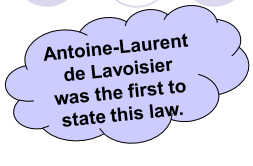
Unit 6 - Chemical Reactions

Physical Science

Law of Conservation of Mass



- Atoms never disappear
- Atoms last forever
- How things are bonded may change, but the total number of atoms stays the same

Atom Inventory

Example:

$Mg + O_2 \rightarrow MgO$

Left	Elements	Right

Balanced? Yes No

Balancing

- When balancing a chemical equation you may only change the coefficient (big number in front of the substance)
- Balancing example #1:
  - $2\,Mg + O_2 \rightarrow 2\,MgO$

$2 \times 1 = 2$ Mg $1 \times 2 = 2$
2 O $1 \times 2 = 2$

Atom Inventory

Example:

$C_3H_8 + O_2 \rightarrow CO_2 + H_2O$

Left	Elements	Right

Balanced? Yes No

Balancing (cont.)

- When balancing a chemical equation you may only change the coefficient (big number in front of the substance)
- Balancing example #2:
  - $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

3 C $1 \times 3 = 3$
8 H $2 \times 4 = 8$
$10 \times 2 = 2$ O $3 \times 2 + 4 \times 1 = 10$

Atom Inventory

Example:

$Na(OH) + H_2(SO_4) \rightarrow Na_2(SO_4) + H(OH)$

Left	Elements	Right

Balanced? Yes No

Balancing (cont.)

- When balancing a chemical equation you may only change the coefficient (big number in front of the substance)
- Balancing example #3:
  - $2\,Na(OH) + H_2(SO_4) \rightarrow Na_2(SO_4) + 2\,H(OH)$

2	1	Na	2		
2	1	OH	1	1	2
2		H	1	1	2
1		SO_4	1		

Count groups in parentheses as one piece!

Balance the Following Reactions:

1. $Cu + Pt(CN)_2 \rightarrow Pt + Cu(CN)$

Reaction Type:

Balance the Following Reactions:

2. $C_5H_{12} + O_2 \rightarrow CO_2 + H_2O$

Reaction Type:

Balance the Following Reactions:

3. $Ag + O_2 \rightarrow Ag_2O$

Reaction Type:

Balance the Following Reactions:

4. $H_2(CO_3) \rightarrow H_2O + CO_2$

Reaction Type:

5 Reaction Types:

- 1) Single Replacement
- 2) Double Replacement
- 3) Synthesis
- 4) Decomposition
- 5) Combustion

Now let's look at each type individually

Single Replacement

- Definition - One metal replaces another
- Generically written as:
  - Element + Compound → Compound + Element
- Example #1:
  - $Mg + HCl \rightarrow MgCl_2 + H_2$
- Example #2:
  - $Cu + Ag(NO_3) \rightarrow Ag + Cu(NO_3)_2$

Double Replacement

- Definition – Two metals switch partners
- Generically written as:
  - Compound + Compound →Compound + Compound
- Example #1:
  - $2NaCl + BaF_2 \rightarrow 2NaF + BaCl_2$
- Example #2:
  - $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$

Synthesis

- Definition – Two chemicals combining to make one product
- Generically written as:
  - Element + Element → Compound
    - of course, the reaction would need to be balanced
- Example #1:
  - $H_2 + O_2 \rightarrow H_2O$
- Example #2:
  - $Mg + O_2 \rightarrow MgO$

Decomposition

- Definition – One reactant breaking into two products
- Generically written as:
  - Compound → Element + Element
    - of course, the reaction would need to be balanced
- Example #1:
  - $MgCl_2 \rightarrow Mg + Cl_2$
- Example #2:
  - $H_2O_2 \rightarrow H_2O + O_2$

Combustion

- Definition – Carbon compounds burning with O_2 to make H_2O and CO_2
- Generically written as:
  - $C_xH_x + O_2 \rightarrow CO_2 + H_2O$
- Example #1:
  - $CH_4 + O_2 \rightarrow CO_2 + H_2O$
- Example #2:
  - $C_2H_6O + O_2 \rightarrow CO_2 + H_2O$

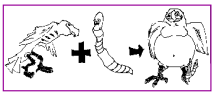
Visual Review of Types of Reactions

Single Replacement

Double Replacement

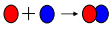
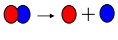
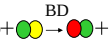
Combustion

Decomposition



Synthesis

Watch the movie and then complete the chart. Chemical Reactions

Type of Reaction	Definition	★ Equation
Synthesis	Two or more elements or compounds combine to make ONE substance	A + B → AB 
Decomposition	Compounds break down into simpler substances	AB → A + B 
Single Replacement	Occurs when one element replaces another one in a compound	AB + C → AC + B 
Double Replacement	Occurs when different atoms in two different compounds trade places	AB + CD → AC + BD 

A = Red B = Blue C = Green D = Yellow

Identifying Chemical Reactions

2. Use colored pencils to circle the common atoms or compounds in each equation to help you determine the type of reaction it illustrates. Use the code below to classify each reaction.

S = Synthesis D = Decomposition SR = Single Replacement DR = Double Replacement

____ $P + O_2 \rightarrow P_4O_{10}$

____ $Mg + O_2 \rightarrow MgO$

____ $HgO \rightarrow Hg + O_2$

____ $Al_2O_3 \rightarrow Al + O_2$

____ $Cl_2 + NaBr \rightarrow NaCl + Br_2$

____ $H_2 + N_2 \rightarrow NH_3$

____ $Na + Br_2 \rightarrow NaBr$

____ $CuCl_2 + H_2S \rightarrow CuS + HCl$

____ $HgO + Cl_2 \rightarrow HgCl + O_2$

____ $C + H_2 \rightarrow CH_4$

____ $KClO_3 \rightarrow KCl + O_2$

____ $S_8 + F_2 \rightarrow SF_6$

____ $BaCl_2 + Na_2SO_4 \rightarrow NaCl + BaSO_4$

Heats of Reaction

- Reactions can either
  - Give off heat — Feels Hot
    - Exothermic
    - The energy level at the **end** of the reaction **is lower** than the energy level at the **beginning** of the reaction
    - Therefore, the change in heat (ΔH) is negative
  - Take in heat — Feels Cold
    - Endothermic
    - The energy level at the **end** of the reaction **is higher** than the energy level at the **beginning** of the reaction
    - Therefore, the change in heat (ΔH) is positive

Heats of Reaction (cont.)

- Reactions require energy to get started
  - The energy can be:
    - Heat
    - Light
  - The energy required to get a reaction started is called **Activation Energy**

The Activation Energy activates the reaction

Rates of Reaction

- Ways to make reactions happen faster/slower:
  - Increase the concentration
  - Increase the temperature
  - Make the particles smaller (increase surface area)
  - Add a catalyst
  - Use an inhibitor