NOTES #14/AqChemJ/Solutions Chem. & Quantitative Analysis/AP Chemistry

I. GRAVIMETRIC ANALYSIS:

1. An analytical technique based on the measurement of MASS.

2. A __________________________ must *always* be formed. Ideal technique for _________________________________.

3. Types of problems:

a. **THE UNKNOWN REACTANT**:
- a sample substance of unknown composition is dissolved in water and allowed to react with another substance to form a PRECIPITATE.
- The precipitate is filtered off, dried, and massed.
- *Knowing the mass and chemical formula of the precipitate formed, we can do basic stoichiometry to calculate the mass of the particular chemical component (usually an ION) in the original sample.*
- From this mass and the mass of the original sample, percent by mass of component in original compound can be determined.

Ex1: A 0.5662 g sample of an ionic compound containing Cl^- ions and an unknown metal is dissolved in water and treated with an excess of $AgNO_3$. If you measured 1.0882 g of precipitate, what is the % by mass of Cl in the original sample? From this data, decide if the unknown compound is NaCl or KCl.

b. **BASIC STOICH**
- THINK BACK TO STOICHIOMETRY. It's all about ____.
- The only difference this time is that in order to get mole values, you have to use the MOLARITY expression.

# of moles = (Molarity)/(Volume)

CAN *YOU* TRAVEL THE ROAD TO MOLEVILLE?

- As always, make sure you start off with a BALANCED EQUATION so you can correctly figure the mole ratios. Also, if you are ever given info about *both* reactants, you'll first have to determine the __________________________ before you can accurately determine the amount of product to be made.

4. Something to keep in mind, gravimetric analysis is a HIGHLY accurate technique *only* if...

a.

b.

Ex2: Calculate the mass of $PbSO_4$ (s) formed when 1.25 L of 0.0500 M $Pb(NO_3)_2$ and 2.00 L of 0.0250 M Na_2SO_4 are mixed.

II. TITRATIONS

1. **Basic Premise:** A solution of known molarity is added gradually (using a buret) to a solution of unknown molarity. The two solutions react to completion. By calculating the # of moles of "known molarity" in the soln used and by considering the balanced equation and stoichiometry, the # of moles of the unknown soln can be determined. From there, using M = mol/liters, the molarity of the unknown soln can be calculated.
2. Two major types of titration: ACID/BASE TITRATION and REDOX TITRATION

III. ACID-BASE TITRATIONS

1. Always involves an ____ (Acid + Base --->)

   ex: NaOH (aq) + HCl (aq) -------> ________________________________ ** *Products are NEUTRAL!!*

2. How do you know when a neutralization rxn is complete?

   a. Use an ____________________, a substance that has distinctly different colors in an acidic and basic medium.

   b. **PHENOLPHTHALEIN** - most common indicator

   - It's_________________________ in an acidic medium, ________________________ in a basic medium.

   c. Equivalence Point - point at which ALL of the acid has been completely reacted with (or neutralized by) the base.

   d. End Point This is when the indicator kicks in and tells when the reaction is complete. Remember, the solution needs to be just slightly basic for the indicator to turn pink. This is very close to the equivalence point (about one drop difference)!

Ex3: What volume of a 0.50 M H_2SO_4 solution is needed to completely neutralize 10.0 mL of 0.20 M NaOH?

V. REDOX TITRATIONS

1. EXACT same as Acid/Base titrations except we titrate an oxidizing agent against a reducing agent (instead of acid/base).

2. Equivalence Point: point at which all the reducing agent is completely oxidized by the oxidizing agent.

3. How do you know when the Redox reaction is complete?

   a. The oxidizing agent (usually) will change colors at the point where all or most of it has been reduced.

   b. Most common internal redox indicators:

4. Typical titration calculations.....the equations and stoichiometry is sometimes a little more complex.

   ex: $5\ Fe^{2+} + MnO_4^- + 8\ H^+ \longrightarrow Mn^{2+} + 5\ Fe^{3+} + 4\ H_2O$

   $5\ Fe^{2+}$ are ________________________ for every 1 MnO_4^- that is ___________________________.

Ex4: Calculate the # of grams of SO_2 in a sample of air if 7.37 mL of 0.00800 M $KMnO_4$ solution are required for titration.

$$5\ SO_2\ (g) + 2\ MnO_4^- + 2\ H_2O\ (l) \longrightarrow 5\ SO_4^{2-} + 2\ Mn^{2+} + 4\ H^+$$