# Biological Membranes

## Model Answers 3

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|---|---|
| Level | A Level |
| Subject | Biology |
| Exam Board | OCR |
| Module | Foundations in Biology |
| Topic | Biological Membranes |
| Booklet | Model Answers 3 |

**Time allowed:** **45 minutes**

**Score:** **/33**

**Percentage:** **/100**

**Grade Boundaries:**

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

## Question 1

Cut pieces of agar jelly can be used to investigate the factors affecting diffusion rates in cells.

Four pieces of agar jelly containing universal indicator were soaked in the same concentration of hydrochloric acid for one minute.

The cubes were then removed and blotted dry.

Which of the following pieces of agar jelly would be the first to turn entirely red?

A. a cube with edges 4 cm each

B. a cuboid with edges 2 cm, 4 cm and 6 cm

**C .** a cuboid with edges 3 cm, 3 cm and 5 cm

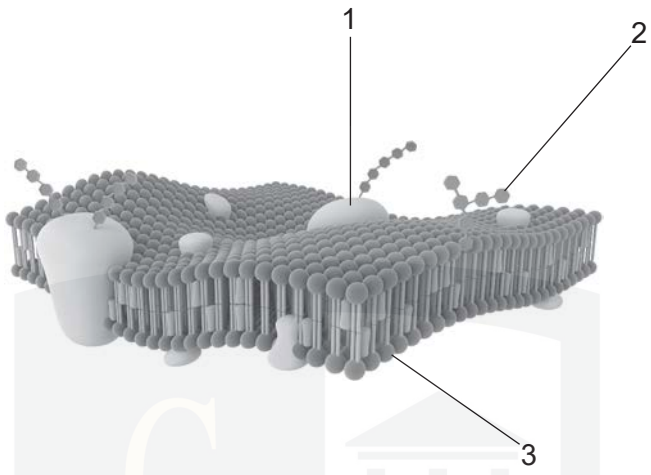
**D** a sphere with diameter 4 cm

**[1]**

Although its surface area is not the largest, it is the thinnest so diffusion has less distance to cover

## Question 2

The diagram below shows part of a plasma membrane.




Which of the label lines points to a structure that could contain a sulfur atom?

A. 1, 2 and 3

B. Only 1 and 2

C. Only 2 and 3

D. Only 1

**[1]**

Only proteins can contain sulphur and the label is pointing to a protein. Remember disulphide bonds?

## Question 3

Membranes are found both at the surface of cells and within cells.

(a) State **two** functions of membranes **within** cells. **[2]**

Any two from:

- Membranes separate the contents of organelles from the cytoplasm (**compartmentalisation**)
- Membranes form **vesicles** for transport
- Membranes control what substances **enter** and **leave organelles**
- Membranes acts as the site for **reactions** to take place
- Membranes provide a surface for **attachment** of **enzymes/ribosomes**

***Exam tip**: Ensure you write about membranes **within** cells and **not** the plasma membrane*

**(b)** Describe the arrangement and functions of **two** named components of a cell surface membrane.

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

**[5]**

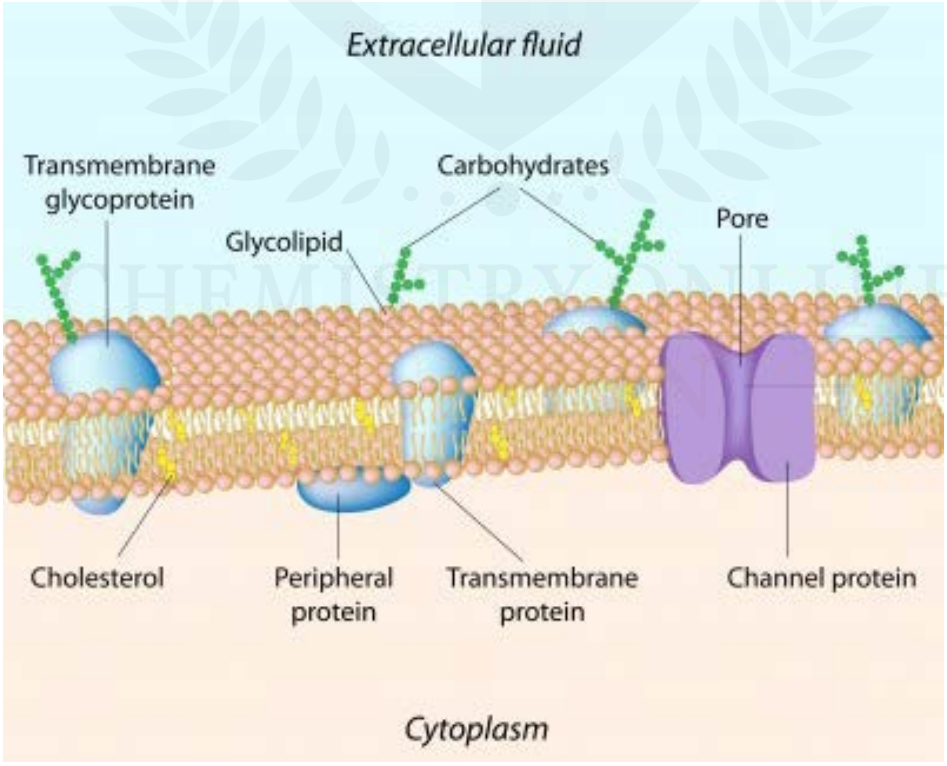
- The phospholipids form a **bilayer**
- This provides a barrier to large or polar molecules
- **Proteins** form **channels/carriers** within the phospholipid bilayer
- These allow **facilitated diffusion**/ active transport/ **cotransport** of molecules across the phospholipid bilayer

OR

- These act as **enzymes**
- **Cholesterol** molecules fit between the **fatty acid** tails of the **phospholipids**
- These stabilise the membrane, regulating the fluidity
- **Glycoproteins/ glycolipids** sit on the surface of the membrane
- This allows for **cell signalling/ receptor** sites/ adhesion/ **antigens**/ stabilising cell shape

***Exam tip**: You get one mark for a component and one for the **matching** function; shown here in pairs of statements. You gain QWC marks here for using **at least** two key terms (shown in bold) in the **correct context**.*

Diagram to show the structure of the phospholipid bilayer of the cell surface membrane:



**(c) (i)** Which component of a cell membrane becomes more fluid as temperature increases? **[1]**

**Phospholipid bilayer**

The phospholipids gain more kinetic energy as temperature increases, allowing them to move around more.

**(ii)** Which component of a cell membrane denatures as temperature increases? **[1]**

**Proteins**

The tertiary structure of a protein becomes affected as temperature increases, as the bonds holding it together may break, denaturing the protein.

**(iii)** Liver cells contain membrane-bound organelles called peroxisomes. These organelles contain catalase, an enzyme that breaks down hydrogen peroxide to release oxygen gas.

A student carried out an investigation on catalase using the following procedure:

- two identical sized cubes were cut from a piece of fresh liver
- one cube was frozen overnight and then defrosted
- the other cube was stored in the refrigerator
- both cubes were returned to room temperature and were placed in separate test tubes containing equal volumes of 2% hydrogen peroxide solution.

The student observed that the cube of liver that had been frozen and defrosted, bubbled significantly more than the cube that had been refrigerated.

Suggest an explanation for this result.

**[2]**

- The freezing/defrosting process **damages** the **peroxisome membrane**
- This **increases** the **permeability** of the membrane to catalase/hydrogen peroxide
- So **more hydrogen peroxide was broken down,** releasing more oxygen gas as bubbles

The question states that the cube that had been refrigerated bubbled significantly more. We are also told that peroxisomes contain catalase, which breaks down hydrogen peroxide to produce a gas. You therefore need to make the link between the fact that the piece that had been refrigerated showed more reaction between catalase and hydrogen peroxide, and therefore more enzyme was able to escape from inside the organelle. This must been that the membrane was more damaged.

**[Total: 11]**

## Question 4

**(a)** The structure of cell membranes can be described as 'proteins floating in a sea of lipids'. This membrane structure allows certain substances to pass through freely whereas other substances cannot.

State the term used to describe a membrane through which some substances can pass freely but others cannot.

**[1]**

**Partially permeable**

***Note**: 'semi' permeable will not be accepted here, as semi implies 'half', which is not the case*

(b) Complete the following paragraph about cell membranes, using the most appropriate terms.

**[4]**

The model of cell membrane structure is called the **Fluid mosaic model** model. Phospholipid bilayers with specific membrane proteins account for the ability of the membrane to allow both passive and **Active** transport mechanisms. Ions and most polar molecules are insoluble in the phospholipid bilayer. However, the bilayer allows diffusion of most non-polar molecules such as **Fats**. Protein channels, which may be gated, and **Carrier/ transporter** proteins enable the cell to control the movement of most polar substances.

- **Fats / lipids / oils / cholesterol / oxygen / carbon dioxide / steroid hormones**

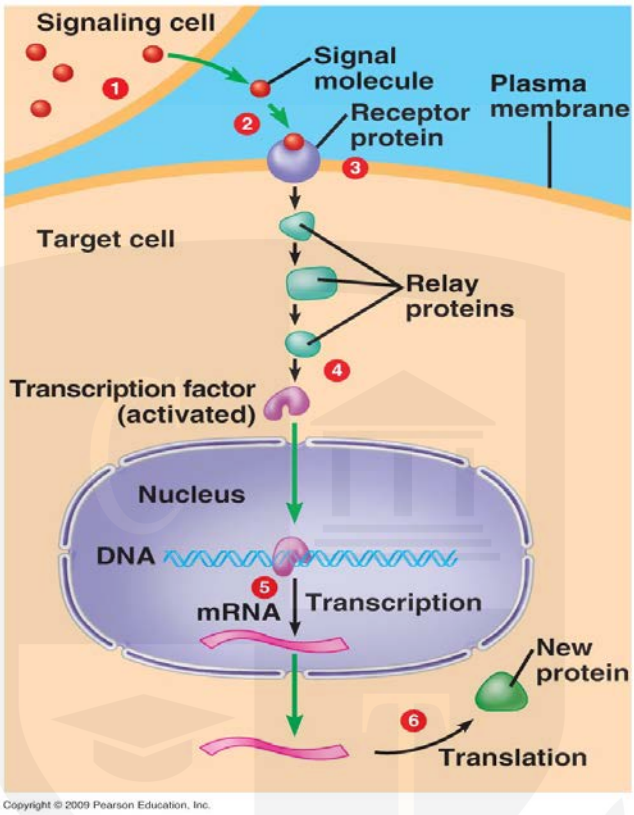
(c) One function of membranes that is not mentioned in **(b)** is cell signalling.

**(i)** State what is meant by *cell signalling*. **[1]**

Cell signalling is

- the **communication** between cells
- where a molecule released by one cell causes a **change** in another cell

A diagram to show an example of cell signalling:




**(ii)** Explain how cell surface membranes contribute to the process of cell signalling.

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

**[4]**

Cell surface membranes contribute to cell signalling by

- the release of a signal molecule by **exocytosis**
- proteins / **glycoproteins** / **glycolipids** act as **receptors**
- the receptor has a **specific** structure
- the shape of receptor and signal are **complementary**
- the attachment of the signal molecule causes change inside the cell
- the cell surface membrane allows entry of some signal molecules

***Exam tip**: you must use at least two of the words in bold to gain the QWC mark.*

**[Total: 10]**

## Question 5

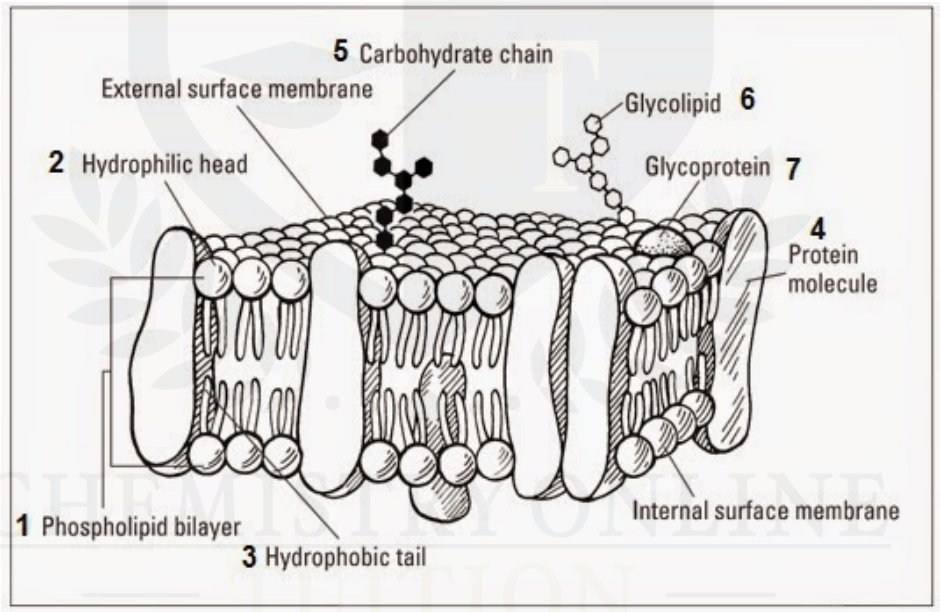
The cell surface membrane allows different substances to enter and leave the cell.

(a) List **three** components of a cell surface membrane. **[3]**

Components of a cell surface membrane include (any three from):

- Phospholipids
- Proteins
- Cholesterol
- Glycoproteins
- Glycolipids

Diagram to show the structure of the cell surface membrane:

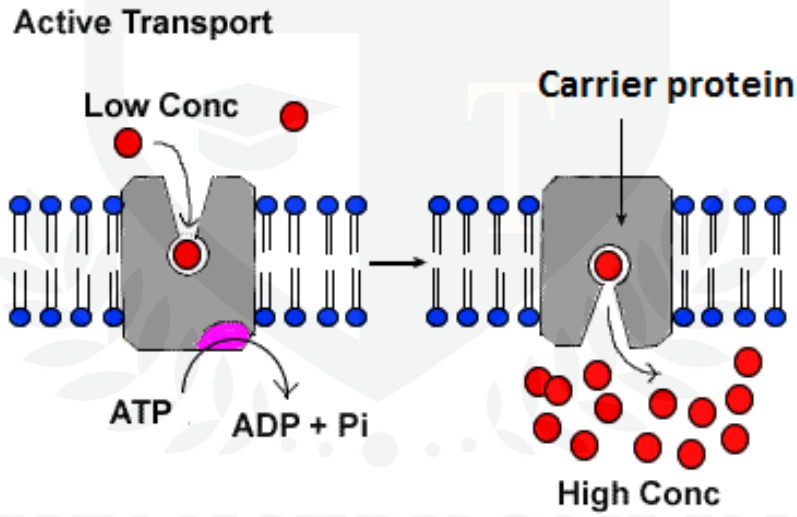


**(b) (i)** Explain what is meant by the term *active transport*. **[2]**

Active transport is:

- The movement of substances against a **concentration gradient**, from low to high concentration
- Using **ATP**
- Using a **carrier protein**

Active transport of glucose across the membrane:



**(ii)** State **two** examples of active transport in cells.

For each example, you should name the substance that is transported **and** the cell involved.

**[2]**

Examples of active transport in cells are (any two from):

- Hydrogen ions move out of companion cells in phloem tissue
- Sucrose out of sieve tube at sink
- Ions move into root hair cells against a concentration gradient
- Ions across the endodermis
- Potassium ions into stomata to open them
- Sodium ions out of the cells of the loop of Henle (kidney)
- Calcium ions into muscles for contraction

***Note:*** *there are several suitable examples not listed here. Equally, some of these examples are from the second year of the course material.*

**(c)** In addition to active transport, substances can pass through cell surface membranes by:

- diffusion
- facilitated diffusion
- osmosis
- bulk transport (endocytosis / exocytosis) **[3]**

For each example described in Table 2.1 below, state how the substance crosses the cell surface membrane. The first one has been done for you.

**Table 2.1**

| Example | Mechanism of movement across cell surface membrane |
|---|---|
| Release of the enzymes into the gut | Bulk transport |
| A plant cell taking up water | Osmosis<br>The movement of water across a membrane always occurs by osmosis. |
| Calcium ions entering a nerve cell down a concentration gradient | Facilitated diffusion<br>This has to be diffusion (passive) as the ions are travelling down a concentration gradient. Ions are charged, so cannot pass directly across the phospholipid bilayer. They therefore must enter a channel protein (so this is facilitated diffusion). |
| Oxygen entering a red blood cell | Diffusion<br>Oxygen travels down a concentration gradient and can pass directly across the bilayer, so this is simple diffusion |

Diagram to show osmosis in a plant taking up water:

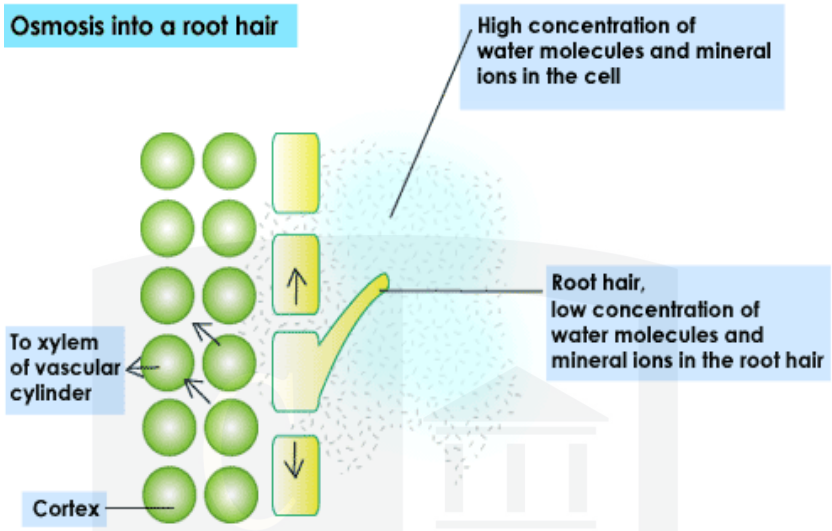



Diagram to show facilitated diffusion of calcium ions entering a nerve cell:

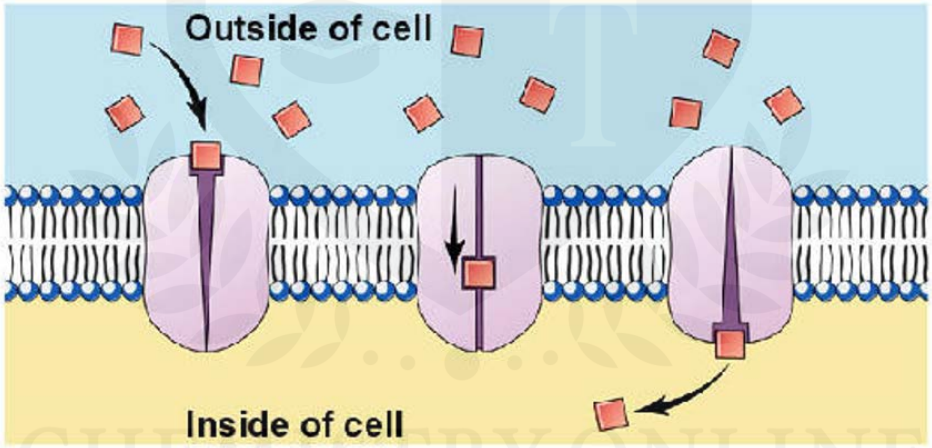
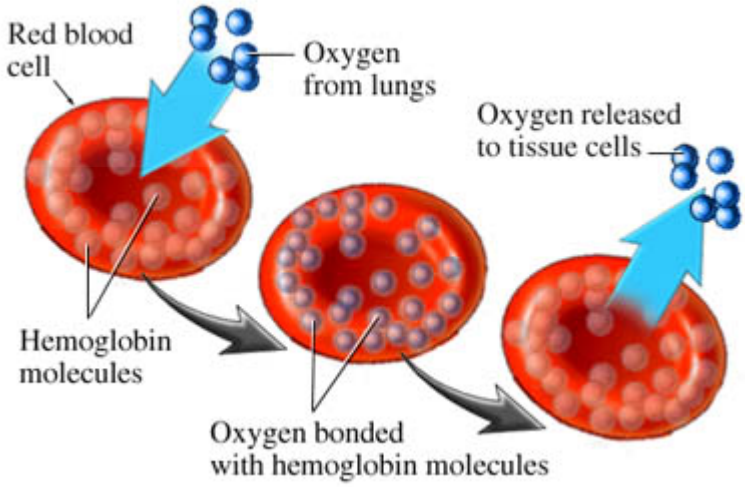



Diagram to show oxygen entering a red blood cell via diffusion:




**[Total: 10]**