Notes – Introduction to Chemical Equations & Reactions

A **chemical reaction** is the process by which one or more substances are changed into one or more different substances.

Involves either the breaking or forming of new bonds. This rearrangement of atoms results in new substances.

Ex: Boiling water. What is the composition of the liquid water? What is the composition of the water vapor? Has a chemical reaction occurred? No, it's just a phase change. No bonds are broken, and no bonds are formed.

Let's look at the features of a chemical equation:

$$(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + Cr_2O_3(s) + 4H_2O(g)$$

Label: Reactants, products, phases, reaction arrow.

Reactants are the original substance that we start with, they're like the ingredients for making cookies.

Products are the substances that are formed by the rearrangement of atoms that occurs during the chemical reaction. They're like the cookies. Note that in this case, bonds are both broken and formed.

A reaction arrow shows the direction of a reaction, and is usually forward. We say: "Yields" or "reacts to form" or "produces"

Sometimes a reaction is reversible and we use ↔ to indicate that.

Phases can be either:

Gas (g)

Liquid (l)

Solid (s)

Aqueous (aq), which means dissolved in water, but the water does not participate in the reaction.

A **chemical equation** represents, with symbols and formulas, the identities and relative molecular or molar amounts of the reactants and products in a chemical reaction.

In other words: a chemical reaction is like a recipe that tells you exactly how much of each ingredient and in what ratio you can react to form a specific product.

Consider the bicycle:

2 wheels + 1 frame →1 bicycle

Important: Unlike algebra, at any govern time you can only have the reactants, or the products but NOT BOTH! These two do not exist simultaneously, they are mutually exclusive.

Also notice that no matter is either created or destroyed in this reaction. Let's take an atomic inventory, or inventory of the atoms to confirm this.

$$(NH_4)_2Cr_2O_7(s) \rightarrow N_2(g) + Cr_2O_3(s) + 4H_2O(g)$$

Element	# atoms in reactants	# atoms in product
N	2	2
H	8	8
Cr	2	2
O	7	7

Atoms are neither created nor destroyed in a chemical reaction, just REARRANGED.

This idea is called conservation of mass.

According to the law of **conservation of mass**, the total mass of reactants must equal the total mass of products for any given chemical reaction.

How to tell if a chemical reaction has occurred:

1. Energy is either absorbed or released
    a. That can be in the form of heat or light.
    b. Be careful, some physical changes involve heat or light.
2. Production of a gas
3. Formation of a precipitate
    a. A solid that is produced as a result of a chemical reaction in solution and that separates from the solution is known as a **precipitate.**
4. Change in color

Characteristics of a chemical equation:

1. Chemical equation must represent all know facts
    a. By that I mean it must list all reactants on the left and all products on the right.
2. The equation must contain the correct formulas for the reactants and products.
    a. Naming ionic compounds or covalent compounds

3. The law of conservation of mass must be satisfied.
    a. We say that the equation must be balanced, and we accomplished by adding the appropriate coefficients. A balanced chemical equation has the same number of each type of atom on each side. (We'll do more on this later).
    b. A **coefficient** is a small whole number that appears in FRONT of a formula in a chemical equation.
    c. You may ONLY add coefficients, you can't touch the subscripts at this point.

Conservation of mass is one of the SINGLE MOST IMPORTANT concepts in chemistry. If you don't listen now and ensure you understand, you will be totally lost from this point on.

(lego demo) $2\ H_{2(g)} + O_{2(g)} \rightarrow 2\ H_2O_{(l)}$

In a chemical reaction, atoms (matter) in neither created nor destroyed but rather rearranged by the breaking and forming of bonds.