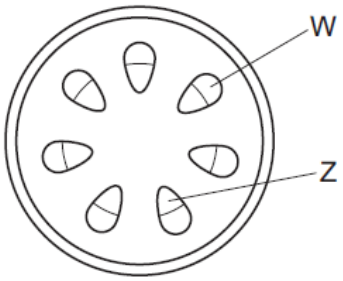
Transport in plants – AS 9700 November 2023

1. Nov/2023/Paper_ 9700/11/No.26

The plan diagram of a transverse section through a dicotyledonous plant stem was drawn by a student. They had stained the section with a chemical that stains lignin.



Which row is correct for tissues W and Z?

	W	Z	stained tissue
A	phloem	xylem	W
B	phloem	xylem	Z
C	xylem	phloem	W
D	xylem	phloem	Z

2. Nov/2023/Paper_ 9700/11/No.28

A plant leaf seen in transverse section with a microscope shows the features listed.

- a thick waxy cuticle on upper surface
- sunken stomata on lower surface
- rolled leaf so the edges curl

What is this leaf adapted for?

A to decrease carbon dioxide uptake

B to increase carbon dioxide uptake

C to decrease water loss by transpiration

D to increase water loss by transpiration

3. Nov/2023/Paper_ 9700/11/No.29

What occurs as carbohydrate is taken out of a sink into a phloem sieve tube element?

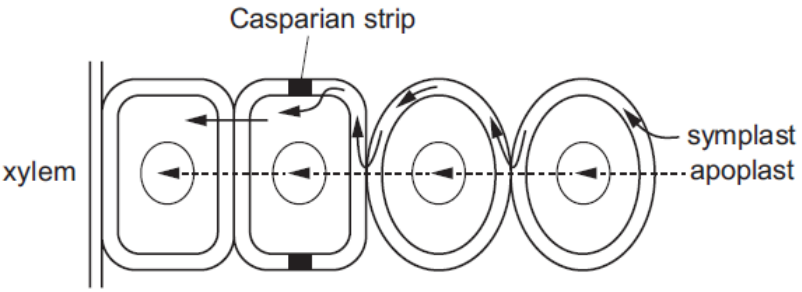
	water potential in phloem sieve tube element becomes	volume of liquid in phloem sieve tube element
A	higher	decreases
B	higher	increases
C	lower	decreases
D	lower	increases

4. Nov/2023/Paper_ 9700/12/No.24

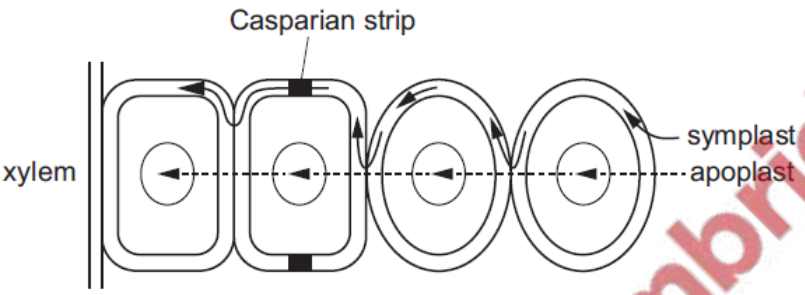
Four students sketched diagrams of the apoplast pathway and the symplast pathway.

Which sketch is the most accurate diagram of the two pathways?

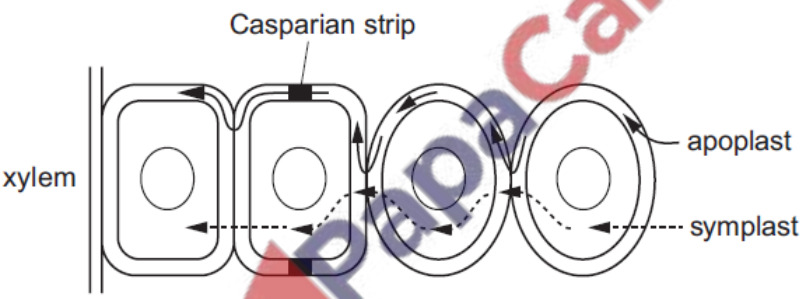
A



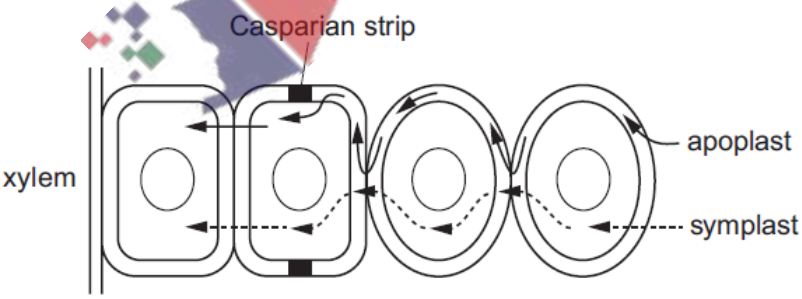
B



C

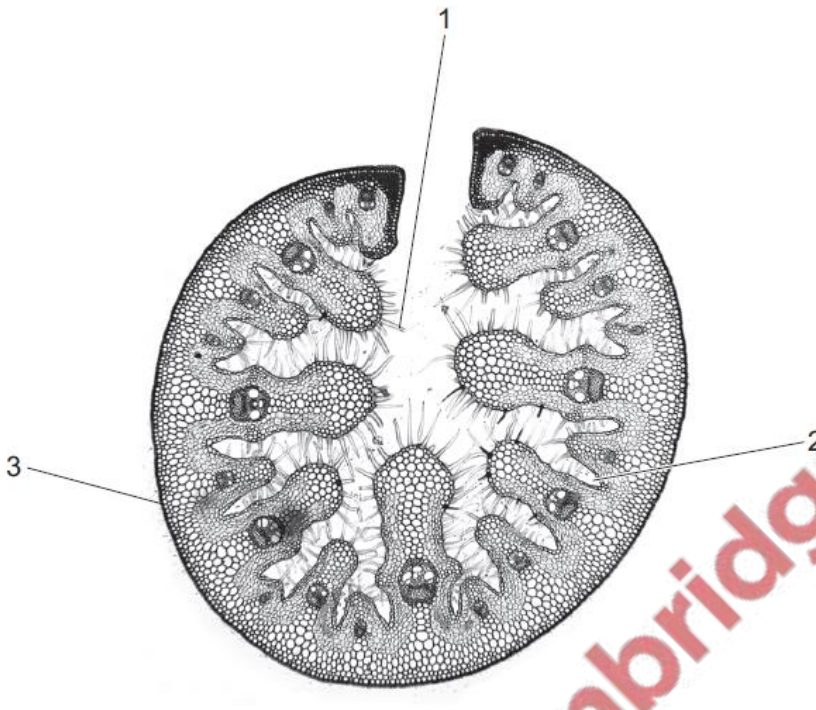


D



5. Nov/2023/Paper_ 9700/12/No.25

The photomicrograph shows some xerophytic adaptations in leaf tissue.



Which row shows the correct functions for structures 1, 2 and 3?

	reduces the water vapour concentration gradient between the inside and outside of the leaf	reduces evaporation from the epidermis of the leaf	traps a layer of moist air
A	1, 2 and 3	3 only	2 only
B	1 and 2 only	1, 2 and 3	1 and 2
C	1 only	2 and 3 only	1 and 2
D	2 and 3 only	1 and 2 only	1 only

6. Nov/2023/Paper_ 9700/12/No.27

When sucrose is loaded into the phloem it has to travel from mesophyll cells to a companion cell and then into the phloem.

Which row shows the relative concentrations of sucrose in each type of cell in order for this process to take place?

	relative concentration of sucrose / arbitrary units		
	mesophyll cell	companion cell	phloem sieve tube element
A	5	10	15
B	5	15	10
C	15	10	5
D	15	5	10

7. Nov/2023/Paper_ 9700/12/No.28

Which feature of transport in plants is correct for xylem **and** phloem?

A It is passive.

B It occurs by mass flow.

C It occurs from source to sink.

D It occurs only in one direction.

8. Nov/2023/Paper_ 9700/13/No.25

Which statement about xylem vessel elements is correct?

A Hollow vessels enable the constant movement of water up and down a plant.

B Pits enable the movement of water into adjacent xylem vessels.

C Vessels contain numerous mitochondria to generate ATP for active transport.

D Vessels contain perforated cross-walls called sieve plates.

9. Nov/2023/Paper_ 9700/13/No.26

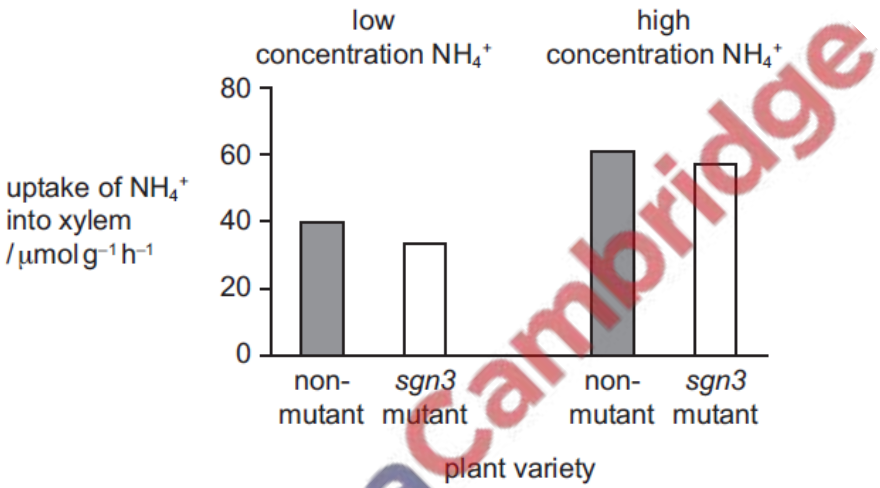
Ammonium ions, NH_4^+, can enter the xylem of plant roots by two pathways.

- In the apoplast pathway, ammonium ions move through cell walls until this pathway is blocked by the Casparian strip. Ammonium ions then enter the cytoplasm of root cells.
- In the symplast pathway, ammonium ions move through the cytoplasm of root cells.

A scientist measured the uptake of ammonium ions into the xylem of *Arabidopsis thaliana*.

The *sgn3* mutant of *A. thaliana* does not have a Casparian strip. In the *sgn3* mutant, ammonium ions can enter the xylem without entering the cytoplasm of root cells.

The bar charts show the scientist's results.



Which conclusion is correct?

A Fewer ammonium ions enter the xylem when they have to move through the cytoplasm of root cells.

B More ammonium ions enter the xylem at low soil concentrations of ammonium ions.

C The Casparian strip acts as a barrier to reduce the movement of ammonium ions into the xylem.

D The loss of the Casparian strip has little effect on the movement of ammonium ions into the xylem.

10. Nov/2023/Paper_ 9700/13/No.27

Which row correctly shows processes required for the movement of water from a root hair cell to the atmosphere?

	cohesion	diffusion	evaporation
A	✓	✓	✓
B	✗	✓	✗
C	✓	✗	✓
D	✗	✓	✓

key
✓ = required
✗ = not required

11. Nov/2023/Paper_ 9700/21/No.3

Plants have specialised cells for the efficient transport of assimilates.

(a) Table 3.1 shows some of the features of two different types of cell found in plant tissue, which are adapted for the efficient transport of assimilates.

Table 3.1

feature of cell	cell type A	cell type B
cytoplasm	✓	✓
nucleus	✗	✓
mitochondria	few	many
cellulose in the cell wall	✓	✓
ribosomes	✗	✓

Key
✓ present
✗ absent

Many plasmodesmata connect type **A** cells with type **B** cells.

Identify cell type **A and** explain why the plasmodesmata are important.

cell type **A** .....

explanation .....

.....

.....

.....

.....

.....

.....

[3]

(b) The polysaccharide callose is found in the cell walls of cells close to plasmodesmata.

Fig. 3.1 is a simplified diagram showing the structure of callose. Not all hydrogen atoms are shown.

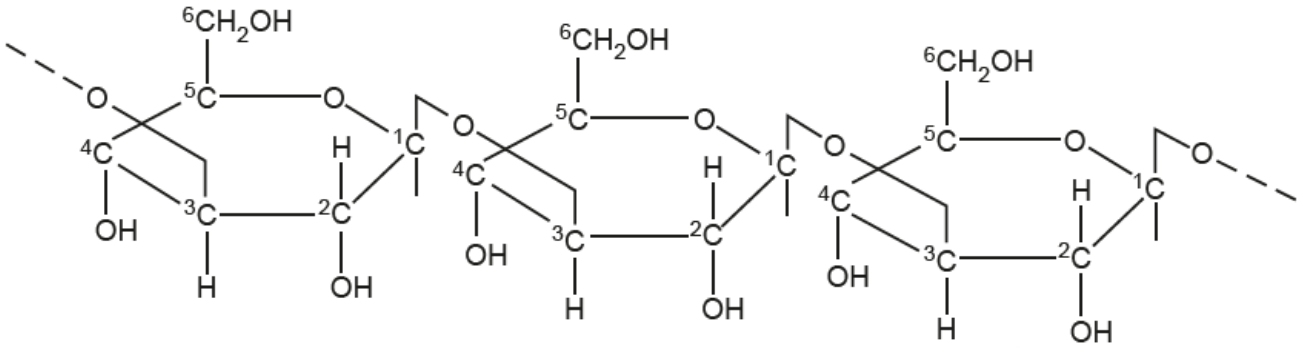


Fig. 3.1

Complete Table 3.2 to compare the structure of a callose molecule with a cellulose molecule.

Table 3.2

feature of polysaccharide	callose molecule	cellulose molecule
monosaccharide used to synthesise the polysaccharide	β-glucose	
bond connecting the monomers		1,4 glycosidic bond
shape of molecule	helix	
orientation of monosaccharides in the molecule		alternate glucose molecules are rotated by 180°

[4]

(c) Hydrogen bonding is important for movement of water through xylem vessels in a plant.

Describe the roles of hydrogen bonding in the movement of water through xylem vessels.

.....

.....

.....

.....

.....

.....

..... [3]

(d) Water that has travelled through xylem vessels reaches the leaves. Cooling of the leaf occurs as a result of the evaporation of water during transpiration.

Water has a high latent heat of vaporisation because water molecules form hydrogen bonds.

With reference to hydrogen bonding, suggest why cooling of the leaf occurs as a result of evaporation of water during transpiration.

.....

.....

.....

.....

..... [2]

[Total: 12]

Water that is absorbed from the soil solution by the roots of a plant enters xylem vessels and is transported to the leaves and buds.

Fig. 6.1 shows four important requirements for the efficient transport of water from the roots to the leaves of a plant.

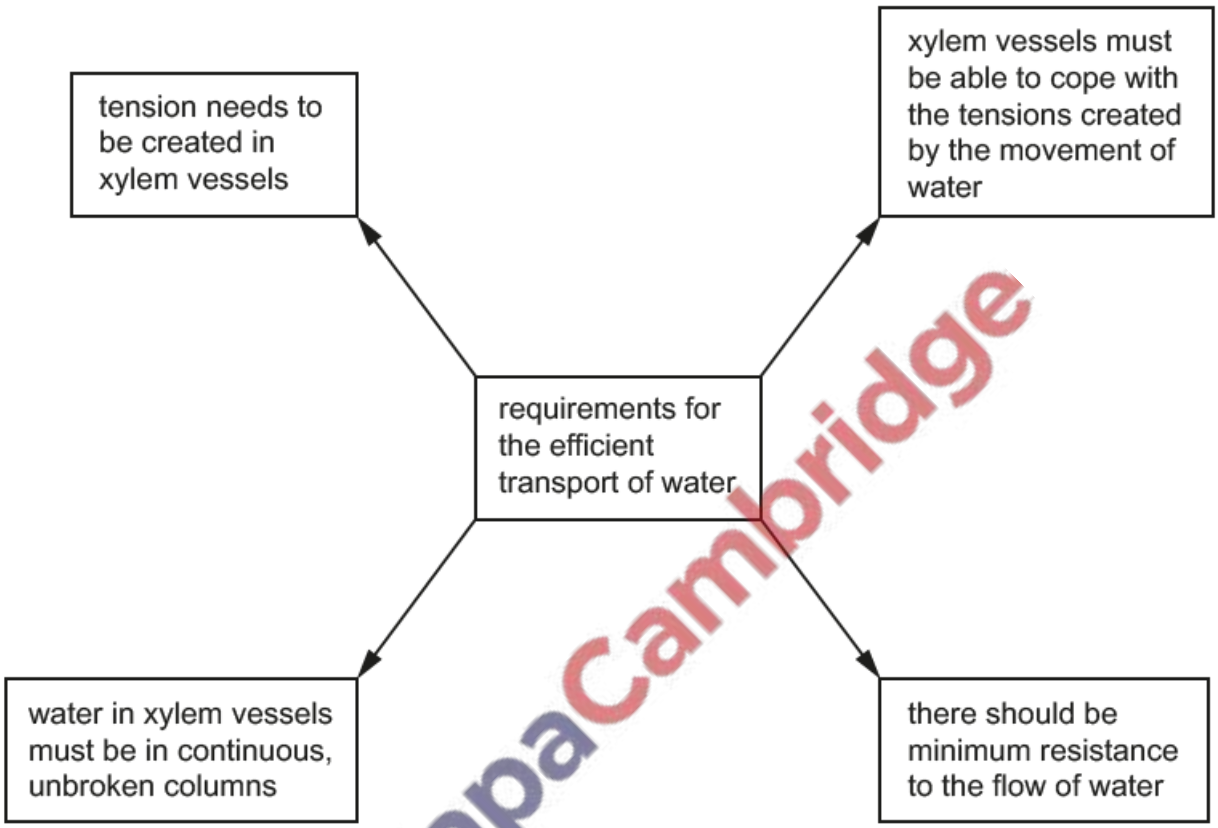


Fig. 6.1

(a) Name the specialised cells that are arranged end to end to form xylem vessels.

..... [1]

(b) Explain how tension is created in the xylem vessels.

.....

.....

.....

.....

.....

..... [2]

(c) Fig. 6.1 highlights how the structure of xylem vessels must be related to their function. This means that during the development of xylem vessels changes need to occur to the cells forming the vessels.

(i) The walls of the cells forming the xylem vessel walls become lignified during development.

Explain how this feature is important for the efficient transport of water.

.....

.....

.....

.....

..... [2]

(ii) During the development of xylem vessels, the end walls of the cells forming the vessels break down. This contributes to minimising resistance to the flow of water.

Describe **one** other main change that needs to occur to these cells so that their structure becomes suited to their function.

.....

.....

..... [1]

[Total: 6]

13. Nov/2023/Paper_ 9700/23/No.5

In flowering plants, transport of assimilates occurs in phloem tissue between sources and sinks.

(a) (i) Explain why a root can be a source **and** a sink.

.....

.....

.....

.....

..... [2]

(ii) State **two** examples of assimilates that are transported in the phloem.

..... [1]

(b) Describe **and** explain the mechanism that is responsible for the movement of phloem sap in sieve tubes.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) Tobacco mosaic virus (TMV) infects many crop plants. The virus passes between cells in the leaves and can travel throughout plants in the phloem.

The enzyme pectin methylesterase (PME) is involved with the production of cell walls. The enzyme is also known to influence the movement of TMV through plants. Scientists investigated the effect of PME on the transport of TMV through plants.

The scientists used three varieties of tobacco plants. Two varieties, **V1** and **V2**, have small quantities of PME. A third variety, **C**, has the normal quantity of PME and was used as the control in this investigation.

The plants in each group were infected with TMV at the same time. The accumulation of the virus particles transported to the leaves at the top of the plants was determined over 36 days.

The results are shown in Fig. 5.1. The arrow indicates when all the plants were infected with TMV.

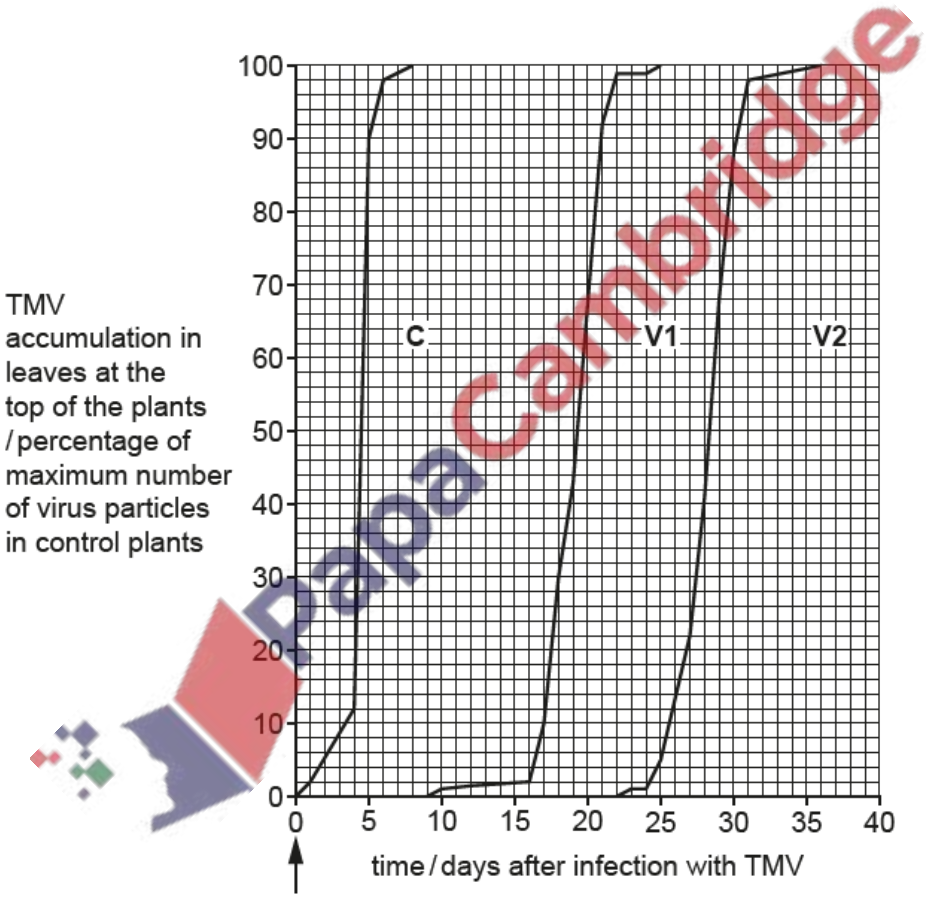


Fig. 5.1

Compare the results for varieties **V1** and **V2** with the control group of plants, **C**.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]