

**CHEMICAL EQUATIONS:**

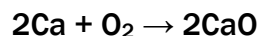
- shorthand expression showing the changes that take place as the result of a chemical change

chemical equation :    **Reactants**     $\rightarrow$     **Products**

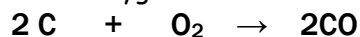
**coefficients** in a balanced equation = give the relative number of moles of reactants and product in that equation.

**GENERAL CLASSES OF REACTIONS:**    (for prediction of products)**1. Direct Combination**    **A + B  $\rightarrow$  AB**

a. metal + nonmetal



b. nonmetal + oxygen  $\rightarrow$  nonmetallic oxide



c. metal oxide + water  $\rightarrow$  metallic hydroxide



metal oxide = basic oxide = basic anhydride

d. nonmetallic oxide + water  $\rightarrow$  acid



nonmetallic oxide = acid oxide = acid anhydride

e. nonmetallic oxide + Metallic oxide  $\rightarrow$  salt

**2. Decomposition**    **AB  $\rightarrow$  A + B**

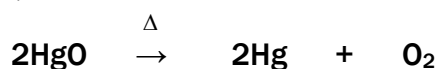
a. hydrates  $\rightarrow$  anhydrous salt + water



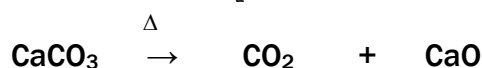
b. chlorates  $\rightarrow$  chlorides + oxygen



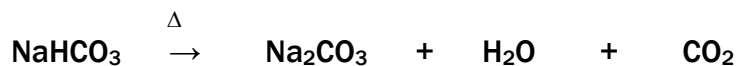
c. (some) metallic oxides  $\rightarrow$  metal +  $\text{O}_2$



d. carbonates  $\rightarrow$   $\text{CO}_2$  + oxides



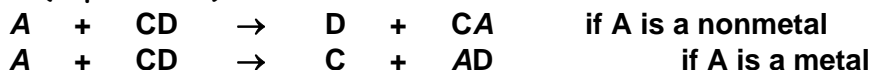
e. bicarbonates  $\rightarrow$  carbonates +  $\text{H}_2\text{O}$  +  $\text{CO}_2$



f. water  $\rightarrow$   $\text{H}_2$  +  $\text{O}_2$

(electrolysis)

### 3. Single Displacement (Replacement)



Principle: *The more active (non)metallic element replaces the less active (non)metallic element.*

activity series (EMF) series for metals (decreasing activity): Mnemonic device

Li K Ba Ca Na Mg Al Mn Zn Cr Fe Ni Sn Pb  
 Little Peter Barry Carl Saw Magnito A Manzy Zebra Carrying Iron Nails To Liverpool.

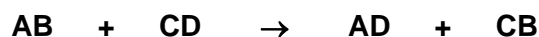
(H) Cu Bi Sb Hg Ag Pt Au  
 He caught Billy A Mexican Silver Plated Goat

Halogens:  $F_2 > Cl_2 > Br_2 > I_2$

Examples:



### 4. Double Displacement (Metathesis)

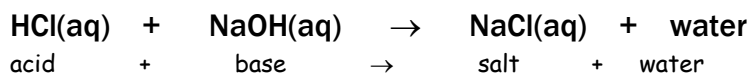


- may result in the formation of an insoluble compound
- know the solubility rules

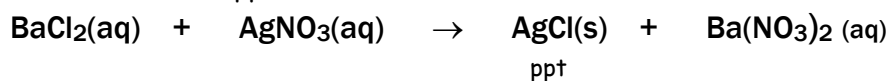
- a. all  $Na^+$ ,  $K^+$ ,  $NH_4^+$  compounds are soluble
- b. all  $NO_3^-$ ,  $CH_3COO^-$ ,  $ClO_3^-$  compounds are soluble
- c. all  $Cl^-$ ,  $Br^-$ ,  $I^-$  compounds (except  $Ag^+$ ,  $Hg_2^{2+}$ ,  $Pb_2^{2+}$ ) are soluble
- d. all  $SO_4^{2-}$  (except  $Ba^{2+}$ ,  $Sr^{2+}$ ,  $Pb^{2+}$ ,  $Ca^{2+}$ ,  $Ag^+$ ) are soluble
- e. most  $O^{2-}$ ,  $OH^-$ ,  $CO_3^{2-}$ ,  $S^{2-}$ ,  $PO_4^{3-}$  (except  $Na^+$ ,  $K^+$ ,  $NH_4^+$ ) are insoluble

Examples:

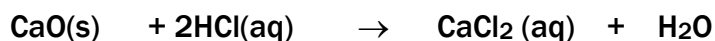
a) Neutralization of Acid and Base



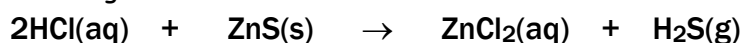
b) Formation of an insoluble ppt



c) Metal oxide + acid  $\rightarrow$  salt + water

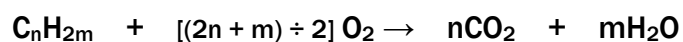


d) Formation of a gas

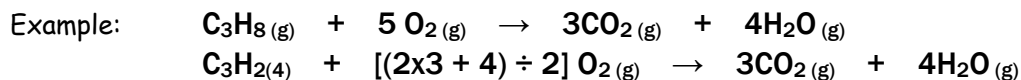


### Combustion reactions of hydrocarbons

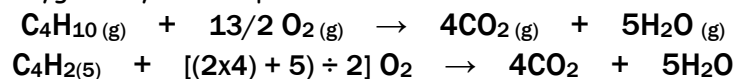
- rapid reactions that produce a flame. It involves  $O_2$  in air as the oxidant. When hydrocarbons are combusted completely in air, they react with  $O_2$  to form gaseous  $CO_2$  and  $H_2O$  vapor. Balancing combustion reactions may follow the following general equation:



-where n = subscript no. of carbon and  
m = subscript of hydrogen divided by 2



- coefficients in oxygen may be accepted in fraction form:



**Oxidation Nos.** - are charges assigned to the atoms of a compound according to some arbitrary rules; to some degree it reflects the positive or negative character of that atom

### Rules in assigning oxidation numbers :

1. Any uncombined atom or an atom in its elemental state is assigned an oxidation number of zero.
2. The sum of the oxidation numbers of the atoms in a compound is zero, since compounds are electrically neutral.
3. The oxidation number of a monoatomic ion is the same as the charge on the ion. In their compounds, group IA metals always have oxidation numbers of +1, group IIA elements always have oxidation numbers of +2.
4. The sum of the oxidation numbers of the atoms that constitute a polyatomic ion equals the charge on the ion.
5. The oxidation number of fluorine, the most electronegative element, is -1 in all fluorine-containing compounds.
6. In most oxygen-containing compounds, the oxidation number of oxygen is -2.

*Few exceptions :*

- a. In peroxides each oxygen has an oxidation number of -1.
  - b. In the superoxide ion (i.e.  $\text{KO}_2$ ), each oxygen has an oxidation number of -1/2.
  - c. In  $\text{OF}_2$  the oxygen has an oxidation number of +2.
7. The oxidation number of hydrogen is +1 in all its compounds except the metallic hydrides, in which hydrogen is in the -1 oxidation state.
  8. In a combination of two nonmetals the oxidation number of the more electronegative element is negative and equal to the charge of the common monoatomic ion of that element.