

Plant Tissues, Organs and Organ Systems

Mark Scheme



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1. The following multiple-choice questions will assess your understanding of the different structures found in plants and their specific roles. Circle the letter of the correct answer for each question.

- a) The figure below shows a section through the leaf of a sycamore tree.

B – is the only correct answer.	1 mark
	Total: 1 mark

- b) The figure below shows part of a the stem of a plant. A strip of the outer bark including the phloem tissue has been removed.

As the phloem tissue has been removed how has the transport of the plant been affected?

D – is the only correct answer.	1 mark
	Total: 1 mark

- c) The figure below shows a cross section across two guard cells of a leaf.

Which labelled structures would also be present in animal cells?

A – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 1 is 3 marks)

2. The figure below shows a germinating seed where the root is emerging from the seed.

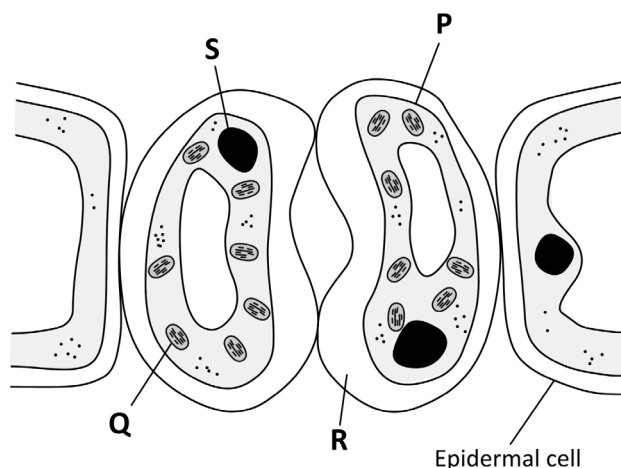
Describe and explain how the structures at X are adapted for their functions.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Identifies the structures as 'root hairs'. Mentions that they absorb water or nutrients, but with limited explanation. May only state a function without linking it to a structural adaptation. Limited use of scientific vocabulary.
Level 2	3 - 4	Correctly identifies root hairs. Describes a key adaptation and links it to a function (e.g., large surface area for water absorption). Explanation may be partially complete or lack detail.
Level 3	5 - 6	Clearly identifies root hairs and their location. Provides a detailed description of multiple adaptations and explains precisely how each adaptation contributes to the function of water and nutrient absorption. Accurate use of scientific terminology related to surface area, diffusion, osmosis (if mentioned), cell walls, etc.

Indicative content:	
X are root hair cells.	
Adaptations: • Long and thin. • Thin cell wall • Large surface area for absorption. • Protein (pumps) in membrane. • Many mitochondria.	
Processes: Osmosis – water absorbed by osmosis. Osmosis is the movement of water from an area of high water concentration to an area of low water concentration moving through a partially permeable membrane. Active transport – ions absorbed by active transport. Active transport is the movement of a substance from an area of low concentration to an area of high concentration moving against its concentration gradient. Energy is required. Reference to many mitochondria.	
	Total: 5 marks

(Total for Question 2 is 5 marks)

3. For gases to pass into and out of a leaf, the stomata need to be open.
The figure below illustrates a stoma along with two guard cells. When the stomata are open, the guard cells are considered turgid, meaning they are filled with water.



- a) Explain how the guard cells help control the size of the stoma.
Use information from the figure above.

An answer to include the following:	
Identifies that guard cells control the opening and closing of the stoma.	1 mark
Explains that when the guard cells take in water, they become turgid, causing the stoma to open.	1 mark
Explains that when the guard cells lose water, they become flaccid, causing the stoma to close.	1 mark
Uses information from the figure, such as labels (e.g., P, Q, R, S), to describe the role of specific structures in the opening/closing mechanism.	1 mark
	Total: 4 marks

- b) A student describes the structure and function of phloem to another student.

"Phloem vessels are made up of dead cells joined together end to end. The vessels are made of a waterproof material and transport water up the plant."

The student has made two mistakes in their description. Write down the **two** mistakes they have made.

An answer to include the following:	
Phloem vessels are made up of living cells, not dead cells.	1 mark
Phloem transports sugars (or dissolved food substances) in both directions, not just water upwards.	1 mark
	Total: 2 marks

(Total for Question 3 is 6 marks)

4. The figure below shows a cross section through a leaf.

- a) Identify the structures labelled in the figure above.

1 = Spongy mesophyll cell.	1 mark
2 = Air spaces.	1 mark
3 = Stoma	1 mark
4 = Guard cell.	1 mark
5 = Waxy cuticle.	1 mark
6 = Upper epidermis.	1 mark
7 = Palisade cell.	1 mark
8 = Vascular bundle.	1 mark
9 = Lower epidermis.	1 mark
10 = Lower waxy cuticle.	1 mark
	Total: 10 marks

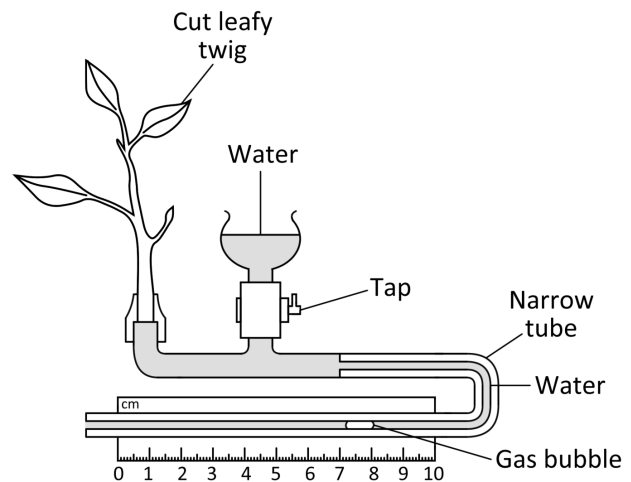
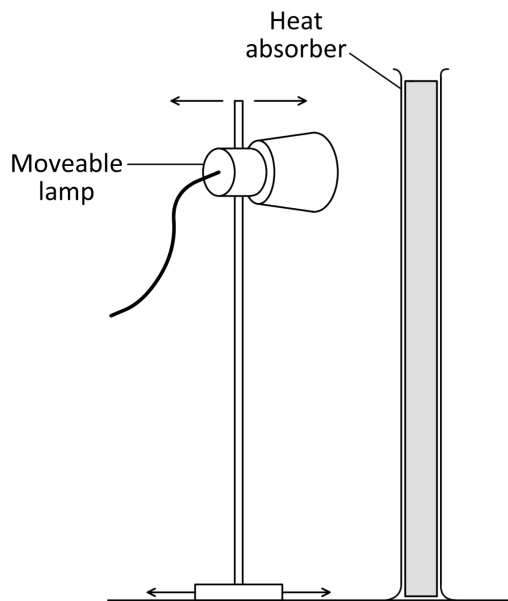
- b) Describe **two** factors that can affect the rate of transpiration in a plant.

An answer to include a description of two of the following:	
Light intensity – Increased light intensity causes stomata to open, leading to a higher rate of transpiration as more water evaporates from the leaf surface. Temperature – Higher temperatures increase the kinetic energy of water molecules, causing faster evaporation and diffusion, leading to an increased transpiration rate. Humidity – Higher humidity reduces the concentration gradient between the inside of the leaf and the surrounding air, decreasing the rate of transpiration. Accept the converse statement for humidity. Wind speed – Increased air movement removes the water vapor around the leaf, maintaining a steep concentration gradient and increasing transpiration.	
	Total: 2 marks

(Total for Question 4 is 12 marks)

5. The figure below shows a simple potometer.

The photometer can be used to investigate the effect of light intensity on transpiration rate of a plant.



a) Describe what happens during transpiration.

An answer to include the following:	
Water evaporates from the surface of mesophyll cells inside the leaf and diffuses out through the stomata.	1 mark
This creates a continuous flow of water (transpiration stream) from the roots, through the xylem, to replace the lost water.	1 mark
	Total: 2 marks

b) Describe how the apparatus can be used to investigate the effect of light on transpiration rates.

An answer to include the following:	
Move the lamp to different distances from the plant to change light intensity.	1 mark
Allow time for the plant to adjust and for water uptake to stabilize.	1 mark
Measure the movement of the air bubble in the capillary tube over a set period of time.	1 mark
Repeat the experiment at different light intensities and compare the results to determine how light affects transpiration rate.	1 mark
	Total: 2 marks

c) The heat sink is a transparent tube of cold water. Explain why a heat sink is used in this experiment.

An answer to include the following:	
The heat sink absorbs heat from the lamp, preventing temperature from increasing.	1 mark
This ensures that only light intensity is affecting transpiration, making the experiment a fair test.	1 mark
	Total: 2 marks

d) Calculate the mean distance that the bubble moved along the tube when the light source was 10 cm from the photometer.

$60 + 64 + 62 = 186$	1 mark
$186 \div 3 = 62 \text{ mm}$	1 mark
	Total: 2 marks

- e) The diameter of the tube in the photometer was 1 mm.
Using your answer from part (d), calculate the volume of water taken up by the plant. Use the equation: $\text{volume} = \pi r^2 l$. Give your answer to 2 significant figures.

$\pi r^2 l = \pi \times 0.5^2 \times 62$	1 mark
$= 48.69 \text{ mm}^3$	1 mark
Answer to 2 sig figs = 49 mm^3	1 mark
	Total: 3 marks

- f) Identify the anomalous reading in their recorded results and suggest a possible reason for this.

Identifies the anomalous reading as experiment 1 when the light source was 40 cm away from the plant.	1 mark
Reason – any one of the following:	
Air bubbles trapped in the apparatus – This could affect water movement and give inaccurate readings. Movement of the lamp – If the lamp is accidentally shifted or its brightness fluctuates, light intensity may not be as controlled as expected. Human error in measurement – Misreading the ruler or timing inconsistencies when recording results.	1 mark
	Total: 2 marks

(Total for Question 5 is 13 marks)

6. The figure below shows a single root hair cell of a plant.

- a) Identify the structures labelled in the figure above.

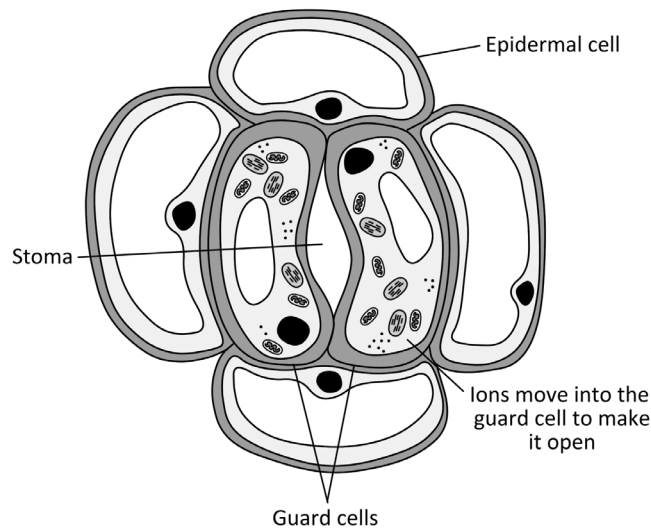
1 = Vacuole.	1 mark
2 = Cell wall.	1 mark
3 = Cell membrane.	1 mark
4 = Ribosomes.	1 mark
5 = Nucleus.	1 mark
6 = Cytoplasm.	1 mark
	Total: 6 marks

- b) Explain how the root hair cell is adapted for its role in absorbing water and minerals.

An answer to include the following:	
<u>Large surface area</u> due to its long, thin extension, increasing the absorption of water and minerals.	1 mark
<u>Thin cell wall</u> to allow water to move into the cell easily by osmosis.	1 mark
<u>Many mitochondria</u> to provide energy for active transport of minerals from the soil.	1 mark
	Total: 3 marks

(Total for Question 6 is 9 marks)

7. The figure below shows a small section of the lower epidermis of a leaf.

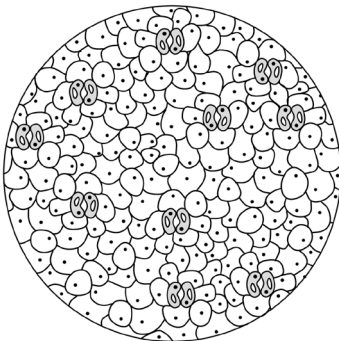


a) Explain how guard cells change shape to open stomata.

An answer to include the following:	
Guard cells actively transport potassium ions (K^+) into the cell from surrounding cells.	1 mark
This lowers the water potential inside the guard cells, causing water to enter by osmosis.	1 mark
The guard cells swell and become turgid, causing them to curve away from each other.	1 mark
This opens the stomata pore, allowing gas exchange and transpiration to occur.	1 mark
	Total: 4 marks

A student viewed the surface of a leaf using a light microscope.

The figure below shows what the student saw through the microscope.



b) The diameter of the image the student saw is 30 mm.
Determine the area of the image the student saw.

$\pi \times r^2$	1 mark
$\pi \times 15^2 = 707 \text{ mm}^2$	1 mark
	Total: 2 marks

c) The student then viewed another five areas of the leaf and recorded the number of stomata that they saw. Calculate the mean number of stomata in the microscope view.

$10 + 18 + 15 + 9 + 13 = 65$	1 mark
$65 \div 5 = 13$	1 mark
	Total: 2 marks

d) The figure below shows a small shoot produced from a seed potato.

What is being transported at A? Circle the letter of the correct answer.

B – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 7 is 9 marks)

8. The figure below shows a cross section through a leaf.

a) Around which cells is most gas exchange taking place?

Circle the letter of the correct answer.

C – is the only correct answer.	1 mark
	Total: 1 mark

b) Identify an organelle that would be present in the cells of the palisade mesophyll cells but that would not be present in a root hair cell.

Chloroplast.	1 mark
	Total: 1 mark

c) State the main process that occurs in the cells found in layer B.

Photosynthesis.	1 mark
	Total: 1 mark

d) Plants lose water via the process of transpiration through their leaves.

Identify the cells present in a leaf that control the rate of transpiration.

Guard cells.	1 mark
	Total: 1 mark

e) Describe **three** factors that affect the rate of transpiration in plants.

An answer to include a description of three of the following:	
Temperature: - Higher temperatures increase the rate of transpiration. - Because warmer temperatures increase the rate of evaporation/diffusion of water from the leaf. Humidity: - Higher humidity decreases the rate of transpiration. - Because there is a smaller concentration/diffusion gradient between the inside of the leaf and the air OR The air is already saturated with water vapour. Wind speed/Air movement: - Higher wind speed increases the rate of transpiration. - Because wind removes water vapour from around the leaf. OR maintains a steeper concentration/diffusion gradient. Light intensity: - Higher light intensity increases the rate of transpiration. - Because it causes the stomata to open (more) for photosynthesis, allowing more water to escape.	
	Total: 3 marks

f) Explain the differences in the structure and function of xylem and phloem tissues.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Identifies either structure or function of xylem or phloem in isolation. May offer very basic descriptions without comparison. Limited understanding of how structure relates to function.
Level 2	3 - 4	Describes the structure and function of either xylem or phloem tissues in detail. Begins to make some comparisons between xylem and phloem, but may be incomplete. Shows some understanding of how structure supports function.
Level 3	5 - 6	Describes the structure and function of both xylem and phloem tissues in detail. Clearly compares and contrasts the structure and function of xylem and phloem. Demonstrates a clear understanding of how structure is directly related to function in both tissues.

Indicative content:	
Xylem: <u>Structure:</u> • Made of dead cells (hollow tubes). • Cells are strengthened with lignin (provides strength and support). • No end walls between cells (allows continuous water flow). • Thick walls (helps withstand pressure). • Narrow lumen. <u>Function:</u> • Transports water and minerals from the roots to the leaves (one-way flow). • Provides support for the plant. • Transpiration stream. Phloem: <u>Structure:</u> • Made of living cells (sieve tube elements and companion cells). • Sieve plates (allow substances to pass between cells). • Companion cells (provide energy and support for sieve tube elements). • Thinner walls compared to xylem. • Wider lumen. <u>Function:</u> Transports sugars (sucrose) from the leaves to other parts of the plant (two-way flow). Allow: translocation.	
	Total: 6 marks

(Total for Question 8 is 13 marks)