EXAM PAPERS PRACTICE

Transport across cell membranes 3

Level: CIE A Level 9700
Subject: Biology
Exam Board: Suitable for all boards
Topic: Transport across cell membranes 3
Type: Questionnaire

To be used by all students preparing for CIE Biology A Level 9700 foundation or higher tier but also suitable for students of other boards.

1 (a) The structure of a plasma membrane is described as a fluid mosaic.
Explain why.

_____

_____

_____

_____

(2)

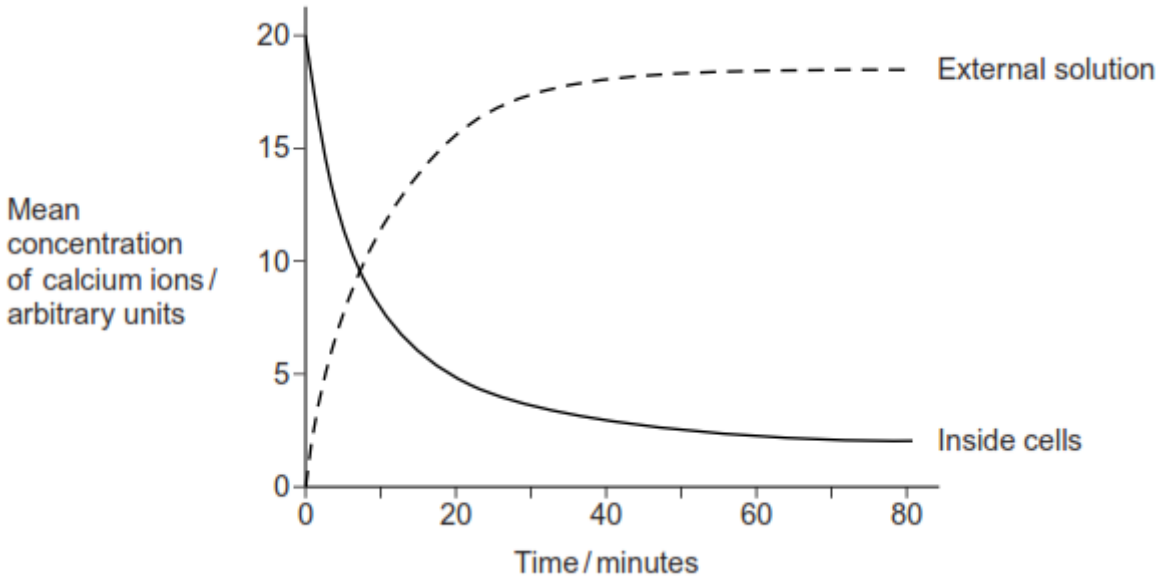
(b) Give **two** functions of proteins in plasma membranes.

1. _____

2. _____

(2)

Scientists investigated the movement of calcium ions across the plasma membrane of human cells. They placed human cells in a solution of calcium ions. At regular intervals, they measured the concentration of calcium ions in the external solution and the concentration of calcium ions inside the cells. Their results are shown in the graph.



(c) By what process did the calcium ions leave the cells after 10 minutes? Use evidence from the graph to support your answer.

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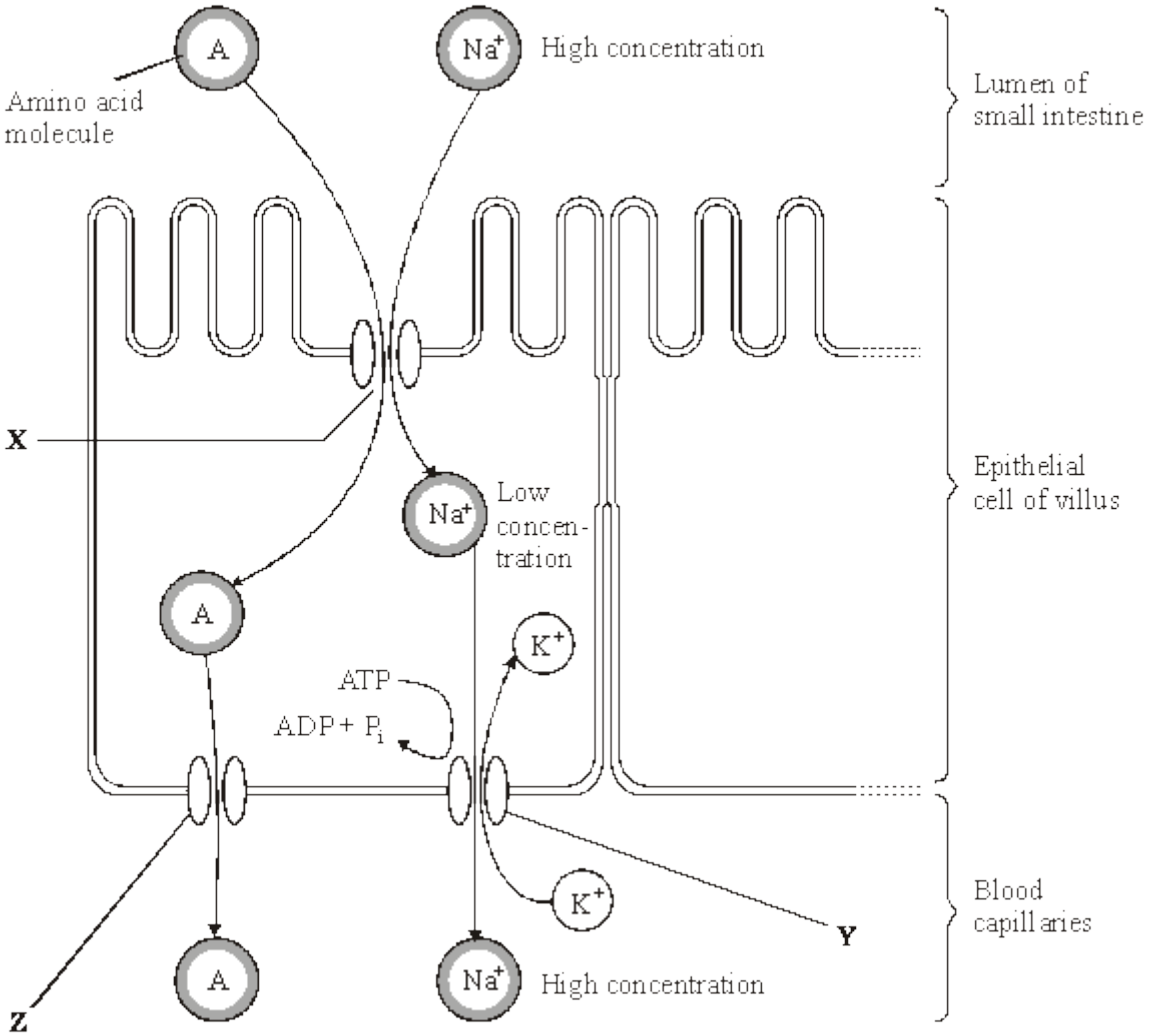
(2)

(Total 6 marks)

2 The diagram shows one method by which amino acids are absorbed from the small intestine into the blood. They are co-transported into the epithelial cell with sodium ions (Na^+) at point **X** on the diagram. Normally, the concentration of sodium ions inside the epithelial cell is low.



Source: adapted from M. ROWLAND, *Biology (University of Bath Science 16-19)* (Nelson Thornes) 1992.

Dinitrophenol (DNP) prevents oxidative phosphorylation. When treated with DNP, the sodium-potassium pump at **Y** no longer works. As a result, the concentration of sodium ions in the cell rises and amino acid absorption stops.

(i) Explain why pump **Y** will **not** work in the presence of DNP.

_____

_____

_____

_____

(2)

(ii) Explain why sodium ions and amino acids are **not** absorbed from the lumen of the small intestine in the presence of DNP.

_____

_____

_____

_____

(2)

(iii) By what mechanism would amino acids leave the epithelial cell at point **Z**?

_____

(1)

(Total 5 marks)

3 Read the following passage.

The plasma membrane plays a vital role in microorganisms. It forms a barrier between the cell and its environment, controlling the entry and exit of solutes.
This makes bacteria vulnerable to a range of antiseptics and antibiotics.

When bacteria are treated with antiseptics, the antiseptics bind to the proteins in the membrane and create tiny holes. Bacteria contain potassium ions at a concentration many times that outside the cell. Because of the small size of these ions and their concentration in the cell, the first observable sign of antiseptic damage to the plasma membrane is the leaking of potassium ions from the cell. Some antibiotics damage the plasma membrane in a similar way. One of these is tyrocidin. This is a cyclic polypeptide consisting of a ring of ten amino acids. Tyrocidin and other polypeptide antibiotics are of little use in medicine.

Other antibiotics also increase the rate of potassium movement from cells. It is thought that potassium ions are very important in energy release and protein synthesis, and a loss of potassium ions would lead to cell death. Gramicidin A coils to form a permanent pore passing through the plasma membrane. This pore enables potassium ions to be conducted from the inside of the cell into the surrounding medium. Vanilomycin also facilitates the passage of potassium ions from the cell.
A molecule of vanilomycin forms a complex with a potassium ion and transports it across the membrane. The potassium ion is released on the outside and the vanilomycin is free to return and pick up another potassium ion. Vanilomycin depends on the fluid nature of the plasma membrane in order to function.

Polyene antibiotics have flattened ring-shaped molecules. The two sides of the ring differ from each other. One side consists of an unsaturated carbon chain. This part is strongly hydrophobic and rigid. The opposite side is a flexible, strongly hydrophilic region. It has been shown that polyene antibiotics bind only to sterols. Sterols are lipids found in the membranes of eukaryotes but not in the membranes of prokaryotic organisms. It is thought that several sterol-polyene complexes come together.
The plasma membranes of eukaryotic cells treated with these polyene antibiotics lose the ability to act as selective barriers and small ions and molecules rapidly leak out.

Use information in the passage and your own knowledge to answer the questions.

(a) By what process do potassium ions normally enter a bacterial cell? Explain the evidence for your answer.

(2)

(b) (i) Draw a peptide bond showing how the COOH group of one amino acid joins to the NH_2 group of another.

(1)

(ii) How many peptide bonds are there in a molecule of tyrocidin (lines 9 - 10)?

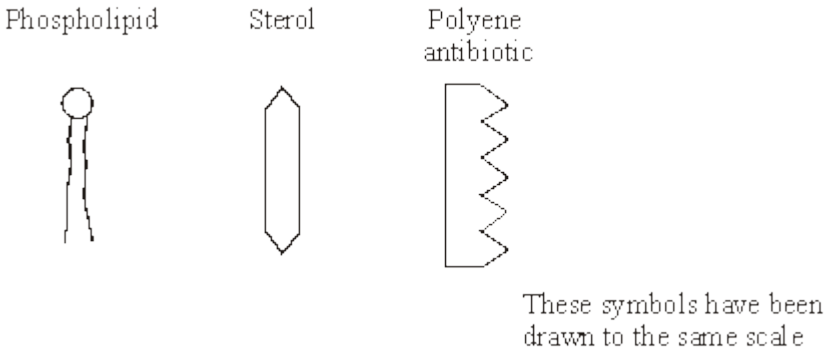
(1)

(c) Experiments have shown that vanilomycin is unable to transport potassium ions across a membrane when it is cooled. Gramicidin A continues to facilitate the movement of potassium ions at these low temperatures. Explain these results.

(3)

(d) Draw a simple diagram of one of the phospholipid layers to show how polyene antibiotics allow small ions and molecules to leak rapidly through a plasma membrane. Use the following symbols to represent the different molecules.

Note that the zigzag line on the symbol for the polyene antibiotic represents its hydrophobic region.



(2)

(Total 9 marks)

4 (a) Explain how the shape of a red blood cell allows it to take up a large amount of oxygen in a short time.

_____

_____

_____

_____

(2)

Samples of blood were mixed with equal volumes of different liquids. A drop of each mixture was put on a slide and examined with an optical microscope. The table shows the appearance of each slide.

Slide	Liquid added	Appearance of slide
A	Distilled water	No cells seen. Slide appears a uniform pale red colour
B	Sucrose solution	Cells are smaller in diameter than in an untreated sample of blood
C	Detergent (dissolves lipids)	No cells seen. Slide appears a uniform pale red colour

(b) (i) What does the appearance of slide **B** tell you about the plasma membrane surrounding a red blood cell?

_____

_____

(1)

(ii) Explain the appearance of slide **C**.

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_____

_____

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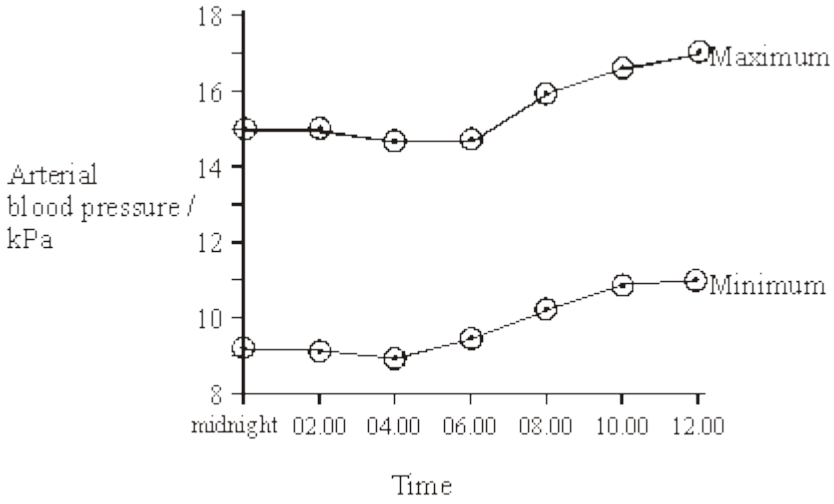
(2)

(Total 5 marks)

5 (a) The graph shows hourly blood pressure recordings from a group of 65 people.



(i) Describe how the mean maximum arterial blood pressure changes over the period shown in the graph.

_____

_____

(1)

(ii) In each cardiac cycle, the arterial pressure has a maximum value. Explain the link between this maximum value and the events of the cardiac cycle.

_____

_____

(1)

(iii) The recordings shown in this graph were taken from an artery. Describe **two** ways in which you would expect blood pressure in a vein to differ from that in an artery.

1 _____

_____

2 _____

_____

(2)

(b) Molecules of different substances differ in size. The relative molecular mass of a substance gives an indication of the size of its molecules. The table shows the relative permeability of the wall of a capillary to different molecules.

Substance	Relative molecular mass	Relative permeability of capillary wall
Water	18	1.00
Urea	60	0.96
Glucose	180	0.60
Haemoglobin	68 000	0.01
Albumin (plasma protein)	69 000	0
Globulin (plasma protein)	140 000	0

(i) Describe the relationship between molecule size and the permeability of the capillary wall.

_____

_____

_____

_____

(2)

(ii) The water potential of the plasma at the venule end of the capillary is more negative than the water potential at the arteriole end. Use the table to explain why.

_____

_____

_____

_____

(2)

(iii) Although the capillary walls are slightly permeable to haemoglobin molecules, there is no haemoglobin in the tissue fluid. Explain what causes the absence of haemoglobin in tissue fluid.

_____

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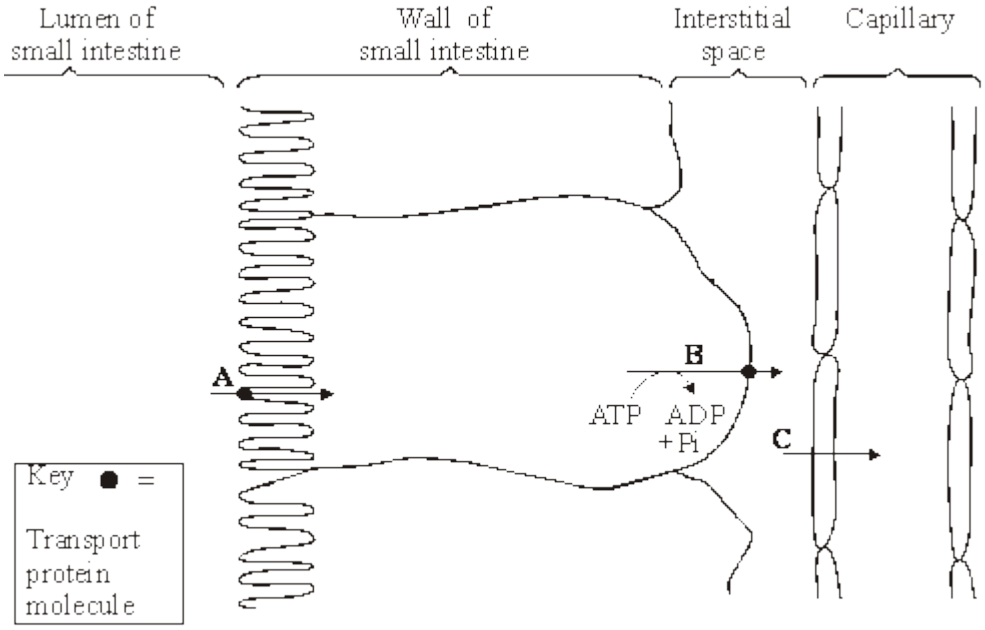
(1)

(Total 9 marks)

6 **S** The figure below shows the processes involved in absorbing amino acids into a capillary from the small intestine.



(i) Name processes **A**, **B** and **C**. In each case, give the evidence for your answer.

A Process _____

Evidence _____

_____

B Process _____

Evidence _____

_____

C Process _____

Evidence _____

_____

(3)

(ii) Explain how process **B** creates the conditions for process **A** to occur.

(2)

(Total 5 marks)

7 Lactose is a disaccharide found in milk. In the small intestine, it is digested into glucose and galactose by the enzyme lactase. Molecules of lactase are located in the plasma membranes of cells lining the small intestine.

(a) What evidence in the paragraph suggests that galactose is a monosaccharide?

(1)

(b) (i) Name **one** other digestive enzyme that is located in the plasma membranes of cells lining the small intestine.

(1)

(ii) Give an advantage of lactase and other digestive enzymes being located in the plasma membranes of cells lining the small intestine, rather than being secreted into the lumen of the small intestine.

(1)

(c) The absorption of galactose from the small intestine is reduced if the absorbing cells are treated with a respiratory inhibitor, such as cyanide. Suggest an explanation for this.

(2)

(Total 5 marks)

8 Read the following passage.

Human milk contains all the nutrients a young baby needs in exactly the right proportions. It is formed in the mammary glands by small groups of milk-producing cells. These cells absorb substances from the blood and use them to synthesise the lipids, carbohydrates and proteins found in milk. Milk-producing cells are roughly cube-shaped and have a height to breadth ratio of approximately 1.2 : 1.

The main carbohydrate in milk is lactose. Lactose is a disaccharide formed by the condensation of two monosaccharides, glucose and galactose. (A molecule of galactose has the same formula as a molecule of glucose – the atoms are just arranged in a different way.)

Lactose is synthesised in the Golgi apparatus and transported in vesicles through the cytoplasm. Because lactose is unable to escape from these vesicles, they increase in diameter as they move towards the plasma membrane. The vesicle membranes fuse with the plasma membrane and the vesicles empty their contents out of the cell.

Use the information from the passage and your own knowledge to answer the following questions.

(a) (i) The breadth of a milk-producing cell is 26 µm. Calculate the height of this cell.

Height = _____ µm

(1)

(ii) Describe and explain how you would expect the height to breadth ratio of an epithelial cell from a lung alveolus to differ from the height to breadth ratio of a milk-producing cell.

_____

_____

_____

_____

(2)

(b) How many oxygen atoms are there in a molecule of

(i) galactose;

_____

(1)

(ii) lactose?

_____

(1)

(c) The lactose-containing vesicles increase in diameter as they move towards the plasma membrane of the milk-producing cell (lines 11-12). Use your knowledge of water potential to explain why.

(2)

(d) Suggest **one** advantage of milk-producing cells containing large numbers of mitochondria.

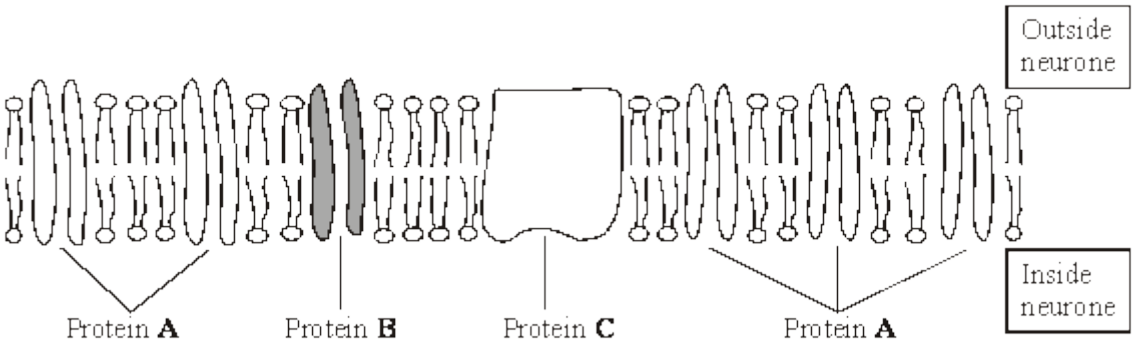
(2)

(e) Some substances pass through the plasma membrane of a milk-producing cell by diffusion. Describe the structure of a plasma membrane and explain how different substances are able to pass through the membrane by diffusion.

(6)

(Total 15 marks)

9 The resting potential of a neurone is maintained by the unequal distribution of ions inside and outside the plasma membrane. The diagram shows the plasma membrane of a neurone and the three different proteins that are involved in maintaining the resting potential.



(a) Protein **C** requires ATP to function. Describe the role of protein **C**.

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_____

_____

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(2)

S (b) (i) Proteins **A** and **B** differ from each other. Explain why different proteins are required for the diffusion of different ions through the membrane.

_____

(2)

(ii) The plasma membrane of the neurone is more permeable to potassium ions than to sodium ions. Give the evidence from the diagram that supports this observation.

_____

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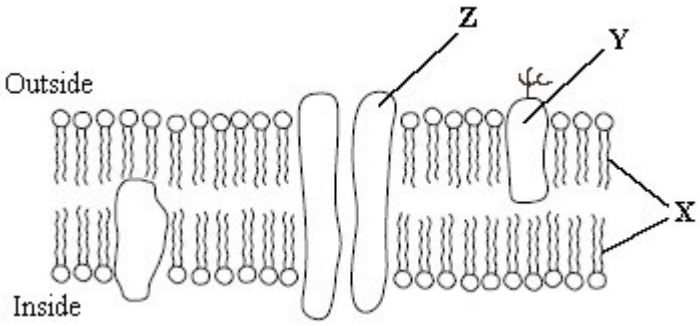
_____

(1)

(Total 5 marks)

10 The diagram shows part of a plasma membrane.



(a) Describe **two** functions of the structure made from the parts labelled **X**.

1. _____

_____

2. _____

_____

(2)

(b) Give **one** function of the molecule labelled **Y**.

_____

_____

(1)

(c) The part labelled **Z** is involved in facilitated diffusion of substances across the membrane.

(i) Give **one** similarity in the way in which active transport and facilitated diffusion transport substances across the membrane.

_____

_____

(ii) Give **one** way in which active transport differs from facilitated diffusion.

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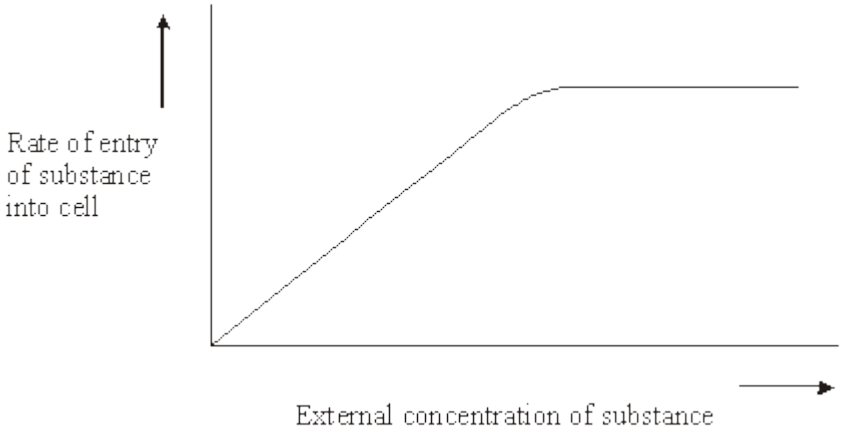
(2)

(iii) The graph shows the relationship between the concentration of a substance outside a cell and the rate of entry of this substance into the cell.



Explain the evidence from the graph that this substance is entering the cell by facilitated diffusion and not by simple diffusion.

(2)

(Total 7 marks)

11 (a) Explain how including leguminous plants in a crop rotation reduces the need to use artificial fertilisers.

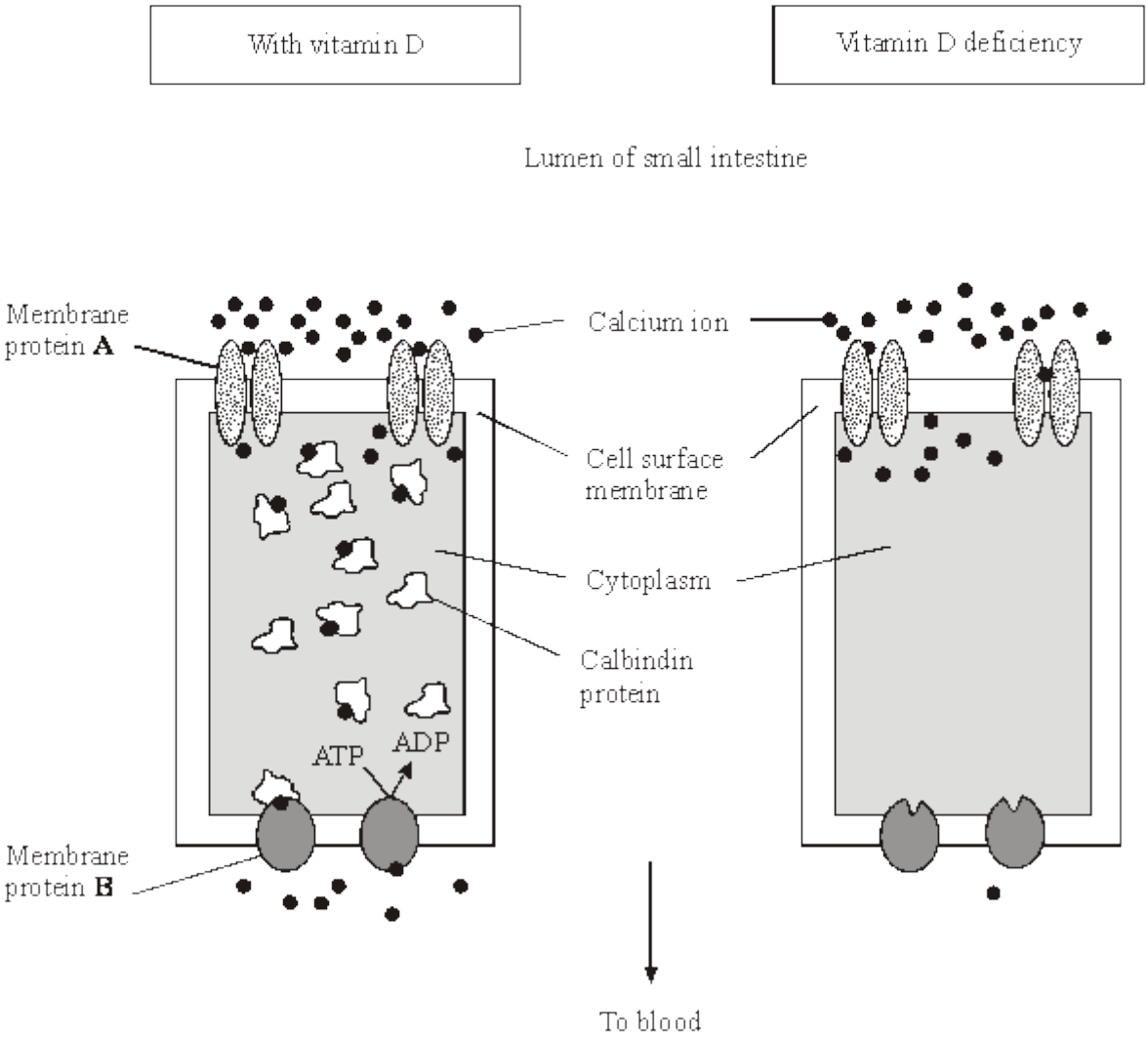
(2)

S (b) Application of very high concentrations of fertiliser to the soil causes plants to wilt. Explain why.

(2)

(Total 4 marks)

12 Vitamin D deficiency reduces the uptake of calcium ions by epithelial cells lining the small intestine. The diagrams show how calcium ions are transported through normal epithelial cells and those deficient in vitamin D.



(i) Use the information in the diagrams to explain how vitamin D deficiency reduces calcium ion uptake through gut epithelial cells.

_____

_____

_____

_____

(2)

S (ii) Membrane proteins **A** and **B** transport calcium ions through cell surface membranes. Explain how each type of membrane protein transports calcium ions.

Protein **A** _____

_____

_____

_____

(2)

Protein **B** _____

_____

_____

_____

(2)

(Total 6 marks)

13 (a) Explain how **three** features of a plasma membrane adapt it for its functions.

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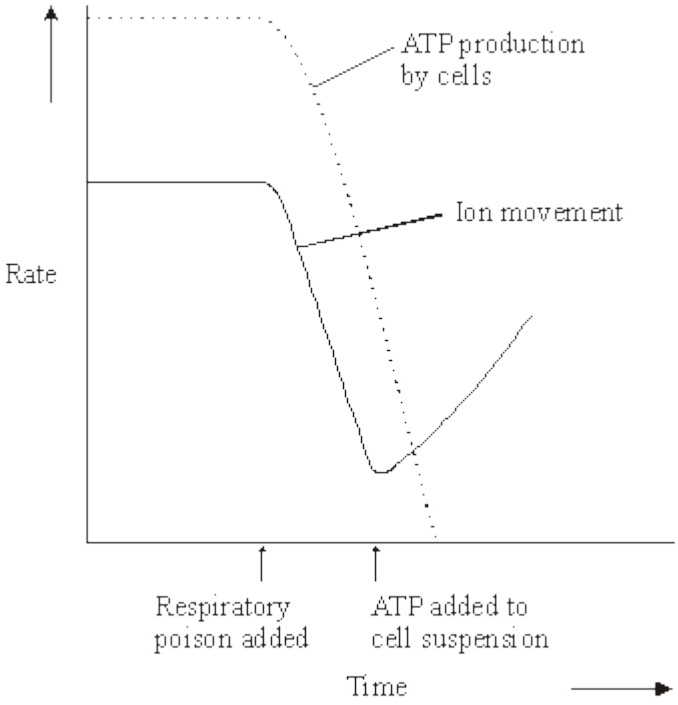
_____

_____

(6)

(b) ATP breaks down to ADP and phosphate releasing energy. The graph shows the rate of ion movement and the rate of ATP production in an investigation carried out on a suspension of cells. At a certain point in the investigation, a respiratory poison was added to the cell suspension. Later, ATP was added to the same cell suspension.

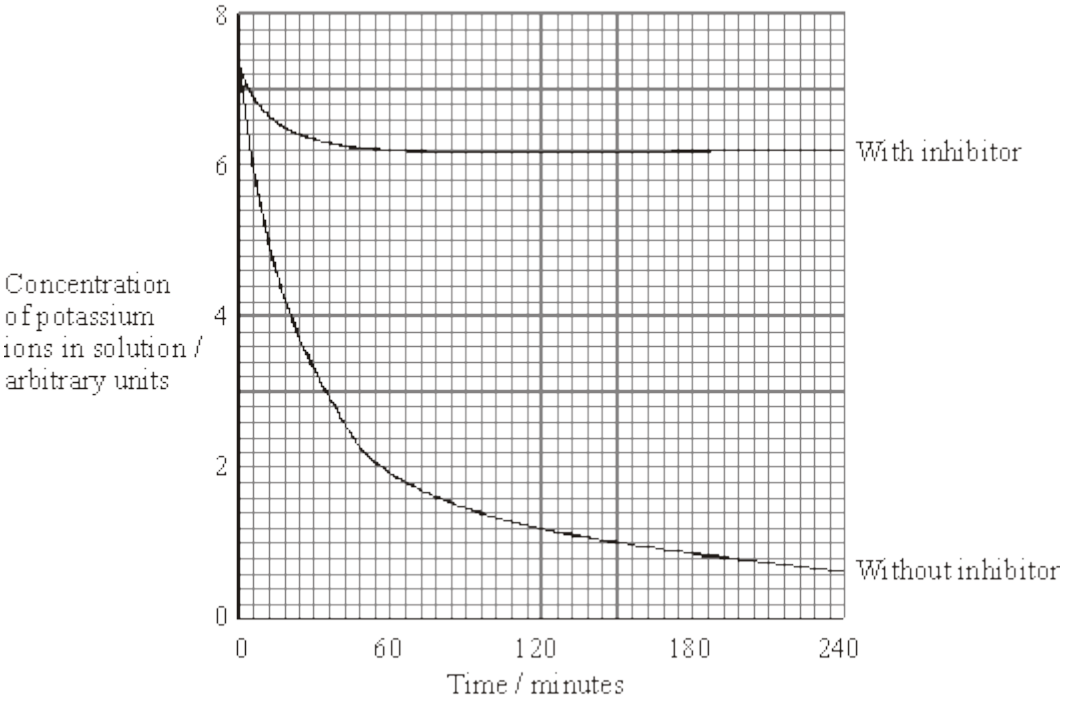


Describe and explain the changes in the rate of ion movement.

(4)

(Total 10 marks)

14 Two samples of the roots of pea plants were placed in solutions containing potassium ions. An inhibitor to prevent respiration was added to one solution. The concentrations of potassium ions in the two solutions were measured at regular intervals. The graph shows the results.



(a) Explain the decrease in the concentrations of potassium ions in the two solutions between 0 and 30 minutes.

(i) With inhibitor

_____

_____

_____

_____

(2)

(ii) Without inhibitor

_____

_____

(1)

(b) Explain why there is no further decrease in the concentration of potassium ions in the solution with the inhibitor after 60 minutes.

(2)

(c) The substance malonate is an inhibitor of respiration. It has a structure very similar to the substrate of an enzyme that catalyses one of the reactions of respiration. Explain how malonate inhibits respiration.

(2)

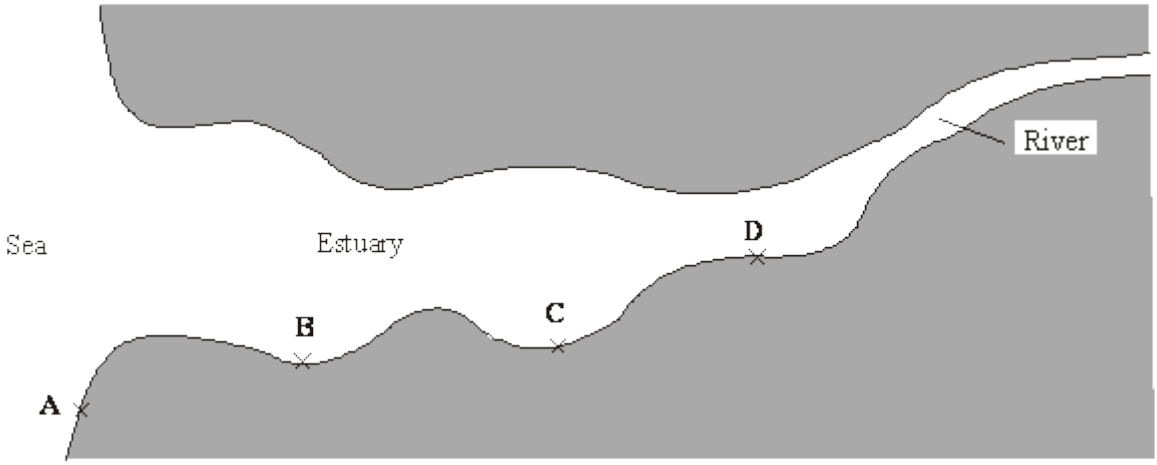
(Total 7 marks)

15 The shore crab is common in Britain. It lives both in the sea and in river estuaries, where it feeds on a wide variety of species.

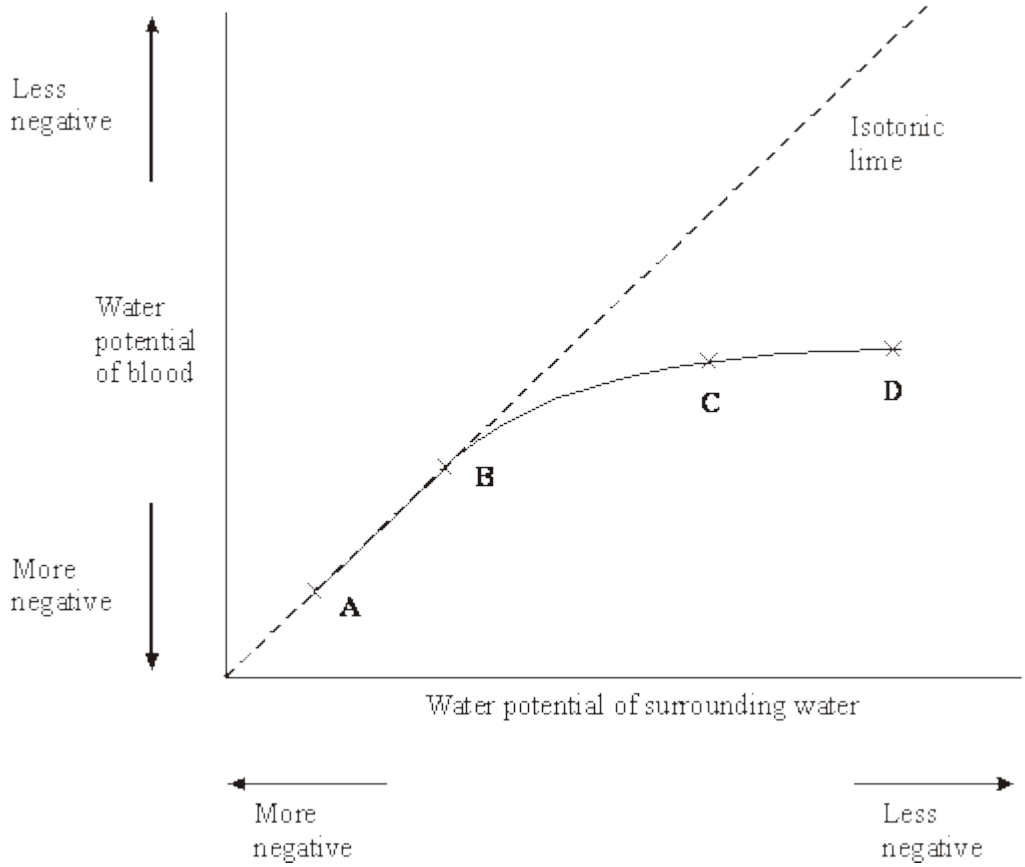
(a) The shore crab has recently spread to, and has established large populations in, the coastal waters of the USA, where it is not a native species. Explain how the shore crab has been able to establish large populations and why this is causing concern to ecologists in the USA.

(5)

In Britain, crabs living in an estuary and along the neighbouring coast were studied. Crabs were collected from four different sites, **A** to **D**, as shown in the map.



The graph shows the mean water potential of the blood of samples of crabs from the four sites in relation to the water potential of the environment at the same sites. The isotonic line shows values at which the water potential of the blood and surrounding water would be the same.



(b) Describe the relationship between the mean water potential of the blood of the crabs and the water potential of the surrounding water.

_____

_____

(1)

S (c) Is there any net movement of water in or out of the blood of the crabs at sites **A** and **B**? Explain your answer.

_____

_____

(1)

S (d) Crabs living at sites **C** and **D** actively transport salts into their blood through their gills.

(i) Explain how this enables crabs to survive at these sites.

_____

_____

_____

(2)

(ii) Crabs are unable to control their body temperature. In winter, when the water temperature falls, crab populations at sites **C** and **D** migrate towards the sea. Suggest the advantage of this behaviour.

_____

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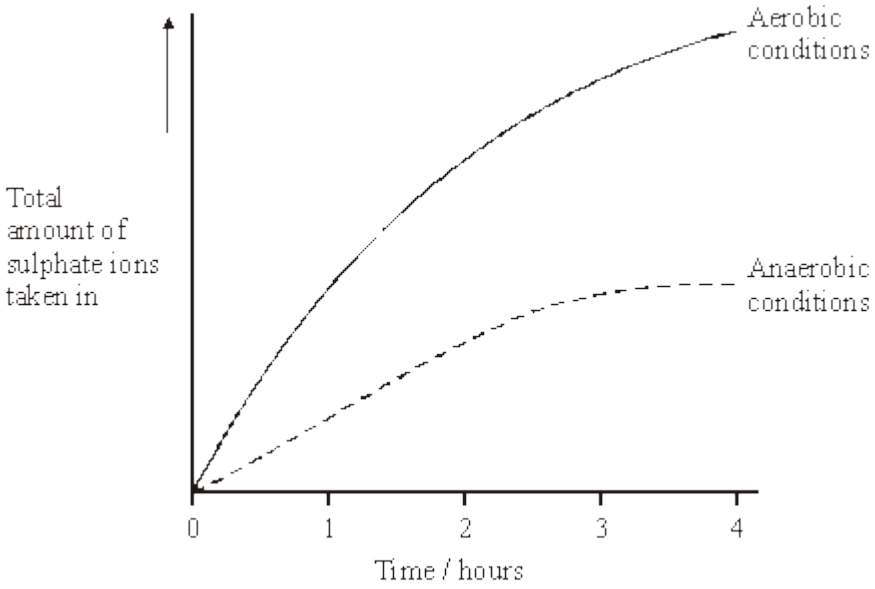
(3)

(Total 12 marks)

16 An investigation was carried out to compare the uptake of sulphate ions by barley roots in aerobic and in anaerobic conditions. The results are shown in the graph.



(i) Explain the evidence from the graph that active transport is involved in the uptake of sulphate ions.

_____

_____

_____

_____

(2)

(ii) Suggest why the uptake of sulphate ions by the roots in anaerobic conditions stopped after 3 hours.

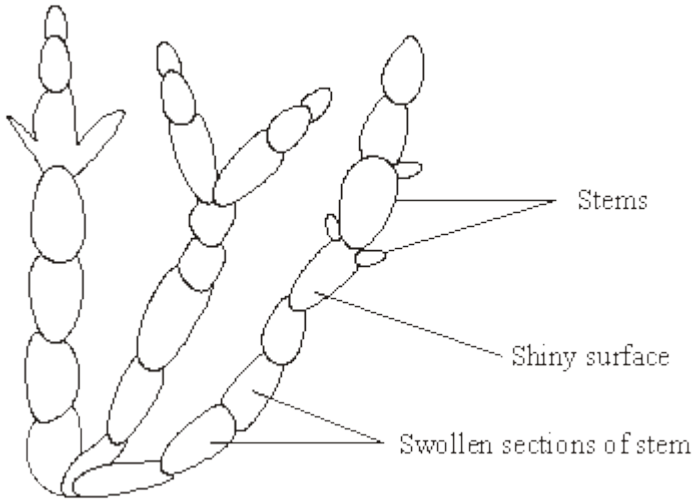
_____

_____

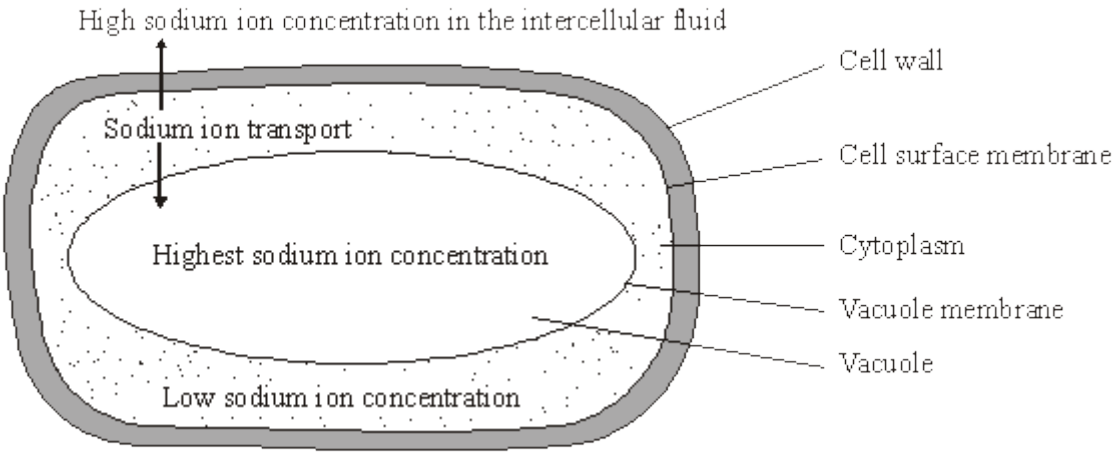
(1)

(Total 3 marks)

17 Glasswort is a plant that grows in salt marshes. The plants are covered by seawater at each high tide. The roots grow in mud which contains a high concentration of salt. The drawing shows a shoot of the plant.



In glasswort cells, sodium ions are transported from the cytoplasm outwards across the cell surface membrane and also into the cell vacuole. The concentration of sodium ions is greater inside the vacuole than in the intercellular fluid, which is the fluid between the cells in tissues. High sodium ion concentrations would disrupt metabolic processes in the cytoplasm. This information is summarised in the diagram below.



S (a) The total concentration of all ions in the cytoplasm is higher than in the intercellular fluid. Explain how this allows the cell to take up water.

_____

_____

_____

_____

(2)

S (b) (i) Explain how sodium ions are transported through the membranes.

_____

_____

_____

_____

(2)

(ii) There is a higher concentration gradient between the cytoplasm and the vacuole than between the cytoplasm and the intercellular fluid. Suggest how the vacuole membrane maintains this higher concentration gradient.

_____

_____

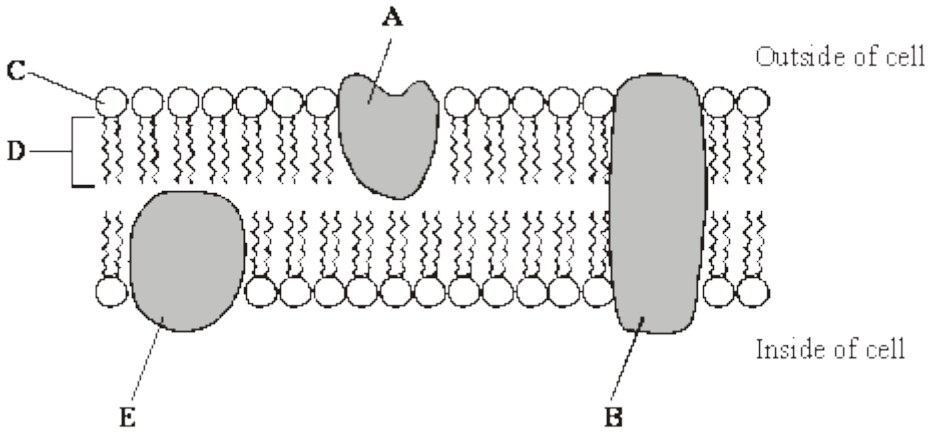
_____

_____

(2)

(Total 6 marks)

18 The diagram shows part of a cell surface membrane.



(a) Complete the table by writing the letter from the diagram which refers to each part of the membrane.

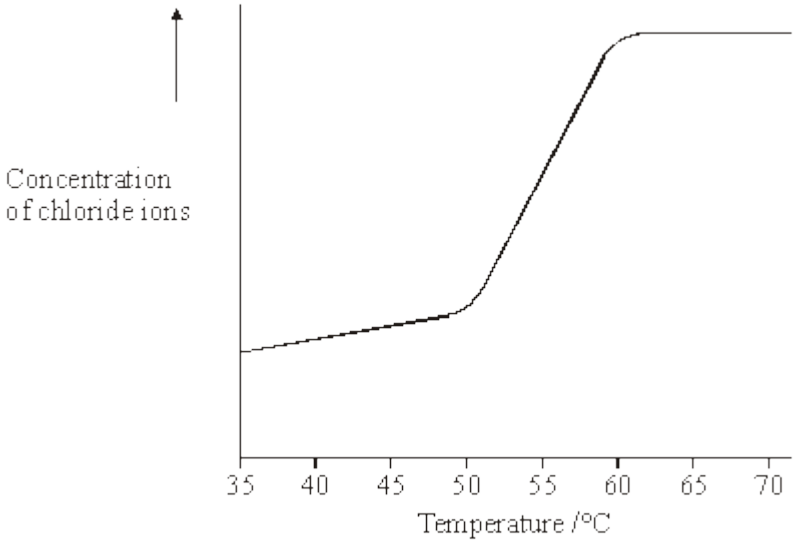
Part of membrane	Letter
Channel protein	
Contains only the elements carbon and hydrogen	

(2)

(b) Explain why the structure of a membrane is described as *fluid-mosaic*.

(2)

(c) When pieces of carrot are placed in water, chloride ions are released from the cell vacuoles. Identical pieces of carrot were placed in water at different temperatures. The concentration of chloride ions in the water was measured after a set period of time. The graph shows the results.

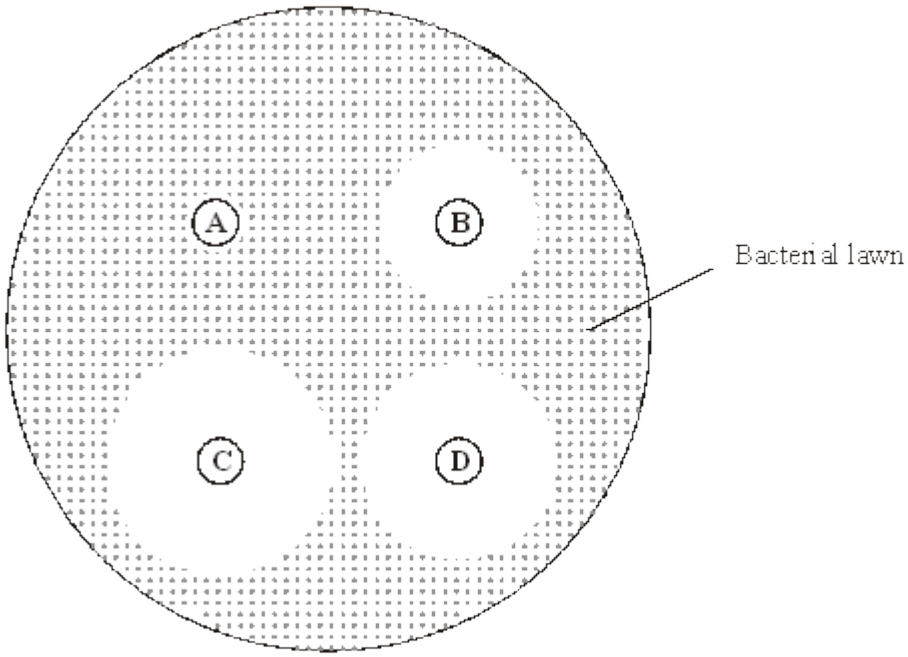


Describe and explain the shape of the curve.

(3)

(Total 7 marks)

19 An agar plate was flooded with a culture of a species of bacterium usually found in the mouth. Four sterile paper discs, **A**, **B**, **C** and **D**, each containing a different brand of mouthwash, were then placed on the agar plate. The drawing shows the appearance of the plate after it had been incubated at 37°C for three days.



(a) Describe the aseptic techniques that would be used when flooding the agar plate with bacteria.

_____

_____

_____

_____

_____

_____

(3)

(b) The effectiveness of a mouthwash can be measured by calculating the total area of a paper disc and the clear zone around it. The area of a circle is given by πr^2, where r is the radius of the circle. Calculate how many times more effective mouthwash **C** is than mouthwash **B**. Show your working.

Mouthwash **C** is _____ times more effective than mouthwash **B**.

(2)

S (c) Several factors affect the rate at which the antiseptic in the mouthwash from each paper disc diffuses through the agar. Describe the effect of **three** named factors on this rate.

1. _____

_____

2. _____

_____

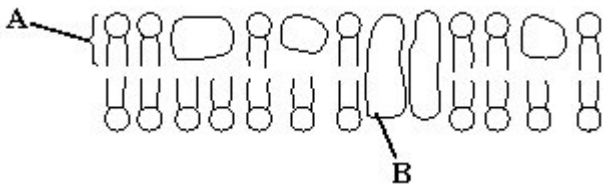
3. _____

_____

(3)

(Total 8 marks)

20 (a) The diagram shows the fluid-mosaic model of a cell surface membrane.



(i) Name the molecules labelled **A** and **B**.

A _____

B _____

(1)

(ii) How does the bilayer formed by substance **A** affect entry and exit of substances into and out of a cell?

_____

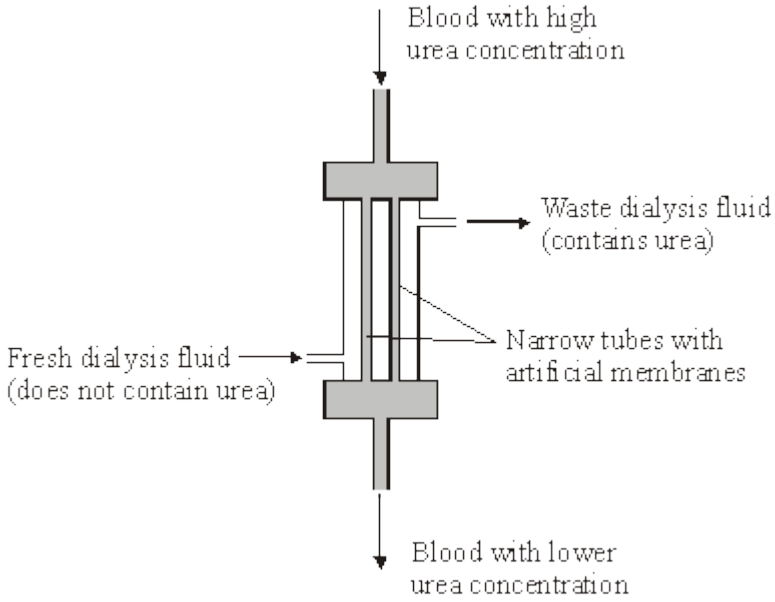
_____

_____

_____

(2)

(b) A dialysis machine contains artificial membranes which enable urea to be removed from the blood of a person with kidney failure. The diagram shows a dialysis machine.



(i) By what process does urea pass from the blood into the dialysis fluid?

_____

(1)

(ii) Suggest **two** reasons for keeping the fluid in the dialysis machine at 40 °C rather than room temperature.

1. _____

_____

2. _____

_____

(2)

(iii) The blood and the dialysis fluid flow in opposite directions in the dialysis machine. Explain the advantage of this.

_____

_____

_____

_____

(2)

(iv) Blood flows through the dialysis machine at a rate of 200 cm^3 per minute. Calculate the total volume which passes through the machine in 5 hours. Give your answer in dm^3 and show your working.

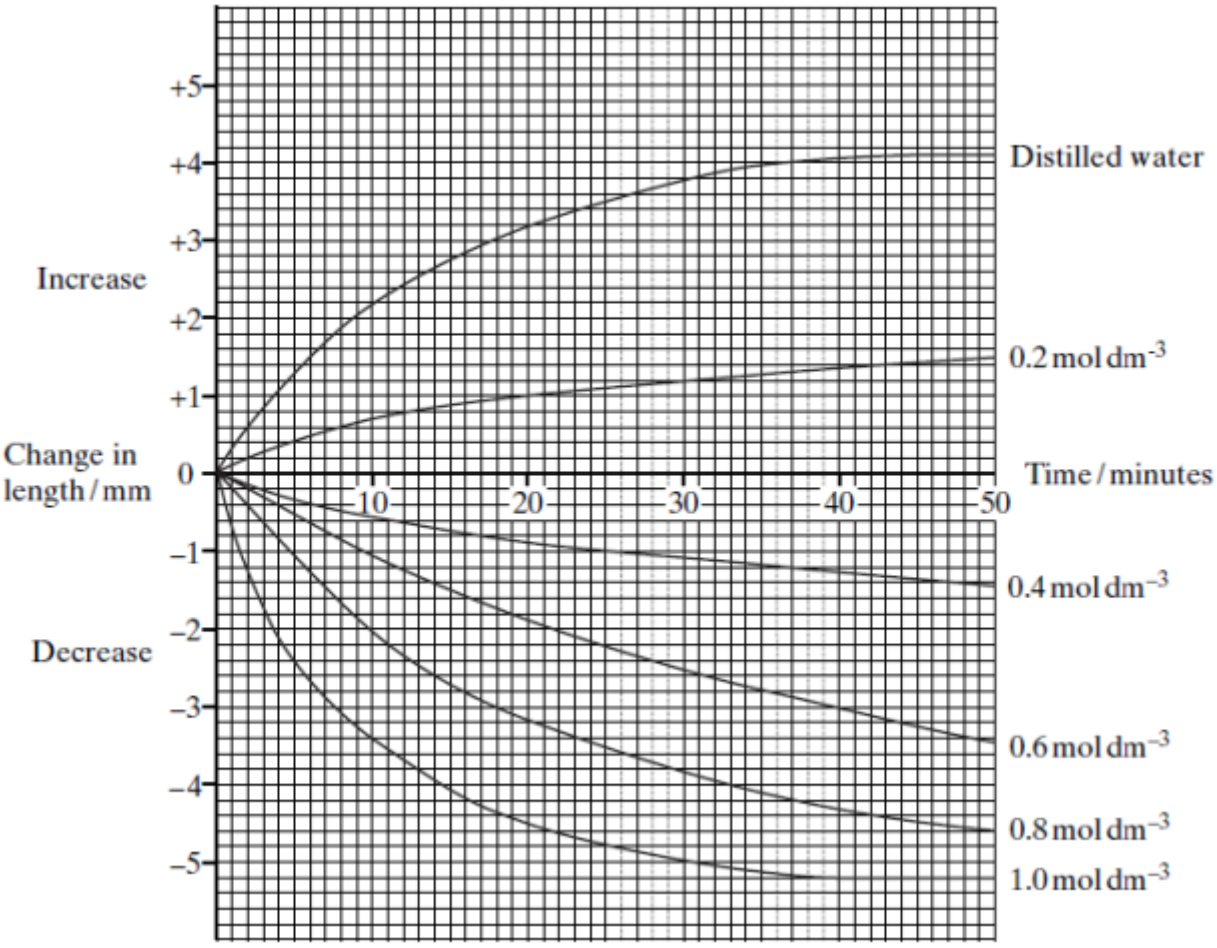
Answer _____ dm^3

(2)

(Total 10 marks)

21 Six cylinders of a standard size were cut from a single large potato. One cylinder was placed in distilled water and the others were placed in sucrose solutions of different concentrations. The length of each cylinder was measured every 5 minutes for the next 50 minutes.

The graph shows the changes in length at each sucrose concentration.



(a) Explain why

(i) the potato cylinder in distilled water increased in length;

(2)

(ii) the potato cylinder in the 1.0 mol dm^{-3} sucrose solution showed no further decrease in length after 40 minutes.

(2)

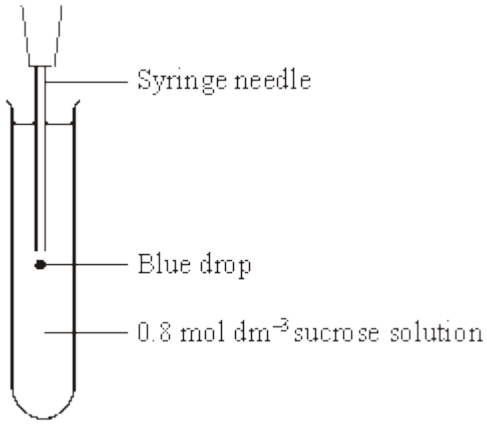
(b) (i) Describe the difference in the rate of decrease in length during the first 10 minutes between the cylinder in the 0.4 mol dm^{-3} and the cylinder in the 0.8 mol dm^{-3} solution.

(1)

(ii) Use your knowledge of water potential to explain this difference.

(1)

(c) After 45 minutes the potato cylinder in the 0.8 mol dm^{-3} solution was removed and blue dye added to this solution. Some of this blue-stained solution was drawn into a syringe. A drop was then released, slowly, halfway down a test tube of fresh 0.8 mol dm^{-3} sucrose solution as shown in the diagram. The blue drop quickly moved to the surface of the liquid in the test tube.



(i) The density of a solution depends on its concentration. The more concentrated the solution the greater its density. Explain why the blue drop had a lower density and therefore moved up.

_____

_____

_____

_____

(2)

(ii) A sucrose solution of concentration 0.3 mol dm^{-3} has a water potential which is equivalent to that of the potato cells. Describe and explain what would happen to the blue drop from this solution.

_____

_____

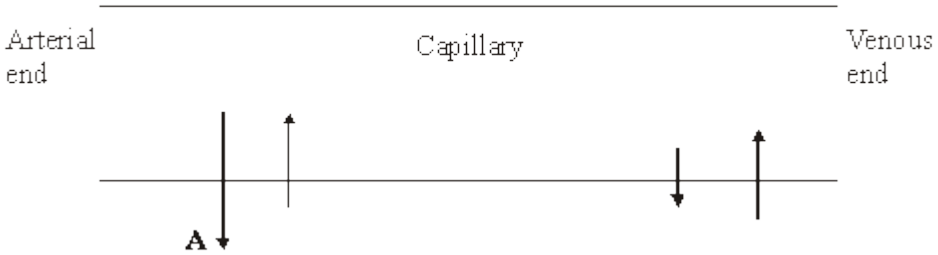
_____

_____

(2)

(Total 10 marks)

22 Tissue fluid is formed when water and small molecules pass out of capillaries at their arterial end. The diagram shows some pressures involved in tissue fluid formation. The relative lengths of the arrows indicate the size of the pressures.



(a) What causes the pressure represented by the arrow labelled **A**?

_____

_____

(1)

(b) Explain why there is a net loss of water from a capillary at the arterial end.

_____

_____

_____

_____

(2)

(c) The total volume of fluid that passes from the capillaries to the surrounding tissue fluid is normally greater than the volume that is reabsorbed into them. Describe what happens to this extra fluid.

_____

_____

_____

_____

(2)

(d) Tissue fluid accumulates in the tissues of people who do not eat enough protein. Explain why.

_____

_____

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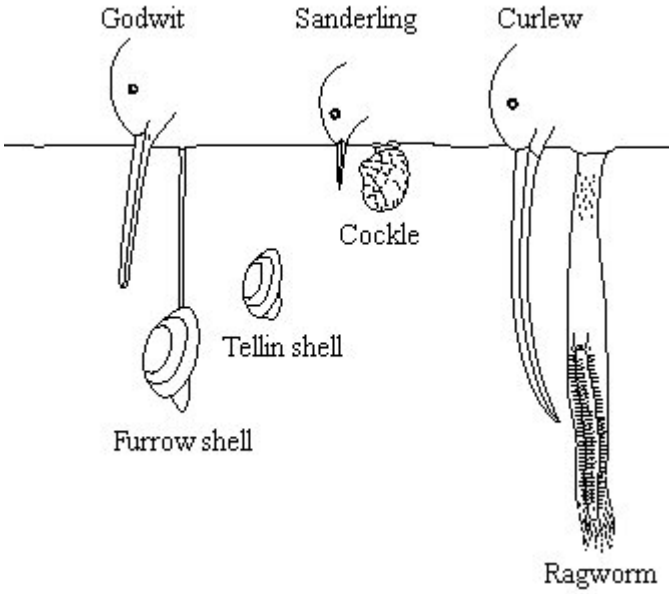
(2)

(Total 7 marks)

23 Some birds feed on animals found in mud in estuaries. The drawing shows the heads of three species of these birds and their prey.



(a) Use the information in the drawing to explain how interspecific competition between the birds is reduced.

_____

_____

_____

_____

_____

(2)

(b) Explain how competition might have played a part in the evolution of the long curved beak of the curlew.

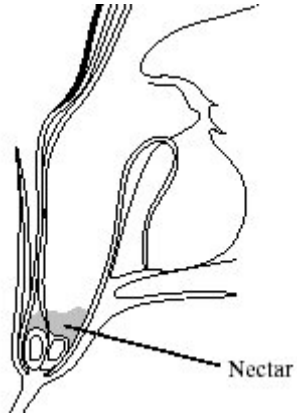
(4)

(c) Mud higher up the shore receives fresh water draining from the land. Ragworms are able to survive in this mud because they can tolerate the absorption of water into their tissues. Explain what causes a ragworm to absorb water when higher up the shore.

(2)

(Total 8 marks)

24 **S** Penstemon plants have mechanisms that regulate the amount of nectar produced by their flowers. Nectar is a solution containing sucrose which attracts insect pollinators. The diagram shows a section through a penstemon flower.



To investigate these mechanisms the volume of nectar produced was determined. A thin strip of filter paper was dipped into the nectar until all the nectar was absorbed. The distance the nectar moved up the paper was measured. The actual volume of nectar was found by reading the value from a calibration curve on a graph. A sucrose solution similar to nectar was used to produce this calibration curve.

(a) (i) The solution contained 22% by mass of sucrose. Describe how you would make 50 cm^3 of this solution.

_____

_____

_____

(1)

(ii) Describe how you would use the solution to produce the calibration curve.

_____

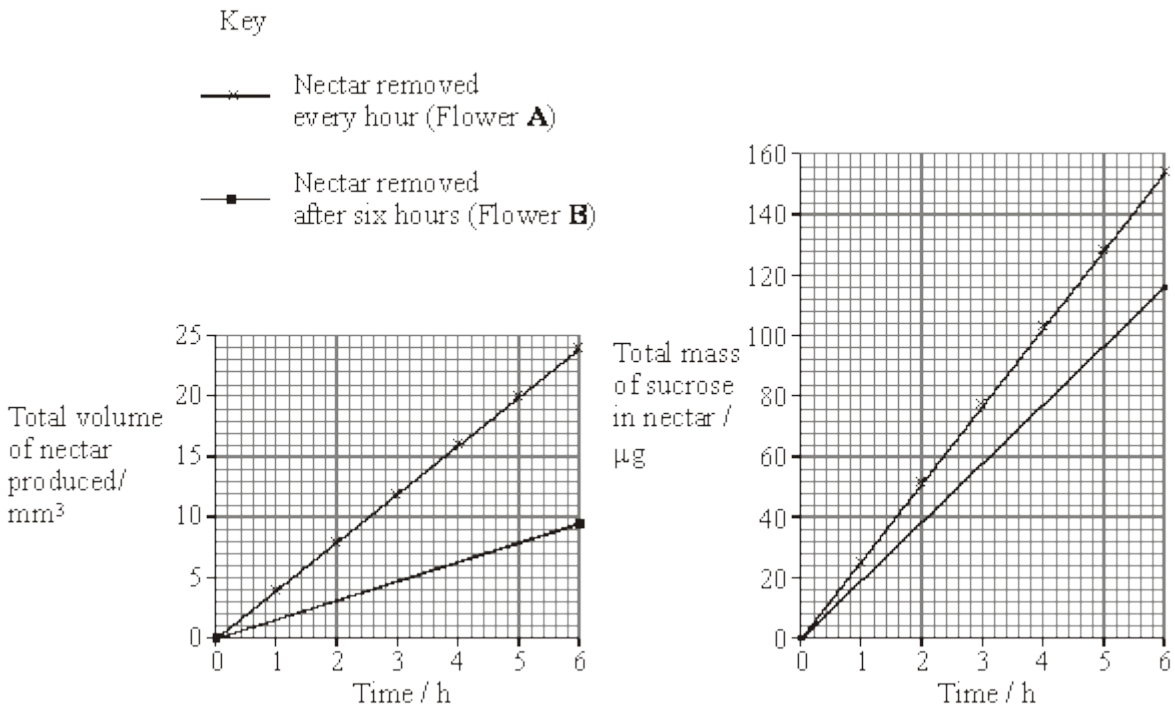
_____

_____

_____

(2)

In one experiment the effect of removing nectar at regular intervals was investigated. First all the nectar was removed from two penstemon flowers. From one flower (**A**) all the nectar produced was removed each hour for the next six hours. In the second flower (**B**) the nectar was allowed to accumulate for six hours. Each time the nectar was removed, the sugar was extracted from the strip of filter paper and its mass was measured. The graphs show the results.



(b) (i) Describe the effects on nectar production and on sucrose secretion of removing the nectar every hour compared with removing it after 6 hours.

_____

_____

_____

_____

(2)

(ii) How would the nectar collected after 6 hours from plant **B** differ from that collected after 6 hours from plant **A**.

_____

_____

(1)

(iii) Pollinating insects such as bees visit flowers and collect nectar. Suggest **one** advantage for penstemon flowers of the response to regular removal of nectar.

_____

_____

_____

_____

(1)

(c) In a different experiment the nectar was removed from two penstemon flowers. In one flower the nectar was replaced with 5 mm^3 of a solution containing a total of 120 µg of sucrose. The second flower was left empty as a control. The two flowers were protected from insects. After three hours the nectar solutions in the flowers were removed. The table shows the results.

	Volume of solution / mm^3		**Mass of sucrose in solution / µg**	
Time / h	**Experimental**	**Control**	**Experimental**	**Control**
0	5.00	0.00	120	0
3	5.75	1.65	104	20

Describe the effect of the addition of sucrose solution on the volume of nectar produced and on the movement of sucrose.

_____

_____

_____

_____

_____

_____

(3)

(d) Nectar is formed by specialised cells in the flower which synthesise sucrose.
Describe how sucrose is moved against a concentration gradient from these cells into the nectar.

_____

_____

_____

_____

(2)

(Total 12 marks)

25 **Essay**

You should write your essay in continuous prose.

Your essay will be marked for its scientific accuracy.

It will also be marked for your selection of relevant material from different parts of the specification and for the quality of your written communication.

The maximum number of marks that can be awarded is

Scientific	16
Breadth of knowledge	3
Relevance	3
Quality of written communication	3

Write an essay on the following topic:

The process of osmosis and its importance to living organisms.

(Total 25 marks)

26 (a) Oxygen and water move through plasma membranes into cells. Describe **two** ways in which these movements are similar.

1. _____

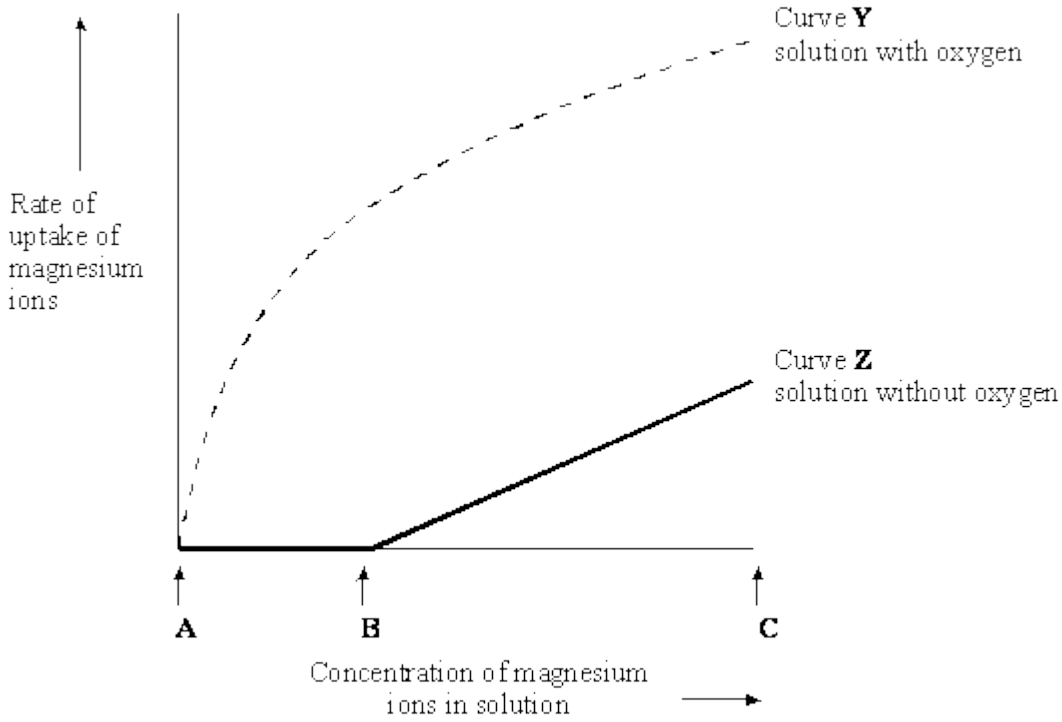
_____

2. _____

_____

(2)

The graph shows the effect of concentration on the rate of uptake of magnesium ions by root hair cells.



(b) For curve **Y** name the process the cells are using to absorb magnesium ions between concentrations **A** and **B**. Use information in the graph to explain your answer.

Name of process _____

Explanation _____

_____

_____

(2)

(c) In the solution without oxygen, explain why no magnesium ions are taken up between concentrations **A** and **B**.

_____

_____

(1)

(d) For curve **Z** explain why the rate of uptake increases between **B** and **C**.

_____

_____

(1)

(Total 6 marks)

27 This question should be answered in continuous prose.

Quality of Written Communication will be assessed in these answers.

(a) Describe and explain **four** ways in which the structure of a capillary adapts it for the exchange of substances between blood and the surrounding tissue.

(4)

(b) Explain how tissue fluid is formed and how it may be returned to the circulatory system.

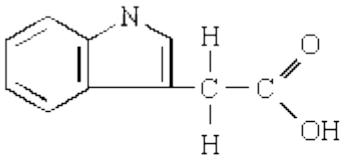
(6)

(Total 10 marks)

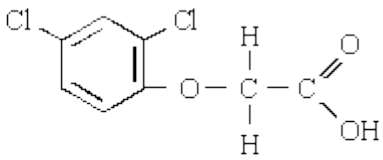
28 IAA is an auxin which stimulates plant growth. It binds to proteins in cell walls. This changes the arrangement of the cellulose molecules, so the walls are more easily stretched. IAA also lowers the pH around the cells.

2,4-D is a systemic herbicide which has the same effect on cell walls as IAA, but it is less easily broken down in plants.

S (a) The diagram shows the molecular structures of IAA and 2,4-D.



IAA



2,4-D

Use evidence from the diagram to suggest

(i) why IAA lowers pH;

_____

_____

(1)

(ii) why IAA and 2,4-D have similar effects on cell walls.

_____

_____

(1)

(b) When 2,4-D is applied to weeds their growth is very rapid but very distorted. After a short time they die. Suggest **one** explanation for the rapid and distorted growth of weeds when 2,4-D is applied.

_____

_____

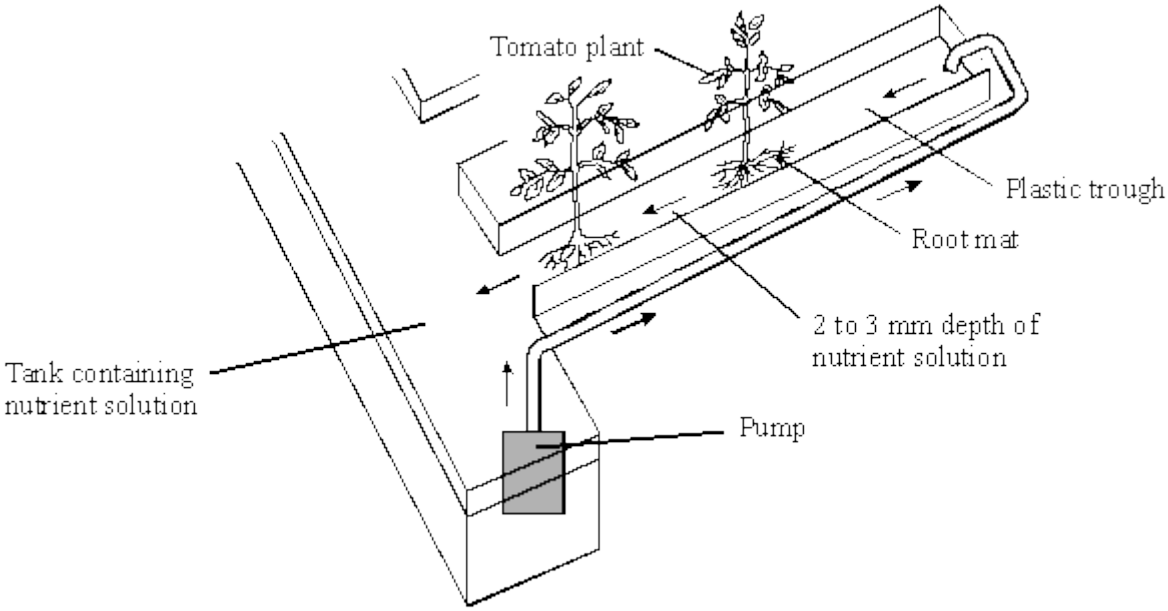
_____

_____

(2)

(Total 4 marks)

29 Tomato growers have increased the yield of fruit from 100 to 400 tonnes per hectare by growing the tomato plants in automatically heated glasshouses and enhancing the carbon dioxide concentration. To control the nutrient supply to the roots, the plants are grown without soil in plastic troughs, as shown in the diagram.



(a) Explain how enhancing the carbon dioxide concentration helps to increase the yield.

(2)

(b) Maintaining a high temperature in a glasshouse in winter, when the light intensity is low, may reduce the yield. Explain how.

(2)

S (c) Tomato fruits have a high percentage of water. When making tomato ketchup, it is more economical to use fruits which have a low percentage of water. Growers can reduce the water content of the fruit by adding sodium chloride to the nutrient solution in the plastic trough.

Explain how adding sodium chloride can reduce the water content of the fruit.

_____

_____

_____

_____

(2)

(Total 6 marks)

30 **S** Gorter and Grendel investigated the structure of the surface membrane of cells. They extracted the phospholipids from the surface membranes of red blood cells in 1 cm^3 of blood and placed them in the apparatus shown in **Figure 1**.

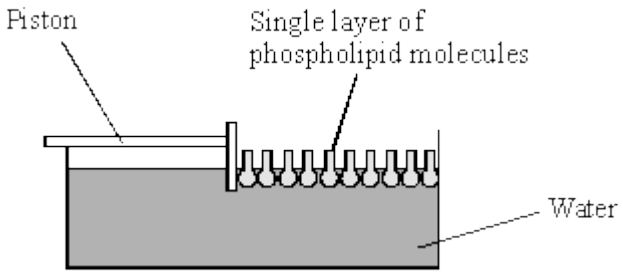


Figure 1

The piston was pushed across the surface of the water until the phospholipid molecules were tightly packed into a single layer. The area covered by the phospholipid molecules was measured. This area was compared with the estimated surface area of the red blood cells from which phospholipids were extracted.

Gorter and Grendel obtained the data shown in the table.

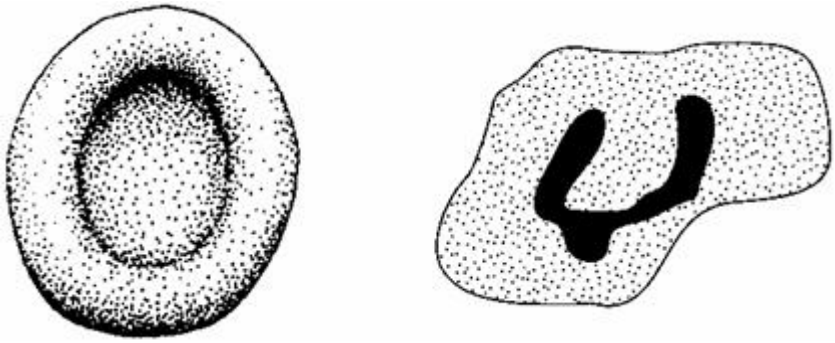
Number of red blood cells per cm^3 of blood	4.74×10^9
Estimated mean surface area of one red blood cell	99.4 μm^2
Surface area of membrane phospholipids extracted from $1cm^3$ of blood	0.92 m^2

(a) Explain what these data suggest about the arrangement of phospholipids in the surface membranes of red blood cells. Support your explanation with suitable calculations.

Show your working.

(3)

(b) **Figure 2** shows a red blood cell and a white blood cell.



Red blood cell White blood cell

Figure 2

Explain why red blood cells were used in this investigation rather than white blood cells.

(2)

(Total 5 marks)

31 (a) Describe **two** differences between active transport and facilitated diffusion.

1. _____

_____

2. _____

_____

(2)

(b) Explain why molecules of oxygen and carbon dioxide are able to diffuse across membranes.

_____

_____

_____

_____

_____

(2)

(c) Explain why ventilation of the lungs increases the efficiency of gas exchange.

_____

_____

_____

_____

_____

(2)

(Total 6 marks)

32 Some strains of the bacterium that causes gonorrhoea are resistant to antibiotics. This makes the disease difficult to treat. One way of testing the effectiveness of antibiotics is to use discs of paper soaked in antibiotic. These are placed in the centre of an agar plate covered by bacteria. A clear zone forms around the disc if the antibiotic is effective.

The table shows some results of an investigation into the effect of four different antibiotics on gonorrhoea bacteria.

Antibiotic	Diameter of clear zone / mm	Minimum diameter of clear zone if antibiotic is effective / mm
A	47	52
B	30	28
C	22	40
D	33	34

(a) Give **two** reasons why it would be important to use sterile techniques during this investigation.

1. _____

_____

2. _____

_____

(2)

(b) (i) The antibiotic reached the bacteria by diffusion. Suggest why an effective antibiotic may produce only a small clear zone.

_____

_____

(1)

(ii) Which antibiotic used in the investigation would be most useful for treating gonorrhoea? Explain your answer.

Antibiotic _____

Explanation _____

_____

(2)

(Total 5 marks)