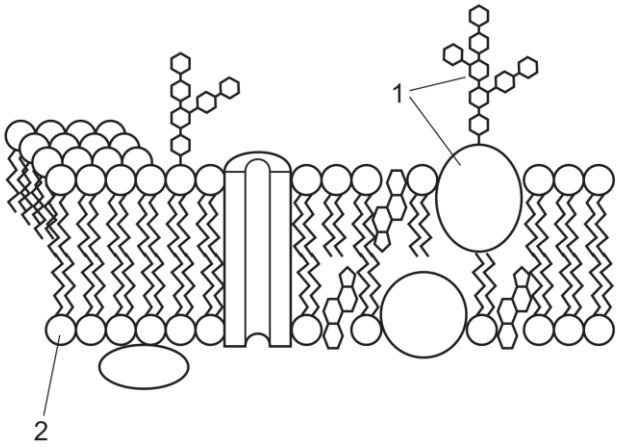
4. Cell Membranes and Transport

4.1 Fluid mosaic membranes

Paper 1

Question Paper

1 The diagram shows part of a cell surface membrane.



Which row correctly identifies the molecules labelled 1 and 2?

	1	2
A	glycoprotein	protein
B	glycolipid	lipoprotein
C	glycoprotein	phosphate head
D	glycolipid	phosphate head

2 An investigation was carried out into the effect of four different treatments on the permeability of the cell surface membranes and tonoplasts of beetroot cells. Beetroot cell vacuoles contain a red pigment. This pigment **cannot** diffuse through the tonoplasts or cell surface membranes.

1 cm^3 cubes were cut from beetroot tissue and washed in running water for 20 minutes to remove any pigment released from damaged cells.

Two cubes were then placed in each of the four test-tubes containing different contents and observed for five minutes.

Which row shows a correct explanation for the observation recorded for one of the treatments?

	treatment	observation	explanation
A	dilute hydrochloric acid	contents of test-tube stay clear	membrane proteins have been denatured
B	ethanol	contents of test-tube turn red	lipids, including membrane phospholipids, have dissolved
C	water at 20 °C	contents of test-tube stay clear	membrane proteins have been denatured
D	water at 80 °C	contents of test-tube turn red	lipids, including membrane phospholipids, have dissolved

3 Which statements about phospholipids in cell surface membranes are correct?

1 Fatty acid tails allow most ions to pass through the membrane.

2 Hydrophobic tails point inwards facing each other.

3 All polar heads face the cytoplasm.

4 The phospholipids help with the flexibility of the membrane.

A 1, 2 and 3 **B** 1 and 3 only **C** 2, 3 and 4 **D** 2 and 4 only

4 Which statement about cell signalling is correct?

A One type of receptor molecule will recognise all ligands in the body.

B The binding of a ligand may cause a change to the shape of the receptor.

C The receptors for ligands are always found on the inside of cells.

D The same ligand is made by all of the cells in the body.

5 Which molecules in cell surface membranes are typically involved in cell recognition?

	cholesterol	glycolipids	glycoproteins	phospholipids
A	✓	✓	✗	✗
B	✓	✗	✗	✓
C	✗	✓	✓	✗
D	✗	✗	✓	✓

key

✓ = involved

✗ = not involved

6 What can increase the fluidity of the cell surface membrane?

1 single bonds between carbon atoms in the fatty acid chains

2 cholesterol

3 longer-chained fatty acids

A 1, 2 and 3 **B** 1 and 3 only **C** 2 and 3 only **D** 2 only

7 Which component of cell surface membranes helps to reduce fluidity of the phospholipids at high temperatures?

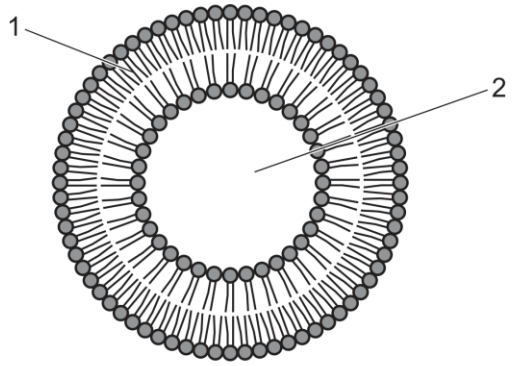
A phosphate groups

B unsaturated fatty acids

C cholesterol

D proteins

8 The diagram shows a liposome.



Liposomes can be used to move therapeutic drugs into cells of the body to treat conditions such as cancer.

Which row shows the property of a drug that could be transported in the sections of the liposome labelled 1 and 2?

	property of drug transported in location 1	property of drug transported in location 2
A	hydrophilic	hydrophilic
B	hydrophilic	hydrophobic
C	hydrophobic	hydrophilic
D	hydrophobic	hydrophobic

9 Which functions are performed by glycoproteins on the surface of a cell surface membrane?

1 to act as enzymes catalysing reactions in the membrane

2 to have a specific site where chemicals can bind

3 to secrete specific chemicals used for cell signalling

A 1, 2 and 3 **B** 2 and 3 only **C** 2 only **D** 3 only

10 The enzyme lactase is found in the membranes of epithelial cells lining the small intestine.

The enzyme is formed by a single polypeptide that folds to give three regions.

- an active site with the free amino group outside the cell
- a short section inside the membrane
- a short section inside the cell

What type of amino acid would be found in each of the three regions?

	outside the cell	inside the membrane	inside the cell
A	hydrophilic	hydrophobic	hydrophilic
B	hydrophilic	hydrophobic	hydrophobic
C	hydrophobic	hydrophilic	hydrophobic
D	hydrophobic	hydrophobic	hydrophilic

11 A student wrote three statements about cell signalling.

1 A signal chemical always has the same shape as a protein receptor on a target cell.

2 An increase in temperature may decrease the effect of cell to cell signalling.

3 A mutation may decrease production of active protein receptors for the cell surface membrane.

Which statements are correct?

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 3 only

12 Which roles of the cell surface membrane result from the properties of the phospholipids?

1 to allow cytokinesis to occur in mitotic cell division

2 to allow entry and exit of oxygen and carbon dioxide

3 to allow the phagocytosis of a bacterium into a cell

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

13 The diagrams show four phospholipid molecules.

Which molecule could contribute most to the fluidity of a cell surface membrane?

A



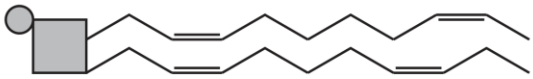
B



C



D



14 Which properties of phospholipids explain why single layers of phospholipids added to water immediately form bilayers?

1 The hydrophobic fatty acid chains repel water molecules so the tails pack together.

2 The non-polar fatty acid chains are attracted to each other by hydrophobic interactions.

3 Hydrogen bonds form between the phosphate groups and water.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

15 What explains how a signal molecule produced by one cell can be detected by a target cell?

A A signal molecule can bind to any type of cell surface receptor.

B A signal molecule has a complementary shape to a cell surface receptor.

C Signal molecules enter the cell by diffusion.

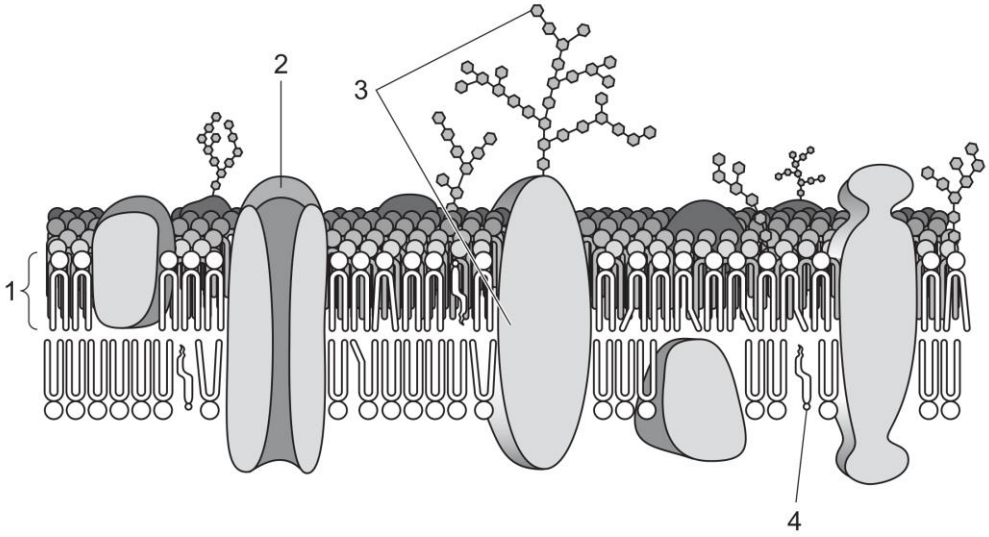
D Signal molecules enter the cell by endocytosis.

16 A decrease in some factors will increase the fluidity of the cell surface membrane.

Which pair of factors, when decreased, will increase the fluidity of the cell surface membrane?

	a decrease in
A	• distance between phospholipid molecules • proportion of short fatty acid chains
B	• distance between phospholipid molecules • temperature
C	• proportion of phospholipids with saturated fatty acid chains • proportion of long fatty acid chains
D	• proportion of phospholipids with unsaturated fatty acid chains • temperature

17 The diagram shows a cell surface membrane.



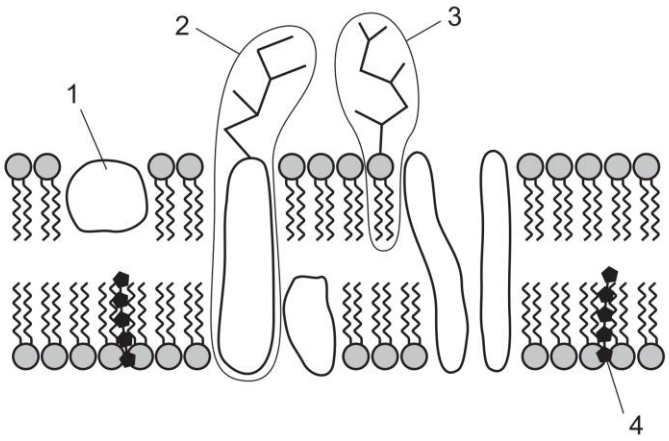
Which statements about the labelled molecules in the membrane are correct?

- 1 is involved in the diffusion of ions.
- 2 is involved in facilitated diffusion.
- 3 is involved in the recognition of antigens.
- 4 is involved in membrane fluidity.

A 1, 2 and 3 **B** 1 and 3 only **C** 1 and 4 **D** 2 and 4 only

18 The diagram shows the fluid mosaic model of membrane structure.

Structures 1, 2, 3 and 4 are types of molecule.



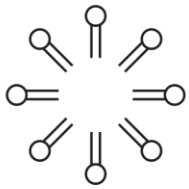
Which types of molecules are always identical?

A 1, 2 and 3 **B** 1 and 4 **C** 2 and 3 only **D** 4 only

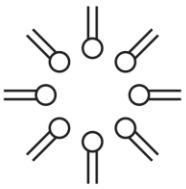
19 When a small quantity of phospholipid is added to a test-tube of water and then shaken vigorously, an emulsion is formed by small droplets called liposomes.

Which diagram shows the arrangement of phospholipid molecules in a cross-section of a liposome?

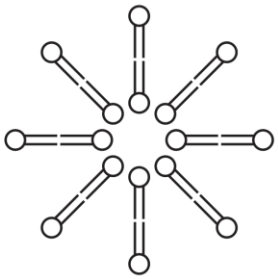
A



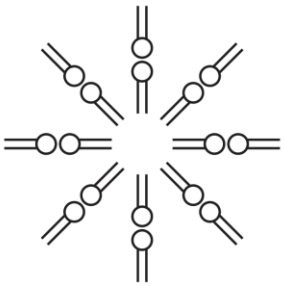
B



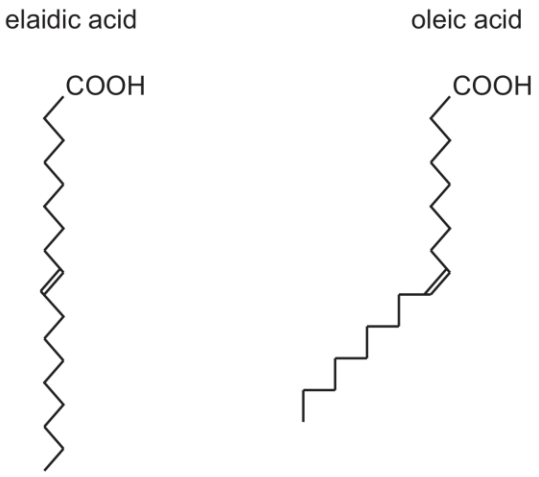
C



D



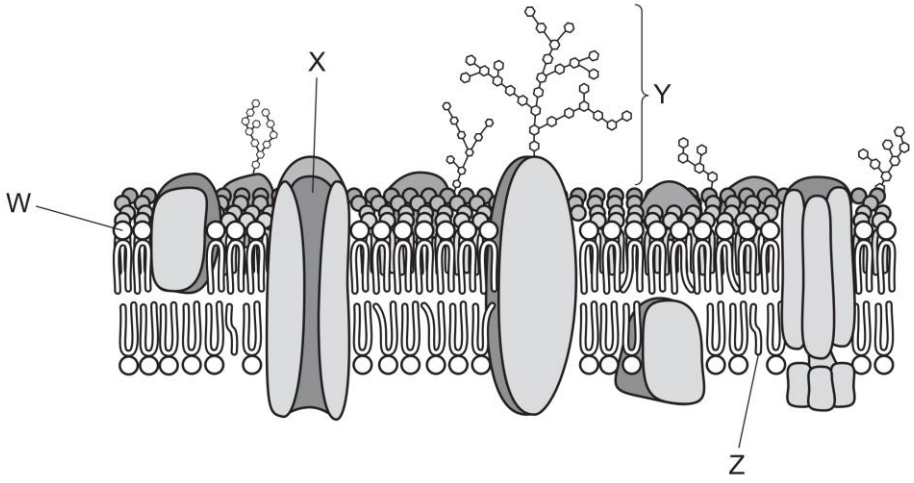
20 The fatty acids elaidic acid and oleic acid have exactly the same structural formulae, with one double bond in the chain. However, the shapes of the chains are different, as shown in the diagram.



Which row shows the effect of the presence of these fatty acids on the structure and behaviour of a cell surface membrane?

	elaidic acid	oleic acid
A	does not fit closely with other fatty acids so that the membrane is less fluid at high temperatures	fits closely with other fatty acids so that the membrane is less fluid at low temperatures
B	does not fit closely with other fatty acids so that the membrane is more fluid at low temperatures	fits closely with other fatty acids so that the membrane is less fluid at low temperatures
C	fits closely with other fatty acids so that the membrane is less fluid at high temperatures	does not fit closely with other fatty acids so that the membrane is more fluid at low temperatures
D	fits closely with other fatty acids so that the membrane is more fluid at low temperatures	does not fit closely with other fatty acids so that the membrane is more fluid at high temperatures

21 The diagram shows a cell surface membrane.



Which is a correct role for a labelled molecule?

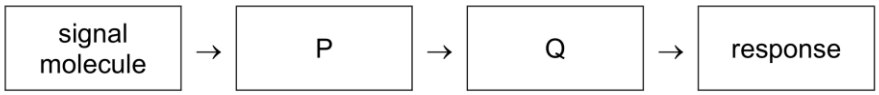
A W is involved in controlling membrane stability.

B X is involved in active transport.

C Y is involved in cell signalling.

D Z is involved in diffusion of ions.

22 The diagram shows a simple cell signalling pathway in which a signal molecule leads to a response, such as a secretion.



Which row identifies P and Q?

	P	Q
A	activated enzyme in cytoplasm	target in cell surface membrane
B	lipid in cell surface membrane	extracellular enzyme
C	protein in cell surface membrane	activated enzyme in cytoplasm
D	target in cytoplasm	protein in cell surface membrane

23 Cell surface receptors used in cell signalling are usually proteins that extend from one side of the membrane to the other side of the membrane.

What is the role of the extracellular part of the protein?

A binding the signalling molecule

B functioning as an enzyme

C increasing the solubility of the receptor

D transmitting the signal from the target cell

24 High concentrations of ethanol can disrupt cell membrane structure and make the cell surface membrane leaky.

Yeast cells release ethanol as a waste product of metabolism.

Yeast cells can alter the composition of the cell surface membrane to reduce the effect of ethanol.

- A saturated fatty acid, X, is replaced by an unsaturated fatty acid, Y.
- Y has a shorter hydrocarbon chain than X.
- There is an increase in the phospholipid to protein ratio.

Which statement would explain why the effect of ethanol is reduced?

A A greater proportion of phospholipid may increase the entry of ethanol via channel proteins.

B An increase in hydrophobic interaction by phospholipid tails improves membrane stability.

C An increase in the proportion of fatty acids with double bonds decreases membrane fluidity.

D The shorter hydrocarbon chain of Y decreases membrane fluidity.

25 Which statements about the cell surface membrane are correct?

1 Channel proteins allow water soluble ions and molecules across the membrane.

2 Glucose can pass into the cell via carrier proteins.

3 Oxygen passes freely through the membrane as it is soluble in lipids.

4 Some glycoproteins act as antigens.

A 1, 2, 3 and 4

B 1, 3 and 4 only

C 1 and 2 only

D 2, 3 and 4 only

26 What can increase the fluidity of the cell surface membrane at low temperatures?

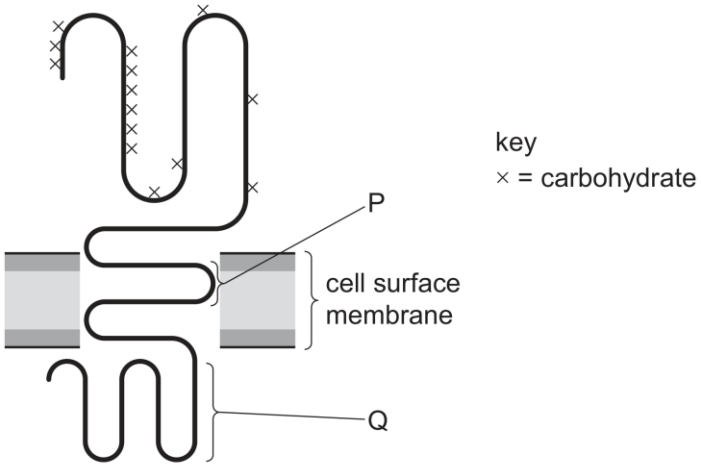
1 double bonds between carbon atoms in the fatty acid chains

2 cholesterol

3 fatty acids having shorter chains

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 3 only

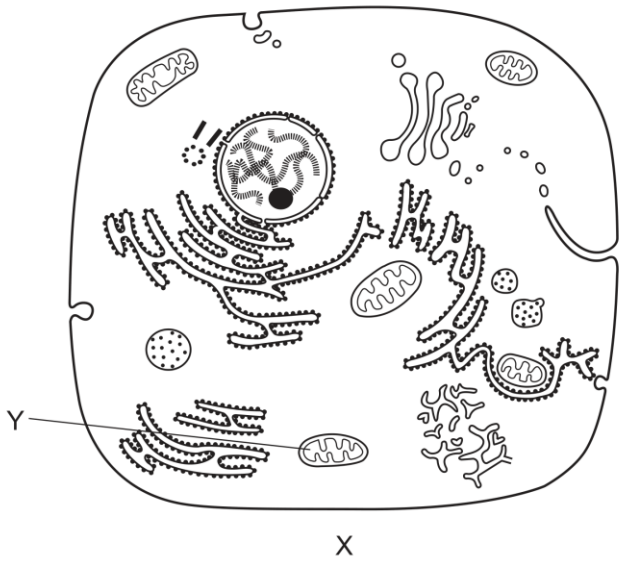
27 The diagram shows a glycoprotein embedded in the cell surface membrane of a human red blood cell. This glycoprotein is part of a system of cell surface blood group recognition sites.



Which row identifies the role of this glycoprotein and regions P and Q of the molecule?

	role of glycoprotein	region P	region Q
A	antigen	amino acids with hydrophobic R groups	amino acids with hydrophilic R groups in the cell's cytoplasm
B	carrier	amino acids with hydrophilic R groups	amino acids with hydrophilic R groups in the cell's cytoplasm
C	channel	amino acids with hydrophilic R groups	amino acids with hydrophobic R groups outside the cell
D	receptor	amino acids with hydrophobic R groups	amino acids with hydrophobic R groups outside the cell

28 The diagram is a drawing from an electron micrograph of a typical animal cell.



How many layers of phospholipids will a molecule of oxygen cross to travel directly from X, outside the cell, to Y, the matrix of the mitochondrion?

A 3 **B** 4 **C** 5 **D** 6