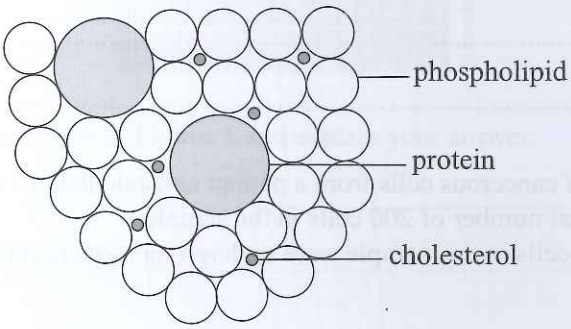
Cell Membranes — 1

Cell membranes may look simple through a microscope, but nothing's as simple as it first seems. In fact, they're actually pretty complex and really important for cells. These questions will make sure your knowledge is tip top.

1 Cell membranes vary in structure due to the adaptation of specialised cells to their functions.

Figure 1 models the arrangement of molecules in a typical cell membrane, observed from above.

Figure 1



1.1 Describe the model illustrated in **Figure 1**.

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(2 marks)

1.2 Explain the effect that a higher percentage of cholesterol would have on the model in **Figure 1**.

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(2 marks)

Epithelial cells in the mammalian ileum absorb nutrients from a mammal's food.

1.3 Suggest and explain **two** ways in which the cell-surface membranes of these cells might be adapted to their function.

1. .....

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2. .....

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(4 marks)

The function of a neurone cell relies upon the rapid movement of cations across its cell membrane.

1.4 Suggest and explain an adaptation that you might expect to observe in the cell membrane of a neurone cell.

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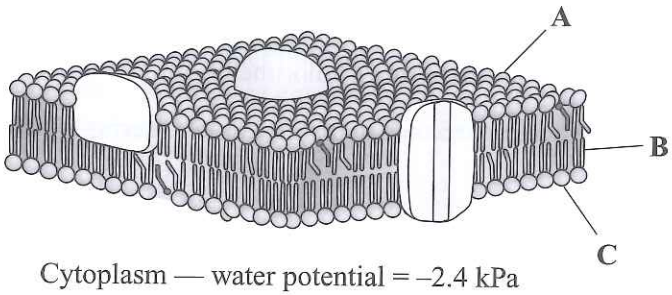
(2 marks)

2 **Figure 2** shows part of the phospholipid bilayer in a cell-surface membrane.

Figure 2

Cell exterior — water potential = –0.5 kPa



Cytoplasm — water potential = –2.4 kPa

2.1 Which letter (**A-C**) represents the hydrophobic part of the phospholipid bilayer?

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(1 mark)

2.2 When phospholipids come together to form a cell membrane, a bilayer structure is always formed. Explain why.

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(3 marks)

2.3 Using the information in **Figure 2**, describe the direction of movement of water across the cell membrane. Give a reason for your answer.

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(2 marks)

3 Explain how co-transport is used to transport sodium ions and glucose into cells in the mammalian ileum, across their cell membranes.

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(5 marks)

4 Beetroot cells contain a vacuole. The vacuole contains red pigments called betalains, which are contained within the vacuole by a phospholipid membrane. A scientist wanted to investigate the effect of temperature on the permeability of this membrane.

Sections of beetroot were cut from the main plant and soaked in distilled water overnight. The cut sections were then placed in fresh samples of distilled water and incubated at different temperatures for 30 minutes. The beetroot sections were then removed from the water and discarded. Each sample of water was then analysed using a colorimeter.

4.1 Why were the cut sections of beetroot soaked in distilled water overnight?

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(1 mark)

4.2 Suggest a negative control that could have been used in this investigation.

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(1 mark)

Table 1 illustrates the results that were obtained from the colorimetry analysis. The percentage absorbance illustrates the proportion of transmitted light at blue/green wavelengths that was absorbed by the pigments in the water.

Table 1

Temperature / °C	Absorbance
20	0.05
30	0.16
40	0.35
50	0.60
60	0.73

4.3 Use your knowledge of the structure of cell membranes to explain these results.

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(4 marks)

4.4 A second investigation found that membrane permeability increased as the pH was decreased. Suggest an explanation for this.

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(3 marks)

EXAM TIP

Examiners love a good practical question, so you'll need to brush up on terms like 'negative control'. When it comes to explaining results, be clear about what any table or graph is showing you — if the results for a colorimetry experiment show transmission of light rather than absorbance, the numbers will be the opposite way round to the ones above.

Score

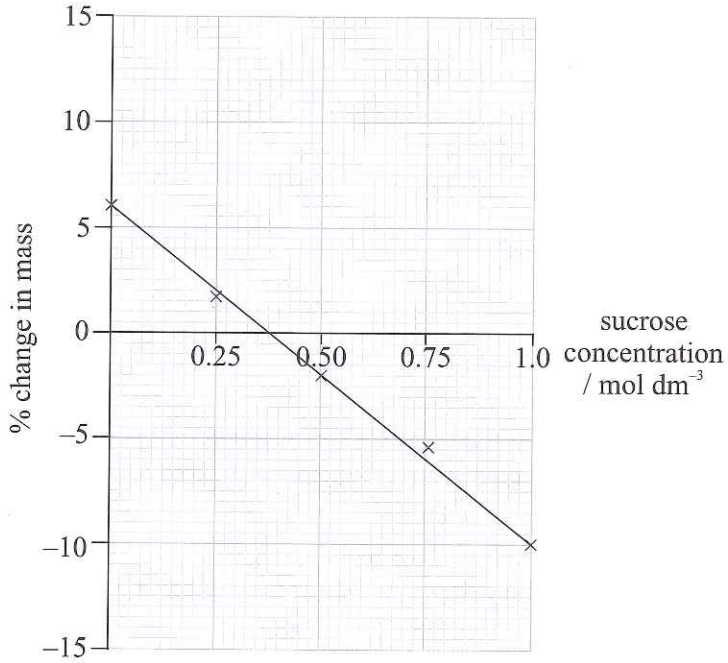
30

Cell Membranes — 2

1 Plants contain a mixture of solutes. Depending on the relative concentrations of solutes inside a plant cell and its environment, water will move into or out of the cell by osmosis.

Some students wanted to investigate the water potential of white potato cells. To do so they incubated samples of white potato in different concentrations of sucrose solution. The mass of each sample was measured before and after the incubation. The change in mass was then calculated. **Figure 1** shows a calibration curve of the results.

Figure 1



1.1 The students prepared the different concentrations of sucrose solution for their investigation using a stock solution of 1 mol dm^{-3} sucrose solution and distilled water.
Complete **Table 1** to show the volumes of stock solution and water used to make up each concentration.

Table 1

Concentration of sucrose solution to be made up / mol dm^{-3}	Volume of 1 mol dm^{-3} sucrose solution used / cm^3	Volume of water used / cm^3	Final volume of solution to be made up / cm^3
1	20	0	20
0.75	15		20
0.5			20
0.25			20
0			20

(2 marks)

1.2 Give **two** control variables for this investigation.

1. .....

2. .....

(2 marks)

Table 2 shows the relationship between sucrose concentration and water potential.

Table 2

Sucrose concentration / mol dm^{-3}	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Water potential / kPa	–270	–540	–850	–1130	–1460	–1810	–2190	–2590	–3030	–3530

1.3 Use **Table 2** and **Figure 1** to estimate the water potential of the potato tissue.
Show your working.

water potential = ... kPa
(2 marks)

1.4 Suggest how the water potential of sweet potato tissue is likely to differ from the water potential of the white potato tissue used in the students' investigation. Explain your answer.

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(2 marks)

2 Ca^{2+} ATPases are carrier proteins that transport Ca^{2+} ions across cell-surface membranes. Each Ca^{2+} ATPase has one subunit that has an ATP binding site and acts as an enzyme.

2.1 Ca^{2+} ATPase spans the width of the cell-surface membrane.
The ATP binding site is always on the cytoplasm side of the membrane. Suggest why.

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(1 mark)

2.2 Suggest and explain why Ca^{2+} ATPase has a subunit that acts as an enzyme.

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(2 marks)

2.3 Explain why Ca^{2+} ions are always transported across cell-surface membranes via carrier or channel proteins.

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(2 marks)

EXAM TIP

'Estimate' means you need to give an approximate value rather than calculate an exact answer. It needs to be a sensible estimate though, not just a stab in the dark guess, so you need to think about the best method to use to obtain your estimate.

Score

13