Transport in Plants (3.2): Eduqas A Level Biology Exam Questions by Topic

22 questions · 69 marks · about 83 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · A level Component 3 · June 2019 · Q1(b)(ii) · 2 marks

(ii) Water and minerals can follow several paths from the soil to the xylem. These are the apoplast, symplast and vacuolar pathways. Both the symplast and vacuolar routes involve water crossing cell membranes. Explain why the vacuolar route is slower than the symplast pathway. [2]

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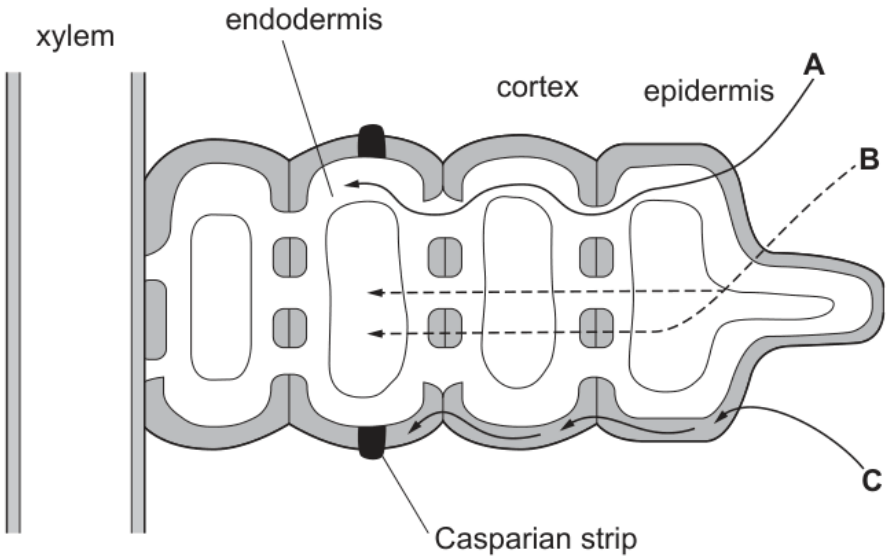
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Question 2 · A level Component 3 · June 2024 · Q3(a)(i) · 2 marks

3. Water lost by transpiration from the leaves of plants results in a flow of water across the roots, as shown in **Image 3.1**.

Image 3.1



(a) (i) Use the information in **Image 3.1** to name the **three** pathways **A**, **B** and **C** by which water moves from the soil to the endodermis. [2]

A .....

B .....

C .....

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Question 3 · A level Component 3 · June 2024 · Q3(a)(ii) · 3 marks

(ii) Complete the table below to describe **three** differences between pathways **A** and **B** in **Image 3.1**. [3]

Pathway **A**	Pathway **B**
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....	....
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Question 4 · A level Component 3 · June 2024 · Q3(a)(iii) · 2 marks

(iii) State the function of the Casparian strip. [2]

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Question 5 · AS Component 2 · June 2018 · Q5(f) · 3 marks

When cyanide solution was added to the soil in the pot the root pressure was observed to fall significantly.

(f) With reference to the role of the Casparian strip, explain how cyanide would result in the reduction in root pressure observed. [3]

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Question 6 · A level Component 2 · June 2022 · Q4(a)(ii) · 3 marks

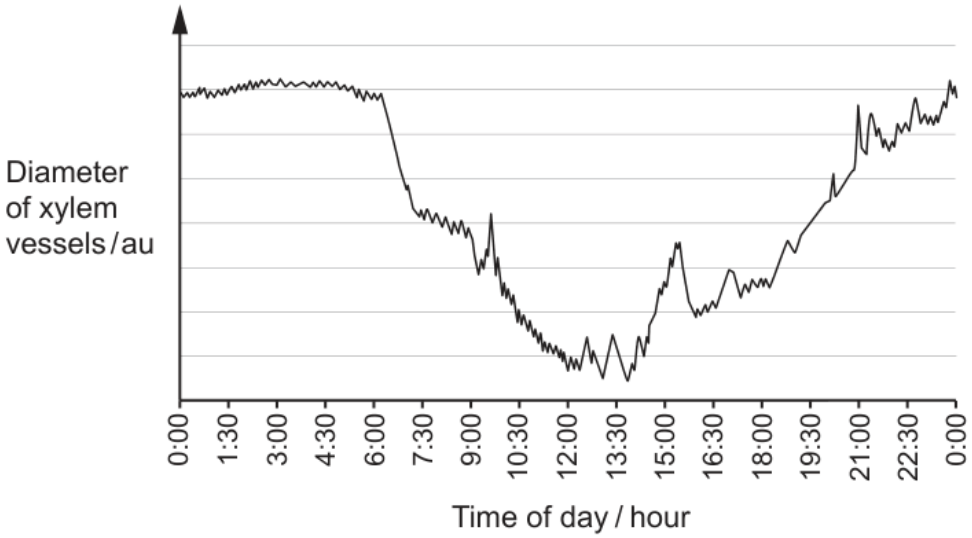
(ii) Cadmium ions are only able to pass into the xylem due to the presence of specialised protein molecules in the cell membranes of one tissue layer in the roots.

Name the tissue in the plant where these specialised protein molecules would be found and explain why the solution used in the hydroponic system needs to be oxygenated. [3]

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(b) Water molecules in the xylem are attracted to each other by cohesion and to the inside of the xylem vessels by adhesion. The rate of water movement affects the diameter of the xylem vessels.
The variation in the diameter of xylem vessels over a 24-hour period is shown in **Graph 3.2**.

Graph 3.2



(i) The diameter of a tree trunk was measured over a 24-hour period.
Use the information above to predict and explain what would happen to the trunk diameter between 6:00 hours and 12:00 hours. [5]

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Question 8 · A level Component 3 · June 2019 · Q1(c)(i) · 1 mark

(c) In the stem of a buttercup, vascular tissues are organised into bundles.

(i) Describe how the arrangement of the vascular tissues in a stem of a buttercup is different from their arrangement in the root. [1]

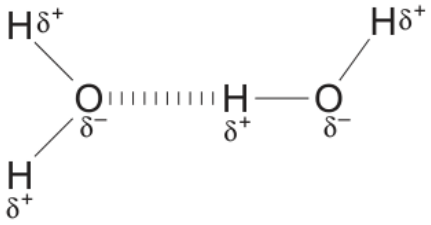
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Question 9 · A level Component 3 · Autumn 2021 · Q2(a) · 3 marks

2. **Image 2.1** shows two adjacent water molecules.

Image 2.1



(a) Explain how **one** feature shown in **image 2.1** enables water molecules to travel up the xylem. [3]

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Question 10 · AS Component 2 · Autumn 2020 · Q2(a)(i) · 4 marks

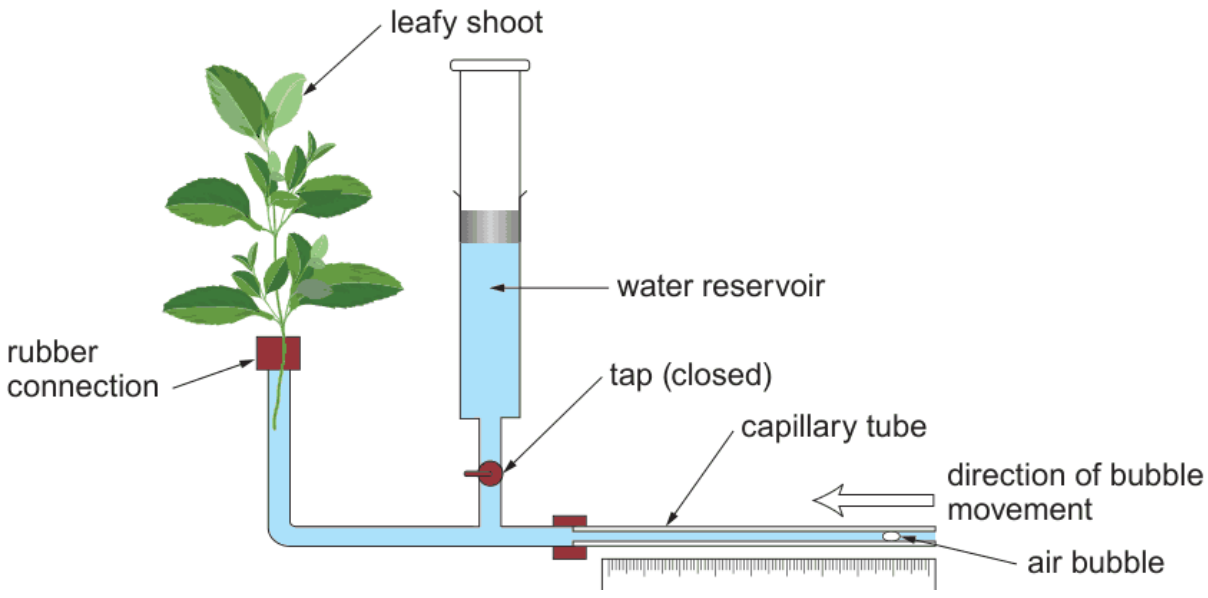
2. Transpiration is the loss of water vapour from the leaves of a plant. This allows water to move through the xylem of the plant.

(a) (i) Explain how the cohesion-tension theory accounts for most of the water movement through the xylem of a plant. [4]

Question 11 · information from earlier in the question

(b) A potometer was set up, as shown in **image 2.1**, to investigate transpiration in plants. The shoot was exposed to a range of different air speeds using a hairdryer.

Image 2.1



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(c) **Table 2.2** shows the results of the experiment for three air speeds generated by the hairdryer.

Table 2.2

Air speed setting	Distance moved by the bubble in 12 minutes / mm
slow	28
medium	35
fast	47

A student made the following conclusion from these results: '*Increasing the air speed caused an increase in the distance the bubble moved.*'
Suggest **three** reasons why it would not be possible to be confident in this conclusion.
[3]

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Question 12 · information from earlier in the question

Readings were taken and the total volume of water taken up by the leafy shoot was calculated, as shown in the table below.

	Total volume of water taken up by the leafy shoot / cm^3	
Time / minutes	**not enclosed in polythene bag**	**enclosed in polythene bag**
0	0	0
10	2.4	2.2
20	4.1	2.9
30	5.6	2.9
40	6.6	2.9

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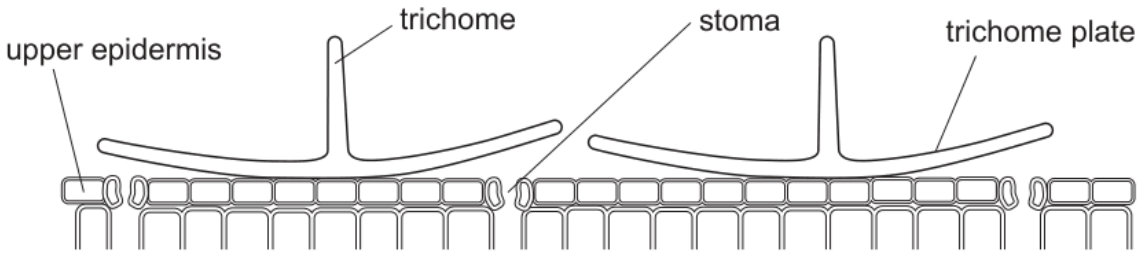
Question 12 · AS Component 2 · June 2017 · Q2(b)(iii) · 5 marks

(iii) Describe and explain the results shown. [5]

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Tillandsia punctulata, a bromeliad species, lives high in the canopy layer of the rainforest where there is a higher temperature and a lower relative humidity. This species shows an adaptation to the environment as they have hair-like structures (trichomes) which stick up from plates which cover the stomata. The arrangement is shown in **Image 5.4**

Image 5.4

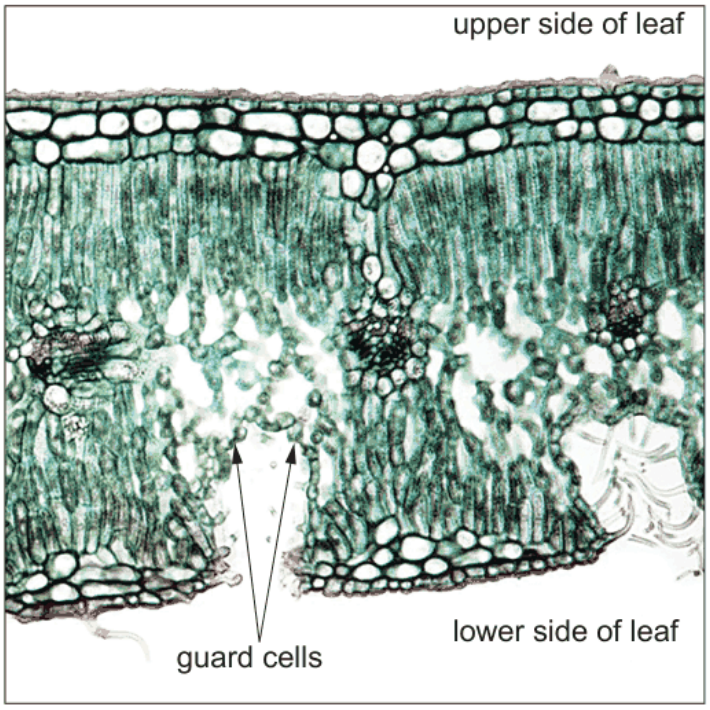


(ii) Using all the information provided, suggest why this arrangement of trichome plates and stomata is an adaptation for survival in the exposed conditions of the upper canopy. [3]

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(b) When the stomata are open, loss of water vapour also occurs. **Image 3.2** shows a section of a leaf from a plant which has adaptations to reduce this loss of water vapour from its leaves.

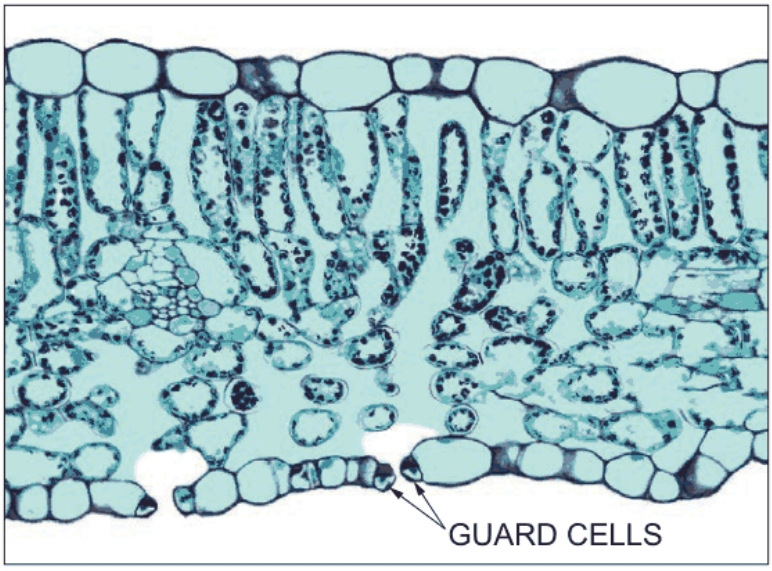
Image 3.2



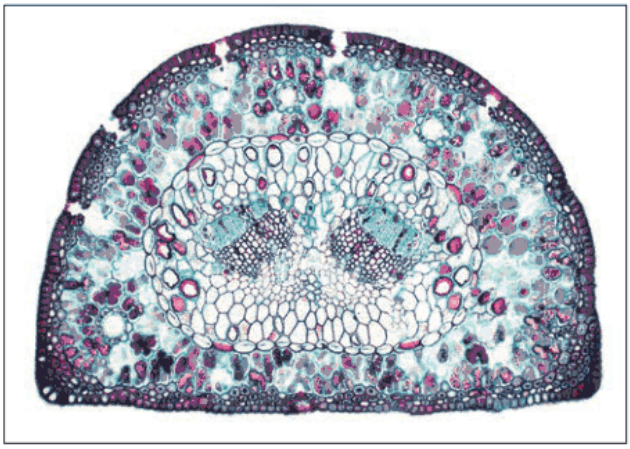
(i) Identify the **type** of plant which has the type of adaptations shown in **Image 3.2**. Describe **and** explain **three** adaptations shown in **Image 3.2** which reduce the loss of water vapour. [4]

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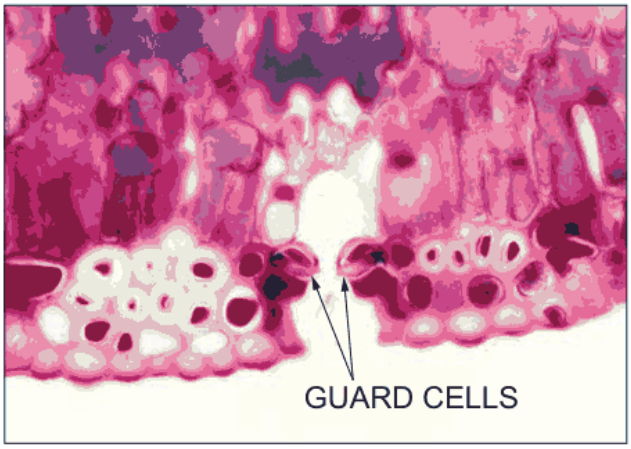
3. There is a wide variation in the rate of water loss from different plant species. Such variation is often due to structural features of the leaf. The photomicrographs below show transverse sections of a leaf of privet *(Ligustrum sp.)* and a leaf of pine *(Pinus sp.)*.



Ligustrum sp. T.S. leaf



Pinus sp. T.S. leaf



detail of stoma of *Pinus sp.*

(a) Use the photomicrographs to explain why less water vapour is lost through the stomata of *Pinus sp.* than through the stomata of *Ligustrum sp.* . [3]

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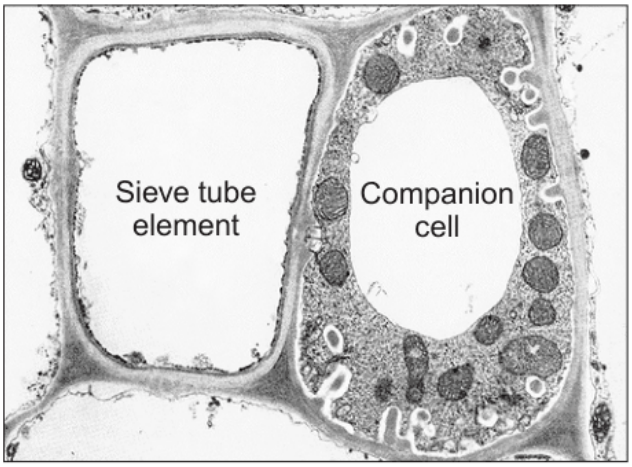
Question 16 · A level Component 3 · Autumn 2020 · Q5(c)(i) · 3 marks

(c) (i) It was observed that the rate of movement varied throughout the day. The rate was greatest at midday. Explain this observation. [3]

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

(d) **Image 5.4** shows part of the phloem from a tomato plant.

Image 5.4



Explain how **one** feature of each cell shown in **image 5.4** enables the translocation of sucrose through the plant. [4]

Companion cell

Sieve tube element

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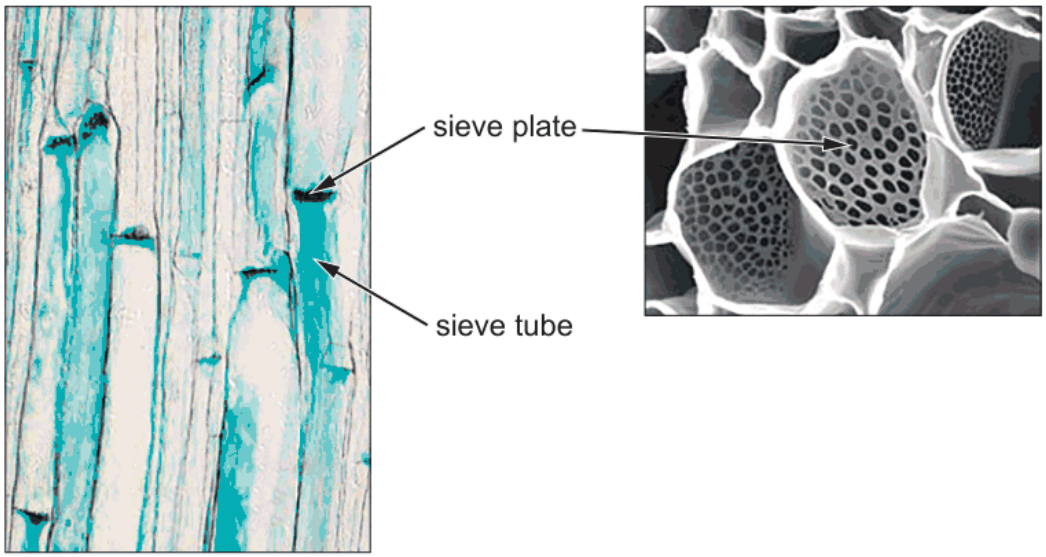
Question 18 · information from earlier in the question

3. Tomato plants, *Solanum lycopersicum*, are grown commercially for their edible fruit. They produce bright yellow flowers from which the fruit develop.

Sucrose is a disaccharide transported in phloem tissue and used by tomato plants as a source of energy.

Image 3.1A shows a light micrograph of phloem tissue.

Image 3.1B shows an electron micrograph of a sieve plate.



(a) The mechanism of transport in phloem is described as the mass flow hypothesis. Increasing hydrostatic pressure in the sieve tubes at the source in the leaves drives the transport of sucrose to sinks elsewhere in the plant.

Question 18 · AS Component 2 · June 2023 · Q3(a)(ii) · 2 marks

(ii) The rate of flow of solutes in the phloem sieve tubes of tomato plants may be up to ten times faster than the flow of solutes through other cells.

Using Images 3.1A and 3.1B and your knowledge of sieve tube structure, describe and explain **one** structural feature that allows a relatively fast flow rate to be achieved in the sieve tubes. [2]

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Question 19 · AS Component 2 · June 2023 · Q3(a)(iv) · 3 marks

(iv) The rate of uptake and translocation of sucrose in phloem was found to be inhibited by:

- low temperature
- phosphate deficiency
- cyanide.

Explain why **each** of these observations appear to contradict the mass flow hypothesis, which describes a passive process. [3]

Question 20 · A level Component 3 · June 2025 · Q3(c) · 4 marks

(c) The mass flow hypothesis of movement of sugars in the phloem suggests there is a pressure gradient from source to sink.
Explain how high pressure is generated in the phloem near the source cells. [4]

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(d) The transport of sucrose in the phloem was investigated using radioactive carbon dioxide and ringing of the stem.

- All leaves were removed apart from one midway down the stem.
- Radioactive carbon dioxide $^{14}CO_2$ was added to a chamber surrounding the leaf.
- The level of ^{14}C was then measured at the top of the stem, in the leaf and in the root.
- The experiment was then repeated on three more plants but with the stem being ringed to remove the phloem in a combination of locations. **Image 3.2** shows the setup up of the apparatus.

Image 3.2

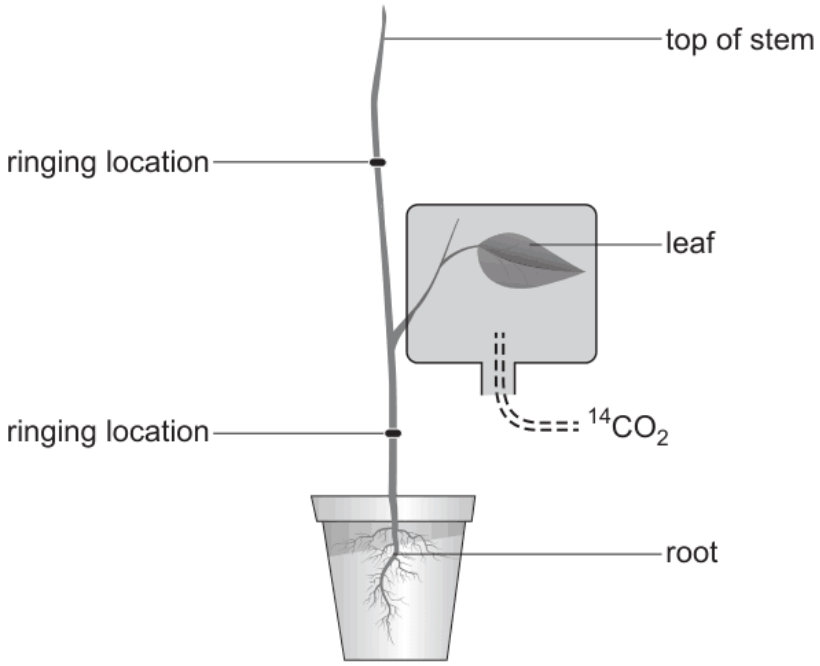


Table 3.3 shows the results of the investigation.

Table 3.3

Plant	Ringing location in relation to leaf	Level of ^{14}C / au		
		Leaf	Top of stem	Root
A	none	2.5	3.3	0.9
B	above	2.3	0.0	1.7
C	below	2.1	4.1	0.0
D	above and below	2.1	0.0	0.0

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Question 21 · A level Component 3 · June 2025 · Q3(d)(ii) · 4 marks

(ii) Use the information from **Image 3.2** and **Table 3.3** to make **two** conclusions about the transport of sucrose in plants. Justify each conclusion. [4]

Conclusion 1

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Conclusion 2

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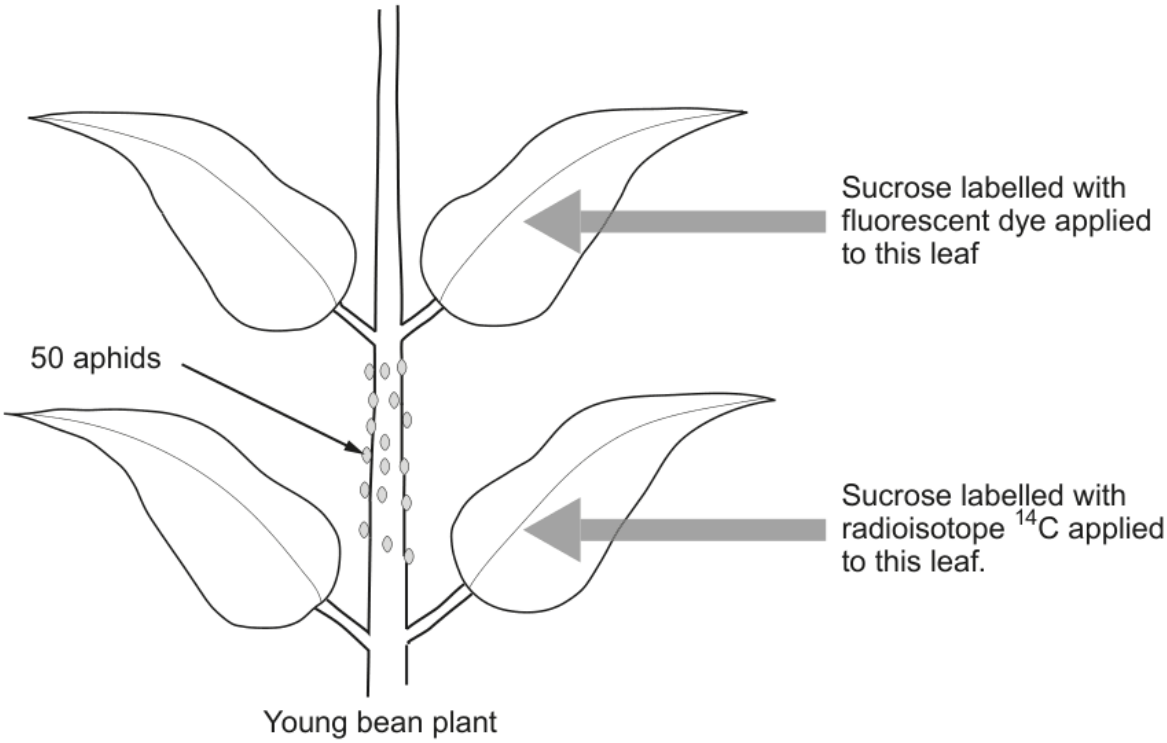
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In this way aphids can be used to sample sap from the stems of plants. By applying substances to leaves scientists are able to track what is being transported in single tubes. One such experiment to compare downward and upward transport is shown below:



Fifty aphids were feeding between two successive layers of leaves. Sucrose labelled with fluorescent dye was applied to an upper leaf and radioactive sucrose was applied to the corresponding lower leaf. The aphids were removed from their stylets as shown opposite, sap was then collected at **20 minute** intervals and tested for radioactivity and fluorescence.

Radioactivity and fluorescence were both detected in the sap from each individual aphid.

(b) Explain why this observation **does not** support the mass flow hypothesis and name an alternative hypothesis which could account for the observation. [3]

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Mark schemes

Question 1 · A level Component 3 · June 2019 · Q1(b)(ii) · 2 marks

(ii)	**vacuolar**: water crosses more membranes than symplast/ water moves in and out of vacuole/ water has to pass through the {tonoplast/ vacuolar membrane}/ water has to pass through vacuole and cytoplasm (1) NOT vacuole to vacuole **symplast**: (moves through cytoplasm and) {cell membrane/ plasmodesmata} / only crosses one membrane (1)		2	2

Question 2 · A level Component 3 · June 2024 · Q3(a)(i) · 2 marks

3	(a)	(i)	A symplast B vacuolar C apoplast 2 All for 2 marks 2 for 1 mark		2		

Question 3 · A level Component 3 · June 2024 · Q3(a)(ii) · 3 marks

(ii) **Any three (x1) from**

A	B
(only) cytoplasm / no vacuole	(cytoplasm and) vacuole (1)
(only needs to cross cell membrane / does not cross {vacuolar membrane / tonoplast}	crosses (cell membrane and) {vacuolar membrane / tonoplast} (1)
(only) uses plasmodesmata/ does not use cell walls	uses (plasmodesmata and) cell walls (1)
Faster movement / less resistance (to movement)	Slower movement / more resistance (to movement) (1)

3 3

Question 4 · A level Component 3 · June 2024 · Q3(a)(iii) · 2 marks

	(iii)	{Forces / moves / diverts} {water / (dissolved) ions} from the apoplast (pathway) (1) Accept blocks apoplast pathway into the {symplast (pathway) / cell / cytoplasm} (1)	1	1	2	

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Question 5 · AS Component 2 · June 2018 · Q5(f) · 3 marks

(f)		**Any 3 (x1) from:** Stops apoplast pathway/forces ions into symplast pathway (1) Movement of Ions into xylem requires active transport (1) Cyanide is a respiratory inhibitor/prevents cells respiring/Stops ATP synthesis (1) Lower water potential gradient reduces root pressure/ORA (1)		3	3	

Question 6 · A level Component 2 · June 2022 · Q4(a)(ii) · 3 marks

(ii)	Endodermis (1) {Cadmium/ions} have to be actively transported into cells (1) {Synthesis of ATP / {oxygen needed for/ aerobic} respiration} (1)	1	2	3		

Question 7 · A level Component 3 · June 2024 · Q3(b)(i) · 5 marks

(b)	(i)	A. Trunk diameter decreases (1) **Any four (×1) from:** B. An increase in light (intensity) results in stomata opening / stomata open in {day / sun} (1) C. (so) the transpiration rate increases / owtte (1) D. Because of cohesion between water molecules / owtte (1) E. adhesion of water to walls of the xylem / owtte (1) F. (Resulting in the) diameter of xylem vessels being reduced (1)	2	3	5	2	

Question 8 · A level Component 3 · June 2019 · Q1(c)(i) · 1 mark

(c)	(i)	arranged around the {periphery / edge} (of the stem) (1) No reverse argument for arrangement in root	1		1	1

Question 9 · A level Component 3 · Autumn 2021 · Q2(a) · 3 marks

2	(a)	**Any three (x1) from:** Hydrogen bonds provide cohesion/ water molecules polar so form hydrogen bonds (1) Transpiration pulls water up/ continuous column of water up the xylem (1) Forms a transpiration stream (1) Also provides adhesion to walls of the xylem vessels (1)	3	3

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Question 10 · AS Component 2 · Autumn 2020 · Q2(a)(i) · 4 marks

2	(a)	(i)	A. Explanation of cohesion - water molecules are polar so attract each other/ xylem wall / form hydrogen bonds with each other/ xylem wall (1) B. Explanation of adhesion – water attracted to lignin/ capillarity (1) C. {Loss of water/ transpiration} from the {leaves/stomata} creates tension (1) Accept drop in pressure D. Water is pulled up xylem/ref to transpiration stream (1)	4	4

Question 11 · AS Component 2 · Autumn 2020 · Q2(c) · 3 marks

(c)	**Any three (x1) from:** Only did one repeat / should do repeats (1) Hair dryer generates heat so temperature not controlled (1) Should have used more air speeds (1) Other variables not controlled e.g. light/ humidity/ CO_2 (1) Accept descriptions	3	3	3

Question 12 · AS Component 2 · June 2017 · Q2(b)(iii) · 5 marks

2	(b)	(iii)		**Any 5 (x1) from:** A. Polythene bag: Initial increase but (after 20 mins) {no further increase / curve plateaus} **and n**o bag: {(steady) increase /constant rate of uptake} (1) B. water vapour {trapped inside polythene bag / cannot diffuse away from leaves} / increased humidity inside bag (1) C. {no diffusion gradient / no concentration gradient/ equilibrium reached / correct description of equilibrium} in the bag(1) D. water uptake stopped / no more water vapour diffuses out of stomata (1) must be linked to the idea of no diffusion gradient E. with no bag, there is a {diffusion/ concentration/ water potential} gradient (1) F. because {diffusion shells {are removed/ do not build up}/ water vapour removed from (lower) surface of leaf/ ORA} (1)	4	1	5	

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Question 13 · A level Component 3 · June 2022 · Q5(b)(ii) · 3 marks

(ii)	**Any three (x1) from** Plates {trap a layer of {still air/water} / prevent blowing water away} (1) Layer becomes saturated with water vapour/ (area of) increased humidity (1) Reduce {concentration/ water potential} gradient (1) So water loss decreases/ conserves water/ less transpiration/ ORA (1)	3	3

Question 14 · AS Component 2 · June 2022 · Q3(b)(i) · 4 marks

	(b)	(i)		Xerophyte (1) Sunken stomata/stomata in pits + less air movement (1) Trichomes/hairs + {to trap water vapour/ reduce the gradient} (1) Thick {cuticle/ epidermis} + reduce evaporation (1)		4		4		

Question 15 · AS Component 2 · June 2018 · Q3(a) · 3 marks

3	(a)		Sunken stomata + Water vapour builds up in pits (1) Reduces diffusion gradient (1) Rate of transpiration reduced Ligustrum has no pits/stomata nearer surface + Moving air can easily disrupt diffusion shells/blow away water vapour. (1)	3	3	

Question 16 · A level Component 3 · Autumn 2020 · Q5(c)(i) · 3 marks

(c)	(i)	Any **three** (x1) from: • As light intensity /temperature are at their highest. (1) • The rate of photosynthesis is highest around midday (1) • Photosynthesis produces sugars that are transported into the phloem for transport (1) • this increases the pressure, so rate is greater. (1) Accept reverse answers	3	3

Question 17 · A level Component 3 · Autumn 2020 · Q5(d) · 4 marks

(d)	Companion cell: (large number of) mitochondria produce ATP (1) To (actively) transport sugars into/out of sieve tubes (1) Sieve tube: very few cell contents give more space (1) For unrestricted flow/mass flow/ transport of sugars (1)	4	4

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Question 18 · AS Component 2 · June 2023 · Q3(a)(ii) · 2 marks

(ii)	Sieve plates have (many) pores/sieve tubes have very little cytoplasm/ fewer organelles (1) Reject 'no' cytoplasm/'no' organelles. less flow resistance (for phloem solution) OWTTE (1)	2	2		

Question 19 · AS Component 2 · June 2023 · Q3(a)(iv) · 3 marks

(iv)	**Any 3 (x1) from** Suggests energy required (for the process)/ATP used/ ORA (1) Low temp slows respiration/ decreases kinetic energy (1) Phosphate needed for production of ATP (1) cyanide inhibits respiration/reference to correct part of respiratory pathway (1)	2	1	3		

Question 20 · A level Component 3 · June 2025 · Q3(c) · 4 marks

(c)	**Any four (x1) from** A. Sugars in the {sieve tube elements / phloem} {reduce water potential/ increased solute potential} (1) B. Water moves into {sieve tube elements / phloem} (1) C. down water potential gradient (1) D. by osmosis (1) E. (water moving into phloem) increases <u>hydrostatic</u> pressure / owtte (1)	3	1	4	

Question 21 · A level Component 3 · June 2025 · Q3(d)(ii) · 4 marks

(ii)	**Any two (x2) linked conclusions** Plant {B and C / D} No sucrose movement past ring (when phloem is removed) (1) proves phloem transports sucrose (1) OR Plant {A/ B and C} shows {sucrose/ ^{14}C} in both {tip/ top} and root (1) Sucrose can move {upwards and downwards/source to sink/ owtte} (1) OR Plant A shows more ^{14}C in tip than root (1) {Higher usage of sucrose / increased respiration/ increased cell division} in tip than root (1)	4	4	4	

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Question 22 · AS Component 2 · June 2016 · Q3(b) · 3 marks

(b)	• because mass flow is from {sources to sinks/ one direction/ same direction} (1) Reject down unqualified	1		
	• this flow is {two way / bidirectional / up and down/ in both directions } (in the sieve tubes/ in the phloem) (1)	1	1	3
	• named alternative hypothesis e.g. cytoplasmic streaming / electro-osmosis / active phloem loading / diffusion/ active transport/ protein filaments (1)			

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