Marks
4

- Assuming ideal behaviour, calculate the mass of $MgCl_2 \cdot 6H_2O$ that should be dissolved in 1.0 L of water at 37 ºC to obtain a solution with an osmotic pressure of 6.0 atm, the same as that of cell cytoplasm.

The molar mass of $MgCl_2 \cdot 6H_2O$ is:

(24.31 (Mg) + 2 × 35.45 (Cl) + 12 × 1.008 (H) + 6 × 16.00 (O)) g mol^{-1}

= 203.3 g mol^{-1}

An osmotic pressure of 6.0 atm corresponds to (6.0 × 101.3) kPa = 607.8 kPa.

The osmotic pressure, *Π*, is given by *Π* = c*RT*. Hence, the concentration, *c*, required is:

$c = \Pi / RT$ = (607.8 × 10^3 Pa) / (8.314 m^3 Pa K^{-1} mol^{-1} × ((37 + 273) K))

= 0.236 M

$MgCl_2 \cdot 6H_2O$ dissolves to give Mg^{2+} + $2Cl^-$: three particles per mole. Hence, the number of moles of $MgCl_2 \cdot 6H_2O$ required to give this concentration of particles in 1.0 L is:

number of moles = 0.236 / 3 mol = 0.0786 mol

Hence, the mass of $MgCl_2 \cdot 6H_2O$ required is:

mass = number of moles × molar mass = 0.0786 mol × 203.3 g mol^{-1} = 16 g

Answer: **16 g**