CHE1031 Lecture 4 Summary: Stoichiometry of chemical reactions

4.1 Writing and Balancing Chemical Equations

Chemical equations are symbolic representations of chemical and physical changes. **Formulas** for the substances undergoing the change (**reactants**) and substances generated by the change (**products**) are separated by an **arrow** and preceded by integer **coefficients** indicating their relative numbers. **Balanced equations** are those whose coefficients result in equal numbers of atoms for each element in the reactants and products. Chemical reactions in **aqueous solution** that involve ionic reactants or products may be represented more realistically by **complete ionic equations** and, more succinctly, by **net ionic equations**.

4.2 Classifying Chemical Reactions

Chemical reactions are classified according to similar patterns of behavior. A large number of important reactions are included in three categories: **precipitation**, **acid-base**, and **oxidation-reduction (redox).** Precipitation reactions involve the formation of one or more **insoluble** products. Acid-base reactions involve the transfer of hydrogen ions between reactants. Redox reactions involve a change in **oxidation number** for one or more reactant elements. Writing balanced equations for some redox reactions that occur in aqueous solutions is simplified by using a systematic approach called the **half-reaction method**.

4.3 Reaction Stoichiometry

A balanced chemical equation may be used to describe a reaction's **stoichiometry** (the relationships between amounts of reactants and products). Coefficients from the equation are used to derive **stoichiometric factors** that subsequently may be used for computations relating reactant and product masses, molar amounts, and other **quantitative** properties.

4.4 Reaction Yields

When reactions are carried out using less-than-stoichiometric quantities of reactants, the amount of product generated will be determined by the **limiting reactant.** The amount of product generated by a chemical reaction is its **actual yield.** This yield is often less than the amount of product predicted by the stoichiometry of the balanced chemical equation representing the reaction (its **theoretical yield**). The extent to which a reaction generates the theoretical amount of product is expressed as its **percent yield**.

4.5 Quantitative Chemical Analysis

The stoichiometry of chemical reactions may serve as the basis for quantitative chemical analysis methods. **Titrations** involve measuring the volume of a titrant solution required to completely react with a sample solution. This volume is then used to calculate the concentration of **analyte** in the sample using the stoichiometry of the titration reaction. **Gravimetric analysis** involves separating the analyte from the sample by a physical or chemical process, determining its mass, and then calculating its concentration in the sample based on the stoichiometry of the relevant process. **Combustion analysis** is a gravimetric method used to determine the elemental composition of a compound by collecting and weighing the gaseous products of its combustion.