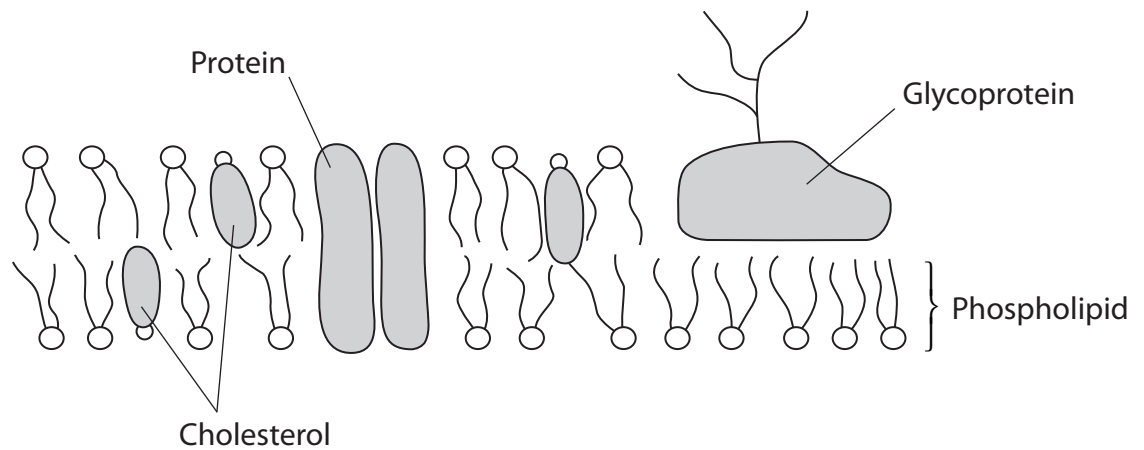


- 1 The fluid mosaic model explains our current knowledge of the structure of cell membranes and the movement of molecules in and out of cells.

The diagram below illustrates some of the components of the fluid mosaic model.



- (a) For each of the statements below, put a cross in the box that corresponds to the correct sentence.

(i) Osmosis is an example of

(1)

- A active transport
- B mass transport
- C movement of a solute down a concentration gradient
- D passive transport

(ii) During facilitated diffusion

(1)

- A ATP is used to move ions
- B ions move against a concentration gradient
- C ions move down a concentration gradient
- D ions move directly through the phospholipid bilayer with no other molecules involved

(iii) Endocytosis

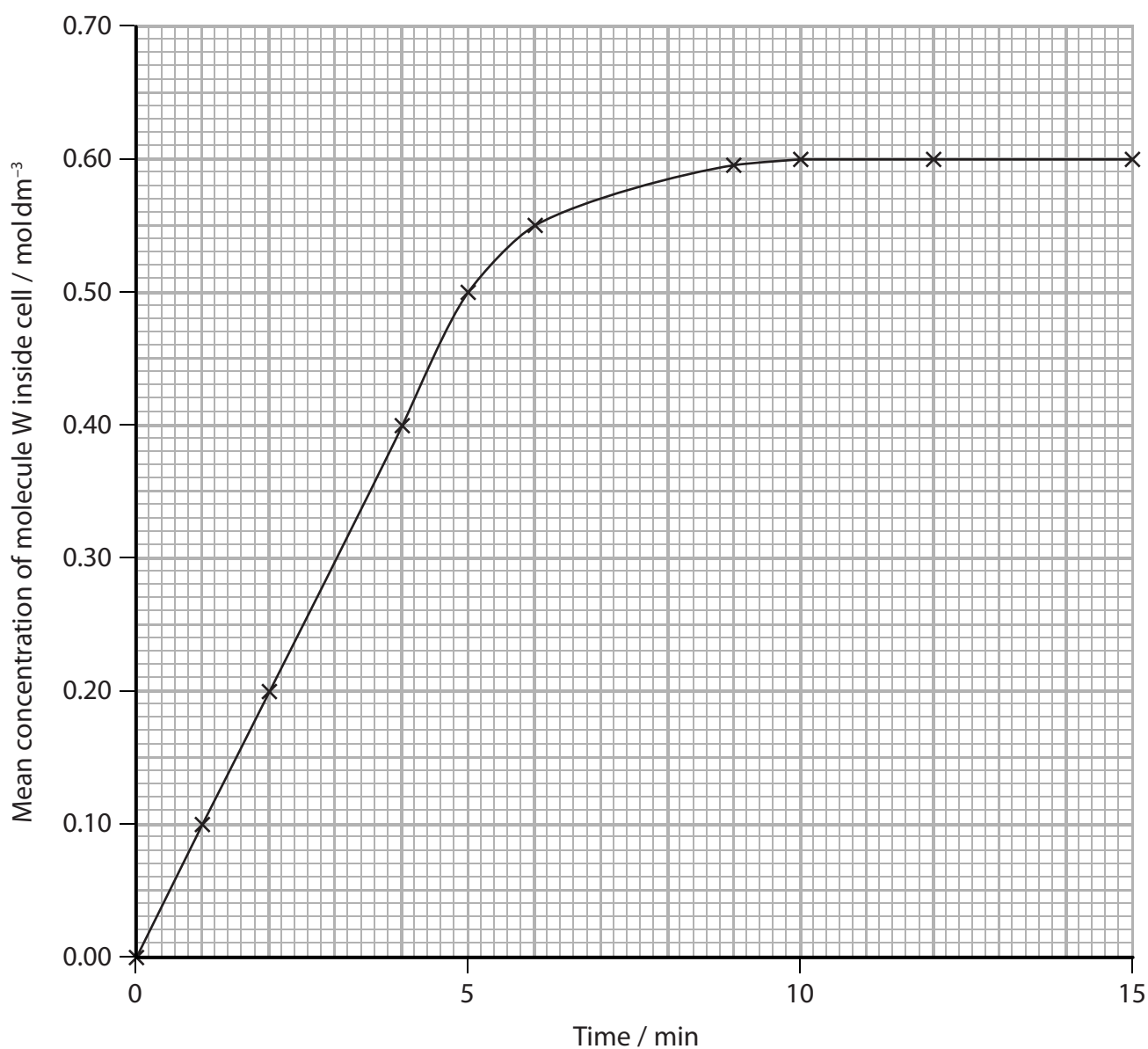
(1)

- A involves the bulk release of molecules from a cell
- B involves the production of a vacuole or vesicle
- C is a passive process
- D is involved in gas exchange

(b) A student investigated the movement of molecules into red blood cells. He placed red blood cells into a solution of molecule W.

He then measured the concentration of W inside the cells over a period of 15 minutes.

The graph below shows the results of this investigation.



(c) The student then left the red blood cells in distilled water.

After 2 minutes, he observed that some of the red blood cells had a larger volume and some had burst.

Suggest an explanation for his observations.

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(Total for Question 1 = 11 marks)

2 Infection with human immunodeficiency virus (HIV) can lead to the condition known as AIDS. Patients with AIDS are very susceptible to infections caused by bacteria and viruses.

(a) The table below shows some features of bacteria and viruses.

For each feature, place **one** cross in the appropriate box, in each row, to show whether it is found in bacteria only, in viruses only or in both bacteria and viruses.

(3)

Feature	Bacteria only	Viruses only	Both bacteria and viruses
Cytoplasm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nucleic acids	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Protein coat (capsid)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

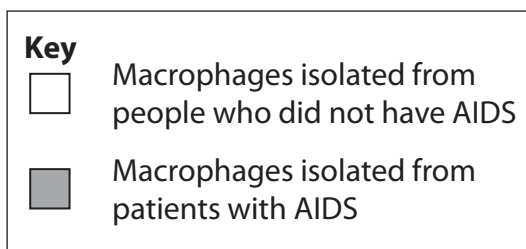
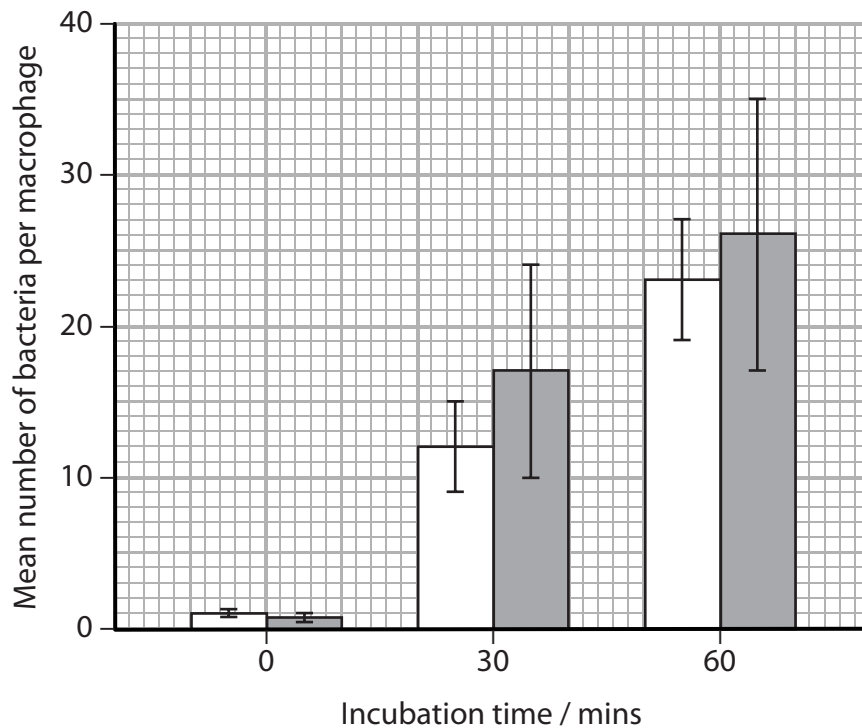
(b) Phagocytosis by macrophages is a non-specific response to infection.

The ability of macrophages to carry out phagocytosis of bacteria was investigated.

Macrophages from patients with AIDS were compared with macrophages from people who did not have AIDS.

These macrophages were obtained from the lungs of the individuals and incubated with bacteria for 60 minutes. The mean number of bacteria per macrophage was recorded at the start of the incubation period, after 30 minutes and after 60 minutes.

The results of this investigation are shown in the graph below.



(i) It was concluded that there was no significant difference in the ability of these macrophages to carry out phagocytosis.

Using the information in the graph, suggest why this conclusion was made.

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(ii) Using the fluid mosaic model of cell membranes, explain how a macrophage carries out phagocytosis of bacteria.

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(c) Antibiotics can be used to treat bacterial infections of patients with AIDS.

(i) Distinguish between a bacteriostatic antibiotic and a bactericidal antibiotic.

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(ii) Suggest why antibiotics are not used to treat infections caused by viruses.

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(Total for Question 2 = 12 marks)

3 The cell vacuoles of beetroot (*Beta vulgaris*) contain the red pigment betalain.

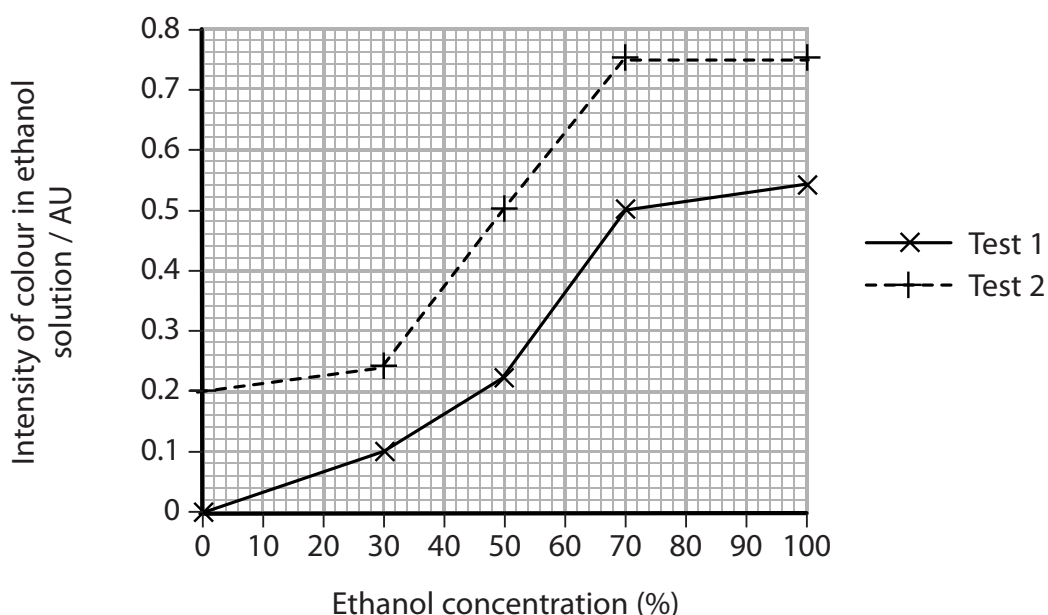
A student investigated the effect of ethanol on the permeability of beetroot cell membranes.

In this investigation, 10 identical pieces were cut from one beetroot. One piece of beetroot was left in 10 cm³ of 30% ethanol for 20 minutes at 20 °C.

After 20 minutes, the piece of beetroot was removed and the intensity of the colour of the ethanol solution was measured using a colorimeter.

This was repeated with other pieces of beetroot that were left in ethanol concentrations of 0%, 50%, 70% and 100%, at 20 °C.

The student repeated this investigation with the other five pieces of beetroot at the same temperature of 20 °C. The graph below shows the results of these investigations.



(a) Using the information in the graph, describe the effect of ethanol concentration on the intensity of colour.

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(b) Using the information in the graph and your knowledge of membrane structure, explain the effect of ethanol on the permeability of beetroot cell membranes.

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(c) Suggest why the results for these two investigations are different.

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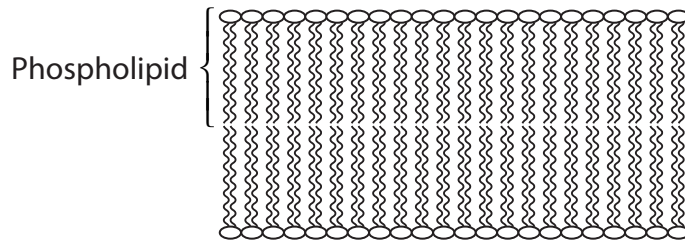
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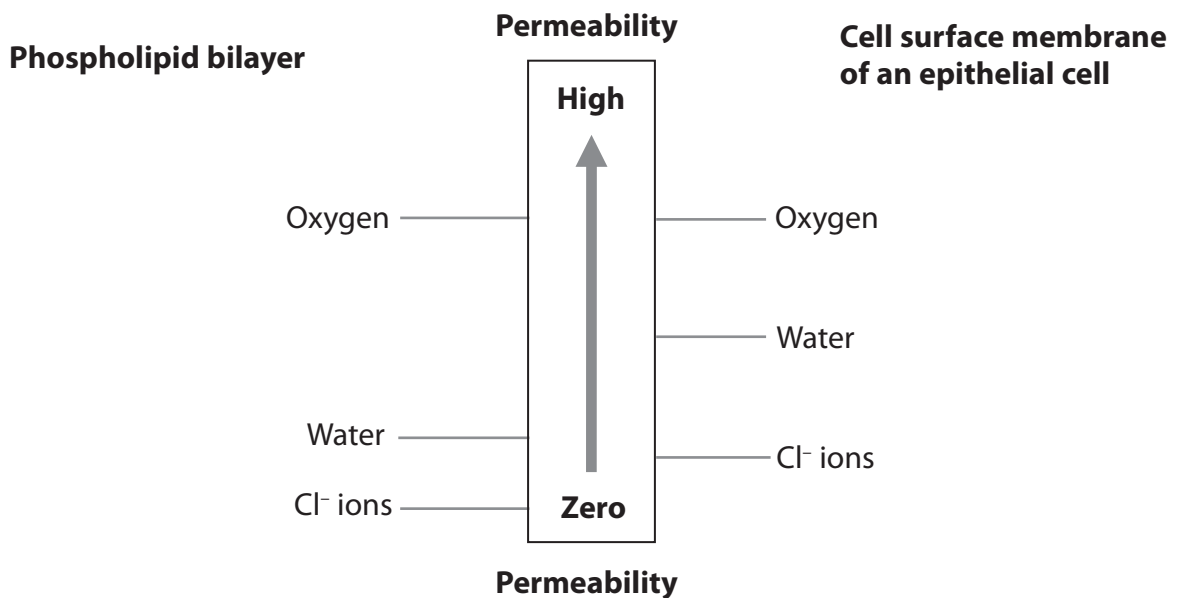
(Total for Question 3 = 9 marks)

4 Artificial membranes have a variety of medical applications.

It is possible to make an artificial membrane consisting of a phospholipid bilayer only, as shown in the diagram below.



The diagram below represents the relative permeability to oxygen, water and chloride ions (Cl^-) of a phospholipid bilayer and a cell surface membrane of an epithelial cell of the trachea.



Using the information in the diagram and your knowledge of membrane structure, suggest an explanation for each of the following.

- (a) The permeability to oxygen is the same for a phospholipid bilayer and a cell surface membrane.

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(b) The permeability to chloride ions (Cl^-) is different in the two membranes.

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(c) The rates of osmosis will be different in the two membranes.

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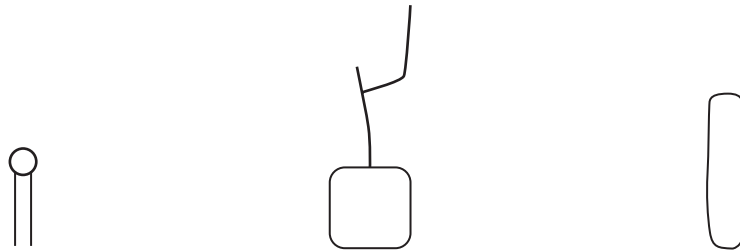
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(Total for Question 4 = 7 marks)

- 5 The cell surface membrane is involved in the transport of materials into and out of the cell.

The symbols below represent some of the components of a cell surface membrane.



- (a) Using these three symbols and your own knowledge, in the space below draw a diagram to show the structure of a cell surface membrane.

(3)

(b) The table below gives statements relating to the processes of diffusion, facilitated diffusion and active transport.

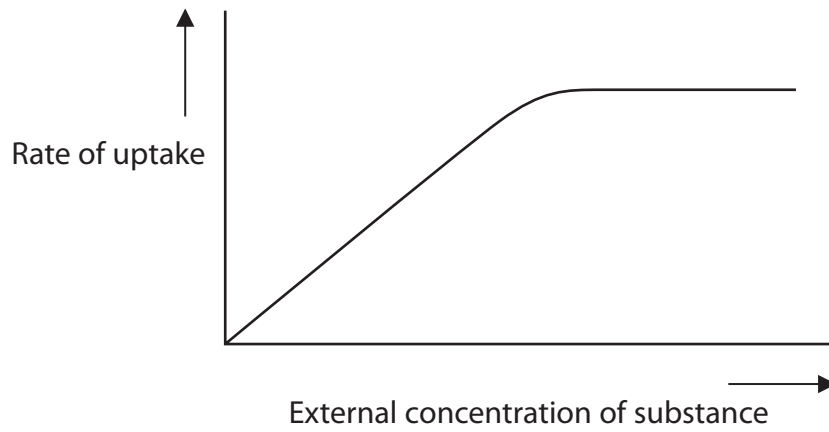
For each process, place a tick (✓) in the box if the statement applies to that process.

Place a cross (✗) in the box if the statement does not apply to the process.

(3)

Statement	Process		
	Diffusion	Facilitated diffusion	Active Transport
ATP is required			
Membrane proteins are involved			
Direction of transport is always down a concentration gradient			

(c) The graph below shows the rate of uptake of a substance by facilitated diffusion into a cell.



Using the information in the graph, explain why the rate of uptake changes.

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(Total for Question 5 = 8 marks)