## **TYPES OF REACTIONS:**

Almost all reactions can be described as one of four basic types, or combinations of these types:

## <u>**1. COMBINATION REACTION (SYNTHESIS):** $A + B \rightarrow AB$ </u>

Examples:  $2 \text{ Na} + \text{Cl}_2 \rightarrow 2 \text{ NaCl}$  $2 \text{ H}_2 + 2 \text{ O}_2 \rightarrow 2 \text{ H}_2\text{O}$  $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}$ 

Whenever elements combine to make compounds, one element is oxidized (it loses electrons) and the other is reduced (it gains electrons). However, this is not always true when small compounds combine to make larger compounds (see the last example). A special type of combination reaction is the **formation of a complex ion**:

 $Cu^{2+} + 4 NH_3 \rightarrow Cu(NH_3)_4^{2+}$ 

Another special type of combination reaction is a <u>combustion</u>, meaning a reaction in which something combines with oxygen and gives off heat and light:

 $\begin{array}{ccc} C + O_2 \rightarrow CO_2 \\ 2 Mg + O_2 \rightarrow 2 MgO \end{array}$ 

Combustion of a compound includes break-up (decomposition) of the compound first.

### **<u>2. DECOMPOSITION</u>**: $AB \rightarrow A + B$

Examples:  $2 H_2 O \rightarrow 2 H_2 + O_2$ 

 $CaCO_3 \rightarrow CaO + CO_2$ 

Decompositions are generally the opposite (reverse) of combination reactions, and they usually involve oxidation and reduction (but not in the last example).

#### 3. SINGLE REPLACEMENT (also called DISPLACEMENT):

General form: A + BC  $\rightarrow$  AC + B ("A displaces B") Examples: Zn + H<sub>2</sub>SO<sub>4</sub>  $\rightarrow$  ZnSO<sub>4</sub> + H<sub>2</sub>

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

In these, a "more reactive" element displaces a "less reactive" one from a compound. These reactions <u>always</u> involve oxidation and reduction.

#### 4. DOUBLE REPLACEMENT REACTIONS: AB + CD → AD + CB

"Changing partners"; "You balance 3 things, the 4th balances automatically" In theory, these reactions are <u>reversible</u>, EXCEPT FOR:

- A.\_PRECIPITATION REACTIONS in which an insoluble precipitate forms Example: AgNO<sub>3</sub> + HCl → HNO<sub>3</sub> + AgCl (precipitates) (continues to completion because AgCl is insoluble)
- B. ACID-BASE REACTIONS and other reactions in which water is formed (Reactants are an ACID and a BASE; products are a SALT and WATER) Example: NaOH + HCl → NaCl + H2O (goes to completion because water is formed)

<u>C. Reactions in which A GAS IS FORMED</u> Example:  $ZnS + 2 HCl \rightarrow ZnCl_2 + H_2S$ 

(goes to completion because gas escapes)

# **D.\_Reactions in which A PRODUCT REACTS FURTHER or BREAKS DOWN**

Example:  $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2CO_3$  followed by H\_2CO\_3 \rightarrow H\_2O + CO\_2 (goes to completion because H\_2CO\_3 breaks down, gas escapes)