Q.1.

(c) Describe the process by which water passes from the soil into the root hairs.

.....

.....

.....

.....[2]

Q2.

(c) Explain how oxygen and glucose move from the blood inside the capillary to the tissue fluid in the muscle.

oxygen .....

.....

.....

glucose .....

.....

.....[3]

Q3.

6 Fig. 6.1 shows a diagram of a plasma (cell surface) membrane.

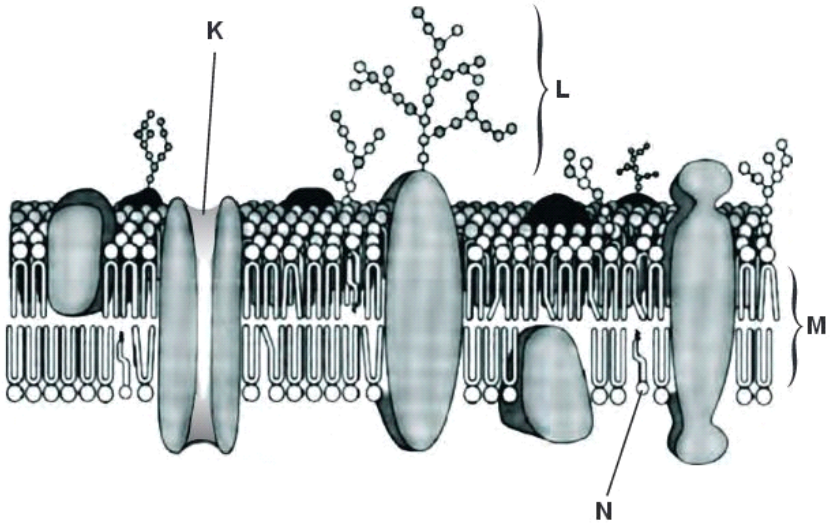

Fig. 6.1

(a) Indicate, by putting a circle, ( ), around **one** of the following, the width of the membrane shown in Fig. 6.1.

0.7 nm 7.0 nm 70 nm $7 \cdot 10^{-5}$ m 700 µm 7.0 µm [1]

(b) Outline the functions of the following components of the plasma membrane.

K .....

.....

L .....

.....

M .....

.....

N .....

.....[4]

(c) Some substances may cross plasma membranes by simple diffusion. Glucose, however, does not.

Explain why glucose cannot pass across membranes by simple diffusion.

.....

.....

.....

.....[2]

(d) In an investigation, animal cells were exposed to different concentrations of glucose. The rate of uptake of glucose into the cells across the plasma membrane was determined for each concentration. Fig. 6.2 shows the results.

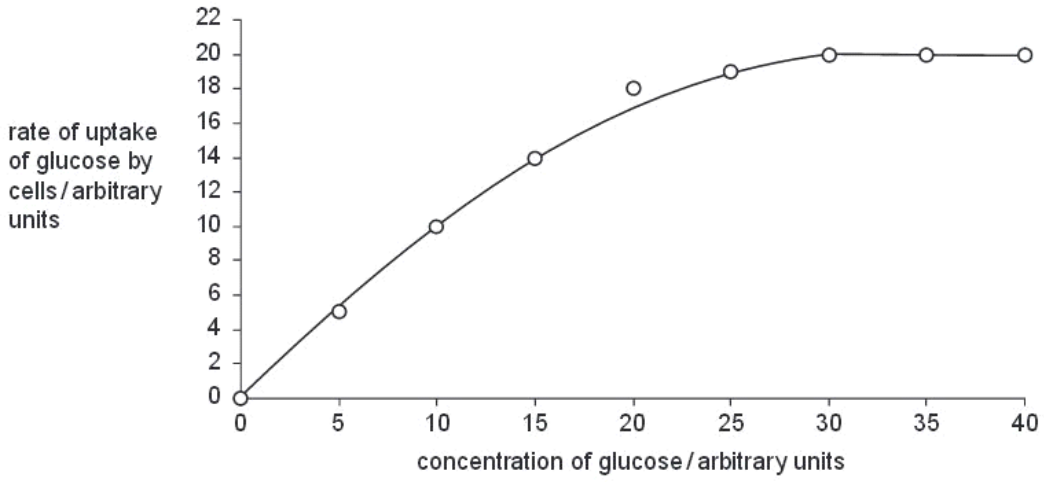

Fig. 6.2

Using the information in Fig. 6.2, explain how the results of the investigation support the idea that glucose enters cells by facilitated diffusion.

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.....

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.....

.....[2]

(e) State how active transport differs from facilitated diffusion.

.....

.....

.....[1]

[Total: 10]

Q4.

(d) A student investigated the effect of temperature on beetroot tissue. Beetroot cells contain a dark red pigment known as betalain, which is stored inside their vacuoles.

The student

- cut the beetroot tissue into cubes of the same size
- washed the cubes thoroughly in distilled water
- placed the same number of cubes into distilled water at seven different temperatures.

After 30 minutes, samples of the water were removed and placed in a colorimeter to measure the transmission of light. The lower the percentage transmission the more betalain is present in the water.

The results are shown in Fig. 2.2.

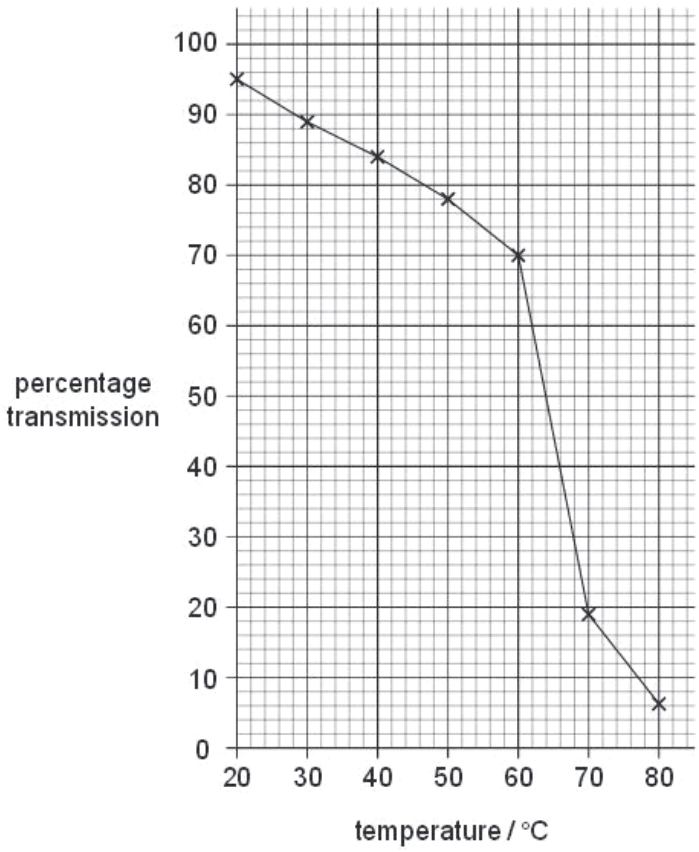

Fig. 2.2

Using the information in Fig. 2.2,

(i) describe the student's results;

.....

.....

.....

.....

.....

..... [3]

(ii) explain the effect of increasing temperature on the beetroot tissue.

.....

.....

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.....

.....

..... [3]

Q5.

3 Fig. 3.1 shows a flatworm which lives in ponds, streams and rivers. The dimensions of the flatworm are 12.5 mm long by 3.0 mm wide. Its volume was estimated as 12.6 mm^3. Flatworms do not have a transport system for the respiratory gases, oxygen and carbon dioxide.

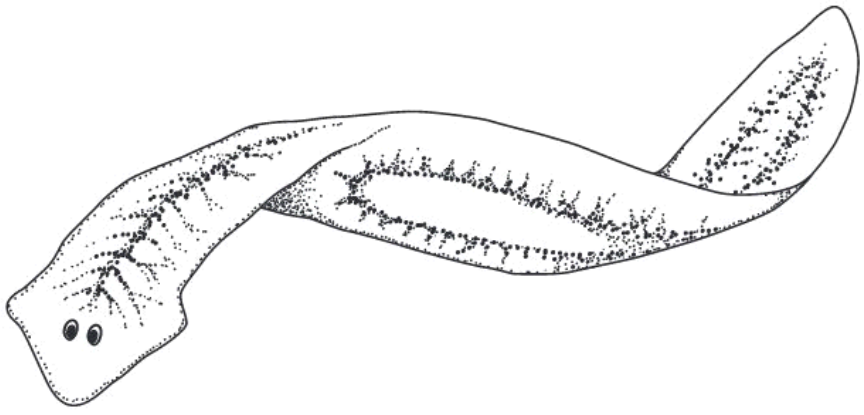

Fig. 3.1

(a) With reference to Fig. 3.1 and the information above, explain how flatworms survive without a transport system for respiratory gases.

.....

.....

.....

.....

.....

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.....

.....[4]

(b) This flatworm lives in freshwater that has a low concentration of sodium ions. The flatworm's body fluids have a higher concentration of sodium ions than the surrounding water.

(i) Suggest how the flatworm retains sodium ions in its body fluids.

.....

.....

.....

.....[2]

(ii) State **one** role of sodium ions in organisms.

.....

.....[1]

[Total: 7]

Q6.

(ii) Explain how a phospholipid is suited to its role in cell membranes.

.....

.....

.....

.....

.....

.....[3]

Q7.

1 One role of the cell surface membrane is to control the entry and exit of substances.

(a) Complete Table 1.1 to show the transport mechanisms across cell surface membranes and examples of materials transported.

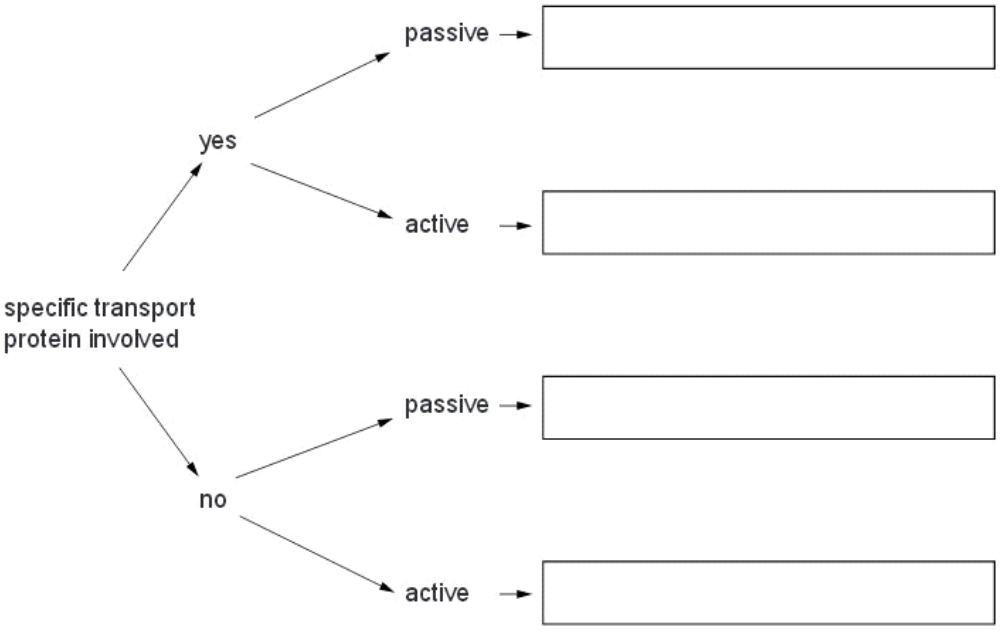
Table 1.1

transport mechanism across cell surface membrane	example of material transported across membrane
active transport	sodium ions
	oxygen molecules
	bacteria
exocytosis	mucin (for mucus)
facilitated diffusion	
osmosis	

[2]

(b) Each transport mechanism across cell surface membranes has a characteristic set of features.

In **each** of the boxes below, state **one** example of a transport mechanism that matches the pathway shown.



[4]

[Total: 6]

Q8.

5 Fig. 5.1 shows a section of a cell surface membrane.

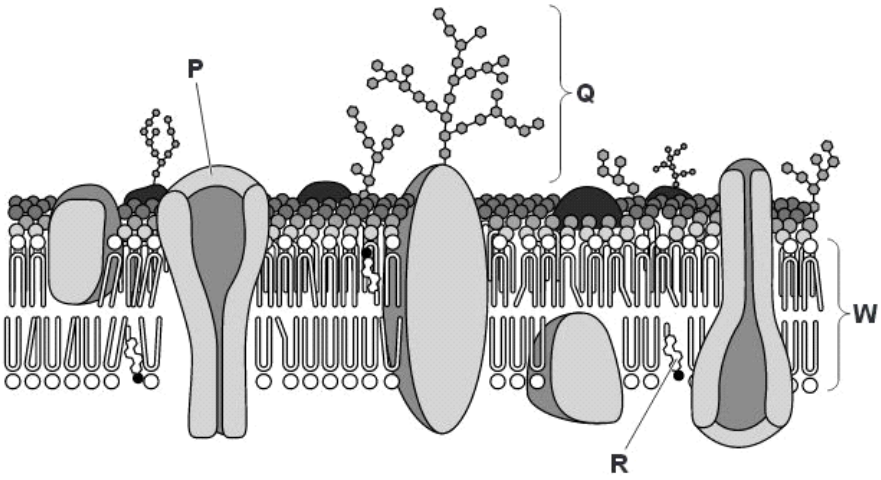


Fig. 5.1

(a) State the functions of structures **P**, **Q** and **R**.

P .....

.....

Q .....

.....

R .....

..... [3]

(b) Circle the width of the membrane shown as **W** in Fig. 5.1.

17.0 μm 1.7 μm 0.7 μm 70.0 nm 17.0 nm 7.0 nm 0.7 nm [1]

(c) Membranes, such as the cell surface membrane, are described as having a fluid mosaic structure.

Explain what is meant by the term *fluid mosaic*.

.....

.....

.....

.....

..... [2]

(d) Aquaporins are membrane channel proteins in plant and animal cells. They permit the movement of water across membranes. Explain why they are necessary.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 9]

Q9.

In some organisms, trehalose is used as an energy store and gives protection against the harmful effects of very low temperatures. Trehalose is sometimes referred to as a cryoprotectant, allowing organisms to survive in freezing conditions.

Freezing temperatures can damage the cell surface membrane and membranes within the cell.

(c) Explain the importance of the cell surface membrane to cells.

.....

.....

.....

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.....

.....

..... [3]

Q10.

(c) The membrane surrounding the vacuole, called the tonoplast, has a fluid mosaic structure.

Describe the structure of this membrane.

.....

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.....

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.....

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.....

.....

..... [4]

(d) Palisade mesophyll cells have very large vacuoles.

Explain how water moves from the xylem in the leaf into these vacuoles.

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..... [3]

Q11.

1 Fig. 1.1 is a drawing made from an electron micrograph showing a cross-section of an alveolus and two adjacent capillaries.

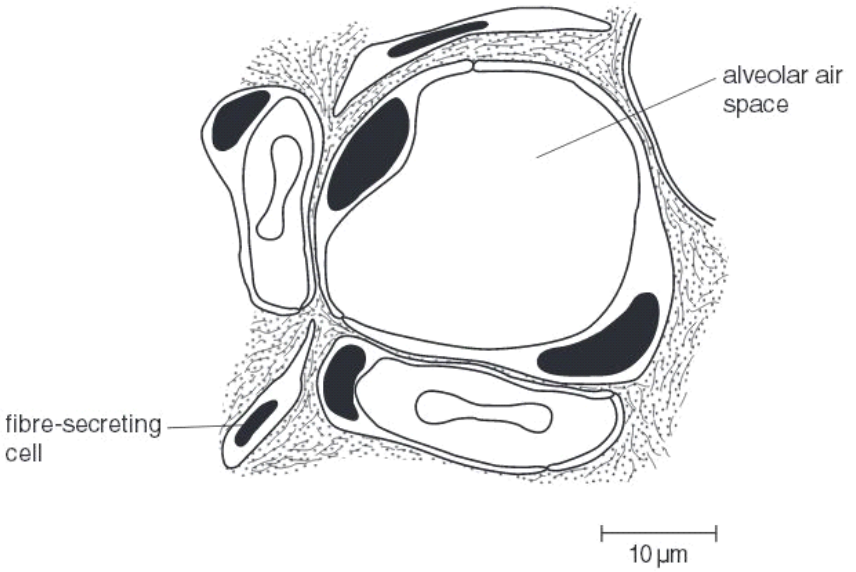


Fig. 1.1

(b) With reference to Fig. 1.1, describe the process of gaseous exchange in the alveolus.

.....

.....

.....

.....

.....[4]

Q12.

5 **(a)** State the roles of glycoproteins, carrier proteins and cholesterol in the cell surface membrane of an animal cell.

glycoproteins .....

.....

.....

carrier proteins .....

.....

.....

cholesterol .....

.....

.....[4]

(b) Fig. 5.1 is a diagram of an animal cell showing the concentrations and direction of movement of an ion **(A)** and a non-polar molecule **(B)** on either side of the cell surface membrane.

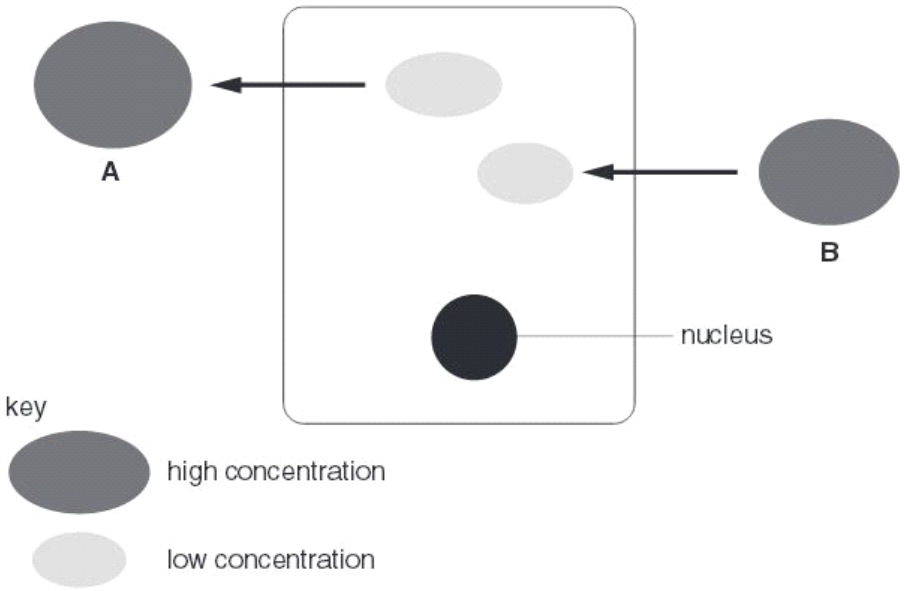


Fig. 5.1

With reference to Fig. 5.1, explain how **A** and **B** cross the cell surface membrane of the cell.

A .....

.....

.....

B .....

.....

.....[4]

(c) Describe how particles, such as bacteria, are taken up by phagocytes.

.....

.....

.....[2]

(d) Phagocytes contain many lysosomes.

State the function of lysosomes in phagocytes.

.....

.....[1]

[Total: 11]

Q13.

2 Phospholipids are components of cell surface membranes.

(a) Describe how phospholipid molecules are arranged in a cell surface membrane.

You may use the space below for a **simple annotated** diagram if you wish.

.....

.....

.....

.....

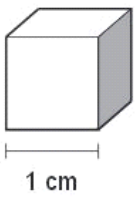
[2]

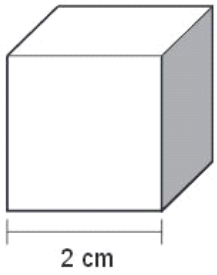
Q14.

5 An experiment was performed to find the effect of surface area:volume ratio on the rate of osmosis.

Pieces of yam were cut into cubes of the following sizes:

- 2 cm × 2 cm × 2 cm (surface area = 24 cm^2, volume = 8 cm^3)
- 1 cm × 1 cm × 1 cm (surface area = 6 cm^2, volume = 1 cm^3)





The cubes were carefully blotted dry, weighed and their fresh masses recorded.

One cube, 2 cm × 2 cm × 2 cm, was put into a beaker and covered with distilled water.

Eight cubes each measuring 1 cm × 1 cm × 1 cm were put into another beaker of distilled water, making sure that they were all covered with distilled water.

At intervals for a period of 45 hours, the cubes were removed from the beakers, blotted dry, reweighed and then replaced into fresh distilled water. The percentage increase in mass was calculated for the eight cubes of side 1 cm and the one cube of side 2 cm. The results are shown in Fig. 5.1.

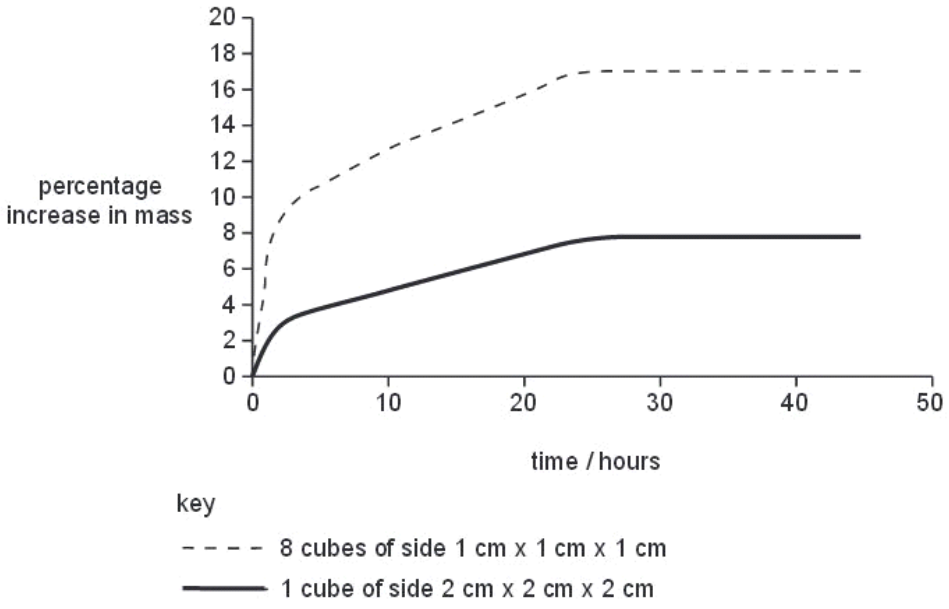


Fig. 5.1

(a) Explain why **eight** cubes of side 1 cm × 1 cm × 1 cm were used in this experiment.

.....

.....[1]

(b) Describe the results shown in Fig. 5.1.

.....

.....

.....

.....

.....

.....[3]

(c) Explain, **in terms of water potential**, why all the cubes of yam gained in mass.

.....

.....

.....

.....

.....

.....[3]

(d) Explain why the percentage increase in mass for the eight cubes of side 1 cm was faster than that of the cube of sides 2 cm.

.....

.....

.....

.....[2]

[Total: 9]

Q.15.

1 Fig. 1.1 is a photograph taken at low tide in a mangrove swamp in Mozambique.

Fig. 1.1

The photograph shows a hermit crab surrounded by the pneumatophores ('breathing roots') of mangrove trees. The hermit crabs live inside the shells of dead molluscs. Large birds, such as Goliath herons, feed on the hermit crabs. The vertical pneumatophores are an adaptation to the soil in the swampy, coastal environment that contains very little oxygen. They are exposed to the air at low tide. The soil has a very high salt content as the sea often covers the area. Some bacteria are able to grow deep in the rich organic mud where the oxygen concentration is very low.

(b) Explain how the cells in the roots of mangrove trees obtain sufficient oxygen and water in this extreme environment.

oxygen .....

.....

.....

.....

water .....

.....

.....

.....

.....[5]

Q.16.

(c) Other proteins are found in cell surface membranes.

Describe three roles of the proteins in cell surface membranes.

1 .....

.....

2 .....

.....

3 .....

.....[3]

Q.17.

3 Red blood cells are suspended in plasma which has a concentration equivalent to that of 0.9% sodium chloride (NaC*l*) solution.

A student investigated what happens to red blood cells when placed into sodium chloride solutions of different concentration.

A small drop of blood was added to 10cm^3 of each sodium chloride solution. Samples were taken from each mixture and observed under the microscope. The number of red blood cells remaining in each sample was calculated as a percentage of the number in the 0.9% solution. The results are shown in Fig. 3.1.

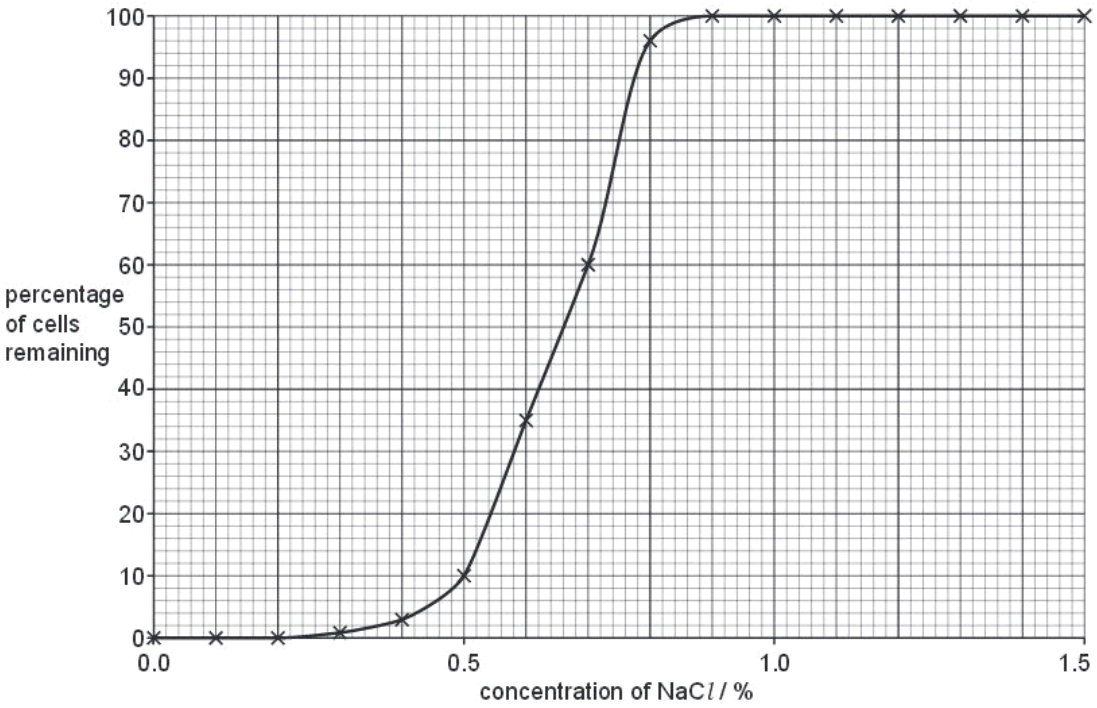


Fig. 3.1

(a) With reference to Fig. 3.1, describe the student's results.

.....

.....

.....

.....

.....

.....

.....

.....[3]

The student also measured the cell volumes of the red blood cells in three of the sodium chloride solutions. The results are shown in Table 3.1.

Table 3.1

concentration of sodium chloride /%	mean red cell volume /μm^3
0.7	120
0.9	90
1.5	65

Fig. 3.2 shows the appearance of some red blood cells removed from the 1.5% sodium chloride solution.

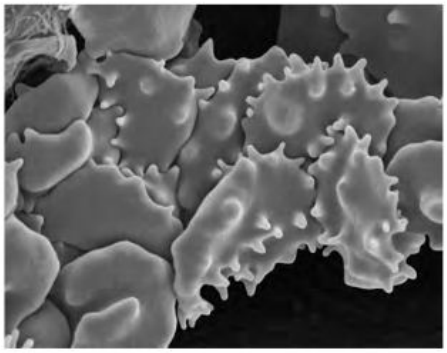


Fig. 3.2

(b) Explain the results shown in Fig. 3.1, Table 3.1 and Fig. 3.2, in terms of **water potential**.

0% NaCl solution .....

.....

.....

.....

.....

0.7% NaCl solution .....

.....

.....

.....

.....

1.5% NaCl solution .....

.....

.....

.....

[6]

Q.18

(b) Describe the process of *exocytosis*.

.....

.....

.....

.....

.....

..... [3]

Q.19

(c) A student carried out an investigation into osmosis using red blood cells.

Red blood cells were placed in sodium chloride (salt) solutions at five different concentrations. For each concentration, a sample was added immediately to a microscope slide and the cells were viewed using a light microscope for a period of time. The observations recorded are shown in Table 3.1.

Table 3.1

concentration of salt solution / %	observation of red blood cells
0.0	swell and burst, numbers decrease
0.4	increase in size
0.9	remain the same size
1.5	decrease in size
3.0	smaller and shrivelled

Explain, in terms of **water potential** and osmosis, the results that the student obtained.

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(d) The student also carried out a similar investigation using plant cells with cell walls removed. These cells were suspended in a 12% mannitol solution so that the water potential inside and outside of the cells was equal.

For Examiner's Use

Fig. 3.1 is a photomicrograph of these cells.

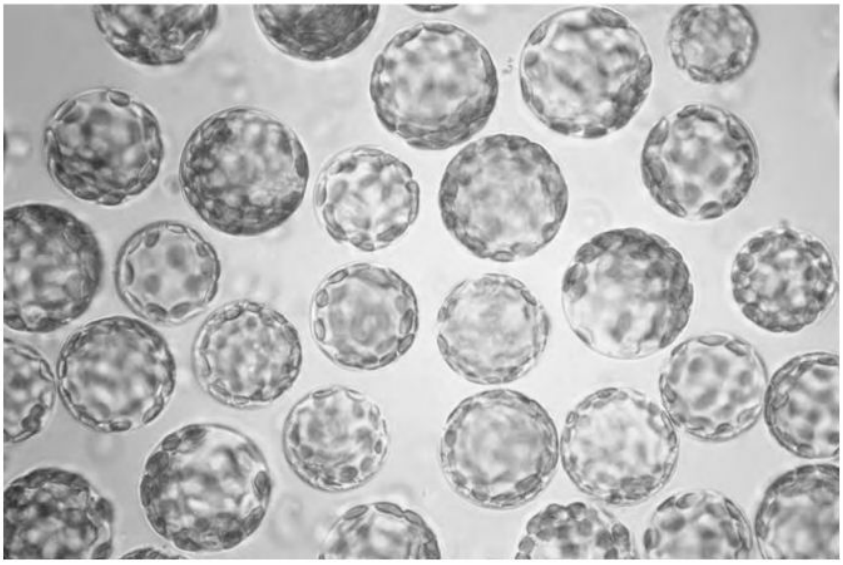


Fig. 3.1

The student removed a sample of these cells. The sample was placed into distilled water and was viewed using a light microscope.

Describe what you would expect the student to observe and explain why this would not occur with normal plant cells.

.....

.....

.....

..... [2]

Q.20.

1 Fig. 1.1 shows a diagram of part of a cell surface membrane.

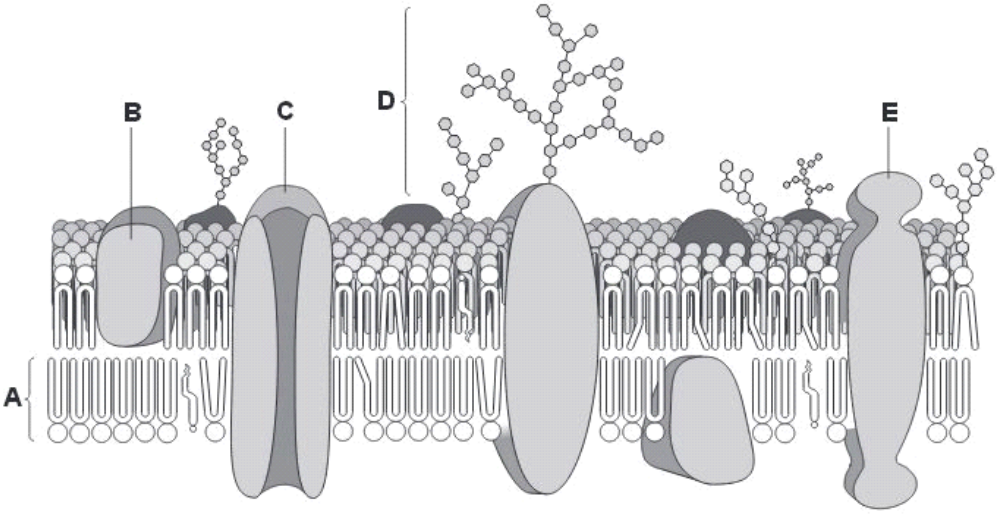


Fig. 1.1

(a) (i) Name molecules **A** and **B**.

A .....

B .....[2]

(ii) Explain how the features of molecules of **A** cause them to form a layer in the membrane as seen in Fig. 1.1.

.....

.....

.....

.....

.....[3]

(b) State the functions of **C** and **D**.

C .....

.....

D .....

.....[2]

(c) Structure **E** is a protein composed of 588 amino acids.

Calculate the minimum number of nucleotide base pairs required in the gene coding for this protein. Show your working.

Answer = ...[2]

[Total: 9]

Q.21.

1 Fig. 1.1 is a diagram of a cell surface membrane.

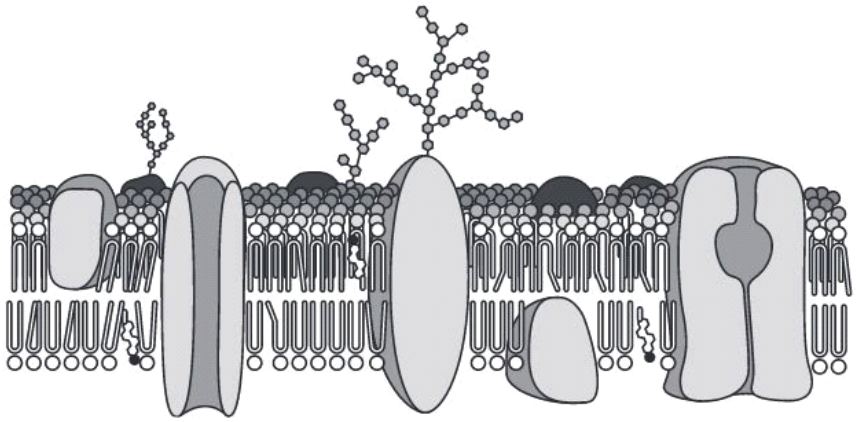


Fig. 1.1

(a) Use a label line and the appropriate letter to label each of the following on Fig. 1.1.

P protein for active uptake of potassium ions

Q protein for facilitated diffusion of polar molecules

R receptor site for a hormone

S hydrophilic heads of phospholipids on the internal surface of the membrane

T molecule that modifies the fluidity of the membrane [5]

(b) Some cells take in bacteria by endocytosis.

Explain how endocytosis occurs at a cell surface membrane.

.....

.....

.....

.....

.....

.....[3]

[Total: 8]

Q.22.

3 *Azotobacter vinelandii* is a bacterium found in the soil that is able to fix atmospheric nitrogen. One feature of nitrogen-fixing bacteria is the ability to synthesise the enzyme nitrogenase, a molybdenum- and iron-containing, protein complex.

(a) (i) Molybdenum is a mineral ion found in the soil solution. It enters the cell as molybdate ions, through membrane transport proteins. The proteins have the ability to bind to, and hydrolyse, ATP.

Name **and** describe the mechanism of transport of molybdate ions into the cell.

.....

.....

.....

.....

.....

.....[3]

Q23.

2 Thale cress, *Arabidopsis thaliana*, is used to study the roles of genes and proteins in plants.

For Examiner Use

The cell membranes of the root hairs of *A. thaliana* contain proteins called aquaporins that allow the movement of water between the soil and the cytoplasm as shown in Fig. 2.1.

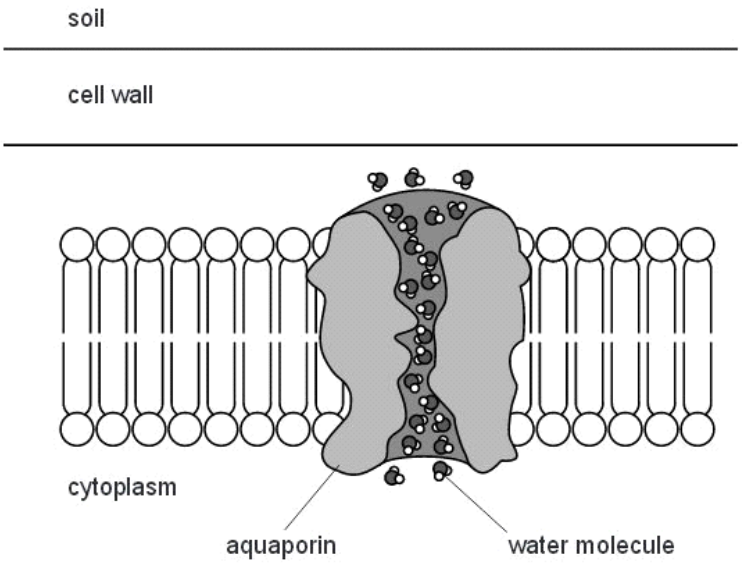


Fig. 2.1

(a) With reference to Fig. 2.1:

(i) explain how water is absorbed by root hairs of *A. thaliana*

.....

.....

.....

.....

.....

.....[3]

(ii) state why aquaporins are necessary in cell surface membranes.

.....

.....[1]

(b) Describe the pathway taken by water from the cytoplasm of the root hair cell to a xylem vessel in the centre of the root.

.....

.....

.....

.....

.....

.....[3]

Q.24.

2 The fluid mosaic model of membrane structure was first proposed in 1972 by Singer and Nicolson. The model describes in detail how the components of a membrane are organised.

(a) Some of the components of the cell surface membrane are:

- phospholipid molecules
- protein molecules
- cholesterol molecules.

(i) In the box below, draw a labelled diagram of a section through a cell surface membrane to show how the above components are organised within the membrane.

The diagram should include other named components of the membrane.

Label the inner and outer surfaces of the membrane.

[5]

(ii) Suggest why 'fluid mosaic' is an appropriate term to use to describe membrane structure.

.....

.....

.....

.....

.....

..... [3]

[Total: 8]

Q.25.

(c) Some pea plants were grown with their roots in a solution of mineral ions. The solution was kept aerated for three days.
The concentrations of five ions in the solution and in the root tissue were determined after the three days. The results are shown in Table 2.2.

Ex

Table 2.2

ion	concentration / mmol dm^{-3}	
	surrounding solution	root tissue
potassium (K^+)	1.0	75.0
magnesium (Mg^{2+})	0.3	3.5
calcium (Ca^{2+})	1.0	2.0
phosphate (PO_4^{3-})	1.0	21.1
sulfate (SO_4^{2-})	0.3	19.7

With reference to Table 2.2, suggest how cell surface membranes of root cells are responsible for the concentrations of ions in the roots compared to the surrounding solution.

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.....[5]

Q.26.

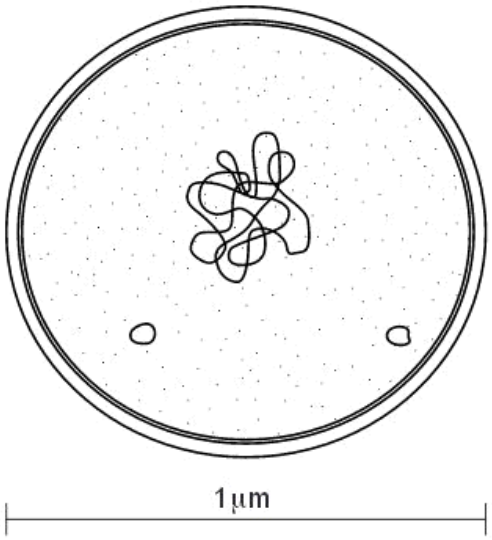


Fig. 4.1

(b) Bacterial cells behave in a similar way to plant cells when immersed in solutions of different water potential.

Suggest **and** explain what would happen to bacteria placed in a solution with a water potential more negative than their cell contents.

.....

.....

.....

.....

.....

.....[3]

Q.27.

1 (a) Cell surface membranes are involved with the movement of substances into and out of cells.

Calcium pumps in cell surface membranes maintain a concentration of calcium ions inside the cytoplasm that is a thousand times lower than outside the cell.

Fig. 1.1 shows the movement of calcium ions across a cell surface membrane.

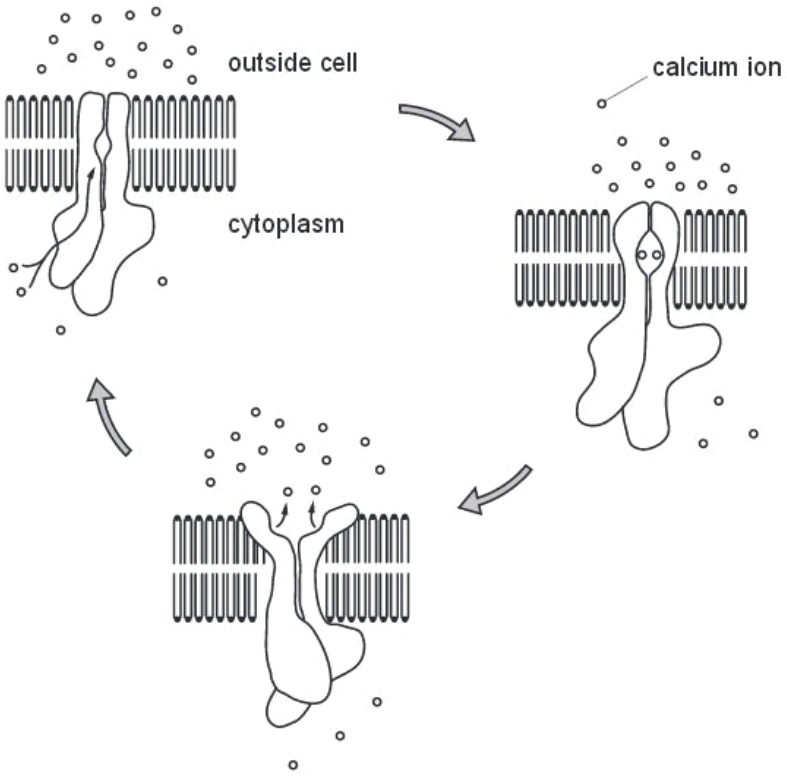


Fig. 1.1

With reference to Fig. 1.1,

(i) explain why calcium ions do not pass through the phospholipid bilayer;

.....

.....

.....

.....[2]

(ii) name and describe the process by which calcium ions are moved across the membrane.

name .....

description .....

.....

.....

.....

.....[3]

(b) Phagocytosis is the process by which bacteria are ingested by cells.

Describe the role of the cell surface membrane during phagocytosis.

.....

.....

.....

.....

.....

.....[3]

(c) Phagocytic cells contain many lysosomes.

Describe the function of lysosomes in destroying ingested bacterial cells.

.....

.....

.....

.....

.....

.....

.....

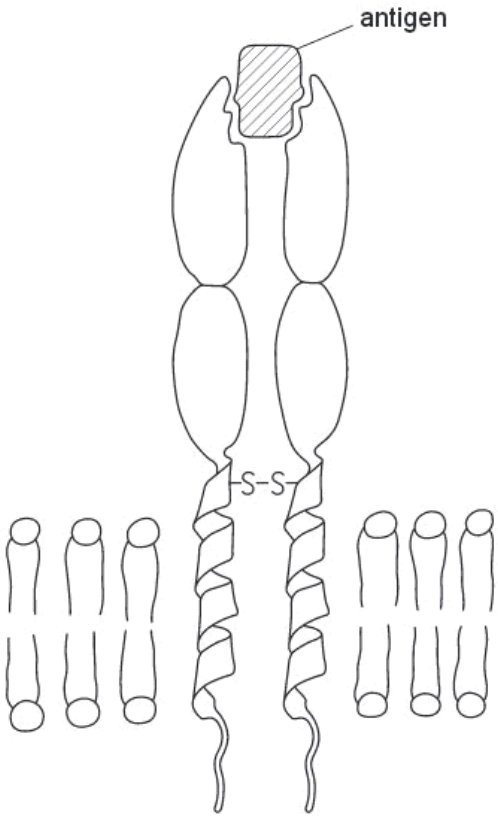
.....[4]

[Total: 12]

Q.28.

1 Receptor proteins are part of the fluid mosaic structure of cell surface (plasma) membranes of T-lymphocytes. Each type of receptor protein is specific to a particular antigen.

Fig. 1.1 shows a receptor protein and the surrounding phospholipids of a cell surface membrane of a T-lymphocyte.



(a) (i) Draw a bracket (}) on Fig. 1.1 to indicate the width of the phospholipid bilayer. [1]

(ii) Explain the term *fluid mosaic*.

.....

.....

.....

.....

..... [2]

(c) Describe three functions of cell surface membranes, **other than** the recognition of antigens.

1 .....

.....

2 .....

.....

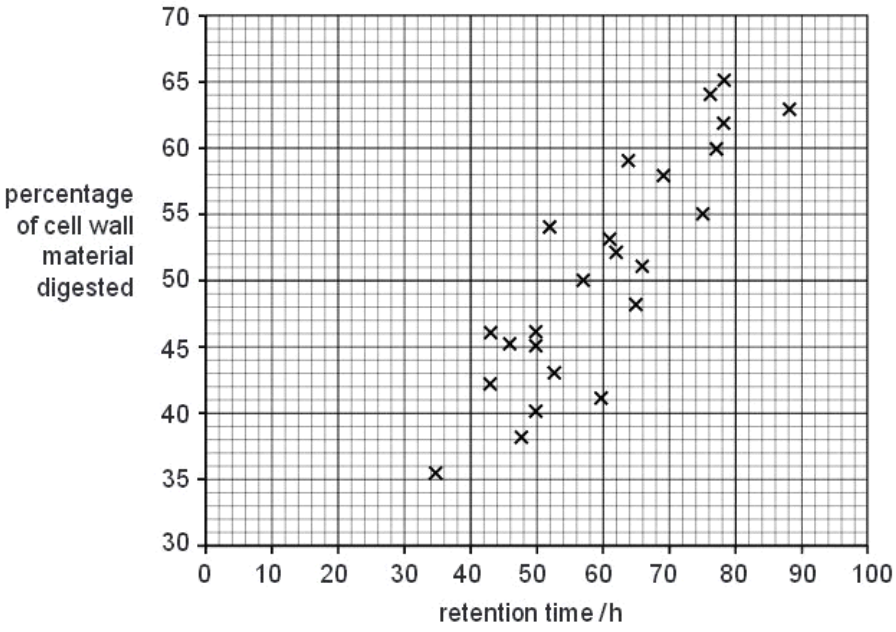
3 .....

..... [3]

Q.29.

Animals do not have the ability to produce enzymes to digest cellulose. Most herbivores have bacteria in their digestive systems that can digest cellulose.

Fig. 5.1 shows the results of a study on 24 different herbivores. The percentage of cell wall material that was digested by each animal was determined. The time taken for the plant material to pass through the digestive system, the retention time, was also recorded.



(c) Digested material in animals is absorbed using both facilitated diffusion and active transport.

State two similarities **and** two differences between facilitated diffusion and active transport.

similarities:

1. .....

2. .....

differences:

1. .....

2. .....

[4]