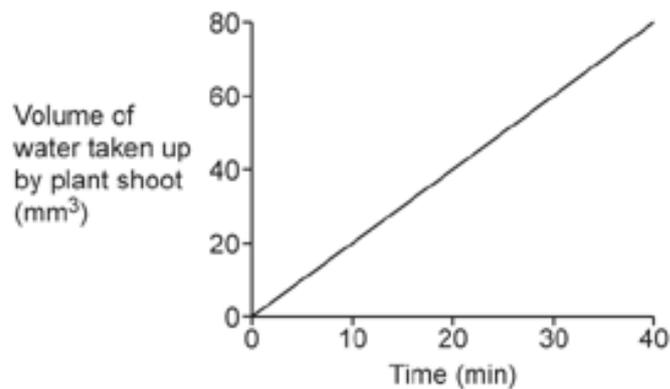
Explain **two** ways that xerophytes are adapted to prevent water loss in dry environments.

1

2

[2]

3. A potometer was used to estimate the rate of transpiration. The graph below shows the results from the experiment.



What is the estimated rate of transpiration?

- A 0.5 mm³ min⁻¹
- B 1.0 mm³ min⁻¹
- C 2.0 mm³ min⁻¹
- A 4.0 mm³ min⁻¹

Your answer

[1]

4(a).

- i. State the cause of transpiration in plants.

[1]

- ii. Two factors that affect the rate of transpiration in plants are humidity and air movement.

Name **one** other factor that affects the rate of transpiration in plants.

[1]

(b).

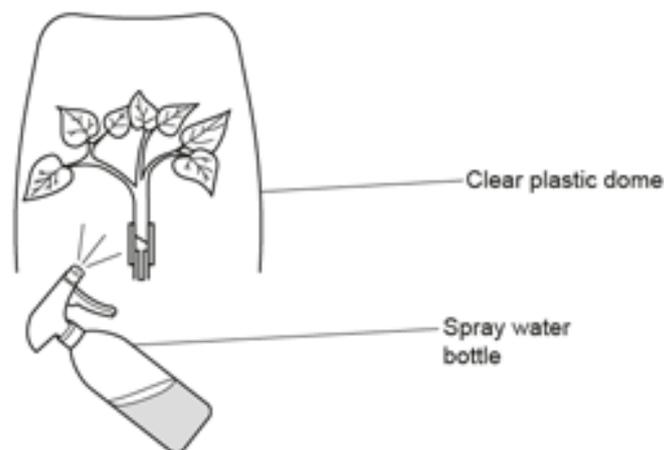
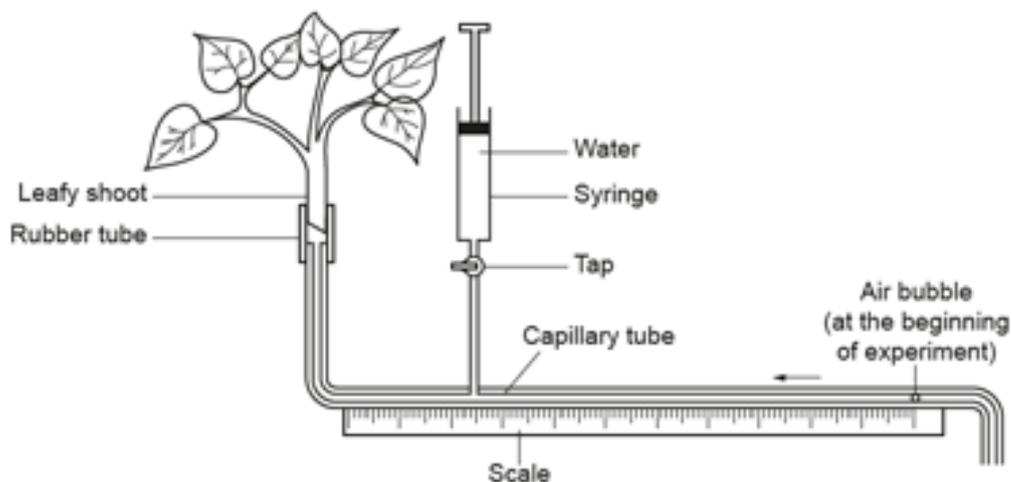
A class of students investigated the effect of humidity on the rate of transpiration from a leafy shoot.

They made the assumption that the volume of water uptake by a leafy shoot is equivalent to the volume of water lost through transpiration.

This is the method the class followed:

- The class was divided into three groups.
- Each group had a potometer and a leafy shoot, shown in the figure.
- Each group investigated one humidity level and completed three trials.
- They measured the distance moved by the air bubble in a fixed time.
- Group A used only the apparatus shown in the figure.

- Groups B and C added to the apparatus. They put a clear plastic dome over the leafy shoot and used a water spray to vary the humidity around the leafy shoot. This is shown in the additional figure with the plastic dome and spray water bottle.



- i. Suggest **three** improvements the students could have made to their investigation.

Improvement 1

Improvement 2

Improvement 3

[3]

- ii. The students' results are shown in the tables.

Group A. Experiment conducted for 3 minutes.

Number of sprays of water	Distance moved by bubble (mm)				Rate of bubble movement (mm min ⁻¹)
	Trial 1	Trial 2	Trial 3	Mean	
0	34	30	31		

Group B. Experiment conducted for 5 minutes.

Number of sprays of water	Distance moved by bubble (mm)				Rate of bubble movement (mm min ⁻¹)
	Trial 1	Trial 2	Trial 3	Mean	
1	31	34	32	32.3	6.5

Group C. Experiment conducted for 5 minutes.

Number of sprays of water	Distance moved by bubble (mm)				Rate of bubble movement (mm min ⁻¹)
	Trial 1	Trial 2	Trial 3	Mean	
2	12	10	9	10.3	2.1

Complete the table by filling in the missing values for mean **and** rate of bubble movement for group A.
Give your answers to **1** decimal place.

Mean = mm
Rate of bubble movement = mm min⁻¹
[2]

iii. State the conclusion that can be drawn from the students' results.

.....
[1]

(c). The students wanted to see how air movement affects rate of transpiration.

Describe how you would **modify** the apparatus shown in both figures to determine how air movement affects rate of transpiration.

.....
[2]

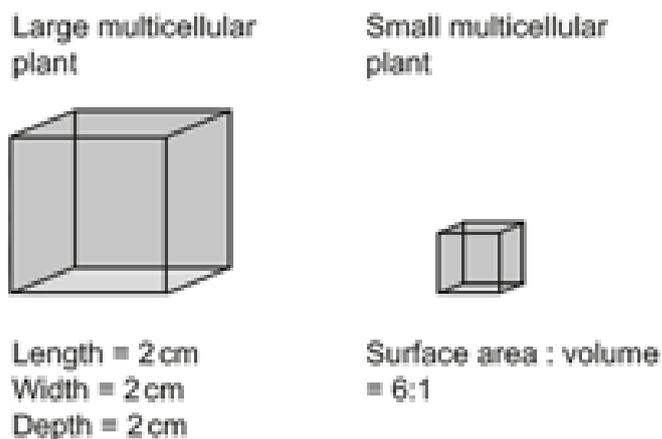
5. Which of the options is an adaptation of a hydrophyte?

- A A thick waxy cuticle
- B Fewer leaves, which results in a reduced SA: V ratio
- C Many stomata on the upper surfaces of leaves
- D Storage of water in parenchyma tissue in roots and stems

Your answer

[1]

6(a). The figure below shows two cubes that represent a large and a small multicellular plant.



- i. Using the data provided in the figure, calculate the surface area : volume of the large multicellular plant.

Surface area : volume = **[2]**

- ii. Explain why a large multicellular plant needs a transport system but a small multicellular plant does not.

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

7(a). In 1933 two scientists published a study in which they investigated the movement of coloured dyes in the transpiration stream of the stems of sycamore trees growing in a wood.

They bored holes in the stems and poured dye solution into the borehole. Then they sealed the hole with impermeable tape.

- i. Describe what is meant by the term **transpiration stream**.

----- [2]

- ii. Suggest why the scientists sealed the borehole with tape.

----- [1]

- iii. The scientists found that the dye moved both up and down the stems.

A student wanted to investigate this in the laboratory. They devised an experiment using water-soluble food dyes injected into the stems of sunflower plants growing in pots.

Suggest how they could observe the route taken by the dyes.

----- [2]

(b). Plants are often watered with a solution containing minerals to help them grow.

While preparing a class practical a technician accidentally watered some sunflower plants with a mineral concentration that was 1000 times higher than normal.

- i. Explain why the plants wilted, even though they were given a lot of water.

----- [3]

- ii. The teacher suggested that the same effect would be seen if the plants had been watered with a solution containing cyanide ions that inhibit ATP synthesis.

Explain whether the teacher was correct.

----- [2]

- iii. Explain why plants growing in high light intensity require more water than plants growing in shade, even when the temperatures are the same.

----- [2]

8. Which of the options describes movement of water through a plant?

- A** The Casparian strip forces water to enter the cytoplasm before it can enter the xylem.
- B** Water can move across the root by the apoplast pathway because of plasmodesmata between cells.
- C** Water is drawn up the xylem because of adhesion between water molecules.
- D** Water moves by osmosis from a low water potential to a high water potential.

Your answer

[1]

9(a). Dicotyledons are a large and diverse group of multicellular plants that includes oak trees and dandelions.

Explain, using examples of transported substances, why multicellular plants need transport systems.

[3]

(b). Fig. 16.1 is a light micrograph of a transverse section through the leaf of a dicotyledon.

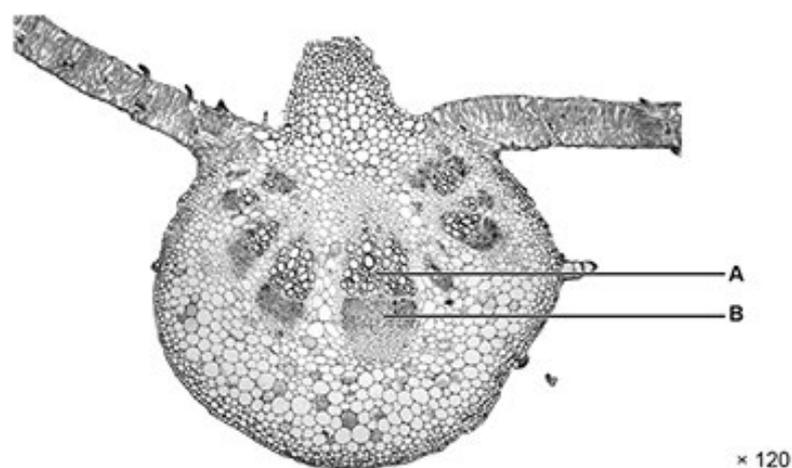


Fig. 16.1

i. Identify the tissue labelled **B** in Fig. 16.1.

B

[1]

ii. State **two** functions of structure **A**.

1

2

[2]

(c). **Fig. 16.2** below and in the **insert** is a coloured scanning electron micrograph (SEM) of a longitudinal section through vascular tissue in the stem of a dicotyledon.

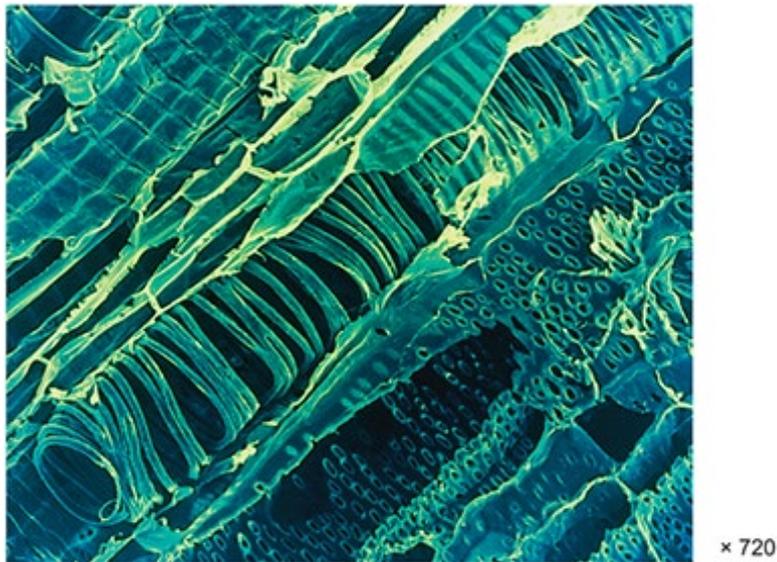


Fig. 16.2

Explain how **two** features, visible in **Fig. 16.2**, show that this tissue is adapted to its function.

1

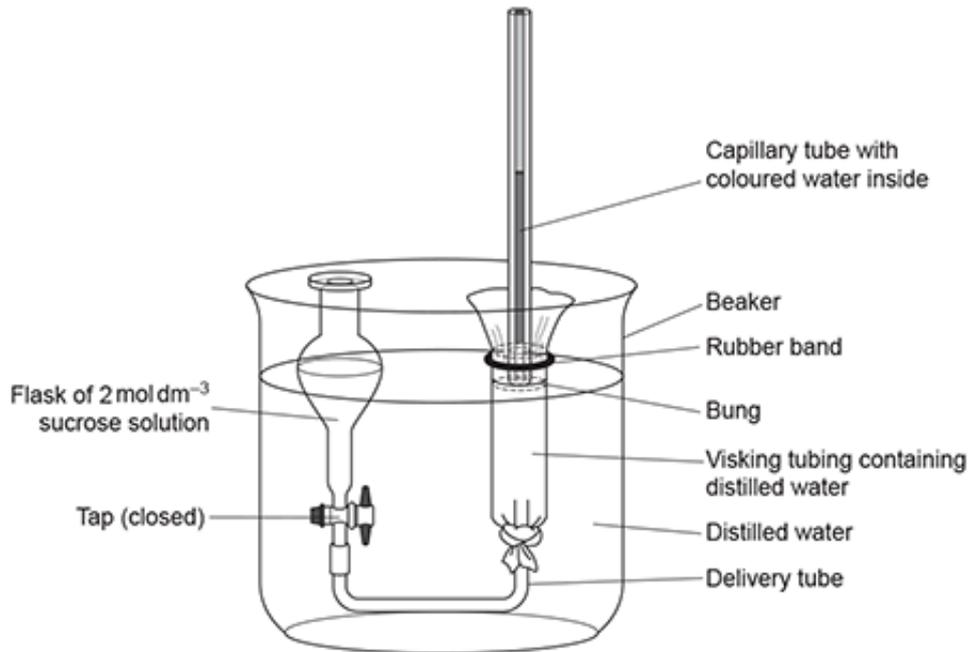
2

[4]

10. A student is investigating how sucrose is loaded into phloem sieve tubes by companion cells, using a model of phloem tissue.

To create the model, the student added distilled water to a bag made from Visking tubing (an artificial partially permeable membrane). They inserted a capillary tube into one end of the Visking tubing and connected the other end to a flask containing 2 mol dm^{-3} sucrose solution.

They placed the Visking tubing and connected flask into a beaker of distilled water, as shown in the diagram.



The capillary tube, the flask and the beaker of distilled water represent plant tissues involved in the active loading of sucrose. The Visking tubing represents the cell surface membrane of the phloem sieve tube.

The student opens the tap on the flask and the level of the coloured water in the capillary remains the same. After a few minutes, the water level in the capillary tube starts to rise. The tap is then closed after 5 minutes.

- i. Describe what happens inside the model, immediately after the tap on the flask is opened.

[1]

- ii. Explain why the water level in the capillary tube starts to rise after a few minutes.

[2]

- iii. With reference to the diagram, name the plant cells or tissues that are represented by:

The capillary tube

The beaker of distilled water

The flask

----- [3]

11(a). Water molecules are transported in the stem of a sunflower. Water molecules are polar and are therefore attracted to each other.

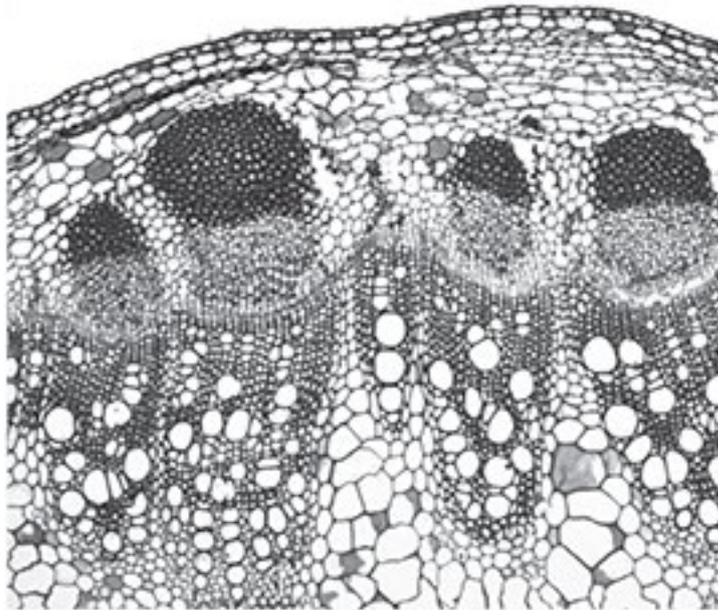
- i. Draw **two** water molecules **and** label the bond between the two molecules.

[3]

- ii. Explain how the properties of water are related to the transport role of water in a stem.

----- [3]

(b). The photomicrograph is of a transverse section of a stem of a sunflower, *Helianthus annuus*.



i. **On the photomicrograph**, label the location of meristem tissue.

[2]

ii. Name the type of microscope used to produce the photomicrograph **and** explain the reasons for your choice.

Name of microscope _____

Reasons for your choice _____

[3]

12. *Victoria cruziana* is a tropical species of flowering plant, native to South America. Its leaves have stomata only on their upper surface and contain a large amount of aerenchyma tissue, which contains air spaces.

Which group of plants does *Victoria cruziana* belong to?

- A Epiphytes
- B Halophytes
- C Hydrophytes
- D Xerophytes

Your answer

[1]

13. Cells in the leaves of plants synthesise amino acids.

Which of the statements explains why plants need a vascular system to support amino acid synthesis?

- A To transport amino acids to the roots using xylem tissue
- B To transport nitrates to the leaves using phloem tissue
- C To transport nitrates to the leaves using xylem tissue
- D To transport sucrose to the leaves using phloem tissue

Your answer

[1]

END OF QUESTION PAPER