Ch 12: Stoichiometry Outline
SCSh5.e: Solve scientific problems by substituting quantitative values, using dimensional analysis and/or simple algebraic formulas as appropriate.
SC2.d: Identify and solve different types of stoichiometry problems, specifically relating mass to moles and mass to mass.
SC2.e: Demonstrate the conceptual principle of limiting reactants.

Online Practice: http://mailer.fsu.edu/~rlight/stoich/

12.1 The Arithmetic of Equations

- **A balanced chemical equation provides the same kind of quantitative information that a recipe does.**
- **Chemists use balanced chemical equations as a basis to calculate how much reactant is needed or product is formed in a reaction.**
- When you know the quantity of one substance in a reaction, you can calculate the quantity of another substance consumed or created in the reaction.
- Quantity can be grams, moles, liters, tons or molecules.
- Stoichiometry is the calculation of quantizes in chemical reactions.
- **A balanced chemical equation can be interpreted in terms of different quantities, including numbers of atoms, molecules, or moles, mass and volume.**
- A balanced equation indicates the number and type of each atom, molecules, and/or moles that makes up each reactant and each product
- A balanced chemical equation obeys the law of conservation of mass
- The total number of grams of reactants does equal the total number of grams of product
- **Assuming standard temperature and pressure, a balanced equation also tells you about the volume of gases.**
- 1 mole of any gas at STP occupied a volume of 22.4L
- **Mass and atoms are conserved in every chemical reaction**

12.2 Chemical Calculations

- Mole ratio is a conversion factor derived from coefficients of a balanced chemical equation interpreted in terms of moles.
- **In chemical calculations, mole ratios are used to convert between moles or reactants and moles of product, between moles of reactants, or between moles of products.**
- Steps in solving a mass-to mass problem
    1. Change the mass of X to moles of X by multiplying by $\frac{1\ mol\ X}{molar\ mass\ g\ X}$. X is any element/compound
    2. Change the moles of X to moles of Y by multiplying by mole ratio ($\frac{\#\ mol\ Y}{\#\ mol\ X}$) from balanced chemical equation.
    3. Change the moles of Y to grams of Y by multiplying by $\frac{molar\ mass\ g\ Y}{1\ mol\ Y}$.
- **In typical stoichiometric problems, the given quantities are first converted to moles. Then the mole ratio from the balanced equation is used to calculate the number of moles of the wanted substance. Finally, the moles are converted to any other unit of measurement related to the unit mole, as the problem requires.**
- 1 mole = molar mass g
- 1 mole = 6.02×10^{23} particles
- 1 mole = 22.4 L

12.3 Limiting Reagent and Percent Yield

- **In a chemical reaction, an insufficient quantity of any of the reactants will limit the amount of product that forms.**
- Limiting reagent is the reagent that determines the amount of product that can be formed by a reaction.
- Excess reagent is the reactant that is not completely used up in a reaction.
- Given quantities of reactants are sometimes expressed in units other than moles; the first step is to convert each reactant to moles.
- Theoretical yield is the maximum amount of product that will form during a reaction.

- Actual yield is the amount of product that actually forms when the reaction is carried out in a laboratory.
- Percent yield is the ratio of the actual yield to the theoretical yield expressed as a percent.
- $Percent\ yield = \frac{actual\ yield}{theoretical\ yield} x\ 100\ \%$
- **The percent yield is a measurement of the efficiency of a reaction carried out in the laboratory.**