Model Answers: Medium

1

The correct answer is **C** because:

- In distilled water the water will move from the pure water (high water potential) **into** the cell (lower water potential) via osmosis, causing **animal cells** to swell and **burst**
- The **cell wall** of plant cells is **strong** and withstands the pressure of increased water in the cell cytoplasm, therefore plant cells swell and become **turgid**

Both plant and animal cell surface membranes are **partially permeable**, which means that they let **some** molecules across, but **not** all. This is thanks to the phospholipids creating a **hydrophobic barrier** and channel/carrier proteins enabling the transport of **specific** molecules.

The presence of a vacuole does **not** affect the movement of water into the cell causing cell bursting.

Plant cell walls are made of cellulose and are freely permeable, however, this does not explain why animal cells burst but plant cells do not.

2

The correct answer is **C** because:

- -2500 kPa is a **very low water potential**, lower than most cells, and this will cause water to move **out** of cells via **osmosis** down its water potential gradient into the seawater
- The movement of water out of the cells will cause them to **shrivel** and **die**
- The root hair cells need to **lower** their own water potential by **increasing** the concentration of **solutes**, such as salts, in order to create a concentration **equilibrium** with the seawater and stop the movement of water by osmosis

If root hair cells had a very high water potential then this would **increase** the rate of osmosis out of the cell and cause the root hair cell to shrivel and die.

Having leaves with a large surface area will **increase** the rate of osmosis out of the cell as there will be a larger surface area for osmosis to take place.

Having a high density of **stomata** (pores in the underside of leaves which allow gas exchange and **transpiration**) will increase the amount of water loss which will **not** be favourable for the plant.

3

The correct answer is **C** because:

- Water will move by osmosis **into** Z down a water potential gradient due to the solution at Z being more concentrated
- This causes a corresponding increase in the pressure at Z (referred to as hydrostatic pressure) and therefore a pressure gradient between Z and Y, causing a mass flow of sucrose solution from Z to Y (moving fluid from a source to a sink)
- This would make X the phloem and W the xylem. Water will initially be drawn along tube W from the beaker with Y to the beaker with Z (as water gradient established by water being drawn into Z)
- Z therefore represents leaves and Y represents roots

A & **B** are incorrect as this option involves the solution moving against the direction of flow created by hydrostatic pressure increasing at Z as a result of the movement of water by osmosis.

D is incorrect as this option lists the source as the roots and the sink as the leaves which would be incorrect.

4

The correct answer is **D** because:

- All of these structures are very large, much larger than 2.4nm
- For example, haemoglobin is the **smallest** of the options and it is a protein that spans **6.9nm**.
- Glycogen is a **polymer** made of glucose molecules, therefore if one glucose molecule is just about to fit through a pore, glycogen will not be able to.

Visking tubing mimics the membrane of cells and these structures would require bulk transport (endocytosis and exocytosis) to cross a cell membrane.

5

The correct answer is **C** because:

- Viruses enter the cell by **endocytosis** (specifically phagocytosis)
- A virus will bind to a **protein receptor** (probably a glycoprotein) on the **extracellular** side of the cell surface membrane
- This protein will then signal for the cell membrane to wrap around the virus and **engulf** it
- The cell membrane completely surrounds the virus and pinches off to form a **vesicle** within the cell

The virus would bind to a protein receptor, not a phosphate head. Bulk transport **into** the cell is called **endocytosis** (**en** sounds like **in**), bulk transport **out** of the cell is called **exocytosis** (**ex**it).

6

The correct answer is **B** because:

- Sucrose is actively transported from companion cells into the sieve tubes resulting in a higher solute concentration (lower water potential or a more negative water potential)
- This allows for the translocation of sucrose and amino acids

A is incorrect as the increased number of sucrose molecules **increases** the **solute** concentration thus decreasing the water potential or making it more negative.

C & **D** are incorrect as sucrose is **actively transported** into sieve tubes.

7

The correct answer is **B** because:

- Water moves from a **high water potential** to a **low water potential** via **osmosis.**
- **Diagram 1** shows **normal** red blood cells with water constantly moving in both directions across the cell membrane via osmosis, this means that the water potential outside the cell is the **same** as the water potential inside the cell. The solution is therefore **isotonic**.
- **Diagram 2** shows red blood cells swelling and **bursting** because more water is moving **into** the cell than out of the cell, this means that the water potential outside the cell is **higher** than the water potential inside the cell. The solution is **hypotonic**.
- **Diagram 3** shows red blood cells **shrivelling** because more water is leaving the cell than entering the cell because the water potential outside the cell is **lower** than the water potential inside the cell. The solution is **hypertonic**.
- Therefore, cells in diagram 3 are in the solution with the lowest water potential, followed by cells in diagram 1. The cells in diagram 2 are in solution with the highest water potential (the closest to pure water).

8

The correct answer is **D** because:

- A **steeper concentration gradient** (a large difference between the concentration of two areas) **increases** the speed of diffusion
- **Higher temperatures** give molecules more **kinetic energy** which causes them to diffuse **faster**.
- A **higher surface area to volume ratio** means that for a specific volume, there is **more** surface area (more cell membrane) for the molecules to diffuse across hence **increasing** the rate of diffusion
- **Smaller**, **non-polar** and **non-charged** molecules diffuse **faster** across the membrane because they can travel directly past the phospholipids

and do **not** rely on **channel/carrier proteins** which slow down the speed of transport
- Option **D** gives is the best **overall** speed due to the values of each of the factors being **favourable** to diffusion speed

9
The correct answer is **D** because:

- There are two types of transporter proteins in cell membranes: **channel proteins** and **carrier proteins**
- Channel proteins allow a specific molecule to travel down its concentration gradient and does **not** undergo **conformational change** (it is basically a tunnel through the membrane that fits one specific molecule)
- Therefore, a potassium ion channel does not undergo conformational change
- **Carrier proteins** require a **conformational change** to enable the transport of molecules across the membrane, this may be because:
    - The channel is **gated** and only opens in particular situations (e.g. when a neurotransmitter binds)
    - The carrier protein is a **symporter** or **antiporter** which transport two different molecules at the same time
    - The carrier protein requires ATP hydrolysis (energy) to **actively** transport the molecules up their concentration gradient

10
The correct answer is **A** because:

- The pores in the membrane separating the two solutions is **too small** for glucose to pass through, so the amount of glucose in each solution remains **constant**
- Therefore, water moves by **osmosis** down its **water potential gradient** to create an **equilibrium** between the two solutions
- Water moves from solution **1** to solution **2** so that there is an equal ratio of water to glucose which cause the volume of water in solution 1 to decrease and the volume of solution 2 to increase by the same amount
- The concentration of solution 1 from the start to the end increases as there is less water per glucose molecule, the opposite is true for solution 2.