2. SOLUTION

2.26 If the density of some lake water is 1.25 g mL^{-1} and contains 92g of Na^+ ions per kg of water, calculate the molality of Na^+ ions in the lake.

Sol.

Molar mass of Na = 23 $gmol^{-1}$

$\therefore$ No. of moles of Na^+ ions present

$$= \frac{92}{23} = 4 \text{ moles}$$

$$\therefore \text{Molality} = \frac{4 \times 1000}{1000} = 4 \text{ m.}$$

2.27 If the solubility product of CuS is 6 x 10^{-16}, calculate the maximum molarity of CuS in aqueous solution.

Sol.

$CuS \rightleftharpoons Cu^{2+} + S^{2-}$, $K_{sp} = 6 \times 10^{-16}$

Maximum molarity of CuS in aqueous solution means solubility of CuS.

Let the solubility of CuS be S mol L^{-1}

$\therefore$ $K_{sp} = [Cu^{2+}]\,[S]^{2-}$

$6 \times 10^{-16} = S \times S = S^2$

$$\therefore S = \sqrt{6 \times 10^{-16}} = 2.45 \times 10^{-8} \text{ mol } L^{-1}.$$

2.28 Calculate the mass percentage of aspirin ($C_9H_8O_4$ in acetonitrile (CH_3CN) when 6.5g of CHO is dissolved in 450 g of CH3CN.

Solution:

Mass percentage of aspirin

$$= \frac{\text{Mass of aspirin}}{\text{Mass of aspirin + Mass of acetonitrile}} \times 100$$

$$= \frac{6.5}{6.5 + 450} \times 100 = 1.424\%$$

2.29 Nalorphene ($C_{19}H_{21}NO_3$), similar to morphine, is used to combat withdrawal symptoms in narcotic users. Dose of nalorphene generally given is 1.5 mg. Calculate the mass of 1.5 x 10^{-3} m aqueous solution required for the above dose.

Solution:

$1{\cdot}5 \times 10^{-3}$ m aqueous solution of nalorphene means that $1{\cdot}5 \times 10^{-3}$ mole of nalorphene is dissolved in 1 kg of water.

Molar mass of nalorphene, $C_{19}H_{21}NO_3$

$= 19 \times 12 + 21 + 14 + 3 \times 16 = 311\ g\ mol^{-1}$

$\therefore\ 1{\cdot}5 \times 10^{-3}$ mole of nalorphene

$= 1{\cdot}5 \times 10^{-3} \times 311 g = 0{\cdot}467\ g$

$\therefore$ Mass of solution $= 0{\cdot}467 + 1000 = 1000{\cdot}467$ g.

For 0·467g of nalorphene, mass of solution required = 1000·467g

For 1·5 mg ($1{\cdot}5 \times 10^{-3}$g) of nalorphene, mass of solution required

$$= \frac{1000{\cdot}467}{0{\cdot}467} \times 1{\cdot}5 \times 10^{-3} = 3{\cdot}21 g.$$

2.30 Calculate the amount of benzoic acid (C_6H_5COOH) required for preparing 250 mL of 0.15 M solution in methanol 0.15 M solution means than 0.15 mole of benzoic acid is dissolved in 1L of solution.

Solution:

0·15 M solution means than 0·15 mole of benzoic acid is dissolved in 1L of solution.

Molar mass of C_6H_5COOH

$= 12 \times 6 + 5 + 12 + 2 \times 16 + 1 = 122 g\ mol^{-1}$

$\therefore$ 0·15 mol of $C_6H_5COOH = 0{\cdot}15 \times 122 = 18{\cdot}3g$

Thus, 1 L or 1000 mL of solution contain

$= 18{\cdot}3$g of C_6H_5COOH

$\therefore$ 250 mL of the solution will contain

$$= \frac{18{\cdot}3}{1000} \times 250 = 4{\cdot}575 g \text{ of } C_6H_5COOH.$$