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Level: HL IB in Biology

Subject: Biology

Topic: IB HL Biology

Type: Mark Scheme

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All International Baccalaureate IB Topic Questions HL Biology

BIOLOGY

HL - IB

Key skills

Answer 1

The correct answer is C because vesicles transport substances within the cell that are to be released at the cell surface membrane by exocytosis.

A is incorrect because facilitated diffusion is not an active process and so does not require ATP (ATP is produced in the mitochondria).

B is incorrect because lysosomes are not involved in DNA synthesis or DNA replication.

D is incorrect because ribosomes are involved in the production of polypeptides, not phospholipids.

Answer 2

The correct answer is C.

- The role of cholesterol is to maintain the correct fluidity of the cell membrane.
- Glycoproteins are proteins with a carbohydrate chain attached. They are specific in structure and act as antigens in cell recognition. Some glycoproteins act as hormone receptors.
- Membrane proteins have various roles, one of which is to act as a receptor for hormones.
- Glycoproteins can also act as receptors, such as when they bind to neurotransmitters during nerve impulse transmission.

Note that while the specification doesn't necessarily cover the roles of all of these molecules in great detail (e.g. you may not know the specifics of glycolipid function), there are enough obviously wrong statements here for you to work out the correct answer.

Answer 3

The correct answer is B.

- Chloride ions are negatively charged, so can only cross the membrane by facilitated diffusion or active transport
- If a chloride ion is moving down its concentration gradient (by facilitated diffusion) it will travel through a channel protein
- If a chloride ion is moving against its concentration gradient (by active transport) it will travel through a pump protein

A is incorrect because the role of cholesterol is to maintain the correct fluidity of the membrane; it does not transport ions.

C is incorrect because glycolipids (and glycoproteins) are used in cell recognition, signalling and adhesion but do not transport ions.

D is incorrect because chloride ions are charged and therefore cannot pass through the hydrophobic middle section of the phospholipid bilayer.

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Answer 4

The correct answer is D.

- Integral proteins are amphipathic, meaning that their hydrophilic region can sit outside the membrane and their hydrophobic region can sit within the membrane; this can result in proteins that span the whole width of the membrane, like W, or that are embedded halfway into the membrane, like X
- Glycoproteins are proteins with attached carbohydrates, and are found on the extracellular side of the membrane.
- Phospholipids consist of a hydrophilic phosphate head and two hydrophobic fatty acid tails. They are the most abundant molecule in the membrane.

Note that peripheral proteins are hydrophilic, so they do not extend into the central region of the membrane at all, but are bound to the surface of the membrane. This means that X cannot be a peripheral protein.

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Answer 5

The correct answer is A.

- Only the small hydroxyl (-OH) group at one end of the cholesterol molecule is hydrophilic. The rest of the molecule is hydrophobic. This means that most of the cholesterol molecule is attracted to the hydrocarbon tails at the centre of the membrane, as these are also hydrophobic.
- Cholesterol restricts molecular motion in the membrane and therefore reduces its fluidity. As it is a largely hydrophobic molecule, it also reduces the permeability of the membrane to particles such as sodium ions and hydrogen ions, which are hydrophilic.

Note that cholesterol can also function to increase membrane fluidity at very low temperatures, as it prevents the phospholipids from crystallising, meaning that statement II of option B would be correct at low temperatures. This doesn't affect the answer to this question, however, as statement I of option B is incorrect.

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Answer 6

The correct answer is A; in the 1950s and 1960s, experimental evidence accumulated that did not fit with the Davson-Danielli model.

- Membrane proteins are globular.
- Membrane proteins are free to move.

Statements relating to the properties and arrangement of phospholipids (B and D) here are not relevant to the study of membrane proteins.

Statement C is incorrect; the surface of the membrane is hydrophilic, while the inside is hydrophobic.

Note that you are not expected to know lots of details about the historical models of membrane structure, but you should be able to apply your knowledge of the fluid mosaic model and the scientific method to questions like this one.

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Answer 7

The correct answer is C.

- For certain particles, e.g. non-polar particles such as oxygen, simple diffusion can occur across the entire cell surface membrane.
- Ions and certain other particles, e.g. large and/or polar molecules, cannot diffuse between phospholipids. They must pass through protein channels or carriers in the plasma membrane; this is facilitated diffusion.

A is incorrect because the diffusion rate increases as the concentration gradient increases for both simple diffusion and facilitated diffusion (i.e. both should be directly proportional).

B is incorrect because simple diffusion can occur across a membrane.

D is incorrect because both simple and facilitated diffusion are passive processes that do not require ATP.