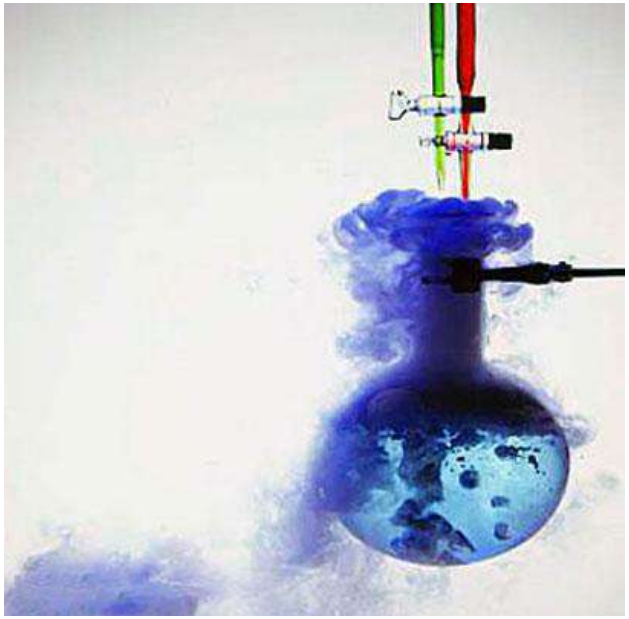
NOTES: 11.2 – Types of Reactions



Types of Chemical Reactions:

- Combination / Synthesis
- Decomposition
- Single Replacement
- Double Replacement
- Combustion

Combination / Synthesis Reactions:

Definition: Reaction where two or more substances react to form a single substance.

A + B → AB

Examples:

$2K\,(s) + Cl_2\,(g) \rightarrow 2KCl\,(s)$

$SO_2\,(g) + H_2O\,(l) \rightarrow H_2SO_3\,(aq)$

Decomposition Reactions:

Definition: Reaction where a single compound is broken down into two or more products.

AB → A + B

Examples:

$2H_2O\ (l) \rightarrow 2H_2\ (g) + O_2\ (g)$

$CaCO_3 \rightarrow CaO + CO_2$

Single-Replacement Reactions:

Definition: Reaction where atoms of one element replace atoms of a second element in a compound.

$XA + B \rightarrow BA + X$

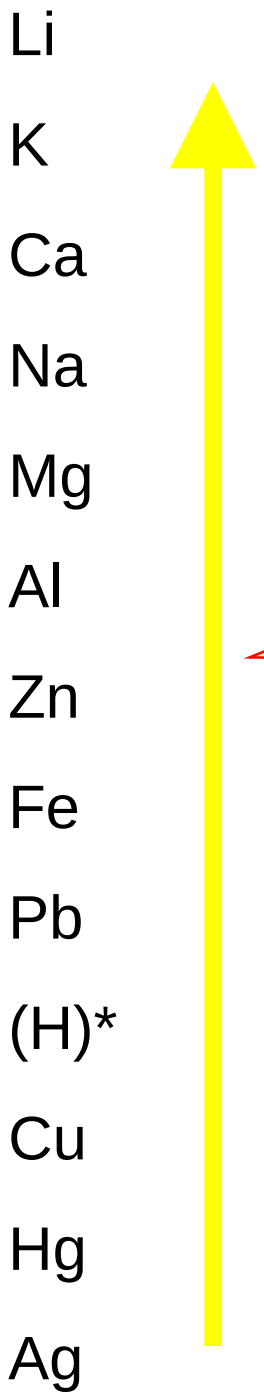
Note: *A reactive metal will replace any metal listed below it in the activity series. See table 8.2 on page 217. Generally, nonmetal replacement is limited to the halogens. The activity of the halogens decreases as you go down Group 7A of the periodic table.*

Examples:

$2AgNO_3 + Mg \rightarrow Mg(NO_3)_2 + 2Ag$

$Mg + LiNO_3 \rightarrow$ no reaction!!

Activity Series of Metals:



Increasing Activity.
Any element will replace any element below it.

***Metals from Li to Na will replace H from acids and from water; from Mg to Pb they will replace H from acids only**

For example…

Ca + MgO ➔ _____ + _____

For example…

Ca + MgO ➔ CaO + Mg

The Ca will replace the Mg because Ca is more active than Mg. That is to say…Ca is above Mg on the activity list.

Double-Replacement Reactions:

Definition: Reaction that involves an exchange of positive ions between two compounds.

$$\mathbf{XA + BY \rightarrow BA + XY}$$

Note: *These reactions generally take place between two ionic compounds in aqueous solution, and are often characterized by one of the products coming out of solution in some way.*

Examples:

$2NaCN(aq) + H_2SO_4(aq) \rightarrow 2HCN(g) + Na_2SO_4(aq)$

$Na_2S(aq) + Cd(NO_3)_2(aq) \rightarrow CdS(s) + 2NaNO_3(aq)$

Combustion Reactions:

Definition: Reaction where an element or a compound reacts with oxygen, often producing energy in the form of heat and light.

Examples:

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + \text{heat} + \text{light}$

$2Mg(s) + O_2(g) \rightarrow \mathbf{2MgO\ (s)}$

Combustion of Hydrocarbons:

If the reactant is a hydrocarbon, the products are always **carbon dioxide and water.**

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Examples: label, complete and balance the reactions.

Example 1:

Al *(s)* + O_2 *(g)* ➔

Examples: label, complete and balance the reactions.

Example 1:

4Al *(s)* + 3O_2 *(g)* ➔ **2Al_2O_3**

COMBINATION / SYNTHESIS

Example 2:

$Na + Sn(NO_3)_2$ ➔

Example 2:

$2Na + Sn(NO_3)_2 \rightarrow Sn + 2NaNO_3$

SINGLE REPLACEMENT

Example 3:

C_2H_6 *(l)* + O_2 *(g)* ➔

Example 3:

$2C_2H_6\ (l) + 7O_2\ (g) \rightarrow 4CO_2 + 6H_2O$

COMBUSTION

Example 4:

PbO_2 *(s)* ➔

Example 4:

PbO_2 *(s)* ➔ **Pb + O_2**

DECOMPOSITION

Example 5:

$NaOH + Fe(NO_3)_3$ ➔

Example 5:

$3NaOH + Fe(NO_3)_3$ ➔ $3NaNO_3 + Fe(OH)_3$

DOUBLE REPLACEMENT

Example 6:

$KOH + H_3PO_4$ ➔

Example 6:

$3KOH + H_3PO_4 \rightarrow K_3PO_4 + 3H_2O$

DOUBLE REPLACEMENT