

KARACHI EDU • COACHING CENTER NOTES

Chapter 6: Solutions

High-detail notes covering types of solutions, solubility, concentration units (Molarity, Molality, % composition), saturated/unsaturated solutions, and suspension vs colloids.

What is a Solution?



Homogeneous Mixture

A uniform mixture of two or more substances whose composition and properties are uniform throughout.



Solute

The component present in a smaller amount that gets dissolved (e.g., salt, sugar).



Solvent

The dissolving medium present in larger quantity (e.g., water, alcohol).

CLASSIFICATION

Types of Solutions Based on Physical States

01

Gas in Liquid

Oxygen dissolved in water (O_2 in H_2O), carbonated beverages (CO_2 in water).

02

Liquid in Liquid

Miscible liquids like ethanol in water ($\text{C}_2\text{H}_5\text{OH}$ and H_2O).

03

Solid in Liquid

Common salt or glucose dissolved in water creating a true solution.

Saturated, Unsaturated & Supersaturated

Unsaturated Solution

Contains less solute than it has the capacity to dissolve at a given temperature.

Saturated Solution

Contains maximum amount of dissolved solute in equilibrium with undissolved solute at specific temperature.

Supersaturated Solution

Contains more dissolved solute than a saturated solution; highly unstable and crystallizes rapidly upon disturbance.

Factors Affecting Solubility

Nature of Solute–Solvent

"Like dissolves like". Polar solutes dissolve in polar solvents (NaCl in H_2O); non-polar in non-polar (oil in benzene).

Temperature Effect

For most solids, solubility increases with temperature (endothermic). For gases, solubility decreases as temperature rises.

Pressure Effect (Henry's Law)

Pressure has negligible effect on solids/liquids but directly increases gas solubility in liquids.

Concentration Units: Molarity (\$M\$) & Molality (\$m\$)

Molarity (\$M\$)

Number of moles of solute dissolved per liter of solution.

Formula: $M = \frac{\text{Moles of solute}}{\text{Volume of solution in L}}$

Molality (\$m\$)

Number of moles of solute dissolved per kilogram of solvent.

Formula: $m = \frac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$

Key Difference

Molarity varies with temperature due to volume change, whereas molality remains independent of temperature.

Percentage Concentration Formulations

Percent Weight by Weight (% w/w)

Grams of solute in 100 g of solution.

$$\% \frac{w}{w} = \frac{\text{Wt. of solute}}{\text{Wt. of solution}} \times 100$$

Percent Weight by Volume (% w/v)

Grams of solute in 100 cm^3 (100 mL) of solution.

$$\% \frac{w}{v} = \frac{\text{Wt. of solute (g)}}{\text{Vol. of solution (mL)}} \times 100$$

Percent Volume by Volume (% v/v)

Volume of liquid solute in 100 mL of solution.

$$\% \frac{v}{v} = \frac{\text{Vol. of solute}}{\text{Vol. of solution}} \times 100$$

Solutions, Suspensions & Colloids

True Solution

- Particle size: $< 1\text{ nm}$
- Transparent and homogeneous
- Passes through filter paper
- Does not show Tyndall effect

Colloids

- Particle size: $1\text{ to }1000\text{ nm}$
- Translucent appearance
- Passes through filter paper
- Exhibits strong Tyndall effect

Suspensions

- Particle size: $> 1000\text{ nm}$
- Opaque and heterogeneous
- Particles settle down on standing
- Separated by filtration

Tyndall Effect & Brownian Movement

Tyndall Effect

Scattering of a light beam by colloidal particles, making the path of light clearly visible (e.g., sunlight through dusty room air).

Brownian Movement

Continuous, zig-zag random motion of colloidal particles resulting from constant bombardment by molecules of dispersion medium.

Stability Factor

Brownian motion counteracts gravity, keeping colloidal particles suspended indefinitely without settling.

Sample Problem: Calculating Molarity

Problem Statement

Calculate the molarity of a solution containing 5.85 g of NaCl dissolved in water to make 500 mL (0.5 L) of solution. ($\text{Na} = 23$, $\text{Cl} = 35.5$).

Step-by-Step Solution

- Molar mass of $\text{NaCl} = 23 + 35.5 = 58.5\text{ g/mol}$
- Moles of $\text{NaCl} = \frac{5.85\text{ g}}{58.5\text{ g/mol}} = 0.1\text{ moles}$
- Molarity $M = \frac{0.1\text{ mol}}{0.5\text{ L}} = 0.2\text{ M}$

Key Takeaways for KARACHI EDU Students

True Solutions

Homogeneous mixtures with particle size under 1 nm that never settle.

Solubility Rules

Governed by solute-solvent polarity and temperature variations.

Concentration Calc

Master Molarity (M) and Molality (m) formulas for exam numericals.

Colloids vs Suspensions

Distinguish by particle size, filtration behavior, and Tyndall effect.

Questions & Discussion

KARACHI EDU Coaching Center — Chemistry Department IX
