

# Concentration-1

## Some Basic concepts of chemistry-4

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**67.**  $6.02 \times 10^{20}$  molecules of urea are present in 100 mL of its solution. The concentration (M) is [NEET 2013].

*Explanation:* Molecules  $\rightarrow$  moles, then divide by volume in litres.

*Approach:*  $n = \frac{N}{N_A}$ ,  $M = \frac{n}{V(L)}$ .

**Steps:**

$$n = \frac{6.02 \times 10^{20}}{6.022 \times 10^{23}} \approx 1.00 \times 10^{-3} \text{ mol}$$

$$V = 100 \text{ mL} = 0.100 \text{ L}$$

$$M = \frac{10^{-3}}{0.100} = \boxed{0.01 \text{ M}}$$

*Why?* Molarity is moles of solute per litre of solution.

*Similar practice (with answer):*  $3.01 \times 10^{21}$  molecules in 250 mL solution  $\Rightarrow M = \frac{3.01 \times 10^{21}/N_A}{0.25} = \boxed{0.02 \text{ M}}$ .

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**68.** Which expression of concentration is temperature independent? [CBSE AIPMT 1995, 1992]

**Answer with reason:**  $\boxed{\text{Molality}}$  — kyunki yeh solvent ke mass par based hota hai, jabki molarity/normality/formality volume par depend karte hain (volume  $T$  se change hota hai).

*Similar practice (with answer):* Mass % vs molarity — kaun  $T$ -independent?  $\rightarrow \boxed{\text{Mass\%}}$ .

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**69.** 25.3 g of  $\text{Na}_2\text{CO}_3$  is made up to 250 mL solution. If it dissociates completely, molar concentrations of  $\text{Na}^+$  and  $\text{CO}_3^{2-}$  are respectively? ( $M = 106 \text{ g mol}^{-1}$ ) [CBSE AIPMT 2010]

*Explanation:*  $\text{Na}_2\text{CO}_3 \longrightarrow 2\text{Na}^+ + \text{CO}_3^{2-}$ .

*Approach:* Moles of salt  $\rightarrow$  molarity of salt  $M_s$ ; then  $[\text{Na}^+] = 2M_s$ ,  $[\text{CO}_3^{2-}] = M_s$ .

**Steps:**

$$n_s = \frac{25.3}{106} = 0.2387 \text{ mol}, \quad V = 0.250 \text{ L}$$

$$M_s = \frac{0.2387}{0.250} = 0.9548 \text{ M} \approx 0.955 \text{ M}$$

$$[\text{Na}^+] = 2M_s = \boxed{1.910 \text{ M}}, \quad [\text{CO}_3^{2-}] = \boxed{0.955 \text{ M}}$$

*Similar practice (with answer):* 5.3 g  $\text{Na}_2\text{CO}_3$  in 100 mL:  $M_s = 0.5 \text{ M} \Rightarrow [\text{Na}^+] = \boxed{1.0 \text{ M}}$ ,  $[\text{CO}_3^{2-}] = \boxed{0.5 \text{ M}}$ .

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**70.** How many grams of 70% (w/w) concentrated  $\text{HNO}_3$  are needed to prepare 250 mL of 2.0 M  $\text{HNO}_3$ ? [NEET 2013]

*Explanation:* Required moles  $\rightarrow$  required mass of pure acid  $\rightarrow$  divide by mass fraction.

*Approach:*  $n = MV = 2.0 \times 0.250 = 0.50 \text{ mol}$ ;  $m_{\text{pure}} = nM(\text{HNO}_3) = 0.50 \times 63 = 31.5 \text{ g}$ ; mass of

solution =  $\frac{31.5}{0.70}$ .

**Steps:**

$$m_{\text{solution}} = \frac{31.5}{0.70} = \boxed{45.0 \text{ g}}$$

Similar practice (with answer): 500 mL of 1 M HNO<sub>3</sub> using 70% acid  $\Rightarrow m_{\text{pure}} = 31.5 \text{ g} \Rightarrow m_{\text{solution}} = \boxed{45.0 \text{ g}}$ .

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**71. What is the mole fraction of solute in a 1.00 m (molal) aqueous solution? [CBSE AIPMT 2015]**

Explanation: 1 m = 1 mol solute per 1 kg water.

Approach: Moles of water =  $1000/18 = 55.555$ ;  $x_{\text{solute}} = \frac{1}{1 + 55.555}$ .

Calculation:  $x = \boxed{0.0177}$ .

Similar practice (with answer): 2 m aqueous solution  $\Rightarrow x = \frac{2}{2 + 55.555} = \boxed{0.0348}$ .

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**72. Conc. H<sub>2</sub>SO<sub>4</sub> is 98% by mass and density = 1.80 g mL<sup>-1</sup>. Volume needed to make 1.00 L of 0.100 M H<sub>2</sub>SO<sub>4</sub> is — [CBSE AIPMT 2007]**

Approach: Required pure acid =  $0.100 \times 1.00 \times 98 = 9.8 \text{ g}$ . Mass of solution =  $9.8/0.98 = 10.0 \text{ g}$ .

Volume =  $\frac{10.0}{1.80} \text{ mL}$ .

Answer:  $V = \boxed{5.56 \text{ mL}}$  ( $\approx 5.55 \text{ mL}$ ).

Similar practice (with answer): For 0.5 L of 0.2 M solution: pure acid = 9.8 g again  $\Rightarrow$  volume =  $\boxed{5.56 \text{ mL}}$ .

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**73. The mole fraction of solute in a one-molal aqueous solution is — [CBSE AIPMT 2005]**

Same working as Q71  $\Rightarrow \boxed{0.018}$ .

Similar practice (with answer): 0.5 m aqueous solution  $\Rightarrow x = \frac{0.5}{0.5 + 55.555} = \boxed{0.00897}$ .

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**74. 1 M, 2.5 L NaOH is mixed with 0.5 M, 3 L NaOH. Find molarity of the resultant solution. [CBSE AIPMT 2002]**

Approach: Total moles =  $M_1V_1 + M_2V_2$ , total volume =  $V_1 + V_2$ .

Steps:

$$n_{\text{tot}} = 1 \times 2.5 + 0.5 \times 3 = 2.5 + 1.5 = 4.0 \text{ mol}$$

$$V_{\text{tot}} = 2.5 + 3 = 5.5 \text{ L}$$

$$M = \frac{4.0}{5.5} = \boxed{0.727 \text{ M}} \quad (\approx 0.73 \text{ M})$$

Similar practice (with answer): 0.2 M, 1 L mixed with 0.8 M, 0.5 L gives  $M = \frac{0.2 \times 1 + 0.8 \times 0.5}{1.5} = \boxed{0.4 \text{ M}}$ .

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**75. Molarity of liquid HCl if density = 1.17 g cm<sup>-3</sup> (assume pure) [CBSE AIPMT 2001].**

Approach: 1 L mass =  $1.17 \times 10^3 \text{ g}$ . Moles =  $\frac{1170}{36.5}$ .

Answer:  $M = \boxed{32.05}$ .

Similar practice (with answer): If density = 1.20 g cm<sup>-3</sup>,  $M = \frac{1200}{36.5} = \boxed{32.88}$ .

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**76. The molar concentration of 20 g of NaOH in 5 L solution is — [AIIMS 1998]**

Steps:  $n = 20/40 = 0.5 \text{ mol}$ ;  $M = 0.5/5 = \boxed{0.10 \text{ M}}$ .

Similar practice (with answer): 8 g NaOH in 2 L  $\Rightarrow M = \boxed{0.10 \text{ M}}$ .

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**77. Temperature does not affect — [AIIMS 1997, 2001]**

Answer with note:  $\boxed{\text{Molality}}$  (mass based, volume se independent).

Similar practice (with answer): Normality  $N$   $T$ -dependent?  $\rightarrow \boxed{\text{Yes (dependsonvolume)}}$ .

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**78. Molarity of  $\text{H}_2\text{SO}_4$  with density  $1.84 \text{ g mL}^{-1}$  and 98% by weight at  $35^\circ\text{C}$  is — [AIIMS 2001]**

*Approach:* 1 L solution mass = 1840 g; pure acid =  $0.98 \times 1840 = 1803.2 \text{ g}$ ; moles =  $1803.2/98$ .

**Answer:**  $M = \boxed{18.4}$ .

*Similar practice (with answer):* Density  $1.50 \text{ g mL}^{-1}$  at 80% by mass  $\Rightarrow M = \frac{0.80 \times 1500}{98} = \boxed{12.24}$ .

**79. 24.5 g of NaOH in 1 L solution — molarity? [2010]**

**Steps:**  $n = 24.5/40 = 0.6125 \text{ mol}$ ;  $M = \boxed{0.6125 \text{ M}}$ .

*Similar practice (with answer):* 20 g NaOH in 0.5 L  $\Rightarrow M = \boxed{1.0 \text{ M}}$ .

**80. 0.4 mol HCl and 0.2 mol  $\text{CaCl}_2$  dissolved to make 500 mL solution. Molarity of  $\text{Cl}^-$  is — [2000]**

*Approach:* HCl gives 1  $\text{Cl}^-$ ;  $\text{CaCl}_2$  gives 2  $\text{Cl}^-$ . Total  $\text{Cl}^-$  moles =  $0.4 + 2 \times 0.2 = 0.8$ ;  $M = 0.8/0.5$ .

**Answer:**  $\boxed{1.6 \text{ M}}$ .

*Similar practice (with answer):* 0.2 mol NaCl + 0.1 mol  $\text{MgCl}_2$  in 1 L  $\Rightarrow [\text{Cl}^-] = \boxed{0.4 \text{ M}}$ .

**81. Assertion–Reason: “One molal aqueous solution of glucose contains 180 g glucose in 1 kg water.” Reason: “Solution having 1 mol solute in 1000 g solvent is called 1 m.” [2008]**

**Answer:**  $\boxed{\text{(a) Both true, and R is the correct explanation}}$ .

*Similar practice (with answer):* 2 m solution definition?  $\rightarrow \boxed{2 \text{ mol solute per } 1000 \text{ g solvent}}$ .

**82. Match List-I (Example) with List-II (Type of solution).**

List-I	List-II
A. Milk	I. Liquid in liquid
B. Alloys	III. Solid in solid
C. Amalgam	II. Liquid in solid
D. Smoke	IV. Solid in gas

**Correct matching:**  $\boxed{A \rightarrow I, B \rightarrow III, C \rightarrow II, D \rightarrow IV}$  (same as option 3).

*Similar practice (with answer):* Fog is which type?  $\rightarrow \boxed{\text{Liquid in gas (aerosol)}}$ .

**83. In one molal solution that contains 0.5 mol of a solute, the amount of solvent present is — (NEET 2020)**

*Explanation:* 1 m  $\Rightarrow$  1 mol per 1000 g solvent. Proportionality use karo.

**Answer:**  $\boxed{500 \text{ g of solvent}}$ .

*Similar practice (with answer):* 0.2 mol solute in a 1 m solution needs solvent =  $\boxed{200 \text{ g}}$ .