

7. Transport in plants

NOTE: phloem sieve tubes have endoplasmic reticulum.

1.

Why does an air bubble in a xylem vessel element stop the flow of water?

- 1 loss of adhesion
- 2 loss of cohesion
- 3 collapse of xylem vessel element

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

Ans: D

2.

A student wrote the following statements about a possible mechanism for loading sucrose from a source.

- 1 When energy is released from ATP, the released energy is used to move sucrose through a co-transporter protein in the companion cell membrane.
- 2 As sucrose is moved into a companion cell the pH in the cell wall of the companion cell decreases.
- 3 Proton pumps in the cell membrane of a companion cell move sucrose into the phloem sieve tube element.

Which statements are correct?

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

Ans: D

- The cotransport of sucrose and H⁺ ions is NOT an active process. Only pumping of H⁺ ions out of the companion cell is active!
- When sucrose moves into companion cell, it is cotransported with H⁺ ions, so pH in the cell wall decreases due to decrease in H⁺ ions.

3.

Some of the features present in transport tissues are listed.

- 1 lignified walls
- 2 cytoplasm
- 3 mitochondria
- 4 pits
- 5 plasmodesmata

Which features are present in xylem vessel elements?

- A** 1, 2, 3 and 4
- B** 1, 4 and 5
- C** 1 and 4 only
- D** 2, 3 and 5

Ans: C

REMEMBER: xylem vessel elements DO NOT have plasmodesmata!!

4.

Which molecules form hydrogen bonds with water during transpiration?

- 1 cellulose in the xylem wall
- 2 suberin in the xylem wall
- 3 other water molecules in the xylem

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

Ans: C

5.

Some plant species can take up heavy metal contaminants that are dissolved in soil water and then transport them within the plant. Within plant cells, the heavy metals accumulate mainly in the vacuole.

Which suggestions about the transport and accumulation of heavy metals are valid?

- 1 After initial entry into the root, some of the heavy metals can pass through the tonoplast to be stored in the vacuole of cells in the cortex.
- 2 The heavy metals take an apoplastic pathway in the xylem but at the endodermis must take a symplastic pathway.
- 3 The rate of accumulation of the heavy metals in leaf cells will be faster at night, when photosynthesis is not occurring, than during the day.
- 4 The presence of heavy metals causes the transpiration stream to slow down and reduce the rate of transpiration.

A 1 and 2

B 1 and 4

C 2 and 3

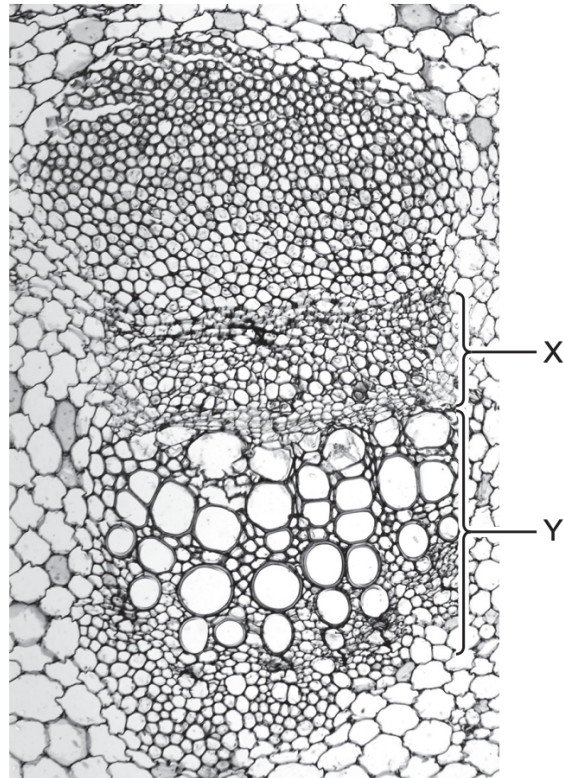
D 3 and 4

Ans: A

- Photosynthesis↑ = transpiration↑, so option 3 is wrong
- There is no data to support option 4

6.

The photomicrograph shows a vascular bundle found in a plant organ.



Which statements about this vascular bundle are correct?

- 1 The vascular bundle is part of the structure of a root.
- 2 Some of the cells in region X have very large numbers of mitochondria.
- 3 Region Y is made up of a number of different cell types.

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

Ans:

- X = phloem; Y = xylem (due to large lumen of xylem vessels)
- 1 is false, since in root xylem will be in centre with phloem all around; this appears to be stem
- 2 is true, since companion cells in phloem have many mitochondria
- 3 is true since xylem tissue has 4 different types of cells

7.

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

Ans: A

8.

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.

Ans: D

- Narrow tube means that more water molecules are exposed to the walls of the tube, increasing adhesion with the walls of the tube

9.

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

Ans: D

10.

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

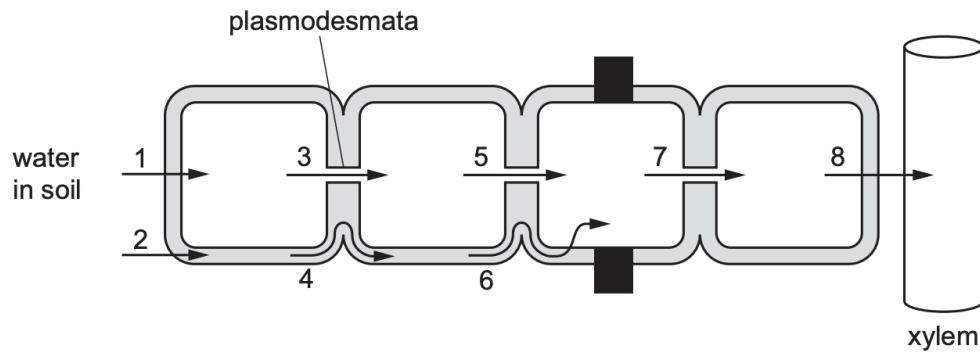
Which row correctly matches three of the descriptions with cell wall components?

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

Ans: D

11.

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

Ans: C

12.

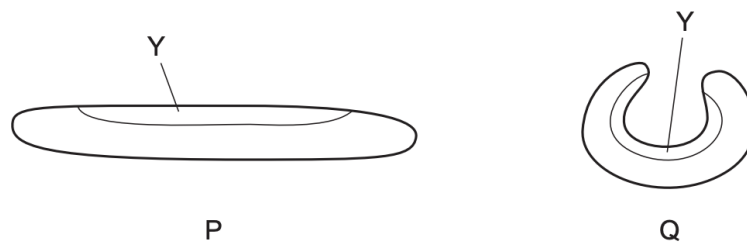
Which row correctly identifies sources and sinks of sugars?

	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

Ans: A

13.

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

Ans: A

- After 45 minutes, cells in P become turgid and cells in Q become plasmolysed, thus option 2 is right
- Thus after 45 minutes, P has a less negative water potential, as it has already filled up with some water, thus option 1 is right
- After 45 minutes, there won't be net diffusion of water into P

14.

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

Ans: A

- Chloroplasts are inside palisade mesophyll cell, so sucrose has to diffuse out
- It then travels by apoplast & symplast pathway to the companion cells

15.

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

Ans: A

16.

Which statement correctly describes the association between a companion cell and its sieve tube cell?

- A** The companion cell provides all of the ATP used for energy-requiring processes in both types of cell.
- B** The companion cell controls the active transport of molecules through the sieve plates.
- C** The companion cell prevents side-to-side movement of assimilates between sieve tube cells.
- D** The companion cell provides a nucleus that controls cellular activities in both types of cell.

Ans: D

NOTE: Because sieve tube elements are devoid of a nucleus, the nuclei of companion cells control their metabolic activities.

17.

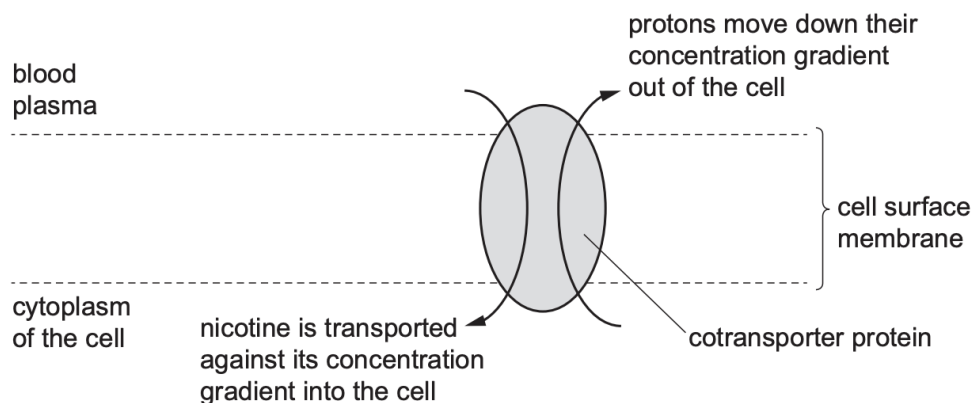
Which conditions are needed to allow the mass flow of sucrose in phloem sieve tubes?

	phloem sieve tube in sources	phloem sieve tube in sinks
A	higher hydrostatic pressure higher water potential	lower hydrostatic pressure lower water potential
B	higher hydrostatic pressure lower water potential	lower hydrostatic pressure higher water potential
C	lower hydrostatic pressure higher water potential	higher hydrostatic pressure lower water potential
D	lower hydrostatic pressure lower water potential	higher hydrostatic pressure higher water potential

Ans: B

18.

The diagram shows how nicotine is transported from the blood plasma into a cell using a type of cotransporter mechanism.



In the phloem tissue, there is a cotransporter mechanism that moves sucrose into the cytoplasm of a companion cell.

Which statement correctly describes a similarity between the cotransport of nicotine and the cotransport of sucrose?

- A** The cotransporter proteins generate a proton gradient by moving protons out of the cell by active transport.
- B** The protons are transported through the cotransporter proteins by facilitated diffusion.
- C** The protons move through the cotransporter proteins in the opposite direction to the movement of nicotine and sucrose.
- D** The cotransporter proteins use energy from ATP to transport protons with nicotine and sucrose.

Ans: B

NOTE: mechanism of cotransport of sucrose

- Hydrogen ions/ protons pumped out of companion cell through cotransport proteins against concentration gradient, using energy from ATP
- Sucrose cotransported with protons back into companion cell
- Sucrose moves against concentration gradient; protons move down concentration gradient back into companion cell by facilitated diffusion using cotransport protein

19.

A student observed the effect of two different concentrations of salt solution on blood cells.

The student added each concentration of salt solution to one of two microscope slides, and then a small drop of fresh blood was added.

Each slide was viewed using the high power lens of a microscope and the student's observations were recorded.

slide 1 No red blood cells were visible.

slide 2 The red blood cells were visible but looked slightly crinkled.

Which row correctly explains the results obtained?

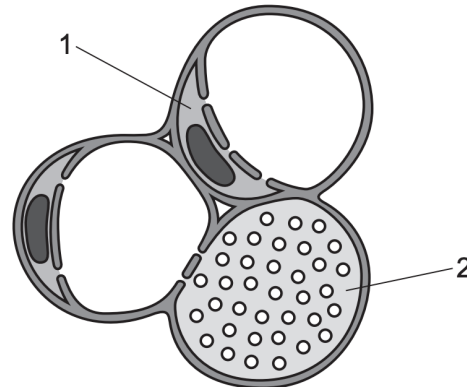
	slide 1	slide 2
A	Swelling of the cells caused them all to burst.	The Ψ of the cell was more negative than the Ψ of the external solution.
B	The Ψ of the cell was more negative than the Ψ of the external solution.	The Ψ of the external solution was more negative than the Ψ of the cell.
C	The Ψ of the cell was less negative than the Ψ of the external solution.	There is a net movement of water out of the cell by osmosis.
D	The Ψ of the external solution was less negative than the Ψ of the cell.	The Ψ of the cell was very similar to, but slightly more negative than, the Ψ of the external solution.

key
 Ψ = water potential

Ans: B

20.

The diagram shows a transverse section through a transport tissue in a plant.



Which row correctly identifies cell 1 and cell 2?

	cell 1	cell 2
A	companion cell	phloem sieve tube element
B	companion cell	xylem vessel element
C	phloem sieve tube element	phloem sieve tube element
D	phloem sieve tube element	xylem vessel element

Ans: A

21.

Which statement correctly describes the movement of solutes in the symplast pathway?

- A** Cell surface membranes regulate the selective absorption of solutes into the symplast pathway.
- B** Plasmodesmata control the movement of solutes from the symplast pathway to the apoplast pathway.
- C** The symplast pathway transports dissolved mineral ions from the soil that **cannot** be transported by the apoplast pathway.
- D** The movement of solutes through plasmodesmata in the symplast pathway is prevented in the endodermis by suberin.

Ans: A

22.

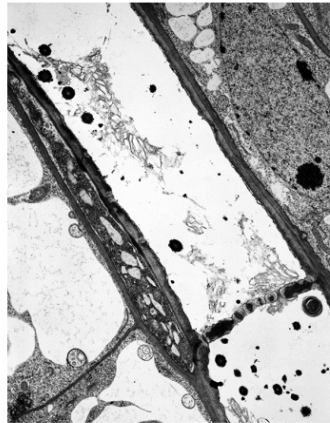
Which substances in xylem tissue are impermeable to water and prevent the collapse of the vessels?

	impermeable to water	prevent collapse
A	cellulose	cellulose only
B	cellulose	lignin only
C	lignin	cellulose only
D	lignin	cellulose and lignin

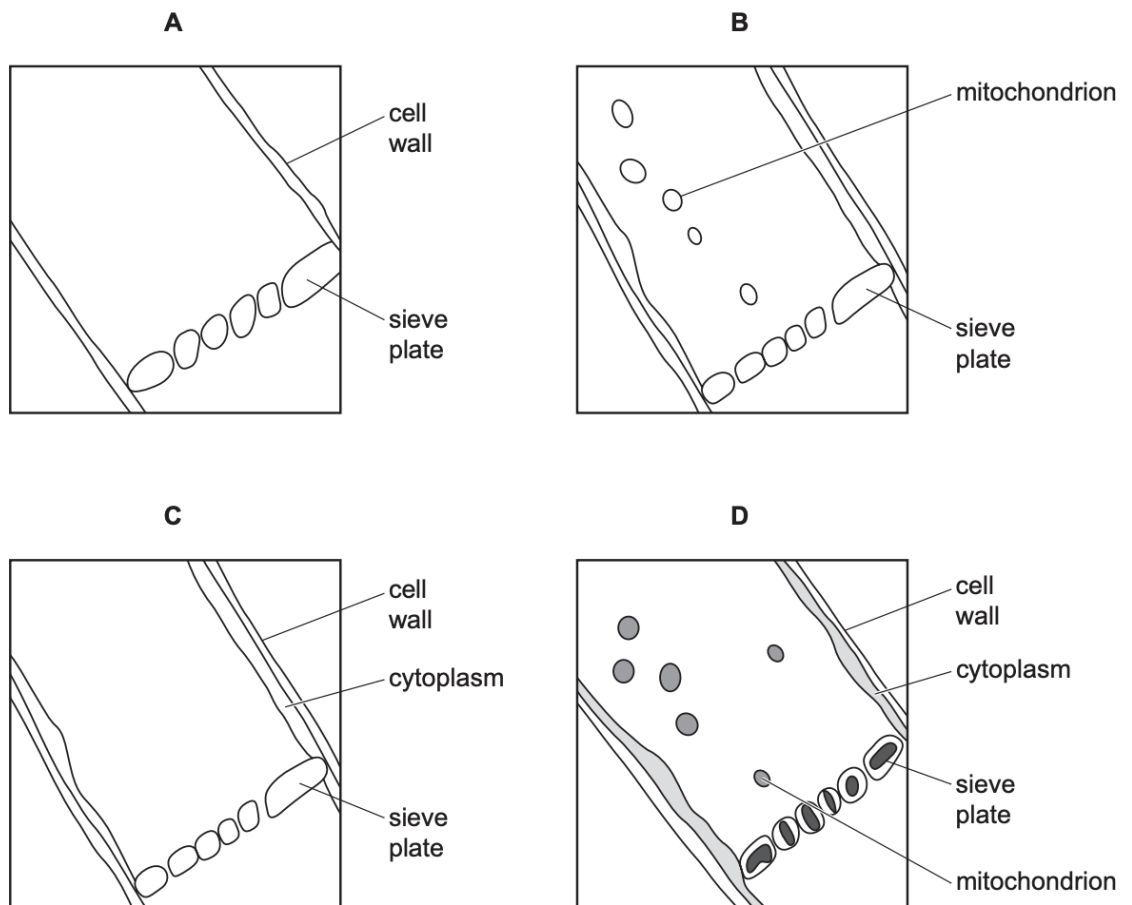
Ans: D

23.

27 The electron micrograph shows a longitudinal section through phloem tissue.



Which student's drawing of a sieve tube element is correctly drawn and labelled?



Ans: C

24.

Xylem vessel elements are specialised cells that are adapted for the transport of water.

Which statement correctly matches an adaptation of a xylem vessel element to its function?

- A** Cytoplasm is only found in a thin layer next to the cell walls and does **not** contain any organelles. This reduces resistance to the flow of water in the xylem vessels.
- B** The end walls between xylem vessel elements have partially broken down, forming end plates. This reduces resistance to the flow of water in the xylem vessel.
- C** The walls of the xylem vessel elements contain cellulose that is hydrophilic and can form hydrogen bonds to water, allowing adhesion of water molecules to the vessel walls.
- D** Xylem vessel elements have plasmodesmata that connect them with companion cells. The companion cells provide ATP, which is needed for the transport of water.

Ans: C

25.

A student makes an accurate labelled plan diagram of a section of a leaf containing a vascular bundle.

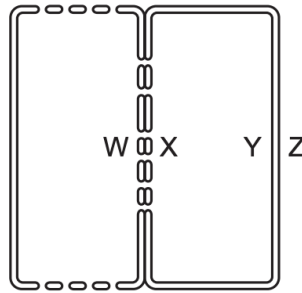
Which statement correctly describes part of their plan diagram?

- A** The vascular bundle has labels for the xylem vessel elements, phloem sieve tube elements and companion cells.
- B** The vascular bundle is divided into two sections, with the section closer to the upper epidermis labelled as xylem and the other section labelled as phloem.
- C** In the section of the vascular bundle positioned closer to the lower epidermis, each sieve tube element has an associated companion cell.
- D** The phloem sieve tube elements are drawn with thick cell walls to represent the lignin in the walls.

Ans: B

26.

The diagram shows a phloem sieve tube element and a companion cell that are involved in translocation of sucrose.



Which process correctly describes the translocation of sucrose through these cells?

- A** Sucrose moves from Y to Z by active transport.
- B** Protons move from Y to Z by active transport.
- C** Protons move from Z to Y by diffusion.
- D** Protons move from X to W by diffusion.

Ans: B

27.

Which types of molecules are cotransported into companion cells?

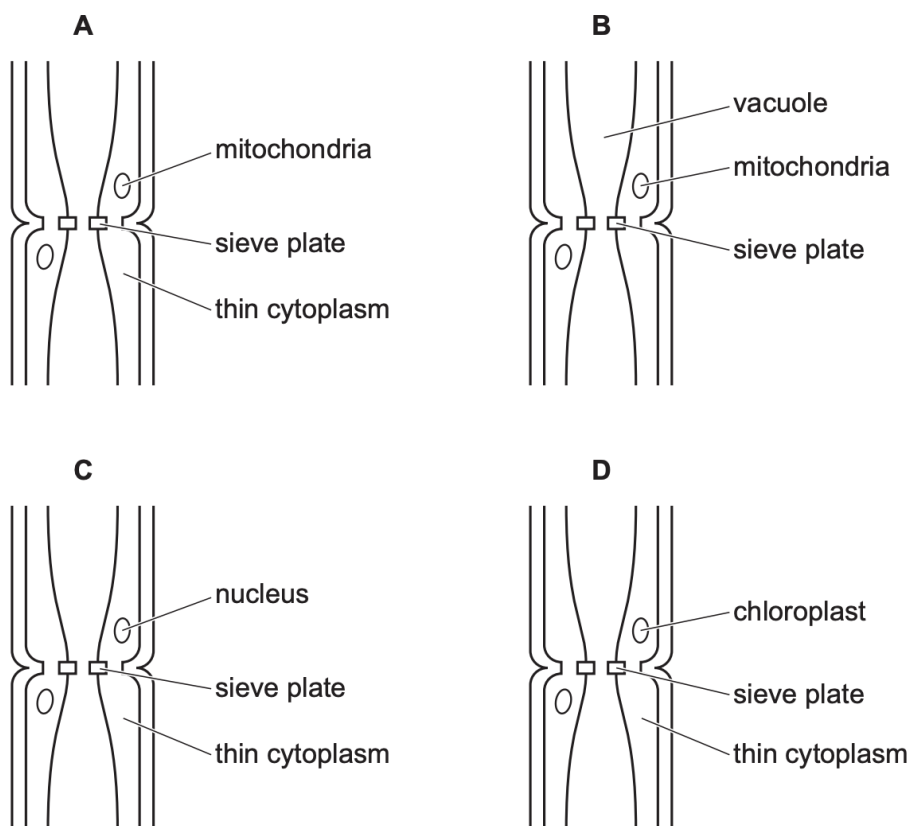
- A** monomers and disaccharides
- B** monomers and polysaccharides
- C** polymers and disaccharides
- D** polymers and monosaccharides

Ans: A

28.

Four students have drawn and labelled part of a structure seen on an electron micrograph.

Which student has labelled their drawing correctly?



Ans: A

NOTE:

- Phloem sieve tube elements have thin cytoplasm AND mitochondria
- They DO NOT have nuclei OR chloroplasts!!

29.

Which row identifies cells with plasmodesmata?

	phloem sieve tube element	companion cell	xylem vessel element
A	✓	✓	✓
B	✓	✓	x
C	✓	x	✓
D	x	✓	✓

key

✓ = plasmodesmata present

x = plasmodesmata not present

Ans: B

30.

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

Ans: B

31.

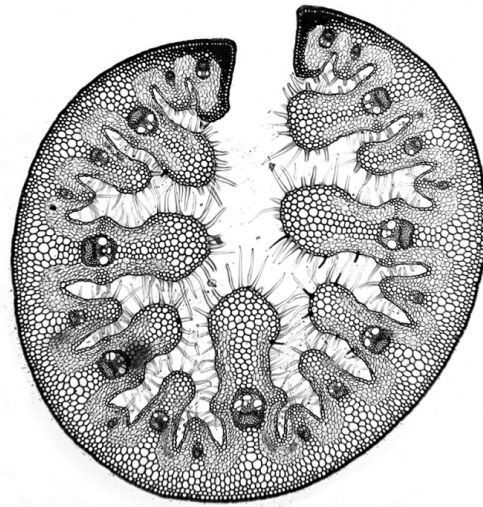
Where does water evaporate from during transpiration?

- A** intercellular spaces
B leaf surface
C mesophyll cell walls
D stomatal pores

Ans: C

32.

The photomicrograph shows a transverse section of the leaf of a species of grass.



The grass is specially adapted to grow in a dry habitat.

Which row correctly explains how the features help the grass to grow in this habitat?

	hair-like structures	leaf shape
A	increase internal humidity	decrease external humidity
B	decrease external humidity	increase internal humidity
C	increase internal humidity	increase internal humidity
D	decrease external humidity	decrease external humidity

Ans: C

33.

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.

Ans: A