**The Five Types of Chemical Reactions**

**Synthesis Reaction**

A synthesis reaction (also called a combination reaction) is where two or more elements or compounds combine to form a more complex product. This type of reaction is easy to recognize because you will always see two or more reactants on the left side of a chemical equation, but only one product on the right side. The generic equation for this reaction can be written as:

**A + B AB**

A simple example of this type of reaction is when solid calcium is combined with solid sulfur to form solid calcium sulfide. This can be written as:

**Ca(s) + S(s) CaS(s)**

Now let’s try a little more challenging one:

Solid sodium reacts with chlorine gas to make solid sodium chloride.

(Note chlorine is a diatomic element!)

**2 Na(s) + Cl2(g) 2 NaCl(s)**

**Decomposition Reaction**

A decomposition reaction is where a single chemical species (a reactant) is broken down into two or more simpler elements or compounds. This type of reaction is easy to recognize because you will always see two or more products on the right side of a chemical equation, but only one reactant on the left side. The generic equation for this reaction can be written as:

**AB A + B**

A simple example of this type of reaction is when gaseous carbon dioxide is decomposed into solid carbon and gaseous oxygen. This can be written as:

**CO2(g) C(s) + O2(g)**

Now let’s try a little more challenging one:

Solid aluminum oxide can be decomposed into solid aluminum and oxygen gas.

(Note oxygen is a diatomic element!)

**2 Al2O3(s) 4 Al(s) + 3 O2(g)**

**Single Replacement Reaction**

A single replacement reaction is where a single element reacts with a compound creating a new compound and a new element. The generic equation for this reaction can be written as:

**A + BX AX + B**

As you can see from the above reaction, the element **A** has replaced the element **B** in the compound **BX** creating new compound **AX** and the new element **B**.

Now let's look at a real reaction. When solid lithium reacts with a solution of sodium chloride, a solution of lithium chloride and solid sodium are produced.

Li(s) + NaCl(aq) LiCl(aq) + Na(s)

In the above reaction, the metal lithium replaced the metal sodium within sodium chloride to produce lithium chloride and sodium. You can think of it as a substitution of one element for another. The replaced element does not always have to be the metal.

Now let’s try a little more challenging one:

Solid magnesium reacts with aqueous aluminum nitrate to make aqueous magnesium nitrate and solid aluminum.

(Note nitrate is a polyatomic ion!)

**Double Replacement Reaction**

A double replacement reaction is where two compounds in solution trade cations (positive ions) to form two new compounds.

The generic equation for this reaction can be written as:

**AX + BY BX + AY**

As you can see from the above reaction, the **A** and **B** have switched places.

An aqueous solution of hydrogen chloride (also called hydrochloric acid) and an aqueous solution of sodium hydroxide will produce a solution of sodium chloride and water.

HCl(aq) + NaOH(aq) NaCl(aq) + H2O(l)

Now let’s try a little more challenging one:

An aqueous solution of silver nitrate reacts with aqueous calcium chloride to make aqueous calcium nitrate and solid silver chloride.

(Note silver ions are Ag+)

**Combustion Reaction**

A combustion reaction is technically any reaction that is burned in oxygen. Heated high enough, almost anything can burn. However, for our purposes, when we talk about combustion, we will limit it to the burning of any compound that contains only carbon and hydrogen (and sometimes oxygen). When such a compound is burned in oxygen, the same two products are always produced: carbon dioxide and water. So the generic reaction would look like this:

 hydrocarbon + O2(g) CO2(g) + H2O(g)

Here is a specific example: When gaseous methane is burned it produces carbon dioxide and water vapor.

 CH4(g) + 2O2(g) CO2(g) + 2H2O(g)

Now let’s try a little more challenging one:

When propene gas ( C3H6(g) ) is burned (in oxygen) it produces carbon dioxide and water vapor.