

Name	Date started	Target end date
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GCE AS / A LEVEL – BIOLOGY UNIT 2 QUESTION PACK

1072-01 (Legacy BY2) · New spec Unit 2 Topic 10 · AS unit, first sat 2016, 80 marks, 1h 30min paper

REVISE

.wales

BIOLOGY – UNIT 2 · TRANSPORT IN PLANTS &Mdash; XYLEM & TRANSPIRATION

BY2.2.6 Adaptations for transport in plants – xylem, transpiration and the cohesion-tension theory

Xylem tissue structure, the transpiration stream, the cohesion-tension theory, root pressure, and factors affecting transpiration rate (with potometer-style experimental questions).

LEGACY 2008 SPECIFICATION

Estimated time for entire question pack: ~2 h 21 min

Derived from the legacy BY2 paper's pace of ~1.1 min/mark, padded for long-prose answers (88 marks over 7 questions).

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains every question from the legacy WJEC BY2 papers (2008 modular spec, 2011–2017) that maps onto new-spec AS Unit 2 Topic 10 (2.6).

Questions are ordered by source paper date.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working – quality of written communication will affect marks. A calculator is allowed. Diagrams included in answers must be fully annotated.

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Q	Source	Max	Mark	Q	Source	Max	Mark
1	Jan 12 Q3	18		5	Jun 15 Q5	13	
2	Jun 13 Q2	13		6	Jan 14 Q5	12	
3	Jan 13 Q3	10		7	Jun 16 Q5	9	
4	Jun 14 Q2	13		Total			
						88	

Transport in Plants – Xylem & Transpiration – what the new spec asks

WJEC GCE AS / A Level Biology (from 2015) · Unit 2: Biodiversity & Physiology of Body Systems · Topic 2.6.

Xylem tissue

- Vessels & tracheids: dead, lignified, hollow tubes.
- Pits allow lateral water movement.
- Also provide structural support to the plant.

Transpiration

- Evaporation of water from mesophyll cells through stomata.
- Driven by water vapour gradient (humidity, temperature, wind).
- Inevitable consequence of CO₂ uptake for photosynthesis.

Cohesion-tension theory

- Loss of water at leaf creates tension in xylem.
- Water molecules cohere (H-bonds) ⇒ continuous column.
- Adhesion of water to xylem walls also helps.

Root uptake & pressure

- Apoplast (cell walls), symplast (cytoplasm), vacuolar pathways.
- Casparian strip forces water into symplast at endodermis.
- Active ion pumping creates root pressure (guttation evidence).

Transport in Plants – Xylem & Transpiration in one page

Quick-reference notes – revisit before each question.

Xylem structure

Vessels & tracheids: dead, lignified, hollow.

End walls broken down in vessels – continuous tube.

Pits allow lateral movement; provide structural support.

Water pathways

Apoplast: through cell walls.

Symplast: through cytoplasm via plasmodesmata.

Vacuolar: through vacuoles.

Endodermis & Casparian strip

Suberin in endodermal cell walls – impermeable.

Forces water from apoplast into symplast.

Allows control over what enters xylem.

Root pressure

Active pumping of ions into xylem.

Water follows osmotically; pushes sap up.

Evidence: guttation; bleeding cut stems.

Cohesion-tension

Transpiration – water loss from leaf surface.

Tension pulls column of water up xylem.

Cohesion of H-bonded water maintains continuous column.

Transpiration factors

↑ light, temperature, wind, air movement ⇒ ↑ rate.

↑ humidity ⇒ ↓ rate.

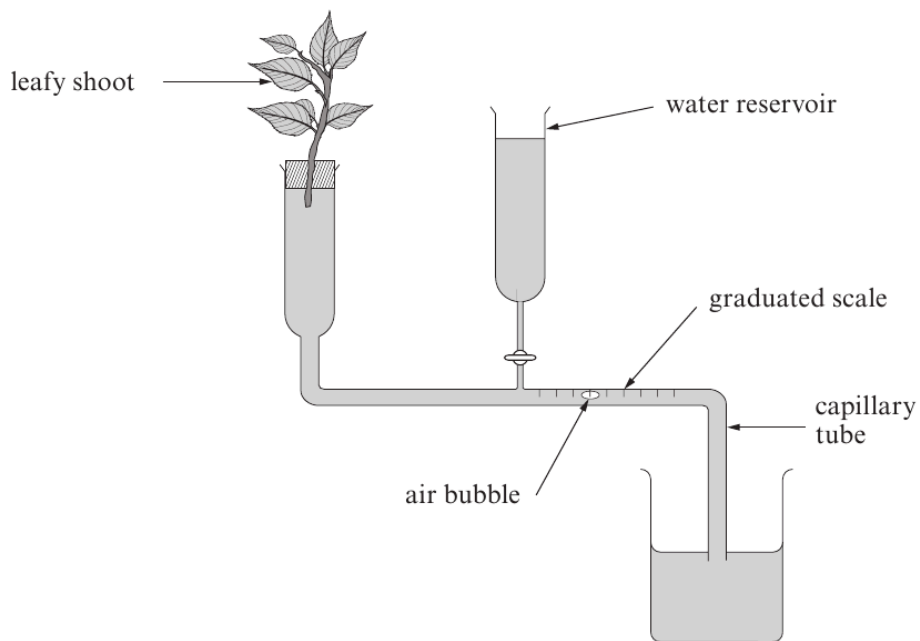
Potometer measures water uptake (proxy for transpiration).

3. (a) State the name of the process by which plants lose water from their leaves. [1]

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- (b) The apparatus shown in the diagram was used to study how wind speed affects the rate at which a leafy shoot loses water.

The same shoot was exposed to air moving at different speeds. At each speed the distance moved by the air bubble in 5 minutes was recorded.



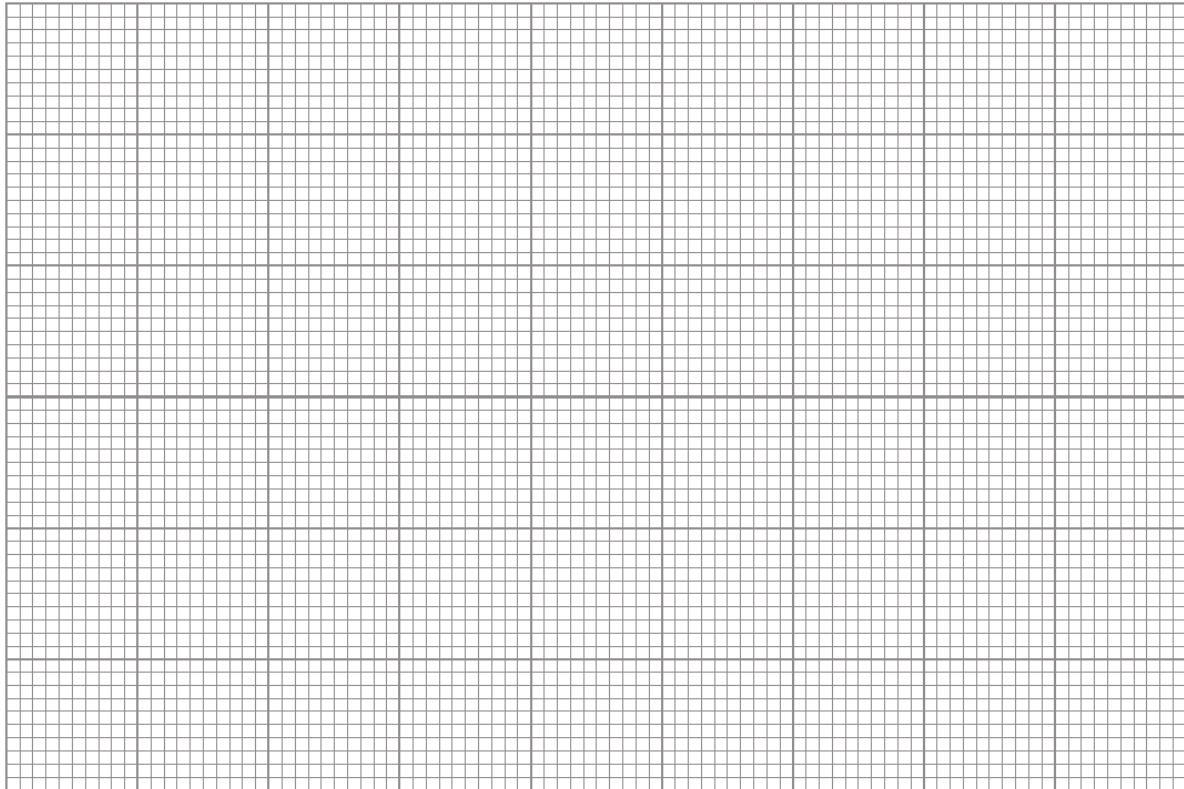
- Name the apparatus shown in the diagram. [1]

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- (c) The table below shows the results of the investigation.

<i>Wind speed / m s⁻¹</i>	0	5.0	10.0	15	20	25.0
<i>Distance travelled by air bubble / mm</i>	50	195	260	285	300	275

- (i) Plot the data as a graph on the grid provided. [4]



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- (ii) Describe and explain the effect of wind speed on the distance travelled by the air bubble as the wind speed increased from 0 to 20 ms⁻¹. [2]

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- (iii) Describe **one** theory that would explain how water moves up the stem of the leafy shoot. [3]

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- (d) The results show that at wind speeds above 20ms^{-1} the distance travelled by the bubble decreased. One explanation for this decrease could be due to the closure of the stomata by guard cells.

Describe the role of **each** of the following in the operation of guard cells in closing stomata.

- (i) K^+ (potassium ions). [1]

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- (ii) Water potential of the cells. [1]

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- (iii) Unevenly thickened cell walls. [1]

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- (e) Humidity and temperature also affect the rate at which water is lost from leaves.

In the table below underline the correct word to show whether **an increase** in each factor would increase or decrease the rate of water loss from plants and explain how each factor causes this change. [4]

<i>Factor</i>	Effect on rate of water loss	<i>Explanation</i>
Increased humidity	Increase / Decrease	
Increased temperature	Increase / Decrease	

(Total 18 marks)

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2. (a) Plants carry out the process of transpiration.

State what is meant by the term *transpiration*.

[2]

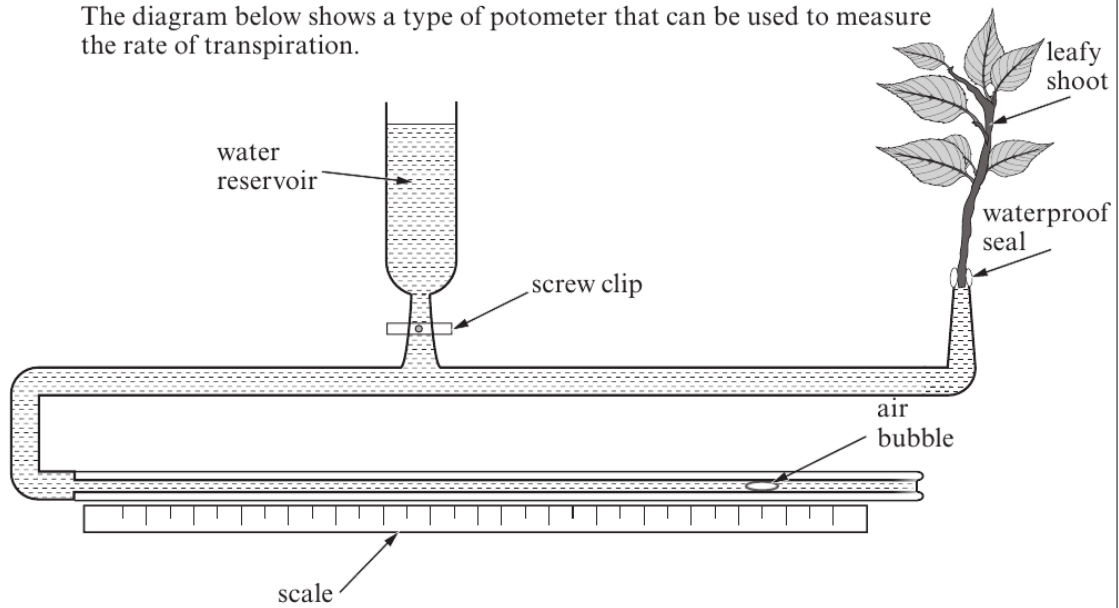
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The diagram below shows a type of potometer that can be used to measure the rate of transpiration.



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(b) State **two** practical measures which should be taken when setting up the apparatus to ensure the potometer functions correctly. Give reasons for your answers. [4]

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(c) Water passes through the xylem of the root and stem of a plant before reaching its leaves.

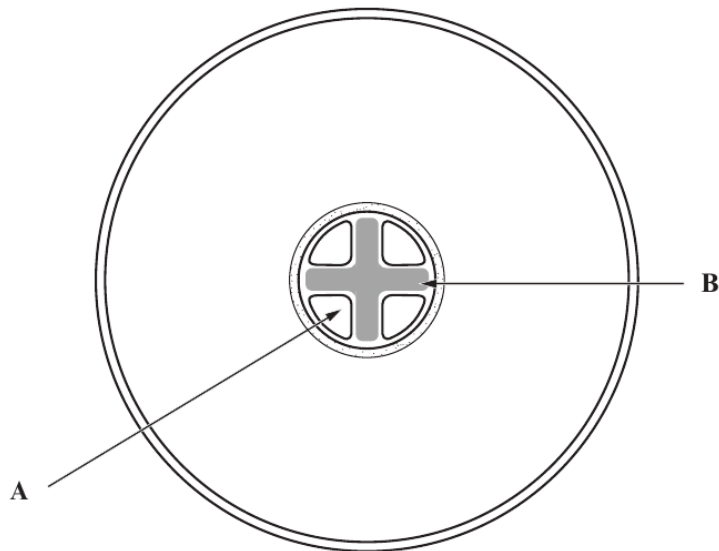
(i) Name the original source of energy that moves water through a plant. [1]

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(ii) Explain how water moves up the xylem. [2]

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(d) The diagram below shows the cross section of a root.



(i) Name the **two** tissues labelled **A** and **B** on the diagram above. [2]

A **B**

(ii) Explain how it is possible to tell that the diagram above is of a root and not a stem. [2]

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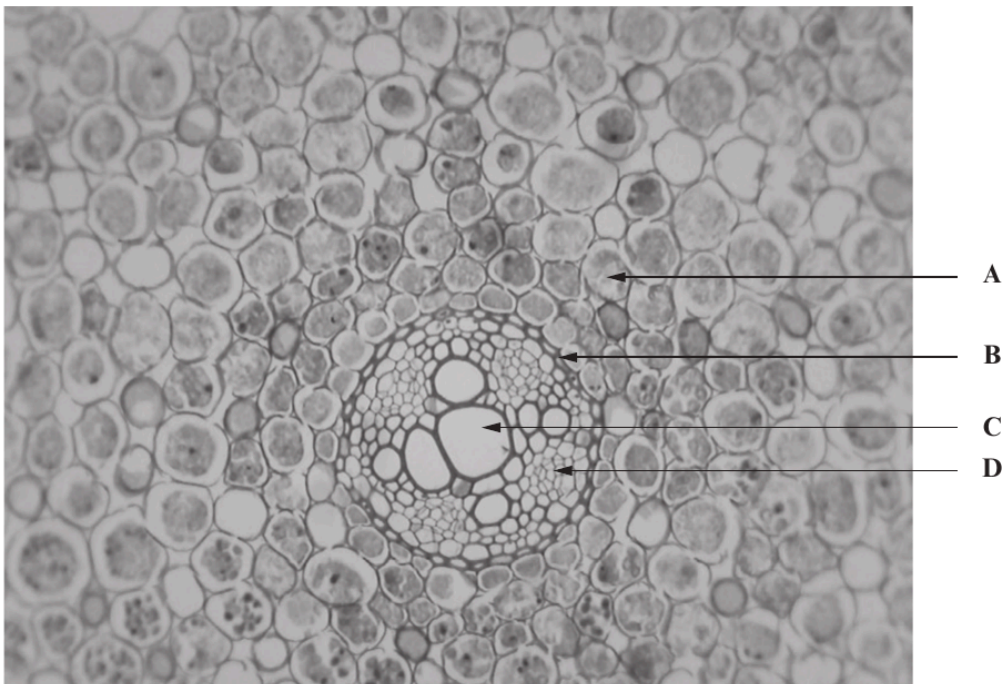
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3. Roots of higher plants contain vascular tissues, the photomicrograph below shows a transverse section through the central part of a buttercup (*Ranunculus sp.*) root.

(a) Name the tissues labelled A-D on the photomicrograph of a root. [2]

A B

C D



(b) Name the tissue shown in the photomicrograph above which is strengthened with lignin [1]
has sieve tubes.

(c) State the function of (i) sieve tube cells [1]

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(ii) companion cells. [1]

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(d) Some water moves across the root cortex through the vacuolar pathway, from vacuole to vacuole of adjacent cells.

(i) Name and describe **two other** pathways by which water moves across the root cortex. [4]

Name of pathway

Description

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Name of pathway

Description

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(ii) How does the Casparian strip affect the route water takes into the stele? [1]

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2. (a) (i) State what is meant by the term *transpiration*. [2]

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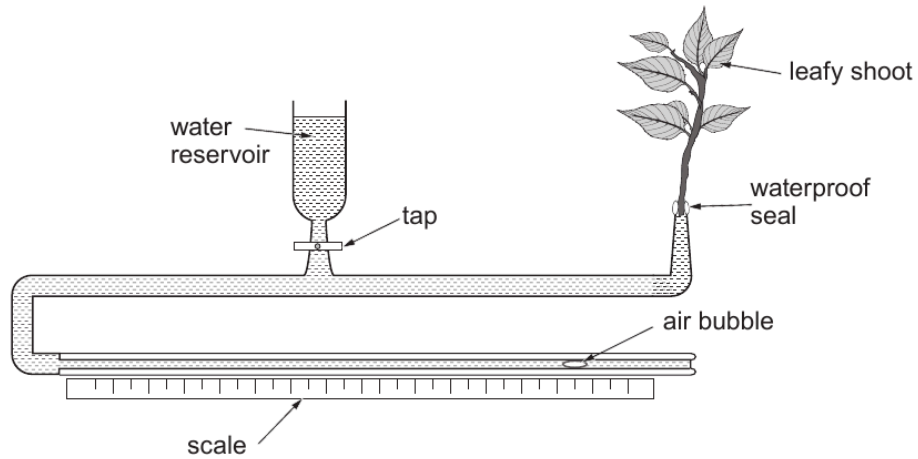
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(ii) Give **one** benefit of transpiration to a plant. [1]

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(b) The diagram below shows a piece of apparatus called a potometer which is used to measure the rate of transpiration.



(i) Suggest why the end of the shoot should be cut under water before being inserted into the potometer. [2]

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(ii) State what measurements would have to be made, in order to determine the rate of transpiration. [2]

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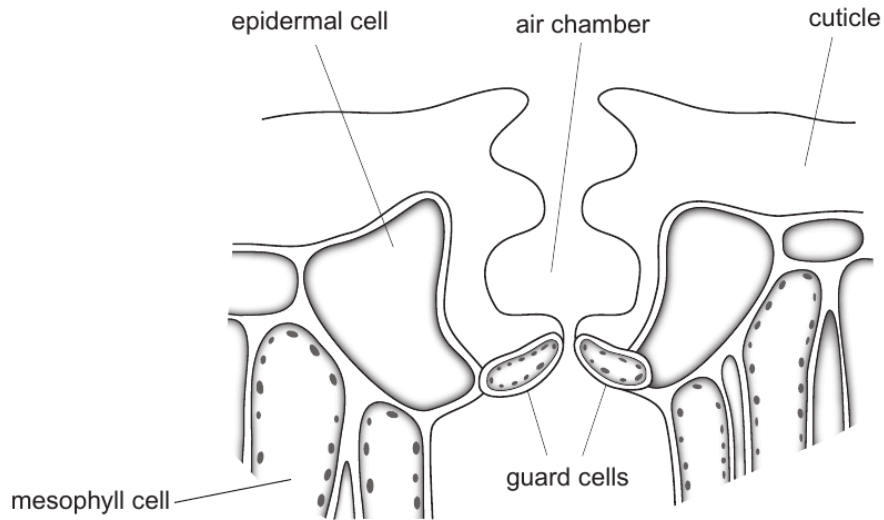
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(c) The diagram below shows a sunken stoma which is an adaptation found in the leaves of some plants that live in very dry conditions.



(i) State the general name for plants that live in, and are adapted for, dry conditions. [1]

(ii) With reference to the diagram, explain how a sunken stoma is able to reduce transpiration. [3]

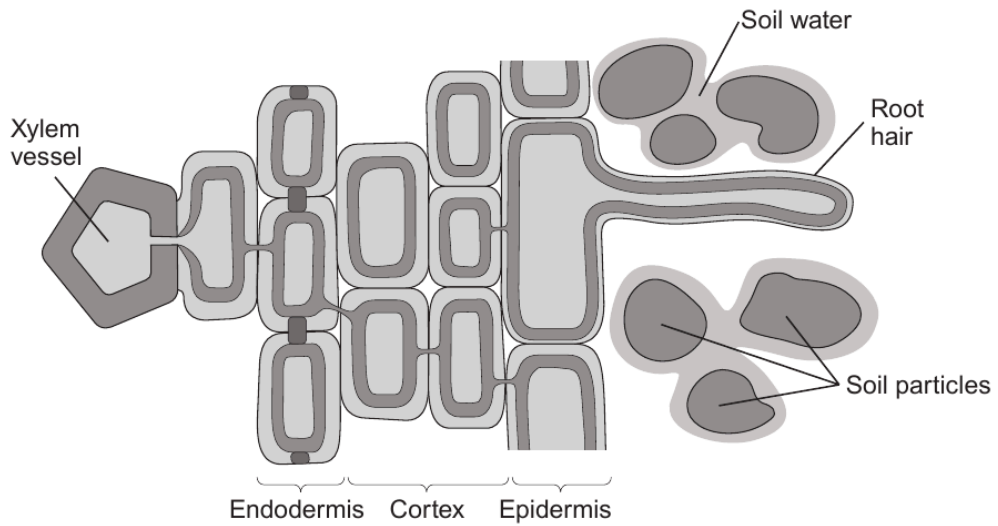
(iii) Describe and explain **two other** adaptations which reduce the rate of transpiration in plants that live in very dry conditions. [2]

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5. Shown below is a diagram of a cross section through a root.



(a) Explain how a root hair cell is adapted to its function. [1]

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(b) Water can travel across the root via the apoplast and symplast pathways. Describe the difference between these two pathways. [2]

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(c) Describe and explain the role of the endodermis in the uptake of water into the xylem vessels and in generating root pressure. [4]

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(d) The transport of organic molecules through a plant can be monitored using radioactive tracers. If a plant is supplied with carbon dioxide containing the radioactive isotope, ^{14}C , then the radioactive carbon will be incorporated into organic molecules which can then be located using autoradiography.

(i) Name the leaf tissue where ^{14}C is incorporated into organic molecules. [1]

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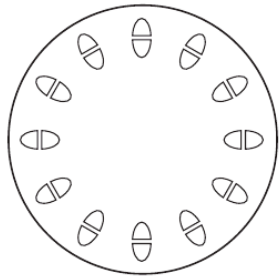
(ii) Name the carbohydrate that is transported through the plant. [1]

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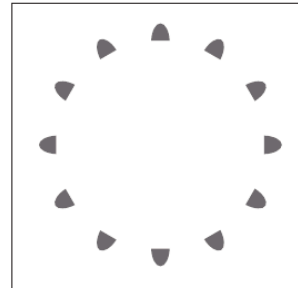
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(e) Below is a transverse section of a dicotyledon stem and an autoradiogram of the same section.



Transverse section of stem



Autoradiogram

What conclusion about the transport of carbohydrates can be drawn from the autoradiogram? [1]

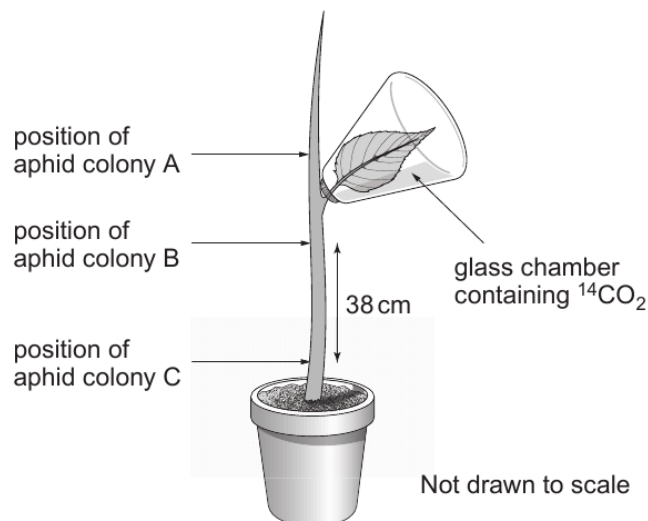
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(f) In an experiment, a single leaf of a plant was supplied with radioactively labelled carbon dioxide. Colonies of aphids were allowed to feed at various locations on the plant, as shown in the diagram below. During feeding, the aphids were anaesthetised and their bodies removed leaving their mouthparts in the plant. The solution of organic molecules flowing out of the mouthparts was then analysed.



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Aphid colony	Time after the start of the experiment when radioactivity was first detected in aphid mouth parts (hours)
A	1.0
B	1.0
C	2.5

(i) How does the evidence from the experiment show that there is bidirectional movement of organic molecules in the plant? [1]

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(ii) Use the information provided to calculate the rate of translocation (cm min^{-1}) of organic molecules through this plant. [2]

..... cm min^{-1}

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5. (a) Four Pea (*Pisum sativum*) leaves **A**, **B**, **C** and **D** were removed from a healthy plant and treated by applying a thin layer of grease to their upper and lower surfaces. The leaves were then placed in an incubator at 60°C and weighed every two hours until there was no further change in mass.

The results are shown in the table below.

leaf	grease application (surface)	starting mass of leaf (g)	final mass of leaf (g)	change in mass (g)	percentage change in mass (%)
A	upper and lower	12.4	11.9	- 0.5	4.0
B	upper only	13.6	11.2		
C	lower only	13.8	12.7	- 1.1	8.0
D	neither	9.3	6.2	- 3.1	20.5

- (i) Complete the table above by calculating the change in mass and percentage change in mass for leaf **B**. Use the space below for your calculation. [2]

- (ii) What does the data reveal about the distribution of stomata on the surfaces of the leaves? [3]

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- (iii) Why were the leaves re-weighed 'until there was no further change in mass'? [1]

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(b) The table below gives the stomatal densities of three other plant species.

species	number of stomata/cm ²	
	upper epidermis	lower epidermis
potato (<i>Solanum tuberosum</i>)	5 100	16 100
bean (<i>Phaseolus vulgaris</i>)	4 000	28 100
marram grass (<i>Ammophila sp</i>)	1 200	0

(i) Marram grass is adapted to grow in dry conditions. State the term used to describe plants that are adapted for dry conditions. [1]

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(ii) Marram grass exhibits leaf rolling. With reference to the **data** in the table above, suggest how Marram grass has adapted its distribution of stomata to conserve water. [3]

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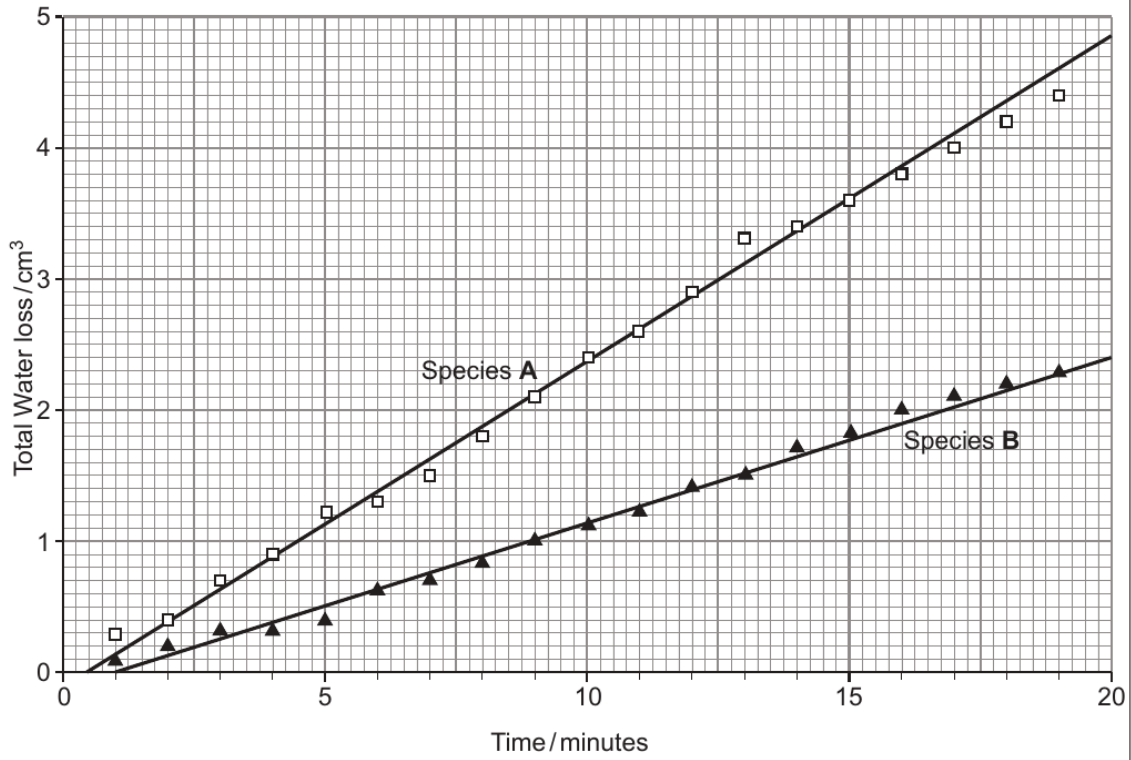
(iii) State **two** further structural adaptations shown by Marram grass which help it to survive in dry conditions. [2]

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5. (a) A student set up an experiment to investigate the rate of transpiration in two different species of plant. The data collected are shown in the graph below.



- (i) State the name of the equipment that the student would have used to collect this data. [1]

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- (ii) Describe how the student would have used this equipment to collect the data shown. [3]

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- (b) Using the data from the experiment, calculate the rate of transpiration for species **A** between 5 and 15 minutes. [2]

Rate of transpiration = $\text{cm}^3\text{min}^{-1}$

- (c) (i) Suggest the type of environment to which species **B** might be adapted. [1]

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- (ii) Describe and explain **one** structural adaptation of the leaves of plant species **B** that could account for the rate of transpiration shown in the graph. [2]

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END OF QUESTION PACK

7 questions · 88 marks · ~2 h 21 min

Source: WJEC BY2 (2008 modular spec, 2011–2017)

Curated for WJEC Biology 2015 spec AS Unit 2 – Topic 10 (2.6)

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