

thebiotutor

AS Biology OCR

Unit F211: Cells, Exchange & Transport

Module 1.2 Cell Membranes

Notes & Questions

Outline the roles of membranes within cells and at the surface of cells.

- The main roles of internal membranes include;
 - Separating the components of organelles from the cell cytoplasm
 - Separates DNA from the cytoplasm but allows RNA to pass
 - Intracellular transport
 - Protects cells from contents of Lysosomes
 - Prevents disruption of metabolic reactions in organelles
 - Photosynthesis
 - Respiration

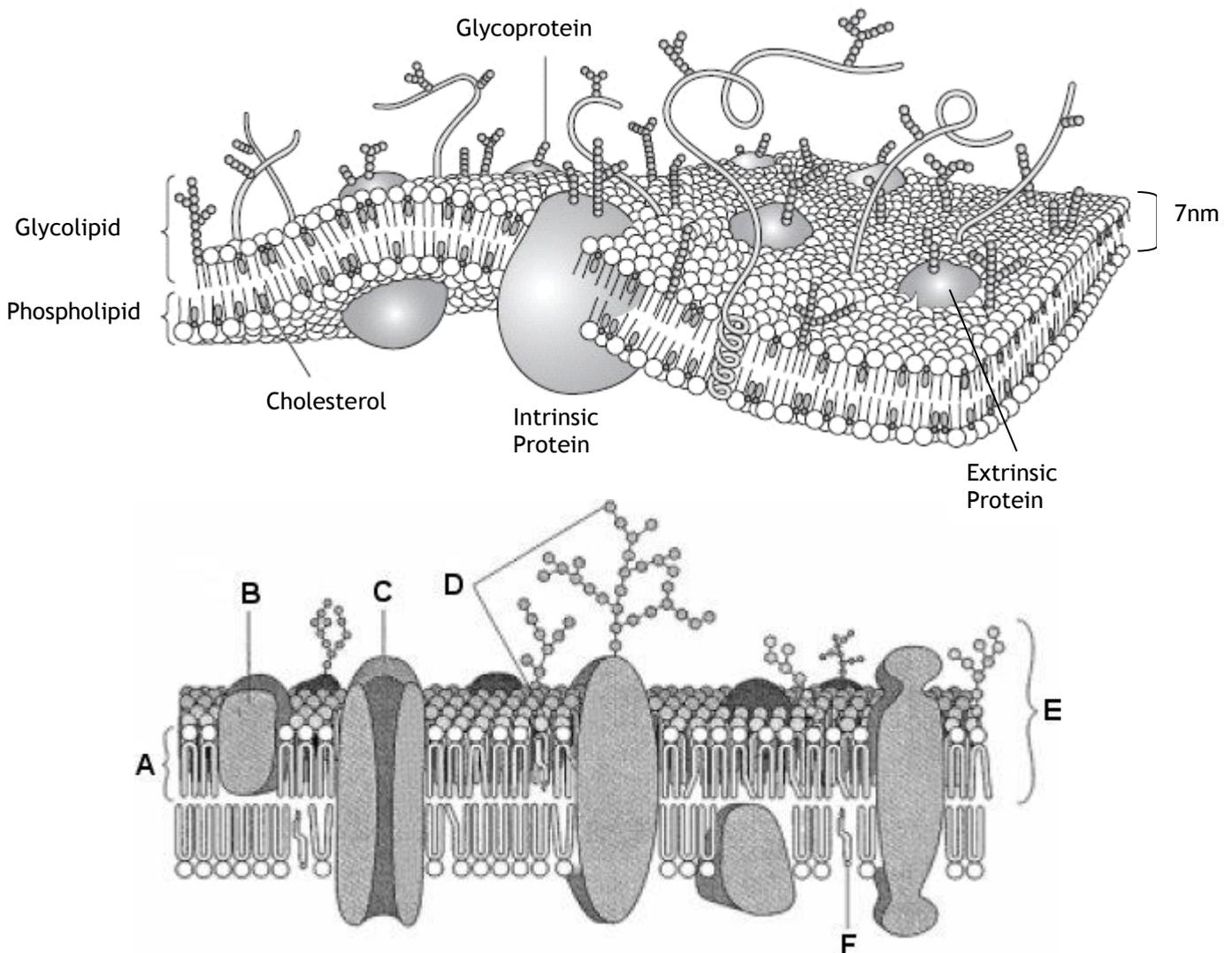
- The main roles of surfaces membranes include;
 - Separating the contents of the cell from the external environment
 - Controls the movement of molecules in and out of cells
 - Facilitated diffusion
 - Active transport
 - Cell recognition
 - Cell to cell attachment
 - Involved in cell signaling - hormones

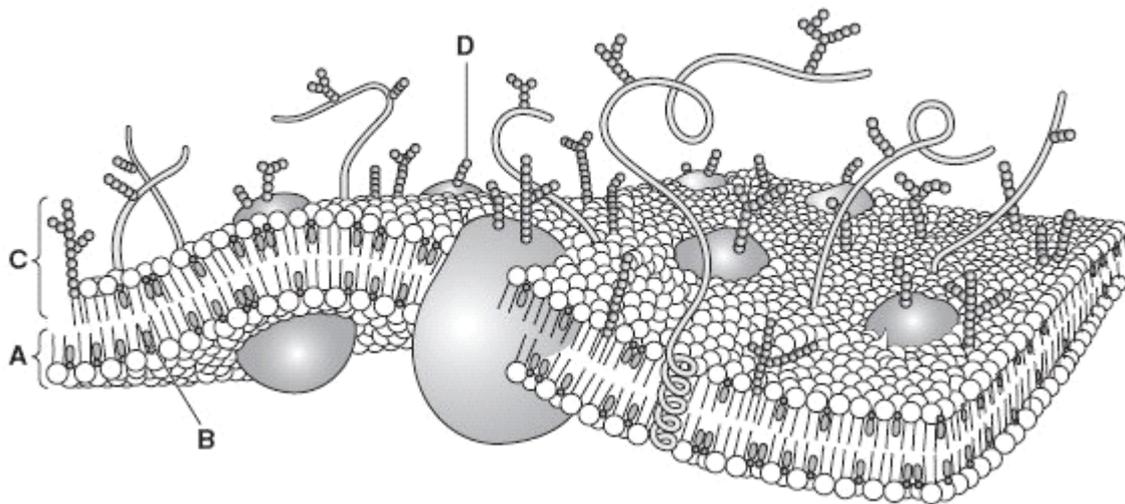
State that plasma (cell surface) membranes are partially permeable barriers.

- Plasma membranes are partially permeable barriers, meaning that some molecules can pass through the plasma membrane easily while others cannot.
 - Plasma membranes are permeable to;
 - Small polar molecules – ethanol, water & carbon dioxide
 - Non-polar molecules – oxygen & fatty acids
 - Plasma membranes are impermeable to;
 - Large polar molecules and charged (Ionic) molecules – sugars and amino acids
 - Water soluble molecules

Describe, with the aid of diagrams, the fluid mosaic model of membrane structure.

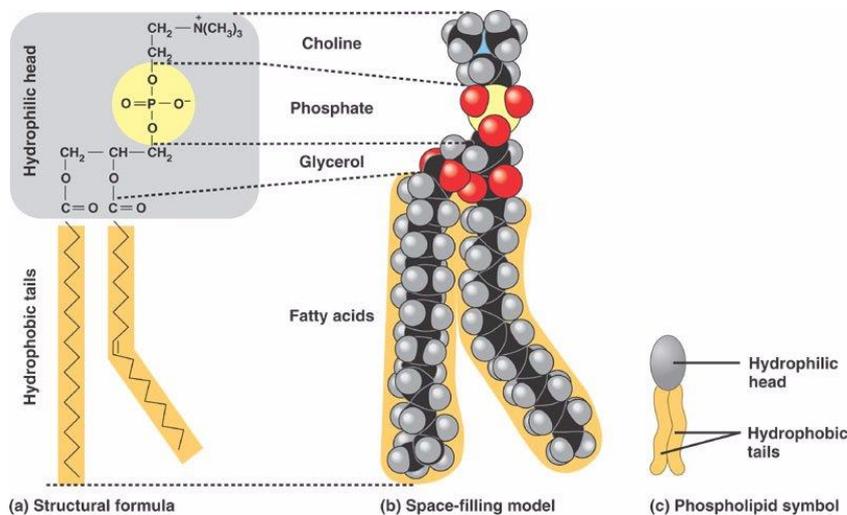
- The structure of all membranes is basically the same. They contain;
 - Lipids (mainly phospholipids)
 - Proteins
 - Carbohydrates
- The fluid mosaic model was first suggested in 1972 to describe the arrangement of molecules in the plasma membrane
- Fluid
 - The phospholipid units are not attached together and are constantly moving
- Mosaic
 - The plasma membrane is comprised of many different components giving a mosaic like appearance.





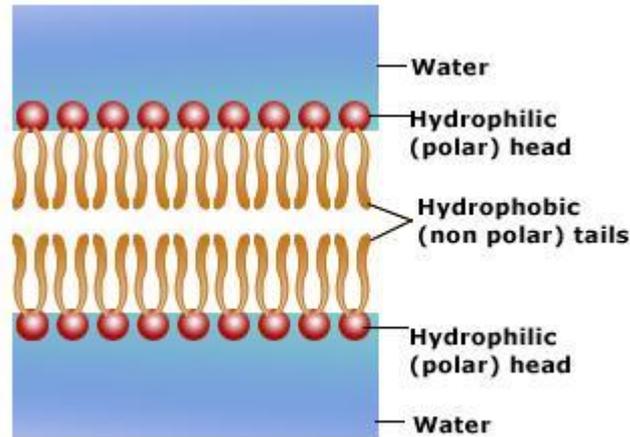
Describe the roles of the components of the cell membrane; phospholipids, cholesterol, glycolipids, proteins and glycoproteins.

- Phospholipids



- Phosphorylated lipid molecule
- Made of;
 - 1 head molecule (Hydrophilic)
 - Phosphate
 - Glycerol
 - 2 tail molecules (Hydrophobic)
 - Fatty acid chains

- Arrange themselves into;
 - A bilayer if there are two layers of phospholipids



- A michelle if there is only one layer of phospholipids

- Cholestrerol

- Type of lipid
- Present in all cell membranes except prokaryotes
- Fit in between the phospholipid, binding to the tails, resulting in the tails being more tightly packed together.
- Makes the membrane less fluid and more rigid at high temperatures
- Makes the membrane more fluid at low temperatures
- Reduces permeability to water, ions and polar molecules

- Glycoproteins & Glycolipids

- Have attached carbohydrate chains – only found on exterior of cell membranes.
- They have a specific shape
- These stabilize the membrane by forming hydrogen bonds between water molecules.
- These can act as receptor sites where drugs, hormones and antibodies can bind.
- They can acts as receptors for cell signaling
- They are also antigens – cell surface molecules involved in the immune system.
- They allow cell recognition (self or non-self)
- They attach to cytoskeleton for cell adhesion

- Proteins
 - Can form channels
 - These allow small or charged particles through
 - Some channels are open all the time while others are gated.
 - Can form carriers
 - Transport molecules and ions across the membrane by active transport and facilitated diffusion
 - Molecules bind to the protein, which stimulates the protein to change its overall shape, allowing the molecule to pass through.
 - Can act as receptors
 - These are involved in cell signaling
 - When a molecule binds to the protein, a chemical reaction is triggered inside the cell.

Outline the effect of changing temperature on membrane structure and permeability.

- Temperature $< 0^{\circ}\text{C}$
 - Phospholipids do not have much energy and so do not move much
 - Phospholipids are tightly packed together and the membrane is rigid
 - Channel and carrier proteins in the membrane denature increasing the permeability of the membrane
 - Ice crystals can form, increasing the permeability when it thaws
- Temperatures between 0°C and 45°C
 - The phospholipids can move around and aren't packed as tightly together
 - Membrane is partially permeable
 - Increases in temperature will result in the phospholipids having more energy, which increases the permeability of the plasma membrane
- Temperature $> 45^{\circ}\text{C}$
 - The phospholipid bilayer starts to breakdown and the membrane becomes more permeable
 - Water inside the cell expands, putting pressure on the membrane
 - Channel and carrier proteins in the membrane denature so they cannot control what enters or leaves the cell – increasing the permeability of the phospholipid bilayer.

Explain the term *cell signalling*.

- Cell signaling: The processes that lead to **communication** and **coordination** between cells.
- Can lead to cell identification / recognition
- Can trigger a response / action
- Cells communicate with each other using messenger molecules.
 - One cell releases a messenger molecule (e.g. hormone)
 - The molecule travels to another cell (e.g. by the blood)
 - The messenger molecule has a **complementary** shape to the receptor site and so binds.

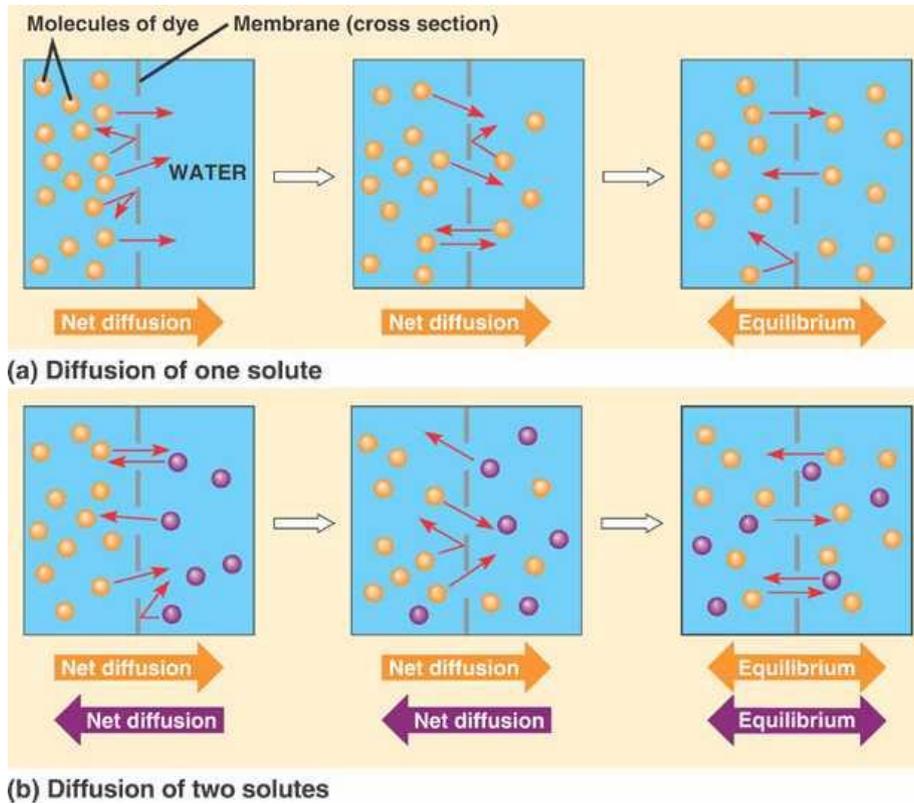
Explain the role of membrane-bound receptors as sites where hormones and drugs can bind.

- Receptor proteins have a specific shape
- Only messenger molecules that have a **complementary** shape can bind to them
- Different cells have different types of receptors and so respond to different messenger molecules
- A cell that responds to a messenger molecule is referred to as a **target cell**
- Messenger molecules can be;
 - Hormones
 - Neurotransmitters
- Many drugs can also affect target cells
- Drugs can also have a complementary shape to a receptor protein.
- This binding can;
 - Trigger a response
 - Block the receptor and prevent it from working effectively.

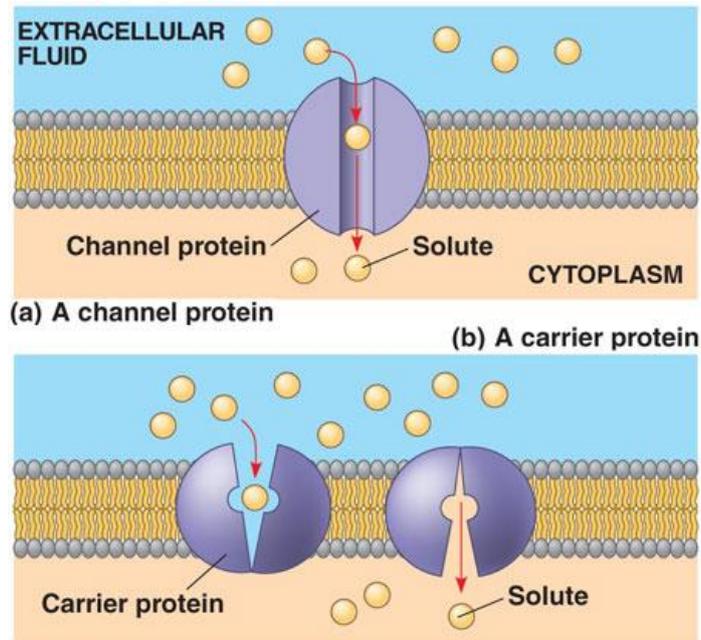
Explain what is meant by *passive transport* (diffusion and facilitated diffusion including the role of membrane proteins), *active transport*, *endocytosis* and *exocytosis*.

- Diffusion
 - Passive process (no ATP required) where molecules move down their concentration gradient.
 - Molecules are small and non-polar such as oxygen and carbon dioxide
 - Rate of diffusion depends on:
 - The concentration gradient - The higher the gradient the faster the rate of diffusion.

- The thickness of the exchange surface - The thicker the surface, the greater the diffusion distance, the slower the rate of diffusion.
- The surface area – The larger the surface area the faster the rate of diffusion.
- Temperature



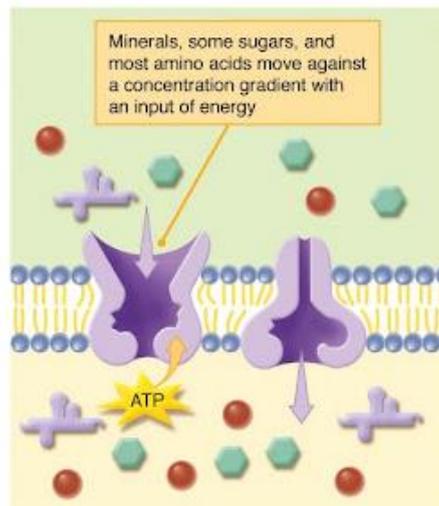
- Facilitated Diffusion
 - Some molecules that are needed by the cell are too large, or charged (therefore cannot pass through the hydrophobic region of the bilayer).
 - Involves protein channels (for polar molecules) and carriers (for large or polar molecules).



- Active transport

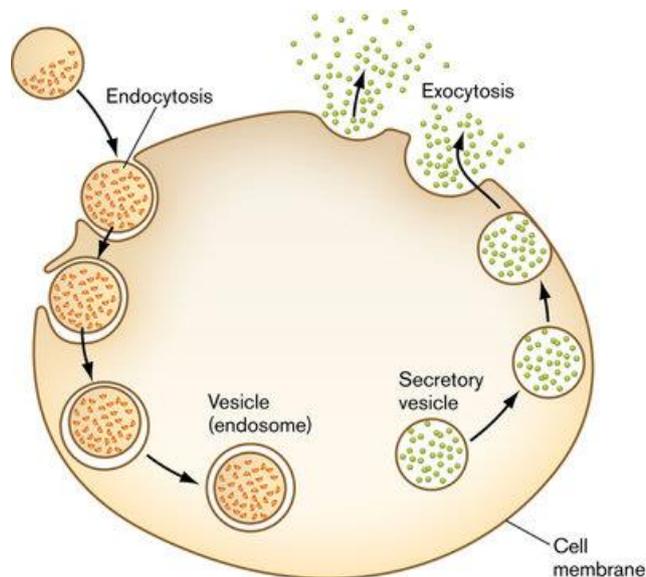
- Some substances that are required by the cell are in lower concentrations outside the cell than inside it.
- Cells can therefore not obtain these molecules by diffusion.
- Carrier proteins are used along with ATP to move molecules across the membrane against their concentration gradient.
- Moves molecules faster than diffusion.
-

ACTIVE TRANSPORT



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- Endocytosis
 - Bulk movement of large molecules into the cell – proteins & bacteria (phagocytes)
 - Solids = Phago
 - Liquids = Pino
 - membrane, folding in / engulfing / invaginates / AW;
 - fuses with itself / pinches off;
 - formation of, vesicle / vacuole; **A** completely surrounded by membrane
 - fate of vesicle; e.g. moves through cytoplasm / fate of contents
 - ref. fluid nature (of membrane) / requires energy;
A active / ATP **R** active transport
 - triggered by binding of molecule (to receptor site);
 - ref. to uptake of solid (Phago) and liquid (pino) (not name alone);

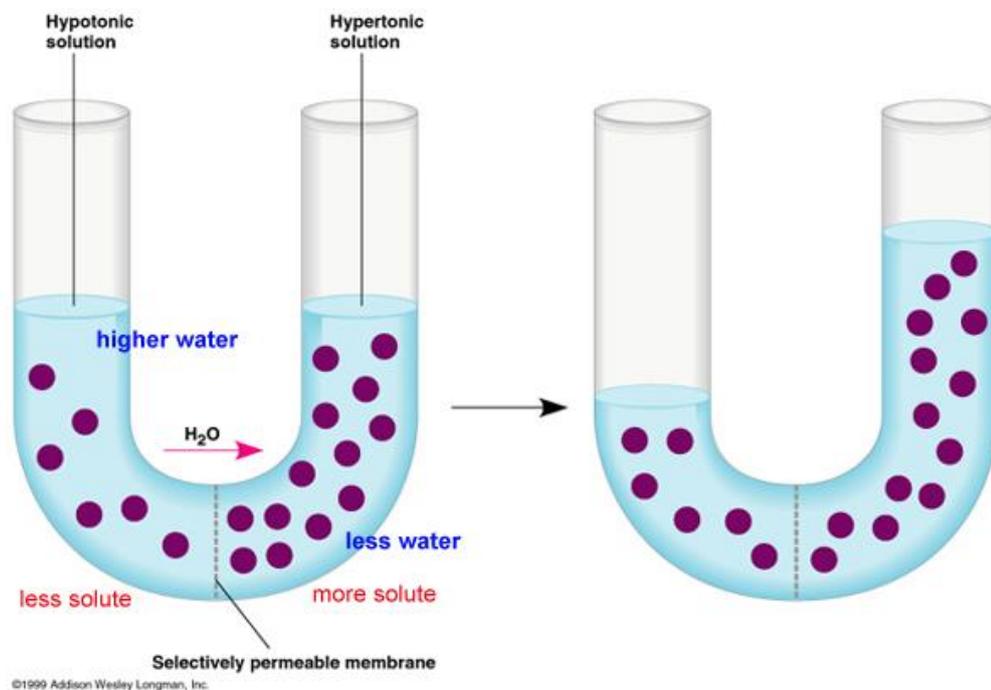


- Exocytosis
 - Bulk movement of large molecules out of the cell.
 - Solids = Phago
 - Liquids = Pino
 - Substances are packaged by the golgi apparatus
 - Delivered to the plasma membrane in vesicles
 - Vesicles migrate to the plasma membrane
 - fuses with the cell plasma membrane;
 - fate of contents
 - ref. fluid nature (of membrane) / requires energy;
A active / ATP **R** active transport
 - triggered by binding of molecule (to receptor site);

- ref. to release of solid (Phago) and liquid (pino) (not name alone);

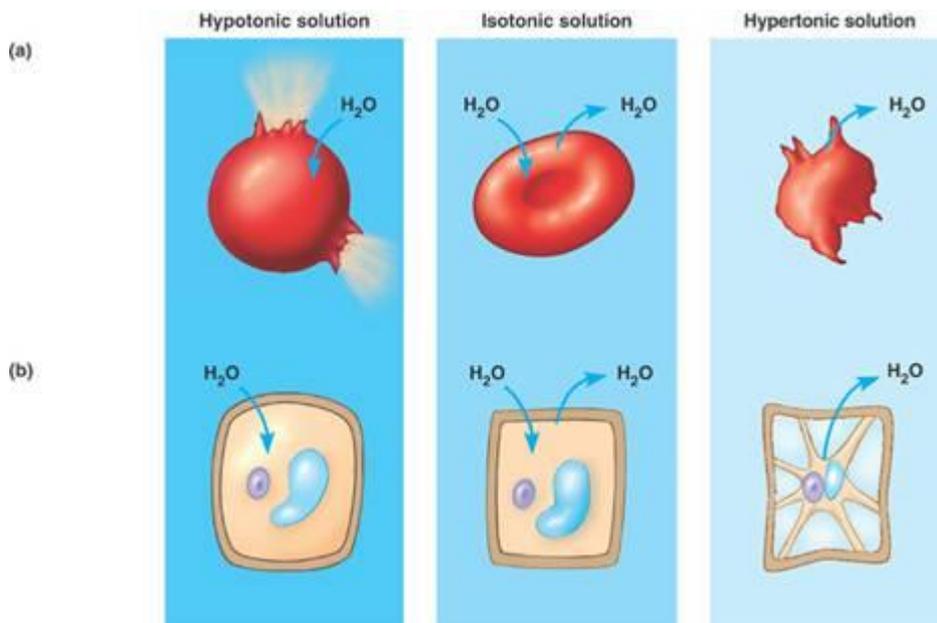
Explain what is meant by *osmosis*, in terms of water potential.

- Osmosis: The diffusion of water molecules across a partially permeable membrane from an area of higher water potential to an area of lower water potential.
- Water potential is the tendency of water molecules to move from one place to another, and is determined by the factors above.
- Pure water has the highest water potential = 0, while the more concentrated the solution the lower the water potential = more negative.
- Although water molecules are polar, they are small enough to pass through the phospholipid bilayer
- Some membranes are very permeable to water as they contain special. Highly selective channel proteins for water known as aquaporins
- The movement of water into and out of cells is influenced by;
 - The amount of free water in the cell cytoplasm and in the exterior environment.
 - The concentration of solutes, such as ions and sugars, on either side of the cell surface membrane.
 - The presence of aquaporins in the membranes
 - The pressure exerted on cell contents by the cell wall, which is rigid and resists expansion and thus the uptake of water.



Recognise and explain the effects that solutions of different water potentials can have upon plant and animal cells.

Cells immersed in	Movement of Water	Response of cells	
		Plant Cells	Animal Cells
Distilled water - Higher water potential than cells	Water moves into the cell by osmosis	Cell becomes TURGID Cell wall prevents any more water entering	Cell swells Cells burst as there is no cell wall and the cell membrane is not strong enough to withstand the pressure
Dilute solution of salt or sugar - same water potential as cells	No net movement of water into or out of cells	Cells remain the same shape and volume	Cells remain the same shape and volume
Concentrated solution of salt or sugar - lower water potential than cells	Water moves out of cells by osmosis	Plasmolysis - vacuole shrinks, pulling the cytoplasm and cell membrane away from the cell wall. Cells become plasmolysed.	Cells decrease in volume and shrink



1. Complete the passage below.

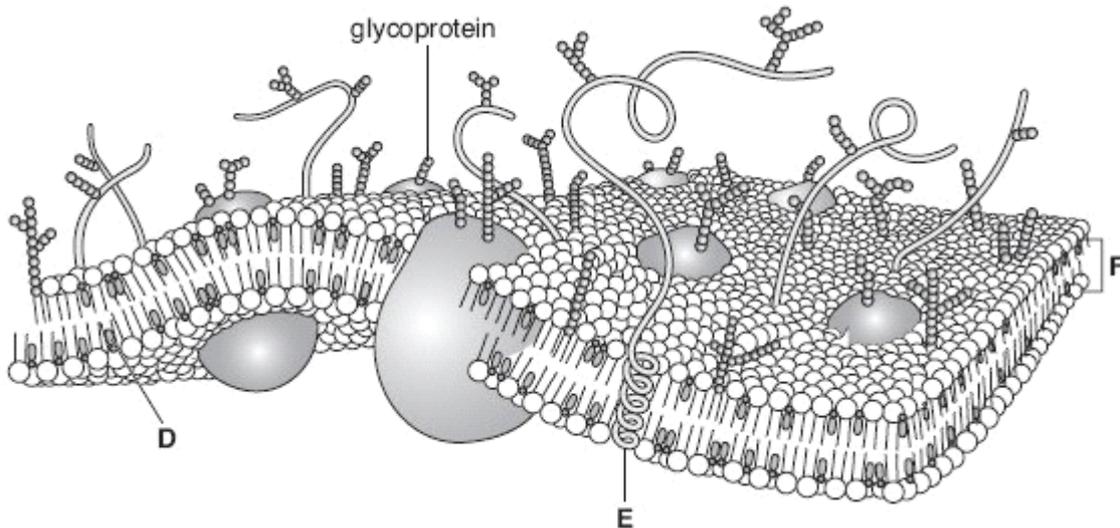
Membranes have a variety of functions in cells. All membranes are permeable. This means that they allow the passage of certain substances by processes such as active transport or through the membrane.

The cell surface membrane, also known as the membrane, surrounds the cytoplasm.

The cell surface membrane consists of a bilayer of To stabilise the structure of the membrane and keep it fluid, molecules of are also found in this bilayer.

[Total 5 marks]

2. The figure below shows the structure of a plasma (cell surface) membrane.



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

D

E

F

[3]

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

D

.....

E

.....

F

.....

[3]

(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*.

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[2]

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

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[2]

[Total 10 marks]

3. In this question, one mark is available for the quality of spelling, punctuation and grammar.

Outline the roles of membranes at the **surface** of cells and **within** cells.

[9]

Quality of Written Communication [1]

[Total 10 marks]

4. 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.



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

small, non-polar substances

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large substances

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polar substances

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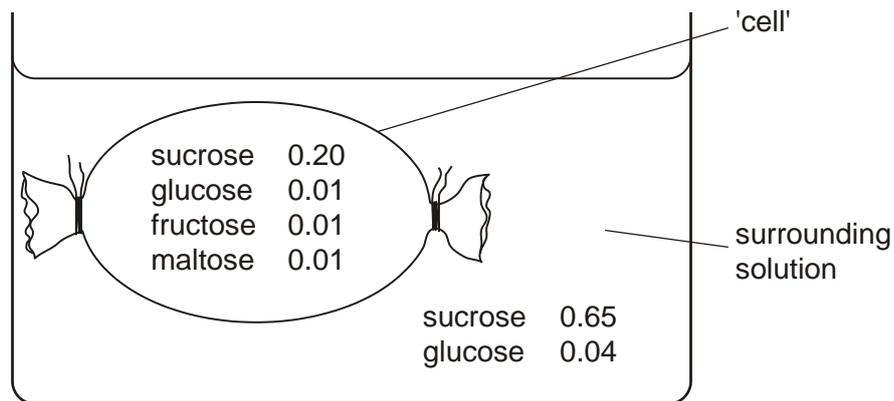
[Total 5 marks]

5. An experiment was carried out in which an artificial membrane was used to form the boundary of a model of a cell. A solution of different sugars was placed inside this 'cell', which was then placed in a beaker containing a solution of sucrose and glucose.

The artificial membrane is:

- permeable to monosaccharides (e.g. glucose and fructose) and water;
- not permeable to disaccharides (e.g. maltose and sucrose);
- flexible.

The diagram below shows the 'cell', together with the concentrations of the sugars inside the 'cell' and in the surrounding solution. The figures represent the concentration in mol dm⁻³.



- (a) (i) State which sugar or sugars will show a net movement **out of** the 'cell'.

.....

[1]

- (ii) State which sugar or sugars will show a net movement **into** the 'cell'.

.....

[1]

- (iii) Name the method by which these sugars cross the membrane.

.....

[1]

- (iv) Explain why the volume of the 'cell' would change during the experiment.

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[4]

- (b) The artificial membrane used in this experiment does not resemble a plasma (cell surface) membrane in all respects.

State **one** method by which substances would be **unable** to cross the artificial membrane.

.....

[1]

[Total 8 marks]