Chapter 3: Stoichiometry

Molecules and Ionic Compounds

Empirical formula – lowest ratio of elements in a compound.
Molecular formula – actual ratio of elements in a compound.
Structural formula – 3D structure of compounds

The Mole

1 mole = 6.02×10^{23} atoms = atomic mass of element (from the PT)
1 mol of Au atoms = 6.02×10^{23} atoms = 196.9665 g/mol
1 mol of Cl_2 = 6.02×10^{23} Cl_2 atoms = 79.906g /mol of Cl_2

Mass percent composition

1) Find the atomic mass from periodic table of all the atoms and add all up to calculate formula mass.
2) Divide mass of different atoms by formula mass and multiply by 100%.
3) Add all %s to make sure you get hundred (there should be no other units left)

Elemental Analysis and Calculation of molecular formula.

1) Use the percent mass as grams (so 32% C is 32g).
2) Convert the grams to mols using atomic mass from periodic table.
3) Set it up as a molecular formula with the ratio, divide all numbers by the smallest number and then round off to give a whole number. In case the answer is 2.5 then multiply all formula by 2 and 3.3 by 3. You should not have to multiply by 4 or 5 – those numbers should be rounded off.

Stoichiometry

Writing and balancing chemical equations. Use the symbols s, l, g and aq for indicate the state of the substance; solid (s), liquid (l), gas (g), aqueous (aq). Write equation always in chemicals symbols to see chemical formulas. Coefficient is the number in front of compound or element after balancing the equation.

Reactant(s) $\longrightarrow$ product(s)

Calculations using stoichiometry:

1) Write equation and balance equation.
2) Write quantities given under compounds/elements so you know what you know.
3) a) Start with what you know!!!!
   b) Calculate mols of given quantity.
   c) Find the mol ratio of given to needed from the balanced equation.
   d) Convert mol to gram of the answer.

$$\begin{array}{ccccccc} A & + & 2B & \longrightarrow & 2C & + & 3D \\ 2\ g & & & & ?\ g & & \end{array}$$

$$\frac{2\ g\ A}{} \ x\ \frac{1\ mol\ A}{g\ A}\ x\ \frac{2\ mol\ C}{1\ mol\ A}\ x\ \frac{g\ C}{I\ mol\ C} = g\ C$$

Percent yields:

Percent Yield = actual/theoretical x 100%

(Theoretical – from stoichiometric calculations and Actual – after performing experiment in the lab)

Limiting reagent: need to calculate mols of all starting materials to find out which is less, that will be the limiting reagent.