10. Titrations - used to determine the concentration of a particular solute in a solution.
- Involves combining a sample of the solution in question w/ another solution of known concentration.
- used w/ acid-base, precipitation, or redox reactions
- equivalence point - point at which stoichiometric equivalent quantities have reacted.

Ex) A sample of iron ore is dissolved in an acid and the iron is converted to Fe^{2+}. The sample is titrated with 47.20 mL of .02240M MnO_4^- solution. The redox reaction is:

$$MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$$

A. How many moles of MnO_4^- were added to the solution?

$$n = .02240\,M \cdot .04720\,L = .00106\,mol\ MnO_4^-$$

B. How many moles of Fe^{2+} were in the sample?

$$.00106\,mol\ MnO_4^- \left(\frac{5\,mol\ Fe^{2+}}{1\,mol\ MnO_4^-}\right) = .00529\,mol\ Fe^{2+}$$

C. How many grams of iron were in the sample?

$$.00529\,mol\ Fe^{2+} \left(\frac{56\,g}{1\,mol}\right) = .296\,g\ Fe$$

Ex) What is the molarity of a sodium hydroxide solution if 48.0mL is needed to neutralize 35.0mL of .144 M H_2SO_4?

$$\underset{2OH^-}{2NaOH} + \underset{2H^+}{H_2SO_4} \rightarrow 2H_2O + Na_2SO_4$$

$$M_A V_A = M_B V_B$$

$$2M_B(48.0mL) = (.144M)(35.0mL)$$

$$M_B = .210M$$

$$.00504\,mol\ H_2SO_4 \left(\frac{2\,mol\ NaOH}{1\,mol\ H_2SO_4}\right) = \frac{.0101\,mol\ NaOH}{.048L} = .210M$$

What is the molarity of $Ca(OH)_2$ needed if 33.3mL is needed to neutralize 22.2mL of .200M HBr?

$$2HBr + Ca(OH)_2 \rightarrow 2H_2O + CaBr_2$$

.200M	?M
22.2mL	33.3mL

$$= .00444 \text{mol HBr} \left(\frac{1 \text{mol } Ca(OH)_2}{2 \text{mol HBr}}\right) = \frac{.00222 \text{mol } Ca(OH)_2}{.0333L}$$

$$= .0667 M$$

$$M_A V_A = M_B V_B$$

$$(.200M)(22.2mL) = 2M_B(33.3mL)$$

$$.0667M = M_B$$