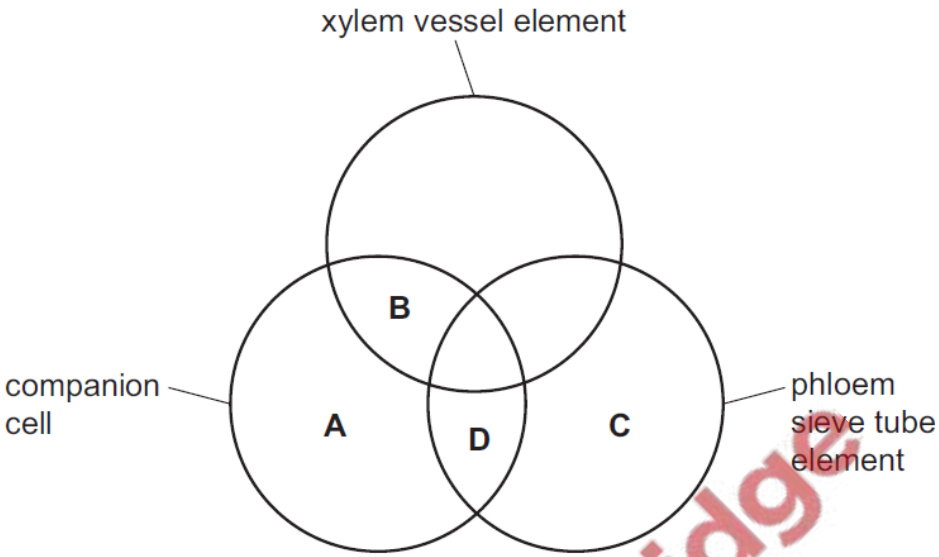
Transport in plants – AS 9700 June 2022

1. June/2023/Paper_9700/11/No.23

Which structures contain cytoplasm with mitochondria and a nucleus?



2. June/2023/Paper_9700/11/No.24

What is the correct term to describe intermolecular hydrogen bonding between water molecules?

A adhesion

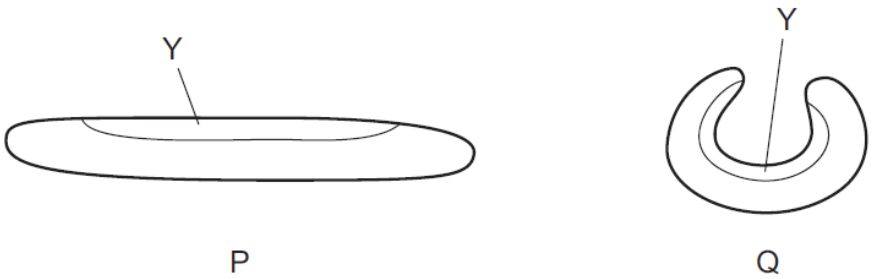
B cohesion

C osmosis

D diffusion

3. June/2023/Paper_9700/11/No.25

The diagram shows the outline of a xerophytic leaf that had been left for 45 minutes in different conditions, P and Q.



Which statements about the cells in layer Y of the leaf in each of the conditions P and Q **after** 45 minutes are correct?

1 There is a less negative water potential in P than in Q.

2 The cells may be turgid in P and plasmolysed in Q.

3 The cells are less turgid in P than in Q.

4 There is no net diffusion of water into Y in either P **or** Q.

A 1, 2 and 4 **B** 1, 3 and 4 **C** 1 and 3 only **D** 2 and 4 only

4. June/2023/Paper_9700/11/No.26

How does sucrose move from chloroplasts to the phloem?

1 diffusion

2 apoplast pathway

3 symplast pathway

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

5. June/2023/Paper_9700/11/No.27

How are companion cells involved in loading sucrose into phloem sieve tube elements?

A actively through cotransporter proteins and passively through plasmodesmata

B actively through cotransporter proteins and plasmodesmata

C passively through cotransporter proteins only

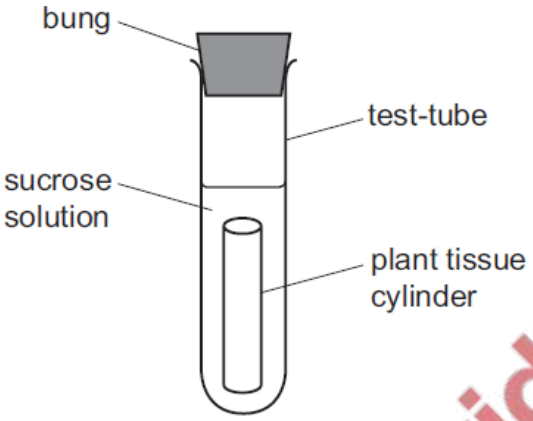
D actively through plasmodesmata only

6. June/2023/Paper_9700/12/No.19

An experiment was carried out to investigate the effect of concentration of sucrose solution on cells in a plant tissue.

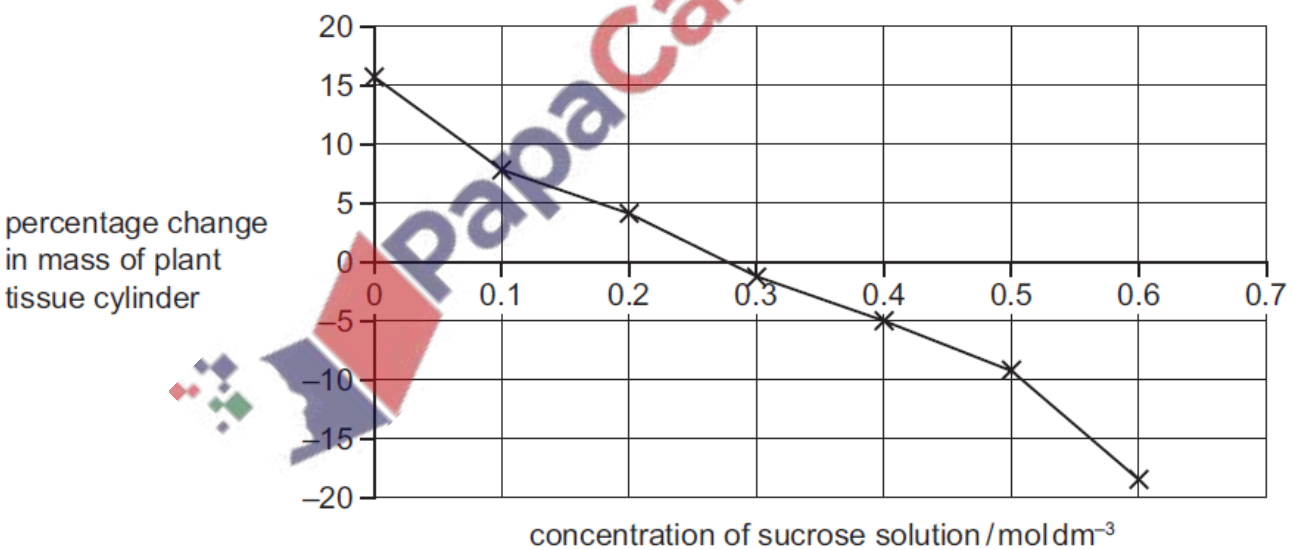
A sample of plant tissue was cut into seven cylinders of equal length and diameter. The mass of each cylinder was recorded.

Each of the seven cylinders was put into a different sucrose solution concentration.



After two hours, the cylinders were removed, blotted dry and reweighed. The percentage change in mass of each cylinder was recorded.

The graph shows the results of this investigation.



Which row explains the results if plant tissue cells were put in a sucrose solution of 0.45 mol dm^{-3}?

	water potential of the cytoplasm of the cells at the start of the experiment compared with the water potential of 0.45 mol dm^{-3} sucrose solution	change in volume of the vacuoles of the cells at the end of the experiment, that were initially placed in 0.45 mol dm^{-3} sucrose solution
A	less negative	decreased
B	less negative	increased
C	more negative	decreased
D	more negative	increased

7. June/2023/Paper_9700/12/No.27

Which statements about the apoplast and symplast pathways are correct?

1 In the apoplast pathway, water molecules move through free spaces in the cellulose cell walls of plant roots.

2 In the symplast pathway, water molecules diffuse through the cytoplasm and plasmodesmata of cells.

3 Water molecules travelling through plant tissue move by mass flow along the apoplast pathway.

4 The Casparian strip blocks the symplast pathway and forces all water molecules to enter the cytoplasm of endodermis cells.

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 2 only

D 3 and 4 only

8. June/2023/Paper_9700/12/No.28

Where does water evaporate from during transpiration?

A intercellular spaces

B leaf surface

C mesophyll cell walls

D stomatal pores

9. June/2023/Paper_9700/12/No.31

Which statement supports the theory of active loading of sucrose into companion cells?

A The pH decreases in the cell wall of the companion cells compared with the cytoplasm.

B The pH decreases in the cytoplasm of the companion cells compared with the cell wall.

C The pH decreases in the companion cells and sieve tube elements.

D The pH decreases in the sieve tube elements compared with the companion cells.

10. June/2023/Paper_9700/13/No.27

Which row correctly explains how the structures of phloem sieve tube elements and xylem vessel elements are related to their functions as transport systems?

	phloem sieve tube elements	xylem vessel elements
A	contain mitochondria to make ATP for the active loading of sucrose into the phloem	cell walls are thickened and contain lignin which makes xylem vessels waterproof
B	contain no nucleus so that dissolved solutes can move easily through cells	end walls between cells are perforated so that water can move easily through xylem vessels
C	end walls between cells are perforated so that dissolved solutes can move between cells	lignin in cell walls gives strength so that xylem vessels do not collapse due to transpiration pull
D	no end walls between cells so that sucrose solution can move up and down the phloem	contain no cytoplasm so that a continuous column of water can move up the xylem vessels

11. June/2023/Paper_9700/13/No.28

Which component of plants is used by the apoplast pathway as water is moved from the soil to the xylem?

A Casparian strip

B cellulose

C endodermis

D suberin

12. June/2023/Paper_9700/13/No.29

Which statements correctly describe transport pathways in dicotyledonous plants?

1 In the symplast pathway, water may move through intercellular spaces.

2 The symplast pathway may be blocked by the tonoplast.

3 In the apoplast pathway, water does **not** move through plasmodesmata.

4 The apoplast pathway may be blocked by the Casparian strip.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

13. June/2023/Paper_9700/13/No.30

Plants, such as the tobacco plant, retain very little of the water they take in and the volume of water lost during transpiration is very high. This is because these plants can only absorb carbon dioxide through open stomata.

Plants use carbon dioxide to synthesise glucose molecules. It is estimated that 400 molecules of water are lost for each carbon dioxide molecule gained.

How many water molecules are lost for a plant to synthesise one molecule of glucose?

A 800 **B** 1200 **C** 2000 **D** 2400

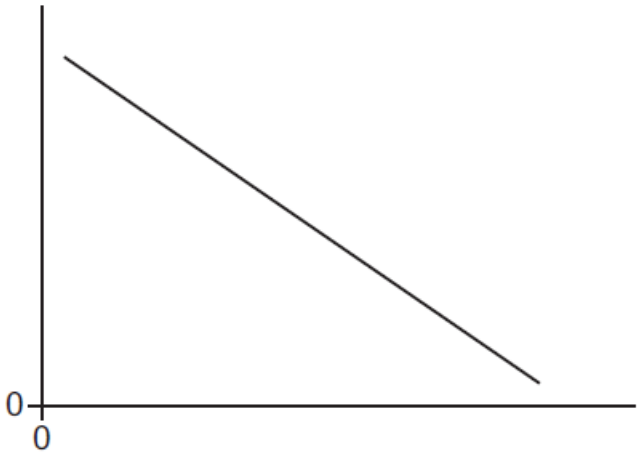
14. June/2023/Paper_9700/13/No.31

Which changes occur as sucrose is transferred from leaves into phloem sieve tubes to be transported to a sink?

	water potential in phloem sieve tubes becomes	volume of liquid in phloem sieve tubes
A	less negative	decreases
B	less negative	increases
C	more negative	decreases
D	more negative	increases

15. June/2023/Paper_9700/13/No.32

The graph shown does not have any axis labels.



Which row shows appropriate labels for the axes that would explain mass flow in phloem?

	x-axis	*y*-axis
A	distance from sink / m	hydrostatic pressure / kPa
B	hydrostatic pressure / kPa	distance from sink / m
C	distance from source / m	hydrostatic pressure / kPa
D	hydrostatic pressure / kPa	distance from source / m

16. June/2023/Paper_9700/21/No.6

Fig. 6.1 is a diagram showing the passage of water through the tissues of a flowering plant from the soil to the atmosphere. The arrows show the direction of water movement.

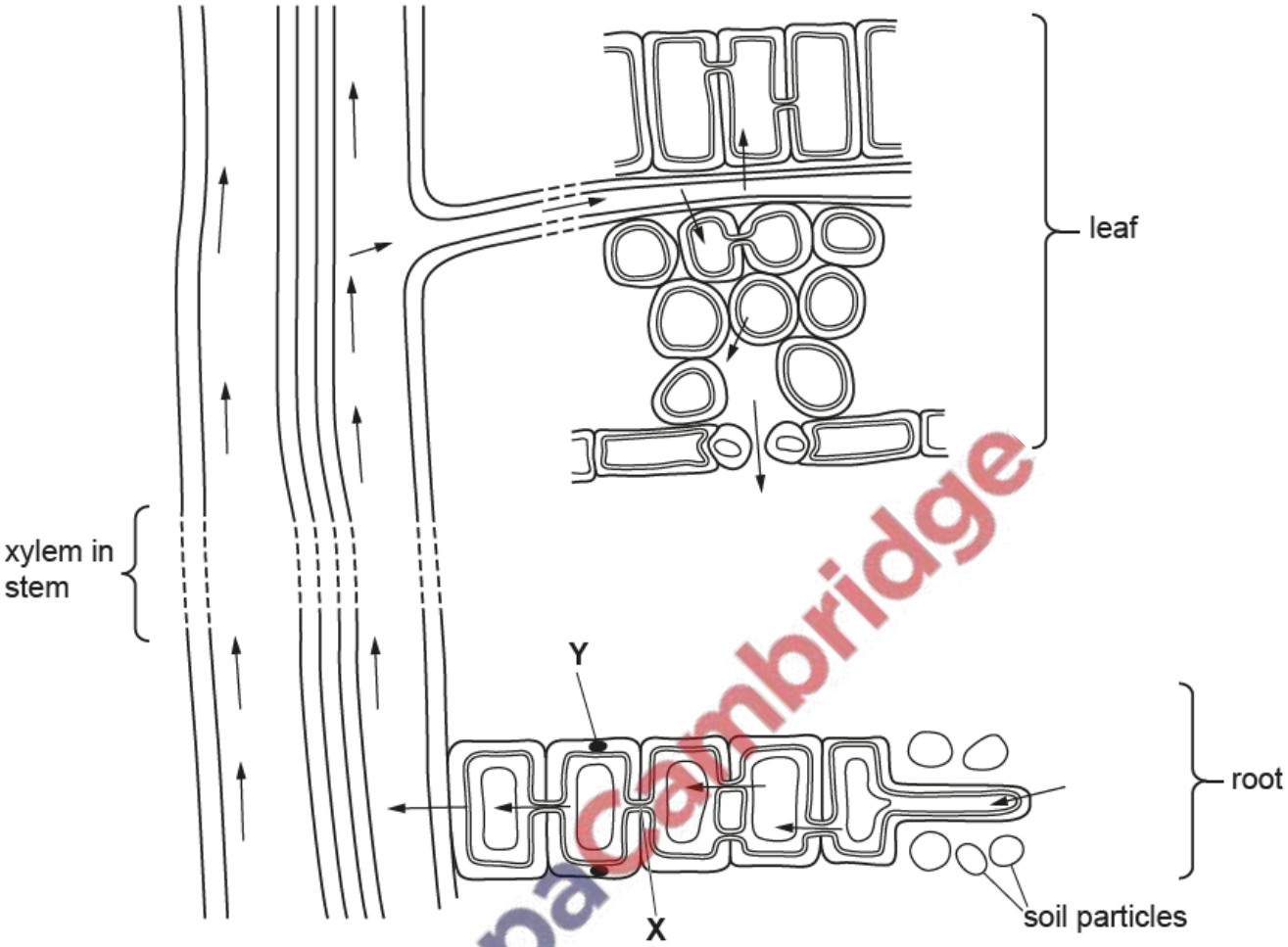


Fig. 6.1

(a) The structure labelled **X** is part of the symplast pathway. State the name of structure **X**.

..... [1]

(b) The structure labelled **Y** in the cell wall is a barrier to the apoplast pathway. State the name of structure **Y**.

..... [1]

(c) With reference to Fig. 6.1, complete the statements about the movement of water in the flowering plant.

Water moves from the soil solution to the cytoplasm of root hair cells by .....

Water moves from the xylem in the root to the leaf by .....

Water moves from mesophyll cell walls to intercellular air spaces by .....

Water vapour moves from intercellular air spaces to the atmosphere outside the leaf by .....

[4]

[Total: 6]

17. June/2023/Paper_9700/22/No.6

The Weibel Lung model was developed after an extensive study of the gas exchange system. The model includes detailed measurements of airway diameters (lumen diameters of the airways). In the model, different parts of the gas exchange system are identified with a generation number, as outlined in Fig. 6.1.

airway		generation number
trachea		0
X		1
↓		2
		3
bronchioles		4
↓		5 ↓ 16
terminal bronchioles		
respiratory bronchioles		17
		18
		19
alveolar ducts		20
		21
		22
alveolar sacs	alveoli	23

Fig. 6.1

(a) The Weibel Lung model describes how each airway divides into two.

Name the airways in generation 1, labelled **X** in Fig. 6.1, that branch from generation 0.

..... [1]

(b) The airways are well supplied with blood. However, the airways from generation 0 to generation 16, shown in Fig. 6.1, are **not** able to carry out gas exchange.

Suggest why the airways from generation 0 to generation 16 are **not** able to carry out gas exchange.

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..... [2]

(c) High-resolution computed tomography (HRCT) is an imaging technique that is used to obtain measurements of airway diameters in people with a pulmonary (lung) disease. Regular, repeated imaging must be avoided because it involves exposure to harmful radiation.

Scientists researched the use of a different technique, HP gas MRI, that does **not** involve harmful radiation. Two types of MRI image, known as projection and multi-Slice, were used to obtain measurements of airway diameters.

Fig. 6.2 shows the results of the HP gas MRI study compared with the Weibel Lung model, for generations 0 to 5. The Weibel Lung model was used as a standard reference for airway diameters.

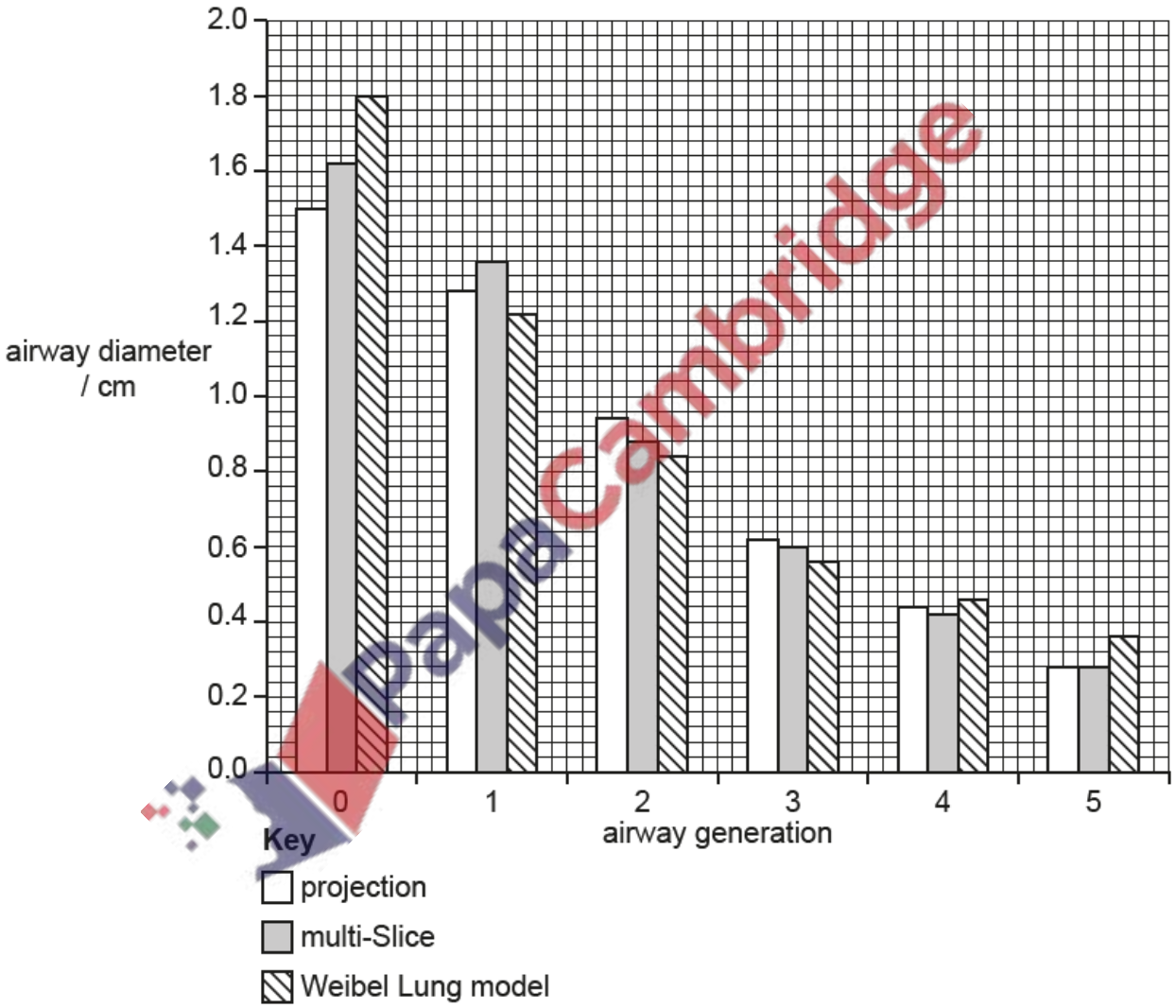

Fig. 6.2

(i) State the relationship shown in Fig. 6.2 between airway diameter and airway generation for the Weibel Lung model data.

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..... [1]

(ii) With reference to the data in Fig. 6.2, explain whether HP gas MRI could be a useful alternative to HRCT in obtaining airway diameter measurements.

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..... [3]

[Total: 7]

18. June/2023/Paper_9700/23/No.5

Phloem and xylem are specialised tissues involved in the transport of water, ions and assimilates in plants.

(a) A photomicrograph of a transverse section of a dicotyledonous stem is shown in Fig. 5.1.

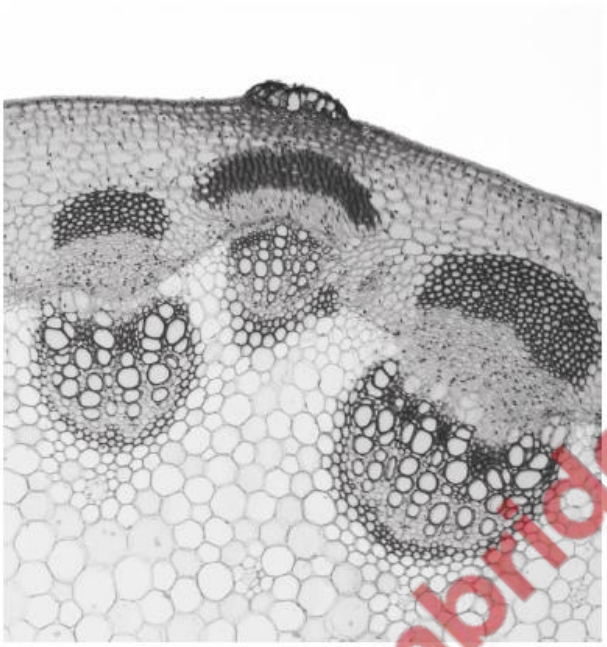

Fig. 5.1

Use label lines and labels to identify the phloem tissue **and** xylem tissue in Fig. 5.1. [2]

(b) **(i)** Describe how sucrose is transported in phloem sieve tubes from photosynthesising leaves to other parts of the plant.

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..... [4]

(ii) Cyanide ions (CN^-) inhibit the activity of an enzyme involved in respiration.

Suggest why the treatment of photosynthesising leaves with CN^- results in less sucrose being transported into phloem sieve tubes.

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..... [2]

(c) A student was asked to carry out semi-quantitative Benedict's tests on two solutions.

- Solution **A** was extracted from the cytoplasm of cells in the mesophyll tissue of photosynthesising leaves.
- Solution **B** was extracted from the phloem sap in phloem sieve tubes.

The solutions were taken from the same plant, and other variables were standardised.

For each solution, the student measured the time taken for the first colour change to appear.

Suggest which of the two solutions, **A** or **B**, would change colour in the shortest time.

Explain your answer.

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..... [2]

[Total: 10]

19. March/2023/Paper_9700/12/No.25

Which row correctly matches the structure and function of phloem sieve tube elements?

	structure	function
A	peripheral cytoplasm with no nucleus	to provide as little resistance to flow as possible
B	end walls modified to form sieve plates	to slow down the rate of transport of solutes
C	elongated cells joined end to end	to form a tube to transport dissolved mineral ions and water
D	cellulose cell wall with no lignin	to prevent loss of water

20. March/2023/Paper_9700/12/No.26

Which feature of xylem vessel elements helps adhesion during transpiration?

A Lignin forms a complete secondary wall.

B New vessels carry extra water as the plants grow.

C There are no cross walls between vessel elements.

D The vessel elements form a narrow tube.

21. March/2023/Paper_9700/12/No.27

Mass flow is the bulk movement of materials from one place to another.

How many of the vessels listed carry fluids by mass flow?

- artery
- phloem sieve tube
- vein
- xylem vessel

A 1 **B** 2 **C** 3 **D** 4

22. March/2023/Paper_9700/12/No.28

Cellulose, lignin and suberin are components of various plant cell walls.

Descriptions of these cell wall components are listed.

1 a component of the Casparian strip

2 redirects water into the symplast pathway

3 a hydrophobic component of cell walls

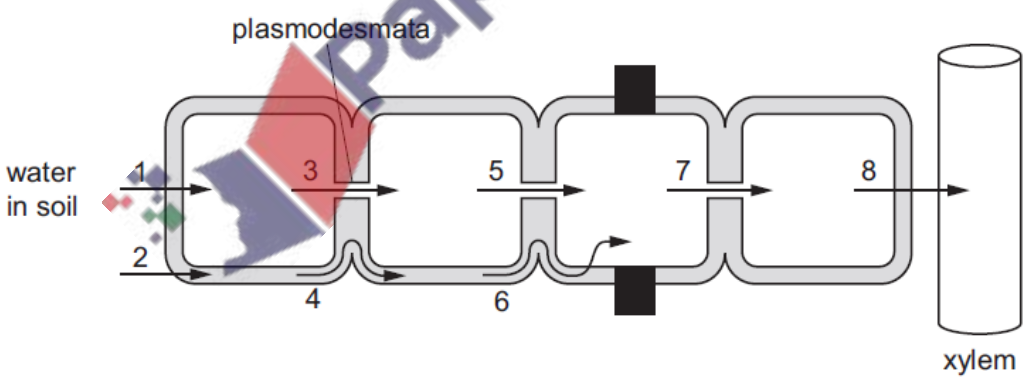
4 water interacts with this molecule in the apoplast pathway

Which row correctly matches three of the descriptions with cell wall components?

	cellulose	lignin	suberin
A	2	4	1
B	3	4	2
C	4	1	2
D	4	3	1

23. March/2023/Paper_9700/12/No.29

The arrows show the direction of water movement across a plant root, from water in the soil to the xylem.



Which arrows show water movement **only** in the apoplast pathway?

A 1, 3, 5, 7 and 8

B 2, 4 and 6

C 2 and 4 only

D 3, 5 and 7 only

24. March/2023/Paper_9700/12/No.30

Which row correctly identifies sources and sinks of sugars?

	root cells absorbing mineral ions	storage cells of seed that is starting to grow
A	sink	source
B	sink	sink
C	source	source
D	source	sink

25. March/2023/Paper_9700/22/No.3

(a) Fig. 3.1 is a diagram of an area of phloem tissue from a transverse section through the stem of a squash plant, *Cucurbita pepo*.

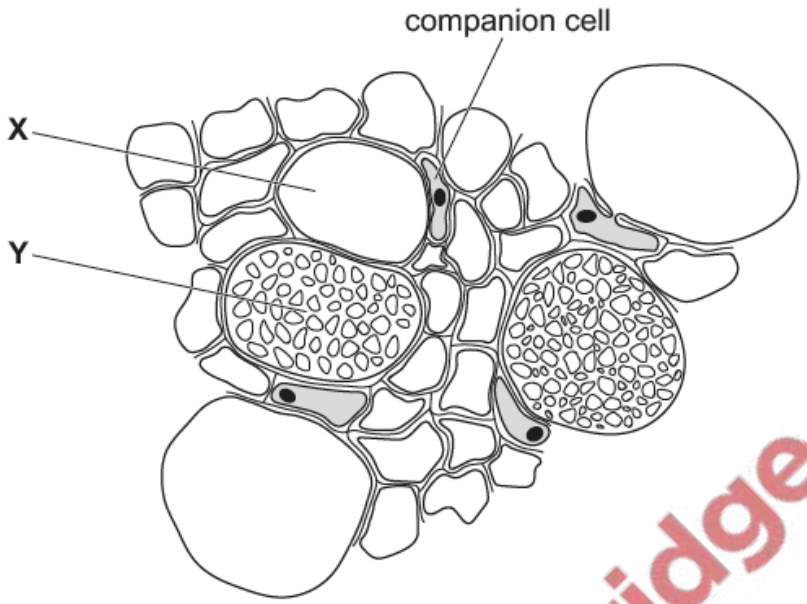


Fig. 3.1

(i) Cell **X** and cell **Y** in Fig. 3.1 are sieve tube elements.

Explain why cell **X** and cell **Y** have very different appearances in this transverse section.

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..... [2]

(ii) Sucrose is formed from the glucose synthesised by mesophyll cells in the leaves of *C. pepo*.

Explain how companion cells are involved in the transfer of sucrose into phloem sieve tubes.

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..... [4]

(b) Hydrogen bonding is important in the movement of water in xylem.

(i) Explain how hydrogen bonding occurs between two water molecules.

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..... [2]

(ii) Outline how hydrogen bonding is involved in water transport in the xylem of a plant stem.

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..... [3]

(iii) Hydrogen bonding between water molecules gives water a relatively high latent heat of vaporisation.

Suggest why it is important to plants that water has a high latent heat of vaporisation.

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..... [2]

[Total: 13]