

1 The cell vacuoles of beetroot (*Beta vulgaris*) contain the red pigment betalain.

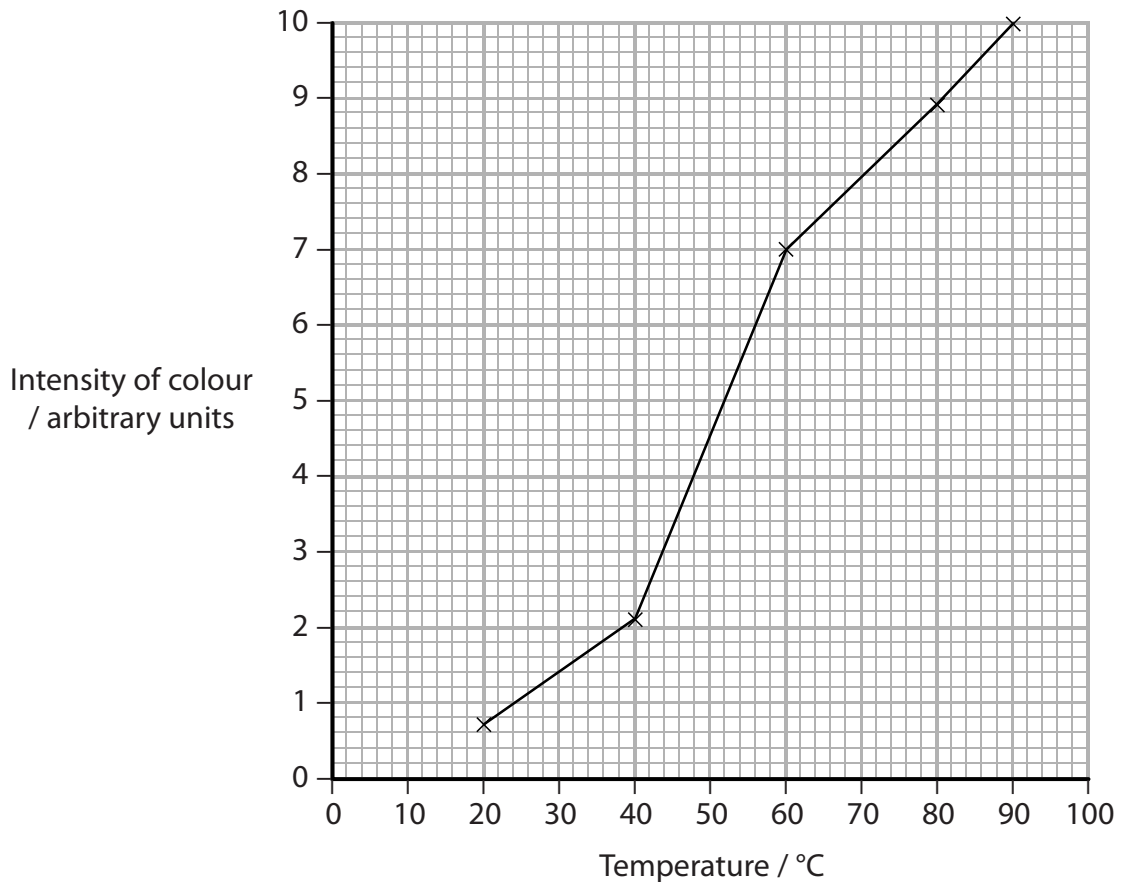
A student investigated the effect of temperature on the permeability of beetroot cell membranes.

In this investigation, five pieces of beetroot were used. One piece of beetroot was left in 10 cm³ of distilled water for 20 minutes at 20 °C.

After 20 minutes, the piece of beetroot was removed and the intensity of the colour of the water was measured using a colorimeter.

This was repeated with the other pieces of beetroot using water temperatures of 40 °C, 60 °C, 80 °C and 90 °C.

(a) The student's results are shown in the graph below.



(i) Using the information in the graph, describe the effect of temperature on the permeability of the cell membranes.

(2)

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(ii) Using the information in the graph and your knowledge of membrane structure, explain the effect of temperature on the cell membranes.

(3)

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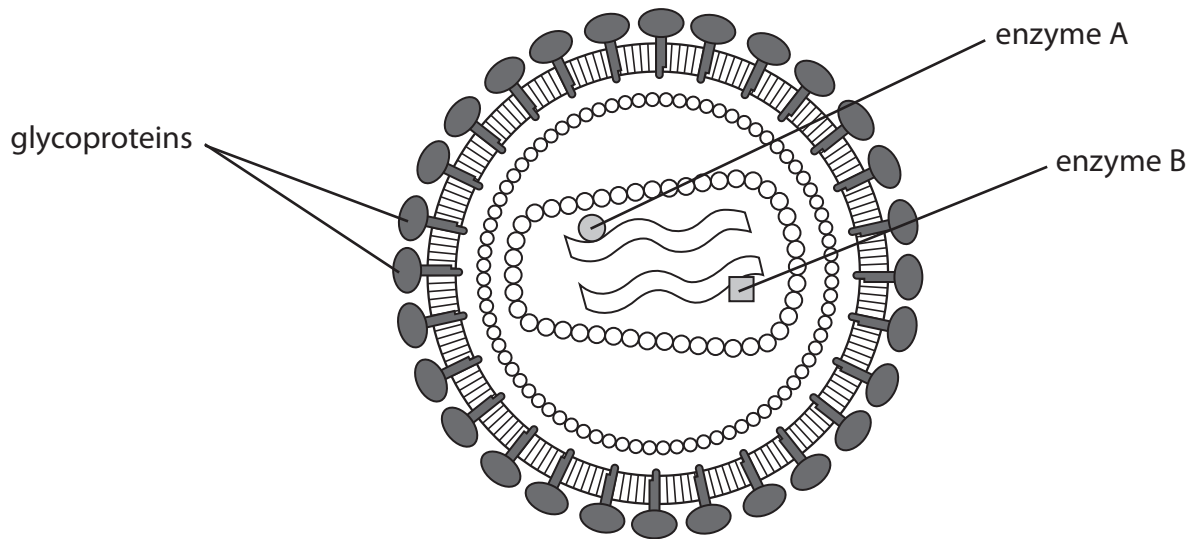
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2 Anti-viral drugs have been developed to treat patients infected with Human Immunodeficiency Virus (HIV).

The diagram below shows the structure of HIV.



(a) A glycoprotein has a carbohydrate attached to a protein molecule.
Describe the three-dimensional structure of a glycoprotein.

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3 The structure and properties of the cell membrane control which molecules can move into or out of the cell.

(a) The phospholipid bilayer plays an important role in this control of movement of molecules.

Explain why the phospholipid molecules form a bilayer.

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(b) The table below describes four methods by which molecules or ions can move through the cell membrane.

| Description of method | Method by which molecules or ions can move through the cell membrane | | | |
|---|--|-------------|---------|--------|
| | A | B | C | D |
| The direction of movement is from a higher concentration to a lower concentration of the molecule | ✓ | ✗ | ✓ | ✓ |
| ATP required | ✗ | ✓ | ✗ | ✗ |
| Membrane proteins involved | ✓ or ✗ | ✓ | ✓ | ✗ |
| A molecule or ion transported by this method | water | sodium ions | glucose | oxygen |

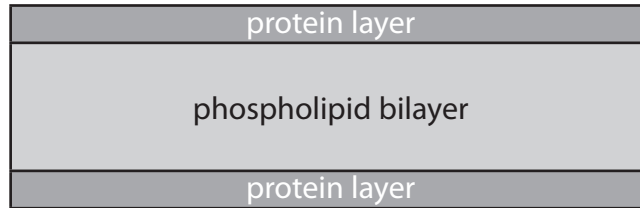
Identify the method of movement by placing a cross ☒ in the correct box in the table below.

(3)

| Method of movement | A | B | C | D |
|-----------------------|---|---|---|---|
| Active transport | ☒ | ☒ | ☒ | ☒ |
| Facilitated diffusion | ☒ | ☒ | ☒ | ☒ |
| Osmosis | ☒ | ☒ | ☒ | ☒ |

- (c) The fluid mosaic model explains our current knowledge of the structure and properties of cell membranes. This model was developed from the Davson-Danielli model.

The diagram below shows the Davson-Danielli model of membrane structure.



- (i) Use the information in the diagram to compare the Davson-Danielli model with the fluid mosaic model.

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- (ii) Explain why the Davson-Danielli model does not support our current knowledge of how molecules can move through the cell membrane.

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(Total for Question 3 = 10 marks)

(b) Suggest **two** properties of molecules that enable them to enter a cell by diffusion. (2)

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(c) Facilitated diffusion and active transport are two ways in which molecules are transported across cell membranes.

Describe **one** similarity and **one** difference between facilitated diffusion and active transport.

(i) Similarity (1)

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(ii) Difference (1)

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(Total for Question 4 = 9 marks)

5 Molecules are transported across the cell membrane in a number of different ways.

(a) Describe the structure of a cell membrane.

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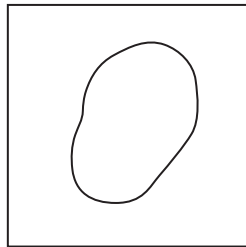
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(ii) Complete the diagram below, to show the concentration of solute P and solute R inside and outside the cell, after 50 minutes.

(1)



(Total for Question 5 = 9 marks)