المحاضرة رقم 4

Example 1

What is the molar concentration of $K_3Fe(CN)_6$ in a solution that contains 63.3 ppm of (329.3 g/mol)?

M =?
ppm= 63.3
F. wt = 329.3 g/mol

$$ppm = 63.3\ mg/L$$

$$ppm = \frac{63.3\ mg/L}{1000\ mg/g}$$

$$ppm = 0.0363\ g/L$$

$$M = \frac{ppm}{F.wt \times 1000}$$

$$ppm = M \times F.wt \times 1000$$

$$M\left(\frac{mol}{L}\right) = \frac{63.3\ (\frac{mg}{L})}{329.3\ (\frac{g}{mol}) \times 1000\ (\frac{mg}{g})}$$

% by weight (% w/w)

$$\%w/w = \frac{\text{mass of solute}}{\text{total mass of solution}} \times 100\%$$

What is the % w/w of a solution if 3.00 grams of NaCl are dissolved in 17.00 g of water?

$$mass\ of\ solute = 3\ g$$

$$total\ mass\ of\ solution = mass\ of\ solute + mass\ of\ solvent$$

$$total\ mass\ of\ solution = 3\ g + 17\ g$$
$$total\ mass\ of\ solution = 20\ g$$

$$\%\frac{W}{W} = \frac{3\ g}{20\ g} \times 100 \rightarrow \%\frac{W}{W} = 15\ \%$$

% by volume (% w/w)

$$\%v/v = \frac{\text{volume of solute}}{\text{total volume of solution}} \times 100\%$$

What is the % v/v of a solution if 20.0 mL of alcohol are dissolved in 50.0 mL of solvent?

$$volume\ of\ solute = 20\ ml$$

$$total\ volume\ of\ solution = volume\ of\ solute + volume\ of\ solvent$$

$$total\ volume\ of\ solution = 20\ ml + 50\ ml$$
$$total\ volume\ of\ solution = 70\ ml$$

$$\%v/v = \frac{20\ ml}{70\ ml} \times 100 \rightarrow \%\frac{V}{V} = 28.5\ \%$$

% by weight /volume (% w/v)

$$weight/volume - percent - (w/v) = \frac{weight - solute, g}{volume - solution, mL} \times 100\%$$

What is the % w/v of a solution if 21.0 g of NaCl are dissolved in 100.0 mL of solution?

$$weight\ of\ solute = 21\ g$$

$$\%w/v = \frac{21\ g}{100\ ml} \times 100 \rightarrow \% \frac{W}{V} = 21.0\ \%$$

Classifying Solutions of Electrolytes

- **Weak electrolytes ionize only partially**
  - NH3 , NH4OH
  - CH3COOH , H2CO3 , H2S, H2SO3 , H3PO4
- **Strong electrolytes ionize almost completely**
  - H_2SO_4 , HCl , HNO_3 , HBr , $HClO_3$, $HClO_4$
  - NaOH , KOH

$$CH_3COOH(aq) \rightleftharpoons CH_3COO^- + H^+$$

$$NaOH\ (aq) \longrightarrow Na^+ + OH^-$$

$$HCl\ (aq) \longrightarrow H^+ + Cl^-$$

$$H_2SO_4\ (aq) \longrightarrow 2\ H^+ + SO_4^{2-}$$

Analytical versus Equilibrium concentration

Analytical concentration is amount of solute that is dissolved in the specific volume of solution .

Analytical concentration has differed from the equilibrium concentration especially when the electrolyte is partially dissolving in solution

Example: Preparation 0.2 M acetic acid by dissolving 0.2 mol of the acetic acid in 1L solution.
What is analytical concentration and equilibrium concentration

Analytical concentration

$$C_{HOAc} = [HOAc]_{undissociated} + [OAc^-]$$

equilibrium concentration

Stoichiometric Calculations

- Stoichiometry is the field of chemistry that is concerned with the **relative quantities of reactants and products** in chemical reactions.
- mass relationships between substances in a chemical reaction
- based on the mole ratio

Mole Ratio

indicated by coefficients in a balanced equation

Equation:	$2\,H_2(g)$	+	$O_2(g)$	$\longrightarrow$	$2\,H_2O(l)$
Molecules:	2 molecules H_2	+	1 molecule O_2	$\longrightarrow$	2 molecules H_2O
Mass (amu):	4.0 amu H_2	+	32.0 amu O_2	$\longrightarrow$	36.0 amu H_2O
Amount (mol):	2 mol H_2	+	1 mol O_2	$\longrightarrow$	2 mol H_2O
Mass (g):	4.0 g H_2	+	32.0 g O_2	$\longrightarrow$	36.0 g H_2O

Stoichiometric calculations in volumetric analysis

Volumetric titration : A solution of accurately known concentration (**Standard solution**) is gradually added to another solution of **unknown** concentration until the chemical reaction between the two solutions is complete.

Equivalence point– the point at which the reaction is complete Indicator – substance that changes color at (or near) the equivalence point The titrant is add Slowly until The indicator changes color (pink)

Endpoint –the point at which the color of indicator changes

Requirements for titration • The reaction must be **stoichiometric.**

$$V_1 * N_1 = V_2 * N_2$$

Where:

V_1: volume of titrant used

N_1: concentration of titrant expressed in normality

V_2: volume dilution . titrand

N_2: concentration of titrand (unknown)