Cell membranes and transport – AS 9700 June 2022

1. June/2023/Paper_9700/11/No.15

Four students, **A**, **B**, **C** and **D**, observed plant epidermal cells that had been placed in a concentrated sucrose solution for 30 minutes. They were asked to identify the partially permeable layer and to explain the appearance of the cells in terms of water potential and movement of water.

Which student is correct?

	partially permeable layer	water potential at start of experiment	movement of water during experiment
A	cell surface membrane	cell contents have a lower water potential than the sucrose solution	water moved out of the cell and no water moved in
B	cell surface membrane	cell contents have a higher water potential than the sucrose solution	more water moved out of the cell than moved in
C	cell wall	cell contents have a lower water potential than the sucrose solution	more water moved out of the cell than moved in
D	cell wall	cell contents have a higher water potential than the sucrose solution	water moved out of the cell and no water moved in

2. June/2023/Paper_9700/11/No.16

The table compares the surface area to volume ratios of five agar blocks that differ in dimensions but which all have the same volume.

The agar blocks can be used to measure the efficiency of diffusion, where efficiency is measured as the time taken for a dye to reach all parts of the block.

	length / mm	width / mm	height / mm	surface area / mm^2	volume / mm^3	surface area : volume ratio
1	8	8	8	384	512	0.75
2	16	16	2	640	512	1.3
3	32	4	4	544	512	1.1
4	32	32	0.5	2112	512	4.1
5	64	4	2	784	512	1.5

Which prediction can be made about the way in which size and dimensions of these blocks affect the efficiency of diffusion?

A The efficiency of diffusion will decrease as the width of a block increases.

B The efficiency of diffusion will increase as the height of a block increases.

C The efficiency of diffusion will increase as a block of fixed volume is flattened.

D The efficiency of diffusion will decrease as a block of fixed volume is elongated.

3. June/2023/Paper_9700/12/No.15

Which molecules in cell surface membranes are typically involved in cell recognition?

	cholesterol	glycolipids	glycoproteins	phospholipids
A	✓	✓	✗	✗
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✗	✓	✓

key

✓ = involved

✗ = not involved

4. June/2023/Paper_9700/12/No.16

What can increase the fluidity of the cell surface membrane?

1 single bonds between carbon atoms in the fatty acid chains

2 cholesterol

3 longer-chained fatty acids

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

5. June/2023/Paper_9700/12/No.17

The three main factors that affect the rate of diffusion across a membrane can be expressed by the relationship shown.

$$\text{rate of diffusion is proportional to } \frac{\text{surface area} \times \text{concentration difference}}{\text{thickness of membrane}}$$

Which changes in the factors would result in the rate of diffusion doubling?

1 Surface area has doubled.

2 Concentration difference has halved.

3 Thickness of membrane has doubled.

4 Thickness of membrane has halved.

A 1, 2 and 4 **B** 1 and 3 **C** 1 and 4 only **D** 2 and 3

6. June/2023/Paper_9700/12/No.18

A student measured the time taken for complete diffusion of a dye into agar blocks of different sizes which were suspended in the dye.

The results are shown.

size of agar block / mm × mm × mm	time for diffusion / s
5 × 5 × 5	6.2
10 × 10 × 10	16.1
15 × 15 × 15	34.5
5 × 10 × 15	

What is the predicted time for complete diffusion of the dye into the agar block measuring 5 mm × 10 mm × 15 mm?

A 6.2 s

B 16.1 s

C 34.5 s

D more than 34.5 s

7. June/2023/Paper_9700/13/No.17

Which row shows the distribution of cholesterol and the carbohydrate chains of glycolipids and glycoproteins in a cell surface membrane?

	cholesterol	carbohydrate chains of glycolipids	carbohydrate chains of glycoproteins
A	between phospholipid heads only	mainly on the outer surface	mainly on the inner surface
B	between phospholipid heads only	mainly on the inner surface	mainly on the outer surface
C	between phospholipids	mainly on the inner surface	mainly on the inner surface
D	between phospholipids	mainly on the outer surface	mainly on the outer surface

8. June/2023/Paper_9700/13/No.18

Which row correctly describes **all** the possible relative concentrations of a substance when the substance is moved by endocytosis or exocytosis?

	endocytosis	exocytosis
A	concentrations equal	concentrations equal
B	concentrations equal, greater inside or greater outside	concentrations equal, greater inside or greater outside
C	concentrations equal or greater outside	concentrations equal or lower outside
D	concentrations equal or lower outside	concentrations equal or greater outside

9. June/2023/Paper_9700/13/No.19

Which statement about simple diffusion is correct?

A It requires specific molecules in the cell surface membrane.

B It is a passive mode of transporting substances.

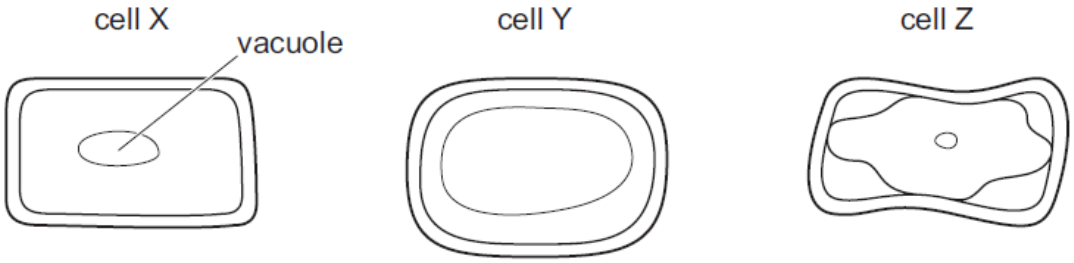
C It always requires a membrane for transport of substances.

D It only happens in the cells of prokaryotes and eukaryotes.

10. June/2023/Paper_9700/13/No.20

Plant cells with the same water potential in their cytoplasm were each put into one of three different concentrations of sugar solution, 10%, 5% and 2.5%.

The cells were left for 50 minutes and then observed using a light microscope.



Which statements are correct?

1 Cell Y had a lower water potential than the sugar solution it was put into.

2 Cell Z was put into the 10% sugar solution.

3 Cell Z had a less negative water potential than the sugar solution it was put into.

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

11. June/2023/Paper_9700/21/No.3

Fig. 3.1 shows some fruits (grapes) of the grapevine, *Vitis vinifera*.

Fig. 3.1

Sucrose is transported in the phloem of the grapevine to the fruits. In the fruits, sucrose is hydrolysed by the enzyme sucrase, which is found in cell walls. The glucose and fructose produced by the hydrolysis of sucrose pass through membrane proteins, known as hexose transporters, into the cytoplasm of the fruit cells.

(a) State why membrane proteins are required for the movement of molecules, such as glucose, across cell surface membranes into cells.

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Researchers investigated one type of hexose transporter, known as VvHT1, which is found in the fruit cells of *V. vinifera*. They used a mutant strain of yeast that has very few hexose transporters in its cell surface membranes to investigate the properties of VvHT1. The researchers inserted molecules of VvHT1 into the cell surface membranes of the mutant strain of yeast.

- Equal volumes of mutant yeast cells with VvHT1 were kept in eight different concentrations of glucose solution.
- The rate of uptake of glucose by the yeast cells in each solution was determined.
- All the solutions were kept at the same temperature and pH.

The results are shown in Fig. 3.2.

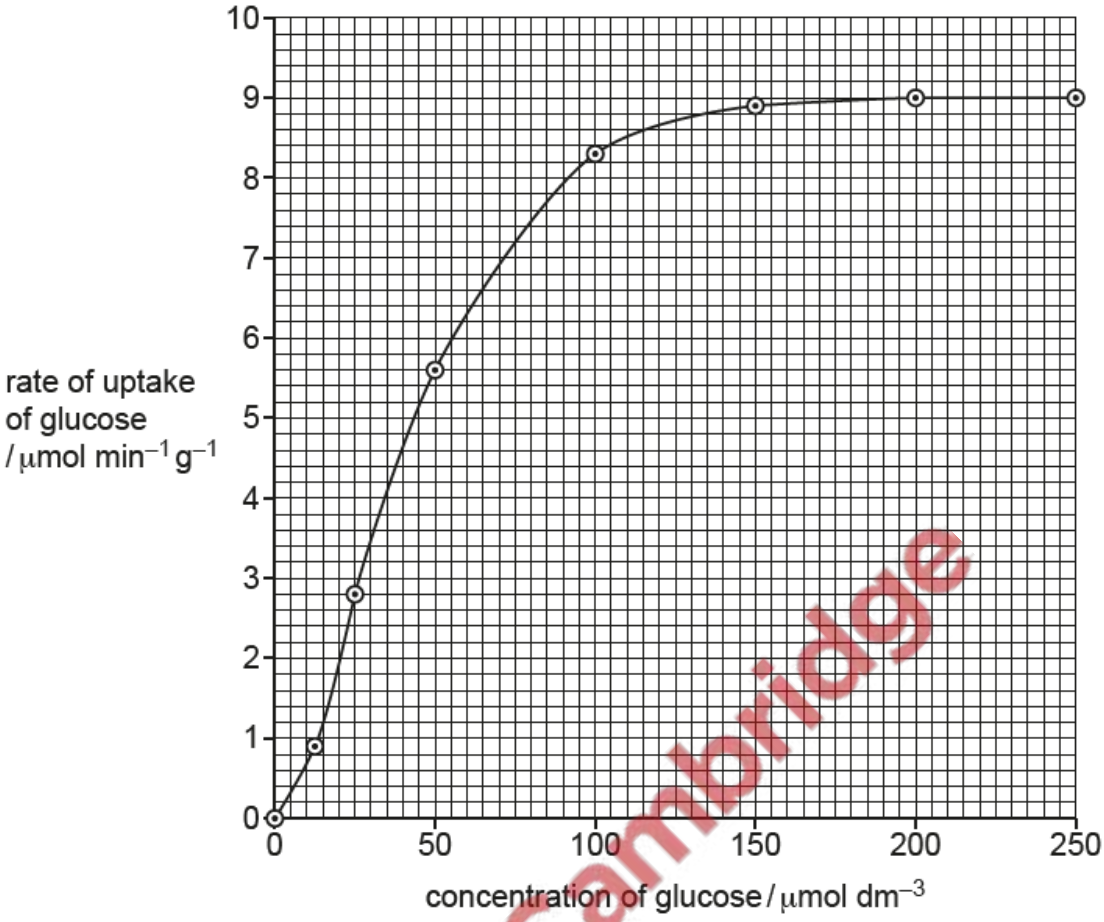

Fig. 3.2

(b) (i) The researchers concluded that VvHT1 is responsible for the facilitated diffusion of glucose into the cells.

Explain how the results in Fig. 3.2 provide evidence to support this conclusion.

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(ii) The researchers thought that grapevines could be modified to have more hexose transporters to increase the size and quality of grapes.

Explain why increasing the number of hexose transporters could be commercially important to growers of grapevines.

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(c) Fig. 3.3 is a diagram of a protein in the cell surface membrane of a macrophage from a mouse.

Macrophages use these proteins in antigen presentation. Non-self antigens bind to the proteins and are involved in the activation of specific T-lymphocytes during the immune response.

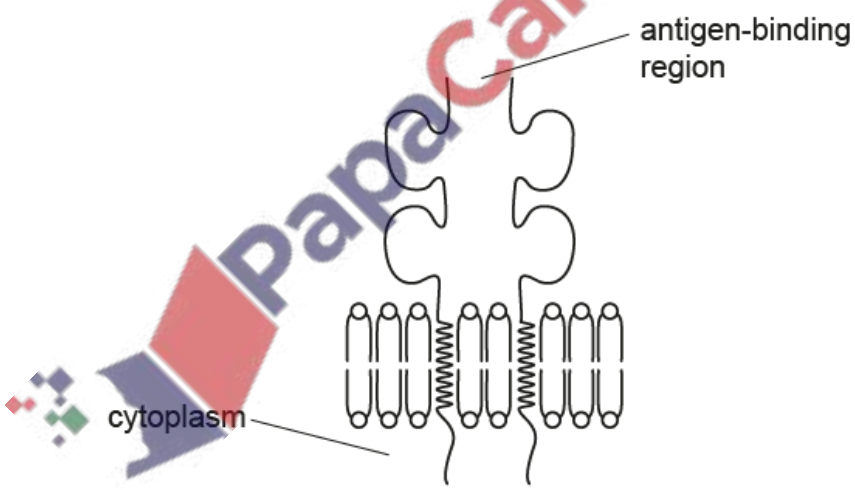

Fig. 3.3

(i) State what is meant by a non-self antigen.

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(ii) Some pathogens enter human cells. Macrophages partially digest these pathogens and present antigens to T-lymphocytes during immune responses.

With reference to Fig. 3.3, explain how T-lymphocytes respond to infection by a specific type of pathogen.

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[Total: 10]

12. March/2023/Paper_9700/12/No.11

Which row correctly shows levels of protein structure that can be held together by each type of interaction?

	hydrogen bonds	hydrophobic interactions	covalent bonds
A	primary, secondary and tertiary structure	tertiary structure	primary and tertiary structure
B	secondary structure	primary and tertiary structure	tertiary structure
C	secondary and tertiary structure	tertiary structure	primary and tertiary structure
D	secondary and tertiary structure	tertiary structure	primary and secondary structure

13. March/2023/Paper_9700/12/No.5

Dialysis (Visking) tubing is an artificial partially permeable membrane with pore sizes of approximately 2.5 nm. Glucose molecules have a diameter of about 1.5 nm and can pass through the pores in the membrane.

What else can pass through the pores?

1 bacteria

2 haemoglobin

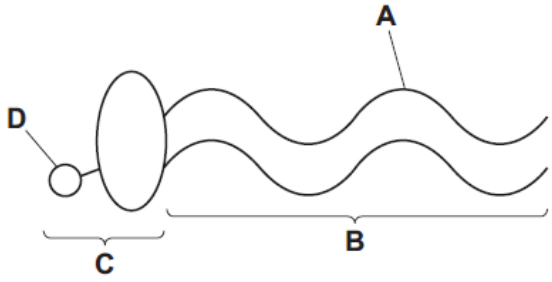
3 ribosomes

4 fructose

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

14. March/2023/Paper_9700/12/No.10

The diagram represents a molecule from a cell surface membrane.



Which description of one of the labels is correct?

A fatty acid at the hydrophilic end of the molecule

B hydrophobic end of the triglyceride molecule

C hydrophobic end of the glycerol molecule

D phosphate group at the hydrophilic end of the molecule

15. March/2023/Paper_9700/12/No.17

Which of these substances can pass directly through cell surface membranes without using a carrier protein or a channel protein?

1 Ca^{2+}

2 CO_2

3 $C_6H_{12}O_6$

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

16. March/2023/Paper_9700/12/No.18

What happens to the surface area to volume ratio of a cube when the length of each side is doubled?

A The ratio decreases by four times.

B The ratio halves.

C The ratio doubles.

D The ratio increases by four times.