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Solution-4b . Conv. of Conc. Units-2

Q. A 2.90m solution of methanol (CH_3OH; MW = 32.02 g/mol) in water has a density of 0.984 g/mL. What are its (a) mass% (b) molarity and (c) mol% of CH_3OH?

(a) mass% → $\left(\frac{\text{mol } CH_3OH}{\text{total mols}}\right) \times 100\%$

(b) molarity → $\frac{\text{mol } CH_3OH}{\text{L soln}}$

mass% → mass CH_3OH / mass soln.

2.90m $\frac{2.90 \text{ mol } CH_3OH}{1 \text{ kg } H_2O}$ $d_{soln} = 0.984 \text{ g/mL}$

⇒ assume 1L

(a) mass% = $\frac{\text{mass } CH_3OH}{\text{mass soln}}$ → from mol..

mass soln → mass of CH_3OH + mass of H_2O (1 kg H_2O)

mass of CH_3OH = 2.90 mol × $\frac{32.02 \text{ g}}{1 \text{ mol}}$ = 92.9 g CH_3OH.

mass of soln = 92.9 g CH_3OH + 1000 g H_2O = 1093 g soln.

$\left(\frac{92.9 \text{ g } CH_3OH}{1093 \text{ g soln}}\right) \times 100\% = \boxed{8.5\%}$

(b) molarity = $\frac{\text{mol solute}}{\text{L}}$ — (2.9 mol)

L → use density

1093 g soln. × $\frac{1 \text{ mL}}{0.984 \text{ g}}$ × $\frac{1 \text{ L}}{1000 \text{ mL}}$ = 1.11 L

2.9 mol / 1.11 L = $\boxed{2.61 \text{ M}}$

(c) mol% CH_3OH = $\frac{\text{mol } CH_3OH}{\text{mol } CH_3OH + \text{mol } H_2O}$ → 2.9

mol H_2O from mass of H_2O (1 kg).

1000 g H_2O × $\frac{1 \text{ mol}}{18 \text{ g}}$ = 55.5 mol H_2O.

$\left(\frac{2.9 \text{ } CH_3OH}{2.9 \text{ } CH_3OH + 55.5 \text{ } H_2O}\right) \times 100\% = \boxed{4.97\%}$