Model Answers: Hard

1

The correct answer is **D** because:

- Active transport is dependent on the presence of **carrier proteins** that undergo conformational change (due to the presence of ATP) to move substances from a lower concentration to a higher concentration **not** on the fluidity of the cell surface membrane

A is incorrect as endocytosis involves the cell surface membrane needing to move to engulf large molecules or large quantities of molecules.

B & **C** are incorrect as osmosis and diffusion involve molecules moving through the cell surface membrane.

2

The correct answer is **C** because:

- Although **osmosis** occurs the beetroot has the same water potential as the sucrose concentration therefore the **net** movement of water molecules will be zero (lateral movement), that is there will not be a change in concentration (thus density) of the sucrose solution extracted from the bathing solution
- **0.4 mol dm^{-3}** is the concentration of sucrose that shows lateral movement and therefore has the same water potential as the beetroot cells

Firstly, you work out the relation of 0.4 mol dm-3 to the concentrations that have water potential values:

0.7 mol dm^{-3} - 0.1 mol dm^{-3} = 0.6 mol dm^{-3}

(0.6 mol dm^{-3}/ 6) x 4 = 0.4 mol dm^{-3}

Then you do the same to the water potential values to find the water potential at 0.4 mol dm^{-3}:

(-1876 kPa) - (-251 kPa) = -1625 kPa

(-1625 kPa / 6) x 4 = -1083 kPa

- In water potentials **lower** than -1083 kPa the droplets **moved down** due to them being extracted from bathing solutions that had **lower** sucrose concentrations or **higher** water potentials than the water potential of the beetroot cells (as more water molecules moved out of the beetroot discs resulting in a more dense solution)
- In water potentials **higher** than -1083 kPa the droplets **moved up** due to them being extracted from bathing solutions that had **higher** sucrose concentrations or **lower** water potentials than the water potential of the beetroot cells (as water molecules moved into the beetroot discs resulting in a less dense solution)

3

The correct answer is **D** because:

- If the volume of the cytoplasm increases the surface area (SA) to volume (V) ratio decreases thus the rate of **diffusion** slows as does the rate of metabolism
- This is because diffusion is only effective over **short** distances, and if the oxygen needs to travel a long distance to the mitochondria for use in respiration the rate of energy (**ATP**) production will **decrease**
- If oxygen cannot diffuse into the cell quickly enough aerobic respiration cannot occur and therefore **active transport** and **exocytosis** will not occur as these

processes require cellular energy

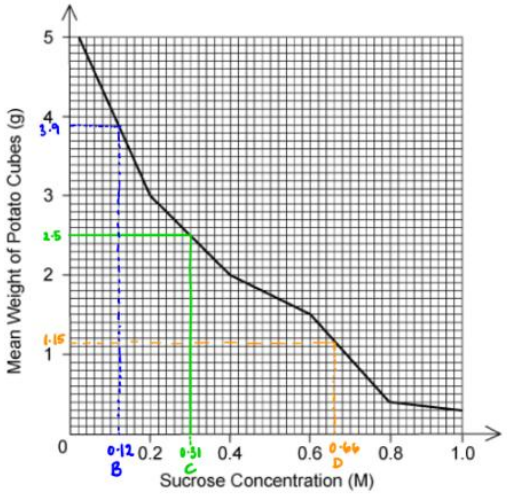
A & **C** are incorrect as the growth of the cell affects diffusion, active transport **and** exocytosis.

B is incorrect as the rate of osmosis is not dependent on the mass of the cell. It is **dependent** on the water potential.

4

The correct answer is **C** because:

- If the potato has the same water potential as the sucrose concentration then the **net** movement of water molecules will be zero, that is there will not be a change in weight
- If the initial weight of the potato cubes was 2.5g then the sucrose concentration where there has been no change in mass is at 0.31M



A is incorrect as 0 M of sucrose (water) would cause the potato cubes to **increase** in weight as the water molecules moved from higher water potential (in the test tube) to lower water potential (inside the potato)

B is incorrect as 0.12 M would cause the potato cubes to **increase** in weight, as shown on the graph, as the water moved by osmosis from the higher water potential (in the test test tube) to the lower water potential (inside the potato)

D is incorrect as 0.66 M would cause the potato cubes to **decrease** in weight, as shown on the graph, as the water moved by osmosis from the higher water potential (inside the potato) to the lower water potential (in the test tube)

5

The correct answer is **B** because:

Cuboid (1):

- The surface area of the cuboid (1) is 32 cm^2
  - (4 x 2 x 4) + (4 x 1 x 2) = 32
- The volume is 8 cm^3
  - 4 x 2 x 1 = 8
- Therefore the ratio is **4:1**
  - 32:8 = 4:1 (divide both by 8)

Cube (2):

- The surface area of the cube (2) is $24cm^2$
    - (2 x 2) x 6 = 24
- The volume is 8 cm^3
    - 2 x 2 x 2 = 8
- Therefore the ratio is **3:1**
    - 24:8 = 3:1 (divide both by 8)
- The **greater** the surface area to volume ratio the **faster** the rate of diffusion (Fick's Law states that the rate of diffusion is directly proportional to the surface area)

A is incorrect as the SA:V ratio is bigger in 1 than 2 **not** smaller

C is incorrect as the SA:V is smaller in 2 than 1

D is incorrect as the SA:V are **not** equal

6

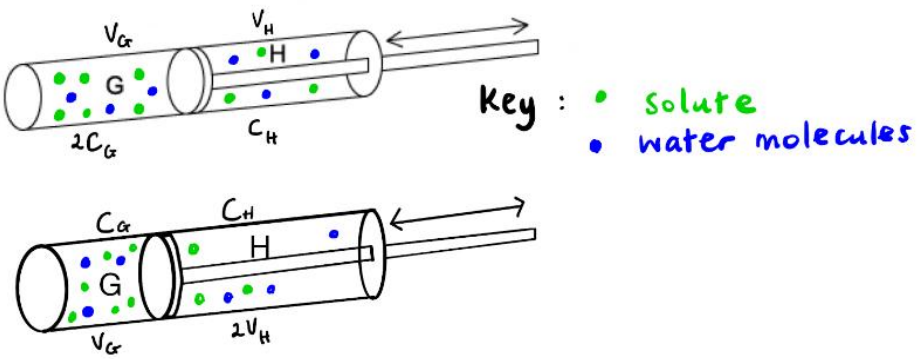
The correct answer is **D** because:

- As the percentage of oxygen **increases**, so does the **rate** of sodium uptake, which means that sodium uptake is **dependent** on oxygen
- Oxygen is used in **respiration** to produce **ATP** (cellular energy), at low oxygen percentages there is not enough ATP produced to transport the sodium ions
- Therefore, sodium ions are moving by **active** transport (energy requiring) **up** their concentration gradient
- The other options are all examples of **passive** transport, which don't require energy. However, **only** water can move via osmosis - not sodium ions.

7

The correct answer is **D** because:

- Initially the concentration in compartment G is twice that of compartment H ($C_G = 2C_H$) and the volumes of the compartments are equal ($V_G = V_H$)
- Therefore to reach osmotic equilibrium the volume in H must be doubled to increase the concentration to reach the same concentration as compartment G



A is incorrect as doubling the concentration **and** volume of compartment H would result in a higher concentration in compartment H.

B is incorrect as as the initial concentration in G was double H then having the same volume in both compartments would not allow the osmotic equilibrium to be reached

C is incorrect as this would result in compartment H having double the concentration of G

8

The correct answer is **C** because:

- Water potential is dependent on the **concentration** of a **solute**
- Glucose is the smallest molecule out of the options and therefore more molecules of glucose is needed to make up the same weight, resulting in a higher concentration of glucose
- A higher concentration of solute results in a lower (less pure) water potential

9

The correct answer is **B** because:

- The **net** movement of molecules is from a region of **higher** concentration to a region of **lower** concentration down a gradient due to the random movement of molecules
- Once there is no difference between the concentration gradients then the **net** movement does not alter **but** the molecules will continue to move randomly so the rate will be kept constant

A is incorrect as ATP is only required during the **active transport** of molecules

C is incorrect as carrier proteins will constantly be involved in moving substances, they will only be saturated **briefly** as they transport a molecule across the membrane and will then be free again

D is incorrect as the higher concentration does not alter the number of carrier proteins present or their effectiveness in transporting molecules, so they will continue to move substances into and out of the cell depending on the concentration gradient

10

The correct answer is **D** because:

- The closer the water potential is to 0 the less solutes are present and therefore the more pure the water is
- **Cell Y** (-300 kPa) has the **highest** water potential and therefore water will move by osmosis from this cell to the other two
- **Cell Z** (-600 kPa) has a **higher** water potential than **cell X** (-900 kPa) therefore water will move by osmosis from Z to X

A is incorrect as water will move from an area of high (less negative) water potential to an area of low (more negative) water potential, therefore water would not travel from X (-900 kPa) to Y (-300 kPa)

B is incorrect as the water would not move from cell Z to Y as there is a **lower** water potential in Z (-600 kPa) than Y (-300 kPa)

C is incorrect as the water would not move from cell X to Z as there is a **lower** water potential in X (-900 kPa) than Z (-600 kPa)