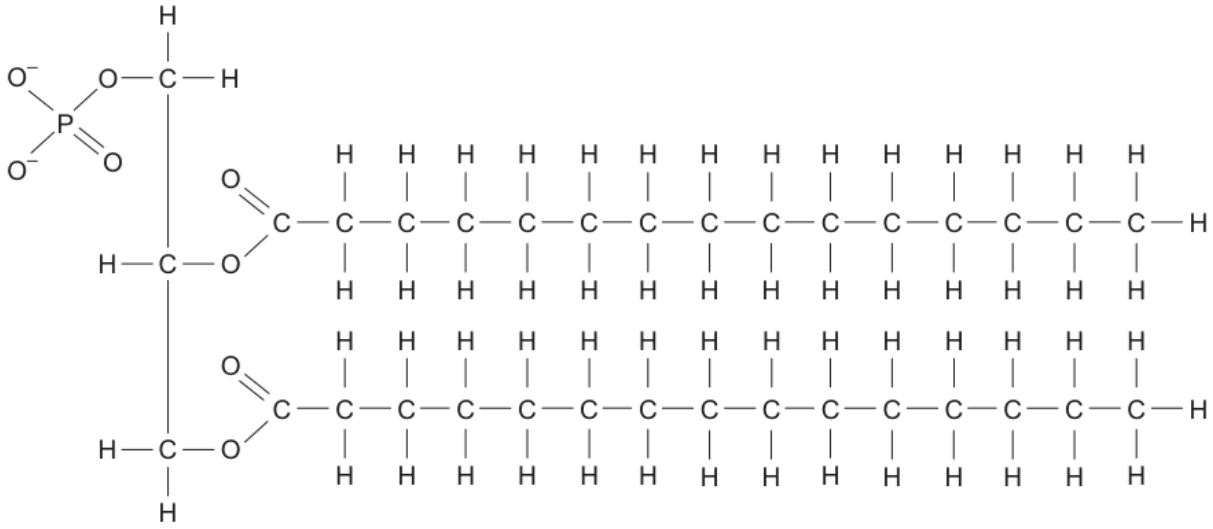
Cell Membranes and Transport (CC3): Eduqas A Level Biology Exam Questions by Topic

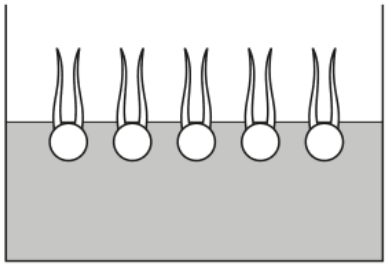
21 questions · 49 marks · about 59 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · information from earlier in the question

(b) The diagram below shows a different type of lipid. It is the main component of cell membranes.



When these lipid molecules are extracted from the plasma membranes of cells, they arrange themselves on the surface of water as shown in the diagram below.



Question 1 · AS Component 1 · June 2017 · Q1(b)(ii) · 1 mark

(ii) The plasma membrane of a single human red blood cell has a surface area of approximately 140 μm^2. Calculate the area of water covered by the lipids extracted from the plasma membrane of a single red blood cell. [1]

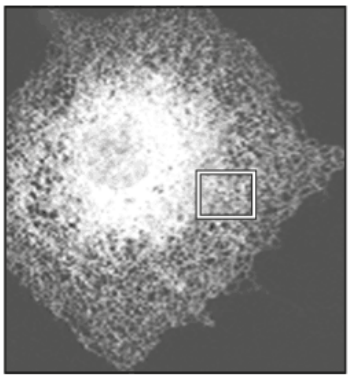
Area = ... μm^2

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

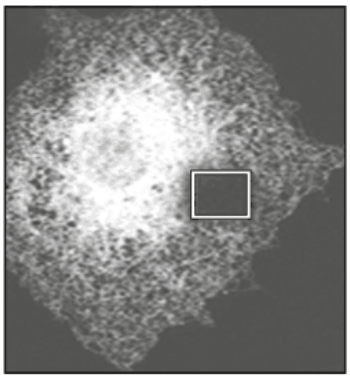
Question 2 · AS Component 1 · June 2017 · Q1(c) · 3 marks

(c) A human cell was genetically engineered to produce plasma membrane proteins that fluoresced when exposed to UV light. These proteins permanently lose their ability to fluoresce if exposed to a laser beam.

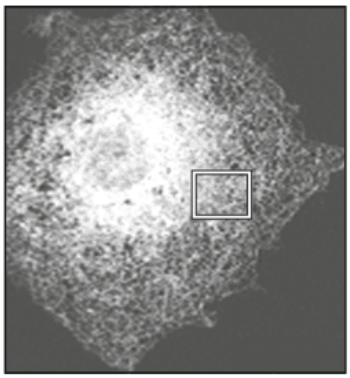
The images below show part of a cell before and after exposure to a laser beam. The white square shows the area exposed to the laser.



1. appearance of cell **before** exposure to a laser beam



2. appearance of cell **immediately after** exposure to a laser beam



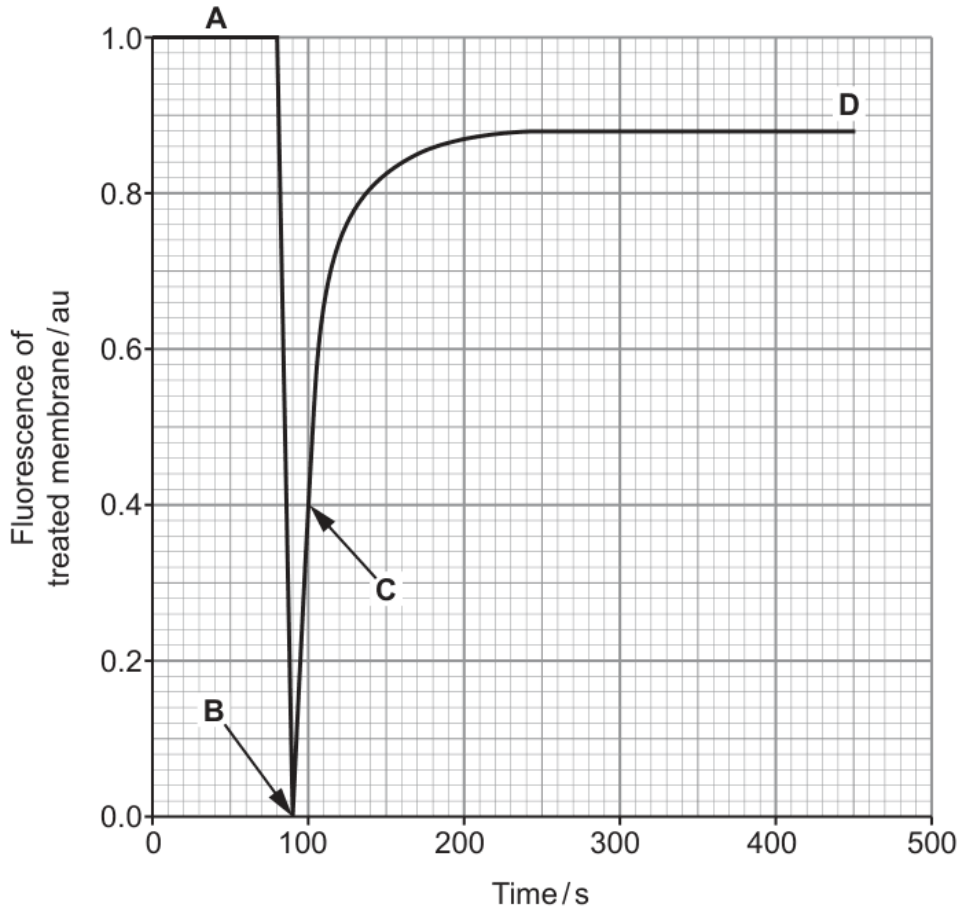
3. appearance of cell **five minutes** after exposure to a laser beam

Explain how these images provide evidence for the currently accepted model of the plasma membrane. [3]

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

3. (a) Cell membranes are composed of a double layer of phospholipids.
An experiment was carried out to investigate the positioning of phospholipids in the membrane of a living cell. All phospholipids in the membrane were labelled with a fluorescent marker dye. When the marker dye absorbed light, it stopped fluorescing. The membrane in the area exposed to light then appeared as a dark spot. The level of fluorescence of the membrane over a period of time is shown in **Graph 3.1**.

Graph 3.1

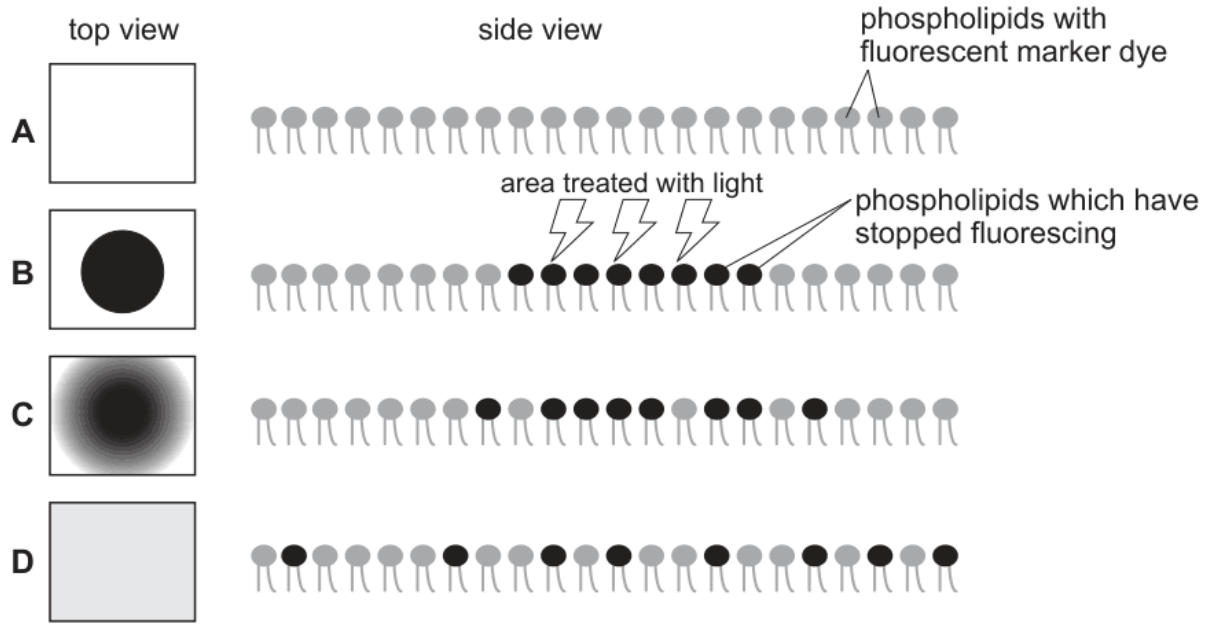


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Question 3 · AS Component 1 · June 2023 · Q3(a)(ii) · 3 marks

Image 3.2 shows the top and side view of an area of the membrane before, during and after exposure to a light source.

Image 3.2



(ii) Use the results shown in **Graph 3.1 and Image 3.2** and your knowledge of membrane structure to explain the recovery of the fluorescence. [3]

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Question 4 · A level Component 2 · June 2017 · Q1(c)(ii) · 3 marks

(ii) Studies have shown that the plasma membranes of cells in these growths have some transmembrane proteins with shorter carbohydrate side chains.

In the boxes below, draw diagrams of a short section of the plasma membrane from a normal and an abnormal cell. Include labels for the following structures: phospholipid bilayer, transmembrane protein and carbohydrate side chains. [3]

Normal	Abnormal

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 5 · A level Component 1 · June 2024 · Q4(a)(iii) · 2 marks

(iii) Carotene is a hydrophobic molecule.
Suggest why carotene molecules are found embedded in thylakoid membranes rather than in the stroma. [2]

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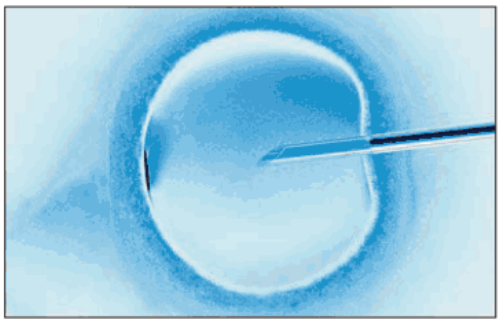
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Question 6 · A level Component 2 · June 2018 · Q2(c)(i) · 2 marks

(c) Some human fertility problems are due to poor morphology (abnormal shape) or poor motility (not moving normally) of spermatozoa. These causes of infertility can be treated by a special type of In Vitro Fertilisation (IVF) called Intra-Cytoplasmic Sperm Injection (ICSI). It differs from conventional IVF in that a single spermatozoon is injected directly into a secondary oocyte, instead of fertilisation taking place in a dish where many spermatozoa are placed near a secondary oocyte.



Intra-Cytoplasmic Sperm Injection

However, fertilisation does not always proceed to completion. A solution of a 'calcium ionophore' may be used to stimulate gated calcium ion channels in the oocyte plasma membrane. Ionophores are molecules that facilitate ion passage in or out of cell membranes.

(i) Use your knowledge of the structure of the plasma membrane to state what is meant by the term *'gated calcium ion channel'*. [2]

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Question 7 · A level Component 3 · Autumn 2020 · Q2(a)(ii) · 1 mark

(ii) Explain why the sodium ions do not diffuse across the **phospholipid bilayer** despite the concentration gradient. [1]

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Question 8 · AS Component 1 · June 2023 · Q3(d)(i) · 2 marks

(d) The effect of sodium chloride concentration on membrane structure was studied using beetroot cells. Beetroot cells contain a red pigment called betalain which is released when the membrane structure is disrupted. A temperature of 30 °C disrupts the membrane structure and allows the pigment to escape from the cell.

The method used to study the membrane structure is shown below:

Method

- Samples of beetroot were added to test tubes containing a range of sodium chloride solutions.
- They were left for five minutes at 30 °C.
- A sample of the liquid was then placed in a cuvette.
- The absorbance of light was recorded using a colorimeter.

(i) Suggest why the temperature would need to be controlled in this experiment. [2]

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Question 9 · information from earlier in the question

The results of the investigation are shown in **Table 3.6**.

Table 3.6

NaCl concentration /%	Absorbance of betalain solution / au			
	Trial 1	Trial 2	Trial 3	Mean
0.1	0.49	0.52	0.48	0.50
0.2	0.26	0.26	0.27	0.26
0.3	0.14	0.20	0.15	.....
0.4	0.09	0.10	0.08	0.09
0.5	0.03	0.01	0.03	0.02

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Question 9 · AS Component 1 · June 2023 · Q3(d)(iii) · 4 marks

(iii) Use the data in **Table 3.6** to describe and explain the effect of increasing the concentration of the NaCl solution on the permeability of the beetroot membrane. [4]

Question 10 · information from earlier in the question

(c) DCPIP (2,6-dichlorophenol-indophenol) is a blue dye which acts as an electron acceptor and becomes colourless when it accepts electrons.

The flow diagram describes the method used by a student to isolate chloroplasts. **Image 6.4** shows a centrifuge tube containing the isolated chloroplasts.

Method

Grind spinach leaves in an ice-cold solution of sucrose and buffer.

↓

Filter extract.

↓

Centrifuge to obtain a small pellet of chloroplasts.

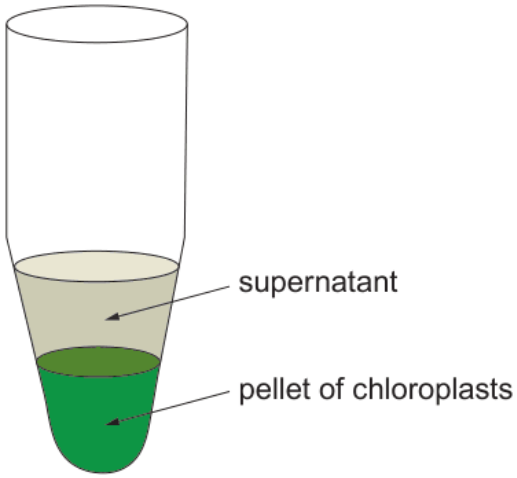
↓

Separate pellet from supernatant.

↓

Re-suspend the chloroplasts and keep cool.

Image 6.4



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 10 · A level Component 1 · June 2022 · Q6(c)(ii) · 1 mark

(ii) The solution used in the experiment was isotonic to the stroma in the chloroplasts. State the meaning of the term isotonic. [1]

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Question 11 · A level Component 2 · June 2023 · Q2(a) · 2 marks

2. Scientists studied the changes associated with growth occurring in the root tip region of wheat plants. They measured the dry mass of cells and the volume of cells at different distances from the root tip.

The results are shown in **Table 2.1**.

Table 2.1

Distance from end of root tip /mm	Mean dry mass of cells /pg	Mean volume of cells /μm^3
1	2.5	20
2	2.5	25
3	2.5	35
4	3.5	45
5	4.5	55
6	5.5	65

(a) Suggest why there is an increase in the volume of the cells between 1 and 3 mm from the end of the root tip, even though the dry mass remains constant. [2]

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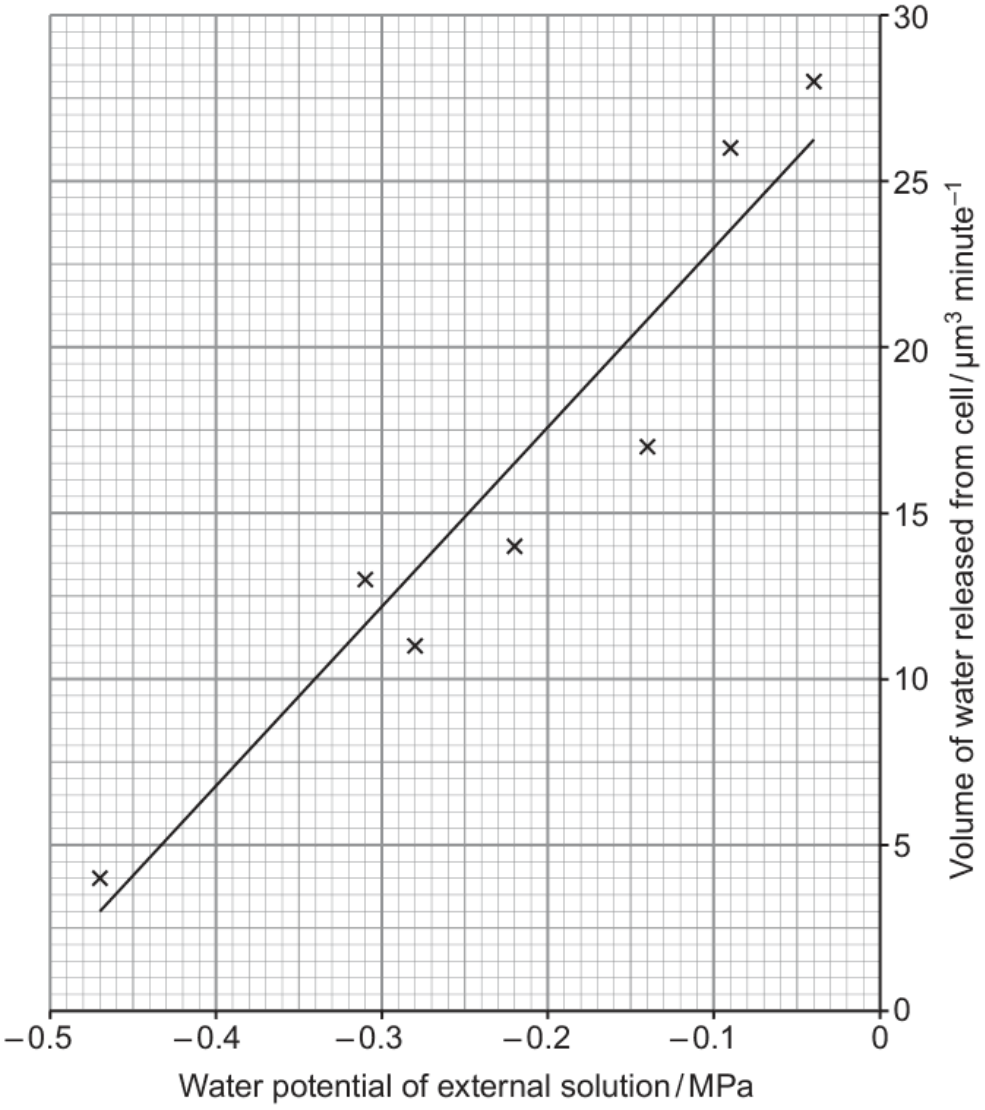
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Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

(b) *Chlamydomonas* lives in freshwater. When viewed under a light microscope, the contractile vacuoles are seen to fill and empty on a regular basis. They are involved in regulating the water content of the cell.
The graph shows the volume of water released from a cell of *Chlamydomonas* per minute at different water potentials of external solution.
A line of best fit is drawn.



Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 12 · AS Component 1 · June 2018 · Q5(b)(ii) · 4 marks

(ii) Explain why the volume of water released from a cell of *Chlamydomonas* increases as the water potential of the external solution increases. [4]

Question 13 · information from earlier in the question

6. *Erwinia* is a genus of Gram-negative bacteria that causes a disease called soft-rot in many different plant species.

The bacteria usually enter the tissues of a plant through wounds in the exterior surface. They obtain respiratory substrates from the host plant by secreting a range of enzymes, including cellulases and phospholipases.

As the infection continues it first induces plasmolysis of the surrounding tissue and then rotting of the tissues. This spreads inwards from the site of infection until it reaches the vascular tissues. The infection then spreads upwards through the plant causing the parts of the plant above the initial site of infection to wilt.

Question 13 · A level Component 3 · June 2018 · Q6(a)(ii) · 2 marks

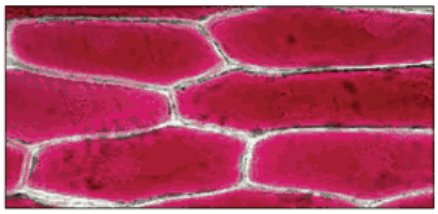
(ii) Explain how the products of cellulose breakdown result in the plasmolysis of cells in the plant tissue surrounding the site of infection. [2]

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

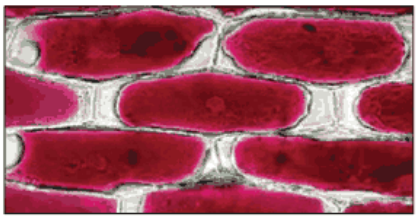
Question 14 · information from earlier in the question

Photographs of some of the cells from the red onion tissue used in the investigation are shown below.

S



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Question 14 · AS Component 1 · June 2019 · Q6(b)(vi) · 2 marks

(vi) Red onion tissue was placed in a solution with a solute potential of −1800 kPa. After 30 minutes, the cells appeared like those shown in **T** above. Explain this observation. [2]

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Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 15 · information from earlier in the question

2. An investigation was carried out to determine the water potential of potato tissue using the following method.

1. Cut four cylinders of potato tissue, each approximately 50 mm long.
2. Place 30 cm^3 distilled water and three different concentrations of sodium chloride (NaCl) solution into four different boiling tubes.
3. Record the mass of each cylinder to the nearest 0.1 g.
4. Place one cylinder into each boiling tube.
5. Leave at room temperature for 45 minutes.
6. Gently blot and re-weigh the cylinders.

The results of the investigation are shown in **Table 2.1**.

Table 2.1

Concentration of NaCl / mol dm^{-3}	Initial mass of cylinder / g	Final mass of cylinder / g	Change in mass / g	Percentage change in mass
0.0	4.2	4.5	0.3	7.14
0.2	4.1	4.2	0.1	2.44
0.6	4.4	3.9	–0.5	–11.36
0.8	4.2	3.5	–0.7	.....

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Question 15 · AS Component 1 · June 2022 · Q2(a)(iv) · 4 marks

(iv) With reference to the results of this investigation, describe **and** explain the relationship between the concentration of NaCl and the percentage change in mass of the potato cylinders. [4]

Question 16 · AS Component 1 · June 2024 · Q5(b)(i) · 2 marks

(b) (i) The steps below show part of a method that could be used to find the water potential of the carrot tissue.

- Prepare six cylinders of carrot, each measuring 40 mm in length.
- Record the initial mass of each cylinder.
- Place one cylinder into one of a range of sucrose solutions (0.0 M, 0.2 M, 0.4 M, 0.6 M, 0.8 M or 1.0 M).
- Leave for 24 hours.
- Carefully dry each cylinder and record the final mass of each cylinder.

Complete the method above by stating the final steps which would be required to find the water potential of the carrot tissue. [2]

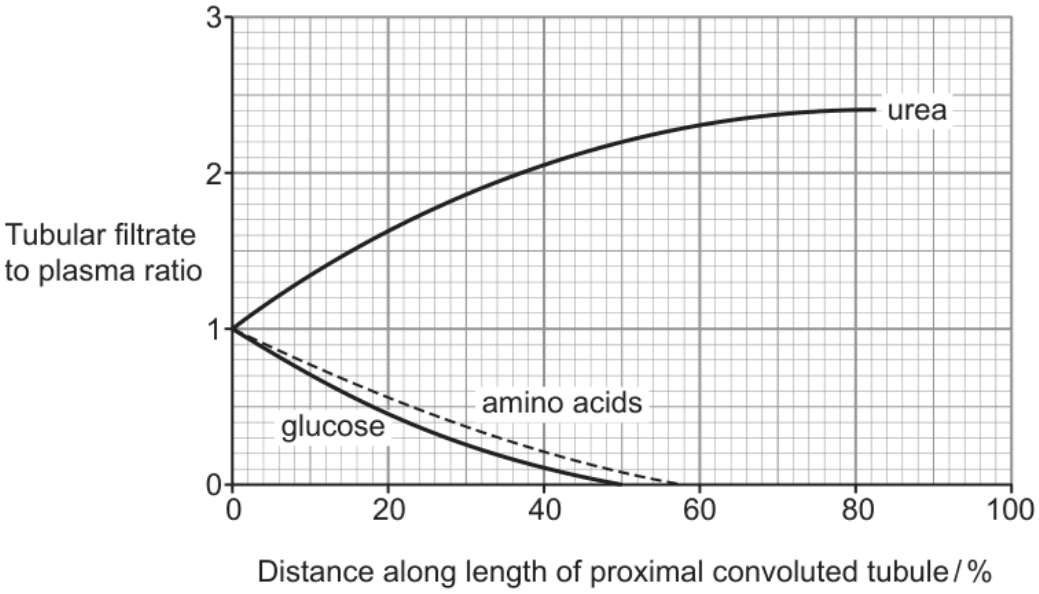
Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

Question 17 · information from earlier in the question

4. In an adult human, approximately 180 dm^3 of fluid is filtered from the glomeruli into the Bowman's capsules per day. As the filtrate moves along the proximal convoluted tubules (PCT) some substances are selectively reabsorbed. By the time the filtrate has reached the end of the proximal convoluted tubules 70% of the water has been reabsorbed.

Graph 4.1 shows the change in the tubular filtrate to plasma ratio due to the reabsorption of water.

Graph 4.1



(a) Explain the change in tubular filtrate to plasma ratios for:

Question 17 · A level Component 3 · June 2023 · Q4(b) · 1 mark

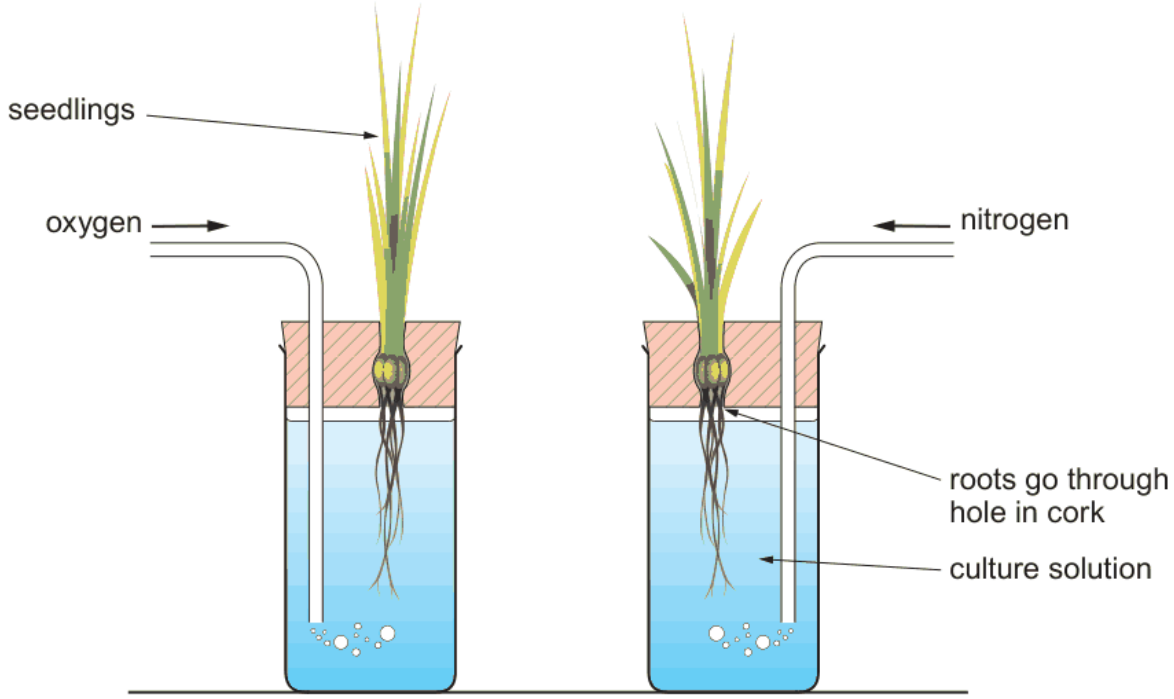
(b) Non-polar molecules, such as the insecticide DDT, are fat soluble and diffuse through the cell membranes of the cells in the PCT.
Suggest why more of these molecules diffuse through the cells into the blood at the terminal end of the PCT. [1]

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Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

3. Barley seedlings were grown as shown in the diagram below, each in the same volume of culture medium. The culture medium contained known concentrations of all the ions needed for plant growth. Oxygen was bubbled through the culture medium of one experimental set up and nitrogen was bubbled through the other.



The concentration of phosphate ions in each culture solution was measured every four hours for 24 hours. It was assumed that the decrease in the concentration of phosphate ions was due to uptake of phosphate ions by the plant roots.

Questions, mark schemes and examiners' report extracts © WJEC CBAC Ltd (Eduqas).

(b) The results of the investigation are shown in the table below.

	Concentration of phosphate in culture solution /mmol dm^{-3}	
Time/hours	**with oxygen**	**with nitrogen**
0	100.0	100.0
4	51.5	80.2
8	26.3	55.1
12	12.2	38.4
16	6.3	14.1
20	0.4	6.0
24	0.2	5.2

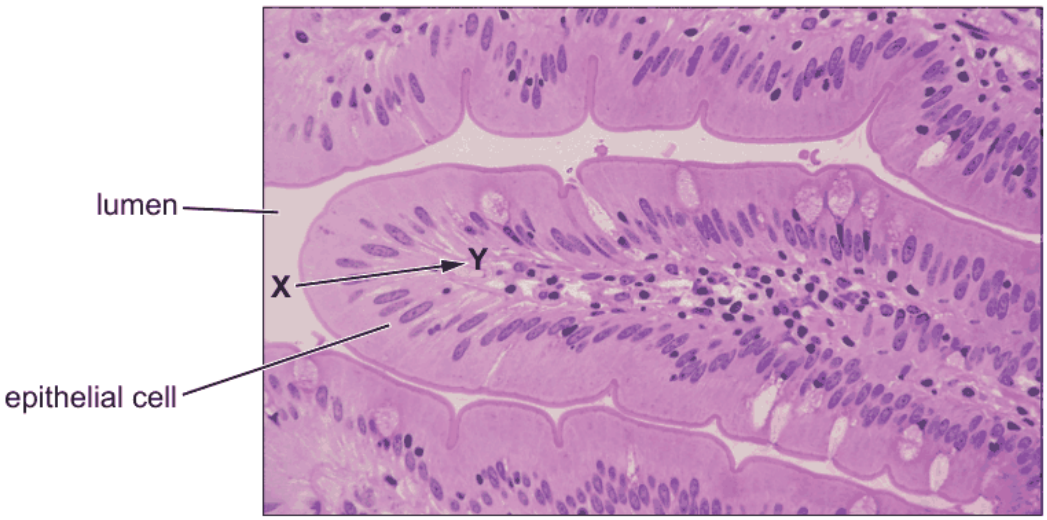
It was concluded that uptake of phosphate ions can occur by both active transport and diffusion. Explain how the evidence supports this conclusion. [2]

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Question 19 · information from earlier in the question

(b) **Image 4.2** is a photomicrograph of part of the ileum. An epithelial cell is labelled.

Image 4.2



Question 19 · AS Component 2 · June 2023 · Q4(b)(ii) · 3 marks

(ii) Describe the process of glucose transport from the lumen of the small intestine into and then out of epithelial cells as it is absorbed along the pathway from **X** to **Y**, indicated by the arrow in **Image 4.2**. [3]

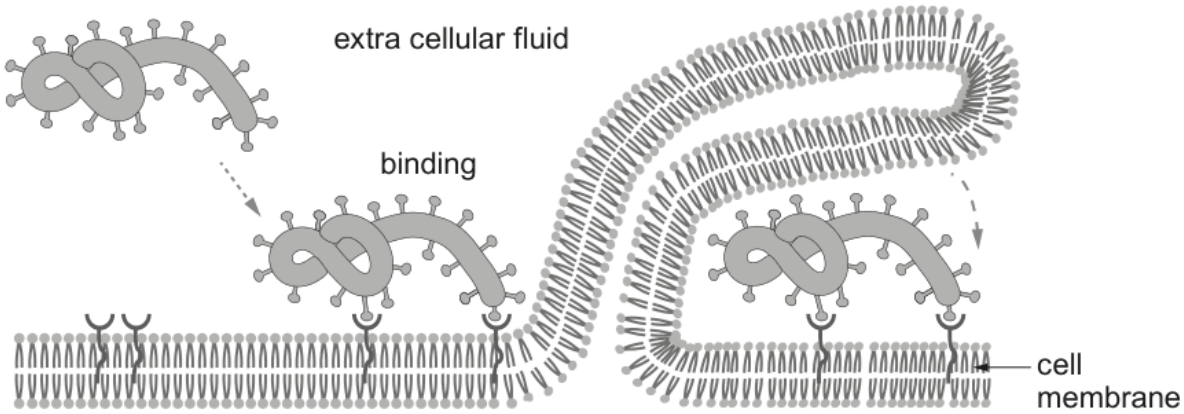
Question 20 · AS Component 2 · June 2023 · Q4(b)(iii) · 2 marks

(iii) The lumen of the small intestine contains water from food and digestive secretions. Describe how the transport of glucose into the epithelial cells affects the absorption of water from the lumen. [2]

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Question 21 · AS Component 1 · June 2016 · Q2(c) · 3 marks

The initial stage of infection involves the following process.



(c) Using information from the diagrams, explain how Ebola virus particles enter a host cell. [3]

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Mark schemes

Question 1 · AS Component 1 · June 2017 · Q1(b)(ii) · 1 mark

(ii)	140 x 2 = 280µm^2	1	1 1	

Question 2 · AS Component 1 · June 2017 · Q1(c) · 3 marks

1	(c)	• ref to fluid mosaic model (1) • proteins can {move / diffuse} within membrane / proteins are arranged randomly(1) • {Fluorescence restored in the area exposed to the laser after 5 minutes / {Other/ non affected} proteins can move into the area exposed to the laser after 5 minutes (1) (must in context of protein movement)	1	1 1	3	

Question 3 · AS Component 1 · June 2023 · Q3(a)(ii) · 3 marks

(ii)	**Any three (×1) from** Fluid mosaic model (1) Dark spot disappears as non-fluorescing move around/ ORA (1) Phospholipids can change position/ Components of the membrane aren't bound together (1) Fluorescence does not return to original level (1)	3	3	

Question 4 · A level Component 2 · June 2017 · Q1(c)(ii) · 3 marks

	(ii)		**Any 3** correct labels from: phospholipid bilayer, transmembrane protein, carbohydrate chain (1) reasonable quality drawing – phospholipid bilayer+ transmembrane protein + side chain(1)Accept one tail Second drawing with shorter carbohydrate chain (1)	2	1	3	

Question 5 · A level Component 1 · June 2024 · Q4(a)(iii) · 2 marks

(iii)	(Carotene hydrophobic is embedded in centre of membrane because) • {fatty acids in membranes / centre of membrane / centre of phospholipid bilayer} are {hydrophobic / non-polar} (1) • whereas the stroma is {hydrophilic / polar} (1)	1	1	2

Question 6 · A level Component 2 · June 2018 · Q2(c)(i) · 2 marks

(c)	(i)	{transmembrane/intrinsic/channel/description of } protein (1) With a channel that can be opened (and closed) to allow (or prevent) Ca^{2+} through (1) Reject active transport/carrier protein	1	1	2

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Question 7 · A level Component 3 · Autumn 2020 · Q2(a)(ii) · 1 mark

(ii)	(ions are hydrophilic and) membrane has hydrophobic {tails/ centre} NOT lipid soluble	1	1	

Question 8 · AS Component 1 · June 2023 · Q3(d)(i) · 2 marks

(d)	(i)	It would affect kinetic energy of the molecules (1) Would allow more pigment to escape (1) Reference to denaturation (1)	2	2	

Question 9 · AS Component 1 · June 2023 · Q3(d)(iii) · 4 marks

(iii)	As the NaCl concentration increases, the absorbance decreases (1) Less absorbance means less pigment released /More NaCl reduces the pigment released (1) More NaCl the less permeable the membrane (1) Use of data (1)	1	3	4	4

Question 10 · A level Component 1 · June 2022 · Q6(c)(ii) · 1 mark

(ii)	same concentration of solutes/ same water potential	1	1	1	

Question 11 · A level Component 2 · June 2023 · Q2(a) · 2 marks

2	(a)	water entered (the cells) (1) by osmosis (1)	2	2	2

Question 12 · AS Component 1 · June 2018 · Q5(b)(ii) · 4 marks

(ii)	**Any four (x1)from:** 1. water moves into {cell/contractile vacuoles}(1) 2. by osmosis (1) 3. down a water potential gradient / from a hyopotonic solution to a hypertonic soltion / water potential inside (cell/contractile vacuoles) lower than water potential outside (1) 4. (as the water potential of the external solution increase) the water potential gradient becomes steeper (1) 5. Rate of osmosis increases / water moves into the cell faster (1) 6. contractile vacuoles empty to get rid of excess water from the cell (1)	1	3	4

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Question 13 · A level Component 3 · June 2018 · Q6(a)(ii) · 2 marks

(ii)	more sugar reduces {solute potential/water potential} outside cells (1) water moves out of cells by osmosis (1)	1 1	2		

Question 14 · AS Component 1 · June 2019 · Q6(b)(vi) · 2 marks

(vi)	External {solute/water} potential more negative than cell {solute /water} potential (1) (So) water moves out of cell by <u>osmosis</u> (1)	2	2		

Question 15 · AS Component 1 · June 2022 · Q2(a)(iv) · 4 marks

(iv)	**Any four (×1) from:** A. Between 0.0 and 0.2 mol dm^{-3} water potential of bathing solution is greater than ψ_{cell} / hypotonic to cell ORA (1) B. Water moves into tissue by osmosis down water potential gradient (1) C. 0.6 mol dm^{-3} and 0.8 mol dm^{-3} water potential of bathing solution is lower than ψ_{cell} / hypertonic to cell ORA (1) D. Water moves out of tissue by osmosis down water potential gradient (1) E. Where candidate's line crosses zero on the x axis, tissue and bathing solution are in equilibrium / isotonic / no water potential gradient (1) F. No net movement of water into or out of tissue (1)	4	4	4	

Question 16 · AS Component 1 · June 2024 · Q5(b)(i) · 2 marks

(b)	(i)	**Any two (x1) from:** Calculate <u>percentage</u> change in mass (1) Draw graph to estimate concentration where no change in mass / or description of (1) Use solute potential table to infer water potential / owtte (1)	2	2	2	

Question 17 · A level Component 3 · June 2023 · Q4(b) · 1 mark

(b)	higher concentration gradient (for DDT as more water has been absorbed)	1	1	

Question 18 · A level Component 3 · June 2018 · Q3(b) · 2 marks

(b)	absorption is highest with oxygen + indicates active transport (as this requires ATP) (1) also occurs in absence of oxygen + indicates diffusion as this is not dependent on respiration/passive process (1)	2	2	

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Question 19 · AS Component 2 · June 2023 · Q4(b)(ii) · 3 marks

(ii)		**Any three (×1) from** Glucose enters epithelial cell by co transport (1) With (diffusion of) sodium ions/Na^+ (1) Glucose exits/leaves (epithelial) cell by facilitated diffusion (1) sodium ions/ Na^+ are actively transported out of cells to create a concentration/diffusion gradient (1)	3	3	

Question 20 · AS Component 2 · June 2023 · Q4(b)(iii) · 2 marks

(iii)	Glucose lowers the water potential of the epithelial cells (1) Water moves into epithelial cells/out of lumen (of the ileum) by osmosis (1)	2	2	

Question 21 · AS Component 1 · June 2016 · Q2(c) · 3 marks

(c)		• Binding to receptor/ glycocalyx/ carbohydrate (chains)/ glycoprotein/ protein (1) • Phagocytosis / endocytosis / (macro)pinocytosis (1) • Plasma/cell membrane {encloses/ engulfs} the virus (in a vesicle) (1)	3		3

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