9-16-05

CHM 123 - Lecture (Friday 10:30 am)

Concentrations of solutions:

- Concentration: amount of solute dissolved in a given quantity of solvent or solution.

- Molarity (M) = $\frac{\text{moles of solute}}{\text{volume of solution in liters}}$

$1.00\ M \Rightarrow 1.00\ mol$ solute / 1 L solution

- Dissolve 0.25 mol NaCl in 0.500 L solution

$$\text{Molarity} = \frac{0.25\ mol\ NaCl}{0.500\ L\ solution} = \underline{\underline{0.5\ M}}$$

Example

Calculate molarity of a solution prepared by dissolving 10.0 g of $AgNO_3$ in enough water to make 250.0 mL of solution.

$$\text{mol of } AgNO_3 = (10.0\ g)\left(\frac{1\ mol\ AgNO_3}{169.8731\ g}\right) = 0.05887\ mol$$

$$\text{molarity} = \frac{0.05887\ mol\ AgNO_3}{0.25\ L\ solution} = \underline{\underline{0.235\ M}}$$

Dilution

Sometimes you want to take a concentrated solution and dilute it. The new concentration, volume are given by:

$$\underbrace{M_1 V_1}_{\text{initial concentration and volume}} = \underbrace{M_2 V_2}_{\text{final concn. and volume.}}$$

Example:

What is the molar concentration of nitrate ions in 3.05M calcium nitrate?

$3.05M\ Ca(NO_3)_2$

$2\ NO_3^-$ for every $1\ Ca(NO_3)_2$

$$\text{Molarity} = \left(3.05M\ Ca(NO_3)_2\right)\left(\frac{2\ mol\ NO_3^-}{1\ mol\ Ca(NO_3)_2}\right) = \underline{\underline{6.10\ M\ NO_3^-}}$$

Example

Describe how to prepare 0.500L of 0.0250M aqueous solution of potassium dichromate?

$K_2Cr_2O_7$

$$mol\ K_2Cr_2O_7 = (0.500L)\left(\frac{0.0250mol}{L}\right) = 0.0125mol$$

$$mass = (0.0125mol)\left(\frac{294.1846\ g}{1\ mol}\right) = 3.68g.$$

Weigh out 3.68g of $K_2Cr_2O_7$ and dissolve in small amount of water. Dilute to 500 mL.

Titrations

- Chemical reactions of solution of known concentration with solution of unknown concentration.

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

- Point at which stoichiometrically equivalent amounts of HCl and NaOH are brought together is called the equivalence point (end point).
- Typically use an indicator that changes color at the equivalence point.

Example

What is the molarity of a solution of NaOH if it requires 23.97mL of that solution to reach the phenolphthalein end point when adding it to a solution containing 0.5333g of $KHC_3H_4O_4$?

$$KHC_3H_4O_4 + NaOH \longrightarrow NaKC_3H_4O_4 + H_2O$$

~~mol $KHC_3H_4O_4$ = (0.5333g)(1mol~~

mol $KHC_3H_4O_4$ $\Longrightarrow$ mol NaOH $\Longrightarrow$ molarity $\left(\frac{\text{mol NaOH}}{0.02397\text{L soln.}}\right)$