Fundamentals of Analytical Chemistry

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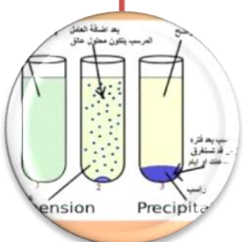
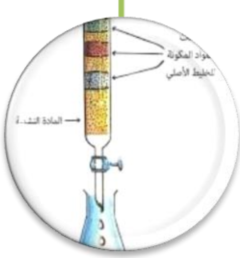
CLASSIFICATION OF ANALYTICAL METHODS

Analytical Techniques



Chemical Methods (Classical Method)

Physical Methods (Instrumental Method)



Quantitative

Qualitative

Separation

Calculations Used in Analytical Chemistry

$$no.of\ mole = \frac{mass\ of\ substance}{formule\ weight}$$

$$Molarity = \frac{no.of\ moles\ solute\ (mole)}{volume\ of\ solution\ (L)}$$

$$Molarity = \frac{mass\ of\ solute\ (g)}{formule\ weight(\frac{g}{mol})} \times \frac{\frac{1\ L}{1000\ ml}}{x\ ml}$$

Q/ Preparation of solution is contained 0.28 g NaOH that is dissolved in 500 ml of water? (F.wt = 40 g/ mol)

$$Molarity = \frac{mass\ of\ solute\ (g)}{formule\ weight(\frac{g}{mol})} \times \frac{\frac{1000\ ml}{1\ L}}{x\ ml}$$

$$Molarity\ (NaOH) = \frac{0.28(g)}{40\ (\frac{g}{mol})} \times \frac{\frac{1000\ ml}{1\ L}}{500\ ml}$$

$$Molarity\ (NaOH) = 0.014\ mol/L$$

Calculations Used in Analytical Chemistry

$$\text{Normality}\left(\frac{eq}{L}\right) = \frac{\text{Number of equivalent of solute}}{\text{Volume of solution }(L)}$$

$$N\left(\frac{eq}{L}\right) = n\left(\frac{eq}{mol}\right) \times \frac{m\,(g)}{f.wt(\frac{g}{mol})} \times \frac{1000(\frac{ml}{L})}{v(ml)}$$

$$\text{Number of milliequivalents }(meq) = \frac{m\,(mg)}{eq.wt\,(\frac{mg}{meq})} = \text{normality }(meq/L) \times \text{volume }(L)$$

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

Reaction Type	Reacting Unit
Acid , base	H+ , OH-
Oxidation–reduction	electron

Calculate the Normality of 2.35 g/250 ml solution of $KMnO_4$ (F.wt=158.04 g/mol) if Mn^{7+} is reduced to Mn^{2+}?

Solution:

$$Ew\left(\frac{eq}{g}\right) = \frac{F.wt\ (\frac{g}{mol})}{n\ (\frac{eq}{mol})}$$

$$Ew\left(\frac{eq}{g}\right) = \frac{158\ (\frac{g}{mol})}{5\ (\frac{eq}{mol})} \longrightarrow E.W = 31.6(\frac{g}{eq})$$

$$N\left(\frac{eq}{L}\right) = \frac{m(g)}{eq.wt(\frac{g}{eq})} \times \frac{1000\ ml/L}{v\ (ml)}$$

$$N\left(\frac{eq}{L}\right) = \frac{2.35(g)}{31.6\ (\frac{g}{eq})} \times \frac{1000\ ml/L}{250\ (ml)}$$

$$N\left(\frac{eq}{L}\right) = 0.2974\ (\frac{eq}{L})$$

Molarity Calculation for Liquid

$$Molarity\left(\frac{mole}{L}\right) = \frac{specific\ gravity\ \left(\frac{g}{ml}\right)\ x\ Percentage\ of\ purity\ \%\ \ x\ 1000\frac{ml}{L}}{Formule\ weight\ \left(\frac{g}{mole}\right)}$$

Density expresses the mass of a substance per unit volume.
In SI units, density is expressed in units of **kg/L** or alternatively **g/mL**.

Specific gravity is the ratio of the mass of a substance to the mass of an equal volume of water.

Please note that all of the above information you can find on packing lable of solution.

Q/ Preparation of 100 ml of 6.0 M HCl from a concentrated solution that has a specific gravity of 1.18 and is 37% (w/w) HCl (36.5 g/mol)?.

$$Molarity\left(\frac{mole}{L}\right) = \frac{1.18\left(\frac{g}{ml}\right) x \ \frac{37}{100} x \ 1000\frac{ml}{L}}{36.5(\frac{g}{mole})} \longrightarrow Molarity\left(\frac{mole}{L}\right) HCl\,Conc. = 11.9 \ mole/L$$

$$M\,dil. \times \quad V \ dil \quad = \quad M\,conc. \quad \times \quad V\,conc.$$

$$6\,\frac{mol}{L} \times 100\,ml \quad = \quad 11.9\,mol/L \times \quad V\,conc.$$

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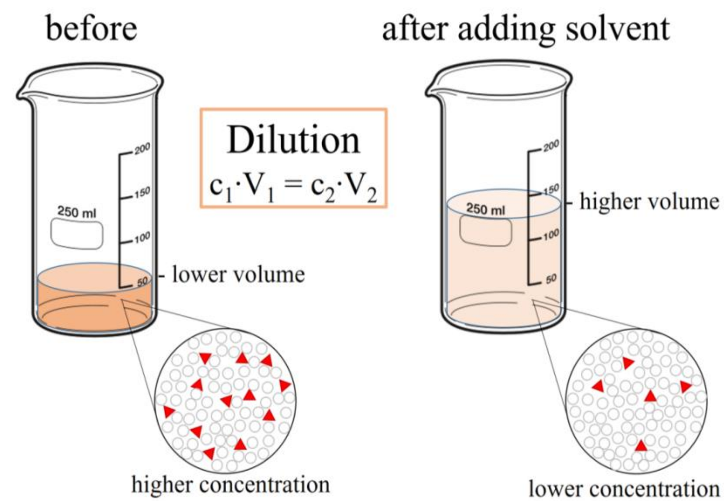
$$V \ \ HCl\,conc. \quad = \quad 50.4\,ml$$



The chemical composition of aqueous solutions

Classifying Solutions of Electrolytes

Weak electrolytes ionize only partially

- NH_3 , NH_4OH
- CH_3COOH , H_2CO_3 , H_2S, H_2SO_3 , H_3PO_4

Strong electrolytes ionize almost completely

- H_2SO_4 , HCl , HNO_3 , HBr , $HClO_3$, $HClO_4$
- NaOH , KOH

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

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

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

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