

1. John grows tomatoes in his greenhouse.



(i) John needs to water his tomato plants regularly.

The water will be moved through the plant by the xylem.

Which sentence best explains how the xylem is adapted to its function?

Put **one** tick (✓) in the correct box.

Companion cells contain mitochondria to release energy.

Perforated plates allow movement between cells.

Cells are joined end to end with no connecting cell walls.

Cells are joined end to end and contain cytoplasm.

[1]

(ii) It is a lovely summer's day in John's greenhouse.

Various factors affect the rate of photosynthesis:

- light intensity
- temperature
- carbon dioxide concentration

Which **one** of the factors above is likely to limit the rate of photosynthesis of John's tomato plants?

Explain your answer.

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[3]

2(a). A student does an experiment to find out more about how the process of osmosis works.

The student was provided with ten pieces of potato, each about 5 cm long.

She was also given five dishes each containing a different **unknown** concentration of sugar solution.

The student put two pieces of potato in each dish and left them for 30 minutes. She then removed the potato pieces and re-measured their length.

The student recorded the results in this table.

Dishes of sugar solution	Length of potato (cm)				Change in mean length (cm)	Percentage change
	Original	After 30 minutes in sugar solution				
		Piece 1	Piece 2	Mean		
1	4.9	5.0	5.4	5.2	+0.3	
2	5.1	4.3	4.1	4.2	-0.9	-18.4
3	5.0	4.8	4.4	4.6	-0.4	-8.0
4	5.2	5.7	5.9	5.8	+0.6	+11.5
5	4.9	4.8	4.8	4.8	-0.1	-2.0

(i) The student has not finished working out the results.

Calculate the missing value and write it in the table.

[2]

(ii) The table below shows the concentration of sugar solution in each of the five dishes.

Use the results from the student's experiment to show which solution was in each dish.

Write down the correct dish number in the column headed "Dish".

Sugar solution concentration (mol dm <sup>-3</sup> )	Dish
0.2	
0.4	
0.6	
0.8	
1.0	

(iii) The student measured the length of the pieces of potato as a quick way to obtain results.

Why does this method not measure the total change to the pieces of potato?

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[1]

(iv) How could the student modify the experiment to show the rate of water movement by osmosis in pieces of potato?

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[2]

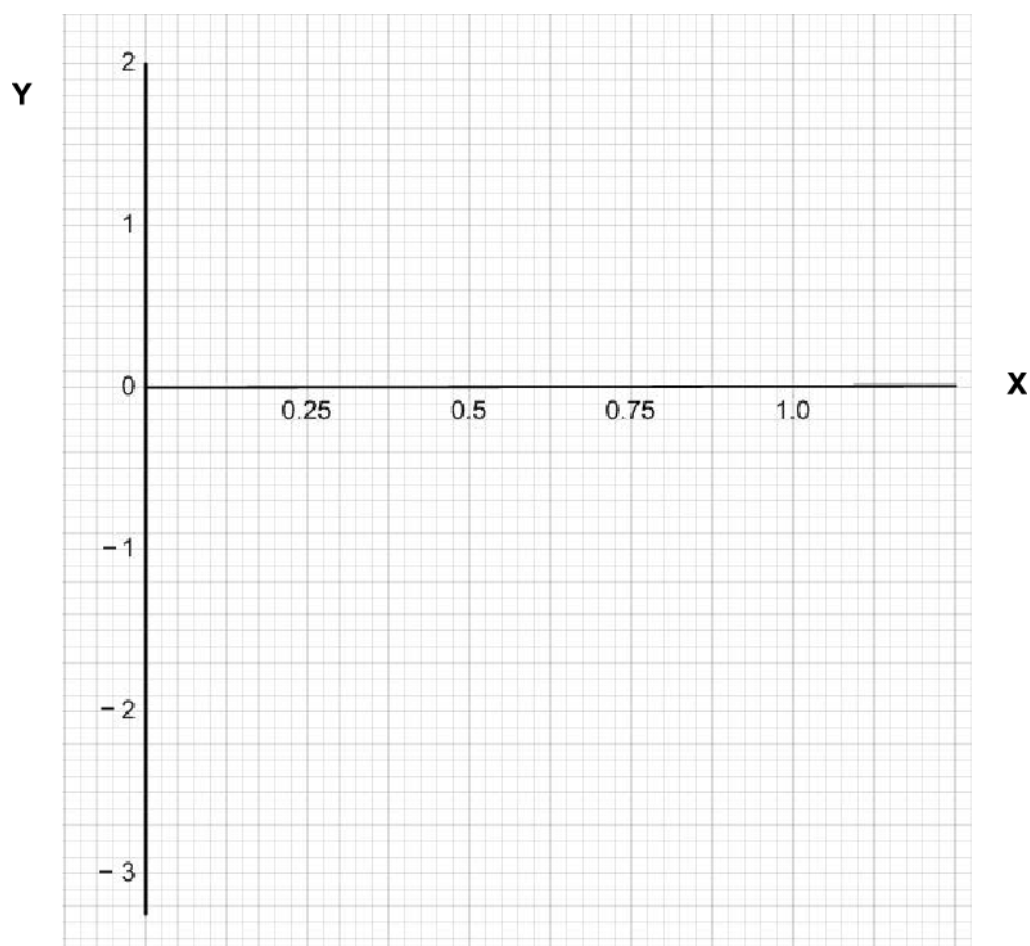
(b). Another student did a similar experiment.

These are his results.

Sugar solution concentration ( $\text{mol dm}^{-3}$ )	Change in mean length (mm)
1.00	- 1.9
0.75	- 1.2
0.50	- 0.5
0.25	+ 0.3
0.00	+ 1.0

(i) Use the information in the table to label the X and Y axis on the grid below.

[1]



(i) Plot the student's results on the grid. [2]

(ii) Draw a line of best fit on the grid. [1]

(iii) Use your graph to find the concentration of the sugar solution where the potato pieces do not change in length.

sugar solution concentration \_\_\_\_\_ mol / dm<sup>-3</sup> [1]

(iv) What can you conclude, in terms of osmosis, at this concentration?

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----- [1]

3. Carbon dioxide enters a leaf and is used in photosynthesis.

Which of the following is the correct name for this type of movement?

Put a **ring** round the name of the process by which carbon dioxide enters the leaf.

diffusion

osmosis

phototropism

respiration

[1]

4. Water enters and leaves plant tissues by osmosis.

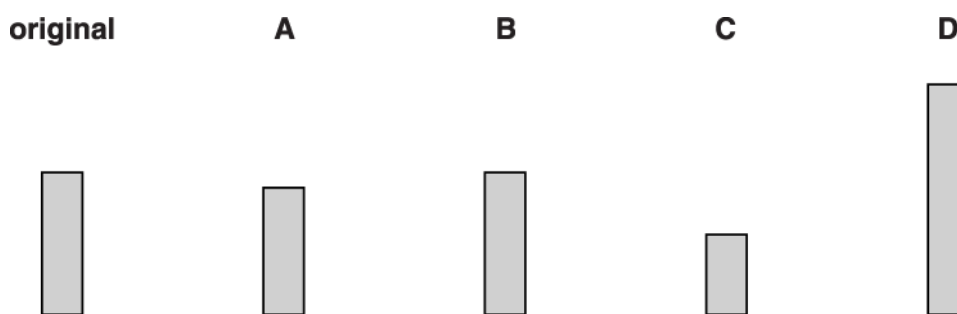
Kaye is investigating how plant tissue takes up water.

She uses four potato chips, A, B, C and D.

The chips are all cut to the **same length**.

Kaye puts the four chips into four different concentrations of sugar solution.

The diagram shows the original length of the chips and the length of each chip after soaking for 60 minutes in the sugar solutions.



(i) Write letters A, B, C and D in the table to show which chip was in each solution.

Concentration of solution in arbitrary units	Potato chip
0.0	
0.3	
0.6	
0.9	

[2]

(ii) Kaye has another potato chip, X, which has been in a different concentration of sugar solution.

Potato chip X was originally cut to the same length as the other chips.

The diagram shows potato chip X after soaking for 60 minutes in the sugar solution.



**original**

**A**

**B**

**C**

**D**

**X**



The label on the test tube containing chip X has rubbed off.

Use the results of Kaye's experiment to estimate the concentration of sugar solution (in arbitrary units) in the test tube containing chip X.

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----- [2]

5. Paul's cat has injured its leg.

He takes the cat to the vet.

The vet explains that the cat has an infected leg, probably caused by a puncture wound.

The vet advises Paul to bathe the wound with a saline solution to help keep it clean. A saline solution contains salt dissolved in water.

Complete these sentences to explain why the vet has given this advice.

Choose the best words from this list.

around

diffusion

evaporation

into

osmosis

out of

salt

starch

water

The saline solution contains a lot of salt.

This will cause the \_\_\_\_\_ to move \_\_\_\_\_ the bacteria.

This process is called \_\_\_\_\_ .

The bacteria are killed.

[3]

6. Molecules move in and out of cells by various processes, including osmosis.

What is **osmosis**?

Complete the sentence.

Osmosis is the overall movement of \_\_\_\_\_ molecules from a dilute to a more concentrated solution across a membrane that is \_\_\_\_\_

[1]

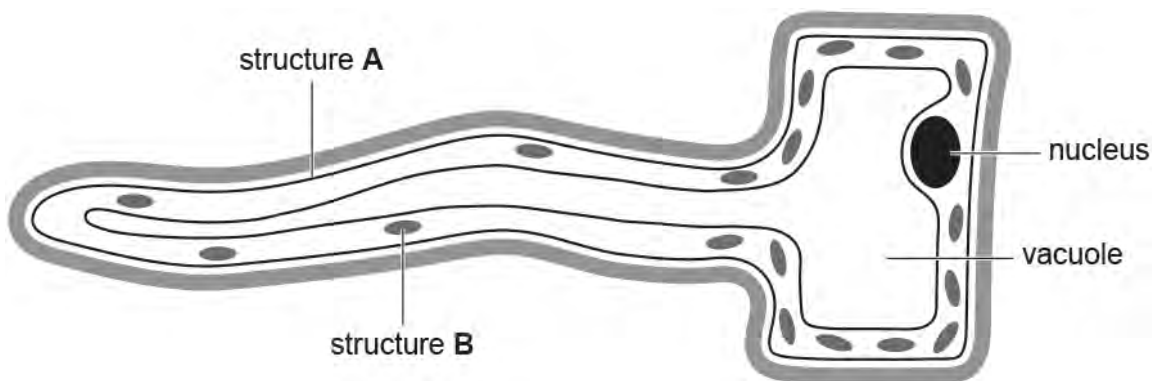
7(a). Nina is learning about substances absorbed by plants. She finds out that plants absorb nitrate ions from the soil.

Explain why nitrate ions are essential for plant growth and survival.

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----- [2]

(b). Nitrate ions are absorbed into a plant root through root hair cells.

Nina finds this diagram of a root hair cell.



(i) State the names of structures A and B.

A -----

B -----

[2]

(ii) Explain the roles of A and B in transporting nitrate ions into the root hair cell.

A -----  
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B -----  
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[2]

(iii) The shape of the root hair cell is an adaptation.

Explain how this adaptation helps the root hair cell to absorb nitrate ions more effectively.

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[2]

(c). The root hair cells also absorb water from the soil.

Complete the sentences below to describe how water is transported through a plant.

Choose the correct words from the list.

Each word may be used once, more than once or not at all.

diffusion

flowers

meristem

osmosis

phloem

stomata

xylem

Water is transported from the soil into the root cells by .....

Water is pulled from roots to leaves through the ..... tissue

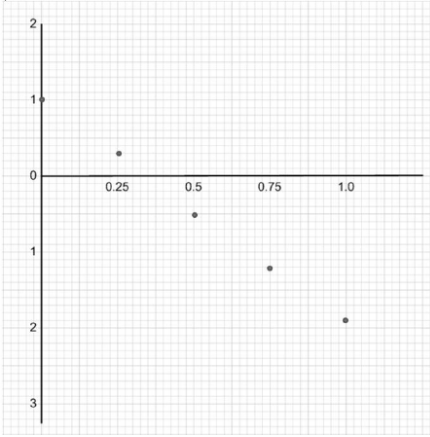
in the plant stem.

Water molecules are lost from the leaves into the atmosphere because of .....

through open .....

[4]

**END OF QUESTION PAPER**


Question			Answer/Indicative content	Marks	Guidance
1		i	Cells are joined end to end with no connecting cell walls ✓	1	If more than one box is ticked, do not award the mark even if the correct box is also ticked.
		ii	<b>Any three from</b> Carbon dioxide concentration ✓ As carbon dioxide concentration in air is very low ✓ Temperature will be high ✓ Light intensity will be high ✓	3	1 mark for identification and 2 marks for explanation <b>ALLOW</b> quoted figures e.g. 0.03%
			<b>Total</b>	<b>4</b>	
2	a	i	<b>FIRST CHECK THE ANSWER IN TABLE.</b> <b>If answer = +6.1 award 2 marks</b>  $(0.3 \div 4.9) \times 100$ ✓ +6.1 ✓	2	<b>DO NOT ALLOW</b> answer if not given to 1d.p.
		ii	4, 1, 5, 3, 2 ✓	1	
		iii	Does not take into account width ✓	1	<b>ALLOW</b> reference to diameter / volume
		iv	Set up experiment as above and re-measure every 10 minutes / other suitable time period ✓ Find out how long it takes until there is now further change in length ✓	2	
	b	i	X = sugar concentration (mol / dm <sup>-3</sup> ) <b>AND</b> Y = change in mean length (mm) ✓	1	<b>DO NOT ALLOW</b> axis labels without units
		ii		2	5 plots correct = 2 3 or 4 plots correct = 1
		iii	Straight line through points ✓	1	
		iv	0.35 to 0.4 ✓	1	

Question			Answer/Indicative content	Marks	Guidance
		v	Any one from Idea that it is the same concentration as the potato cell content ✓ Water movement is the same in both directions / no net Flow in or out of the potato ✓	1	
			<b>Total</b>	<b>12</b>	



Question			Answer/Indicative content	Marks	Guidance										
3			Diffusion (1)	1	<p><b>Examiner's Comments</b></p> <p>This was not well answered – few recognised the diffusion as the correct term for the process by which carbon dioxide enters the leaf. Respiration was the most common incorrect response.</p>										
			<b>Total</b>	<b>1</b>											
4		i	<p style="text-align: center;">Concentration of solution</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">in arbitrary units</td> <td style="width: 50%;">Potato chip</td> </tr> <tr> <td>0.0</td> <td><b>D</b></td> </tr> <tr> <td>0.3</td> <td><b>B</b></td> </tr> <tr> <td>0.6</td> <td><b>A</b></td> </tr> <tr> <td>0.9</td> <td><b>C</b></td> </tr> </table>	in arbitrary units	Potato chip	0.0	<b>D</b>	0.3	<b>B</b>	0.6	<b>A</b>	0.9	<b>C</b>	2	<p>4 correct = 2 marks 2 or 3 correct = 1 mark 1 or 0 correct = 0 marks</p> <p><b>Examiner's Comments</b></p> <p>This question was very often answered with the responses in exactly the reverse order to the correct one, suggesting that candidates were unclear about the mechanism of osmosis.</p>
in arbitrary units	Potato chip														
0.0	<b>D</b>														
0.3	<b>B</b>														
0.6	<b>A</b>														
0.9	<b>C</b>														
		ii	answer between 0.01 – 0.29 (2) between D and B OR close to D (1)	2	<p>ignore ref. to units</p> <p><b>ecf</b> accept correct value between D and B – based on the values presented in 2(a)(i) = 1 mark max</p> <p><b>Examiner's Comments</b></p> <p>Most candidates were able to draw a reasonable conclusion from their answer to the first part of the question.</p>										
			<b>Total</b>	<b>4</b>											
5			water (1) out of (1) osmosis (1)	3	<p><b>Examiner's Comments</b></p> <p>Candidates were asked to complete a sentence describing the effect of salt on bacterial cells. Perhaps surprisingly, answers scoring full marks were rarely seen – few could state that the name of the process was osmosis.</p>										
			<b>Total</b>	<b>3</b>											

Question			Answer/Indicative content	Marks	Guidance
6			water and partially-permeable membrane (1)	1	<p>accept H<sub>2</sub>O</p> <p>accept semi or selectively for 'partial'</p> <p><b>Examiner's Comments</b></p> <p>This question involved the candidates in completing the sentence about osmosis. Most knew that the first word was water; however, few knew that the 2nd space needed 2 words, 'partially permeable' and therefore failed to score.</p>
			Total	1	

Question		Answer/Indicative content	Marks	Guidance
7	a	(nitrate ions are the plant's only source of) nitrogen ✓  to make amino acids/proteins/nitrogenous compounds ✓	2 (AO 1.1 × 2)	ALLOW examples e.g. enzymes / DNA  <b>Examiner's Comments</b>  Very few candidates showed understanding that nitrate ions are the plant's source of nitrogen, or that this is necessary for making amino acids and therefore proteins.
	b	i	A (cell/partially-permeable) membrane ✓  B mitochondrion ✓	2 (AO 2.1 × 2)  ALLOW mitochondria  <b>Examiner's Comments</b>  The names of many different cell structures were given for both A and B, suggesting that many candidates were simply guessing using terms they knew from lessons about cells.   <b>Misconception</b>  It was common to see chloroplasts suggested as the name of structure B. This could be evidence of the misunderstanding that all plant cells have chloroplasts, as one of the features that sets them apart from animal cells, regardless of the cell's position and function in the plant. Root hair cells, of course, do not need chloroplasts because they are underground where there is no light.
		ii	A (transports nitrate ions into the cell by) <u>active transport</u> (using carrier proteins) (against a concentration gradient) ✓  B provides ATP/energy (from cellular respiration) (for active transport) ✓	2 (AO 1.1 × 2)  <b>Examiner's Comments</b>  To score marks here, candidates needed to link ideas about active transport (B3.2.2a) and cellular respiration (B4.1.3).

Question			Answer/Indicative content	Marks	Guidance
		iii	<p>increased/large surface area (to volume ratio) ✓</p> <p>so there is increased/more active transport/absorption/uptake (of nitrate ions) ✓</p>	2 (AO 1.1 × 2)	<p><b>ALLOW</b> quicker (but not quickly, as comparison required)</p> <p><b>Examiner's Comments</b></p> <p>To score marks here, candidates needed to link ideas about active transport across the cell membrane (B3.2.2a) to the benefits of increasing the surface area of an exchange surface (B5.1.7).</p>
	c		<p>osmosis ✓</p> <p>xylem ✓</p> <p>diffusion ✓</p> <p>stomata ✓</p>	4 (AO 1.1 × 4)	
			<b>Total</b>	<b>12</b>	