Balancing Chemical Equations

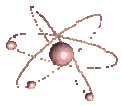
Chemical Equation

coefficients

$$2H_2 + O_2 \rightarrow 2H_2O$$

reactants products

➔is the shorthand that scientists use to describe a chemical reaction.



http://www.mikeblaber.org/oldwine/chm1045/notes/Stoich/Equation/coeff.gif

Chemical Equation 2

coefficients

$$2H_2 + O_2 \rightarrow 2H_2O$$

reactants products

➔Tells chemists at a glance the reactants, products, physical state and the proportions of each substance present

http://www.mikeblaber.org/oldwine/chm1045/notes/Stoich/Equation/coeff.gif

Reactants

- ➔Are those elements or compounds that are about to undergo a chemical reaction
- ➔They are always located to the **LEFT** of the reaction arrow (➔)
- ➔**$2H_{2(g)} + O_{2(g)}$** ➔ $2H_20_{(g)}$ + Energy
- ➔In the above equation, the two diatomic gases (H_2 & O_2) are **reactants**

Reaction Arrow

- ➔The arrow (➔) indicates that a chemical reaction has occurred
- ➔The arrow (➔) means the phrase **"yields to produce"**
- ➔$2H_{2(g)} + O_{2(g)}$ ➔ $2H_20_{(g)}$ + Energy

Products

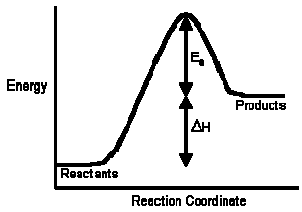
- ➔Refers to the elements or compounds/molecules that are created as result of the chemical reaction
- ➔They are always located to the **RIGHT** of the reaction arrow ➔
- ➔$2H_{2(g)} + O_{2(g)}$ ➔ $2H_20_{(g)}$ + Energy

How phases of matter is represented.

- ➔Remember the three phases of matter?
- ➔(g) means "gas" state/phase
- ➔(l) means "liquid" state/phase
- ➔(s) means "solid" state/phase
- ➔(aq) means **dissolved in solutions (aqueous—dissolved in water)** and elements/molecules are in the ionic state (i.e. Na^{+1} and NO_3^{-1})

Endothermic Reactions

- ➔Endothermic reactions require an input of energy or absorption of energy into reaction in order for the reaction to occur
- ➔ "ENERGY" is on the left of reaction arrow!



http://www.chem.tamu.edu/class/majors/tutorialnotefiles/exoea.gif

Exothermic Reactions

- ➔Exothermic reactions are those reactions in which energy is released as a byproduct
- ➔Combustions (burning) is classic example
- ➔"Energy" is on the right side of reaction arrow!

http://jchemed.chem.wisc.edu/JCESOFT/CCA/CCA3/STILLS/GLYCER/GLYCER/64JPG48/7.JPG

4 Types of Chemical Reactions

1) Synthesis
2) Decomposition
3) Single Replacement
4) Double Replacement

http://mcdowellowens.com/img/fire_investigation.jpg

Synthesis

- ➔"syn" means "together"
- ➔"-thesis" means "to make"
- ➔Thus, synthesis means "to make together"
- ➔Is a type of chemical reaction in which smaller elements or molecule combine to form a larger molecule
- $H_{2(g)} + O_{2(g)} \rightarrow 2H_20_{(g)}$ + Energy

Decomposition

- ➔Is a type of chemical reaction in which a larger molecule breaks down into either simpler molecules or elements

http://www.inhabitat.com/wp-content/uploads/plasticbag2.jpg

Decomposition of Water (HOH)

- $HOH_{(l)}$ ➔ $H^{+1}{}_{(aq)}$ + $OH^{-1}{}_{(aq)}$
- Water Acid Base

➔Water dissociates/breaks down into its acid (H^{+1}) and its base (OH^{-1})

➔ This is example of decomposition has water molecule is broken down into simpler elements.

Single Replacement

➔Is a type of chemical reaction in which one cation is replaced by another

➔Example: Hydrosulfuic Acid reacts with solid silver to produce solid silver sulfide and hydrogen gas.

* $H_2S_{(aq)}$ + $2Ag_{(s)}$ ➔ $Ag_2S_{(s)}$ + $H_{2(g)}$

➔hydrogen cations have been replaced by silver cations

Double Replacement

➔Is a type of chemical reaction in which <u>BOTH</u> pairs of cations and anions in a given molecules change partners and new products with new cations and anions are formed

When an acid reacts with a base…An example of double replacement!

- Hydrochloric Acid Water
- $HCl_{(aq)}$ + $NaOH_{(aq)}$ ➔ $H0H_{(l)}$ + $NaCl_{(aq)}$
- Sodium Hydroxide (BASE) **Sodium Chloride (Salt)**

➔ A salt and water is produced!

- **By the way…**

➔HCl and NaOH are reactants

➔HOH and NaCl are products

Law of Conservation of Matter

➔In a chemical reaction, matter is neither created nor destroyed.

➔In a chemical equation, the number of specific atoms of an element going into a reaction must equal the number of atoms of that element produced

Balancing Chemical Equations

➔Thus, applying the Law of Conservation of matter, number of atoms of an element going into a chemical equation must equal the number of atoms of an element produced.

➔However, they can change who they originally bonded with.

Example of Balanced Equation

- Methane gas (CH_4) reacts with oxygen gas yields to produce water vapor, carbon dioxide gas and energy.
- $CH_{4(g)} + 2O_{2(g)} \rightarrow 2H_20_{(g)} + C0_{2(g)}$ + Energy
- List of elements

Reactants:	Products:
1 Carbon	1 Carbon
4 Hydrogen	4 Hydrogen
2 Oxygen	4 Oxygen

Another Example of Balanced Equation

- $CH_3OOH + NaHCO_3 \rightarrow CH_3COONa +$
- Acetic Acid Sodium Sodium Acetate
- (vinegar) Hydrogen $+H_20_{(l)} + C0_{2(g)}$
  Carbonate (water) (carbon dioxide)
  (Baking Soda)

Number of atoms	number of atoms
2 Carbon	2 Carbon
5 Hydrogen	5 Hydrogen
5 Oxygen	5 Oxygen
1 sodium	1 Sodium