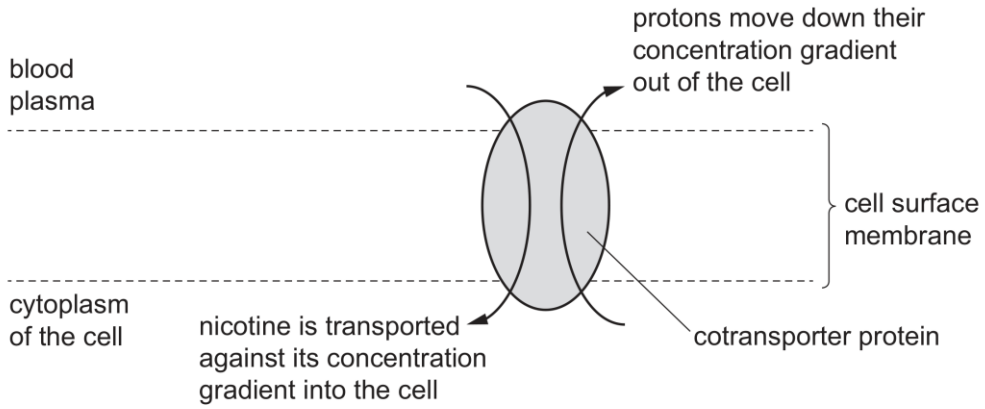
7. Transport in Plants

7.2 Transport mechanisms

Paper 1

Question Paper

1 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.

2 Which substance makes xylem vessel walls impermeable to water?

A cellulose

B lignin

C suberin

D collagen

3 Which row correctly identifies sinks for sucrose transported by mass flow in plants?

	root storage organ	growing leaf bud	growing shoot tip
A	✓	✓	✓
B	✓	✗	✓
C	✗	✓	✗
D	✗	✗	✓

key

✓ = sink

✗ = not a sink

4 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.

5 Which statement helps to explain why water molecules are forced to move through xylem vessel elements as a consequence of transpiration?

A Water molecules form hydrogen bonds with cellulose in the walls of xylem vessel elements in a process known as adhesion.

B Water molecules form hydrogen bonds with neighbouring water molecules in a process known as cohesion.

C Water molecules form ionic bonds with dissolved mineral ions, which helps to keep the water molecules together in a continuous column.

D Water has a high latent heat of vaporisation and this prevents the evaporation of water in the xylem vessel elements.

6 Which statement correctly identifies the movement of sucrose and amino acids in plant vascular tissue?

A They are carried from source to sink by mass flow in upward and downward directions.

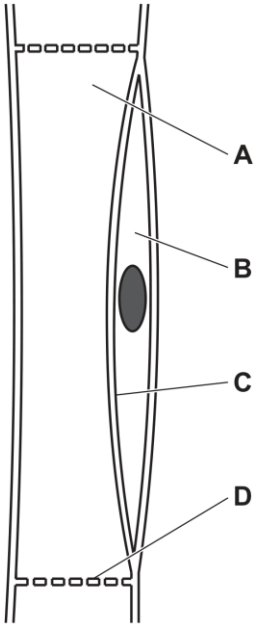
B They are carried from sink to source by cohesion-tension in upward and downward directions.

C They are carried from sink to source by mass flow in one direction.

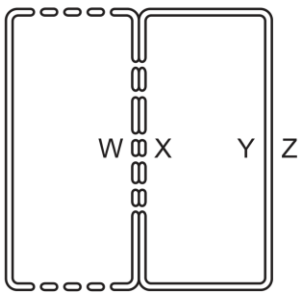
D They are carried from source to sink by cohesion-tension in one direction.

7 The diagram shows a longitudinal section of a phloem sieve tube with a companion cell.

Where are the mitochondria located for the release of energy for cotransport?



8 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.

9 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

10 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

11 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

12 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

13 Where does water evaporate from during transpiration?

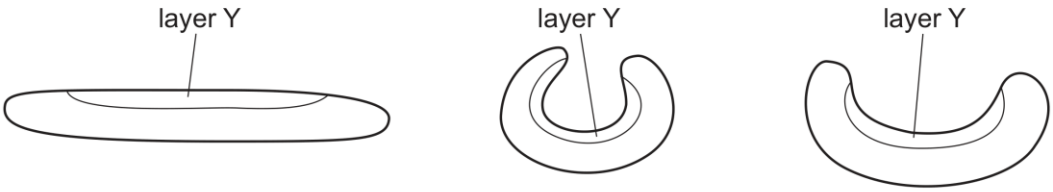
A intercellular spaces

B leaf surface

C mesophyll cell walls

D stomatal pores

14 The diagram shows the outline of three xerophytic leaves of the same type in three different conditions, P, R and S.

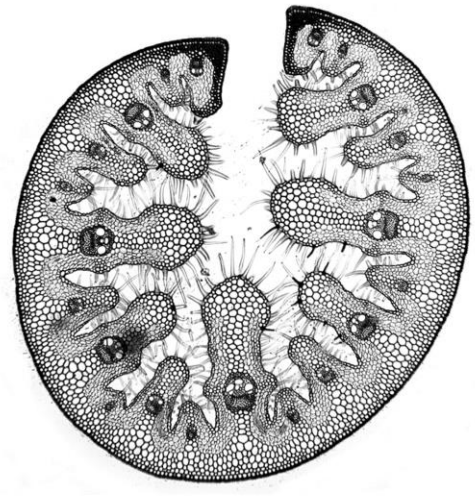


P R S

Which description of the water potential of the cells in layer Y is correct?

	water potential of cells in layer Y		
	P	R	S
A	higher than R and S	lower than P and S	lower than P
B	higher than S	lower than P	higher than P
C	lower than R	higher than S	higher than R
D	lower than R and S	higher than P	lower than P

15 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

16 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.

17 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

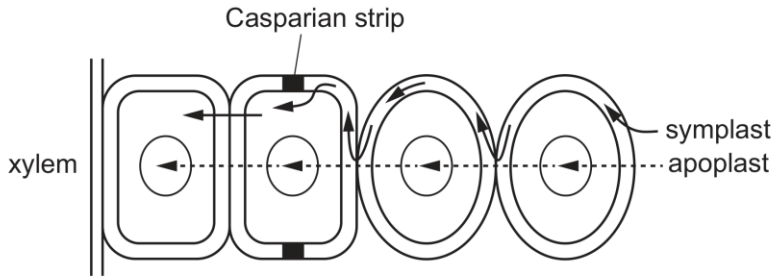
18 What occurs as carbohydrate is taken out of a sink into a phloem sieve tube element?

	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

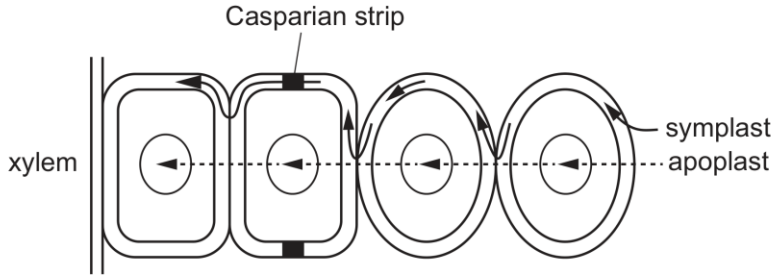
19 Four students sketched diagrams of the apoplast pathway and the symplast pathway.

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

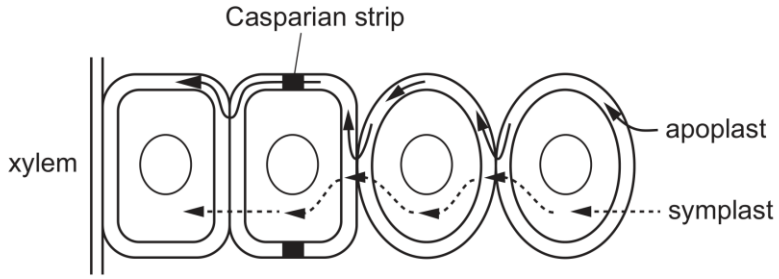
A



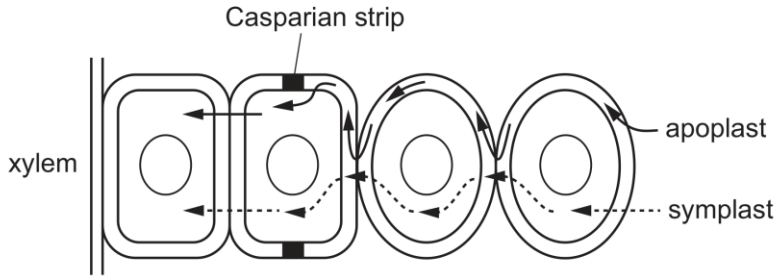
B



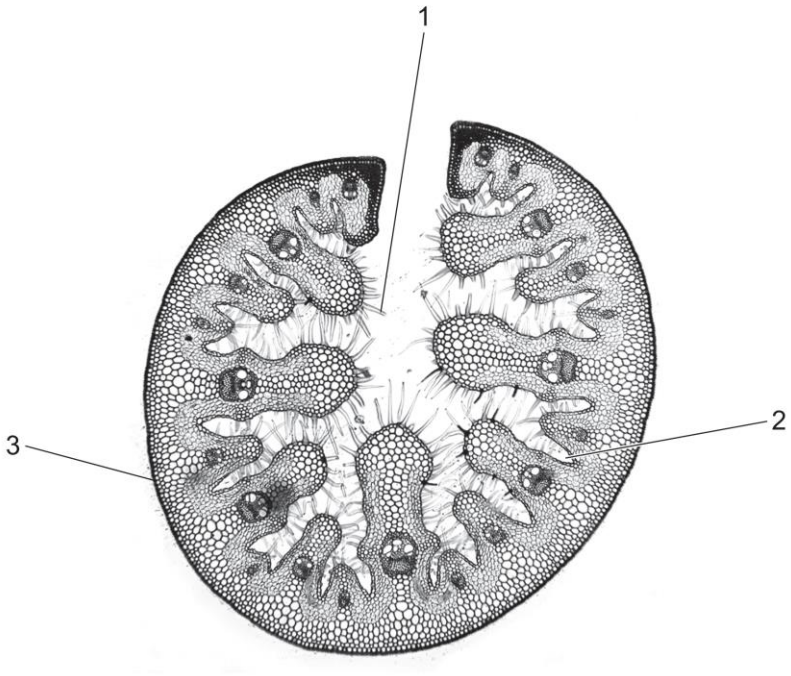
C



D



20 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

21 Which processes are required for the transfer of assimilates from a source cell into a phloem sieve tube?

A active transport, facilitated diffusion and simple diffusion

B active transport and exocytosis

C active transport and simple diffusion only

D active transport only

22 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

23 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.

24 Which row is correct for the movement of water in a root?

	pathway	molecule present in Casparian strip
A	apoplast pathway through intercellular spaces	suberin
B	apoplast pathway through plasmodesmata	lignin
C	symplast pathway through plasmodesmata	lignin
D	symplast pathway through intercellular spaces	suberin

25 The table contains some information about uptake and movement of water and of mineral ions in plants.

	water	mineral ions
mechanism for uptake	osmosis	diffusion, active transport
site of uptake	root hair cells	root hair cells
mechanism of release	evaporation, diffusion	diffusion, active transport
site of release	stomata	plant cells

Using the information provided, which factors will affect the uptake and movement of water or of mineral ions in plants?

1 humidity

2 surface area of root hair cell

3 oxygen concentration

4 temperature

A 1, 2, 3 and 4

B 1, 3 and 4 only

C 1 and 3 only

D 4 only

26 Which changes to the water potential and the volume of solution in the phloem sieve tube occur when sucrose is moved from a photosynthesising leaf into the phloem sieve tube?

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

27 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

28 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

29 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

30 What is the correct route for the movement of water from cell to cell in the apoplast pathway?

A through adjacent cell surface membranes

B through intercellular spaces

C through plasmodesmata

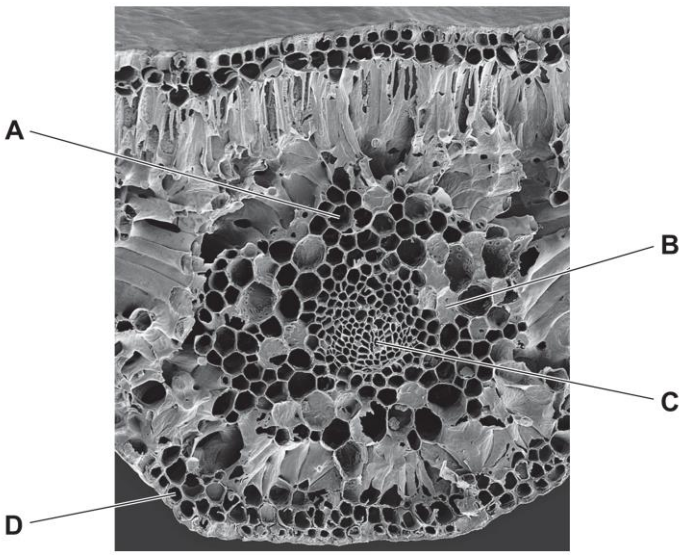
D through the Casparian strip

31 Which row shows the correct sequence for the movement of sucrose into phloem sieve tubes?

	first	second	third
A	diffusion of sucrose into the companion cell cytoplasm	active transport of protons into the companion cell cytoplasm	cotransport of protons and sucrose into the sieve tubes
B	cotransport of protons and sucrose into the companion cell cytoplasm	active transport of protons out of the companion cell cytoplasm	diffusion of sucrose into the sieve tubes
C	active transport of protons into the companion cell cytoplasm	diffusion of sucrose into the companion cell cytoplasm	cotransport of protons and sucrose into the sieve tubes
D	active transport of protons out of the companion cell cytoplasm	cotransport of protons and sucrose into the companion cell cytoplasm	diffusion of sucrose into the sieve tubes

32 The electron micrograph shows a cross-section of a leaf vein and some neighbouring cells.

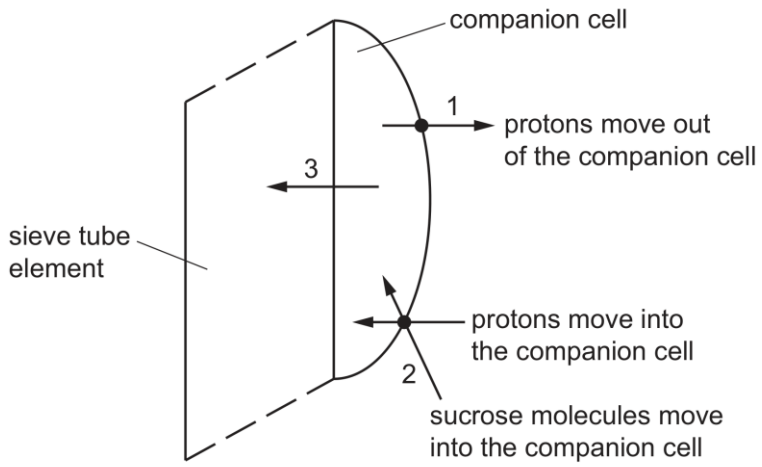
Which structure contributes to mass flow by the use of proton pumps?



33 Which row is correct for the sucrose concentrations and the water potentials in a source and a sink in a potato plant, at 12:00 p.m.?

	sucrose concentration		water potential	
	source	sink	source	sink
A	higher	lower	higher	lower
B	higher	lower	lower	higher
C	lower	higher	higher	lower
D	lower	higher	lower	higher

34 The diagram shows one possible way in which sucrose may be loaded into a sieve tube element.



Which steps require ATP?

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

35 Which statements correctly describe transport pathways in dicotyledonous plants?

1 In the apoplast pathway, water may move through plasmodesmata.

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

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

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

36 Which statement about the movement of water from roots to leaves is **not** correct?

A A continuous column of water is partly maintained by the attraction of water molecules to cellulose.

B Hydrogen bonding between water molecules enables mass flow of water.

C Hydrostatic pressure in xylem vessel elements is higher in roots than in leaves.

D Water potential changes throughout the length of the xylem vessel elements.

37 Which terms describe the method by which water is transported within xylem vessel elements?

1 cotransport

2 cohesion-tension

3 osmosis

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

38 What contributes to the upward movement of water in a xylem vessel of a plant?

1 cohesion of water molecules by hydrogen bonding

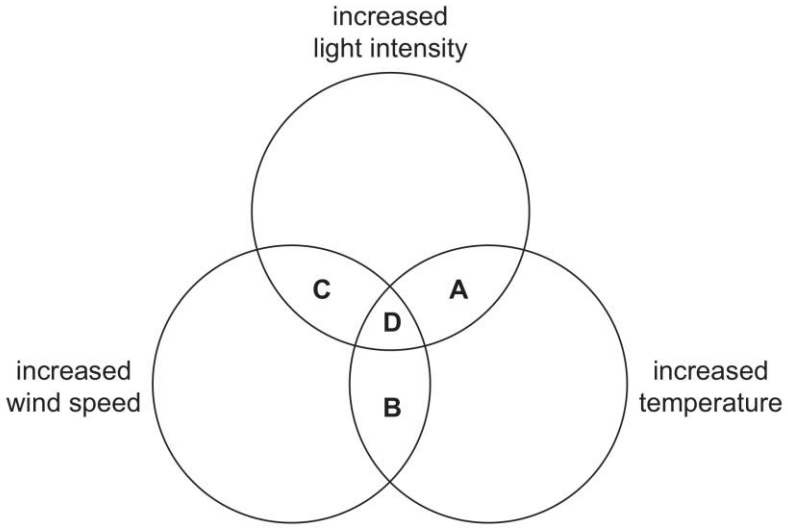
2 adhesion of water molecules to the cellulose walls of xylem vessels by hydrogen bonding

3 removal of water from xylem vessels in a leaf reduces the hydrostatic pressure in the xylem

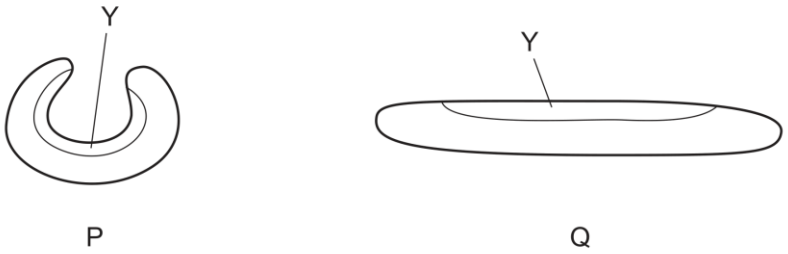
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

39 The diameter of a tree trunk usually decreases slightly during the day.

Which changes in environmental factors during the day could cause the diameter to decrease even more?



40 The diagram shows a xerophytic leaf in different conditions, P and Q.



Which statements describe the difference between the cells in layer Y in conditions P and Q?

1 more negative water potential in P than Q

2 more cells plasmolysed in P

3 cells less turgid in Q

4 water potential becomes zero in Q

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

41 Different substances, such as sucrose and amino acids, can move in different directions in the phloem sieve tube elements.

Which statement explains this?

A Active transport occurs in some phloem sieve tube elements and mass flow occurs in other sieve tube elements.

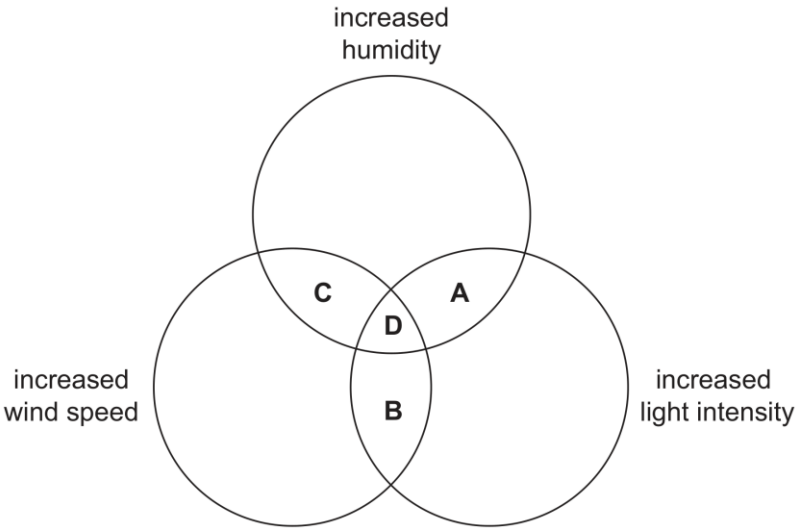
B Both active transport and mass flow occur in each individual phloem sieve tube element.

C Mass flow occurs in both directions at the same time in each individual phloem sieve tube element.

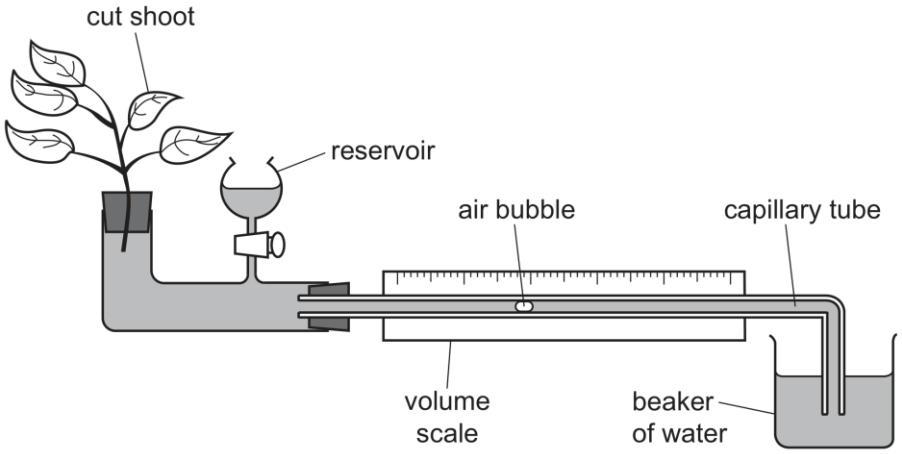
D Mass flow occurs in different directions in different phloem sieve tube elements at the same time.

42 The diameter of a tree trunk usually decreases slightly during the day.

Which changes in environmental factors during the day could cause the diameter to decrease even more?



43 A student wanted to find out the rate of transpiration using a potometer as shown.



The student was told to work out a value for transpiration using the units mm^3, m^{-2} and $hour^{-1}$.

Which measurements would the student need to take?

A volume of water in the reservoir, length of the capillary tubing, temperature and how many leaves are on the shoot

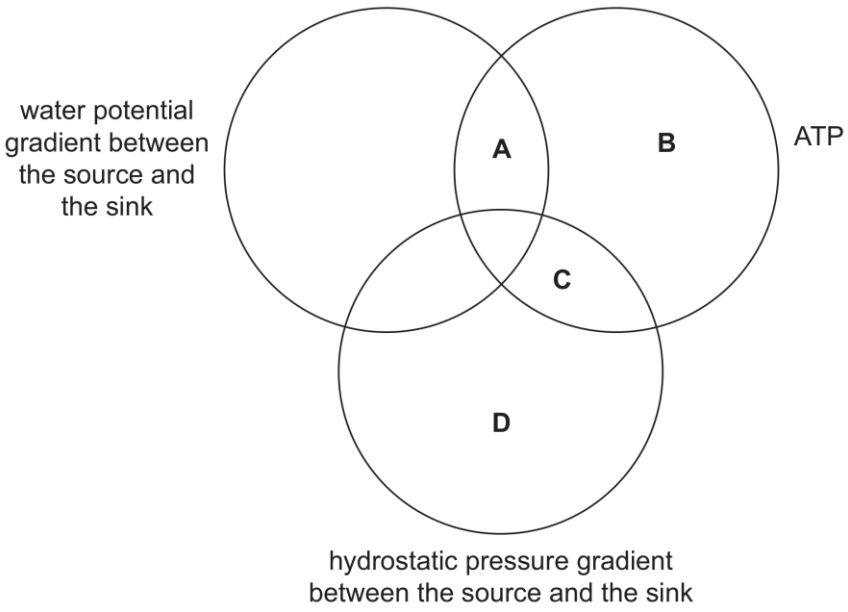
B volume of water in the reservoir, radius of the capillary tubing, time and surface area of the leaves

C distance air bubble moves, radius of the capillary tubing, time and surface area of the leaves

D distance air bubble moves, length of the capillary tubing, temperature and how many leaves are on the shoot

44 In plants, assimilates such as sucrose are loaded from source cells into sieve tube elements. The assimilates are then transported from source to sink.

What is needed to transport sucrose from source cells through phloem tissue to sink cells?



45 Water molecules are attracted to each other. This property is important in the upward movement of water in xylem.

Which term is used to describe the attraction of water molecules to each other?

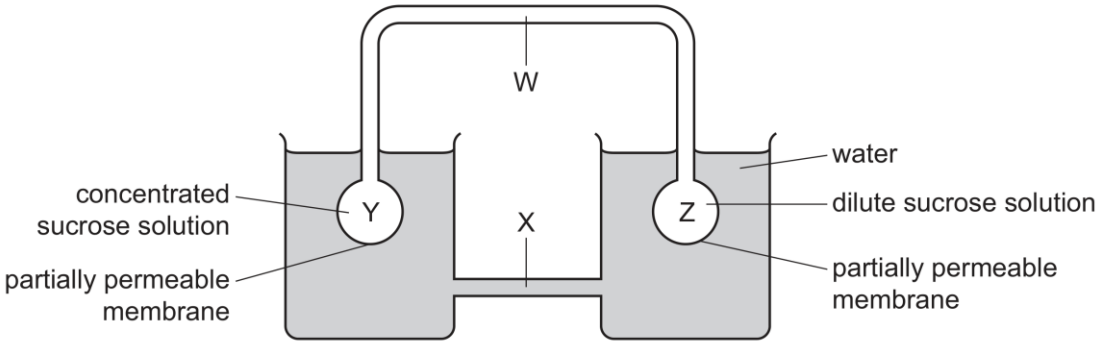
A adhesion

B cohesion

C hydrophilic

D polar

46 The diagram shows a model to demonstrate mass flow.



In a plant, what are the structures W, X, Y and Z and what is the direction of flow of solution along W?

	phloem	xylem	roots	leaves	direction of flow along W
A	W	X	Y	Z	from Z to Y
B	W	X	Z	Y	from Y to Z
C	X	W	Y	Z	from Y to Z
D	X	W	Z	Y	from Z to Y

47 Which statements about water movement in plants are correct?

1 Water can pass through cellulose cell walls.

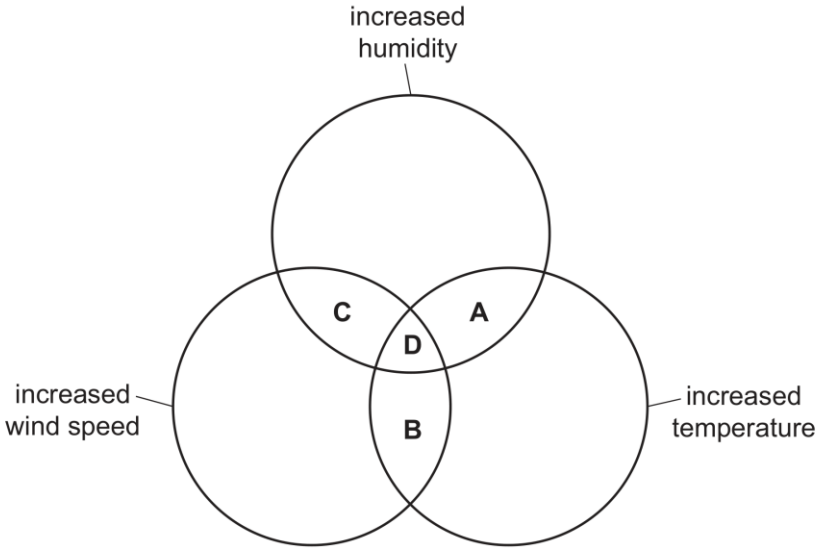
2 Water cannot pass through lignified cell walls.

3 Water can pass through cell walls that contain suberin.

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

48 The diameter of a tree trunk usually decreases slightly during the day.

Which changes in environmental factors during the day could cause the diameter to decrease even more?



49 Which sequence of events could lead to mass flow in a phloem sieve tube?

1 Sucrose moves into a sieve tube element.

2 Protons (H^+) and sucrose molecules move into a companion cell through a co-transporter protein.

3 A very high hydrostatic pressure is produced.

4 The water potential of the sieve tube element decreases.

5 Protons (H^+) are actively pumped out of a companion cell.

6 Water moves down a water potential gradient by osmosis.

A $1 \rightarrow 2 \rightarrow 5 \rightarrow 6 \rightarrow 4 \rightarrow 3$

B $3 \rightarrow 1 \rightarrow 2 \rightarrow 5 \rightarrow 6 \rightarrow 4$

C $3 \rightarrow 5 \rightarrow 1 \rightarrow 2 \rightarrow 4 \rightarrow 6$

D $5 \rightarrow 2 \rightarrow 1 \rightarrow 4 \rightarrow 6 \rightarrow 3$

50 A number of processes contribute to maintaining a water potential gradient in plants allowing water to reach the highest parts of a plant.

Which processes are responsible for maintaining this water potential gradient?

1 capillarity

2 osmosis

3 transpiration

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

51 What is a correct statement about the movement of substances absorbed by roots?

A Ions have to pass through cell walls to cross the endodermis.

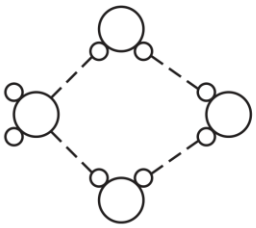
B Ions move through the symplastic pathway only until they reach the Casparian strip.

C Soil water has a more negative water potential than the xylem sap.

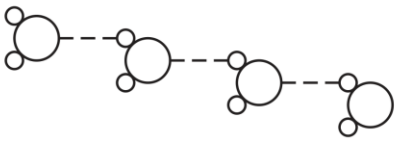
D Water passes through the symplastic pathway along a water potential gradient.

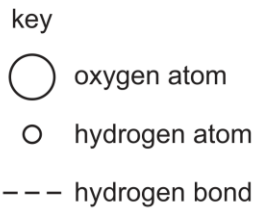
52 Which arrangement of four molecules of water shows how water may cohere when moving up a xylem vessel?

A

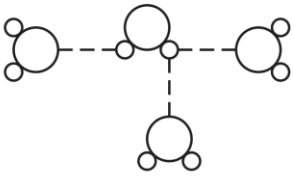


B

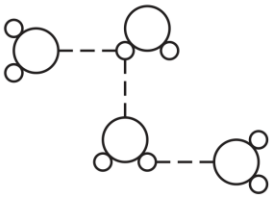




C



D



53 Which statement about sucrose loading into companion cells and then into the phloem sieve tube element is **not** correct?

A Hydrogen ions and sucrose molecules move into the companion cells using a carrier protein.

B Hydrogen ions are pumped out of the companion cells by active transport.

C Sucrose molecules are carried into the companion cells down the concentration gradient for sucrose.

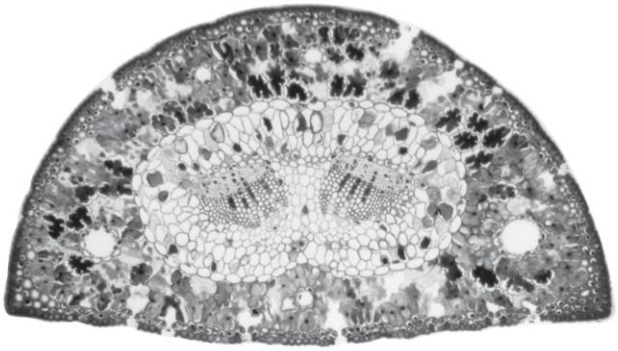
D Sucrose molecules move from a companion cell into the sieve tubes of the phloem through plasmodesmata.

54 External factors change the rate of transpiration, which also affects the water potential gradient of cells in the leaf.

Which combination is correct?

	external factor changing the rate of transpiration	water potential gradient in the leaf
A	decreasing temperature	increases
B	decreasing wind speed	increases
C	increasing relative humidity	decreases
D	increasing sunlight	decreases

55 The photomicrograph shows a transverse section through a leaf.



×50

Which features of a xerophytic leaf are visible in this section?

1 sunken stomata

2 two layers of epithelium

3 thick cuticle

4 small surface area to volume

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

56 Which changes occur as carbohydrates move out of a root cell into a phloem sieve tube?

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

57 Some fungi cause wilting in crop plants by growing within the xylem vessel elements.

Which process will be directly affected by these fungi?

A cohesion between water molecules

B development of root pressure

C mass flow during movement of assimilates

D uptake of water by root hair cells

58 Which features have a role in the transport of water in xylem vessel elements?

1 capillary action

2 adhesion

3 hydrogen bonding

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

59 The loading of sucrose into companion cells involves a number of processes.

Which process is active?

A the movement of hydrogen ions into the cytoplasm of companion cells

B the movement of hydrogen ions out of the cytoplasm of companion cells

C the movement of sucrose into companion cells

D the movement of sucrose out of companion cells

60 The statements describe events that occur during the movement of sucrose.

1 Hydrostatic pressure is decreased.

2 Hydrostatic pressure is increased.

3 Sucrose is loaded into the phloem vessel.

4 Sucrose is unloaded from the phloem vessel.

5 Water moves by osmosis into the phloem.

6 Water moves by osmosis out of the phloem.

7 Water potential decreases in the phloem.

8 Water potential increases in the phloem.

Which sequence correctly describes what happens in a plant at a source during the movement of sucrose?

A $3 \rightarrow 7 \rightarrow 5 \rightarrow 2$

B $3 \rightarrow 8 \rightarrow 6 \rightarrow 1$

C $4 \rightarrow 7 \rightarrow 5 \rightarrow 2$

D $4 \rightarrow 8 \rightarrow 6 \rightarrow 1$

61 Which combination of features is correct for a phloem sieve tube element as it unloads into a sink?

	water potential	lignified cell wall
A	higher than sink	absent
B	higher than sink	present
C	lower than sink	absent
D	lower than sink	present

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

Which vessels carry fluids by mass flow?

1 artery

2 phloem sieve tube

3 vein

4 xylem vessel

A 1, 2, 3 and 4

B 1, 2 and 3 only

C 1 and 3 only

D 2 and 4 only

63 Which two rows are correct for the movement of water from the soil into a root?

	soil	root
1	lower solute concentration	higher solute concentration
2	higher water potential	lower water potential
3	higher solute concentration	lower solute concentration
4	lower water potential	higher water potential

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

64 ATP is used in companion cells to provide the energy for loading a sieve tube element with sucrose.

How does the co-transporter mechanism use this energy?

A to pump hydrogen ions into the sieve tube element

B to pump hydrogen ions out of the companion cell

C to pump sucrose into the sieve tube element

D to pump sucrose out of the companion cell

65 Which statement correctly describes a transport pathway in plants?

A In the apoplast pathway, water may move through plasmodesmata.

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

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

D The symplast pathway may be blocked by the tonoplast.

66 The statements are descriptions of how water moves across the root to the xylem vessel elements.

1 Water enters cell walls.

2 Water enters cytoplasm by osmosis.

3 Water moves from cell to cell through plasmodesmata.

4 Water moves through cell walls.

Which statements describe the apoplast pathway?

A 1, 2, 3 and 4

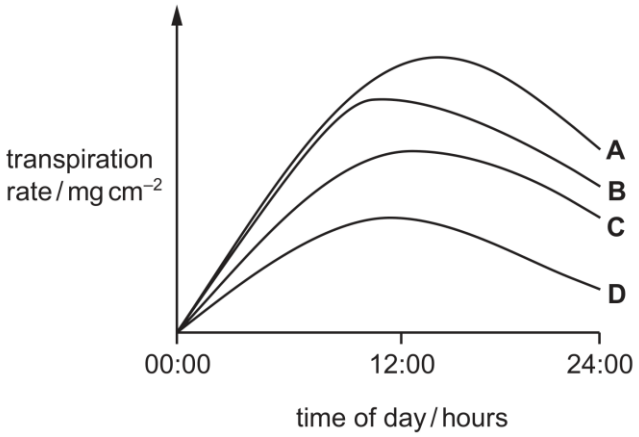
B 1, 2 and 3 only

C 1 and 4 only

D 4 only

67 Four plants, **A**, **B**, **C** and **D**, were grown in the same conditions and their transpiration rates measured.

Which plant is most likely to be a xerophyte?



68 Sucrose moves from a mesophyll cell in a leaf into a phloem sieve tube element.

Which changes to the water potential and the volume of liquid in the phloem sieve tube element are correct?

	water potential becomes	volume of liquid
A	less negative	decreases
B	less negative	increases
C	more negative	decreases
D	more negative	increases

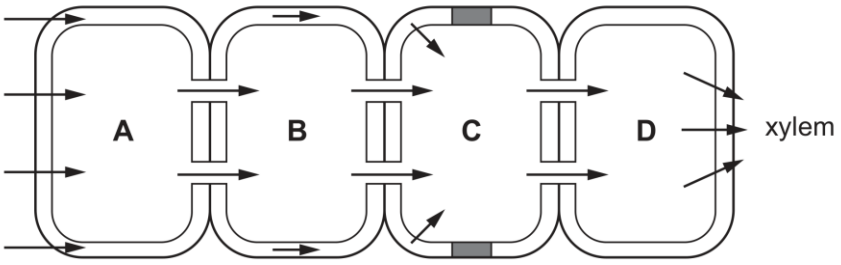
69 Irrigating crop plants with water containing low concentrations of salt causes an increase in the concentration of salt in the soil.

What explains why the increase in salt concentration could eventually kill the crop?

	water potential in roots	water potential in soil	direction of water movement
A	decreases		out of the roots
B	increases		into the roots
C		decreases	out of the roots
D		increases	into the roots

70 The diagram shows the pathway of water across root cells to the xylem.

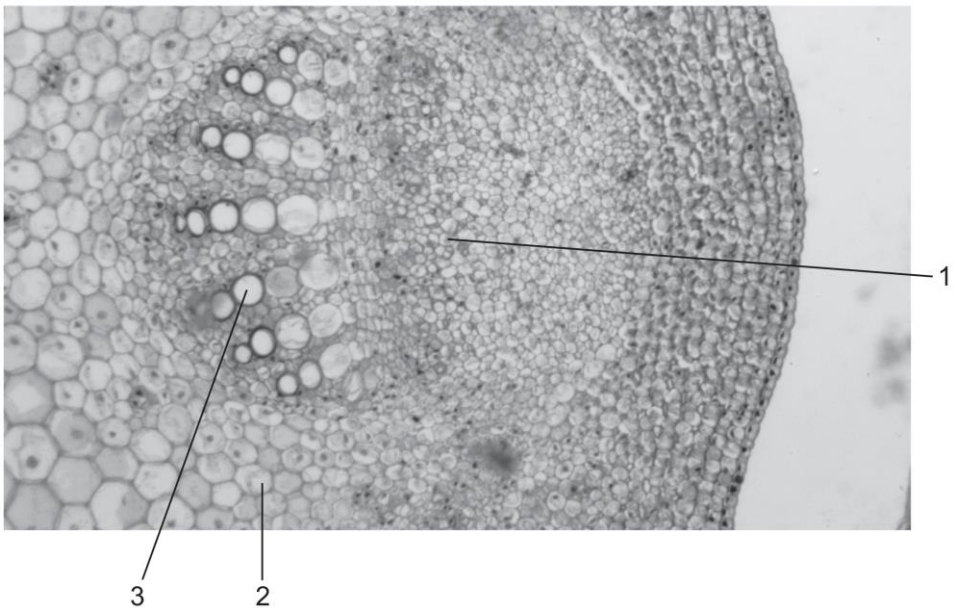
Which cell is in the endodermis?



71 Which row shows the cause of mass flow in the phloem and the direction of movement of phloem sap by mass flow?

	cause of mass flow in the phloem	direction of movement of phloem sap by mass flow
A	hydrostatic pressure gradient	sink to source
B	hydrostatic pressure gradient	source to sink
C	water potential gradient	sink to source
D	water potential gradient	source to sink

72 The photomicrograph shows a vascular bundle.



Which describes the relationship of water potential in the labelled cells?

A Cell 3 is less negative than cell 1.

B Cell 2 is less negative than cell 3.

C Cell 3 is more negative than cells 1 and 2.

D Cells 1, 2 and 3 have the same water potential.

73 Which features have a role in the transport of water in xylem vessel elements?

1 capillary action

2 cohesion

3 hydrogen bonding

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

74 What is a definition of transpiration?

A the evaporation of water vapour from a leaf due to the diffusion of water from an area of low water potential to high water potential

B the loss of water vapour from a plant to its environment by diffusion down a water potential gradient

C the movement of water from root to leaf due to the adhesion of water molecules to one another

D the uptake of water by plant roots by movement of water down a continuous water potential gradient from air to soil

75 What is a function of the hairs (trichomes) on xerophytic leaves?

A adding a waterproof layer

B protecting the stomata

C reducing the surface area

D trapping a layer of moist air

76 What is the role of ATP in a companion cell when sucrose is loaded into a sieve tube element?

A moving sucrose into the sieve tube element

B removing protons from the sieve tube element

C removing protons out of the cytoplasm of the companion cell

D taking up sucrose into the cytoplasm of the companion cell

77 A potometer was used to measure the transpiration rate of a leafy shoot.

What could be the correct units?

A cm min **B** $cm^2 min^{-1}$ **C** $cm^3 g^{-1} min$ **D** $cm^3 min^{-1}$

78 Which combination of features is characteristic of a phloem sieve tube element as it is loaded from a source?

	water potential of the phloem sieve tube element	lignification of the cell wall
A	higher than source	absent
B	higher than source	present
C	lower than source	absent
D	lower than source	present

79 Which statements correctly describe transport pathways in dicotyledonous plants?

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

2 In the symplast pathway, water does not move through intercellular spaces.

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

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

80 Which properties of water molecules are important in the upward flow of water through xylem?

1 Water molecules are attracted to each other by hydrogen bonding.

2 Water molecules are attracted to cellulose by adhesion.

3 Water molecules have high cohesion in water columns.

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

81 What is correct for a phloem sieve tube element that is unloading to a sink?

	water potential of the phloem sieve tube element becomes	lignification of the cell wall
A	less negative than sink	absent
B	less negative than sink	present
C	more negative than sink	absent
D	more negative than sink	present

82 Which statement concerning transpiration is correct?

A On a humid day, the water potential gradient between the intercellular air space and the external atmosphere increases to stimulate water loss by evaporation.

B Water arriving at the spongy mesophyll cells via the symplast pathway must move by osmosis through the cell surface membrane before evaporation from the surface of the cells.

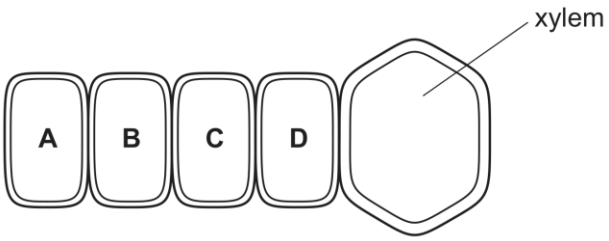
C Water diffuses down the water potential gradient from the saturated air space through the guard cells before evaporating from the surface of the cells into the atmosphere.

D Water moves up the xylem in the apoplast pathway and can continue on this pathway by osmosis to reach the spongy mesophyll cells before evaporating into the intercellular air space.

83 The diagram shows a xylem vessel in a root and four adjacent parenchyma cells.

As water moves up the xylem vessel, it is replaced by water from cell **D**. Water in cell **D** is replaced by water in cell **C**, resulting in a flow of water from cell **A** to the xylem.

Which cell has the least negative water potential?



84 Which statement correctly describes an event in the process of mass flow in phloem sieve tube elements?

A Any part of a plant where sucrose is loaded into a sieve tube element is called a sink.

B Loading sucrose into a sieve tube element increases the water potential inside it.

C Mass flow in the phloem is a passive process occurring at the same rate as diffusion.

D Sucrose moves down a hydrostatic pressure gradient in the phloem from source to sink.

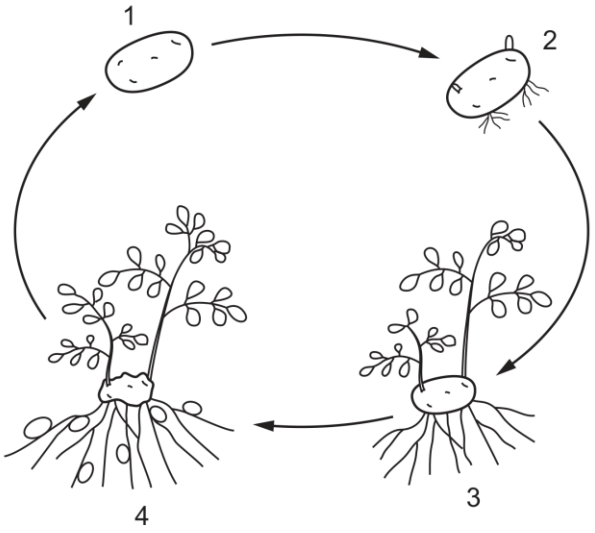
85 The diagram shows a potato tuber at different stages.

1 dormant tuber (not growing)

2 sprouting roots and shoots

3 growing roots and shoots

4 making new potato tubers



Which row identifies a stage where a potato tuber acts as a source and a stage where it acts as a sink?

	source	sink
A	1	3
B	2	4
C	3	2
D	4	1