

CHM 123 - Lecture (Friday 10:30 am)

Concentrations of solutions:

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

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

$$1.00 \text{ M} \Rightarrow 1.00 \text{ mol solute} / 1 \text{ L solution}$$

- Dissolve 0.25 mol NaCl in 0.500 L solution

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

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

$$\text{mol of AgNO}_3 = (10.0 \text{ g}) \left(\frac{1 \text{ mol AgNO}_3}{169.8731 \text{ g}} \right) = 0.05887 \text{ mol}$$

$$\text{molarity} = \frac{0.05887 \text{ mol AgNO}_3}{0.25 \text{ L solution}} = \underline{\underline{0.235 \text{ M}}}$$

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?

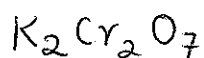


2 NO₃⁻ for every 1 Ca(NO₃)₂

$$\text{Molarity} = (3.05\text{M Ca(NO}_3)_2) \left(\frac{2 \text{ mol NO}_3^-}{1 \text{ mol Ca(NO}_3)_2} \right) = \underline{\underline{6.10\text{M NO}_3^-}}$$

Example

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



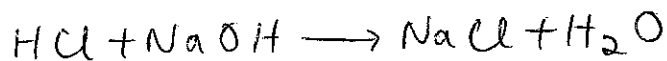
$$\text{mol K}_2\text{Cr}_2\text{O}_7 = (0.500\text{L}) \left(\frac{0.0250\text{mol}}{\text{L}} \right) = 0.0125\text{mol}$$

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

Weigh out 3.68g of K₂Cr₂O₇ and dissolve in small amount of water. Dilute to 500 mL.

Titration

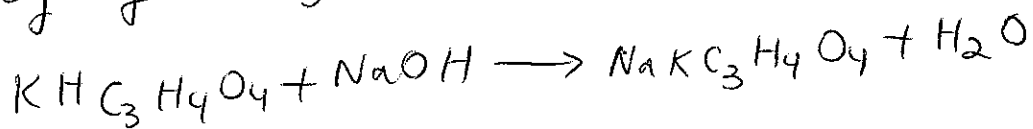
- Chemical reactions of solution of known concentration with solution of unknown concentration.



- 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 23.97 mL of that solution to reach the phenolphthalein end point when adding it to a solution containing 0.5333 g of $\text{KHC}_3\text{H}_4\text{O}_4$?



$$\cancel{\text{mol KHC}_3\text{H}_4\text{O}_4} = \cancel{(0.5333 \text{ g})} \left(\cancel{1 \text{ mol}} \right) \Rightarrow \text{mol NaOH} \Rightarrow \text{molarity} \left(\frac{\text{mol NaOH}}{0.02397 \text{ L soln.}} \right)$$