Biological Membranes

Question Paper 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Foundations in Biology
Topic	Biological Membranes
Booklet	Question Paper 1

Time allowed: **50 minutes**

Score: **/37**

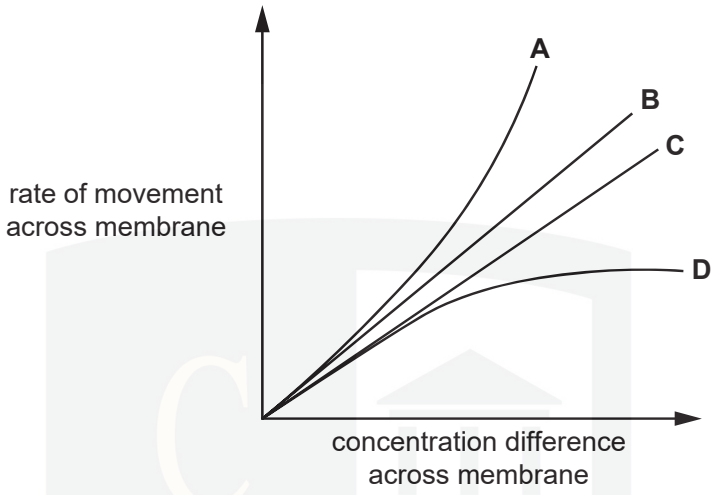
Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

The graph shows the rate of movement of four different substances across a membrane.



The substances shown in the graph are: carbon dioxide, testosterone (a lipid-based hormone), ethanol and sodium ions.

Which of the lines, **A** to **D**, represents the pattern of movement of sodium ions across a membrane?

[1]

Question 2

An investigation into how a change in sodium chloride concentration effects osmosis in potato cells concluded that the isotonic point of the potato was 0.25 M.

Which of the statements, **A** to **D**, describes what is happening at the isotonic point? **[1]**

A. there is a net movement of water from the sodium chloride solution into the potato cells

B. there is a net movement of water from the cytoplasm of the potato cells into the sodium chloride solution

C. there is no movement of water into or out of the potato cell cytoplasm

D. the movement of water into the potato cells is equal to the movement of water out of the potato cells

Question 3

(a) A student carried out an investigation into the effect of ethanol on the permeability of cell membranes in beetroot.

The student's method comprised the following five steps:

1. Cut equal sized pieces of beetroot using a cork borer.
2. Wash the pieces in running water.
3. Place the pieces in 100 cm^3 of different concentrations of ethanol.
4. After 5 minutes, remove samples from each of the ethanol solutions.
5. Place each of the samples into a colorimeter to collect quantitative data.

(i) Each step in the student's method relies on certain assumptions. **[3]**

For each assumption listed below, select the **numbered step** from the student's method that relies upon that assumption.

*Assumption **A***

Pigment will only leak into the solution if membranes are disrupted.

*Assumption **A** relates to step* .....

*Assumption **B***

Absorbance is proportional to concentration of pigment.

*Assumption **B** relates to step* .....

*Assumption **C***

Pigment will be released when the beetroot is sliced.

*Assumption **C** relates to step* .....

(ii) The student kept the ethanol solutions at a constant temperature. State **two other** variables which need to be controlled in this investigation to ensure the data collected are valid.

[2]

(b) Fig. 20.1 shows the graph plotted by the student.

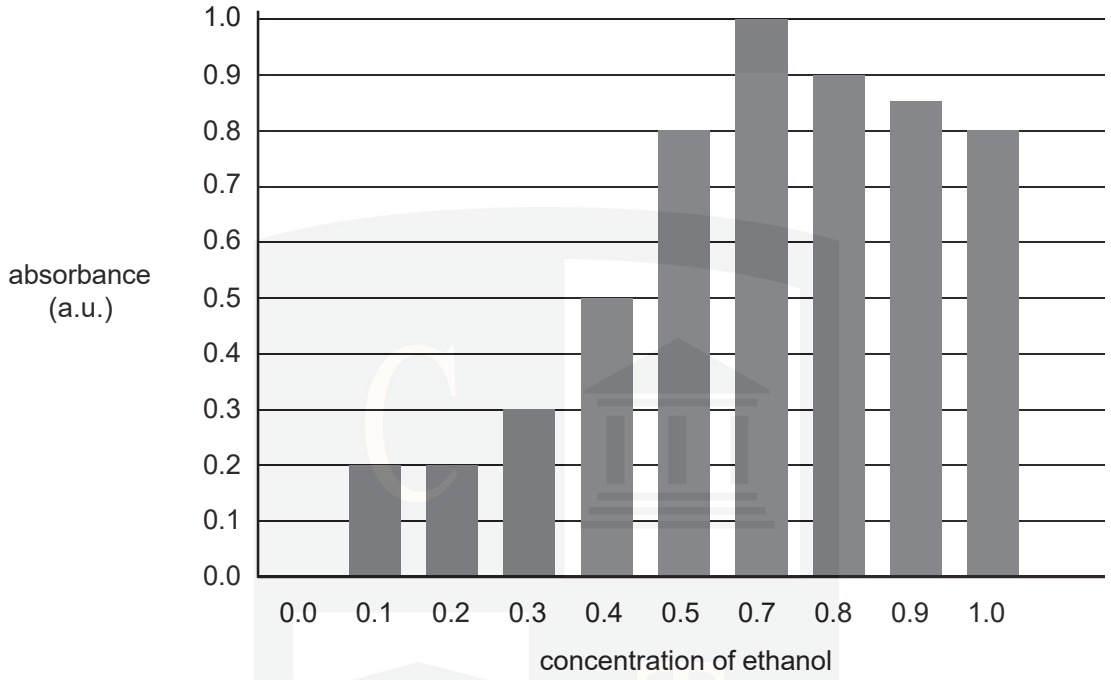


Fig. 20.1

(i) Make **three** criticisms of the way the student has displayed these results. **[3]**

(ii) Explain how carrying out replicates would improve this investigation. **[2]**

[Total: 10]

Question 4

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]**

(b) Plasma membranes are partially permeable, allowing some molecules to cross the membrane with relative ease.

One molecule that crosses membranes easily is the steroid hormone progesterone which is produced in the ovaries from cholesterol.

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

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

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

(i) State how the structure of the cell surface membrane allows potassium ions to enter or leave a cell. **[1]**

(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.

[2]

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

A colorimeter was used to measure the concentration of purple betalain pigment that leaked out 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**.

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

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

. **[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]**

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

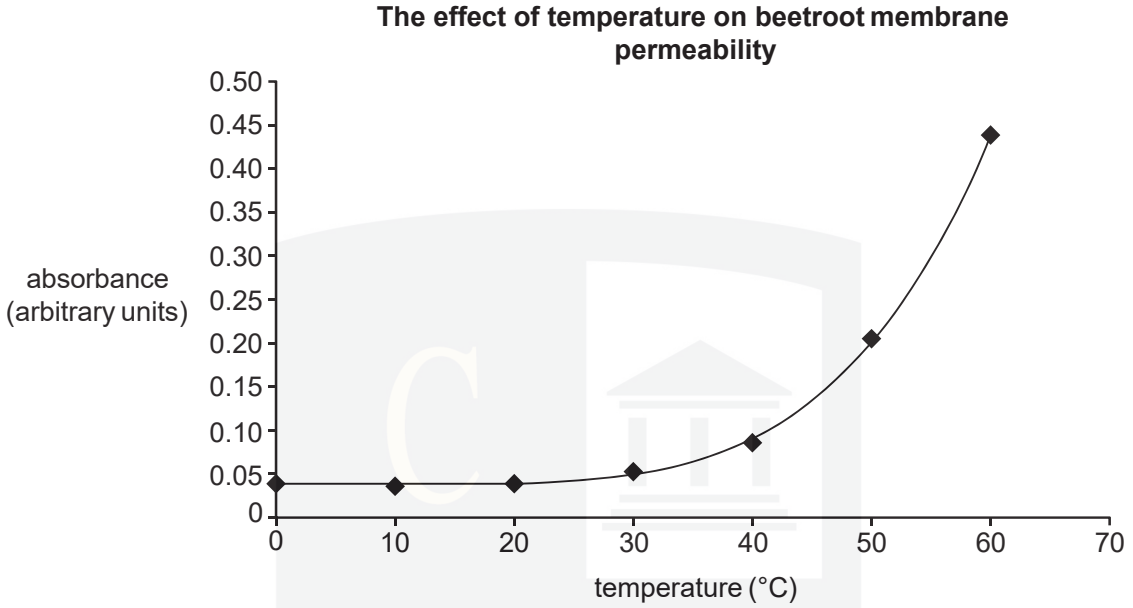


Fig. 23

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

[3]

[Total: 16]

Question 5

Transmembrane proteins are involved in the transport of sugars across the plasma membrane.

(a) Glucose can be moved into cells by facilitated diffusion using proteins called GLUT proteins. These proteins expose a single binding site on one side of the membrane. Glucose binds to this site and causes a change in the shape of the protein. This change moves the glucose across the membrane and releases it on the other side.

(i) Explain why facilitated diffusion via GLUT proteins requires no metabolic energy.

[*2*]

(ii) Glucose can also be absorbed by an active process which requires metabolic energy.
What is the immediate source of this energy in cells? **[1]**

(iii) Explain why glucose cannot pass through a cell membrane by simple diffusion. **[*2*]**

(b) A student investigated the effect of alcohol on the permeability of membranes in plant cells. The student wanted to find the minimum concentration of alcohol at which all the cells became permeable to the stain Evans Blue. Evans Blue stains the nucleus of the cell.

The student followed this method:

- The student placed samples of onion epidermis into different concentrations of ethanol.
- After five minutes a few drops of Evans Blue stain was added to each sample.
- After a further five minutes, the samples were viewed using a light microscope.
- The student observed 20 cells and recorded how many contained a blue nucleus.

Table 21.1 shows the student's results.

Concentration of ethanol (%)	**Number of cells with a blue nucleus**	**% cells with blue nucleus**
0	1	5
10	4	20
20	16	80
30	20	100
40	20	100

Table 21.1

(i) Identify **one** limitation of the method the student followed. **[1]**

(ii) On evaluating the results the student decided to use a narrower range of ethanol concentrations.

Suggest what range of ethanol concentrations the student should use and give a reason for your choice.

[*2*]

(iii) How would using a narrower range of alcohol concentrations improve the investigation?

[1]

[Total: 9]