Chemical Equations

I. Chapter 8 - Chemical Equation – represents with symbols and formulas, the identities and relative amounts of the reactants and products in a chemical reaction
  A. Reactants - substances that exist before a chemical reaction occurs
    1. placed on the left side of a chemical equation
  B. Products - substances that are made as a result of a chemical reaction
    1. placed on the right side of a chemical equation

II. Identifying a chemical reaction
  A. Evolution of heat and light (ex. Combustion)
  B. Production of a gas – bubbling in a solution indicates a reaction is occurring
  C. Formation of a precititate – a solid settling out of a solution
  D. Color change

III. Balancing a Chemical equation
  A. Know what the reactants and products are, and write a word equation for the reaction
  B. Write the correct balanced formula for all reactants and products
    1. Don't forget BrINClHOF is diatomic
  C. Use coefficients to balance the left side of the equation with the right side. (Conservation of Matter)
    1. coefficient – a small whole number that appears in front of a formula in a chemical equation.
    2. Use (g) for gas, (l) for liquid, (s) for solid and (aq) to indicate a substance is dissolved in water.

IV. Types of Chemical Reactions
  A. Synthesis Reactions (direct combination)
    1. element or compound + element or compound ® compound
  B. Decomposition Reactions (analysis)
    1. compound ® two or more elements or compounds
  C. Single Replacement Reactions
    1. element + compound ® element + compound
    2. Use table J to determine if the reaction will occur. The one above will replace the one below.
  D. Double Replacement Reactions
    1. compound + compound ® compound + compound
      a. usually forms a precipitate - solid substance formed by a change in a liquid or gas medium
      b. Use table F for solubility of the products to determine if a precipitate will form.
  E. Combustion Reaction – substance combines with oxygen, releasing a large amount of energy in the form of light and heat.
    1. Most combustion is with organic compound and always follows the format:
      a. C compound + O_2 à CO_2 + H_2O

V. Ionic equations - stress the reaction and production of ions
  A. only shows the ions which are involved in the reaction
  B. ions which are not in the reaction are called "spectator ions"
    1. Normal Equation - $Cl_2(aq) + 2NaBr(aq)$ ® $Br_2(aq) + 2NaCl(aq)$

2. Ionic Equation - $Cl_2(aq) + 2Br^-(aq) \rightarrow Br_2(aq) + 2Cl^-(aq)$
    a. Na is the spectator ion

VI. Reversible Reactions - one in which the products can react with each other to form the reactants
A. use a 2 way arrow to show this type of reaction.

VII. Chapter 9 - Stoichiometry
A. Mole – Mole Problems
1. Set up a ratio of moles of substances in the balanced equation to the actual moles
B. ***Mass - Mass Problems***
1. ***Convert the amount of one substance in a formula and determine the amount needed or produced of another substance in the reaction***
a. ***Must use a balanced equation***
b. ***Use the number of moles of each substance used as the conversion point of the problem***
2. ***Sequence of Problem Solving***
a. ***Convert mass to moles (GMW)***
b. ***Use mole ratios in balanced equation to "convert" to the amount of unknown***
c. ***Convert moles of unknown to the mass of unknown (GMW)***
I. ***g of known X 1 mole known X # moles unknown X GMW unknown***
II. ***GMW known # moles known 1 mole unknown***
C. ***Mass - Volume***
1. ***Sequence of Problem Solving***
a. ***Convert mass to moles (GMW)***
b. ***Use mole ratios in balanced equation to "convert" to the amount of unknown***
c. ***Convert moles of unknown to the volume of unknown (22.4L)***
I. ***g of known X 1 mole known X # moles unknown X 22.4L unknown***
II. ***GMW known # moles known 1 mole unknown***
D. ***Volume - Volume***
1. ***Sequence of Problem Solving***
a. ***Convert volume to moles (22.4L)***
b. ***Use mole ratios in balanced equation to "convert" to the amount of unknown***
c. ***Convert moles of unknown to the volume of unknown (22.4L)***
I. ***L of known X 1 mole known X # moles unknown X 22.4L unknown***
II. ***22.4L known # moles known 1 mole unknown***
E. ***Mole - Volume Relationships***
1. ***Use the formula for density to help solve the number of moles present***
F. ***Limiting Reactants – the reactant that limits the amounts of the other reactants that can combine and the amount of product that can form in a chemical reaction. The substance not used up is the excess reactant.***
1. ***Divide the # of moles of each reactant by the coefficient to determine the Limiting reactant (lowest number obtained)***
G. ***Theoretical Yield – the maximum amount of product that can be produced from a given amount of reactant.***
H. ***Actual Yield – the measured amount of a product obtained from a reaction***
I. ***Percent Yield = actual yield/theoretical yield x 100***

I. Predicting Equations

A. Reactions occur if:

1. A precipitate forms from a solution of soluble reactants.
2. Water forms in the reaction of an acid and a base.
3. A weak electrolyte forms from a solution of strong electrolytes.
4. A gas forms that escapes from the reaction mixture

B. Rules for Determining Solubility

-------Soluble Compounds---------

1. All compounds of the alkali metals (Group IA) are soluble
2. All salts containing NH_4^+, NO_3^-, ClO_4^-, ClO_3^-, and $C_2H_3O_2^-$ are soluble.
3. All chlorides, bromides, and iodides (salts containing Cl^-, Br^-,or I^-) are soluble except when combined with Ag^+, Pb^{2+}, and Hg_2^{2+} (note the subscript "2")
4. All sulfates (salts containing SO_4^{2-}) are soluble except those of Pb^{2+}, Sr^{2+}, Hg_2^{2+}, and Ba^{2+}.

-------Insoluble Compounds-------

5. All hydroxides (OH^- compounds) and all metal oxides (O^{2-} compounds) are insoluble except those of Group IA and of Ca^{2+}, Sr^{2+}, and Ba^{2+}.

   Note: When metal oxides do dissolve, they react with water to form hydroxides. The oxide ion, O^{2-}, does not exist in water. For example:

   $Na_2O(s) + H_2O$ à $2\ NaOH(aq)$

6. All compounds that contain PO_4^{3-}, CO_3^{2-}, SO_3^{2-}, and S^{2-} are insoluble, except those of Group IA and NH_4^+.

-------Special Reactions Involving Polyatomic Ions-------

7. Reactions of Carbonates, Bicarbonates, and Sulfites, with acids. Also Bases with Ammonium Salts
    a. HCO_3, H_2CO_3, will break down into $H_20 + CO_2$
    b. H_2SO_3 will break down into $H_2O + SO_2$
    c. $NH_4(aq) + OH^-(aq)$ à $NH_3(g) + H_2O$