Biological Membranes

Model Answers 4

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Foundations in Biology
Topic	Biological Membranes
Booklet	Model Answers 4

Time allowed: **50 minutes**

Score: **/37**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

Cells require vitamins and minerals in order to function correctly. These vitamins and minerals need to cross the plasma membrane.

Vitamins are either fat soluble or water soluble. Vitamins A, D, E and K are fat soluble.

Which of the following combinations enter a cell by facilitated diffusion?

A vitamin A and calcium ions

B vitamin C and calcium atoms

C vitamin C and calcium ions

D vitamin A and calcium atoms

[1]

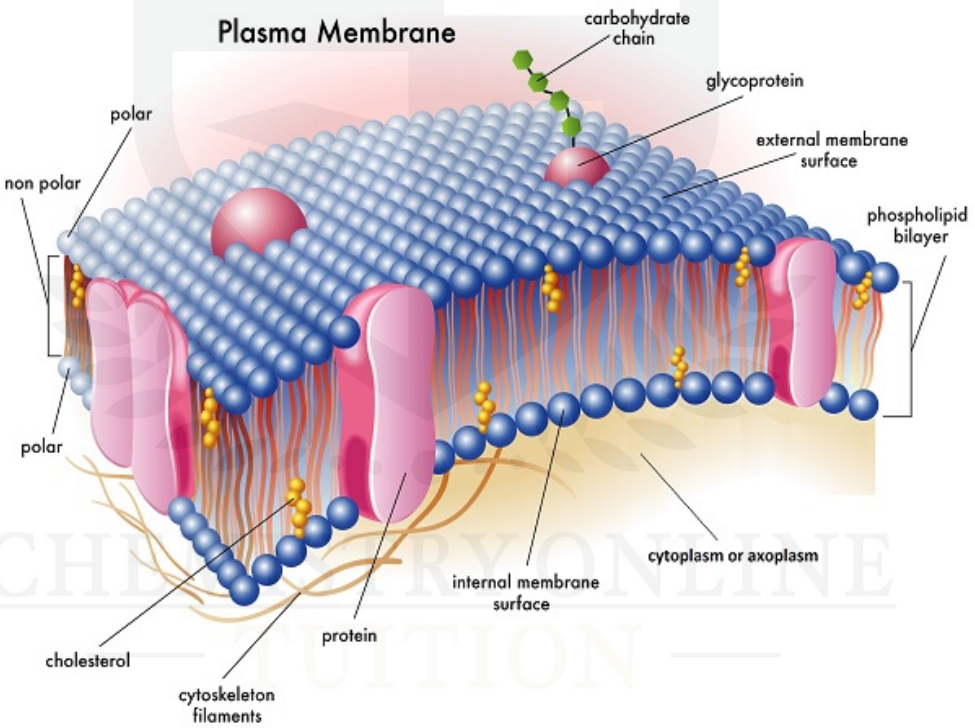
Anything fat soluble can diffuse through the phospholipid bilayer, in this case Vitamin A is fat soluble. So Vitamin C is polar and must cross via channel proteins, calcium ions would cross the same way as they too are polar.

Question 2

(a) Complete the passage below. **[5]**

Membranes have a variety of functions in cells. All membranes are .....partially..... permeable. This means that they allow the passage of certain substances by processes such as active transport or .....facilitated diffusion..... through the membrane. The cell surface membrane, also known as the .....plasma..... membrane, surrounds the cytoplasm. The cell surface membrane consists of a bilayer of .....phospholipids..... . To stabilise the structure of the membrane and keep it fluid, molecules of .....cholesterol..... are also found in this bilayer.

Diagram to show the structure of the plasma (cell surface) membrane:



(b) Membranes contain a variety of proteins. Some of these proteins are combined with carbohydrates to form glycoproteins.

Describe the functions of glycoproteins in the cell surface membrane.

your answer you should use appropriate technical terms, spelt correctly. **[5]**

The function of glycoproteins on the cell membranes are (any four of):

- To act as **antigens**
- in the **recognition** of cells as self (in the case of host cells) or non-self (in the case of foreign cells)
- To allow **cell signalling** between cells
- To act as **receptors** for **hormones**
- As a **receptor** or binding site on transport proteins
- To allow cell **adhesion**, allowing cells to be held together in tissues
- To attach to water molecules (to stabilise the membrane)

Exam tip**: to gain your QWC mark here, you need to use the key words, shown in **bold.

[Total: 10]

Question 3

Fig. 2.1 shows the structure of a plasma (cell surface) membrane.

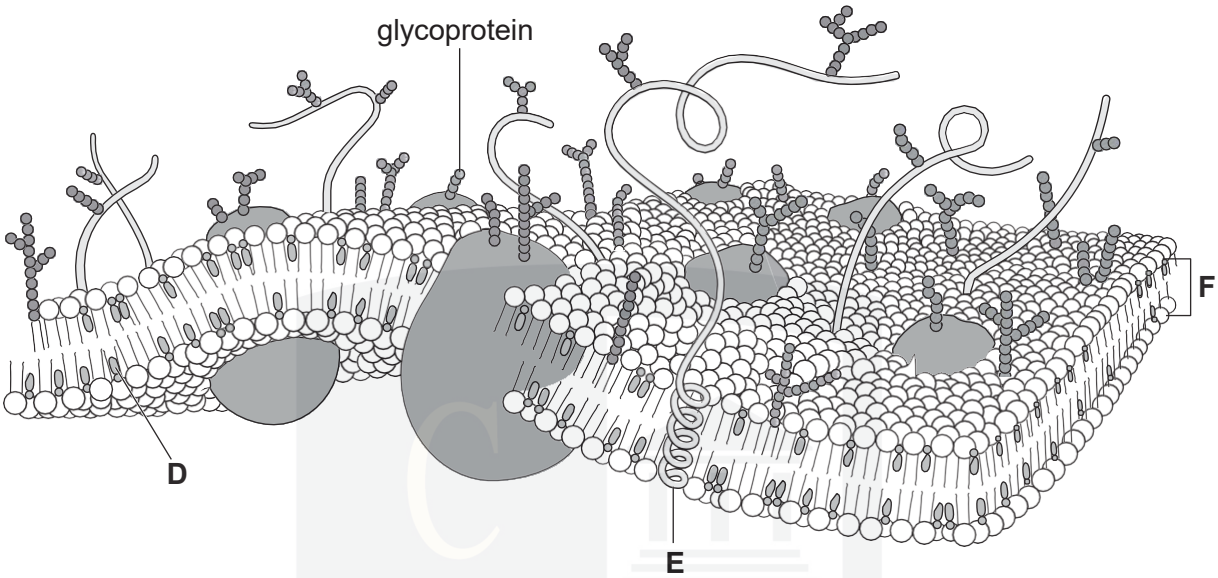


Fig. 2.1

(a) **(i)** Name the components of the plasma (cell surface) membrane labelled **D**, **E** and **F**. **[3]**

D Cholesterol

E Intrinsic protein

Can be identified because this protein is embedded within the phospholipid bilayer

F Phospholipid bilayer

A double layer of phospholipids with the hydrophobic fatty acids tails turned inwards

(ii) State **one** function for each of the components **D**, **E** and **F**. **[3]**

D To **stabilise** the membrane

Cholesterol makes the membrane firmer and less soluble to very small water-soluble molecules

E Allow **charged particles** to pass through the membrane

This could be a channel protein or receptor

F Acts as a **selectively permeable** barrier

Because of the hydrophobic nature of the fatty acid tails, certain molecules cannot pass through the bilayer by simple diffusion. This allows the cell to regulate the uptake of substances.

(b) Glycoprotein molecules are positioned in the plasma (cell surface) membrane with the carbohydrate chain outside the cell.

This is to allow the glycoproteins to act as receptors in the process of cell signalling.

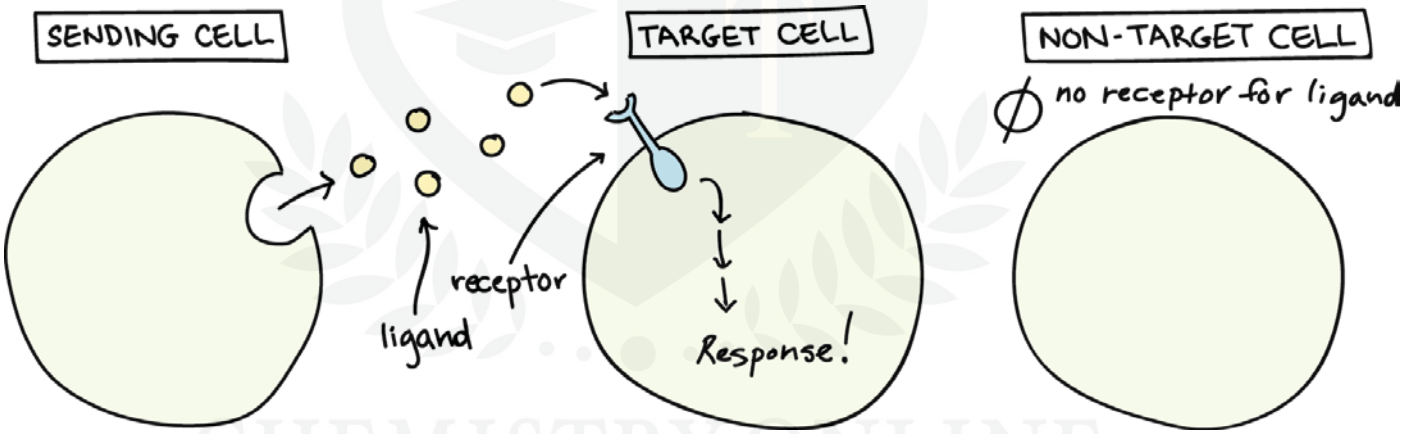
(i) Explain what is meant by the term *cell signalling*. **[2]**

Cell signalling is:

- the communication between cells
- a form of cell recognition
- which enable cells to work together
- to trigger a response inside the cell

***Exam tip**: you just need to understand the concept of cell signalling; in the second year of the A-level you will learn about specific examples.*

Diagram to show an overview of cell signalling:



(ii) Explain **how** a glycoprotein can act as a receptor. **[2]**

Glycoproteins can act as receptors because:

- they have a **specific shape**
- which is **complementary**
- to the trigger **molecule**
- which can **bind to it**

(c) A student investigated the effect of temperature on the release of pigment from pieces of beetroot.

She cut a fresh beetroot into four pieces and placed each piece into water at a different temperature.

After 10 minutes she removed the beetroot and used a colorimeter to test how much pigment had entered the water.

She placed the coloured water into the colorimeter and measured the percentage transmission of light through the water. Her results are shown in Table 2.1.

Table 2.1

temperature of water (°C)	percentage transmission of light
10	85
30	87
50	78
100	0

(i) The results show that below 50 °C little pigment had entered the water.

Explain why there was no transmission of light after the beetroot had been placed in water at 100 °C.

[2]

A temperature of 100°C would:

- damage the cell surface membrane
- and so the pigment would be released
- it is the pigment that absorbs the light

High temperatures damage cell membranes because the proteins become denatured. This would allow all substances through (no longer selective).

(ii) Suggest **three** ways in which the student could have improved her investigation. **[3]**

The student could improve their investigation by (any three of):

- collecting more samples at each temperature
- collecting all her samples from the same beetroot
- using more intermediate temperatures
- using the same volume of water
- ensuring all samples have the same surface area
- blotting the pieces after cutting

[Total: 15]

Question 4

Fig. 2.1 shows diagrams of four cells that have been placed in different solutions.

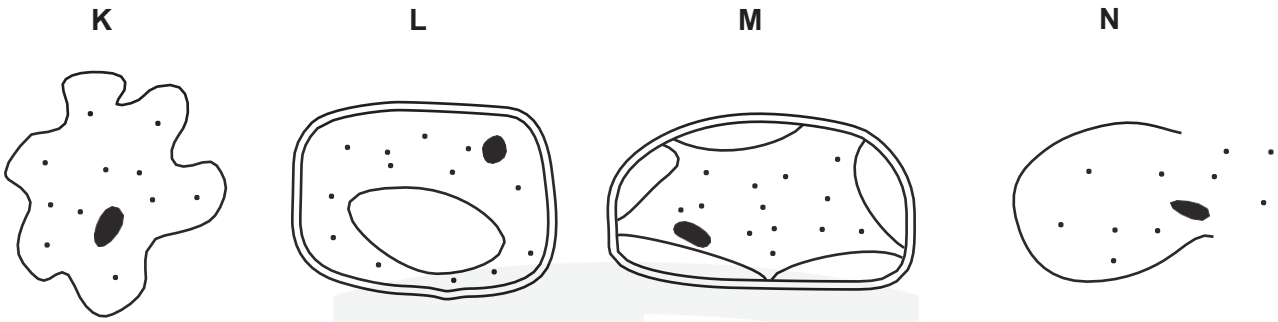


Fig. 2.1

(a) In the table below, write the letter **K**, **L**, **M** or **N** next to the description that best matches the diagram. One has been done for you.

[3]

description	letter
an animal cell that has been placed in distilled water	N
an animal cell that has been placed in a concentrated sugar solution	K
a plant cell that has been placed in distilled water	L
a plant cell that has been placed in a concentrated sugar solution	M

N-the cell bursts because the water potential of the cell is lower than the surrounding water, therefore water travels by osmosis into the cell. Animal cells do not have a cell wall.

K-Animal cells do not have a cell wall. Water moves out of the cell because the water potential of the sugar solution is lower than the cell.

L-plant cells have a cell membrane and wall. The cell is turgid because water moves into the cell because the water potential is lower compared to the distilled water.

(b) Explain, using the term **water potential**, what has happened to cell **M**. **[3]**

In cell M:

- The water moves out of the cell,
- By osmosis
- Because the cell has a higher **water potentia**l than the solution outside.
- Therefore water moves **down a water potential gradient** out of the cell

*Note: this is an explain question, not describe. This means you need to state **why** this has happened.*

(c) Small non-polar substances enter cells in different ways to large or polar substances.

Outline the ways in which substances, **other than water**, can enter a cell through the plasma (cell surface) membrane. **[5]**

In your answer, you should use appropriate technical terms, spelt correctly.

Small, non-polar substances move through the cell membrane:

- **Diffuse** through the phospholipid bilayer

Large substances

- Travel through **carrier** proteins
- Sometime large substances will be transported by **endocytosis**
- Both these processes use **active transport**

Polar substances

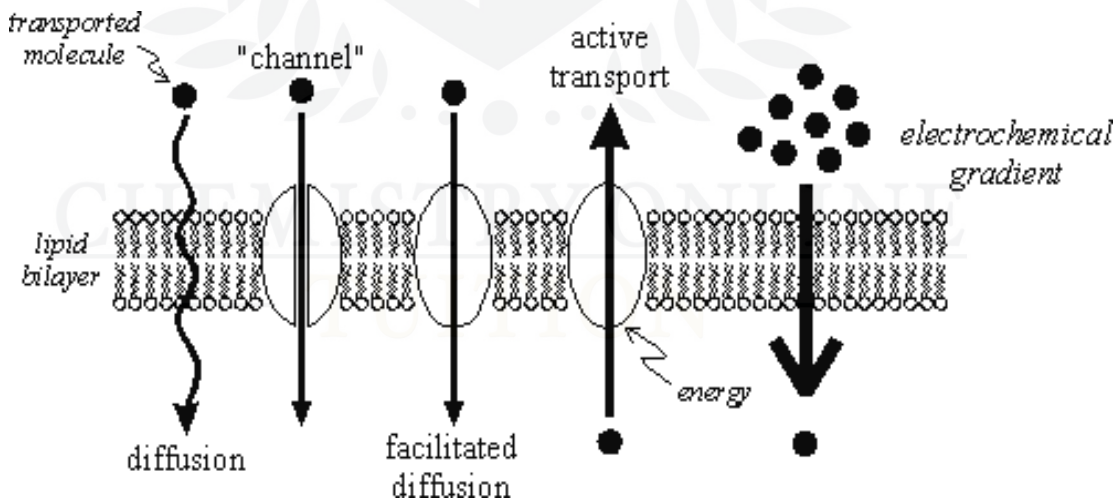
- These travel through **channel** proteins
- They may also travel through **carrier** proteins
- This is a form of **facilitated diffusion**

The cell surface membrane acts to regulate the uptake of substances into the cell. Small, uncharged molecules will be able to pass directly through the hydrophobic phospholipid bilayer. They will move from higher to lower concentration; this is called simple diffusion.

Polar substances will not pass through the bilayer due to the hydrophobic nature of the phospholipids. Therefore specialised membrane-bound proteins with channels in them allow these substances to move across the membrane by facilitated diffusion.

Large substances will not fit through and therefore require transmembrane proteins to facilitate this. They are generally too large to fit through a channel protein, so instead require carrier proteins. They will still move down a concentration gradient, but via the protein; this is called facilitated diffusion. Sometimes, substances can be moved against the concentration gradient; this requires ATP.

Diagram to show how substances cross the plasma membrane:



[Total: 11]