



Biology

Standard and Higher level

B2.1 Membranes and membrane transport Paper 1A

11 May 2026

Zone A afternoon | Zone B morning | Zone C afternoon

1 hour [Paper 1A]

Instructions to candidates

- Answer all questions.
- For each question, choose the answer you consider to be the best.
- A calculator is required for this paper.
- This paper generally presents questions in the same order the concepts are presented in the syllabus guide. The earlier questions are usually but not always easier than the later questions. Although most questions focus on this topic only, some are linked to other topics.
- This paper contains challenging IB-style problems. It is meant to enrich your learning and improve your mastery of the concepts presented in this topic after you have studied it.
- All of the questions here are original and written by me.
- **None of the questions are from past papers.**
- The maximum mark for paper 1A is **[40 marks]**.

1. What is correct about lipid bilayers?
 - A. Phospholipid groups are oriented towards other polar phospholipid groups
 - B. Phospholipid groups are oriented towards the inner cytosolic leaflet only
 - C. Phospholipid groups are oriented towards the outer cytosolic leaflet only
 - D. Phospholipid groups are oriented towards the aqueous solution

2. Which of the following functions of the cell membrane is/are due to the amphipathic structure of phospholipids?
 - I. Energetic stability
 - II. Permeability to hydrophobic molecules
 - III. Active transport
 - A. I only
 - B. I and II only
 - C. I and III only
 - D. I, II, and III

3. What is a function of the lipid bilayer in cell membranes?
 - A. Transport
 - B. Catalysis
 - C. Selective permeability
 - D. Cell signalling

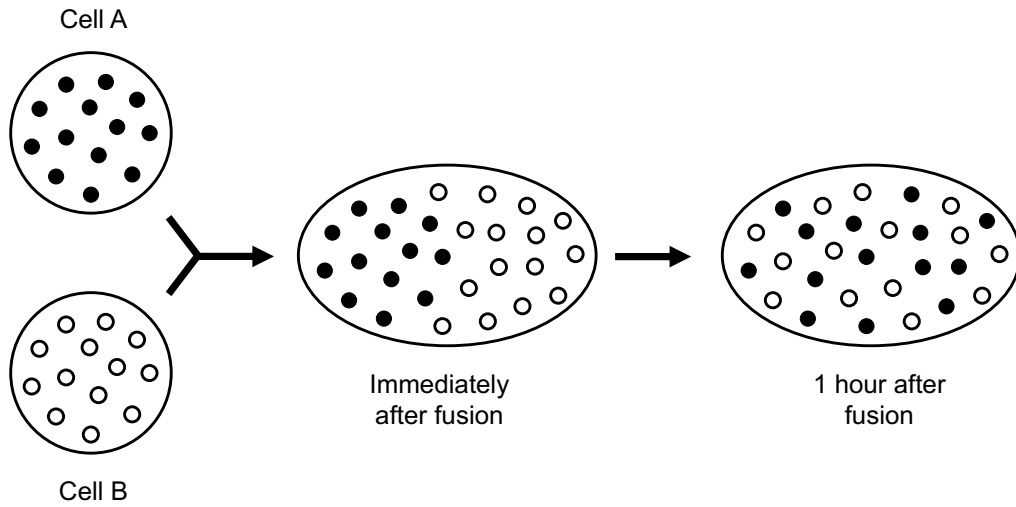
4. What is a consequence of the semi-permeability of the cell membrane?
 - A. Only non-polar particles are able to diffuse through the cell membrane
 - B. Only large and polar particles are unable to diffuse through the cell membrane
 - C. Membrane proteins are required to increase diffuse rate of polar particles
 - D. Membrane proteins are required to prevent simple diffusion of polar particles

5. What molecular properties will lead to a higher rate of simple diffusion across membranes?
- A. Polar and small like water
 - B. Non-polar and small like oxygen
 - C. Non-polar and large like steroid hormones
 - D. Polar and large like glucose
6. What is correct about transport of hydrophilic particles across the membrane?
- A. They only carry out simple diffusion
 - B. They only carry out facilitated diffusion
 - C. They are unable to diffuse across the membrane
 - D. They are unable to freely diffuse across the membrane
7. What is the difference between integral and transmembrane proteins?
- A. Not all transmembrane proteins are integral proteins
 - B. Not all integral proteins are transmembrane proteins
 - C. Only integral proteins are embedded in both lipid bilayers
 - D. Only transmembrane proteins are embedded in one lipid bilayer
8. Which of the following molecules can peripheral proteins be attached to?
- I. Hydrophilic chains
 - II. Hydrocarbon chains
 - III. Phospholipids
- A. I only
 - B. I and II only
 - C. I and III only
 - D. I, II and III

9. Why are aquaporins needed if water can diffuse through membranes?
- A. The size of water molecules reduces their facilitated diffusion rate
 - B. The size of water molecules reduces their simple diffusion rate
 - C. The polarity of water molecules reduces their facilitated diffusion rate
 - D. The polarity of water molecules reduces their simple diffusion rate
10. Cells require vitamins and mineral ions in order to function correctly. Which of the following particles will pass through the membrane by facilitated diffusion?
- A. Fat soluble vitamins and calcium ions
 - B. Fat soluble vitamins and sodium ions
 - C. Water soluble and fat soluble vitamins
 - D. Water soluble vitamins and potassium ions
11. What is correct about the mechanism of transport in pumps?
- A. ATP hydrolysis opens the pump's pore to move solutes against their gradient
 - B. ATP hydrolysis opens the pump's pore to move solutes down their gradient
 - C. A source of energy is used to trigger translocation by conformational changes
 - D. Ligands are used to trigger translocation by conformational changes
12. What type of membrane protein always performs active transport?
- A. Ligand-gated ion channel
 - B. Voltage-gated ion channel
 - C. Carriers
 - D. Pumps
13. What will happen if an animal cell is placed in water that lacks solutes?
- A. Solutes will move by simple diffusion outside of the cell
 - B. Solutes will move by facilitated diffusion outside of the cell
 - C. Water will move by osmosis outside of the cell
 - D. Water will move by osmosis into the cell

14. What makes the cell membrane semi-permeable?
- A. Passive transport
 - B. Active transport
 - C. Phospholipid bilayer
 - D. Continuous sheet-like structure
15. What is **correct** about the mechanism of active transport?
- A. Binding of the solute causes a conformation change that leads to translocation across the membrane
 - B. Binding of the solute does not lead to translocation unless powered by another chemical reaction
 - C. Solute release at the other side of the membrane is caused by ATP hydrolysis
 - D. Solute release is at the other side of the membrane depends on pH
16. What happens if the cell is unable to produce enough ATP to meet energy demand?
- A. The distribution of hydrophobic particles across membranes will be disrupted
 - B. The distribution of hydrophilic particles across membranes will be disrupted
 - C. The rate of active transport will increase to compensate for low energy
 - D. The rate of passive transport will increase to compensate for low energy
17. What is the consequence of a mutation that changes the amino acids lining the inner surface of a channel pore that transports sodium ions?
- A. The channel may become permeable to potassium ions
 - B. The channel may become permeable to calcium ions
 - C. The channel may become less permeable to sodium ions
 - D. The channel may become less permeable to other ions

18. Scientists tagged transmembrane proteins of Cells A and B with dye A and dye B, respectively. The cells were then fused together, and the results after an hour are shown.



Which of the following statements is **true**?

- A. The cell actively moved the transmembrane proteins to where they are needed most
- B. The transmembrane proteins diffused throughout the fluid phospholipid bilayer
- C. The proteins remained in the same place and the dyes attached to other proteins
- D. The cytoskeleton actively rearranged the cell structure after fusion
19. **[AHL]** What is the most likely lipid composition of a highly fluid membrane?
- A. Low cholesterol and high saturated fatty acid levels
- B. Low cholesterol and high unsaturated fatty acid levels
- C. High cholesterol and low saturated fatty acid levels
- D. High cholesterol and low unsaturated fatty acid levels
20. **[AHL]** What is the most likely lipid composition of bacteria in taiga forests?
- A. High saturated fatty acid levels
- B. Low saturated fatty acid levels
- C. Low cholesterol and high saturated fatty acid levels
- D. High cholesterol and low saturated fatty acid levels

21. **[AHL]** Why is membrane fluidity important in endocytosis and exocytosis?
- A. Enables bulk transport at low temperatures
 - B. Enables bulk transport at high temperatures
 - C. Vesicle formation
 - D. Vesicle movement
22. **[AHL]** What structural property enables membranes to pinch off during endocytosis?
- A. Hydrophobic core
 - B. Phosphate heads
 - C. Membrane fluidity
 - D. Cholesterol embedment
23. **[AHL]** What is a direct consequence of exocytosis?
- A. Change in membrane potential due to release of large and charged particles
 - B. Osmosis since water molecules are expelled from the cytosol
 - C. Increase in the surface area of the cell membrane
 - D. Decrease in the surface area of the cell membrane
24. **[AHL]** What is the difference between direct and indirect active transport?
- A. The indirect source of energy
 - B. The direct source of energy
 - C. The type of solute being transported
 - D. The direction of movement along the concentration gradient
25. **[AHL]** What is correct about membrane proteins that carry out active transport?
- A. Symporters are distinct from pumps
 - B. Antiporters are distinct from pumps
 - C. All pumps are symporters but not all symporters are pumps
 - D. All symporters are pumps but not all pumps are symporters

- 26. [AHL]** What is the significance of sodium-potassium pumps in animal cells?
- A. They facilitate the movement of ions across the membrane
 - B. They allow the voltage-gated ion channels to function properly
 - C. They control the potential of the extracellular fluid for neural signalling
 - D. They control the potential of the intracellular fluid for neural signalling
- 27. [AHL]** What is the sodium-potassium pump bound to when it changes conformation?
- A. A phosphate group only
 - B. A phosphate group and 3 sodium ions only
 - C. A phosphate group, ADP, and 3 sodium ions only
 - D. A phosphate group, ATP, and 3 sodium ions only
- 28. [AHL]** What triggers dephosphorylation of the sodium-potassium pump?
- A. The binding of potassium ions
 - B. The difference in membrane potential between the cell and its environment
 - C. The attachment of an ADP molecule to the pump
 - D. Release of the sodium ions into the extracellular fluid
- 29. [AHL]** For every round of activity of the sodium-potassium pump, how does the charge inside the cell change?
- A. It increases by 1
 - B. It decreases by 1
 - C. It stays the same
 - D. It depends on the amount of ATP

30. **[AHL]** A researcher is studying a cell culture treated with a drug and observes that the intracellular concentrations of sodium and potassium ions have increased and decreased, respectively. What membrane protein does the drug most likely inhibit?
- A. Neurotransmitter-gated acetylcholine channels
 - B. Sodium-potassium ion pumps
 - C. Voltage-gated potassium ion channels
 - D. Voltage-gated sodium ion channels
31. **[AHL]** Which of the following is a consequence of administering a drug that blocks the function of the sodium-potassium pump?
- I. Increased loss of glucose through the kidneys
 - II. Decreased absorption of glucose through the small intestines
 - III. Difficulty firing action potentials
- A. I only
 - B. I and II only
 - C. I and III only
 - D. I, II and III
32. **[AHL]** How does nicotine affect membrane transport in neurons?
- A. It increases binding of acetylcholine to voltage-gated nicotinic receptors
 - B. It binds to voltage-gated nicotinic receptors
 - C. It causes sodium ion influx by opening nicotinic receptors
 - D. It makes the cytosol charge more negative by opening nicotinic receptors
33. **[AHL]** What class of transport proteins do sodium-glucose cotransporters belong to?
- A. Symporters
 - B. Antiporters
 - C. Carriers
 - D. Channels

34. **[AHL]** How do sodium-glucose cotransporters work?
- A. They use ATP to establish a sodium gradient that drives glucose transport
 - B. The positive charge of sodium ions is used to translocate glucose molecules
 - C. Phosphorylation of the cotransporter translocates sodium and glucose
 - D. Energy from facilitated diffusion of sodium is used to actively transport glucose
35. **[AHL]** What is the function of cell-adhesion molecules?
- A. Adhesion of cells only to other cells
 - B. Adhesion of cells to only the extracellular matrix
 - C. Adhesion of cells to other cells and the extracellular matrix
 - D. Adhesion of cells to other cells, the extracellular matrix, and ions
36. **[AHL]** A student said that “cell-adhesion molecules (CAMs) are only important because they help cells adhere to each other.” Which statement best evaluates this claim?
- A. Correct because CAMs keep tissues intact
 - B. Correct because CAMs bind to each other to bring bilayers together
 - C. Incorrect because CAMs are proteins that adhere to each other and not cells
 - D. Incorrect because CAMs are also involved in cell recognition
37. **[AHL]** What is **incorrect** about interactions of cells with their environments?
- A. Recognition of cells depends on interactions between transmembrane proteins
 - B. The extracellular matrix can be linked to cells by transmembrane proteins
 - C. Cell adhesion molecules always create open junctions between cells
 - D. Different junctions are composed of different types of adhesion molecules

- 38. [AHL]** What is a consequence of a loss of function mutation in cell-adhesion molecules (CAMs)?
- A. The mutated amino acids cause cells to adhere more tightly to each other
 - B. More ions flow through cell-cell junctions
 - C. Embryonic development is impaired as tissues become more packed
 - D. The cell is able to interact less effectively with its environment
- 39. [AHL]** Cell-adhesion molecules (CAMs) are important in interactions between leukocytes and endothelial cells, enabling immune cells to reach sites of infection. What is an immediate consequence of disruption to CAMs that mediate this immune function?
- A. Decreased innate immunity
 - B. Increased innate immunity
 - C. Decreased adaptive immunity
 - D. Increased adaptive immunity
- 40. [AHL]** Researchers measured the expression levels of E-Cadherin, a type of cell-adhesion molecule, in 200 samples of endometrium cancer tumors.

E-cadherin expression			
Negative (%)	Weak (%)	Moderate (%)	Strong (%)
1.5	12.5	15.5	70.5

What is a valid conclusion?

- A. Since most expression is not negative, loss of E-cadherin is unlikely to affect tumor tissue organization
- B. Data from a sample of 200 tumours are not reliable for generalizations
- C. Stronger expression of E-cadherin is common in endometrium cancer tumors
- D. Strong E-cadherin expression enables tumors to metastasize more effectively

References:

Burandt, Eike et al. "E-Cadherin expression in human tumors: a tissue microarray study on 10,851 tumors." *Biomarker research* vol. 9,1 44. 5 Jun. 2021, doi:10.1186/s40364-021-00299-4

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