4. Cell membranes and transport

1.

Which transport mechanism does **not** require a concentration gradient to be present in order to take place?

A exocytosis

B facilitated diffusion

C osmosis

D transpiration

Ans: A

2.

High concentrations of ethanol disrupt cell membrane structure by denaturing proteins and increasing the separation of adjacent phospholipid molecules. As a result, cell membranes can decrease in thickness by up to 30% and become more permeable.

Yeast cells release ethanol as a waste product of metabolism. In response to increased ethanol concentration in their environment, yeast cells are able to increase the tolerance of their cell membranes to ethanol.

Which statement correctly explains a response to ethanol that could account for the increase in tolerance of yeast cell membranes to ethanol?

A Decreasing the ratio of saturated fatty acids to unsaturated fatty acids within cell membranes helps to prevent the tails of phospholipids on one side of the bilayer from sliding past the tails of phospholipids on the other side of the bilayer.

B Increasing the proportion of palmitoleic acid (a C16 unsaturated fatty acid) to oleic acid (a C18 unsaturated fatty acid) in the phospholipids of the bilayer increases the fluidity of the cell membrane.

C Activating a cell-signalling pathway triggers the unfolded protein response in the endoplasmic reticulum. The unfolded protein response pauses protein synthesis and initiates cell death in yeast cells with a high proportion of mis-folded proteins.

D Increasing the proportion of ergosterol in the cell membrane prevents the accumulation of polar molecules, such as ethanol, within the cell. Ergosterol in yeast cells has a similar effect on membrane permeability as cholesterol in mammalian cells.

Ans: A
DOUBT!!

3.

In an investigation, a plant cell was placed in pure water.

The initial rate at which water molecules entered the cell, R, was greater than the initial rate at which water molecules left the cell.

In a second investigation, a plant cell of the same type was placed in a solution with a water potential equal to that of the cell contents.

What will happen in the second investigation over a period of five minutes?

A Water molecules will not enter or leave the cell because the water potential of the cell contents is equal to that of the solution.

B Water molecules will enter and leave the cell in equal amounts, both at an initial rate that is less than R in the first investigation.

C Water molecules will enter and leave the cell in equal amounts, both at an initial rate that is greater than R in the first investigation.

D Water molecules will enter and leave the cell in equal amounts, both at an initial rate that is equal to R in the first investigation.

Ans: B

4.

Some processes occurring in cells are listed.

1 endocytosis of water into cells

2 exocytosis of enzymes from cells

3 facilitated diffusion of glucose into red blood cells

4 phagocytosis of dead cells by macrophages

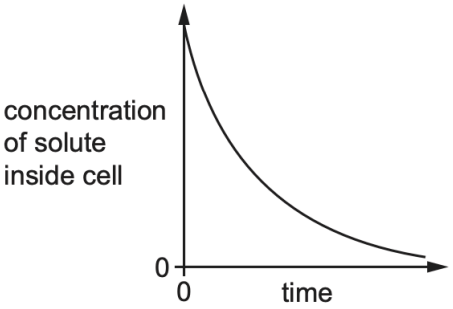
Which processes use ATP?

A 1, 2 and 3 **B** 1, 2 and 4 **C** 1, 3 and 4 **D** 2, 3 and 4

Ans: B

5.

The graph shows changes in the concentration of a solute inside a cell.



What explains this change in concentration?

1 diffusion

2 endocytosis

3 exocytosis

4 osmosis

A 1, 2 and 3 **B** 1, 3 and 4 **C** 1 and 4 only **D** 2 and 4

Ans: B

6.

The indicator cresol red, changes from red to yellow when put into acid.

Four blocks of agar containing cresol red were cut to different sizes measured in millimetres. The blocks were submerged in acid. All other variables were kept constant. The time taken for each of the blocks to completely turn yellow was recorded.

Which of the four blocks became completely yellow most quickly?

A 3 × 30 × 30 **B** 6 × 6 × 6 **C** 6 × 12 × 12 **D** 12 × 12 × 12

Ans: A

Choose the one which has a very small dimension – A in this case

A has largest surface area.

7.

Which features are required to allow for efficient diffusion?

1 a large surface area

2 a short diffusion pathway

3 maintenance of a constant diffusion gradient

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

Ans: A

8.

Batrachotoxin is a poison found in frogs in the Colombian jungle. The poison is used to produce poison darts.

The poison works by increasing the permeability of the cell surface membrane of nerve and muscle cells to sodium ions, which move out of the cells.

Four students made statements about how the poison affects the cells.

1 Water leaves the cells by osmosis, causing the cells to shrink.

2 Water enters the cells by osmosis, causing the cells to burst.

3 When the sodium ions move out of the cells the intracellular fluid has a more positive water potential than the extracellular fluid.

4 When the sodium ions move out of the cells the extracellular fluid has a more positive water potential than the intracellular fluid.

Which statements are correct for the cells affected by batrachotoxin?

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

Ans: A

- When sodium ions move out, water potential inside increases
- Water follows out by osmosis

9.

An indicator is colourless in acid and pink in alkali.

In an experiment a petri dish of agar was prepared using an acidic solution of this indicator.

A disc of agar 1 cm in diameter was removed from the centre to create a well.

A white card showing circular marker lines 1 cm apart was placed underneath the petri dish.

1 cm^3 alkali solution was put into the well in the agar and a stop-watch was started.

A circular disc of pink colour appeared and spread through the agar. It reached the first marker line in a short time but took longer to reach the second marker line and a very long time to reach the third marker line.

What explains these observations?

A facilitated diffusion of alkali solution

B facilitated diffusion of the indicator

C simple diffusion of alkali solution

D simple diffusion of the indicator

Ans: C

- Alkali solution slowly moves down by diffusion

- The pink colour spreads due to movement of alkali solution

10.

Which of these substances can pass directly through cell surface membranes without using a carrier protein or a channel protein?

1 Ca^{2+}

2 CO_2

3 $C_6H_{12}O_6$

A 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 2 only

Ans: D

11.

What happens to the surface area to volume ratio of a cube when the length of each side is doubled?

A The ratio decreases by four times.

B The ratio halves.

C The ratio doubles.

D The ratio increases by four times.

Ans: B

12.

Which statement about cell signalling is correct?

A One type of receptor molecule will recognise all ligands in the body.

B The binding of a ligand may cause a change to the shape of the receptor.

C The receptors for ligands are always found on the inside of cells.

D The same ligand is made by all of the cells in the body.

Ans: B

13.

The table compares the surface area to volume ratios of five agar blocks that differ in dimensions but which all have the same volume.

The agar blocks can be used to measure the efficiency of diffusion, where efficiency is measured as the time taken for a dye to reach all parts of the block.

	length / mm	width / mm	height / mm	surface area / mm^2	volume / mm^3	surface area : volume ratio
1	8	8	8	384	512	0.75
2	16	16	2	640	512	1.3
3	32	4	4	544	512	1.1
4	32	32	0.5	2112	512	4.1
5	64	4	2	784	512	1.5

Which prediction can be made about the way in which size and dimensions of these blocks affect the efficiency of diffusion?

A The efficiency of diffusion will decrease as the width of a block increases.

B The efficiency of diffusion will increase as the height of a block increases.

C The efficiency of diffusion will increase as a block of fixed volume is flattened.

D The efficiency of diffusion will decrease as a block of fixed volume is elongated.

Ans: C

14.

Where in the cell surface membrane are the carbohydrate chains of glycoproteins and glycolipids mainly located?

	glycoproteins	glycolipids
A	inner surface	inner surface
B	inner surface	outer surface
C	outer surface	inner surface
D	outer surface	outer surface

Ans: D

15.

Sodium ions can enter cells across the cell surface membrane.

Which methods could be used by sodium ions to cross a cell surface membrane and enter a cell?

A active transport only

B active transport and facilitated diffusion

C facilitated diffusion and simple diffusion

D simple diffusion only

Ans: B

16.

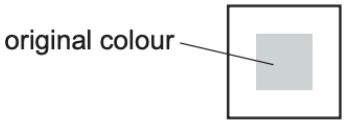
Agar cubes can be used to demonstrate the effect on diffusion of changing the surface area to volume ratio.

Three different agar cubes made using a coloured indicator solution were placed into a dilute acid that diffused into the cubes. As the acid diffused into the agar cubes, the colour of the indicator solution changed.

The cubes had volumes of 1 cm^3, 2 cm^3 and 3 cm^3 and were left in the dilute acid for 10 minutes. All other variables were kept the same.

After 10 minutes, the agar cubes were removed from the dilute acid and cut in half. The cut surfaces were observed and the results were recorded as diagrams. All diagrams were drawn to the same scale.

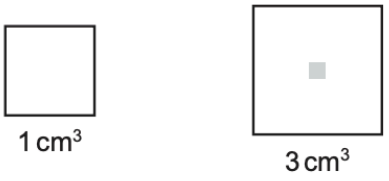
The results for the 2 cm^3 cube are shown.



Which diagrams show the results for the 1 cm^3 and the 3 cm^3 cubes?

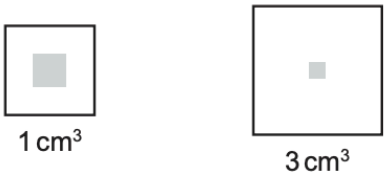
A

B



C

D



Ans: C

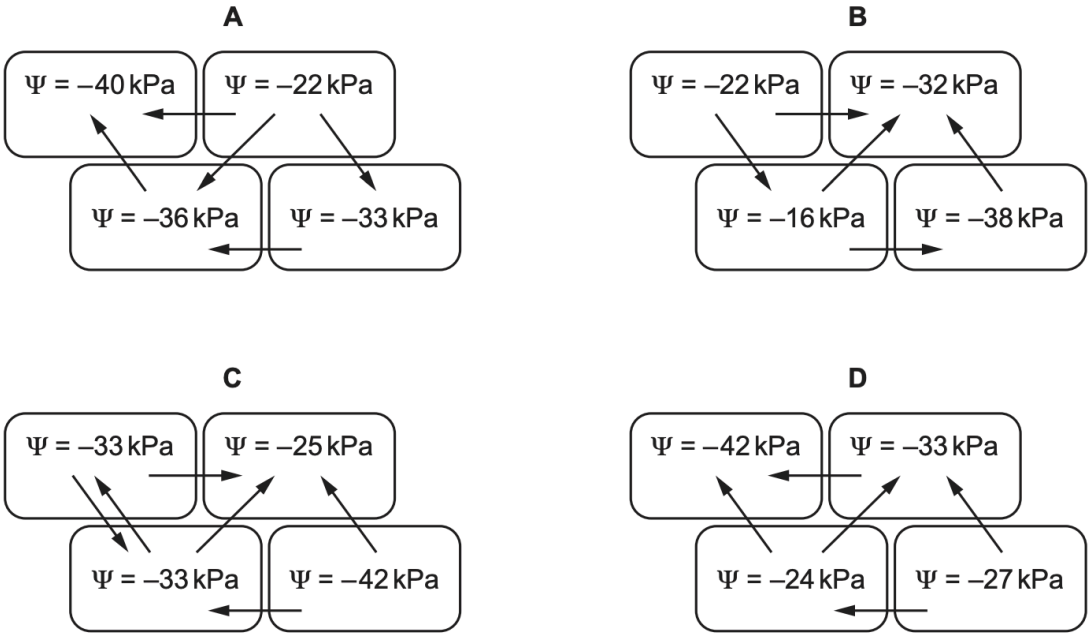
- Measure distance from outside edge of colour to outside edge of cube for 2cm3
- Measure this same distance for 1cm3 and 3cm3 in the options
- The 1cm3 and 3cm3 cubes must have the same distance, since same diffusion distance

17.

Which diagram shows the correct direction of net water movement between the four cells due to osmosis?

key

Ψ = water potential



Ans: A

- Read carefully!!
- High water potential to low water potential = less –ve to more –ve

18.

An investigation was carried out into the effect of four different treatments on the permeability of the cell surface membranes and tonoplasts of beetroot cells. Beetroot cell vacuoles contain a red pigment. This pigment **cannot** diffuse through the tonoplasts or cell surface membranes.

1 cm^3 cubes were cut from beetroot tissue and washed in running water for 20 minutes to remove any pigment released from damaged cells.

Two cubes were then placed in each of the four test-tubes containing different contents and observed for five minutes.

Which row shows a correct explanation for the observation recorded for one of the treatments?

	treatment	observation	explanation
A	dilute hydrochloric acid	contents of test-tube stay clear	membrane proteins have been denatured
B	ethanol	contents of test-tube turn red	lipids, including membrane phospholipids, have dissolved
C	water at 20 °C	contents of test-tube stay clear	membrane proteins have been denatured
D	water at 80 °C	contents of test-tube turn red	lipids, including membrane phospholipids, have dissolved

Ans: B

19.

Phospholipids are formed in a similar way to triglycerides.

A sample contained six phospholipid molecules.

- The molecular weight of a phosphate ion is 95 g mol^{-1}.
- The molecular weight of each individual fatty acid in this sample was found to be 282 g mol^{-1}.
- The molecular weight of glycerol is 92 g mol^{-1}.
- The molecular weight of water is 18 g mol^{-1}.

What is the molecular weight of the sample in g mol^{-1}?

A 2598 **B** 4182 **C** 4506 **D** 4830

Ans: B

NOTE: Structure of a phospholipid

- 1 phosphate head (95)
- 1 glycerol molecule (92)
- 2 fatty acid tails (each 282)
- Water molecule lost in condensation (each 18)

- Each phospholipid undergoes two esterification reactions (one with phosphate, two with fatty acids), so it loses 3 water molecules per molecule.
- Thus for 6 phospholipid molecules = 6(95 + 92 + 2x282) – 6(3x18) = 4182

20.

Which statements about phospholipids in cell surface membranes are correct?

1 Fatty acid tails allow most ions to pass through the membrane.

2 Hydrophobic tails point inwards facing each other.

3 All polar heads face the cytoplasm.

4 The phospholipids help with the flexibility of the membrane.

A 1, 2 and 3 **B** 1 and 3 only **C** 2, 3 and 4 **D** 2 and 4 only

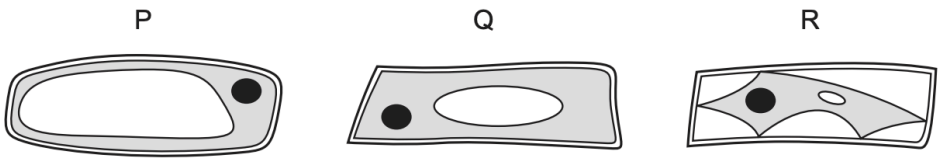
Ans: D

- Statement 3 is wrong because: the inner layer of phospholipid heads does face the cytoplasm, but the outer layer faces the extracellular environment, not just the cytoplasm!

21.

In an experiment, pieces of onion epidermis are put into three different concentrations of sucrose solutions, P, Q and R. The pieces of onion are left for an hour and then examined using the low power of a light microscope.

Each diagram shows one cell from the epidermis that was placed in each of the sucrose concentrations.



What explains the appearance of cells in solution Q?

A The concentration of solution Q is equal to the concentration of the solutes in the cell sap.

B The cytoplasm has the same concentration of sucrose as solution Q.

C The water potential of the cytoplasm is equal to the water potential of the vacuole.

D The water potential of the cell sap is equal to the water potential of solution Q.

Ans: D

22.

Before mitochondria are extracted from cells for microscopy, they are usually kept in a $0.25\,mol\,dm^{-3}$ sucrose solution.

Why is the sucrose solution used?

A to act as a solvent

B to enable the rate of reaction of the mitochondria to be determined

C to prevent the mitochondria from changing in dimension

D to provide a source of energy

Ans: C

23.

Which row is correct for parts of a phospholipid molecule?

	can be saturated or unsaturated	can also be found in a triglyceride
A	head	tail
B	tail	head
C	head	head
D	tail	tail

Ans: D

24.

What can increase the fluidity of the cell surface membrane?

1 single bonds between carbon atoms in the fatty acid chains

2 cholesterol

3 longer-chained fatty acids

A 1, 2 and 3 **B** 1 and 3 only **C** 2 and 3 only **D** 2 only

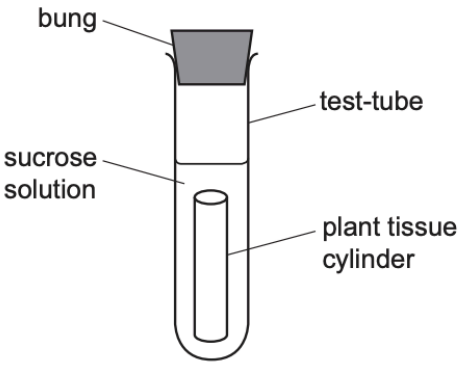
Ans:D

25.

An experiment was carried out to investigate the effect of concentration of sucrose solution on cells in a plant tissue.

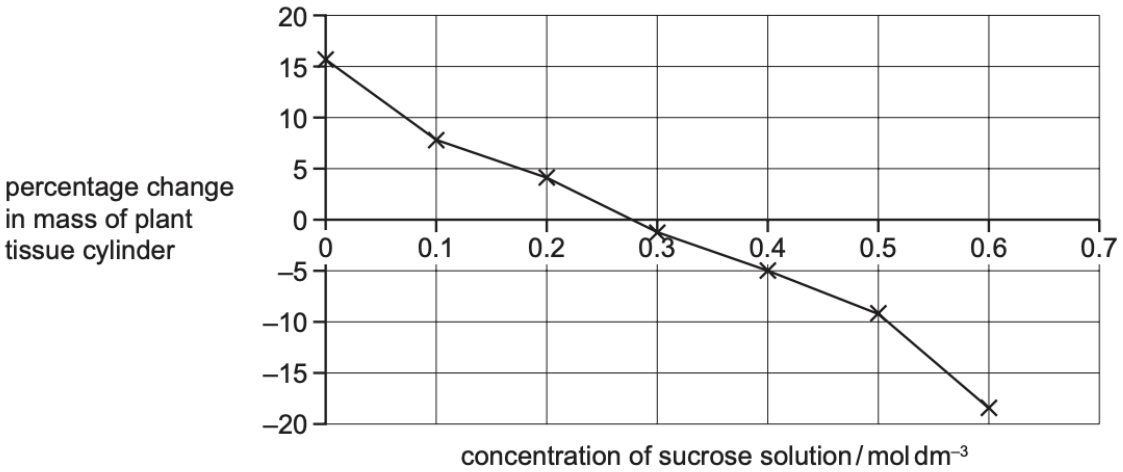
A sample of plant tissue was cut into seven cylinders of equal length and diameter. The mass of each cylinder was recorded.

Each of the seven cylinders was put into a different sucrose solution concentration.



After two hours, the cylinders were removed, blotted dry and reweighed. The percentage change in mass of each cylinder was recorded.

The graph shows the results of this investigation.



Which row explains the results if plant tissue cells were put in a sucrose solution of 0.45 mol dm^{-3}?

	water potential of the cytoplasm of the cells at the start of the experiment compared with the water potential of 0.45 mol dm^{-3} sucrose solution	change in volume of the vacuoles of the cells at the end of the experiment, that were initially placed in 0.45 mol dm^{-3} sucrose solution
A	less negative	decreased
B	less negative	increased
C	more negative	decreased
D	more negative	increased

Ans: A

- At 0.45, the mass decreases. This means water moves out. Thus water potential inside > outside. Thus water potential inside is less -ve than outside
- Since water moves out, volume of vacuole decreases