

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

BIOLOGY



EXAM QUESTION PACK

TOPIC 4: EXCHANGE AND TRANSPORT
CORE PRACTICALS 5 AND 6

SCORE

/53

PERCENTAGE

%

STEMUP

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Q1.

(a) A student investigated the effect of ethanol on plant cell membranes.

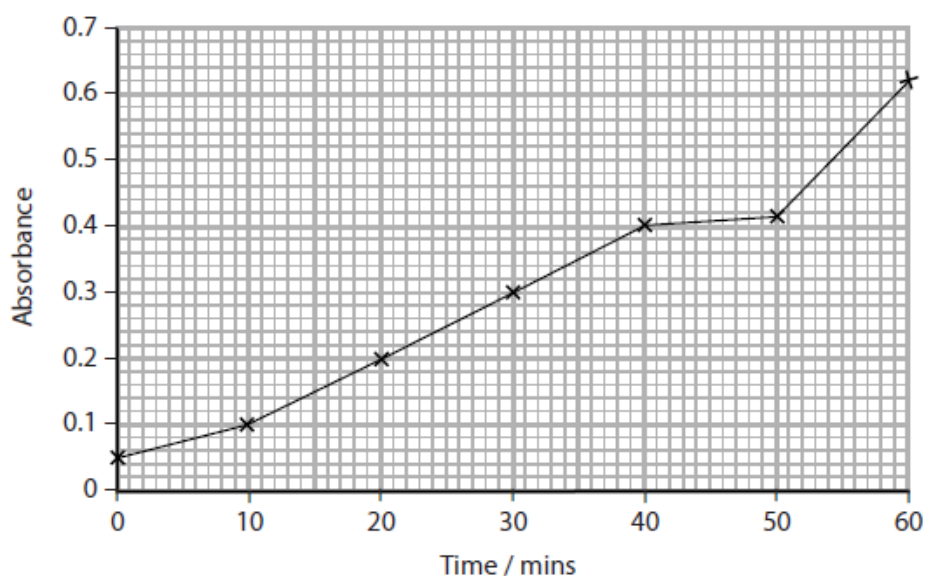
Step 1: The student cut leaf discs from leaves, using a cork borer.

Step 2: These leaf discs were then added to a boiling tube containing 10 cm³ of 40% ethanol solution. The pigments in the leaf discs dissolved in the ethanol, producing a green solution.

Step 3: The boiling tube was shaken and the amount of red light absorbed by this solution (absorbance) was measured at the start.

Step 4: The absorbance was measured every 10 minutes, for an hour.

The graph shows the results of this investigation.



(i) Explain why red light was used in this investigation.

(2)

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(ii) Explain the absorbance value at 0 minutes.

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(iii) Explain the effect of ethanol on plant cell membranes.

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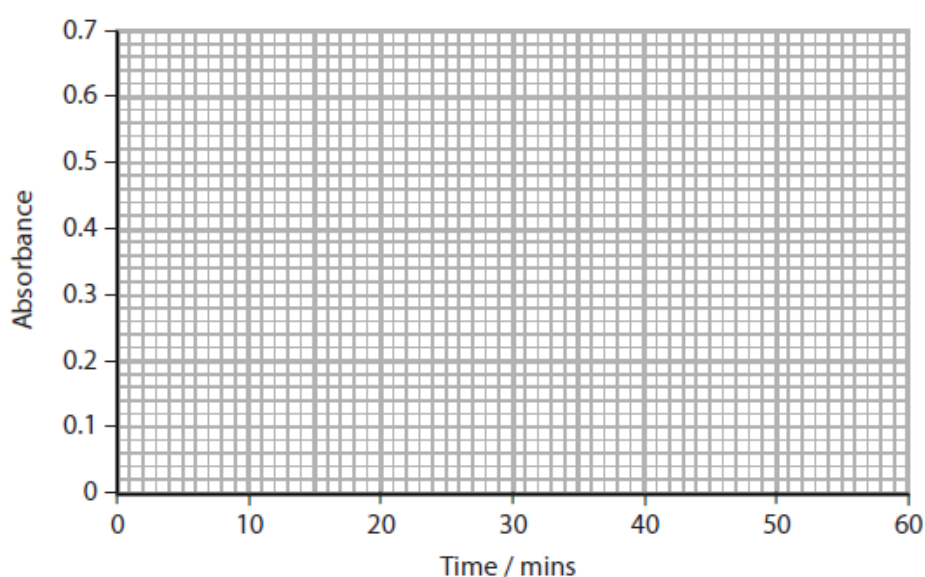
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(b) The student also carried out a control, using water instead of 40% ethanol.

Draw a line on the graph to show the results for this control.

(2)



(c) The student then investigated the effect of ethanol concentration on leaves from different plant species.

Justify the modifications to the procedure in part (a) that will be required to obtain valid data.

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(Total for question = 13 marks)

Q2.

Last year, eight million Christmas trees were bought in the UK.

There are many Christmas tree farms that supply these trees.

The photograph shows young Christmas trees growing on a farm.



Christmas tree farmers remove the other plants (weeds) in order to increase tree growth.

A farmer investigated two methods of removing weeds:

- removing weeds by hand
- spraying herbicides that inhibit weed growth.

The table shows the mean height of Christmas trees using each method, over a five-year period.

Year	Mean height of trees / cm	
	Removing by hand	Using herbicide
0	20	20
1	50	60
2	70	100
3	90	130
4	110	160
5	130	200

A student read that some herbicides work by inhibiting electron transport in photosynthesis.

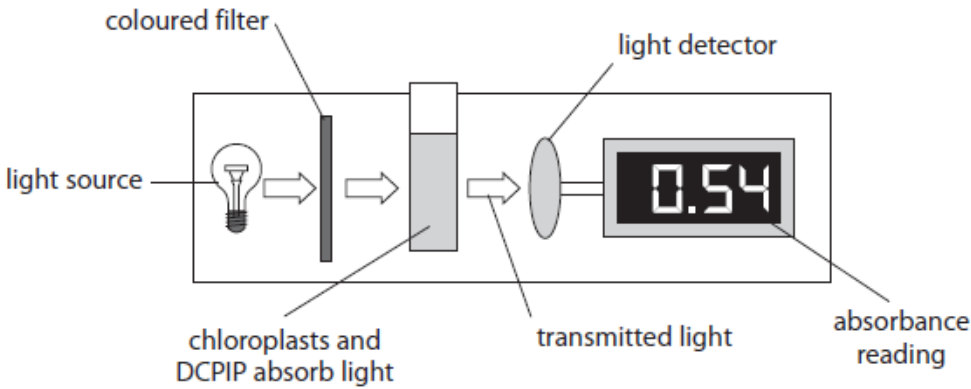
The student investigated this using the indicator DCPIP.

This indicator changes from blue to colourless when it is reduced.

The student used the following method:

- chloroplasts were suspended in two tubes, each containing a solution of DCPIP
- herbicide was added to one of the tubes and no herbicide was added to the other tube
- both tubes were exposed to light
- a colorimeter was used to measure the absorbance in each tube at five minute intervals for 20 minutes.

The diagram shows details of the workings of the colorimeter used by the student.



As DCPIP changes from blue to colourless, the absorbance of light decreases.

(i) Explain how the student used this method to collect valid data.

(4)

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The table shows the results.

Time / min	Absorbance / a.u.	
	With herbicide	Without herbicide
0	0.53	0.54
5	0.54	0.31
10	0.54	0.24
15	0.54	0.20
20	0.53	0.16

(ii) Analyse the data to explain the effect of this herbicide on the growth of weeds.

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(Total for question = 8 marks)

Q3.

Anthocyanin is a purple pigment found in a range of vegetable plants.

The photograph shows some carrots from a variety called Purple Haze.



Describe how you would investigate the effect of temperature on the permeability of the membranes in the root cells of these purple carrots.

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(Total for question = 5 marks)

Q4.

Anthocyanin is a purple pigment found in a range of vegetable plants.

The photograph shows some carrots from a variety called Purple Haze.



The anthocyanins in purple carrots are used as antioxidants in the food industry.

Purple Haze carrots with a mass of 750g contain 1265.25 mg of anthocyanin.

Calculate the percentage of anthocyanin in these carrots.

Give your answer to two decimal places.

(2)

Answer

(Total for question = 2 marks)

Mark Scheme

Q1.

Question Number	Acceptable Answers	Additional Guidance	Mark
(a)(i)	An explanation that makes reference to the following: • red is absorbed (1) • because of the presence of chlorophyll (1)		(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
(a)(ii)	An explanation that makes reference to the following: • {chlorophyll / leaf pigment} was present (1) • because some cells are damaged / discs not washed (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(a)(iii)	An explanation that makes reference to the following: • ethanol {disrupts / damages / dissolves / affects} the phospholipid (1) • therefore the membrane {becomes more permeable / allows pigment out} (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(b)	An answer that makes reference to the following: • starts at 0.05 absorbance value (1) • flat line along 0.05 absorbance value (1)		(2)

Question Number	Answer	Additional Guidance	Mark
(c)	An answer that makes reference to five of the following: • use leaves of {same age / same position on plant} because this affects concentration of pigment (1) • obtain leaf discs from the same part of the leaf because this affects concentration of pigment (1) • use same {cork borer / size of leaf disc / diameter of leaf disc} because this affects concentration of pigment (1) • use same temperature because temperature affects the rate of diffusion (1) • use same volume of ethanol so chlorophyll is diluted the same (1) • replicate each ethanol concentration to {see if results are consistent / identify anomaly / to calculate standard deviation / allow statistical test} (1) • wash discs to remove pigment (1)		(5)

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to four of the following: • use same light intensity (1) • use red filter (1) • use tube {with clean sides / no scratches / holding opaque side} (1) • use a control tube with water to {calibrate / obtain zero absorbance} (1) • same {concentration / volume} of {chloroplasts / DCPIP} (1)	DO NOT ACCEPT same lamp / same bulb / same power / same distance	(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • with herbicide DCPIP not {decolourised / reduced / stays blue} (1) • no electrons available / reduced electron transport (1) • less {reduced NADP / NADPH} (1) • therefore less ATP (1) • because the {Calvin cycle / light independent stage} are affected (1)	ACCEPT converse DO NOT ACCEPT absorbance does not change DO NOT ACCEPT if from ETC implies respiration	(4)

Q3.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to five of the following: • equal mass and shape of carrot tissue cut (1) • carrot tissue submerged in (boiling tubes with) known volume of water (1) • placed in water baths at stated range of temperatures for a stated length of time (1) • contents {filtered / decanted} (1) • absorbance measured / colour charts used (1) • graph plotted / statistical analysis of results (1) • appropriate step to ensure validity (1)	Allow use of cork borer and same length Allow {same surface area / equal cubes} Allow 5 – 100°C (must be at least 5 temps), for 5 – 30 mins Allow transmission measured Allow all tissue from same {carrot / age of carrot} Allow repeats at each temperature and {mean / SD} calculated	(5)

Q4.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: • conversion of mg to g (1) • division by 750 and calculation of percentage (1)	1265.25 mg = 1.26525 g (0.1687 g in 100g) = 0.17 (%) Correct answer with no working gains 2 marks Otherwise correct answer to wrong power of 10 gains 1 mark Correct answer with wrong number of decimal place gains 1 mark	(2)

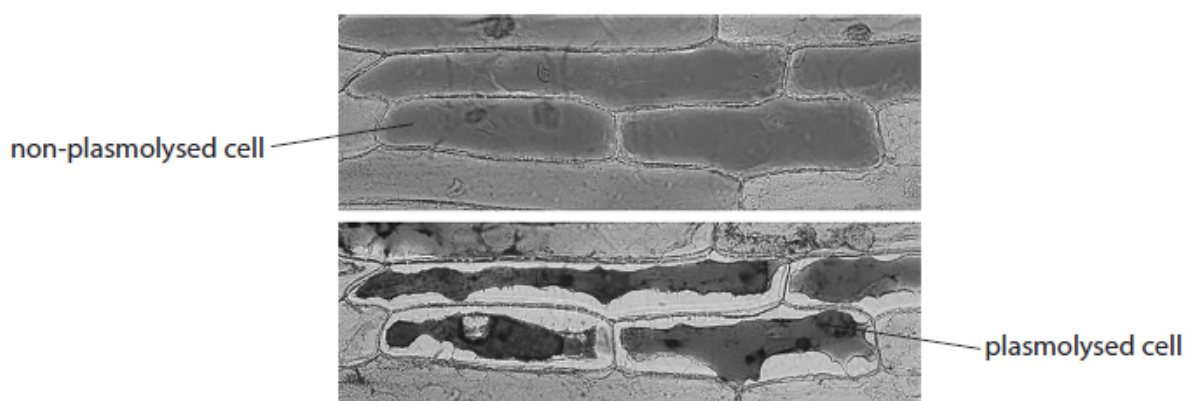
Q1.

The cells of all living organisms contain over 60% water.

A student investigated the effect of salt solution on plant cells.

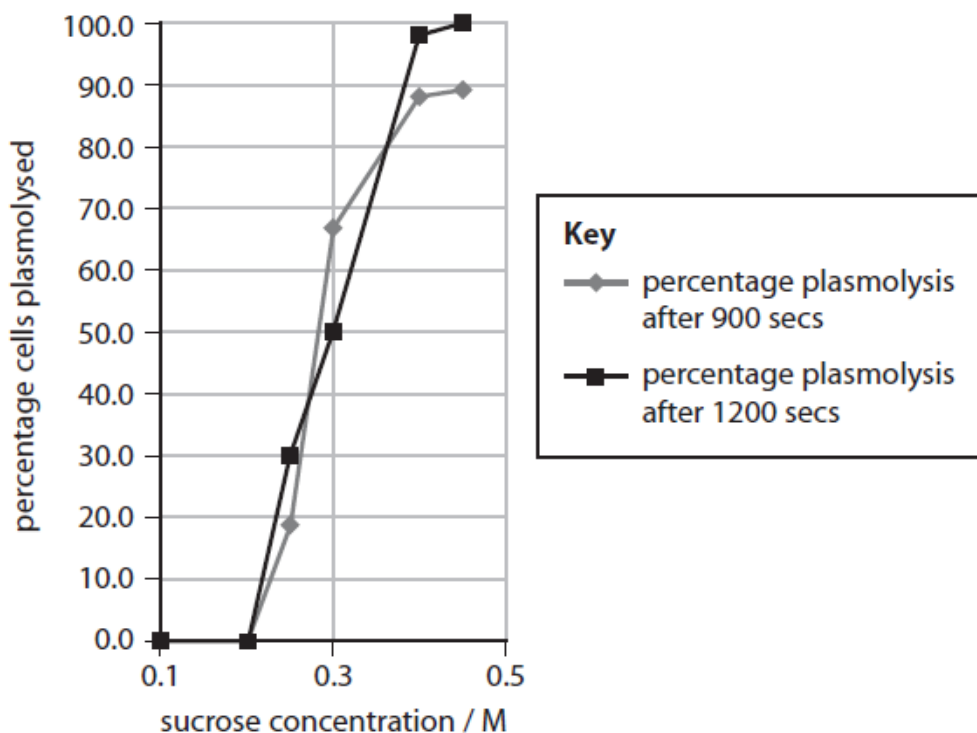
The photomicrograph shows some red onion cells that were placed in a strong salt solution in her investigation.

Some of these cells are plasmolysed because the cytoplasm has lost water, shrunk and pulled away from the cell wall.



As part of her research, the student found some data on the effect of sucrose concentration on plasmolysis in the epidermal cells of another plant species.

The graph shows the data that she found.



* The student concluded that the osmotic potential of these cells was equivalent to 0.3 M of sucrose.

Analyse the data to explain why the osmotic potential of these cells is not necessarily equivalent

to 0.3 M sucrose.

(6)

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Q2.

A student investigated the water potential of potato cells.

The student used this method.

- six potato cubes of the same shape and size were cut from the same potato

- each cube was weighed
- each cube was then placed into a different concentration of sucrose solution
- each cube was removed from the sucrose solution after one hour
- each cube was then reweighed and the percentage change in mass was calculated

The table below shows the results of the investigation.

Concentration of sucrose solution / mol dm ⁻³	Percentage change in mass (%)
0.0	+18.0
0.2	+5.0
0.4	-8.0
0.6	-16.0
0.8	-23.5
1.0	-24.0

The student was given a 1.0 mol dm⁻³ sucrose solution.

State how the student used this solution to make a 0.8 mol dm⁻³ sucrose solution.

(1)

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(Total for question = 1 mark)

Q3.

Devise an experiment, which uses changes in mass, to compare the water potential of carrot tissue with the water potential of potato tissue.

(5)

(Total for question = 5 marks)

The student used this method.

- six potato cubes of the same shape and size were cut from the same potato
- each cube was weighed
- each cube was then placed into a different concentration of sucrose solution
- each cube was removed from the sucrose solution after one hour
- each cube was then reweighed and the percentage change in mass was calculated

The table below shows the results of the investigation.

Concentration of sucrose solution / mol dm ⁻³	Percentage change in mass (%)
0.0	+18.0
0.2	+5.0
0.4	-8.0
0.6	-16.0
0.8	-23.5
1.0	-24.0

The method used by the student could be improved to obtain a more accurate value for the water potential of these potato cells.

Justify **three** improvements that could be made.

(3)

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Q5.

Biodiversity is monitored by conservationists.

The photograph shows a hedge.



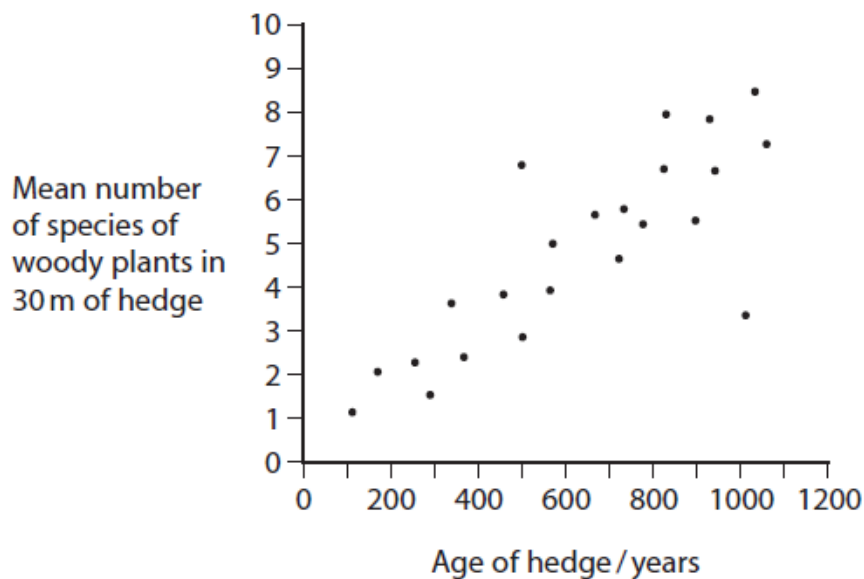
(Source: © 1000 Words/Shutterstock)

Many fields in the UK are separated by hedges.

Conservationists investigated biodiversity in hedges of different ages.

Hedges of different ages were sampled at random and the number of species of woody plants was counted.

The graph shows the results of this investigation.



A student thought that the age of a plant affects the water potential of its tissue.

The student used potatoes of different ages to test this hypothesis.

Justify each step of a method the student could use to compare the water potential of potato tissue of different ages.

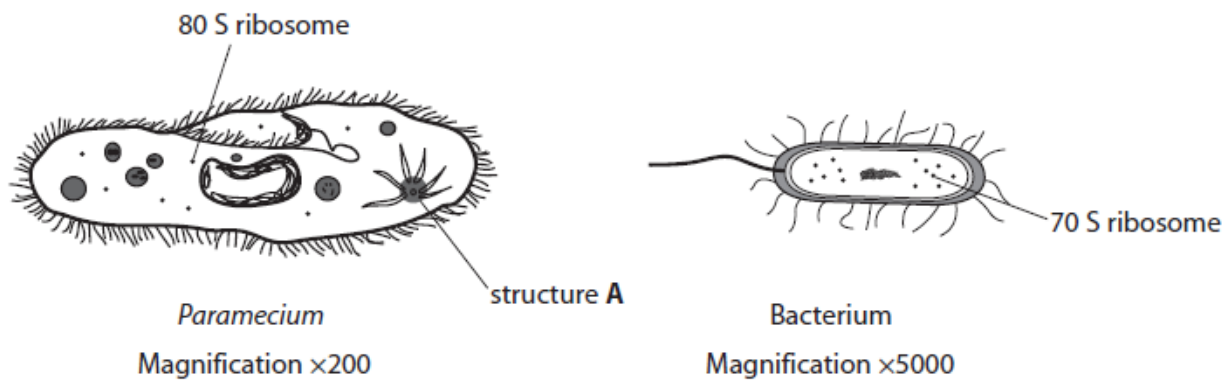
(5)

This image shows a full page of white paper with horizontal dashed lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

(Total for question = 5 marks)

Q6.

The drawings show two single-celled organisms that live in ponds, *Paramecium* and a bacterium.



Structure **A** is a contractile vacuole. This removes water from the *Paramecium*.

Explain why the *Paramecium* needs to remove water.

(3)

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Q7.

A student investigated the water potential of potato cells.

The student used this method.

- six potato cubes of the same shape and size were cut from the same potato
- each cube was weighed
- each cube was then placed into a different concentration of sucrose solution
- each cube was removed from the sucrose solution after one hour
- each cube was then reweighed and the percentage change in mass was calculated

The table below shows the results of the investigation.

Concentration of sucrose solution / mol dm ⁻³	Percentage change in mass (%)
0.0	+18.0
0.2	+5.0
0.4	-8.0
0.6	-16.0
0.8	-23.5
1.0	-24.0

Sketch a graph you could use to identify the water potential of potato cells.

(2)

(Total for question = 2 marks)

Mark Scheme

Q1.

Question Number	Indicative content
*	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • no evidence of replicates, so data may not be valid • water potential = turgor pressure + osmotic potential and at 50% plasmolysis, there is no turgor pressure so water potential = osmotic potential of cells • data for 1200 s suggest that osmotic potential of cell is equivalent to 0.3 M sucrose and more cells are plasmolysed at 1200 s • graphs are different suggesting that water is still moving in and out of the cells, data for 900 s suggests that the osmotic potential of cells is equivalent to less than 0.3 M • cannot be certain that osmotic potential is equivalent to 0.3 M sucrose unless cells are left in sucrose longer than 1200 s • the estimate is changing as time goes by so the cells would need to be left in solution until there is no further increase in the number of plasmolysed cells

Level	Marks	
Level 0	0	No awardable content
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
Level 2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.
Level 3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.

Q2.

Question Number	Answer	Additional Guidance	Mark
	use ratio of 8:2 of sucrose and water	ACCEPT other correct ratios	(1)

Q3.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to five of the following: • use range of at least five concentrations of (sucrose / salt) solution (1) • use equal {size / length / shape / surface area to volume} of pieces of carrot and potato (1) • control carrot and potato {age / part of tissue / temperature} (1) • pieces of carrot and potato submerged in the solutions for the same time (1) • carrot and potato pieces weighed before and after and dried (1) • plot graph of mass change against (salt / sucrose) concentration and use to compare where line cuts x-axis for carrot and potato (1)	Accept locate isotonic point	(5)

Q4.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to three of the following: - control temperature because affects {diffusion / osmosis / molecular movement / membrane permeability} (1) - submerge cubes in sucrose solution so all surfaces in contact (1) - use smaller intervals of sucrose concentration (between 0.2 and 0.4) (1) - blot cubes before weighing to remove surface solution / blot cubes dry to remove excess solution (1) - repeat to identify {anomalies / variability / SD} / because result in table could be {anomalous} (1)	ACCEPT dry but not if linked to dry mass DO NOT ACCEPT to calculate mean	(3)

Q5.

Question Number	Answer	Additional guidance	Mark
	An answer that makes reference to five of the following: - cut potato into chips of same size as this {gives equal surface area (to volume ratio) / affects osmosis} (1) - place potato chips in range of {salt / sucrose} solutions to allow {osmosis / water to enter / water to leave} (1) - blot chips to remove surface water (1) - measure (percentage) change in {mass / length} and {determine loss or gain of water / plot graph} (1) - identify where line crosses x axis as this represents {no change in mass / length / the estimate of water potential} (1) - compare these lines for different ages of potato tissue (1) - use same temperature as this affects {osmosis / diffusion} / leave potato for same time in solutions as this affects	Accept use a cork borer to give samples of standard size (linked to SA or osmosis) Accept dry using a paper towel Accept measure initial {length / mass} and final {length / mass} to find change	

	{osmosis / diffusion} / use same {potato / variety of potato} as this affects {water potential / osmosis / diffusion} (1)		
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Q6.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: - pond water has greater water potential than the cytoplasm therefore water enters by osmosis (1) <i>Paramecium</i> has { only cell membrane / has no cell wall } (1) - so would burst if water not removed (1)		(3)

Q7.

Question Number	Answer	Mark
	An answer that makes reference to the following: • x axis labelled 'sucrose concentration / mol dm⁻³' and y axis labelled 'percentage change in mass' / 'change in mass (%)' (1) • trend shows top left to bottom right, crossing x axis / crossing 0% (1)	(2)