

Cambridge International AS & A Level

BIOLOGY (9700) PAPER 2

Past Paper Questions By Topic
+ Answer Scheme

2015 - 2020

Complete Syllabus



Chapter 4

Cell membranes and transport



4.1 Fluid mosaic membranes

31. 9700_s20_qp_21 Q: 1

Fig. 1.1 shows five biological molecules.

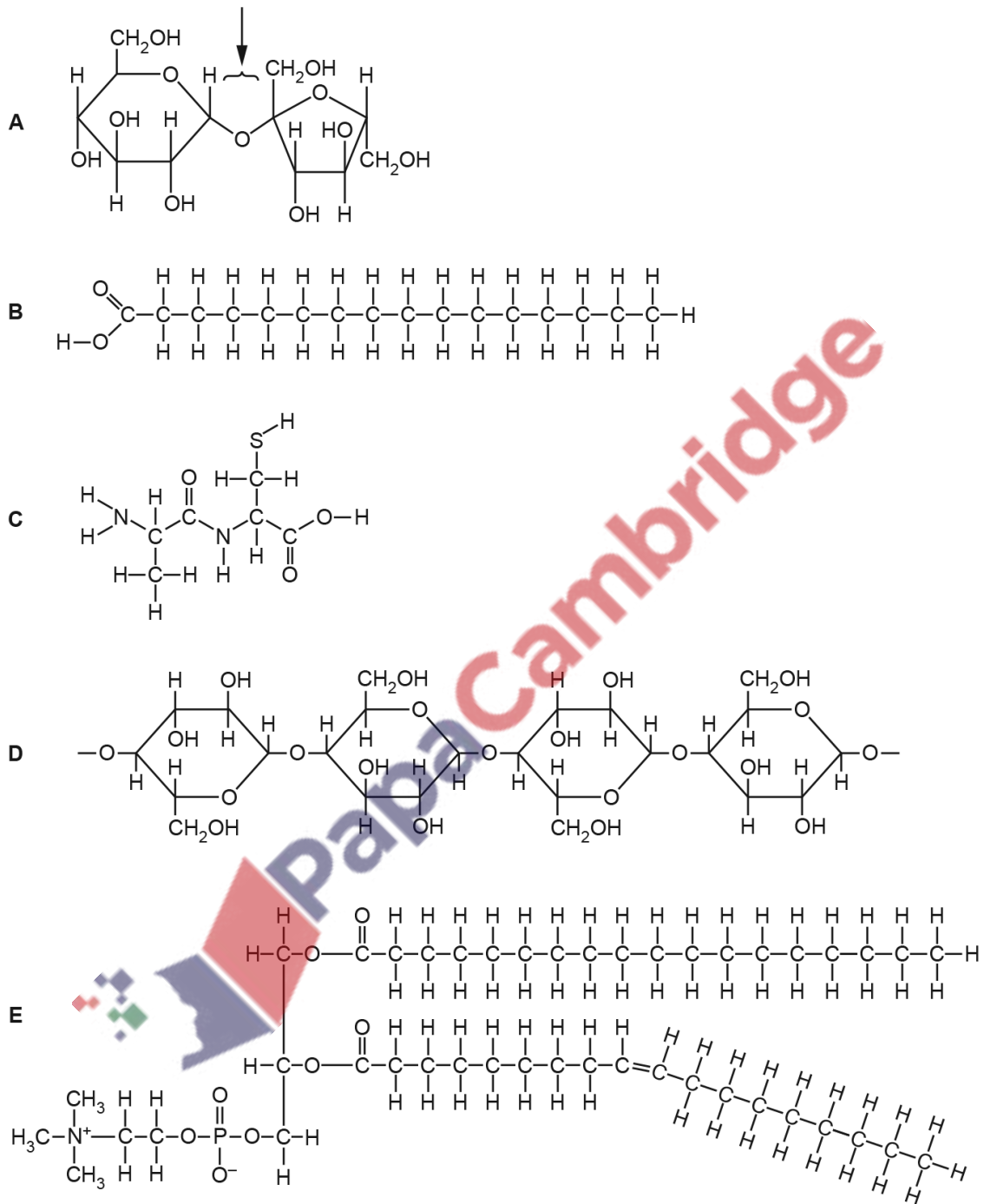


Fig. 1.1

(a) State the name of the bond in molecule **A** indicated by the arrow.

..... [1]

(b) Molecule **B** is described as a saturated fatty acid.

State why molecule **B** is described as a saturated fatty acid.

.....
..... [1]

(c) Molecule **D** is a polymer.

State the name of the monomer that is used to synthesise this polymer.

..... [1]

(d) State the letter of the molecule that could be formed during the hydrolysis of a polypeptide.

..... [1]

(e) State the letter of the molecule that forms part of the cell surface membranes of eukaryotic cells.

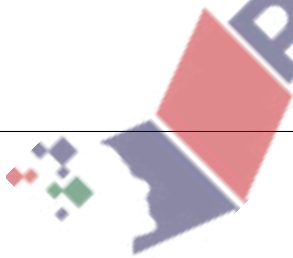
..... [1]

(f) Molecule **A** and molecule **C** dissolve in water. Molecule **B** does **not** dissolve in water.

Explain why molecule **A** and molecule **C** dissolve in water, but molecule **B** does **not** dissolve in water.

.....
.....
..... [1]

[Total: 6]



32. 9700_m19_qp_22 Q: 5

Human prolactin (hPRL) is a globular protein. It is a single polypeptide composed of 199 amino acids. The protein is transported in the bloodstream and has an effect only on cells that have a cell surface membrane protein known as PRLR.

One effect of hPRL is to stimulate cells in the mammary glands to produce breast milk. Cells that have been stimulated by hPRL need more glucose and therefore the passive uptake of glucose increases.

(a) State **one** reason why the cells in the mammary glands that have been stimulated by hPRL need more glucose.

.....

.....

..... [1]

(b) An experiment was carried out to investigate the movement of glucose and hPRL across Visking tubing membrane.

- A short section of Visking tubing, tied at both ends and containing distilled water, was placed into a beaker containing a solution of glucose and hPRL.
- After 20 minutes, separate samples of the solution in the Visking tubing and the solution in the beaker were each tested for the presence of protein and reducing sugar.

A summary of the methods used, the experimental results and the deductions made are shown in Table 5.1.

Table 5.1

sample	method used	colour obtained after testing	deduction
solution in Visking tubing	biuret solution added to sample		protein absent from solution in Visking tubing
solution in beaker			protein present in solution in beaker
solution in Visking tubing	Benedict's solution added to sample and mixture heated in a water-bath		reducing sugar present in solution in Visking tubing
solution in beaker			reducing sugar present in solution in beaker

- (i) Complete the column in Table 5.1 headed **colour obtained after testing**. [2]
- (ii) With reference to the deductions made in Table 5.1, explain the movement of hPRL and reducing sugar across Visking tubing membrane.

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..... [2]

- (c) Outline how glucose crosses the cell surface membranes of the cells of the mammary glands.

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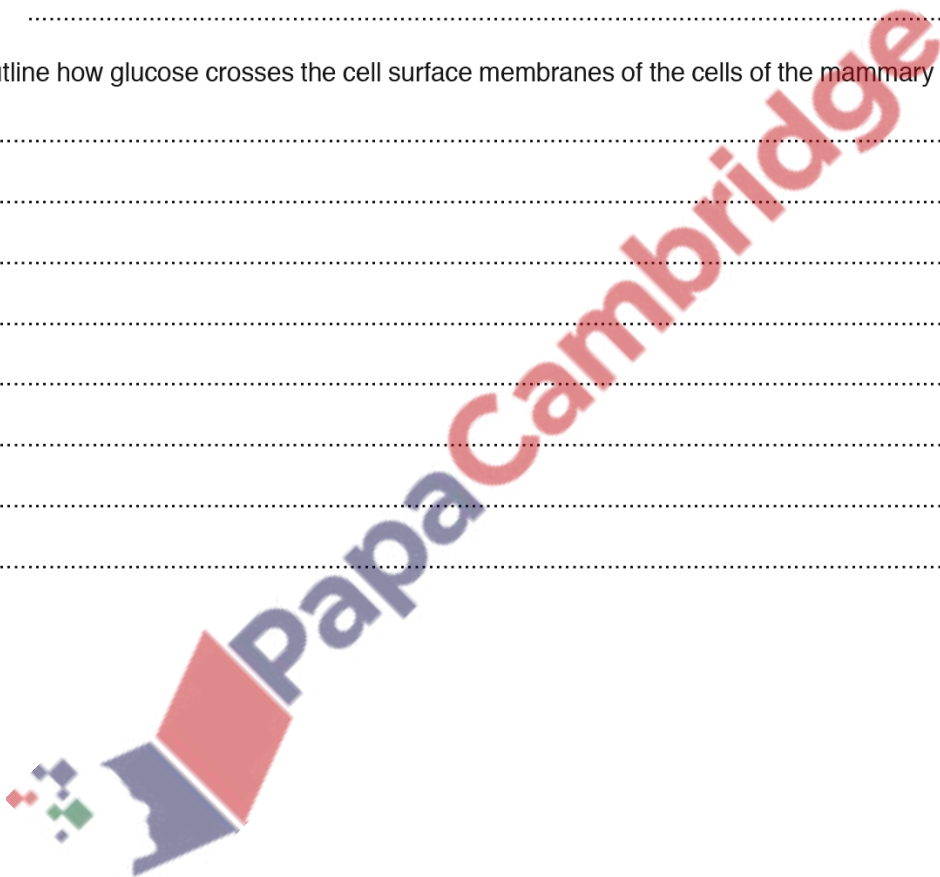
.....

.....

.....

.....

..... [2]



33. 9700_w19_qp_23 Q: 6

Fig. 6.1 is a diagram of the cell surface membrane of a squamous epithelial cell lining an alveolus.

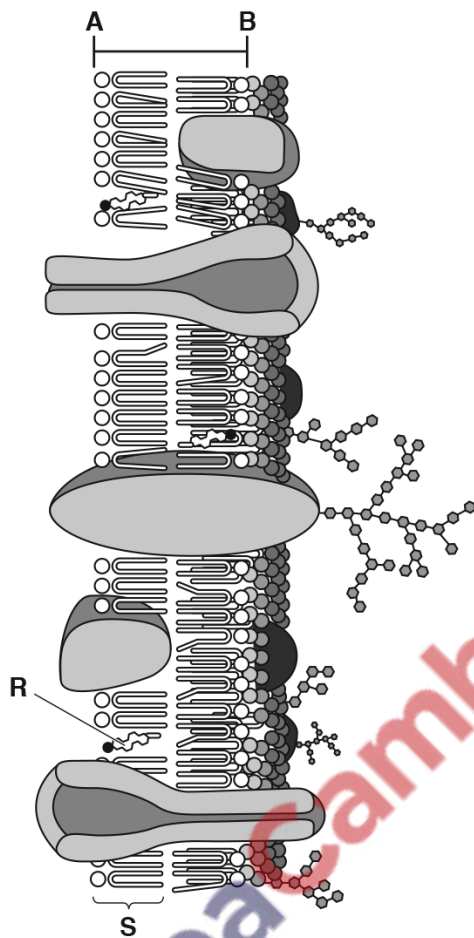


Fig. 6.1

- (a) (i) A student measured the line **A–B** and calculated the actual width of the membrane in Fig. 6.1.

State the unit that the student should use for the actual width of the membrane.

..... [1]

- (ii) With reference to Fig. 6.1, state how to identify the external surface of the cell surface membrane.

.....
 [1]

(b) Name **R** and **S** in Fig. 6.1 and describe their roles in the membrane.

component R

name

role

.....

component S

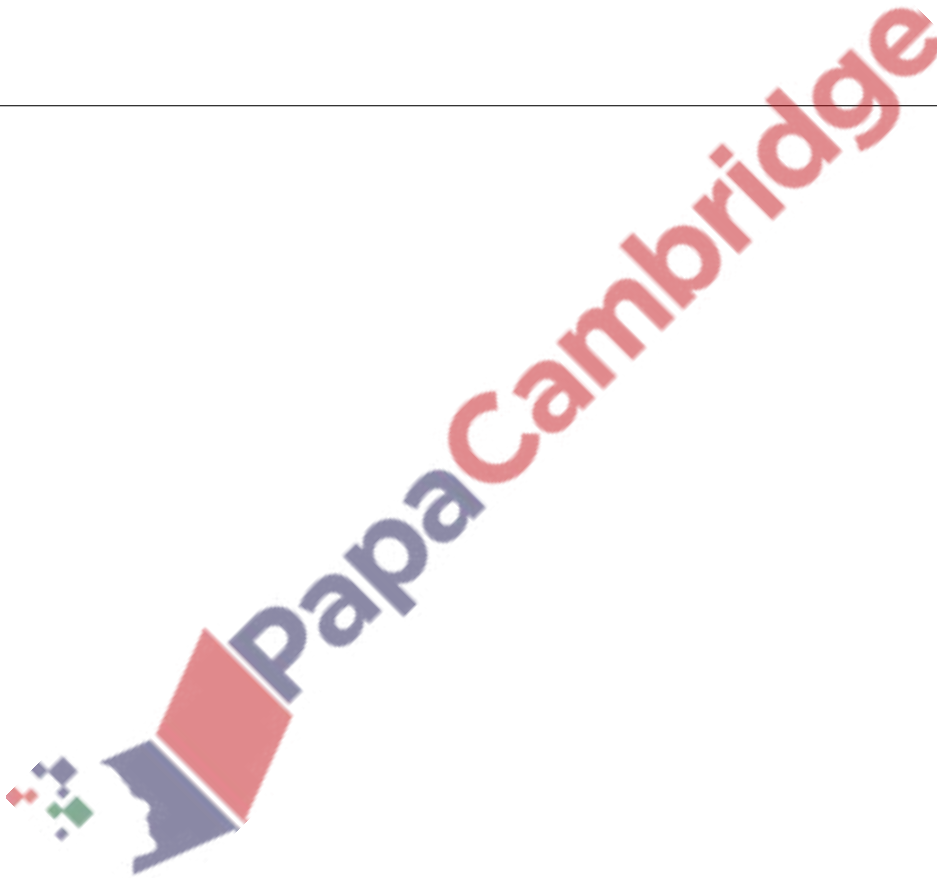
name

role

.....

[4]

[Total: 6]



34. 9700_m18_qp_22 Q: 1

Fig. 1.1 is an electron micrograph of part of a eukaryotic cell.

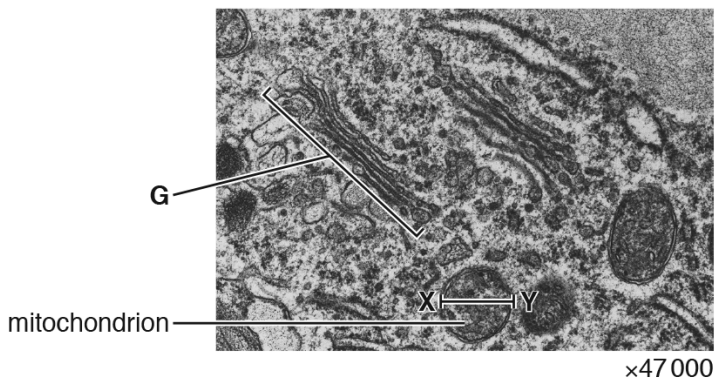


Fig. 1.1

- (a) State how it is possible to deduce that Fig. 1.1 is a transmission electron micrograph and **not** a scanning electron micrograph.

.....
 [1]

- (b) Both the Golgi body and the rough endoplasmic reticulum are part of the internal network of membranes in cells.

Outline structural features shown in Fig. 1.1 that identify **G** as the Golgi body and **not** the rough endoplasmic reticulum.

.....

 [2]

- (c) Calculate the actual diameter, **X–Y**, of the mitochondrion labelled in Fig. 1.1.

Write down the formula that you will use to make your calculation. Give your answer to the nearest whole **nanometre** (nm).

<i>formula</i>

actual diameter nm
 [2]

(d) The inner and outer membranes of the mitochondrion have a fluid mosaic structure similar to other cell membranes. They are both approximately 6 to 7 nanometres (nm) thick.

(i) Outline the fluid mosaic model of membrane structure.

There is space below for a diagram.

.....

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.....

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.....

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.....

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..... [3]

(ii) The inner and outer membranes of the mitochondrion differ in the detail of their membrane components. The inner membrane is also much less permeable than the outer membrane.

Suggest **one** way in which the structure of the inner membrane may differ from that of the outer membrane to produce a **less permeable** inner membrane.

.....

.....

..... [1]

[Total: 9]

35. 9700_s17_qp_23 Q: 4

- (a) Complete Table 4.1 by using a tick (✓) to indicate which statements apply to each of the molecules. Use a cross (X) for statements that do **not** apply.

Some of the boxes have been completed for you.

Table 4.1

statement	ATP	cellulose	haemoglobin	phospholipid
contains phosphorus	✓		X	
found in plants				
contains iron				X
has a structural role				

[4]

- (b) Fig. 4.1 shows two amino acids.

Complete Fig. 4.1 to show how a peptide bond forms between these two amino acids.



Fig. 4.1

[3]

- (c) Some glycoproteins in cell surface membranes function as transport proteins.

State two **other** functions of glycoproteins in cell surface membranes.

1

.....

2

.....[2]

[Total: 9]

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36. 9700_w17_qp_21 Q: 5

Fig. 5.1 is a transmission electron micrograph of part of a cell.

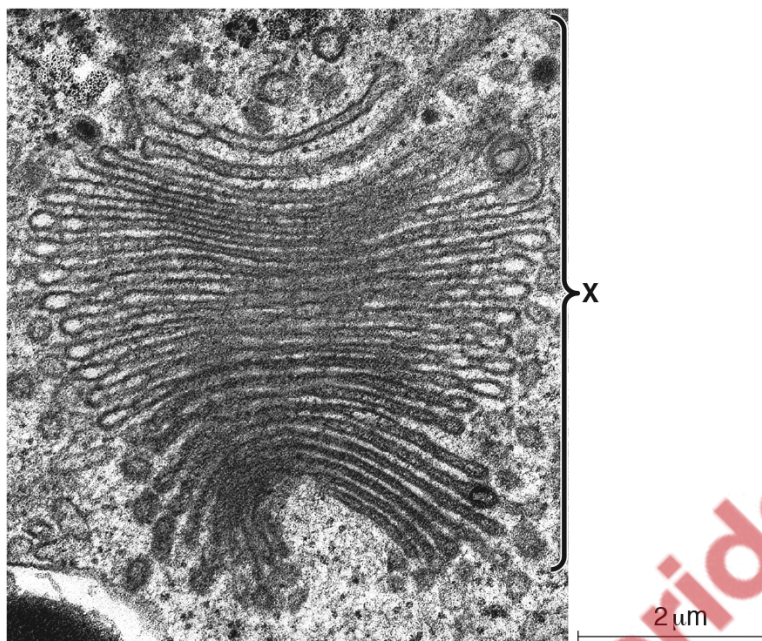


Fig. 5.1

(a) (i) Name the organelle labelled X.

.....[1]

(ii) Put a tick (✓) in the box beside the type, or types, of cell that contain this organelle.

animal cell	
plant cell	
bacterial cell	

[1]

(b) Use the scale bar to calculate the magnification of Fig. 5.1.

Write down the formula and use it to make your calculation. Show your working.

formula

magnification ×[3]

- (c) The organelle in Fig. 5.1 is made from structures surrounded by a single membrane.

Name **two** organelles that are surrounded by double membranes.

.....[2]

- (d) (i) The structure of the cell surface membrane is described as a fluid mosaic.

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

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.....[2]

- (ii) Outline the roles of the cell surface membrane.

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.....
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.....
.....
.....[4]

[Total: 13]

37. 9700_w17_qp_22 Q: 3

Hydrolytic enzymes can function within the cell or can be secreted by the cell, where they are able to catalyse reactions.

(a) State the term used to describe an enzyme that functions within the cell.

.....[1]

(b) The rates of reaction of two different hydrolytic enzymes, enzyme **G** and enzyme **H**, were measured at different substrate concentrations. The results are shown in Fig. 3.1.

The two enzymes have different values of the Michaelis–Menten constant (K_m).

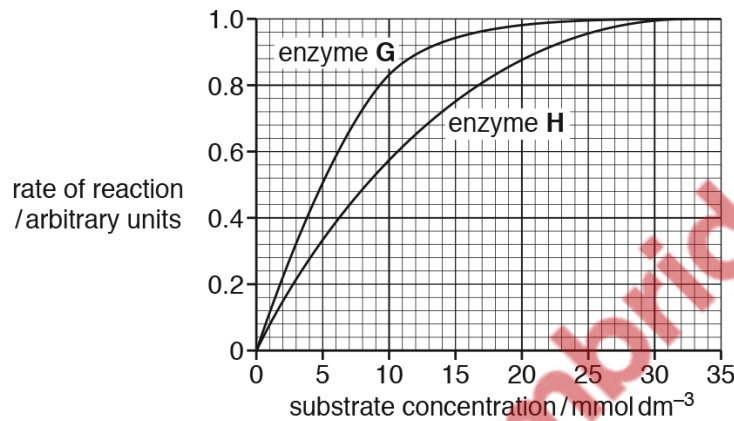


Fig. 3.1

(i) The K_m value of enzyme **G** is 5 mmol dm⁻³.

Use Fig. 3.1 to derive the K_m value for enzyme **H**.

Show your working.

.....

[2]

(ii) With reference to Fig. 3.1, explain how the values of K_m for these enzymes provide information about the relationship between the enzyme and their substrates.

.....

[2]

Cells can break down an old or damaged organelle, such as a mitochondrion, by enclosing the organelle in a membrane formed from the endoplasmic reticulum. This forms a vacuole. Vesicles containing hydrolytic enzymes fuse with the vacuole and the organelle is then digested.

- (c) Name the vesicles in the cell that contain hydrolytic enzymes.

.....[1]

- (d) The cell has internal chemical messengers that signal when an old or damaged mitochondrion should be broken down.

Suggest **one** feature involving mitochondrial structure or function that could lead to the release of these internal signals.

.....

.....[1]

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38. 9700_s16_qp_21 Q: 6

Fig. 6.1 shows an incomplete diagram of the fluid mosaic model of membrane structure. The diagram shows the cell surface membrane of a eukaryotic cell.

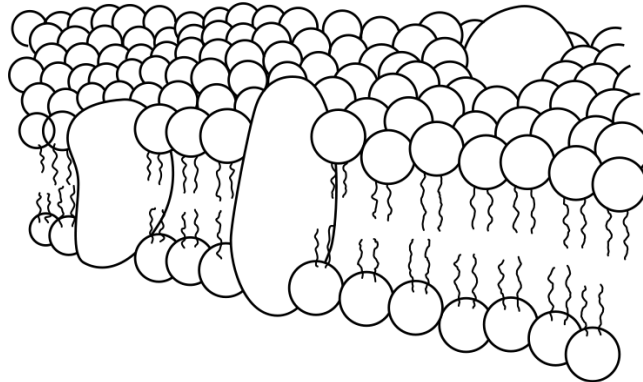


Fig. 6.1

(a) State what is meant by the term fluid mosaic.

.....

 [2]

(b) State the thickness of a cell surface membrane.

..... [1]

(c) List four features of cell surface membranes of eukaryotic cells that are **not** visible in Fig. 6.1.

1

 2

 3

 4
 [4]

[Total: 7]

- (c) State two components of a cell surface membrane **other than** phospholipid molecules and describe their function.

component 1

function

.....

.....

component 2

function

.....

.....[4]

[Total: 11]

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40. 9700_w15_qp_21 Q: 2

Fig. 2.1 is a diagram of the structure of a protein channel for ions in a cell surface membrane.

Fig. 2.1a shows the channel when open and Fig. 2.1b shows the same channel when closed.

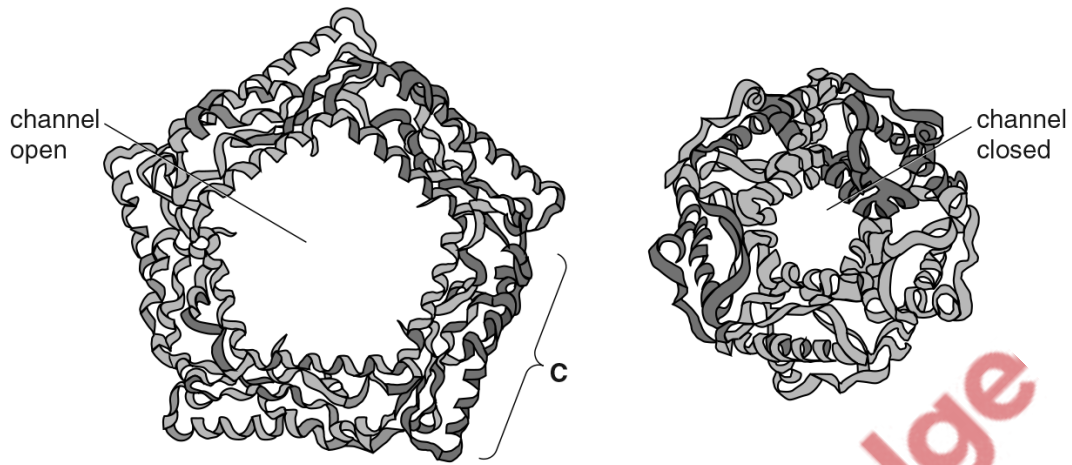


Fig. 2.1a

Fig. 2.1 b

(a) (i) Name the process by which ions pass across the membrane using channel proteins.

..... [1]

(ii) Explain why a channel protein is needed for ions to pass across a cell membrane.

.....
.....
.....
.....
..... [2]



- (b) The channel protein in Fig. 2.1 is made from five identical polypeptide chains.
- (i) Name the level of protein structure which is present when five polypeptide chains form the protein.

..... [1]

- (ii) The part labelled **C** in Fig. 2.1 is another level of protein structure.

Name this level.

..... [1]

- (c) Channel proteins are examples of transmembrane proteins. The polypeptides are held together and also interact with phospholipids in the membrane.

Suggest how the polypeptides are held together **and** suggest how they interact with phospholipids.

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.....
..... [3]

[Total: 8]



4.2 Movement of substances into and out of cells

41. 9700_w20_qp_23 Q: 6

- (a) Fig. 6.1 shows *Vorticella*, which is a single-celled organism that lives in freshwater. *Vorticella* has many cilia which it uses for feeding.



Fig. 6.1

The distance shown by X–Y on Fig. 6.1 is $150\mu\text{m}$.

Calculate the magnification of Fig. 6.1.

State the formula that you will use and show your working.

Write your answer to the nearest whole number.

formula

..... [3]



- (b) The food particles are taken into the gullet by a current of water created by movement of cilia.

Any particles suspended in the water, such as bacteria, are taken into the cell as shown in Fig. 6.2.

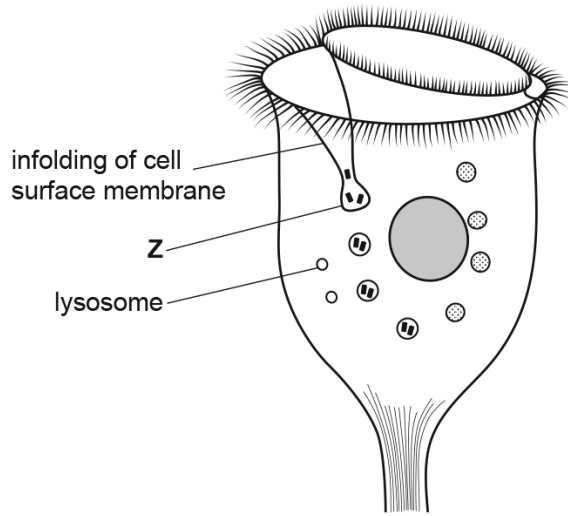


Fig. 6.2

- (i) State the name of the process which takes the bacteria into the cell at **Z** and describe the way in which it occurs.

name

description

.....

[3]

- (ii) Describe the role of lysosomes in intracellular digestion in *Vorticella*.

.....

[3]

[Total: 9]

42. 9700_m18_qp_22 Q: 4

Fig. 4.1 is a diagram of a section through part of a young root.

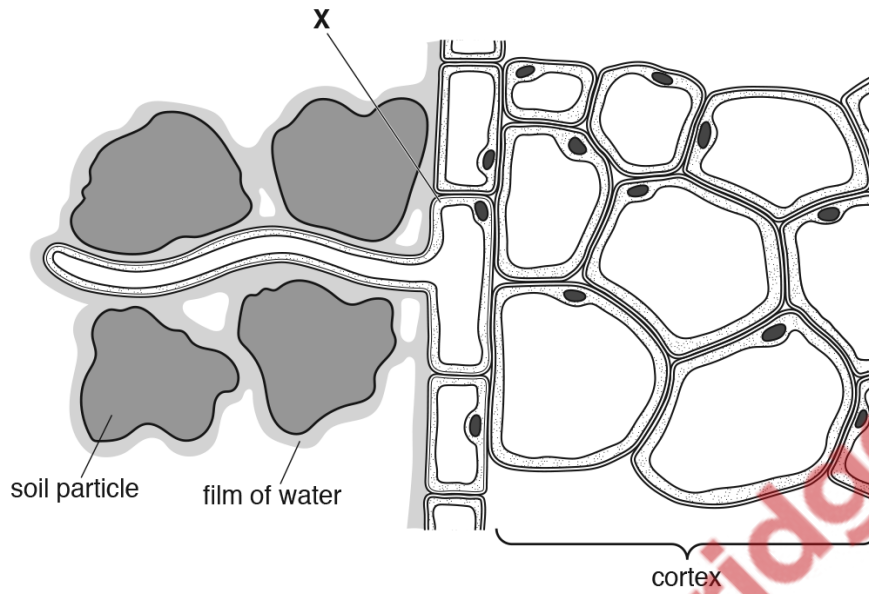


Fig. 4.1

- (a) Describe the pathways by which water passes from the soil to the cells of the cortex shown in Fig. 4.1.

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.....

.....

.....

.....

.....

.....

..... [4]

- (b) There is a greater density of mitochondria in the cytoplasm of cell X than in the cytoplasm of a cell of the cortex.

Suggest why this is so.

.....

..... [1]

[Total: 5]

43. 9700_m17_qp_22 Q: 6

(a) A student investigated the effect of changing the surface area to volume ratio on diffusion.

- Two different-sized blocks of agar, **X** and **Y**, were made.
- The agar contained Universal Indicator solution.
- Universal Indicator solution changes colour when acid is added.
- The blocks were placed in dilute hydrochloric acid at the same temperature.
- The student timed how long it took for each block to change colour completely.

Blocks **X** and **Y** are shown in Fig. 6.1. All dimensions are in cm.

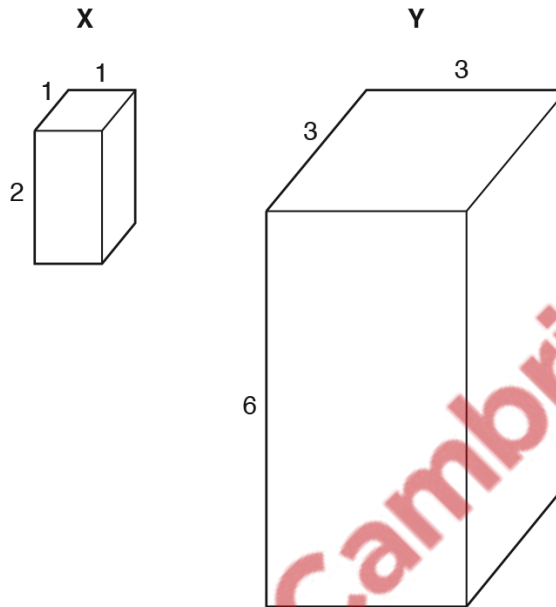


Fig. 6.1

- (i) The surface area to volume ratio of block **X** is 5:1.
Calculate the surface area to volume ratio of block **Y**.
Show your working.

[2]

- (ii) The student observed that block **X** changed colour completely in a much shorter time than block **Y**.

Explain why.

.....

.....

.....

.....

..... [2]

- (iii) Suggest how the results of this investigation help to explain why plants need a transport system.

.....

.....

.....

.....

..... [2]

- (b) An experiment was carried out by the student to investigate the ability of reducing sugars to diffuse through Visking tubing. Fig. 6.2 shows the apparatus used.

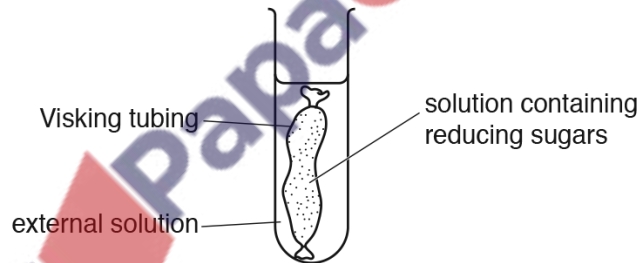


Fig. 6.2

At the start of the experiment, the external solution did not contain any reducing sugars.

At intervals, the student tested for the presence of reducing sugars, both within the Visking tubing and in the external solution.

Name the reagent that is used to test for the presence of reducing sugars.

..... [1]

[Total: 7]

44. 9700_s15_qp_23 Q: 1

The cell surface membrane has a fluid mosaic structure.

(a) Describe what is meant by the term *fluid mosaic*.

.....

[2]

(b) In 1934, the biologists Davson and Danielli published their suggestion for the structure of the cell surface membrane, as shown in Fig. 1.1.

They suggested that the membrane was a phospholipid bilayer with a layer of hydrophilic protein on both surfaces.

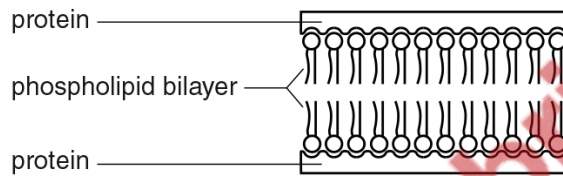


Fig 1.1

State **one** way in which the Davson-Danielli structure is similar to the fluid mosaic structure **and one** way in which it differs from the fluid mosaic model.

similarity

.....
[1]

difference

.....
[1]

- (b) Each molecule of catalase consists of four identical polypeptides. The two forms of catalase in *A. gambiae* differ by only one amino acid at position 2 in the amino acid sequence. Catalase **P** has serine and catalase **Q** has tryptophan.

Suggest how the difference in one amino acid is responsible for the lower activity of catalase **Q** compared with catalase **P**.

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.....
.....
.....
..... [2]

- (c) Female mosquitoes feed on blood in order to produce their eggs. After feeding, the metabolic rate increases for egg production.

The researchers allowed female mosquitoes to feed on blood. They found that female mosquitoes with only catalase **P** produced more eggs than those with only catalase **Q**.

Suggest why there is a difference in egg production between the two types of *A. gambiae*.

.....
.....
.....
.....
..... [2]

- (d) Metal ions can act as a non-competitive inhibitor of catalase.

Explain how copper ions can act as a non-competitive inhibitor.

.....
.....
.....
.....
..... [2]

- (e) Enzyme inhibitors can also inhibit carrier proteins in cell surface membranes.

Explain why carrier proteins are required in cell surface membranes.

.....
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.....
.....
..... [2]

- (f) Describe three roles of cell surface membranes, **other than** the transport of substances into and out of cells.

1.
.....
2.
.....
3.
..... [3]

[Total: 16]

