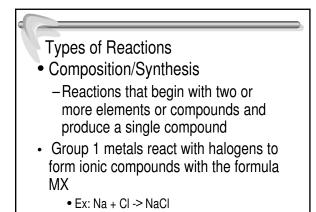
### Chemical Reactions

 The interaction of two or more elements or compounds (the reactants) to form new compound(s) or elements (the products)



 Group 2 metals react with halogens to form ionic compounds with the formula Mx<sub>2</sub>

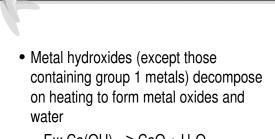
 $-Ex: Mg + F \rightarrow MgF_2$ 

Decomposition

 Reactions that begin with a single compound and produce two or more elements or compounds

 Metal carbonates break down upon heating to produce a metal oxide and carbon dioxide gas

 Ex: CaCO<sub>3</sub> -> CaO + CO<sub>2</sub>



 $-Ex: Ca(OH)_2 \rightarrow CaO + H_2O$ 

### • Metal Chlorates decompose upon heating to produce a metal chloride and oxygen

-Ex: 2KClO<sub>3</sub> -> 2KCl + 3O<sub>2</sub>

### Single Displacement/replacement

 Reactions that begin with a compound and an element and produce a new compound and a new element

## Replacement of a metal with another metal – occurs according to activity of metals

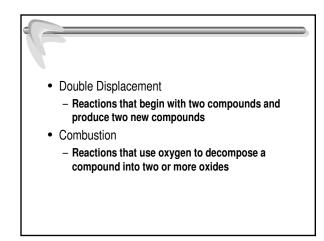
- Aluminum is more active than lead, so when aluminum is placed in a solution of lead (II) nitrate, solid lead and aluminum nitrate solution result
- 2AI + 3Pb(NO<sub>3</sub>)<sub>2</sub> -> 3Pb + 2AI(NO<sub>3</sub>)<sub>3</sub>

### • Replacement of hydrogen in water by a metal

- The most active metals (Group 1) react vigorously with water to produce metal hydroxides and hydrogen gas.
  - $-2Na + 2H_2O \rightarrow 2NaOH + H_2$
- Less active metals require steam to achieve the same reaction

# Replacement of hydrogen in an acid by a metal

- The more active metals react with certain acids to produce a metal salt and hydrogen gas
  - $-Mg + 2HCI \rightarrow H_2 + MgCl_2$



### **Chemical Equations**

- Simple shorthand depictions of chemical reactions
- Writing chemical equations
  - First write correct formulas for the products and the reactants using subscripts
    - · Subscripts in ionic compounds depend on charge
    - Subscripts in molecular compounds depend on prefixes
  - Second balance the products and reactants to exhibit conservation of mass – using coefficients

### Example equations

- Sodium plus chlorine forms sodium chloride
  - Write the formulas for the elements and compounds
  - Na + Cl₂ →NaCl
  - Balance the elements for conservation of mass
  - 2Na + Cl₂ →2NaCl

- Aluminum carbonate plus sodium forms sodium carbonate plus aluminum
- Write the formulas for the elements and compounds (remember that the subscripts are dependant on the charge)
- $AI_2(CO_3)_3 + Na \rightarrow AI + Na_2CO_3$
- Balance the elements for conservation of mass
   Al₂(CO<sub>3</sub>)<sub>3</sub> + 6 Na → 2 Al + 3 Na₂CO<sub>3</sub>

### Symbols in a chemical equation

- (g) gas
- (aq) aqueous in a water solution
- (s) solid
- (I) liquid

## Evidence that a chemical reaction has taken place

- Color change
- Production of a gas
  - Smell
  - bubbles
- Precipitation of a solid
  - Energy change
  - HotCold
  - Light energy given off

### Solubility Rules

- Salts of the alkali metals are soluble
- Ammonium salts are soluble
- Salts containing nitrate, chlorate, perchlorate and acetate are soluble
- Chlorides, bromides and iodides are soluble except lead II, mercury, and silver

### Solubility rules cont.

- Sulfates are soluble except for those of strontium II, barium, mercury and lead II, which are insoluble, and calcium and silver which are moderately soluble
- Hydroxides are insoluble except for those of the alkali metals, which are soluble, and calcium, barium and silver which are moderately soluble

## Solubility rules pg 3

- Sulfites, carbonates, chromates and phosphates are insoluble except for those of ammonium and the alkali metals.
- Sulfides are insoluble except for those of ammonium, the alkali metals and the alkaline earth metals

## Solubility practice

 Fill in the appropriate states in the products BaCl<sub>2</sub>(aq)+ K<sub>2</sub>CrO<sub>4</sub>(aq)→ 2KCl(?) + BaCrO<sub>4</sub>(?) BaCl<sub>2</sub>(aq)+ K<sub>2</sub>CrO<sub>4</sub>(aq)→ 2KCl(aq) + BaCrO<sub>4</sub>(s)

 $\begin{array}{l} \mathsf{Al}_2(\mathsf{SO}_4)_3(\mathsf{aq}) + 6\mathsf{HCI}(\mathsf{aq}) \twoheadrightarrow 2\mathsf{H}_2\mathsf{SO}_4(?) + 2\mathsf{AlCI}_3(?) \\ \mathsf{Al}_2(\mathsf{SO}_4)_3(\mathsf{aq}) + 6\mathsf{HCI}(\mathsf{aq}) \twoheadrightarrow 2\mathsf{H}_2\mathsf{SO}_4(\mathsf{aq}) + 2\mathsf{AlCI}_3(\mathsf{aq}) \end{array}$ 

 $\begin{array}{l} \mathsf{CaCl}_2(\mathsf{aq}) + \mathsf{H}_3\mathsf{PO}_4(\mathsf{aq}) \rightarrow \mathsf{Ca}_3(\mathsf{PO}_4)_2(?) + \mathsf{HCl}(?) \\ \mathsf{CaCl}_2(\mathsf{aq}) + \mathsf{H}_3\mathsf{PO}_4(\mathsf{aq}) \rightarrow \mathsf{Ca}_3(\mathsf{PO}_4)_2(s) + \mathsf{HCl}(\mathsf{aq}) \end{array}$