

**Questions**

**Q1.**

The lipid content of the cell membranes of prokaryotic organisms changes in response to changes in the environmental temperature.

The cell membranes of most organisms belonging to the domain Archaea are lipid monolayers.

The lipid that forms this monolayer is a bipolar lipid.

Explain why a bipolar lipid is a suitable molecule to form the cell membrane.

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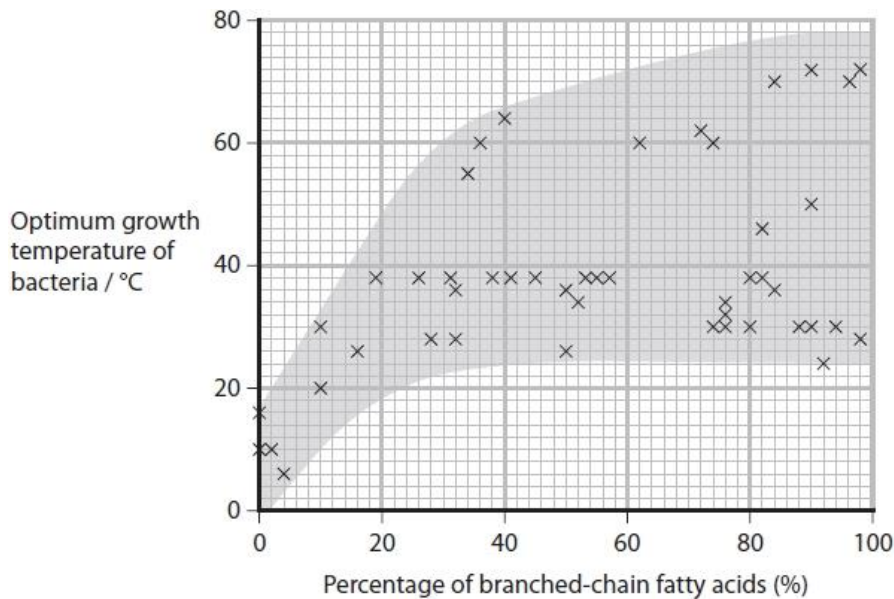
**(Total for question = 2 marks)**

**Q2.**

The lipid content of the cell membranes of prokaryotic organisms changes in response to changes in the environmental temperature.

The percentage of branched-chain fatty acids in membranes of bacteria that have different optimum growth temperatures was investigated.

The graph shows the results of this investigation.



(i) Calculate the mean percentage of branched-chain fatty acids in bacteria whose optimum growth temperature is <20 °C.

(1)

Answer ..... %

(ii) Analyse the data to describe **two** conclusions that can be drawn from this investigation.

(2)

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**(Total for question = 3 marks)**

Q3.

Macrophages are involved in response to infection.

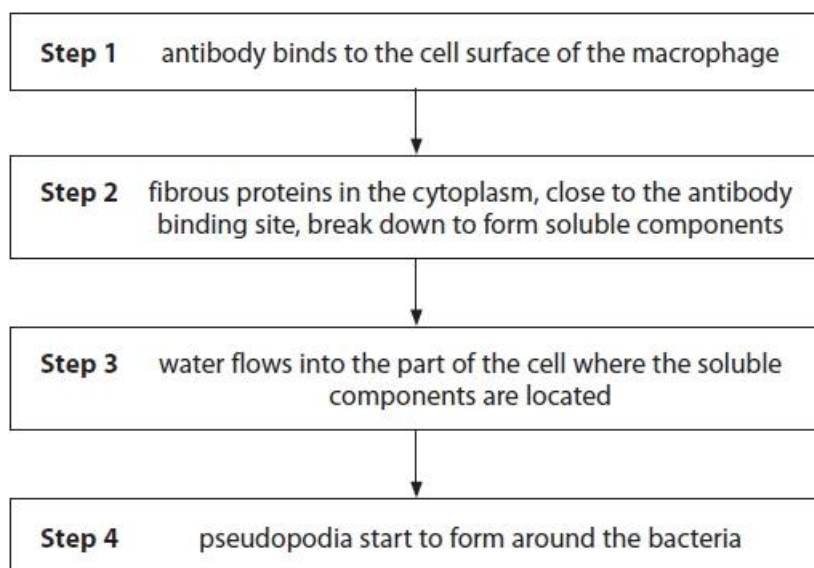
Macrophages engulf bacteria by surrounding the bacteria with pseudopodia.

The image shows a macrophage forming pseudopodia around some bacteria.



(Source: © urfin/Shutterstock)

The flow chart shows one theory for the formation of pseudopodia.



(i) Which diagram shows one antibody binding to the surface of a macrophage (**Step 1**)?

(1)



(ii) Actin is a fibrous protein.

Which row of the table describes the breakdown of actin (**Step 2**)?

(1)

	monomer formed	process by which bond is broken
<input type="checkbox"/> <b>A</b>	amino acid	condensation
<input type="checkbox"/> <b>B</b>	amino acid	hydrolysis
<input type="checkbox"/> <b>C</b>	nucleotide	condensation
<input type="checkbox"/> <b>D</b>	nucleotide	hydrolysis

(iii) Explain why water flows into the part of the cell where the soluble components are located (**Step 3**).

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(iv) Describe the events that take place resulting in T helper cell activation, following the formation of pseudopodia by the macrophages (**Step 4**).

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(Total for question = 7 marks)

**Q4.**

Plants require mineral ions from the soil for healthy growth.

(i) Describe how mineral (inorganic) ions are taken up by active transport.

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(ii) Describe the function of a named mineral ion that is vital for the growth of plants.

(2)

Mineral ions

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Function

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**(Total for question = 5 marks)**

**Q5.**

The lipid content of the cell membranes of prokaryotic organisms changes in response to changes in the environmental temperature.

Phospholipids form a bilayer in the cell membranes of bacteria.

Describe the structure of a phospholipid.

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**(Total for question = 2 marks)**

**Q6.**

Substances can move into or out of cells by a variety of methods.

The properties of cell membranes were investigated using samples of tissue from a beetroot.

The following procedure was used:

- equal sized discs of beetroot were cut, washed and placed in boiling tubes containing 5 cm<sup>3</sup> of distilled water
- one of these boiling tubes was placed in a water bath at 20 °C for 30 minutes
- the discs of beetroot were then removed from the boiling tube
- a colorimeter was then used to measure the absorbance of the liquid in the boiling tube
- this was repeated using water baths at 30 °C, 40 °C, 50 °C, 60 °C and using an ice bath at 5 °C
- each temperature was tested 8 times.

The boiling tubes contained a red pigment that had leaked out of the beetroot discs.

The darker the red colour of the liquid in the boiling tube, the higher the absorbance.

The results of this investigation are shown in the table.

Temperature / °C	Absorbance / a.u.									Mean	Standard deviation
	1	2	3	4	5	6	7	8			
5	0.02	0.03	0.04	0.02	0.04	0.03	0.02	0.01	0.03	0.01	
20	0.10	0.08	0.05	0.10	0.07	0.09	0.06	0.07	0.08		
30	0.12	0.09	0.07	0.10	0.08	0.07	0.09	0.10	0.09	0.02	
40	0.09	0.10	0.12	0.09	0.12	0.13	0.11	0.09	0.11	0.02	
50	0.12	0.17	0.14	0.15	0.20	0.23	0.18	0.19	0.17	0.04	
60	0.85	0.97	1.03	0.89	1.10	0.89	0.92	0.87	0.94	0.09	

(i) Explain which temperature above 30 °C shows the most variation in absorbance.

(2)

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(ii) Calculate the standard deviation for the results at 20 °C.

Use the formula

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}$$

(3)

Answer .....

(iii) Explain the effect of increasing temperature on membrane permeability.

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**(Total for question = 8 marks)**



**Q7.**

Substances can move into or out of cells by a variety of methods.

(i) A small ion is in high concentration outside a cell.

By which method is the ion most likely to enter the cell?

**(1)**

- A** active transport
- B** diffusion
- C** facilitated diffusion
- D** osmosis

(ii) Which of the following are required for active transport?

1 ATP

2 carrier proteins

3 cell membrane

**(1)**

- A** 1 only
- B** 1 and 2 only
- C** 1 and 3 only
- D** 1, 2 and 3

(iii) Which is a description of exocytosis?

**(1)**

- A** a form of active transport in which large particles move into cells
- B** a form of active transport in which large particles move out of cells
- C** a form of passive transport in which large particles move into cells
- D** a form of passive transport in which large particles move out of cells

**(Total for question = 3 marks)**

**Q8.**

The lipid content of the cell membranes of prokaryotic organisms changes in response to changes in the environmental temperature.

A change in temperature can affect the permeability and fluidity of the membrane.

Explain why it is important that the lipid composition of the membrane of prokaryotic organisms changes if the temperature changes.

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**(Total for question = 3 marks)**

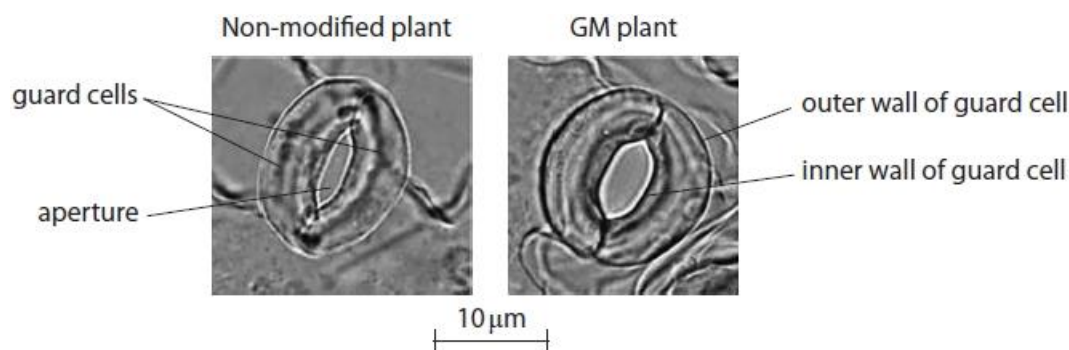
Q9.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Genetically modified (GM) crop plants have been produced that have stomata with a wider aperture than non-modified crop plants.

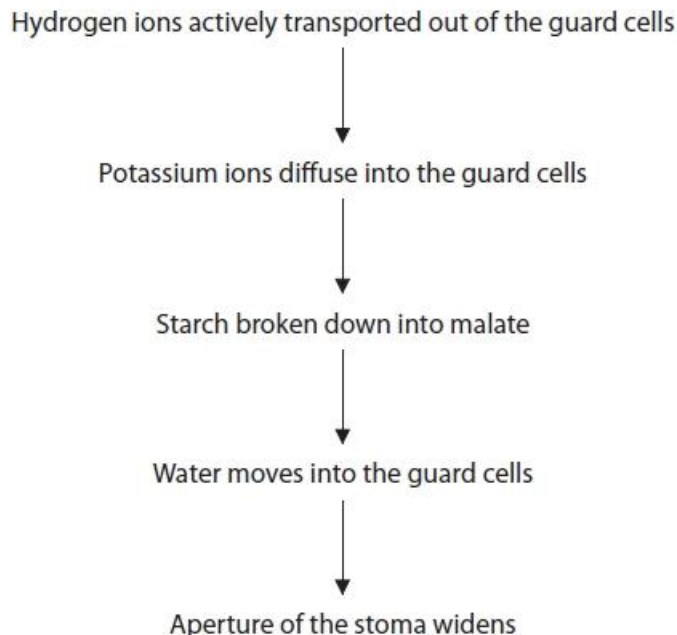
This difference in the width of the aperture is only evident in daylight.

The photographs show the appearance of each type of stoma in daylight.



Sourced from: [http://www.aip.nagoya-u.ac.jp/en/public/nu\\_research/images/Wang\\_f1.jpg](http://www.aip.nagoya-u.ac.jp/en/public/nu_research/images/Wang_f1.jpg)

The flow chart shows some of the steps involved in opening the aperture of a stoma.



(i) What happens when hydrogen ions are actively transported out of the guard cells?

- A** ADP and phosphate ions are converted into ATP by a hydrolysis reaction  
 **B** ADP and phosphate ions are converted into ATP by a condensation reaction  
 **C** ATP is broken down into ADP and phosphate ions by a condensation reaction  
 **D** ATP is broken down into ADP and phosphate ions by a hydrolysis reaction

(1)

(ii) Which of the following explains why water moves into the guard cells?

(1)

- A malate lowers the water potential of the cytoplasm
- B malate raises the water potential of the cytoplasm
- C starch lowers the water potential of the cytoplasm
- D starch raises the water potential of the cytoplasm

(iii) Which of the following explains why the aperture of the stoma widens?

(1)

- A The guard cells become smaller and the inner wall of the guard cell is more flexible than the outer wall
- B The guard cells become smaller and the inner wall of the guard cell is less flexible than the outer wall
- C The guard cells become larger and the inner wall of the guard cell is more flexible than the outer wall
- D The guard cells become larger and the inner wall of the guard cell is less flexible than the outer wall

**(Total for question = 3 marks)**

**Q10.**

Cholera is a disease caused by a bacterial infection that affects the absorption of water in the small intestine.

The bacteria that cause cholera release a toxin.

This toxin affects the CFTR protein found in the membrane of intestinal epithelium cells.

The toxin causes the CFTR protein to pump more chloride ions out of these cells into the intestine. This causes a lot of water to be lost in the faeces.

Explain how the toxin causes this water loss.

**(3)**

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**(Total for question = 3 marks)**

**Q11.**

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

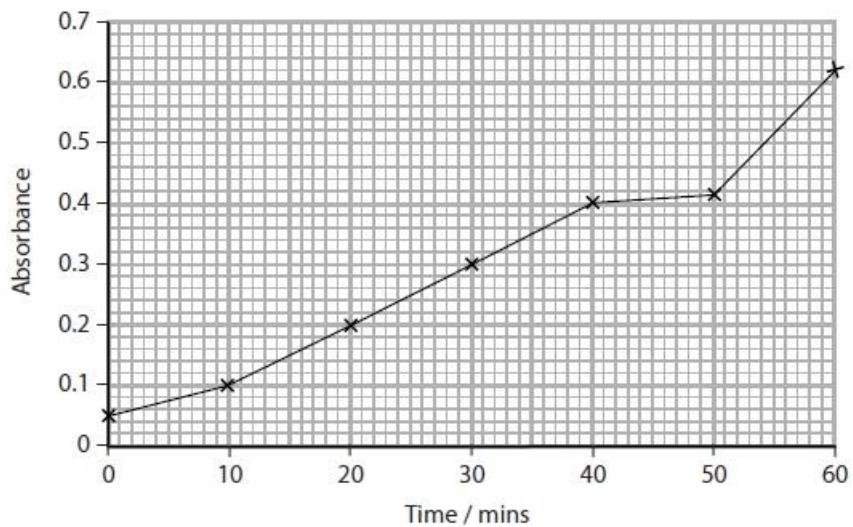
**Step 1:** The student cut leaf discs from leaves, using a cork borer.

**Step 2:** These leaf discs were then added to a boiling tube containing 10 cm<sup>3</sup> 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.

(2)

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

(2)

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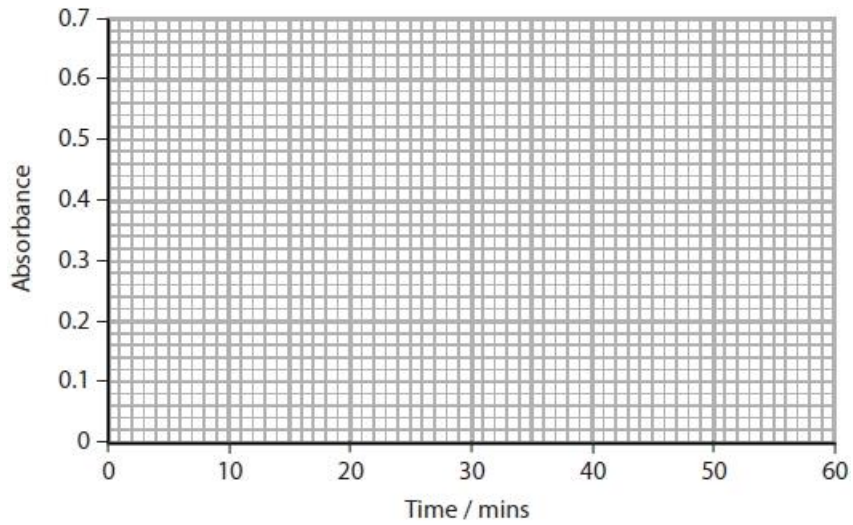
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(b) The student also carried out a control, using water instead of 40% ethanol.

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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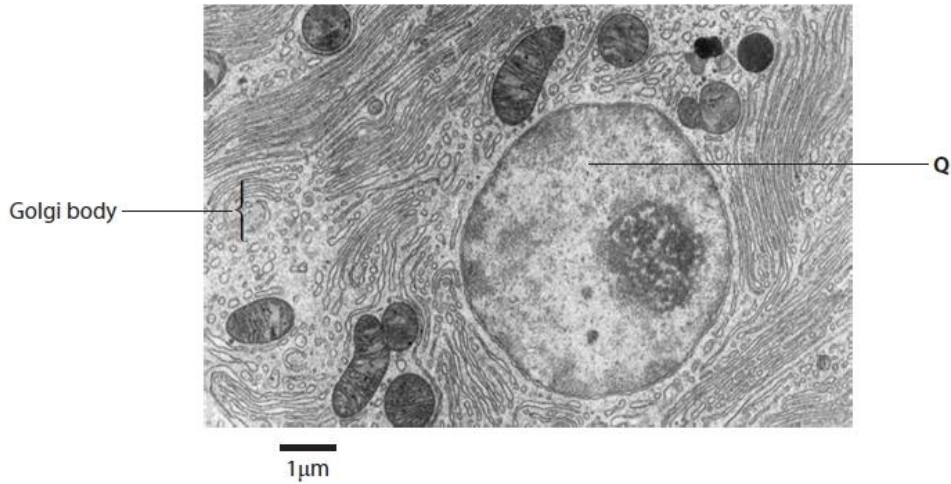
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(Total for question = 13 marks)

Q12.

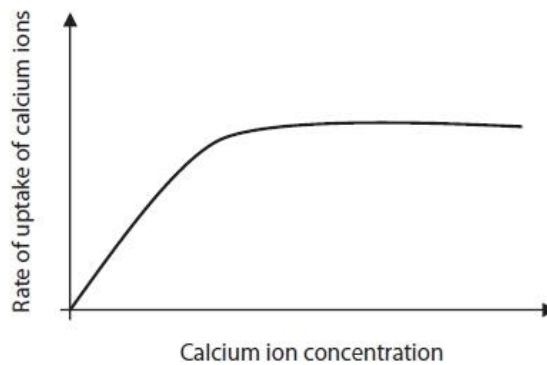
The pancreas is an organ that secretes digestive enzymes.

The electron micrograph shows part of a secretory cell from a human pancreas.



Calcium ions are needed for the secretion of enzymes from pancreatic cells.

The graph shows the effect of increasing calcium ion concentration on the uptake of calcium ions by pancreatic cells.



Explain the effects of calcium ion concentration on the rate of uptake of calcium ions through the pancreatic cell membrane.

(3)

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(Total for question = 3 marks)



## Q13.

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 <sup>-3</sup>	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<sup>-3</sup> sucrose solution.

State how the student used this solution to make a 0.8 mol dm<sup>-3</sup> sucrose solution.

(1)

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(Total for question = 1 mark)

Q14.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Substances move into cells by several processes.

(i) Which of these processes requires energy from respiration?

(1)

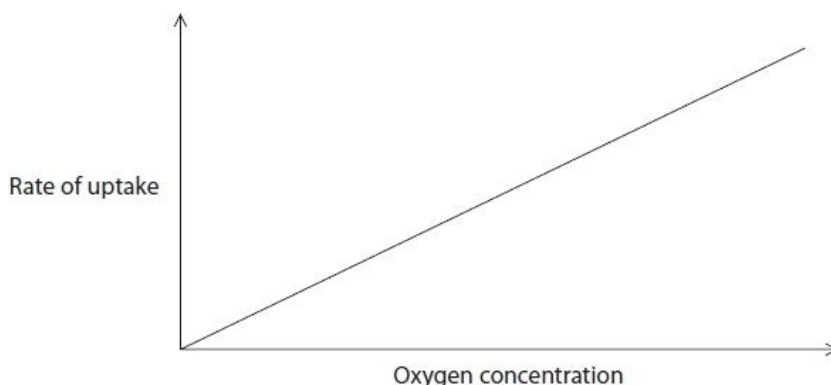
- A diffusion
- B endocytosis
- C facilitated diffusion
- D osmosis

(ii) Which of these processes can occur against a concentration gradient?

(1)

- A active transport
- B diffusion
- C facilitated diffusion
- D osmosis

(iii) The graph shows the effect of increasing oxygen concentration on the rate of uptake of a substance **other** than oxygen.



Which of these processes is shown by the graph?

(1)

- A active transport
- B diffusion
- C facilitated diffusion
- D osmosis

(iv) Which substance can enter a cell by diffusion?

(1)

- A amino acid
- B carbon dioxide
- C glucose
- D protein

(Total for question = 4 marks)

**Q15.**

Auxins and cytokinins are plant growth regulators that control apical dominance and cell elongation.

Auxin is an uncharged molecule when it diffuses through the cell surface membrane. When inside the cytoplasm, auxin develops a negative charge. Auxin leaves cells by facilitated diffusion.

Explain how the structure of the cell membrane affects the transport of auxin.

(2)

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**(Total for question = 2 marks)**

**Q16.**

The structure of a lipid relates to its role in living organisms.

Cell membranes contain lipids that have a phosphate group attached to the glycerol, instead of one of the fatty acids.

Explain the importance of the phosphate group in these lipids.

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**(Total for question = 2 marks)**

## Q17.

A student investigated the effect of the concentration of sodium chloride solution on blood.

The student set up six test tubes, each with a different concentration of sodium chloride solution.

Five drops of blood were added to each test tube.

The appearance of the solutions was then recorded.

Samples of each solution were observed using a light microscope.

The table shows the results of this investigation.

Concentration of sodium chloride (%)	Appearance of solution after blood was added	Observation with light microscope
3.0	very cloudy	cells seen with shrunken edges
1.0	very cloudy	cells seen
0.9	very cloudy	cells seen
0.7	slightly cloudy	cells seen
0.5	cloudy at first, then went clear	no cells seen
0.3	clear	no cells seen

Analyse the data to comment on the effect of the concentration of sodium chloride solution on blood.

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(Total for question = 4 marks)

**Q18.**

A student investigated the effect of the concentration of sodium chloride solution on blood.

The student set up six test tubes, each with a different concentration of sodium chloride solution.

Five drops of blood were added to each test tube.

The appearance of the solutions was then recorded.

Samples of each solution were observed using a light microscope.

The table shows the results of this investigation.

Concentration of sodium chloride (%)	Appearance of solution after blood was added	Observation with light microscope
3.0	very cloudy	cells seen with shrunken edges
1.0	very cloudy	cells seen
0.9	very cloudy	cells seen
0.7	slightly cloudy	cells seen
0.5	cloudy at first, then went clear	no cells seen
0.3	clear	no cells seen

The student then investigated the effect of using glucose solutions and sucrose solutions, instead of sodium chloride solutions.

The appearance of the solutions was recorded and samples were observed using a light microscope.

When the concentration of glucose solution was below 3%, the solution was clear and no blood cells could be seen. When the concentration of glucose solution was above 3%, the solution was cloudy and blood cells could be seen.

When the concentration of sucrose solution was below 6%, the solution was also clear and no blood cells could be seen. When the concentration of sucrose solution was above 6%, the solution was cloudy and blood cells could be seen.

Explain the differences in the effects of the solutions of glucose and sucrose.

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**(Total for question = 3 marks)**

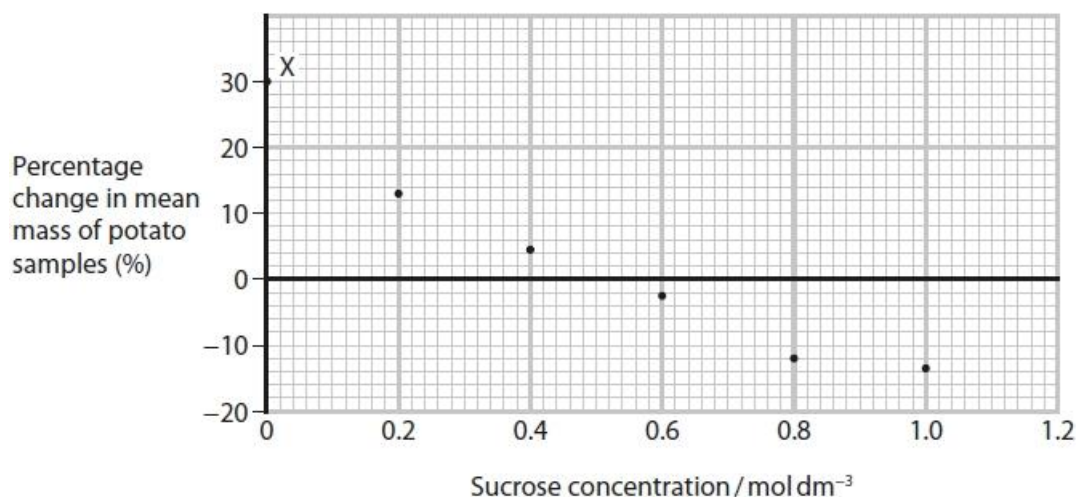
## Q19.

Substances move into cells by several processes.

When plant cells absorb water, the water potential of the cells changes.

The water potential of potato cells was investigated.

The graph shows the percentage change in mean mass of potato samples after immersion in sucrose solutions of different concentrations.



(i) Draw a suitable line on this graph.

(1)

(ii) Give the sucrose concentration that has the same water potential as the cells in these potato samples.

(1)

Answer ..... mol dm<sup>-3</sup>

(iii) The water potential ( $\Psi$ ) of plant cells can be calculated using the equation:

$$\Psi = P + \pi$$

Explain the changes in the water potential of cell ( $\Psi$ ), turgor pressure ( $P$ ) and osmotic potential ( $\pi$ ), at point X on the graph.

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(iv) Explain why it is more difficult to determine the osmotic potential ( $\pi$ ) than the water potential ( $\Psi$ ) of plant cells.

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**(Total for question = 8 marks)**





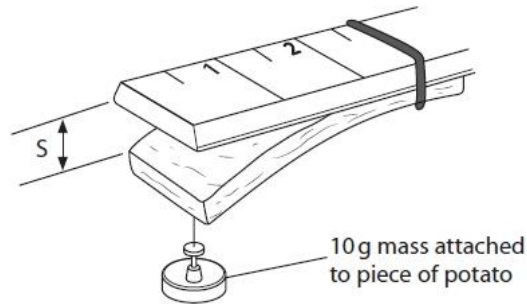
**Q21.**

A student investigated the effect of changes in turgor on plant tissue.

Equal sized pieces of potato were cut and attached to a ruler.

These pieces were immersed in different concentrations of sucrose solution and left for one hour.

The pieces were then removed from the solution and the turgor was determined as shown in the diagram.



The distance (S) that each piece sagged from the ruler was measured.

The table shows the results of this investigation.

Concentration of sucrose solution / mol dm <sup>-3</sup>	Mean distance S / mm
0.00	0.0
0.20	0.5
0.30	4.0
0.35	5.5
0.40	8.0
0.45	9.5
0.50	10.0
0.60	10.5

Criticise the method used to determine turgor in this investigation.

(2)

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**(Total for question = 2 marks)**

Q22.

The photograph shows part of one epithelial cell from the wall of the small intestine.



This cell is adapted to absorb substances by active transport.

State what is meant by the term **active transport**.

(2)

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(Total for question = 2 marks)

Q23.

The photograph shows *Salicornia*, a plant growing on salt marshes close to the sea. *Salicornia* colonises bare mud containing seawater.



A student sampled *Salicornia* plants at the river mouth by the sea and at different distances upstream. Samples of the water in the mud were also taken.

The salt concentration of the plants and the water in the mud were measured.

The results are shown in the table.

Distance upstream from sea / km	Salt concentration / arbitrary units	
	<i>Salicornia</i> plants	Water in the mud
0.0	60.0	2.8
1.6	60.0	1.1
4.8	55.0	0.6
8.0	75.0	0.2

Analyse the data to explain how *Salicornia* is adapted to life in salt marshes.

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(Total for question = 3 marks)

Q24.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

(i) Which of the following statements about facilitated diffusion are correct?

(1)

1. substances move through membrane proteins
2. substances move against a concentration gradient
3. substances move down a concentration gradient
4. substances move between phospholipids

- A** 1 and 2  
 **B** 1 and 3  
 **C** 2 and 3  
 **D** 2 and 4

(ii) The collecting duct is also part of the nephron.

Which of the following are the effects of increased release of antidiuretic hormone (ADH)?

(1)

- A** decreased permeability of the collecting duct to water, producing more concentrated urine  
 **B** decreased permeability of the collecting duct to water, producing more dilute urine  
 **C** increased permeability of the collecting duct to water, producing more concentrated urine  
 **D** increased permeability of the collecting duct to water, producing more dilute urine

**(Total for question = 2 marks)**

## Q25.

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 <sup>-3</sup>	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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(Total for question = 3 marks)

**Q26.**

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)**

**Q27.**

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)**





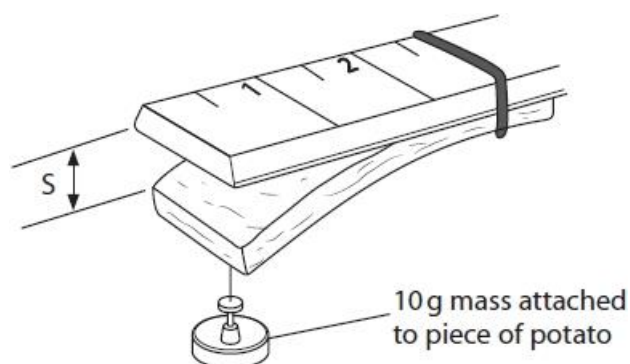
**Q29.**

A student investigated the effect of changes in turgor on plant tissue.

Equal sized pieces of potato were cut and attached to a ruler.

These pieces were immersed in different concentrations of sucrose solution and left for one hour.

The pieces were then removed from the solution and the turgor was determined as shown in the diagram.



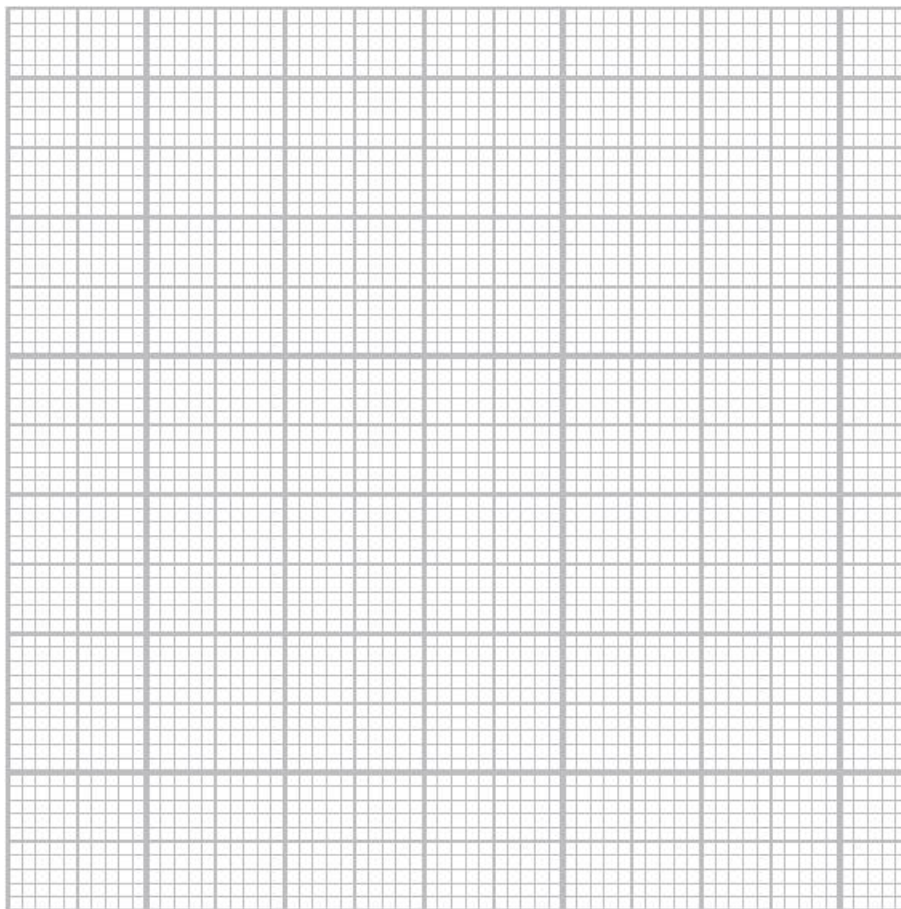
The distance (S) that each piece sagged from the ruler was measured.

The table shows the results of this investigation.

Concentration of sucrose solution / mol dm <sup>-3</sup>	Mean distance S / mm
0.00	0.0
0.20	0.5
0.30	4.0
0.35	5.5
0.40	8.0
0.45	9.5
0.50	10.0
0.60	10.5

(i) Plot a suitable graph to display the results of this investigation.

(3)



(ii) Calculate the mean change in the distance S in mm as the sucrose concentration changes from 0.2 to 0.4 mol dm<sup>-3</sup>.

(2)

Answer ..... mm per mol dm<sup>-3</sup>

(iii) Analyse the data to explain the relationship between the concentration of sucrose and turgor in the pieces of potato.

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**(Total for question = 9 marks)**

**Q30.**

Biodiversity is monitored by conservationists.

The photograph shows a hedge.



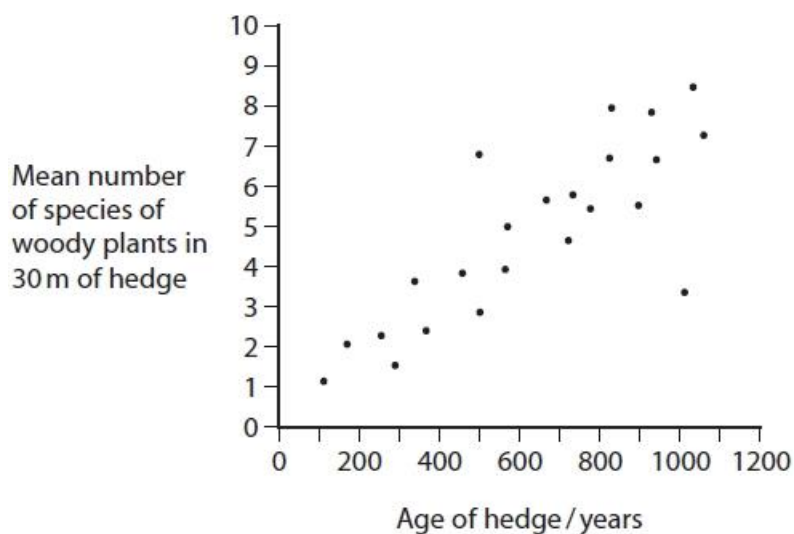
(Source: © 1000 Words/Shutterstock)

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.



**Q31.**

Mineral ions are transported from the soil into the cytoplasm of plant root cells.

The table shows the concentration of sodium ions and chloride ions in soil and in the cytoplasm of plant root cells.

Location	Ion concentration / $\text{mg dm}^{-3}$	
	Sodium	Chloride
soil	28	25
cytoplasm	1988	3750

(i) Give the ratio of sodium ions in the soil to those in the cytoplasm.

(1)

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(ii) Which of the following describes how these mineral ions are transported into the cytoplasm of plant root cells?

(1)

- A** active transport through carrier proteins
- B** diffusion through the phospholipid bilayer
- C** facilitated diffusion through the phospholipid bilayer
- D** mass transport through carrier proteins

**(Total for question = 2 marks)**

Q32.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Substances move into and out of cells by different mechanisms.

(i) Which of these mechanisms moves substances against a concentration gradient?

(1)

- A active transport
- B diffusion
- C facilitated diffusion
- D osmosis

(ii) Which of these mechanisms enables non-polar molecules to pass through cell membranes?

(1)

- A diffusion
- B facilitated diffusion
- C osmosis
- D transpiration

**(Total for question = 2 marks)**

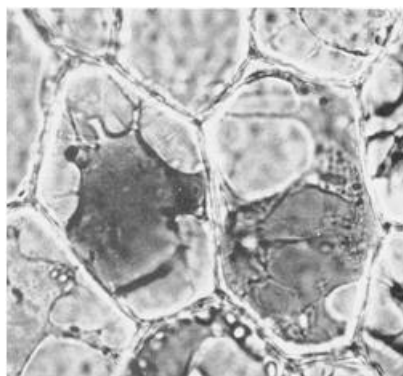
Q33.

Water potential in plant cells can be represented by the equation

$$\text{Water potential} = \text{turgor pressure} + \text{osmotic potential}$$

$$\psi = P + \pi$$

If plant cells are placed in a solution with a lower water potential, the cell membranes will shrink away from the cell wall. The cells are described as plasmolysed.



The point at which 50% of the cells are plasmolysed can be used to estimate the osmotic potential of the cells.

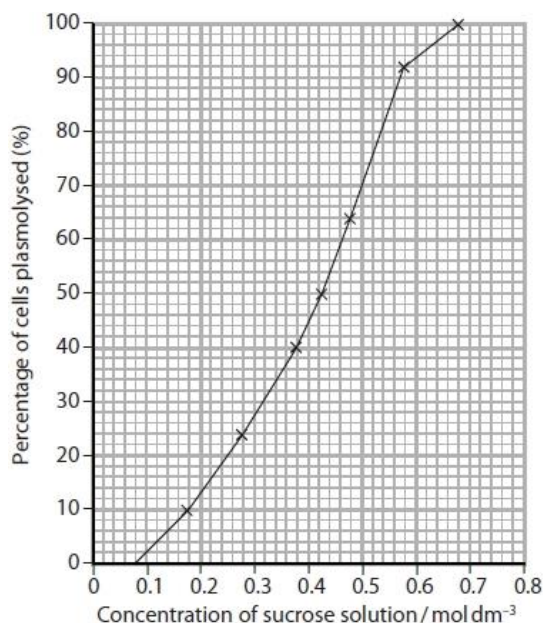
An experiment was carried out to determine the osmotic potential of onion cells.

Onion cells were placed in a range of sucrose concentrations and left for 10 minutes at 25 °C.

A sample of 50 cells was observed for each solution.

The percentage of plasmolysed cells was recorded.

The results are shown in the graph.





The table shows the osmotic potential of a range of sucrose solutions.

Concentration of sucrose solution / mol dm <sup>-3</sup>	Osmotic potential / kPa
0.30	-860
0.35	-970
0.40	-1120
0.45	-1280
0.50	-1450
0.60	-1800

(i) Analyse the data in the graph and in the table to explain how the osmotic potential of these onion cells could be determined.

(3)

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(ii) Explain why the plant tissue was left in sucrose solution for 10 minutes before the cells were observed.

(2)

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**(Total for question = 5 marks)**

**Q34.**

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 <sup>-3</sup>	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

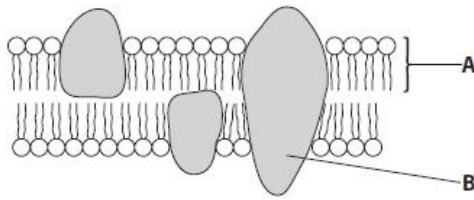
Sketch a graph you could use to identify the water potential of potato cells.

(2)

**(Total for question = 2 marks)**

Q35.

The diagram shows the structure of a cell membrane.



Name the parts labelled **A** and **B**.

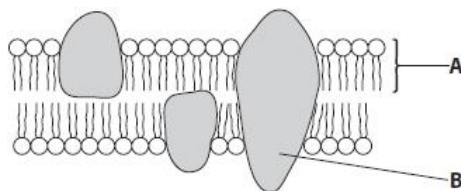
(1)

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(Total for question = 1 mark)

Q36.

The diagram shows the structure of a cell membrane.



Explain how the structure of the membrane controls the transport of polar molecules.

(4)

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(Total for question = 4 marks)

Q37.

Answer the question with a cross in the box you think is correct . If you change your mind about an answer, put a line through the box  and then mark your new answer with a cross .

Transpiration moves water and mineral ions from the roots to the leaves of plants.

Water enters the root hair cells and moves through the root tissues by the apoplastic and symplastic pathways.

(i) Root hairs have a large surface area that increases the rate of uptake of water.

The surface area of a root hair is rounded up to  $3.14 \times 10^5 \mu\text{m}^2$ .  
Which is the actual surface area of this root hair?

- A 31 460  $\mu\text{m}^2$   
 B 314 600  $\mu\text{m}^2$   
 C 313 900  $\mu\text{m}^2$   
 D 3 139 000  $\mu\text{m}^2$

(1)

(ii) Which row of the table shows the movement of water through the apoplastic and symplastic pathways?

(1)

	Apoplastic pathway	Symplastic pathway
<input type="checkbox"/> A		
<input checked="" type="checkbox"/> B		
<input type="checkbox"/> C		
<input type="checkbox"/> D		

(iii) Water moves through the root tissue due to a difference in water potential between one cell and the next cell.

Which row of the table describes this movement?

(1)

	Direction of water movement with respect to water potential	Direction of water movement with respect to concentration of solutions
<input type="checkbox"/> A	higher to lower	concentrated to dilute
<input type="checkbox"/> B	higher to lower	dilute to concentrated
<input type="checkbox"/> C	lower to higher	concentrated to dilute
<input type="checkbox"/> D	lower to higher	dilute to concentrated

(Total for question = 3 marks)

Q38.

Water potential in plant cells can be represented by the equation

$$\text{Water potential} = \text{turgor pressure} + \text{osmotic potential}$$

$$\psi = P + \pi$$

Plant tissue is placed in distilled water.

(i) Which of the following will occur?

(1)

- A more water will leave the tissue than enter
- B the cells will become turgid
- C the tissue will become flaccid
- D the cells will burst

(ii) When the plant tissue is placed in distilled water the value of

(1)

- A P will decrease
- B  $\pi$  will decrease
- C P will increase
- D  $\psi$  will not change

(iii) Which row of the table correctly identifies the values of P and  $\pi$  if the value of  $\psi$  is 0 kPa?

(1)

	P / kPa	$\pi$ / kPa
<input type="checkbox"/> A	0	0
<input type="checkbox"/> B	-4.6	4.6
<input type="checkbox"/> C	4.6	-4.6
<input type="checkbox"/> D	4.6	0

(iv) Which liquid has the lowest water potential ( $\psi$ )?

(1)

- A distilled water
- B  $1.0 \text{ mol dm}^{-3}$  sodium chloride solution
- C  $0.1 \text{ mol dm}^{-3}$  sodium chloride solution
- D  $0.1 \text{ mol dm}^{-3}$  potassium chloride solution

**(Total for question = 4 marks)**

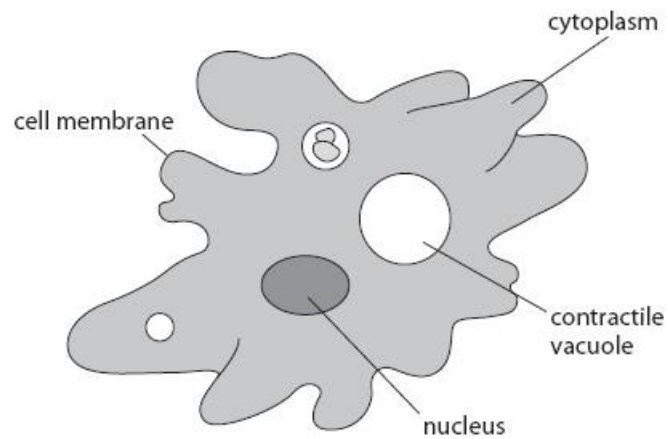
Q39.

*Amoeba proteus* is a single-celled organism that lives in pond water.

*Amoeba* has a structure called a contractile vacuole that removes excess water from the cell.

Water that moves into the cytoplasm is transported into the contractile vacuole. When full, the contractile vacuole moves to the surface of the cell and fuses with the cell membrane. This allows the water it contains to be removed from the cell.

The diagram shows *Amoeba* with a contractile vacuole.



(i) The water leaves the contractile vacuole by

- A endocytosis
- B exocytosis
- C osmosis
- D facilitated diffusion

(1)

(ii) A student investigated the effect of mineral ions in pond water on the rate at which the contractile vacuole emptied.

The student placed different specimens of *Amoeba* in different concentrations of mineral ion solution on microscope slides.

The student recorded the rate at which the contractile vacuole emptied.

The results are shown in the table.

Concentration of mineral ions / arbitrary units	Number of times contractile vacuole emptied per minute
5	14
10	6
15	5
20	3
25	2

Analyse the data to explain the change in the rate at which the contractile vacuole emptied.

(2)

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**(Total for question = 3 marks)**



**Mark Scheme**

Q1.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>because the {two polar groups / outside layers} will interact with the aqueous environment (on each side of membrane) (1)</li> <li>rest of molecule will provide hydrophobic barrier / there will be a hydrophobic layer (inside) (1)</li> </ul>	<p><b>ACCEPT</b> form H bonds with water</p>	<p>(2) EXP</p>

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> <li>1.5 (%)</li> </ul>		<p>(1) GRAD</p>

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>A description that makes reference to two of the following:</p> <ul style="list-style-type: none"> <li>bacteria with higher optimum growth temperatures have a greater percentage of branched chain fatty acids (1)</li> <li>the greater the percentage of branched chain fatty acids the greater the range of optimum growth temperature (1)</li> <li>an optimum growth temperature of more than 40°C needs at least 30% of branched chains (1)</li> </ul>	<p><b>ACCEPT</b> positive correlation between optimum growth temperature and percentage of branched chain fatty acids converse</p> <p><b>ACCEPT</b> bacteria with optimum temperature between 20°C and 40°C had the greatest range in percentage of branched-chain fatty acids converse</p>	<p>(2) EXP</p>

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	<p><b>The only correct answer is D</b></p> <p><b>A</b> is incorrect because antibodies have two antigen binding sites</p> <p><b>B</b> is incorrect because the two binding sites attach to the antigen and not the macrophage</p> <p><b>C</b> is incorrect because there is only one macrophage binding site</p>		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(ii)	<p><b>The only correct answer is B</b></p> <p><b>A</b> is incorrect because hydrolysis reactions breakdown molecules <b>C</b> is incorrect because nucleotides are the monomers of polynucleotides not proteins</p> <p><b>D</b> is incorrect because nucleotides are the monomers of polynucleotides not proteins</p>		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• (because water enters part of cell) by osmosis (1)</li> <li>• from a high water potential to a low water potential / because the osmotic potential inside the cell is lower / from a low solute concentration to a higher solute concentration (1)</li> </ul>	<p><b>ACCEPT</b> more concentrated cytoplasm solute potential for osmotic potential</p> <p><b>IGNORE</b> concentration gradient unqualified water concentration</p>	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iv)	<p>A description that makes reference to three of the following:</p> <ul style="list-style-type: none"> <li>• bacteria engulfed and {digested / broken down} (1)</li> <li>• antigen attached to MHC antigen (1)</li> <li>• macrophage becomes an antigen-presenting cell (to the T helper cell) (1)</li> <li>• CD4 (antigen) of T (helper) cell binds to {antigen / macrophage} (1)</li> </ul>	<p><b>ACCEPT</b> macrophage presents the antigen (to the T helper cell)</p> <p><b>NB</b> CD4 (antigen) of T (helper) cell binds to {antigen-MHC complex = 2 marks</p>	(3) EXP

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that includes three of the following: <ul style="list-style-type: none"> <li>• moved {across membrane / into cell / into root} by carrier proteins (1)</li> <li>• against a concentration gradient (1)</li> <li>• using ATP (1)</li> </ul>	Accept protein pumps Ignore channel proteins  Accept from a low to a high concentration	<b>Exp (3)</b>

Question Number	Answer	Additional Guidance	Mark
(ii)	<ul style="list-style-type: none"> <li>• suitable mineral ion named (1)</li> <li>• appropriate function given (1)</li> </ul>	Mp2 can be given if suitable mineral not named eg nitrogen for nitrate eg <b>nitrate / (ammonium)</b> – formation of amino acids / proteins / enzymes / nucleic acids / nucleotides / DNA / RNA / chlorophyll <b>phosphate</b> – formation of nucleotides / nucleic acids / DNA / RNA / ATP / ADP / amino acids <b>calcium</b> – formation of middle lamella / calcium pectate <b>magnesium</b> – formation of chlorophyll  Accept other correct mineral ions with correct functions potassium, sodium, iron etc	<b>Exp (2)</b>

Q5.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: <ul style="list-style-type: none"> <li>• glycerol attached to two fatty acids (by ester bonds) (1)</li> <li>• and one phosphate attached to glycerol (1)</li> </ul>	<b>ACCEPT</b> from a labelled diagram  <b>NB</b> made from one glycerol two fatty acids and one phosphate = 1 mark if neither mark awarded	<b>(2) EXP</b>

Q6.

Question Number	Answer	Mark
(i)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• 60 °C as it shows the greatest range of absorbance / allow calculation of range (1)</li> <li>• 60 °C as it has the highest standard deviation (2)</li> </ul>	<b>grad (2)</b>

Question Number	Answer	Additional guidance	Mark
(ii)	<p>A calculation that shows:</p> <p>calculation of numerator</p> <p>divide by 7</p> <p>calculation of s</p> <p>0.01852 or 0.0185 or 0.02 scores 3</p>	<p>example calculation</p> <p>allow 1 mark for divide by 7</p> <p>allow two marks for <b>0.000343</b></p> <p>0.01852</p> <p><b>Allow full marks for correct answer with no working</b></p>	<b>EXP (3)</b>

Question Number	Answer	Mark
(iii)	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none"> <li>• as temperature increases the membrane permeability increases gradually then greater after 50° C (1)</li> <li>• (gradually at first) due to increased <u>kinetic energy of pigment molecules</u> (1)</li> <li>• as temperature increases the <u>fluidity</u> of membrane increases due to movement of <u>phospholipids</u>/ reduced bonding attraction between <u>phospholipids</u> (1)</li> <li>• (greatest increase above 50° C) as then the proteins in cell membrane start to denature and (more) pigment molecules escape (1)</li> </ul>	<b>exp (3)</b>

Q7.

Question Number	Answer	Mark
(i)	<p><b>The only correct answer is</b></p> <p><b>C facilitated diffusion</b></p> <p><i>A is not correct because it does not enter via active transport</i></p> <p><i>B is not correct because it does not enter via diffusion</i></p> <p><i>D is not correct because it does not enter via osmosis</i></p>	<b>COMP (1)</b>

Question Number	Answer	Mark
(ii)	<p><b>The only correct answer is</b></p> <p><b>D 1, 2 and 3</b></p> <p><i>A is not correct because statement 1 2 and 3 are correct</i></p> <p><i>B is not correct because statement 1 2 and 3 are correct</i></p> <p><i>C is not correct because statement 1 2 and 3 are correct</i></p>	<b>COMP (1)</b>

Question Number	Answer	Mark
(iii)	<p><b>The only correct answer is</b></p> <p><b>B a form of active transport in which large particles move out of cells</b></p> <p><i>A is not correct because it is not transport into cells</i></p> <p><i>C is not correct because it is not passive transport</i></p> <p><i>D is not correct because it does not passive transport into cells</i></p>	<b>COMP (1)</b>

Q8.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>because membranes control {permeability / what can enter and leave the cell} (1)</li> <li>such as {uptake of nutrients / uptake of oxygen / removal of waste products} (1)</li> <li>because membranes need to be fluid for {movement / cell division} (1)</li> </ul>	<p><b>ACCEPT</b> converse i.e. what would happen if membrane composition did not change</p> <p><b>ACCEPT</b> membranes become more {permeable / leaky} at higher temperatures</p> <p><b>ACCEPT</b> named nutrients / waste products</p> <p><b>IGNORE</b> water role of membrane proteins in transport</p>	(3) EXP

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	D ATP is broken down into ADP and phosphate ions by a hydrolysis reaction	<p>A is incorrect because ATP is broken down</p> <p>B is incorrect because ATP is broken down C is incorrect because condensation reactions form bonds</p>	

Question Number	Answer	Additional Guidance	Mark
(ii)	A malate lowers the water potential of the cytoplasm	<p>B is incorrect because increase in solute concentration raises water potential so water would leave the cells</p> <p>C is incorrect because starch has no osmotic effect</p> <p>D is incorrect because starch has no osmotic effect</p>	

Question Number	Answer	Additional Guidance	Mark
(iii)	D The guard cells become larger and the inner wall of the guard cell is less flexible than the outer wall	A is incorrect because entry of water would make the cell more larger B is incorrect because entry of water would make the cell more larger C is incorrect because the stoma would not form if the inner wall was flexible	

## Q10.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following:  <ul style="list-style-type: none"> <li>• (water moves into the intestine by) <b>osmosis</b></li> <li>• because the concentration of {chloride ions / salt / solute} increases {in intestine / outside the cell}</li> <li>• therefore reducing the water potential (in the intestine)</li> </ul>	(1) (1) (1)  ACCEPT converse for epithelial cells  ACCEPT solute potential decreases {in intestine / outside the cell}	(3)

## Q11.

Question Number	Acceptable Answers	Additional Guidance	Mark
(a)(i)	An explanation that makes reference to the following:  <ul style="list-style-type: none"> <li>• red is absorbed (1)</li> <li>• because of the presence of chlorophyll (1)</li> </ul>		(2)

Question Number	Acceptable Answers	Additional Guidance	Mark
(a)(ii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• {chlorophyll / leaf pigment} was present (1)</li> <li>• because some cells are damaged / discs not washed (1)</li> </ul>		(2)

Question Number	Answer	Additional Guidance	Mark
(a)(iii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• ethanol {disrupts / damages / dissolves / affects} the phospholipid (1)</li> <li>• therefore the membrane {becomes more permeable / allows pigment out} (1)</li> </ul>		(2)

Question Number	Answer	Additional Guidance	Mark
(b)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• starts at 0.05 absorbance value (1)</li> <li>• flat line along 0.05 absorbance value (1)</li> </ul>		(2)



Question Number	Answer	Additional Guidance	Mark
(c)	<p>An answer that makes reference to five of the following:</p> <ul style="list-style-type: none"> <li>• use leaves of {same age / same position on plant} because this affects concentration of pigment (1)</li> <li>• obtain leaf discs from the same part of the leaf because this affects concentration of pigment (1)</li> <li>• use same {cork borer / size of leaf disc / diameter of leaf disc} because this affects concentration of pigment (1)</li> <li>• use same temperature because temperature affects the rate of diffusion (1)</li> <li>• use same volume of ethanol so chlorophyll is diluted the same (1)</li> <li>• replicate each ethanol concentration to {see if results are consistent / identify anomaly / to calculate standard deviation / allow statistical test} (1)</li> <li>• wash discs to remove pigment (1)</li> </ul>		(5)

Q12.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• rate of diffusion increases due to {increased diffusion / concentration} gradient (1)</li> <li>• and rate of uptake levels off as {calcium ion channels / transport proteins / channel proteins} limit rate (1)</li> <li>• because (calcium) ions enter by facilitated diffusion (1)</li> </ul>	<b>Accept</b> all calcium ion channels are being used	(3)

Q13.

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

Q14.

Question Number	Answer	Mark
(i)	<p><b>The only correct answer is B endocytosis</b></p> <p><i>A is not correct because diffusion does not require energy from respiration</i></p> <p><i>C is not correct because facilitated diffusion does not require energy from respiration</i></p> <p><i>D is not correct because osmosis does not require energy from respiration</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p><b>The only correct answer is A active transport</b></p> <p><i>B is not correct because diffusion is not against a concentration gradient</i></p> <p><i>C is not correct because facilitated diffusion is not against a concentration gradient</i></p> <p><i>D is not correct because osmosis is not against a concentration gradient</i></p>	(1)

Question Number	Answer	Mark
(iii)	<p><b>The only correct answer is A active transport</b></p> <p><i>B is not correct because diffusion does not show this response to oxygen</i></p> <p><i>C is not correct because facilitated diffusion does not show this response to oxygen</i></p> <p><i>D is not correct because osmosis does not show this response to oxygen</i></p>	(1)

Question Number	Answer	Mark
(iv)	<p><b>The only correct answer is B carbon dioxide</b></p> <p><i>A is not correct because amino acids cannot enter a cell by diffusion</i></p> <p><i>C is not correct because glucose cannot enter a cell by diffusion</i></p> <p><i>D is not correct because protein cannot enter a cell by diffusion</i></p>	(1)

Q15.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to two from:</p> <ul style="list-style-type: none"> <li>uncharged auxin can diffuse through the {uncharged / hydrophobic / nonpolar} fatty acid tails (1)</li> <li>(negatively) charged auxin has to move through protein channels / carrier proteins (1)</li> </ul>		2

Q16.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to two of the following:</p> <ul style="list-style-type: none"> <li>the phosphate (head) is {polar / hydrophilic}</li> <li>therefore the phosphate can interact with the aqueous environment (1)</li> <li>otherwise the lipids {will form a micelle / will not form a bilayer (and not enclose the cytoplasm) (1)</li> </ul>	ACCEPT dissolve in water in the cytoplasm and environment	(2)

Q17.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>osmosis is occurring (1)</li> <li>at 3%, water has left the red blood cells (by osmosis) (1)</li> <li>at 0.5% and 0.3%, water has gone into the cells (by osmosis) (1)</li> <li>at 0.5% and 0.3% the cells have burst (and cannot be seen) (1)</li> <li>0.7% is close to the water potential of the cells' cytoplasm (1)</li> </ul>	<p>Allow correct reference to {hypertonic /hypotonic / isotonic} solution or to water potential</p> <p>Allow at 3% water leaving RBC by diffusion</p> <p>Allow water potential of cells' cytoplasm is between 0.7 and 1%</p>	(4)

Q18.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>the osmotic potential of the red blood cells is equivalent to 3% glucose or 6% sucrose (1)</li> <li>because the molecular mass of sucrose is twice that of glucose (1)</li> <li>because it is the number of molecules that determine the osmotic potential, not % concentration (1)</li> </ul>	<p>Allow twice the concentration of sucrose is needed to have the same effect</p> <p>Accept sucrose as a disaccharide whereas glucose is a monosaccharide</p>	(3)

Q19.

Question Number	Answer	Additional guidance	Mark
(i)	<ul style="list-style-type: none"> <li>a curve or straight line passing through / near all points</li> </ul>		(1)
(ii)	<ul style="list-style-type: none"> <li>value read from student's graph 0.475-0.575</li> </ul>	allow TE from student line	(1)
(iii)	<p>An explanation that makes reference to four of the following points:</p> <ul style="list-style-type: none"> <li>water enters cell by osmosis (1)</li> <li>as water potential of solution higher than <math>\psi</math> / water potential cell (1)</li> <li>so that P / turgor pressure increases (1)</li> <li>so <math>\psi</math> water potential cell becomes equal to 0.</li> <li>until P / turgor pressure equals <math>\pi</math> / osmotic potential / and opposite (1)</li> <li>as cell wall prevents further entry of water (1)</li> </ul>	<p>increases</p> <p>change in cell osmotic potential negligible</p>	(4)



Question Number	Answer	Additional guidance	Mark
(iv)	<p>An explanation that makes reference to two of the following points:</p> <ul style="list-style-type: none"> <li>cannot measure <math>\pi</math> / osmotic potential directly as <math>\psi</math> waterpotential of cell contains both <math>\pi</math> / osmotic potential and turgor pressure / P (1)</li> <li>can only be measured by using method of incipient plasmolysis (1)</li> <li>when <math>\psi = \pi</math> as P =0 (1)</li> </ul>		(2)

## Q20.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to five of the following:</p> <ul style="list-style-type: none"> <li>use range of at least five concentrations of (sucrose / salt) solution (1)</li> <li>use equal {size / length / shape / surface area to volume} of pieces of carrot and potato (1)</li> <li>control carrot and potato {age / part of tissue / temperature} (1)</li> <li>pieces of carrot and potato submerged in the solutions for the same time (1)</li> <li>carrot and potato pieces weighed before and after and dried (1)</li> <li>plot graph of mass change against (salt / sucrose) concentration and use to compare where line cuts x-axis for carrot and potato (1)</li> </ul>	<p><b>Accept</b> locate isotonic point</p>	(5)

Q21.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to two of:</p> <ul style="list-style-type: none"> <li>reference to repeats / calculation of mean (1)</li> <li>no reference to from same type potato / same temperature / same mass of potato (1)</li> <li>difficult to measure sag /parallax / how clamped / sag may be due to other reasons (1)</li> </ul>		(2)

Q22.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>transport against a concentration gradient / from low to high concentration (1)</li> <li>energy / ATP required (1)</li> </ul>	IGNORE from low concentration gradient to high concentration gradient	(2)

Q23.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none"> <li><i>Salicornia</i> has {higher salt concentration / lower water potential} than the mud (1)</li> <li>because salt taken up by active transport (1)</li> <li>therefore water is taken up by osmosis (1)</li> </ul>		(3)

Q24.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>B <input checked="" type="checkbox"/> B 1 and 3</p> <p><i>A is incorrect because facilitated diffusion does not move substances against a gradient</i></p> <p><i>C is incorrect because facilitated diffusion does not move substances between phospholipids</i></p> <p><i>D is incorrect because facilitated diffusion does not move substances against a gradient</i></p>		<b>1</b>

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>C increased permeability of the collecting duct to water, producing more concentrated urine</p> <p><i>A is incorrect because ADH increases the permeability of the collecting duct</i></p> <p><i>B is incorrect because ADH increases the permeability of the collecting duct</i></p> <p><i>D is incorrect because ADH results in more concentrated urine</i></p>		<b>1</b>



Q25.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to three of the following:</p> <ul style="list-style-type: none"><li>• control temperature because affects {diffusion / osmosis / molecular movement / membrane permeability} (1)</li><li>• submerge cubes in sucrose solution so all surfaces in contact (1)</li><li>• use smaller intervals of sucrose concentration (between 0.2 and 0.4) (1)</li><li>• blot cubes before weighing to remove surface solution / blot cubes dry to remove excess solution (1)</li><li>• repeat to identify {anomalies / variability / SD} / because result in table could be {anomalous} (1)</li></ul>	<p><b>ACCEPT</b> dry but not if linked to dry mass</p> <p><b>DO NOT ACCEPT</b> to calculate mean</p>	<p><b>(3)</b></p>

Q26.

Question Number	Answer	Additional Guidance	Mark
	<p>A description that makes reference to five of the following:</p> <ul style="list-style-type: none"> <li>• equal mass and shape of carrot tissue cut (1)</li> <li>• carrot tissue submerged in (boiling tubes with) known volume of water (1)</li> <li>• placed in water baths at stated range of temperatures for a stated length of time (1)</li> <li>• contents {filtered / decanted} (1)</li> <li>• absorbance measured / colour charts used (1)</li> <li>• graph plotted / statistical analysis of results (1)</li> <li>• appropriate step to ensure validity (1)</li> </ul>	<p>Allow use of cork borer and same length Allow {same surface area / equal cubes}</p> <p>Allow 5 – 100°C (must be at least 5 temps), for 5 – 30 mins</p> <p>Allow transmission measured</p> <p>Allow all tissue from same {carrot / age of carrot}</p> <p>Allow repeats at each temperature and {mean / SD} calculated</p>	(5)

Q27.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• conversion of mg to g (1)</li> <li>• division by 750 and calculation of percentage (1)</li> </ul>	<p>1265.25 mg = 1.26525 g</p> <p>(0.1687 g in 100g) = 0.17 (%)</p> <p>Correct answer with no working gains 2 marks</p> <p>Otherwise correct answer to wrong power of 10 gains 1 mark</p> <p>Correct answer with wrong number of decimal place gains 1 mark</p>	(2)

Q28.

Question Number	Indicative content	Mark
*	<p>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.</p> <p>The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant.</p> <p>Additional content included in the response must be scientific and relevant.</p> <ul style="list-style-type: none"><li>• use different shapes / surface area / lengths</li><li>• place in water</li><li>• use several chips of each shape / surface area / length</li><li>• leave for stated time / 10 mins minimum</li></ul> <ul style="list-style-type: none"><li>• control temperature</li><li>• control potato / species / strain / age</li><li>• measure mass / volume of potato / volume of liquid absorbed</li><li>• calculate mean values</li></ul> <ul style="list-style-type: none"><li>• submerge in water</li><li>• potato chips blotted before weighing</li><li>• control mass / volume of potato</li><li>• calculate rate as <math>\text{g min}^{-1}</math> or <math>\text{cm}^3 \text{min}^{-1}</math></li></ul>	<p style="text-align: right;"><b>(6)</b></p>

Level	Marks	Descriptor
0	0	No awardable content
1	1-2	<p>An explanation of how the investigation should be conducted but with limited analysis, interpretation. Generalised comments made.</p> <p>The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.</p> <p><b>L1 = 1 2 or more L1 = 2</b></p>
2	3-4	<p>An explanation of how the investigation should be conducted with occasional evidence of analysis, interpretation and/or evaluation of the scientific information.</p> <p>The explanation shows some linkages and lines of scientific reasoning with some structure.</p> <p><b>2 or more L1 + 1L2 = 3 2L1 + 2 or more L2 = 4</b></p>
3	5-6	<p>An explanation of how the investigation should be conducted is given which is supported throughout by evidence from the analysis, interpretation and/or evaluation of the scientific information.</p> <p>The explanation shows a well-developed and sustained line of scientific reasoning which is clear, coherent and logically structured.</p> <p><b>2L1 + 2 or more L2 + 1L3 = 5</b> <b>2L1 + 2 or more L2 + 2L3 = 6</b></p>

## Q29.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An answer that makes reference to :</p> <ul style="list-style-type: none"> <li>axes the correct way around with linear scale and labelled {concentration of sucrose and distance or S or sag} (1)</li> <li>correct units sucrose concentration mol dm<sup>-3</sup> and S mm (1)</li> <li>points plotted correctly and joined (dot to dot) (1)</li> </ul>	<p>Allow dot to dot or smooth curve</p> <p>allow points plotted on non linear scale</p>	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>a calculation showing the following steps</p> <ul style="list-style-type: none"> <li>• calculation of difference between 0.2 and 0.4</li> <li>• calculation of mean relationship</li> </ul>	<p>=7.5mm</p> <p><math>7.5 \div 0.2 = 37.5</math></p> <p>allow one mark for 7.5</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An explanation that makes reference to the following points :</p> <ul style="list-style-type: none"> <li>• as concentration increases S increases (1)</li> <li>• At / above 0.2 mol the potato starts to lose water as water potential of potato higher than solution (1)</li> <li>• so (as water leaves cells ) tissues turgor is lost so more S / distance / sag (1)</li> <li>• little change in S above 0.45 mol (as little water loss) (1)</li> </ul>	<p>new MP for overall analysis ignore incorrect ref to turgor increasing for this mp</p> <p>possibly delete these mps</p>	(4)

Q30.

Question Number	Answer	Additional guidance	Mark
	<p>An answer that makes reference to five of the following:</p> <ul style="list-style-type: none"> <li>• cut potato into chips of same size as this {gives equal surface area (to volume ratio) / affects osmosis} (1)</li> <li>• place potato chips in range of {salt / sucrose} solutions to allow {osmosis / water to enter / water to leave} (1)</li> <li>• blot chips to remove surface water (1)</li> <li>• measure (percentage) change in {mass / length} and {determine loss or gain of water / plot graph} (1)</li> <li>• identify where line crosses x axis as this represents {no change in mass / length / the estimate of water potential} (1)</li> <li>• compare these lines for different ages of potato tissue (1)</li> <li>• use same temperature as this affects {osmosis / diffusion} / leave potato for same time in solutions as this affects</li> </ul>	<p>Accept use a cork borer to give samples of standard size (linked to SA or osmosis)</p> <p>Accept dry using a paper towel</p> <p>Accept measure initial {length / mass} and final {length / mass} to find change</p>	
	<p>{osmosis / diffusion} / use same {potato / variety of potato} as this affects {water potential / osmosis / diffusion} (1)</p>		



Q31.

Question Number	Answer	Additional guidance	Mark
(i)	1:71	Ignore 7:497 or 28:1988 or 1/71	(1)

Question number	Answer	Mark
(ii)	<p>The only correct answer is A</p> <p>B is not correct because diffusion happens down a concentration gradient</p> <p>C is not correct because facilitated diffusion happens down a concentration gradient</p> <p>D is not correct because the mineral ions are not moving in bulk</p>	(1)

Q32.

Question Number	Answer	Mark
(i)	<p><b>The only correct answer is A active transport</b></p> <p><i>B is not correct because it does not move substances against a concentration gradient</i></p> <p><i>C is not correct because it does not move substances against a concentration gradient</i></p> <p><i>D is not correct because it does not move substances against a concentration gradient</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p><b>The only correct answer is A diffusion</b></p> <p><i>B is not correct because non-polar does not use facilitated diffusion</i></p> <p><i>C is not correct because non-polar does not use osmosis</i></p> <p><i>D is not correct because non-polar does not use transpiration</i></p>	(1)

Q33.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• use 50% value / use term osmotic potential (1)</li> <li>• 0.43 (mol dm<sup>-3</sup>) (1)</li> <li>• -1200 (kPa) (1)</li> </ul>	<p><b>ACCEPT</b> 0.42 to 0.44</p> <p><b>ACCEPT</b> -1120 to -1280</p>	<b>(3)</b>

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• time for water to move out of the cells / time for osmosis / to complete osmosis / reach equilibrium / time for plasmolysis to occur (1)</li> <li>• therefore accurate value of osmotic potential (1)</li> </ul>		<b>(2)</b>

Q34.

Question Number	Answer	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• x axis labelled 'sucrose concentration / mol dm<sup>-3</sup>' and y axis labelled 'percentage change in mass' / 'change in mass (%)' (1)</li> <li>• trend shows top left to bottom right, crossing x axis / crossing 0% (1)</li> </ul>	<b>(2)</b>



Q35.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <p><b>A</b> phospholipid (bilayer) and  <b>B</b> (glyco) protein / (channel) protein / (integral) protein / (carrier) protein / (intrinsic) protein</p>		<b>(1)</b>

Q36.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to four of the following:</p> <ul style="list-style-type: none"> <li>• polar molecules are {charged / water soluble / hydrophilic} (1)</li> <li>• {phosphate / head} is hydrophilic / {fatty acids / tails} are hydrophobic (1)</li> <li>• {phosphate / head} on outer side / {fatty acids / tails} on inside (1)</li> <li>• therefore {polar / charged / ionic} substances do not pass through the {hydrophobic centre / fatty acids / tails} (1)</li> <li>• and so pass through {carrier / channel} proteins (1)</li> </ul>		<b>(4)</b>

Q37.

Question Number	Answer	Additional Guidance	Mark
(i)	<p><b>The only correct answer is C</b></p> <p><b>A</b> is incorrect because 31 460 would be rounded up to <math>3.15 \times 10^4</math></p> <p><b>B</b> is incorrect because 314 600 would be rounded up to <math>3.15 \times 10^5</math></p> <p><b>D</b> is incorrect because 3 139 000 would be rounded up to <math>3.14 \times 10^6</math></p>		(1)
(ii)	<p><b>The only correct answer is C</b></p> <p><b>A</b> is incorrect because symplast pathway does not go through cell walls</p> <p><b>B</b> is incorrect because it shows the pathways the wrong way round</p> <p><b>D</b> is incorrect because it shows apoplastic going through the cytoplasm</p>		(1)
(iii)	<p><b>The only correct answer is B</b></p> <p><b>A</b> is incorrect because water moves from a dilute solution to a more concentrated one</p> <p><b>B</b> is incorrect because water moves from a high water potential to a lower one</p> <p><b>D</b> is incorrect because water moves from a high water potential to a lower one</p>		(1)

Q38.

Question Number	Answer	Mark
(i)	<p><b>The only correct answer is B</b></p> <p><b>A</b> is not correct because water does not leave the tissue</p> <p><b>C</b> is not correct because cells do not become flaccid</p> <p><b>D</b> is not correct because <i>the cells will not burst</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p><b>The only correct answer is C</b></p> <p><i>A is not correct because P will not decrease</i></p> <p><i>B is not correct because n will not decrease</i></p> <p><i>D is not correct because <math>\phi</math> will change</i></p>	(1)

Question Number	Answer	Mark
(iii)	<p><b>The only correct answer is C</b></p> <p><i>A is not correct because the values are not 0 and 0</i></p> <p><i>B is not correct because the values are not -4.6 and 4.6</i></p> <p><i>D is not correct because the values are not 4.6 and 0</i></p>	(1)

Question Number	Answer	Mark
(iv)	<p><b>The only correct answer is B</b></p> <p><i>A is not correct because distilled water has a high water potential</i></p> <p><i>C is not correct because 0.1 molar sodium chloride does not have the lowest water potential</i></p> <p><i>D is not correct because 0.1 molar potassium chloride does not have the lowest water potential</i></p>	(1)

Q39.

Question number	Answer	Mark
(i)	<p>The only correct answer is B</p> <p>A is not correct because endocytosis would involve water uptake</p> <p>C is not correct because osmosis does not involve fusion of membranes</p> <p>D is not correct because facilitated diffusion does not involve the fusion of membranes</p>	(1)

Question Number	Answer	Additional guidance	Mark
(ii)	An explanation that makes reference to the following: <ul style="list-style-type: none"><li>• as concentration increases rate decreases (1)</li><li>• because (at higher concentrations) less water enters cell / less osmosis into cell (1)</li></ul>	Accept converse  Ignore water potential is lower in solution / water potential similar	(2)