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Cell Membrane & Transport

Exam — Cell Membrane

Pre-med style questions on membrane structure, fluid mosaic
model, diffusion, osmosis, active transport, and vesicular transport

1 Which statement best describes the basic structure of the plasma membrane according to the fluid mosaic model?

A   A rigid layer of triglycerides with scattered DNA and RNA

B   A phospholipid bilayer with proteins embedded and moving within it

C   A single layer of phospholipids covered by a continuous protein coat

D   A double layer of carbohydrates with proteins embedded

E   A rigid protein lattice with phospholipids trapped inside

2 Phospholipids in the plasma membrane are described as amphipathic. What does this mean?

A   They are both proteins and lipids at the same time

B   They contain both hydrophobic and hydrophilic regions

C   They carry both positive and negative charges on the head group

D   They can freely flip from one leaflet of the bilayer to the other

E   They are composed of both DNA and RNA

3 Where are carbohydrate chains typically located in relation to the plasma membrane of animal cells?

A   On the cytosolic side attached to phospholipids

B   On the extracellular side attached to lipids and proteins

C   Embedded within the hydrophobic core of the bilayer

D   Inside the nucleus attached to histones

E   Evenly distributed on both cytosolic and extracellular sides

4 **Which type of membrane protein spans the entire lipid bilayer and often forms channels or transporters?**

  A Peripheral membrane protein

  B Integral transmembrane protein

  C Cytosolic enzyme

  D Extracellular matrix protein

  E Nuclear pore protein

5 **Cholesterol molecules in the plasma membrane of animal cells mainly:**

  A Form ion channels for Na^+ and K^+

  B Act as receptors for peptide hormones

  C Modulate membrane fluidity and reduce permeability to small polar molecules

  D Bind directly to DNA to regulate gene expression

  E Provide most of the membrane's structural rigidity through covalent cross-links

6 **Which of the following molecules diffuses most readily across a pure phospholipid bilayer WITHOUT the help of transport proteins?**

  A Na^+

  B Glucose

  C Cl—

  D O2

  E A small charged peptide

7 **Simple diffusion differs from facilitated diffusion in that simple diffusion:**

    A Requires ATP hydrolysis

    B Can move solutes against their concentration gradient

    C Does not saturate because it does not depend on a limited number of transport proteins

    D Is specific for particular solutes

    E Occurs only in prokaryotic membranes

8 **Which statement about facilitated diffusion through membrane proteins is CORRECT?**

    A It requires ATP directly

    B It moves substances down their electrochemical gradient

    C It can transport solutes only from low to high concentration

    D It is non-specific and transports any solute

    E It involves vesicle formation and membrane fusion

9 **Which feature distinguishes carrier (transporter) proteins from channel proteins?**

    A Channels are specific but carriers are non-specific

    B Carriers undergo conformational changes to transport solutes; channels provide a continuous pore

    C Carriers always require ATP whereas channels do not

    D Channels are used only in prokaryotes; carriers only in eukaryotes

E   Carriers transport only water molecules

10 Aquaporins in cell membranes primarily facilitate:

A   Active transport of Na^+ ions

B   Passive diffusion of water across the membrane

C   Facilitated diffusion of glucose

D   Exocytosis of proteins

E   Endocytosis of lipids

11 Osmosis is best defined as the:

A   Diffusion of any solute across a selectively permeable membrane

B   Movement of water across a selectively permeable membrane from a region of low solute concentration to high solute concentration

C   Active transport of water using ATP

D   Bulk flow of fluid driven by pressure differences

E   Movement of water only when channels are closed

12   A red blood cell is placed in a solution that is hypotonic relative to its cytoplasm. What is the most likely outcome?

A   Water leaves the cell; the cell shrinks (crenates)

B   Water enters the cell; the cell may swell and lyse

C   No net movement of water; cell volume remains constant

D   Only solutes move; water cannot cross the membrane

E   The cell actively pumps out water using ATP

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13 **A plant cell placed in a hypertonic solution will most likely:**

A   Become turgid as water enters

B   Undergo plasmolysis as the plasma membrane pulls away from the cell wall

C   Lyse due to cell wall rupture

D   Remain unchanged because plant cells are impermeable to water

E   Gain solutes without losing water

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14 **Which transport process is correctly matched with its energy requirement?**

A   Simple diffusion – requires ATP

B   Facilitated diffusion – requires ATP

C   Primary active transport – directly uses energy from ATP hydrolysis

D   Secondary active transport – requires no energy at all

E   Osmosis – requires GTP

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15   **The Na^+/K^+ ATPase (sodium–potassium pump) in animal cell membranes typically:**

A   Moves 3 K^+ out and 2 Na^+ in per ATP hydrolysed

B   Moves 3 Na^+ out and 2 K^+ in per ATP hydrolysed

C   Moves Na^+ and K^+ down their concentration gradients

D   Functions by facilitated diffusion

E   Has no effect on membrane potential

16   **Secondary active transport (cotransport) differs from primary active transport in that secondary active transport:**

A   Uses ATP directly at the transport protein

B   Always moves solutes down their concentration gradients

C   Uses the energy stored in an ion gradient generated by primary active transport

D   Does not require membrane proteins

E   Occurs only in prokaryotic cells

17   **A Na^+/glucose symporter in the intestinal epithelium transports glucose into cells against its concentration gradient by coupling it to Na^+ movement. This is an example of:**

A   Simple diffusion

B   Primary active transport driven by ATP at the symporter

C   Secondary active transport using the Na^+ electrochemical gradient

D   Osmosis

E   Exocytosis

18 **Which combination correctly describes uniport, symport, and antiport?**

A Uniport: two solutes in opposite directions; symport: one solute; antiport: two solutes in same direction

B Uniport: one solute; symport: two solutes in same direction; antiport: two solutes in opposite directions

C Uniport: one solute; symport and antiport: bulk vesicle movement

D Uniport: one solute; symport: no solute; antiport: one solute

E Uniport: passive; symport and antiport: always active

19 **Which process is an example of bulk (vesicular) transport across the plasma membrane?**

A Na^+/K^+ ATPase activity

B Simple diffusion of oxygen

C Exocytosis of neurotransmitters from synaptic vesicles

D Facilitated diffusion of glucose via GLUT transporters

E Osmosis through aquaporins

20 **Phagocytosis is best described as:**

A Non-specific uptake of extracellular fluid in small vesicles

B Receptor-mediated uptake of specific ligands in clathrin-coated vesicles

C Engulfment of large particles or cells into large vesicles by specialised cells

D Release of substances from the cell by vesicle fusion with the plasma membrane

E Diffusion of solutes down their concentration gradients

21 Receptor-mediated endocytosis is characterised by:

A   Non-specific uptake of solutes and fluid

B   Involvement of specific receptors and often clathrin-coated pits

C   Transport of ions through open channels

D   Active pumping of solutes using ATP

E   Formation of gap junctions between cells

22 The resting membrane potential of a typical animal cell is mainly generated by:

A   Equal permeability to all ions

B   High permeability to K^+ and the concentration gradient of K^+ across the membrane

C   High permeability to Na^+ and the Na^+ concentration gradient

D   Osmosis of water through aquaporins

E   Active import of Cl— into the cell

23 Which type of membrane transport typically exhibits a maximum rate (Vmax) when substrate concentration is high, analogous to enzyme saturation?

A   Simple diffusion of O2

B   Facilitated diffusion via carrier proteins

C   Facilitated diffusion via open ion channels

D   Osmosis through aquaporins

E   Bulk flow of fluid in capillaries

24 **GLUT transporters (e.g. GLUT1) that mediate glucose uptake into many cells are examples of:**

A Primary active transporters

B Secondary active symporters

C Na^+-dependent glucose cotransporters

D Facilitated diffusion uniporters

E Voltage-gated ion channels

25 **Which factor would generally INCREASE the rate of simple diffusion of a solute across a membrane?**

A Decreasing temperature

B Increasing the thickness of the membrane

C Increasing the concentration gradient of the solute across the membrane

D Decreasing membrane surface area

E Making the solute more charged and hydrophilic

26 **Cystic fibrosis is caused by mutations in a gene encoding CFTR, which functions as:**

A A Na^+/K^+ ATPase

B A voltage-gated Na^+ channel

C A Cl— channel regulated by ATP binding

D A glucose symporter

E   A K$^+$ leak channel

27 **Which statement correctly describes pinocytosis?**

A   Uptake of specific ligands via receptors in clathrin-coated pits

B   Non-specific uptake of extracellular fluid and dissolved solutes into small vesicles

C   Engulfment of large particles like bacteria

D   Fusion of vesicles with the plasma membrane to secrete proteins

E   Diffusion of water through aquaporins

28 **Which of the following processes is DIRECTLY dependent on ATP hydrolysis at the transport protein itself?**

A   Na$^+$/K$^+$ pump

B   Na$^+$/glucose symporter

C   GLUT-mediated glucose transport

D   Aquaporin-mediated water flow

E   Voltage-gated K$^+$ channels opening during an action potential

29 **An ion moves across a membrane from an area of high concentration to low concentration, but against the electrical component of its electrochemical gradient (e.g. a positive ion moving into a more positive compartment). Which of the following best describes this movement?**

A   Always energetically favourable because concentration decreases

B Determined by the net electrochemical gradient, which may still drive net movement without ATP

C Impossible without vesicle formation

D An example of primary active transport

E An example of osmosis

30 Which situation will most likely cause a cell to gain water by osmosis?

A The cell is placed in a hypertonic solution

B The cell is placed in an isotonic solution

C The cell is placed in a hypotonic solution

D Solute concentrations are equal inside and outside

E The cell expresses more aquaporins but is in an isotonic medium

Answer Key

#	Ans	Answer Text
1	B	A phospholipid bilayer with proteins embedded and moving within it
2	B	They contain both hydrophobic and hydrophilic regions
3	B	On the extracellular side attached to lipids and proteins
4	B	Integral transmembrane protein
5	C	Modulate membrane fluidity and reduce permeability to small polar molecu…
6	D	O2
7	C	Does not saturate because it does not depend on a limited number of tran…
8	B	It moves substances down their electrochemical gradient
9	B	Carriers undergo conformational changes to transport solutes; channels p…
10	B	Passive diffusion of water across the membrane
11	B	Movement of water across a selectively permeable membrane from a region …
12	B	Water enters the cell; the cell may swell and lyse
13	B	Undergo plasmolysis as the plasma membrane pulls away from the cell wall
14	C	Primary active transport – directly uses energy from ATP hydrolysis
15	B	Moves 3 Na^+ out and 2 K^+ in per ATP hydrolysed
16	C	Uses the energy stored in an ion gradient generated by primary active tr…
17	C	Secondary active transport using the Na^+ electrochemical gradient
18	B	Uniport: one solute; symport: two solutes in same direction; antiport: t…
19	C	Exocytosis of neurotransmitters from synaptic vesicles
20	C	Engulfment of large particles or cells into large vesicles by specialise…
21	B	Involvement of specific receptors and often clathrin-coated pits
22	B	High permeability to K^+ and the concentration gradient of K^+ across the …
23	B	Facilitated diffusion via carrier proteins
24	D	Facilitated diffusion uniporters
25	C	Increasing the concentration gradient of the solute across the membrane
26	C	A Cl— channel regulated by ATP binding
27	B	Non-specific uptake of extracellular fluid and dissolved solutes into sm…
28	A	Na^+/K^+ pump
29	B	Determined by the net electrochemical gradient, which may still drive ne…
30	C	The cell is placed in a hypotonic solution