AS Level Biology A

H020/01 Breadth in Biology

Question Set 7

1. The fluid mosaic model describes plasma membranes of all living organisms.

(a) How does the fluid mosaic model describe the structure of plasma membranes? **[2]**

The fluid mosaic model describes the plasma membrane as a mosaic of different structural components. Consists of a phospholipid bilayer with hydrophobic tails facing inwards and hydrophilic tails facing outwards. Phospholipid molecules can move laterally within the membrane of flip between layers, giving the membrane its 'fluidity'. Proteins of various different sizes and shapes are randomly distributed throughout the membrane, hence 'mosaic'.

(b) Plasma membranes are partially permeable, allowing some molecules to cross the membranewith relative ease.
One molecule that crosses membranes easily is the steroid hormone progesterone which isproduced in the ovaries from cholesterol.

(i) Explain why progesterone can move across membranes. **[2]**

Progesterone is lipid-soluble and non-polar so diffuses through the phospholipid bilayer.

(ii) Name one other molecule that can cross plasma membranes. **[1]**

Oxygen

(c) **(i)** Potassium ions are unable to move across membranes as they are charged.

State how the structure of the cell surface membrane allows potassium ions to enter orleave a cell. **[1]**

Potassium ions can pass through carrier proteins embedded in the phospholipid bilayer e.g. sodium-potassium pump.

(ii) The process of active transport uses ATP to pump potassium ions through the cell surface membrane against the concentration gradient.

ATP is made up of phosphate groups and two other molecules.

Name the **two** other molecules.

1 Adenine ..... **[2]**

2 Ribose .....

(d) A group of students investigated the effect of temperature on the membranes of beetrootcells.

A colorimeter was used to measure the concentration of purple betalain pigment that leakedout of the cells when they were exposed to different temperatures.

Table 23 shows a summary of the data collected.

Temperature (°C)	Number of readings	Mean absorbance (arbitrary units)	Standard deviation
0	10	0.04	0.01
10	10	0.04	0.02
20	10	0.04	0.02
30	10	0.06	0.02
40	10	0.09	0.03
50	10	0.21	0.06
60	10	0.44	0.18

Table 23

(i) Using the Student's *t*-test formula below, calculate the value of *t* between the data for **50 °C** and **60 °C**.

$$t = \frac{|\overline{x}_A - \overline{x}_B|}{\sqrt{\frac{S_A^2}{n_A} + \frac{S_B^2}{n_B}}}$$

where: $\overline{x}$ is the mean
S is the standard deviation
n is the number of readings

$$\frac{|0.44 - 0.21|}{\sqrt{\frac{0.18^2}{10} + \frac{0.06^2}{10}}} = \frac{0.23}{\sqrt{0.0036}} = 3.83$$

Answer = 3.83 ..... **[3]**

(ii) The critical value for *t* at the significance level of 5%, with 18 degrees of freedom, is 2.10.

Use the value of *t* that you calculated in part **(i)** to explain whether the null hypothesis should be accepted or rejected.

[2]

df = 18, p = 0·05, critical value = 2·10
3·83 is greater than 2·10 ∴ Ho is rejected
there is a statistically significant difference between the means.

(e) The students plotted the data onto a graph, shown in Fig. 23.

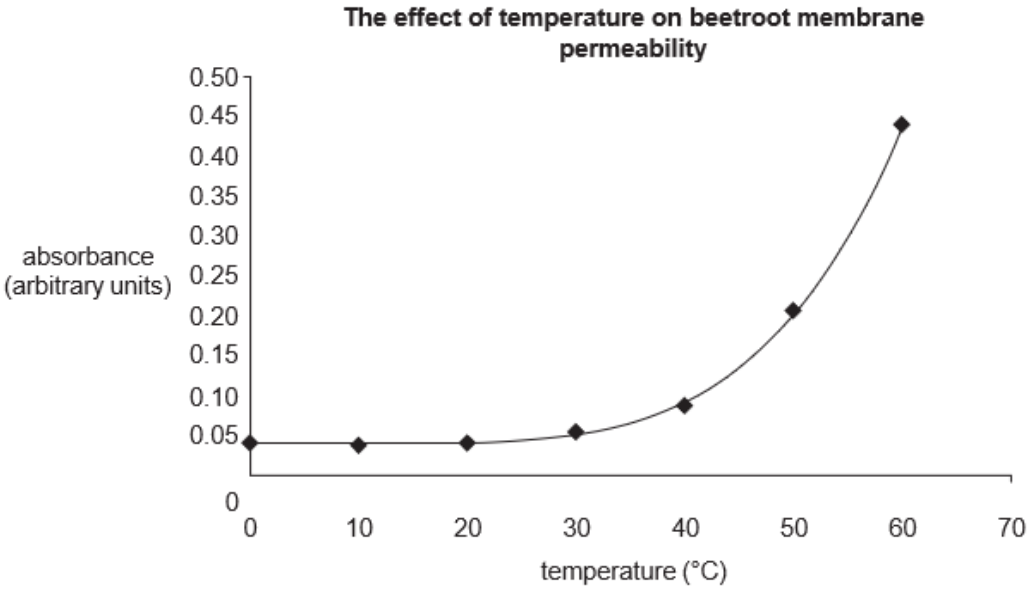

Fig. 23

Describe and explain the pattern of data shown on the graph as temperature increases.

[3]

Increased absorbance signifies increased cellular membrane permeability and an increase in the leakage of beetroot pigment from cells. Between 0°c and 30°c, as temperature increases there is little change in absorbance because the membrane remains intact. Above 30°c, as temperature increases, absorbance begins to increase slowly and then more rapidly. Proteins in the membrane are denatured, disrupting the membrane and causing leakage of pigment out of cells.

Total Marks for Question Set 7: 16