

Chemical Equations and Reactions

Chapter 8

Chemical Rxn

- Chemical rxn is the process where one or more substances are changed into one or more different substances. The atoms are separated, combined, or rearranged, not created or destroyed.
- Chemical equation: chem. rxn represented by formulas and symbols.

Indications of a Chemical Reaction

1. Change in energy

*Endergonic rxn - energy absorbed Ex. Sugar is heated to decompose it.

*Exergonic rxn - energy released in any form as light, sound, heat, electricity... Ex. Lighting a match

*Exothermic rxn - rxn where heat is released Ex. Hot pack

*Endothermic rxn - rxn where heat is absorbed Ex. Cold pack

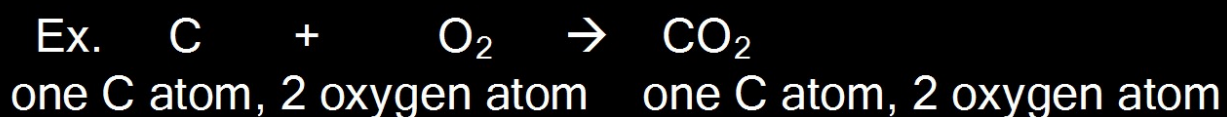
2. Release of a gas _____ Ex. Alkaseltzer in water

3. Formation of a precipitate (solid) from the mixing of two solutions Ex. Hard water and soap → white ppt

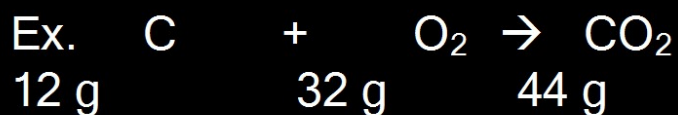
4. Color change _____ Ex. Meat cooked, leaves changing color

●Chemical eqn must be balanced - follow the law of conservation of mass in the following two ways.

A. The number atoms before and after the reaction must be the same.



B. The mass of all the reactants before the rxn must equal the total mass after the rxn.



Memorize the symbols used in Chem Eqns p246

Yields

Reversible Rxn

Gas

Gas Product

Liquid

Solid

Solid that precipitated out

Dissolved in water

Reactants heated

Pressure required

Temp needed for rxn

Catalyst needed - used to alter rate of rxn, but can be recovered without change

Writing word eqn and formula eqn description of rxn:

When solid sodium oxide is added to water at room temp, it forms sodium hydroxide dissolved in water.

a. Sodium oxide + water \rightarrow sodium hydroxide

Note: word eqn doesn't indicate state

b. $\text{Na}_2\text{O (s)} + \text{H}_2\text{O (l)} \rightarrow \text{NaOH (aq)}$

Note: state included, but not balanced yet

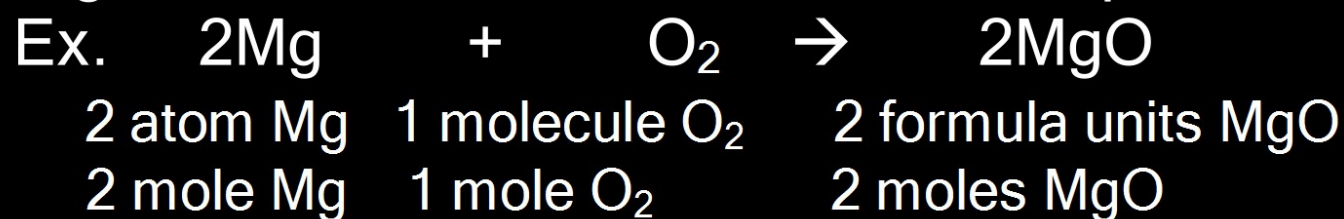
Prac. p248

Balancing Rxns

● Coefficients are used before the formula to indicate multiple sets of substance.

Ex. 2MgO

Significance of Balanced Chemical Equation:



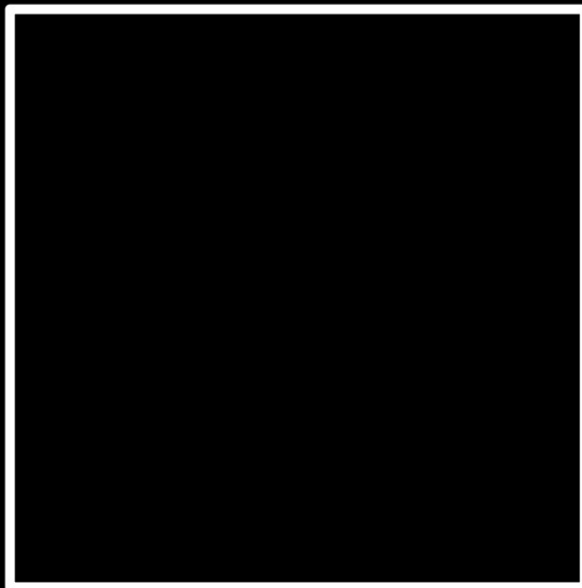
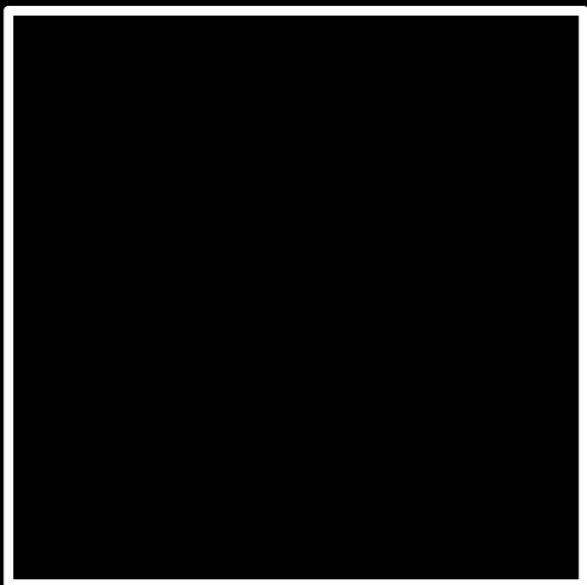
Writing Balanced Chemical Equations

Rules

1. Write correct formulas.
2. Balance atoms that appear once on each side of eqn first. Balance O and H last.
3. Balance polyatomic ion sets.
4. Count atoms to check eqn is balanced.

Other Helpful Hints to be an Expert at Balancing Chem Eqns

1. If odd number of atoms on one side of eqn and even number on other side, DOUBLE only the odd number.
2. If water is a product and hydrogen and hydroxide show as reactants, then rewrite water as H-OH.
3. **Expertise comes only from practice, practice, practice**



Al

O

4 1 3 6 1
4 2 3 2

Write a bal. eqn for:
zinc + hydrochloric acid \rightarrow zinc chloride +
hydrogen gas

Prac p252, 254 and section review p254

Write reactions for the following

Hydrogen gas reacts with Chlorine gas to produce hydrochloric acid

Silver reacts with Oxygen gas to produce Silver Oxide

Example

Lithium + water \rightarrow lithium hydroxide + hydrogen

5 types of Rxns

1. Synthesis rxn, or composition rxn, or combination rxn
2. Decomposition rxn, or analysis rxn
3. Single replacement rxn, or displacement rxn
4. Double Replacement rxn
5. Combustion rxn

Synthesis Rxn

1. Synthesis rxn- two or more substances combine to form a new compd.



*Be sure to look at charges when forming compds.

Examples:



Be on the lookout for:

*Metal oxides react with water to produce
metal hydroxides

Decomposition Rxn

- Decomposition Rxn - a single cmpd breaks down to two or more simpler subst.



Electrolysis (electrical current) can be used for decomposition as in the case of water.

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Hints for Decomposition Rxns

- Binary cmpds decompose into their respective elements.
 $\text{H}_2\text{O} \rightarrow$

- Metal carbonates decompose into metal oxides plus carbon dioxide
 $\text{Al}_2(\text{CO}_3)_3 \rightarrow$

Hints for Decomposition Rxns

- Metal hydroxides decompose into metal oxides plus water



- Metal chlorates decompose into metal chlorides plus oxygen gas.



- Carbonic acid is unstable and decomposes to carbon dioxide and water almost immediately upon formation.

Examples:

1. $\text{HgO} \rightarrow$

2. $\text{CaF}_2 \rightarrow$

3. $\text{CaCO}_3 \rightarrow$

Examples:



Single Replacement Rxns

- Single Replacement Rxns - one element replaces a similar element in a compd.



OR



OR

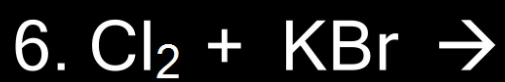


- Must check Activity Series of Elements if replacement will or will not take place. Check handout.
- An element will replace any element below it.
- HINT: Replace H_2O with H-OH

Examples:



Examples:



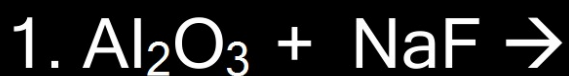
Double Replacement Rxns

- Double Replacement Rxns - ions of two compds exchange to form two new compds. Must be both aqueous solutions.
- This reaction only takes place if
 1. a precipitate is formed
 2. a gas forms
 3. water forms

DR Reactions



Examples:



DR Reactions

$$AX + BY \rightarrow AY + BX$$

Examples:

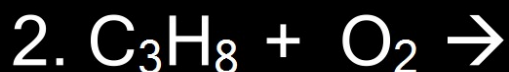


Combustion Rxns

- Combustion rxns - a substance combines with oxygen, releasing a large amount of energy (light and heat)



Ex.



- Section review p264 and section review p267

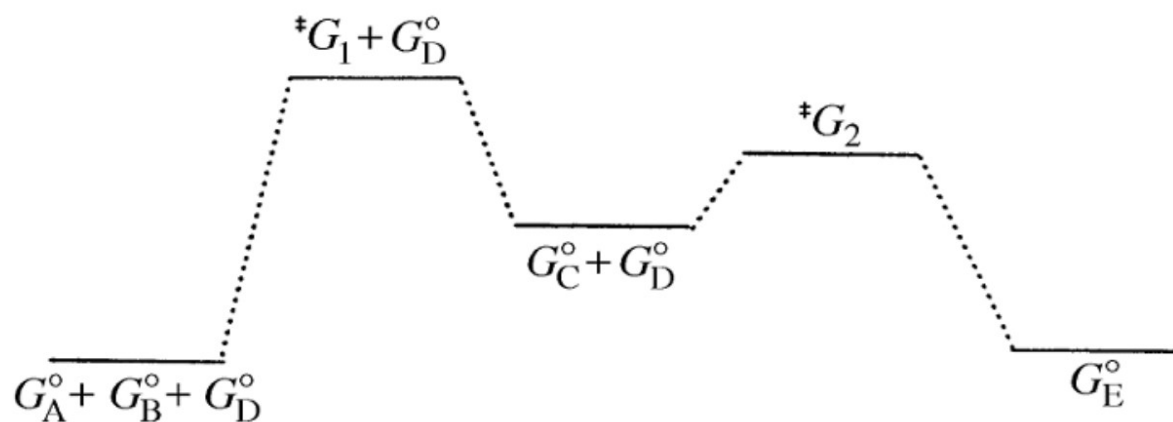
Reaction Rate Factors 17-4

1. Nature of reactants - Ex. Hydrogen and oxygen react very fast together, whereas, iron and oxygen react much more slowly.
2. Surface area - increase in surface area increases the reaction rate. Small pieces of twig burn faster than large logs.
3. Temperature - increase in temperature increases the motion of the molecules, therefore speeds up the rxn. Ex. Food spoil faster at higher temperature

4. Concentration – higher concentration allow reactants to collide more frequently, therefore, react faster.

5. Presence of Catalyst – a substance that changes the rate of the rxn without being used up. Ex. A catalytic converter speeds up removal of pollutants and is used repeatedly.

Energy Profile Diagram



19-1 Oxidation and Reduction Rxns

- Oxidation and reduction rxns - involve the transfer of electrons, also called redox rxns
- Remember LEO the Lion says GER:
Loss of electrons is oxidation
Gain of electrons is reduction
- OIL RIG
Oxidation is losing
Reduction is gaining



$\text{Na}^0 \rightarrow \text{Na}^{+1}$ loss of one electron = oxidation;
Na is oxidized

$\text{Cl}^0 \rightarrow \text{Cl}^{-1}$ gain of one electron = reduction;
Cl is reduced

- All redox rxn must gain and lose the same number of electrons.

Prac.

a. In the corrosion of iron in the presence of oxygen to form rust, identify the oxidation reaction and the reduction reaction.

b. In the tarnishing of silver in the presence of oxygen, identify the oxidation and reduction rxns.

c. What happened to the copper that the Statue of Liberty is made of? What is the evidence of the rxn?

Applications of Redox Reactions:

1. Batteries - All types from car batteries, to batteries for hearing aids

2. Electroplating onto different materials

Ex. Placing a thin layer of gold on jewelry.