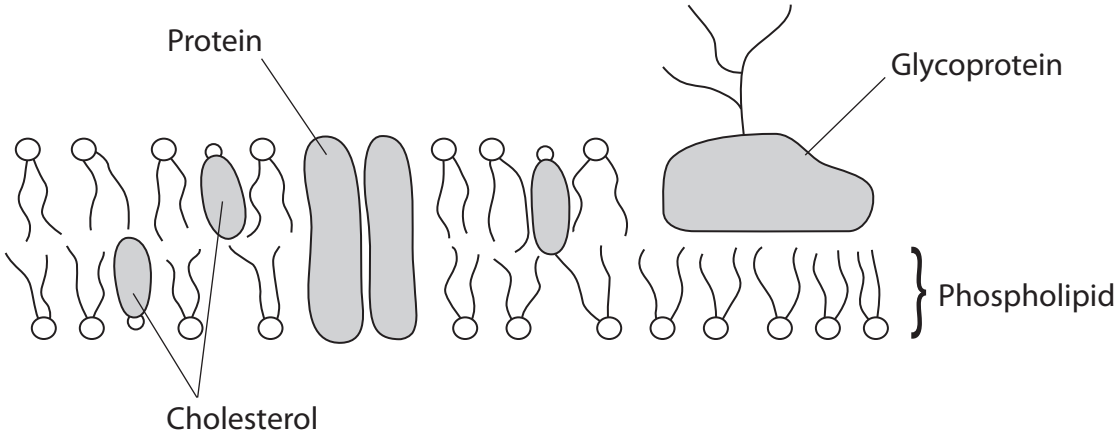
1 One function of the cell membrane is to control which molecules can enter or leave the cell.

The diagram below represents the structure of the cell membrane.



(a) For each of the statements below, put a cross ☒ in the box that corresponds to the correct statement.

(i) The phospholipids form a bilayer because

(1)

☒ **A** the hydrophobic heads dissolve in the aqueous (water) environment

☒ **B** the hydrophobic heads move away from the aqueous environment

☒ **C** the hydrophobic tails dissolve in the aqueous environment

☒ **D** the hydrophobic tails move away from the aqueous environment

(ii) The protein, labelled in the diagram, could be involved in

(1)

☒ **A** endocytosis

☒ **B** exocytosis

☒ **C** facilitated diffusion

☒ **D** phagocytosis

(iii) The fluidity of the membrane is determined by the proportion of

(1)

☒ **A** cholesterol

☒ **B** glycoprotein

☒ **C** phospholipid

☒ **D** protein

(b) A student carried out an experiment to investigate the effect of temperature on the permeability of beetroot membranes. Beetroots are root vegetables that appear red because the vacuoles in their cells contain a water-soluble red pigment. This pigment cannot pass through membranes.

Six cubes of beetroot were cut. One piece of beetroot was placed into a tube containing 10 cm^3 of water and left for 20 minutes at 5 °C. After the 20 minutes, each piece of beetroot was removed from the tubes and the colour of the fluid recorded.

The procedure was repeated at five other temperatures.

The results of this experiment are shown in the table below.

Temperature / °C	Colour of fluid
5	pale pink
22	pale pink
42	pale pink
64	pink
87	dark pink
93	red

Using the information in the table, describe the effect that temperature has on the permeability of the membranes of the beetroot cells.

(2)

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(c) A second student carried out a very similar experiment, using three samples of beetroot at each temperature. She used a colorimeter to determine the intensity of the colour of the fluid produced.

The results of her experiment are shown in the table below.

Temperature / °C	Intensity of colour of fluid / arbitrary units		
	Sample 1	Sample 2	Sample 3
5	0.0	0.0	0.0
22	10.1	9.8	11.1
42	26.3	29.9	31.0
64	80.1	77.0	76.9
87	93.9	95.0	96.0
93	100.0	100.0	100.0

(i) State **two** variables that both of these students must keep the same if their results are to be compared.

(2)

1 .....

.....

2 .....

.....

(ii) Give **two** reasons why the results obtained by the second student are more reliable than those of the first student.

(2)

1 .....

.....

2 .....

.....

(iii) In the first student's experiment at 5 °C, the fluid was pale pink but the fluid in the second student's experiment was colourless.

Suggest an explanation for this difference.

(2)

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(iv) Each of the students used their own results to describe the effect of temperature on the permeability of the membranes of the beetroot cells.

Suggest **one** way in which these two descriptions might differ.

(1)

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(Total for Question 1 = 12 marks)

2 Molecules are transported into and out of cells by several mechanisms.

(a) Read through the following passage that describes some of these mechanisms, then write on the dotted lines the most appropriate word or words to complete the passage.

(4)

Some molecules move across a cell surface membrane by passing down a concentration gradient, through the phospholipid bilayer. The movement of some polar molecules across the membrane involves carrier and channel ..... molecules. When this movement occurs down a concentration gradient, the process is called ..... and when it occurs against a concentration gradient the process is called ..... .

Energy in the form of ..... is used in the movement of molecules against a concentration gradient.

(b) A student wanted to sweeten some strawberries, so she sprinkled some sugar on top of them, one hour before eating them. The student noticed that the sugar that she had sprinkled on them was no longer visible and that there was some juice at the bottom of the bowl.

Appearance on adding sugar

Appearance one hour after adding sugar

The student thought that the juice was the sugar dissolved in water and that the water had come from the fruit.

In order to test this hypothesis, she weighed some fresh strawberries and sprinkled them with sugar. One hour later she rinsed off the juice and reweighed the strawberries. The mass of the strawberries before adding the sugar was 77 g. The mass after rinsing off the juice was 70 g.

(i) Calculate the percentage decrease in the mass of the strawberries.

Show your working.

(2)

Answer ..... %

(ii) Suggest **one** possible source of error in the student's procedure that could make this value for the percentage decrease in the mass of the strawberries inaccurate.

Explain how this source of error would affect the value for the percentage decrease in the mass of the strawberries.

(3)

Source of error .....

.....

.....

Effect on value and explanation .....

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(iii) Using your knowledge of cell transport mechanisms and the properties of water, explain how the juice is formed from the water that came from the fruit.

(3)

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(Total for Question 2 = 12 marks)

3 The size and solubility of molecules has an effect on their ability to be taken up by cells.

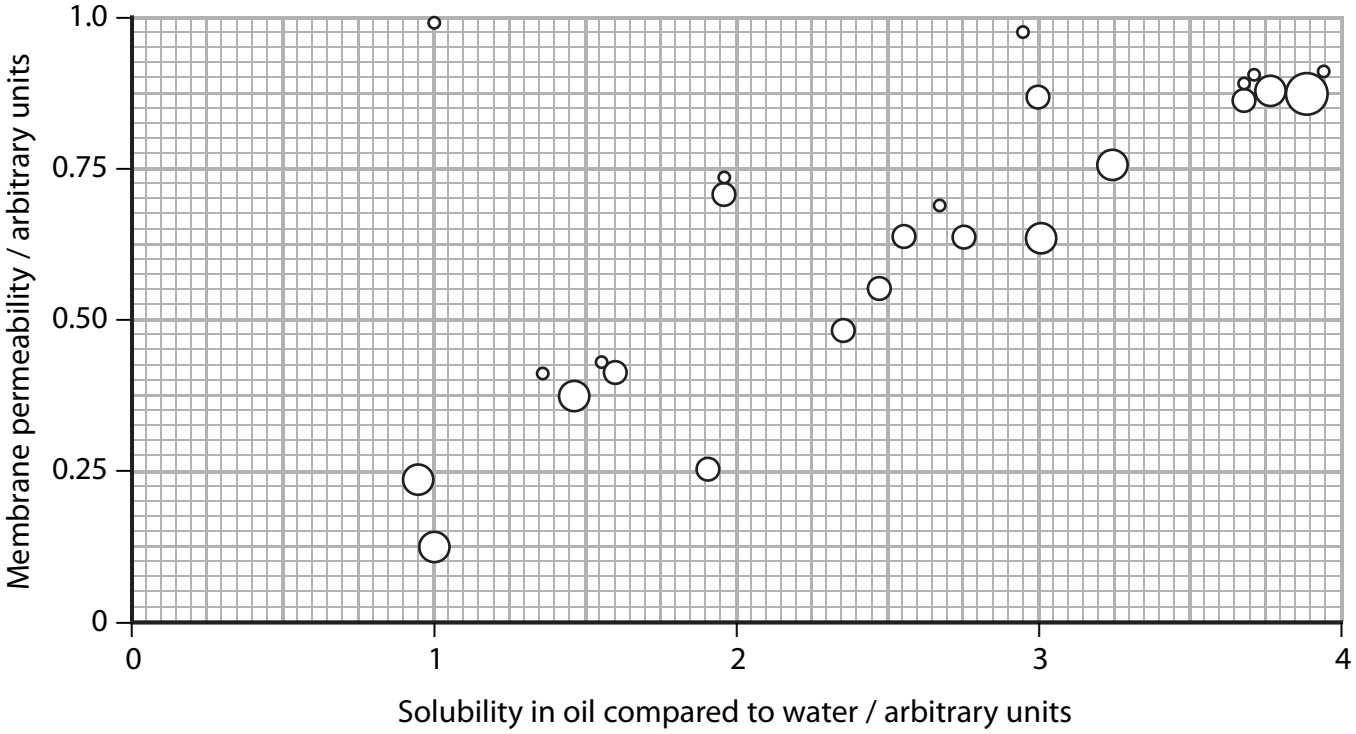
*(a) Describe an experiment you have carried out to investigate the permeability of cell membranes.

(5)

(b) An investigation was carried out into the permeability of a cell membrane to a number of different non-polar, organic molecules. The molecules differed in their size and in their solubility in oil compared with their solubility in water.
The higher the solubility, the more soluble the molecule is in oil compared with water.

The graph below shows the results of this investigation.

The size of the circle drawn on the graph indicates the size of the molecule; the larger the circle, the larger the molecule.



(i) Describe what relationship, if any, there is between the permeability of this cell membrane and the **size** of the molecules.

(1)

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(ii) Describe what relationship, if any, there is between the permeability of this cell membrane and the **solubility** of the molecules in oil compared with water.

(1)

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(iii) Water is able to diffuse through a cell membrane, even though it is a polar molecule.

On the graph, draw a circle, labelled W, to indicate the permeability of the cell membrane to water. The size of the circle should represent the size of the water molecule.

(2)

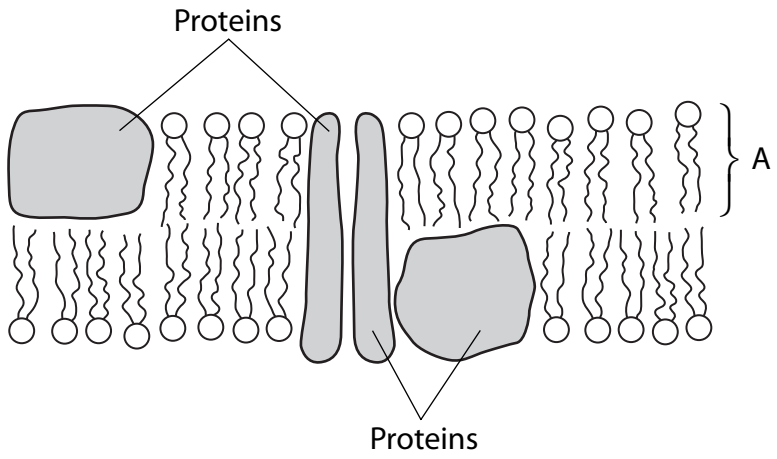
(iv) Use your knowledge of the structure and properties of cell membranes to explain the results of this investigation.

(3)

(Total for Question 3 = 12 marks)

4 The fluid mosaic model describes the structure and properties of cell membranes.

(a) The diagram below shows the structure of a cell membrane based on this model.



(i) Name the molecule labelled A and describe its structure.

(3)

Name .....

Structure .....

.....

.....

.....

.....

.....

(ii) Explain how the properties of molecule A contribute to the structure of the cell membrane.

(3)

(b) Some proteins in the cell membrane are involved in active transport and facilitated diffusion. Describe the role of proteins in these cell transport mechanisms.

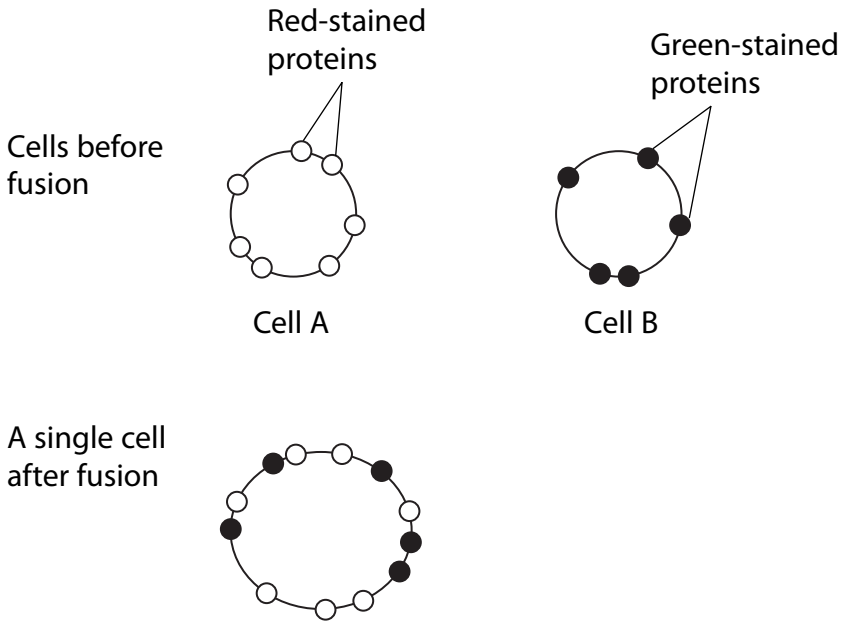
(3)

Active transport

Facilitated diffusion

(c) In an investigation into the properties of the cell membrane, the proteins in the membranes of two cells, A and B, were stained using different dyes. The proteins of one cell were stained green and the proteins of the other cell were stained red. The cells were then fused (merged together) to form a single cell.

The diagram below shows the distribution of the proteins in the cell membranes before and after fusion.



(i) Describe the distribution of the proteins in this single cell after fusion.

(2)

(ii) Describe how the results of this investigation can be explained by the fluid mosaic model.

(2)

(Total for Question 4 = 13 marks)