6.S: Quantitative Relationships in Chemistry (Summary)

- **Stoichiometry** is the relationship between the masses of chemical reactants and products in a given chemical reaction. The coefficients placed in a chemical equation in order to balance it are called the **stoichiometric coefficients**. **Molar stoichiometry** is simply the expression of the coefficients of a reaction in terms of moles of reactants and products.
- In order to find the number of **moles of a product** that is produced in a chemical reaction when you are *given* **moles of reactant**, simply multiply the moles of reactant by the *stoichiometric ratio* relating that reactant and the desired product; i.e.,

$$(mol\,reactant) \times \left(\frac{mol\,product}{mol\,reactant} \right)$$

- In order to find the number of **moles of a product** that are produced in a chemical reaction when you are *given* **mass of reactant**, simply *divide* the mass of reactant by the **molar mass** (to get *moles reactant*) and then *multiply* by the *stoichiometric ratio* relating that reactant and the desired product; i.e.,

$$\left(\frac{grams}{grams/mol} \right) \times \left(\frac{mol\,product}{mol\,reactant} \right)$$

- Always remember, **mass divided by molar mass equals moles**;

$$\left(\frac{grams}{grams/mol} \right) = mol$$

- The *mass* or the *number of moles* that you calculate for a product based on reaction stoichiometry is called the **theoretical yield** for the reaction. The amount of material that you actually isolate from a given reaction is called the **actual yield** and it is always less than the theoretical yield. The ratio of the actual and theoretical yields, expressed as a *percentage* is called the **percentage yield**.
- *If* a reaction requires more than one reactant and *if* you are given the mass, or the number of moles of *each* reactant, you must approach the calculation as a **limiting reactant problem**. To solve a limiting reactant problem, simply perform the standard mass calculation for *each* reactant, noting the mass (or number of moles) of product formed in each calculation. The reactant that yields the *smallest* amount or product from these calculations is called the **limiting reactant**. Reactants that yield *larger* amounts of products in these calculations are called **excess reactants**. The theoretical yield in the reaction will be based *solely* on the calculated amount for the limiting reactant.
- If a reactant in a chemical reaction is said to be "in excess", you assume that you have *unlimited* amount of the reactant, and that it will never be the limiting reactant.