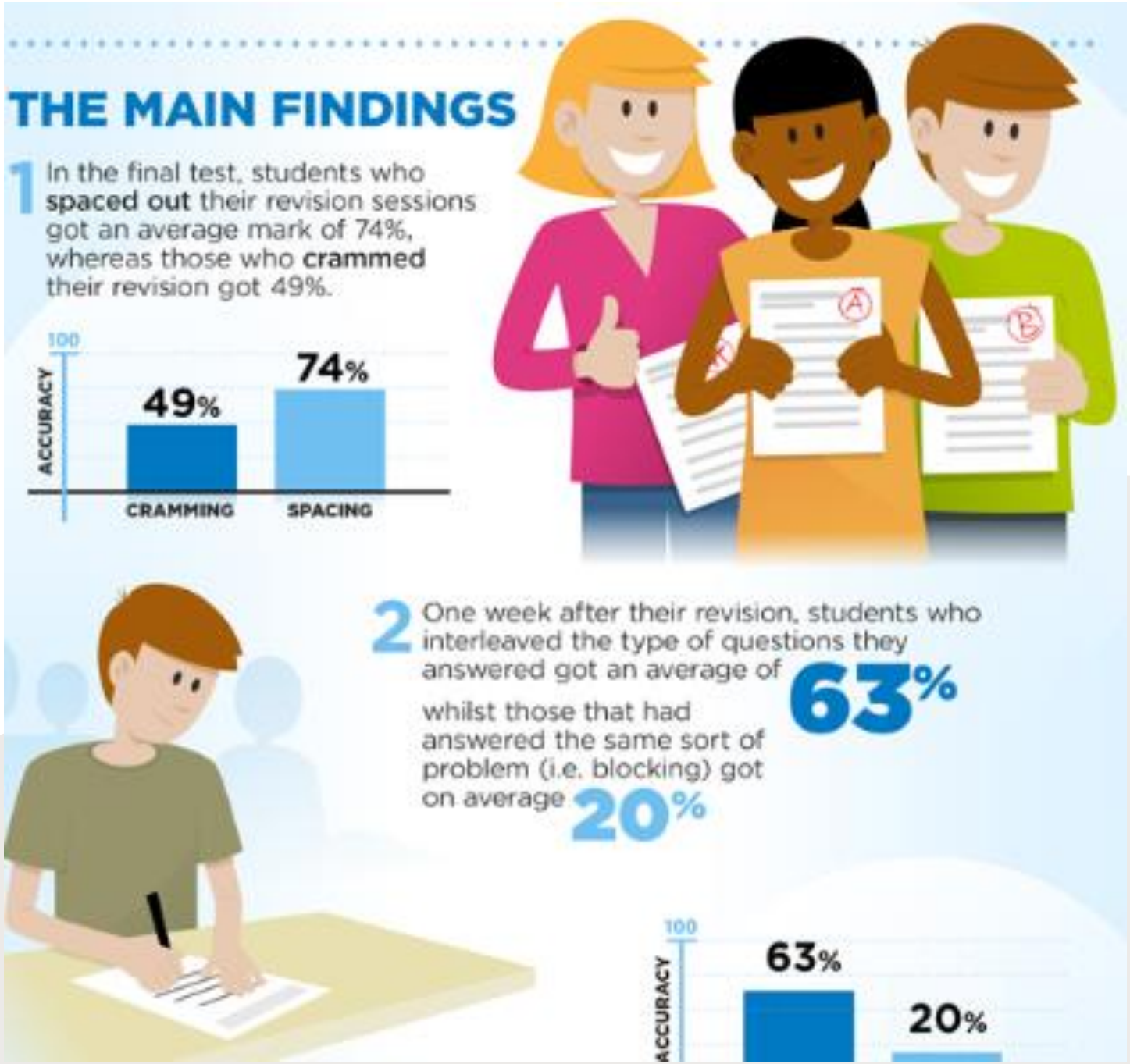
REVISION TECHNIQUES THAT WORK



THE 20 MINUTE REVISION PROCESS



Read the summary sheet



Brain dump key words from reading



Complete 3 different exam questions on the same topic

EXAMPLE- TRANSPIRATION

Water, Hydrogen bonds, cohesion, tension, adhesion, transpiration stream, transpiration pull, water potential, evaporation, gradient, stomata, temperature, wind, humidity, xylem, turgid, guard cells, lignin, pits, symplast, apoplast, casparian strip, root pressure, capillary action, ions, active transport

Transpiration is **the loss of water from a plant in the form of water vapour**

In the leaves, stomata allow water to escape as a vapour and this drives the transpiration stream. Water is absorbed by roots from the soil and transported as a liquid to the leaves via xylem. Xylem tissue is composed of end-to-end dead cells with no end walls. Lignin spirals inside the xylem give it strength, while pits in the side walls allow horizontal transfer of water between xylem vessels.

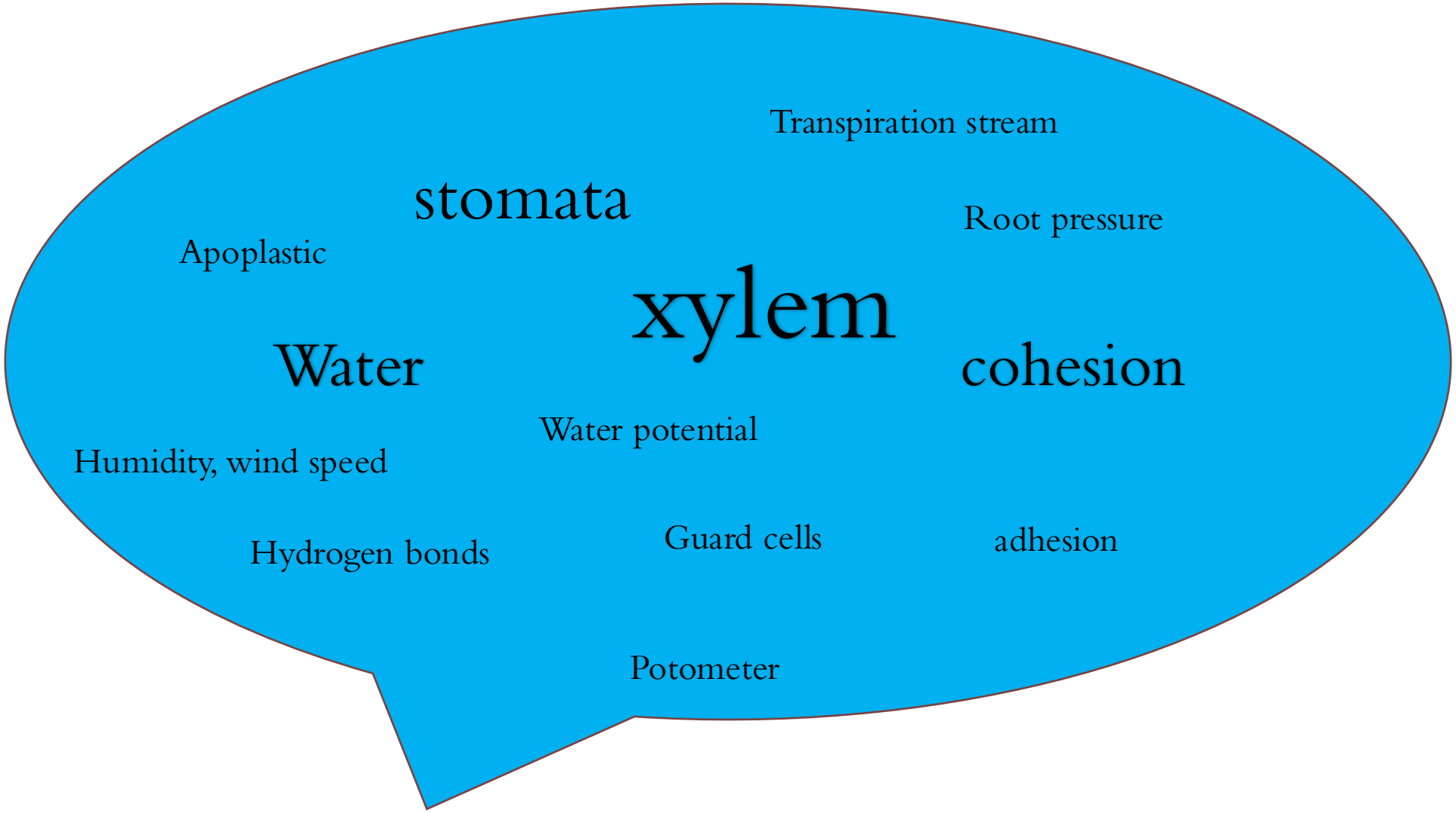
Water is a polar molecule so forms Hydrogen bonds between H and O. This allows cohesion and adhesion to form a transpiration stream. As water is lost from the open stomata, more water molecules are pulled up the xylem and this allows water to continue to move in one direction from roots to leaves. Plants needs water and minerals to allow photosynthesis and other metabolic processes to occur. Stomata on the underside of leaves open when the guard cells around them are turgid. When water moves into the guard cells, they swell and arch open. As water moves out, the guard cells relax and close.

The guard cells are sensitive to light intensity, temperature, wind, relative humidity and carbon dioxide concentrations inside the leaf. When the plant is well hydrated the stomata are open and can exchange Oxygen and Carbon dioxide for the plant to photosynthesis and respire. The open stomata also allow water molecules to evaporate as the plant is warmed by the sun.

Transpiration is fastest in warm conditions. This is due to the water potential being lower outside the plant compared to inside the plant. Water will move from a higher water potential to a lower water potential, from root hair cells that have a large surface area to volume into the adjoining cells via apoplastic, vacuolar & symplastic pathways until the casparian strip is reached at the endodermis just before the vascular tissue. This forces all water via the symplastic & vacuolar pathway to ensure water potential is always lower inside the xylem and continue the transpiration flow. Dissolved ions can be transported into the xylem via active transport to regulate water potential

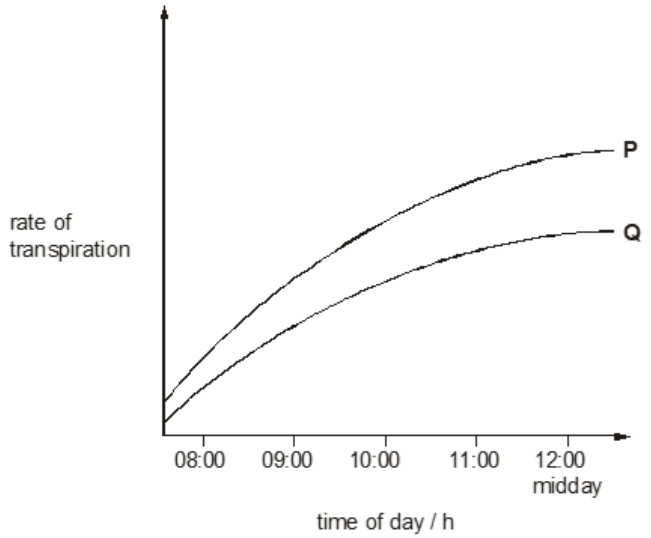
In humid conditions, transpiration rate slows as the water potential gradient reduces between the inside and outside of the plant. In order to maintain transpiration, the plant uses root pressure to ensure water continues to be taken in through the roots, by taking in ions using ATP and lowering the water potential so that water follows. Plants have adapted structures to conserve water and prevent loss, such as waxy cuticle layers, spines, curled leaves and sunken stomata

Brain dump key words from reading



Complete 3 different exam questions on the same topic

The diagram below shows the results gained from an experiment to compare the rates of transpiration in two species, **P** and **Q**. Both species were kept under the same conditions during the course of the experiment.



(i) Give **two** possible explanations for the increase in the rate of transpiration in **both** species **P** and **Q** over the course of the experiment.

5 Fig. 5.1 shows the possible pathways taken by water across the root of a plant.

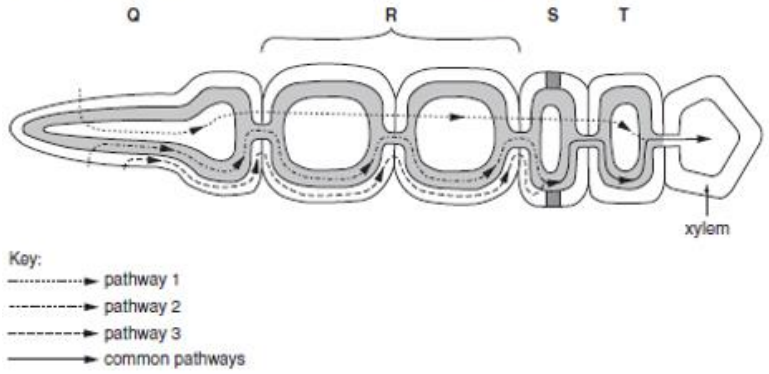


Fig. 5.1

(a) (i) Name the process by which water enters cell **Q** from the soil.

..... [1]

(ii) Pathway 1 is known as the vacuolar pathway, as the water passes into and through the cell vacuoles.

Name pathway 2 and pathway 3.

pathway 2 .....

pathway 3 ..... [2]

(iii) State which letter, **Q**, **R**, **S** or **T**, on Fig. 5.1, represents the endodermis.

..... [1]

(b) Describe **and** explain how water is moved up the xylem from the roots to the leaves.

In your answer you should use appropriate technical terms, spelt correctly.

Increase in sunlight, temperature, CO2 which all increase the rate of photosynthesis and water is required for photosynthesis

5 Fig. 5.1 shows the possible pathways taken by water across the root of a plant.

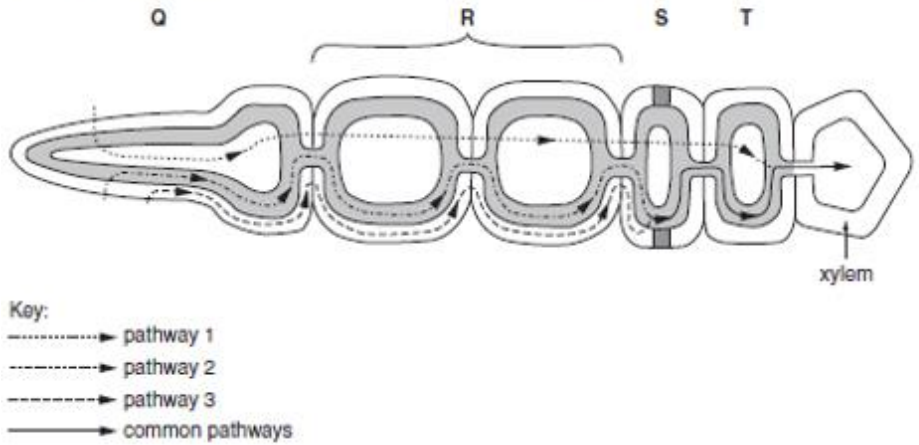


Fig. 5.1

(a) (i) Name the process by which water enters cell **Q** from the soil.

Osmosis [1]

(ii) Pathway 1 is known as the vacuolar pathway, as the water passes into and through the cell vacuoles.

Name pathway 2 and pathway 3.

pathway 2 Apoplastic

pathway 3 Symplastic [2]

(iii) State which letter, **Q**, **R**, **S** or **T**, on Fig. 5.1, represents the endodermis.

S [1]

(b) Describe **and** explain how water is moved up the xylem from the roots to the leaves.

In your answer you should use appropriate technical terms, spelt correctly.

- Water vapour diffuses out of the stomata / moves out of the stomata down its concentration gradient; [1 mark]
- Water evaporates from the surface of the mesophyll cells into the (leaf) air spaces (to replace water vapour lost via the stomata); [1 mark]
- A water potential gradient is created between the mesophyll cells and other nearby cells **SO** water moves by osmosis; [1 mark]
- Water moves out of the xylem into the leaf cells by osmosis / down a water potential gradient; [1 mark]
- Water molecules are attached to each other by cohesion / hydrogen bonds **SO** are pulled up the xylem (to replace water lost to the leaf cells); [1 mark]
- Water molecules are attached to the xylem vessel walls by adhesion **SO** move upwards by capillary action; [1 mark]

1a

1 mark

A potometer can be used to investigate the water uptake of plants under different conditions. Figure 1.1 shows how a student investigated the effect of covering the leaves from plant shoots with grease on the water uptake of the shoots. All of the shoots were from the same plant and had 7 leaves.

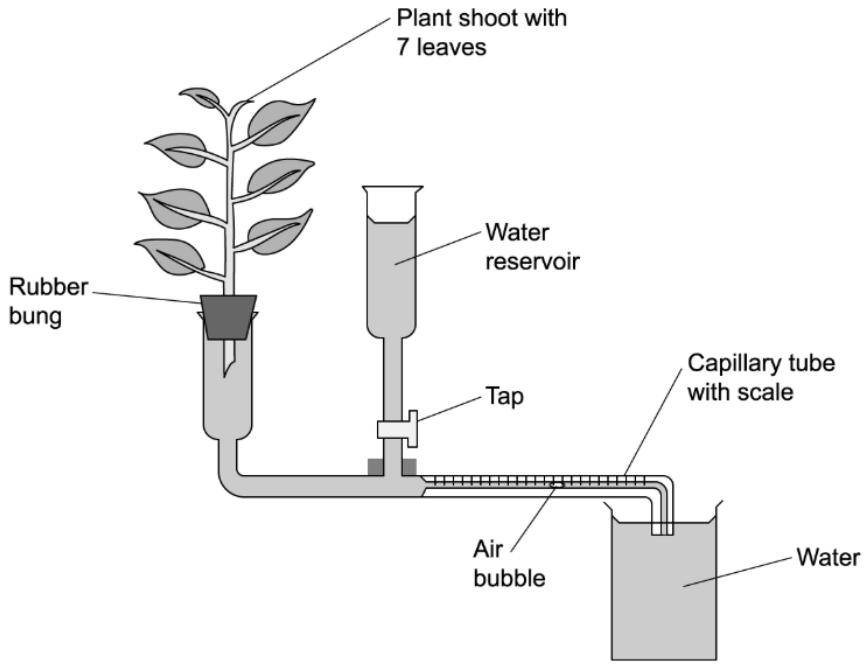


Figure 1.1

When setting up the potometer in Figure 1.1, one of the precautions the students took to ensure reliable measurements of water uptake was to cut the shoots underwater.

Suggest a reason for this.

1b

3 marks

List three features of xylem vessels that make them specialised for the transport of water.

1c

3 marks

A potometer measures the water uptake of a plant in a given time. Water uptake does not represent the true rate of transpiration in a plant due to the other functions of water in plants.

Name **three** functions of water in plants (not including transpiration).

1d

2 marks

The results of the experiment are shown in the table below.

Number of leaves covered with grease on plant shoot	Mean rate of water uptake / cm^3 min^{-1}
0	0.11
1	0.10
2	0.08
3	0.07
4	0.06
5	0.05
6	0.02
7	0.01

Describe the result produced when all 7 leaves have been covered in grease and suggest an explanation for this.

The reason for cutting the shoots underwater is:

- To prevent air (bubble) entering the xylem; [1 mark]

[Total: 1 mark]

If the stem/shoot is cut above water then air from the atmosphere can enter the stem and create an air bubble within the xylem vessels. This air bubble disrupts the continuous column of water in the xylem and can lead to unreliable measurements; it may inflate the water uptake for the plant or prevent any uptake at all by damaging the xylem vessels.

Three features of xylem vessels that adapt them for the transport of water are:

Any three of the following:

- The cells contain no cytoplasm; [1 mark]
- Cell walls are reinforced with lignin/are lignified; [1 mark]
- Water can move between vessels via small gaps called pits in the side walls; [1 mark]
- The end walls are broken down meaning the cells form continuous pipes; [1 mark]

[Total: 3 marks]

Note that the question only asks you to list the special features, so no explanation is necessary. All of these adaptations allow for the flow of water throughout the plant. The ability of water to move between vessels is very important for plants; if one of the vessels becomes damaged from an air bubble or a cut then the plant is still able to transport water to the different body parts.

Three functions of water in plants other than transpiration are:

Any three of the following:

- Water is required for support/turgidity; [1 mark]
- Hydrolysis reactions; [1 mark]
- Photosynthesis; [1 mark]
- Transport of assimilates/sucrose; [1 mark]

[Total: 3 marks]

The underlined words must be contained in your answer to be awarded those marks. Other water roles include temperature regulation and transport of minerals, but because these functions are carried out by transpiration they cannot be credited in this answer.

The result for when all 7 leaves have been covered in grease shows that:

- There is a small amount of / very little water uptake ($0.01\ cm^3\ min^{-1}$) / transpiration when all the leaves are covered in grease; [1 mark]

AND

Any one of the following:

Very little water is taken up because:

- The stomata are blocked by the grease so (most) water cannot diffuse out / evaporate **SO** transpiration stops; [1 mark]

Some water is still taken up because:

- Some water is taken up by the plant but not lost in transpiration **OR** some water is used inside the plant cells; [1 mark]
- The grease is not completely impermeable to water (so some transpiration is still taking place); [1 mark]
- There are some stomata on the stem (so some transpiration is still taking place); [1 mark]

[Total: 2 marks]

Leaves are the main site of transpiration in a plant. The stomata on leaves allow evaporated water to exit the leaf. As the water leaves the leaf, it creates a transpiration stream which is responsible for pulling water up the xylem vessels of the plant. When water is blocked from evaporating this stream stops, greatly reducing the uptake of water. There can still be some uptake of water when all the leaves are covered in grease due to all other water-requiring processes occurring in the plant creating a demand for water.

1

3 marks

Sago pondweed has evolved many adaptations to its aquatic environment. Three such adaptations are described below.

Explain the advantage of each adaptation.

Adaptation 1: No waxy cuticle

Adaptation 2: Stem tissue that contains air spaces

Adaptation 3: A thin, flexible stem

2

6 marks

Plants lose water by transpiration.

The rate of transpiration varies between different species of plant.

The rate of transpiration can be measured using a potometer.

Plan an investigation into the rate of transpiration in two species of plant that would allow valid data to be collected.

Details of how to set up a potometer are not required.

3

4 marks

This question is about the impact of potentially harmful chemicals and microorganisms.

(i) Salts that a plant needs, such as nitrates and phosphates, are taken into root hair cells by active transport.

For which macromolecule does a plant need both nitrogen **and** phosphorus?

[1]

(ii) Flooding of fields by seawater can damage crops. Seawater contains dissolved salts, including sodium chloride.

How would flooding affect soil water potential?

[1]

(iii) Sodium chloride in solution dissociates into Na+ and Cl^-.

Explain how the Casparian strip prevents these ions from reaching the xylem of the plant by the apoplast pathway.

[2]

5a

2 marks

Fig. 1 below shows a microscope cross section through the centre of a plant root.

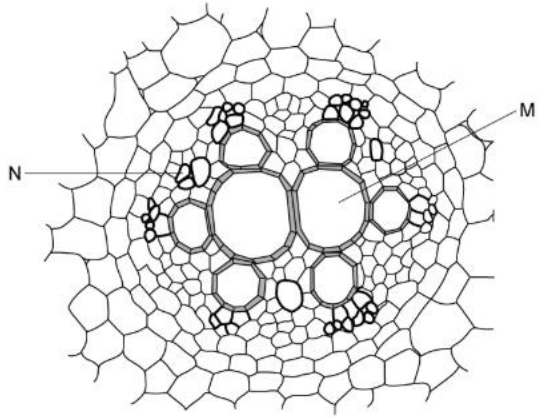


Fig. 1

Identify the tissue types labelled **M** and **N** in **Fig. 1**.

The advantage of each adaptation is...

- (No waxy cuticule =) Water loss is not a problem (for aquatic plants/pondweed) / wax production wastes energy; [1 mark]
- (Stem tissue contains air spaces =) Gives buoyancy / (allows plant to) float / more light will be near surface of water **OR** increases rate of gas exchange; [1 mark]
- (Thin flexible stem =) less support is needed / plant is supported by water / (the plant) can move more (in water) without breaking; [1 mark]

Allow *the plant is less likely to be damaged, e.g. by water currents / animals for marking point 3*

[Total: 3 marks]

This question assesses the quality of your written communication and should be assessed using the following levelled criteria:

	Science content	Communication
Level 3 [5–6 marks]	A full and detailed plan has been laid out for how to carry out a valid investigation into the rate of transpiration.	*There is a well-developed plan and sequence as well as an appreciation of the need to obtain valid data. The information presented is relevant and clearly explained.*
Level 2 [3–4 marks]	A detailed plan has been laid out for how to carry out a valid investigation into the rate of transpiration.	*There is a reasonable explanation and sequence as well as an appreciation of the need to obtain valid data. The information presented is in the most-part relevant and well- explained..*
Level 1 [1–2 marks]	A basic plan has been laid out with some awareness of how to plan a valid investigation.	*The information is basic and communicated in an unstructured way. The information is supported by limited method which may be unclear.*

The investigation can be planned as follows...

Indicative content relating to method and planning to obtain valid data:

- Method described
- Movement of bubble in potometer / mass measured
- Timing distance travelled by bubble
- Repeating investigation with two different plant species
- Repetition to gain replicates
- Calculation (rate / mean)
- Statistical test

Indicative content relating to variables:

- Named variables controlled
  - e.g. temperature, humidity, light, wind, movement, surface area of leaves
- How variables are controlled

Ignore *details of potometer set-up*

[Total: 6 marks]

This question should be marked with a 'best fit' approach where the level is determined by the scientific content and the mark within the level is determined by the quality of the written communication.

Your answer should include a method which would give you valid results, this includes:

- a step by step method – logical and without any key stages emitted
- control of the relevant variables – be specific where you can including mentioning quantities that should be kept the same or methods of maintaining conditions
- a way of measuring the dependent variable – this should include the units used to measure the data
- repeating of the method with different values in the independent variable – this is important as it will demonstrate the effect of the independent variable

(i) Plants need both nitrogen **and** phosphorus for...

- DNA / RNA / nucleic acid; [1 mark]

(ii) Flooding affects soil water potential by...

- Lowering / reducing the water potential **OR** makes the water potential more negative; [1 mark]

(iii) How the Casparian strip prevents Na^+ and Cl^- ions from reaching the xylem of the plant by the apoplast pathway...

Any two of the following:

- The Casparian strip is impervious to water/solutions; [1 mark]
- Which forces water/solutions to pass through the plasma membrane; [1 mark]
- (The plasma membrane consists of a) phospholipid bilayer which repels ions / charged particles; [1 mark]

[Total: 4 marks]

You won't get any marks for referring to suberin in your answer. The main thing that the examiners are looking for here is the concept of charge / ion impermeability. You could also mention that ions need channels because the phospholipid bilayer does not allow charged particles through. You could also refer to the plasma membrane as the cell surface membrane throughout your answer.

Tissue types M and N can be identified as follows...

- M = xylem; [1 mark]
- N = phloem; [1 mark]

[Total: 2 marks]

You should be aware that in roots the vascular tissue is in a **bundle** in the **centre of a root**, so you should recognise that you are looking at xylem and phloem tissue.

While some diagrams may show the xylem vessels in a neat 'x' arrangement in the middle of a root, in reality this is not always the case. You should note that the **xylem** will always be in the **very centre** of a root, and you should also pay attention to the cells themselves; here the xylem cells are easily identifiable by their **thick cell walls** and **larger diameter**. Once you have identified M as xylem, N must then be phloem.

5b

2 marks

Table 1 below shows some results from an investigation into the effect of temperature on root pressure in celery plants.

Temperature / °C	Root pressure / MPa
8	0.00
10	0.01
16	0.04
20	0.09
24	0.14

Table 1

State which statistical test could be used to analyse the results in Table 1. Give a reason for your answer.

5c

4 marks

The investigation in part (b) also measured the effect of temperature on the activity of celery ATPase enzymes. The results are shown in Table 2 below.

Temperature / °C	ATPase activity / μmol Pi mg protein^{-1} h^{-1}
24	32
8	16

Table 2

Use the data in Table 2 and your own knowledge to explain the effect of temperature on root pressure shown in Table1 in part (b).

5d

4 marks

Once water enters the vascular tissue in the root, it is drawn up the plant stem in the transpiration stream.

Explain the upward movement of water via the transpiration stream.

The statistical test that could be used to analyse these results is...

- Spearman's rank / correlation coefficient; [1 mark]

The reason for this is...

- This tests for (linear) correlation/relationship between two variables (in this case temperature and root pressure); [1 mark]

[Total: 2 marks]

The Spearman's rank correlation coefficient test assesses the **level of correlation between two variables**. The data set here contains two variables and shows how one changes as the other increases; were these two variables to be plotted on a graph we would expect there to be a **positive correlation**; the test would indicate whether this correlation is **statistically significant** or not.

Other statisical tests include the student's t-test and the chi squared test, neither of which would be appropriate to use with this data set.

The upward movement of water via the transpiration stream can be explained as follows...

Any four of the following:

- Water vapour diffuses out of the stomata / moves out of the stomata down its concentration gradient; [1 mark]
- Water evaporates from the surface of the mesophyll cells into the (leaf) air spaces (to replace water vapour lost via the stomata); [1 mark]
- A water potential gradient is created between the mesophyll cells and other nearby cells **SO** water moves by osmosis; [1 mark]
- Water moves out of the xylem into the leaf cells by osmosis / down a water potential gradient; [1 mark]
- Water molecules are attached to each other by cohesion / hydrogen bonds **SO** are pulled up the xylem (to replace water lost to the leaf cells); [1 mark]
- Water molecules are attached to the xylem vessel walls by adhesion **SO** move upwards by capillary action; [1 mark]

[Total: 4 marks]

The transpiration stream is the continuous movement of water up the xylem that occurs as a result of transpiration from the leaves. Water vapour **diffuses** out of the leaves through the stomata, creating a **series of water potential gradients** from cell to cell across the leaf to the xylem. Water moves out of the xylem into the leaf by **osmosis**, and due to forces of **cohesion** and **adhesion**, more water molecules are **drawn up the xylem** to replace it.

The effect of temperature on root pressure can be explained as follows...

Any four of the following:

- ATPase activity decreases at low temperatures **AS** molecules have less kinetic energy / molecules collide less frequently / molecules collide with less energy; [1 mark]
- Less ATP is produced for active transport; [1 mark]
- Fewer minerals are transported across the root / into the xylem; [1 mark]
- The water potential of the root cells/xylem does not decrease **OR** there is a reduced water potential gradient across the plant root / between the root cells and the xylem; [1 mark]
- Water does not move into the xylem by osmosis / via the symplast pathway; [1 mark]

Reject *references to the apoplast pathway for marking point 5.*

[Total: 4 marks]

Water moves into and between the cytoplasm of plant cells (the symplast pathway), and eventually into the xylem due to **osmosis**. The water potential gradients required for osmosis to occur are generated by the **active transport of minerals** into and between plant cells. In the **absence of ATP** this active transport **will not occur** and water will not move from cell to cell and eventually into the xylem. The lack of water movement into the xylem will cause root pressure to decrease (as shown in table 5.1).

Note that references to the apoplast pathway will not gain marks here. Water in the apoplast pathway moves through the cell walls and not across cell membranes, so this is not movement by osmosis and is not affected by mineral transport. Water also doesn't enter the xylem via the apoplast pathway due to the Casparian strip, so root pressure (the upward force of water in the xylem in the roots) is not affected by movement along this pathway.

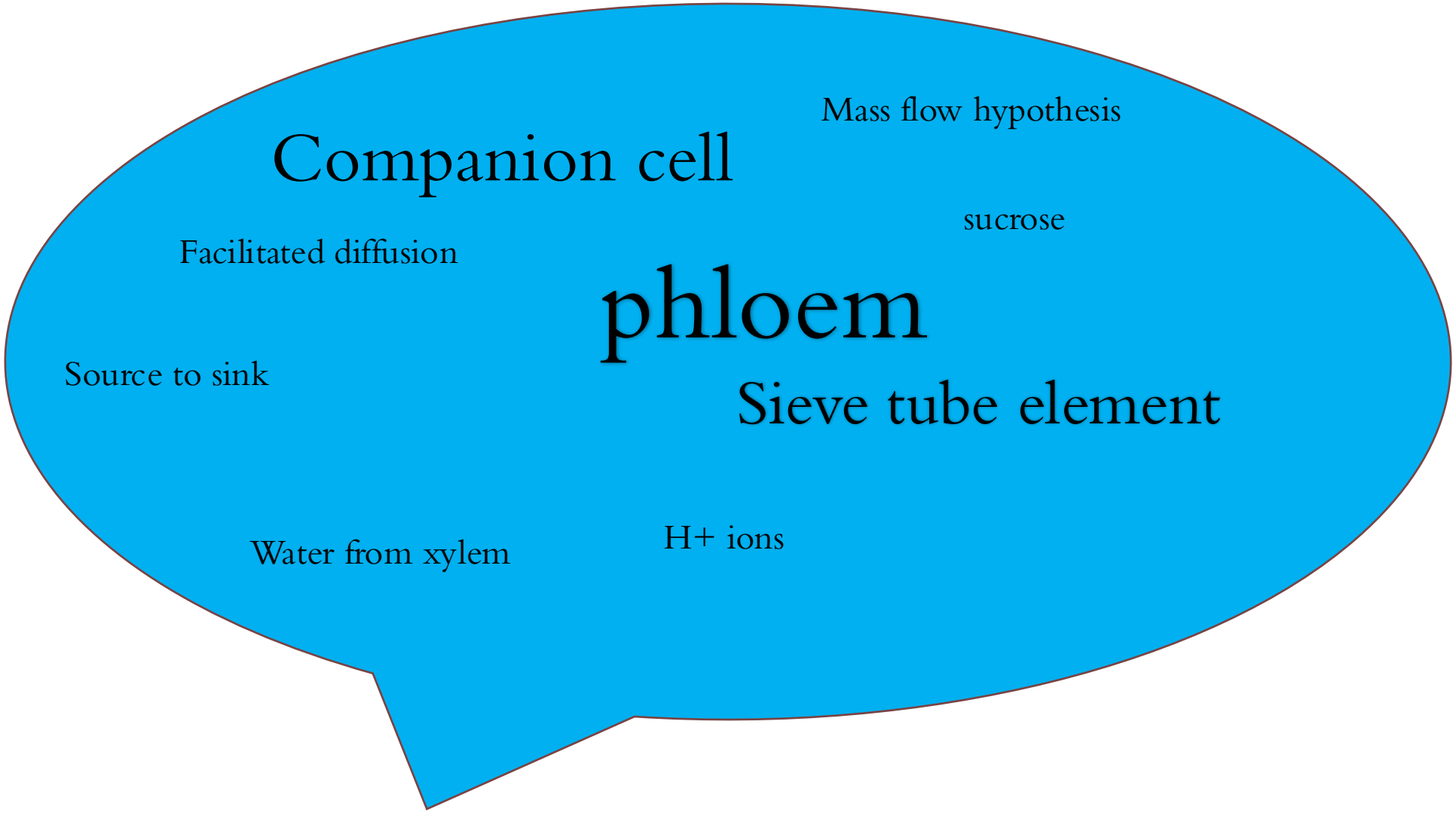
EXAMPLE- TRANSLOCATION

Phloem, sieve tube elements, companion cells, sucrose, two - way transport, mass flow hypothesis, source to sink, photosynthesis, Calvin cycle, facilitated diffusion, active transport, H+ ions, growth, shoots, roots, fruit and storage

- Translocation is the process by which plants move dissolved materials, like sugars and amino acids, throughout the plant. This process occurs in phloem, a network of living cells that transport materials throughout the plant. **Source and sink**
- Translocation moves materials from where they are made (the sources) to where they are used or stored (the sinks)
- Phloem is made up of living cells that are attached end to end. The end cell walls have pores called sieve plates that allow substances to flow between cells
- Translocation can occur in several directions, depending on the plant's development stage and the time of year. For example, in early spring, the roots are the source and the leaves are the sinks. In the summer, the leaves are the source and the roots are the sinks

Translocation also transports sucrose and other substances such as hormones throughout the plant. The transported substances need to reach all cells in the plant so that the sucrose can be converted back into glucose for respiration

Brain dump key words from reading



Complete 3 different exam questions on the same topic

4a

4 marks

Following their formation, assimilates are transported throughout the plant by translocation in phloem.

Phloem sap mainly consists of carbohydrate in the form of sucrose, but also contains other solutes.

(i) Suggest why it is beneficial to the plant for the carbohydrate to be transferred throughout the plant in the form of sucrose rather than as an alternative carbohydrate.

[2]

(ii) How is transport in the phloem similar to and different from transport in the xylem?

[2]

4b

8 marks

Assimilates are loaded into the phloem at the 'source' and then transported to the 'sink'.

(i) Explain, with a suitable example, how some parts of the plant can act as both a 'source' and a 'sink'.

[2]

(ii) **Fig. 19.1** is a diagram that represents the loading of sucrose into the phloem at the 'source'.

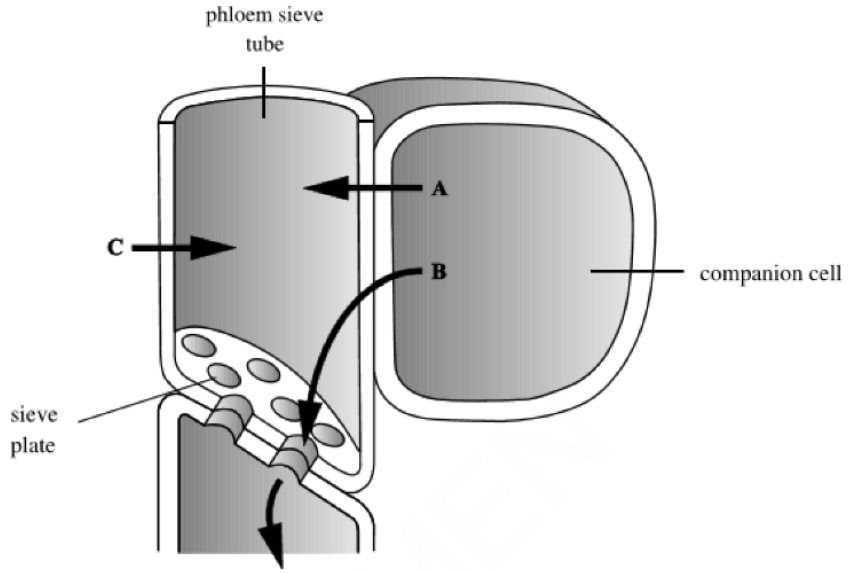


Fig. 19.1

With reference to **Fig. 19.1**, explain the process of the loading of sucrose into the phloem and its movement in the phloem.

[6]

(i) It is beneficial to the plant for the carbohydrate to be transferred throughout the plant in the form of sucrose rather than as an alternative carbohydrate because...

- Sucrose is soluble so it can be transported in sap; [1 mark]
- Sucrose is metabolically (relatively) inactive so it is not used / removed during transport; [1 mark]

(ii) Transport in the phloem is similar to and different from transport in the xylem...

Similarities

A maximum of one of the following:

- Solutes are carried in solution in both; [1 mark]
- Both carry mineral salts; [1 mark]
- Both use mass flow / generated hydrostatic pressure; [1 mark]

Differences

A maximum of one of the following:

- Transport in phloem can take place in different directions **WHILE** transport in xylem only takes place up the plant; [1 mark]
- Phloem carries carbohydrates **WHILE** xylem does not; [1 mark]
- Phloem transport uses living cells **WHILE** xylem does not; [1 mark]
- Xylem uses capillary action / cohesion and adhesion **WHILE** phloem does not; [1 mark]

[Total: 4 marks]

It is important when describing differences that you state what happens in **both structures**, rather than just (in this case) the xylem or the phloem.

(i) Some parts of the plant can act as both a 'source' and a 'sink' because...

- Certain parts can store and then release carbohydrates when needed; [1 mark]
- Suitable examples include root or leaf, which can act as a sink or source at different times of year; [1 mark]

(ii) The process of the loading of sucrose into the phloem and its movement in the phloem is...

This question assesses the quality of your written communication and should be assessed using the following levelled criteria:

	Science content	**Communication**
Level 3 [5–6 marks]	A clear, thorough explanation, showing a good understanding of the principles of loading into phloem, incorporating use of the diagram.	*There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated*
Level 2 [3–4 marks]	A partial explanation showing some understanding of the principles of loading into phloem.	*There is a line of reasoning with some structure. The information presented is relevant and supported by some evidence.*
Level 1 [1–2 marks]	An attempt including some correct principles, but likely to be confused, showing limited understanding of the principles of loading into phloem.	*The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.*

Indicative content:

- At B sucrose is pumped from companion cell into phloem sieve tube
- By active transport
- H^+ / proton co-transport of sucrose
- Reduces the water potential of the sieve tube
- At **A** water enters the sieve tube from the companion cell
- At **C** water enters the sieve tube from xylem
- Increased pressure forces the flow of sap down the phloem
- Through the pores in the sieve plates

[Total: 8 marks]

This question should be marked with a 'best fit' approach where the level is determined by the scientific content and the mark within the level is determined by the quality of the written communication.

4c

10 marks

Fig. 19.2 is a diagram of a potato plant. Potatoes are tubers which are underground storage organs.

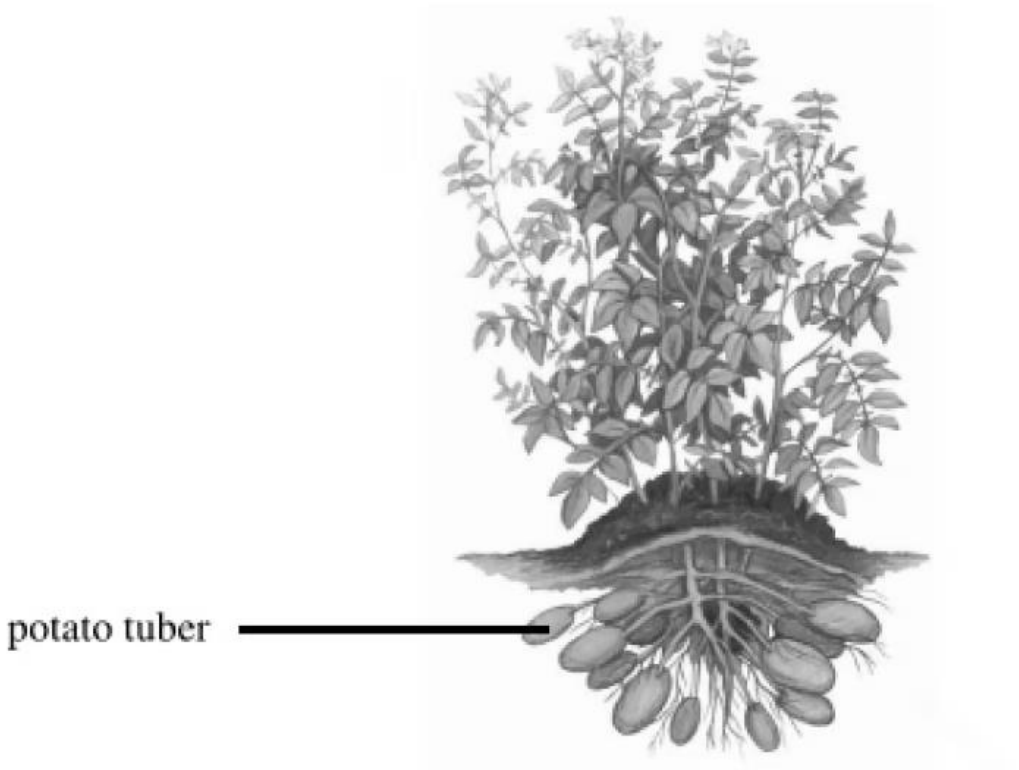


Fig. 19.2

Actively growing tissues have a high demand for carbohydrates. This means that a lot of phloem sap is directed to these tissues and requires sucrose to be unloaded in large amounts.

In an investigation, potato plants were modified by having a gene for invertase inserted into their DNA so that the gene for invertase would be expressed in the tubers. Invertase is responsible for catalysing the hydrolysis of the disaccharide sucrose.

A trial experiment was carried out to compare the properties of the modified plants with those that had not been modified. After harvesting, the tubers of three of each type of plant were compared. The results shown in **Table 19.1**

	Modified	**Not modified**
Mean number of tubers per plant	2.2	5.3
Mean mass per tube (g)	49.7	16.8
Mean sucrose concentration (mg g^{-1} tuber mass)	1.4	13.7
Mean glucose concentration (mg g^{-1} tuber mass)	36.3 ± 3.5	1.9 ± 0.3
Invertase activity (arbitrary units)	62.1	1

Table 19.1

(i) Name the bond that is hydrolysed by invertase.

[1]

(ii) The potato tubers contain monosaccharides.

Compare the concentration of monosaccharides in the modified tubers with those that were not modified.

[2]

(iii) In the modified plants, the unloading of sucrose is increased in the tubers compared with those that were not modified.

The transport of sucrose to the tubers was also increased in the modified plants.

Using the data and the information given, deduce a possible mechanism to account for the increased unloading and transport of sucrose in the modified plants.

[4]

(iv) The trial experiment compared the properties of modified potato plants with those that were not modified.

Analyse the data and draw conclusions about the yield of the tubers of modified plants compared with those tubers from plants which had not been modified.

[3]

(i) The bond that is hydrolysed by invertase is...

- Glycosidic (bond); [1 mark]

(ii) A comparison of the concentration of monosaccharides in the modified tubers with those that were not modified is...

Any two of the following:

- (The concentration is)19 times greater in the modified (tubers); [1 mark]
- 1811% increase in modified compared with unmodified (tubers); [1 mark]
- Standard deviation indicates a greater spread of the data for modified (tubers); [1 mark]

(iii) A possible mechanism to account for the increased unloading and transport of sucrose in the modified plants is...

Any two of the following:

- Sucrose is unloaded at sinks and invertase converts sucrose into glucose / monosaccharide; [1 mark]
- Increases sucrose concentration gradient between phloem and sink; [1 mark]
- Causes increased unloading of sucrose from phloem; [1 mark]

AND

Any two of the following:

- Increases solute gradient between source and sink; [1 mark]
- Removal of water from phloem increases the pressure gradient between source and sink; [1 mark]
- Contributes to increased movement in phloem; [1 mark]

(iv) Conclusions about the yield of the tubers of modified plants compared with those tubers from plants which had not been modified are...

- Modified (tubers) produce fewer **and** larger tubers; [1 mark]
- Modified (tubers) produce a greater mass of tubers; [1 mark]
- 109.34g for modified (tubers) **and** 89.04g for not modified (tubers); [1 mark]

Allow *the reverse argument for marking points 1 and 2*

[Total: 10 marks]