



Membranes and membrane transport: practice questions

8 questions • 27 marks • mark scheme at the back

For IB Diploma Biology, Standard Level and Higher Level (first assessment 2025). **HL only** is additional higher level content, for HL students only.

Name

Total / 27

1 PAPER 1A STYLE [1 mark]

Which substance crosses a lipid bilayer without membrane proteins most rapidly by simple diffusion?

- A. ☐ Sodium ions
- B. ☐ Glucose
- C. ☐ Oxygen
- D. ☐ Amino acids

2 PAPER 1A STYLE [1 mark]

Which statement distinguishes active transport by pump proteins from facilitated diffusion through channel proteins?

- A. ☐ Only active transport is selective for specific particles
- B. ☐ Only active transport can move particles against a concentration gradient
- C. ☐ Only facilitated diffusion involves integral membrane proteins
- D. ☐ Only facilitated diffusion depends on the hydrophobic core of the membrane

3 PAPER 2A STYLE [4 marks]

Draw a labelled two-dimensional diagram of the fluid mosaic model of membrane structure.

4

[5 marks]

Frog (*Xenopus*) egg cells normally have very few aquaporins in their plasma membrane. In an experiment, one group of egg cells was injected with mRNA coding for an aquaporin and a control group was injected with water. All the cells were then placed in a dilute solution and their volume was measured. The data are for practice. (a) Calculate the percentage increase in volume of the aquaporin cells after 180 s. [1] (b) Explain the difference between the two groups. [3] (c) Suggest why the volume of the control cells still increased slightly. [1]

Relative volume of egg cells in a dilute solution (volume at 0 s = 1.00)		
Time / s	Control cells	Aquaporin cells
0	1.00	1.00
60	1.01	1.10
120	1.02	1.21
180	1.03	1.32
240	1.04	Cells burst

Answer =

[illegible]

5

[6 marks]

Explain how the structure of the plasma membrane allows it to control the movement of substances into and out of cells.

[illegible]

PAPER 2A STYLE

HL only

[illegible]

PAPER 2B STYLE

HL only

[illegible]

PAPER 1A STYLE

HL only

A. ☐ A voltage-gated channel that lets K^+ leave the neuron

B. ☐ A neurotransmitter-gated channel that opens when acetylcholine binds, letting Na^+ in

C. ☐ A pump protein that uses ATP to move acetylcholine across the membrane

D. ☐ A voltage-gated channel that opens at the threshold potential, letting Na^+ in

Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

C C: oxygen is small and non-polar, so it passes between the phospholipids; ions and polar molecules do not readily enter the hydrophobic core [1]

2. [1]

B B: pumps use energy from ATP to move particles against a concentration gradient; both processes are selective and both use integral proteins [1]

3. [4]

- phospholipid bilayer drawn with two layers, heads facing outwards and tails inwards [1]
- hydrophilic regions and hydrophobic region correctly labelled [1]
- integral protein shown embedded in / spanning the bilayer [1]
- peripheral protein shown attached to one surface only [1]
- glycoprotein with carbohydrate chain shown on the extracellular side only [1]
- cholesterol shown within the hydrophobic region, between the hydrocarbon tails [1]
- Labels must point clearly to the structure; do not accept proteins drawn on top of the bilayer as integral
- max 4

4. [5]

- (a) $(1.32 - 1.00) \div 1.00 \times 100 = 32\%$ [1]
- (b) aquaporin mRNA is translated, so aquaporins are inserted into the plasma membrane [1]
- (b) aquaporins increase the permeability of the membrane to water [1]
- (b) solute concentration inside the cell is higher than in the dilute solution, so water enters by osmosis [1]
- (b) water enters faster, so volume increases faster / cells burst [1]
- (b) max 3
- (c) water can still cross the bilayer slowly by diffusing between phospholipids / a few aquaporins are present OWTTE [1]

5. [6]

- phospholipids form a bilayer with a hydrophobic (hydrocarbon) core [1]
- core has low permeability to ions / polar molecules / large molecules, so it acts as a barrier [1]
- small non-polar molecules such as O_2 / CO_2 cross by simple diffusion between phospholipids [1]
- simple diffusion is not selective / depends only on size and hydrophilic or hydrophobic properties [1]
- channel proteins allow facilitated diffusion of specific ions [1]
- channels can be gated / opened or closed to control permeability [1]
- aquaporins allow rapid movement of water by osmosis [1]
- pump proteins use energy from ATP to move specific particles against a concentration gradient [1]
- the proteins present determine which particles cross, giving selective permeability [1]
- max 6

6. [4] HL only

- pump uses energy from ATP / is active transport [1]
- ATP phosphorylates the pump, causing a change in shape [1]
- three Na^+ pumped out for every two K^+ pumped in [1]
- net movement of positive charge out of the cell, so the inside becomes negative relative to the outside [1]
- builds concentration gradients: Na^+ high outside, K^+ high inside [1]
- contributes to a resting potential of about -70 mV [1]
- membrane is more permeable to K^+ than Na^+ , so K^+ diffusing out makes the inside more negative [1]
- max 4

7. [5] HL only

- sodium-potassium pumps actively pump Na^+ out of the cell using ATP [1]
- this keeps the Na^+ concentration inside the cell low / creates a Na^+ gradient into the cell [1]
- cotransporter in the membrane facing the lumen moves Na^+ and glucose into the cell together [1]
- Na^+ moves down its concentration gradient [1]
- glucose moves against its concentration gradient [1]
- indirect active transport: the cotransporter does not use ATP directly [1]
- glucose then leaves the cell into the blood by facilitated diffusion [1]
- the same mechanism reabsorbs glucose in the proximal convoluted tubule of the nephron [1]
- max 5

8. [1] HL only

B B: it is a neurotransmitter-gated ion channel; the sodium and potassium channels are the voltage-gated examples [1]