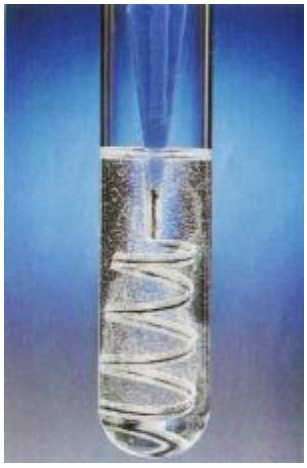
Chapter #5 Types of Chemical Reactions

A chemical reaction occurs when one or more chemicals react to become different chemicals. A chemical reaction is characterized by the re-arrangement of atoms from the reactant side of the equation to the product side



Five Major Chemical Reactions

Evidence for Chemical Reactions

- A **gas** is released.
- An **insoluble substance** is produced.
- A permanent **color** change is observed.
- A **heat** energy change is noted.

(exothermic reaction: releases heat)
(endothermic reaction: absorbs heat)
(Light is emitted)

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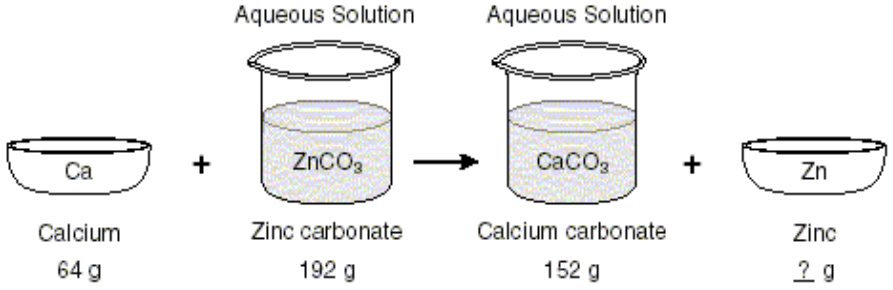
Law of Conservation of Mass

- Established in 1789 by French Chemist Antoine Lavoisier
- States that mass is neither created nor destroyed in any ordinary chemical reaction.
- The mass of substances produced (products) by a chemical reaction is always equal to the mass of the reacting substances (reactants).
- No mass is gained or lost.

Law of Conservation of Mass



According to the law of conservation of mass, how much zinc was present in the zinc carbonate? **A**. 40 g **B**. 88 g **C**. 104 g **D**. 256 g

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Examples:

Synthesis of Iron II sulfide

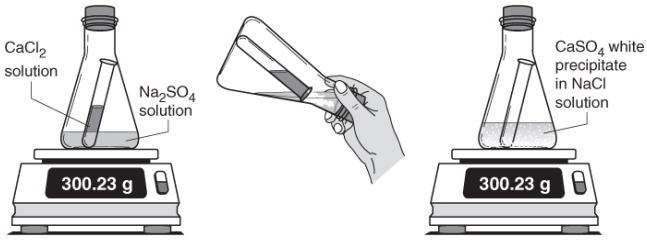
S + Fe ==> FeS

32g + 56g reactants ===> 88g products

Mass of Wood and Oxygen = Mass of Ashes, Carbon Dioxide, and Water

Combustion of wood

Double replacement



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Counting Atoms

Coefficient

- If an element or molecule has a LARGE number in front of it, this is how many atoms of each element there is.
- Examples: **4**Na –FOUR Sodium atoms
  2HCl –TWO Hydrogen atoms and TWO Chlorine atoms

Subscript

- If an element has a small number after it, this is how many atoms of that specific atom there are.
- Examples: H_2O –TWO Hydrogen atoms, and ONE Oxygen atom
  C_2H_4 –TWO Carbon atoms and FOUR Hydrogen atoms

- IF AN ATOM DOES NOT HAVE A NUMBER IN FRONT OR BEHIND, IT IS ALWAYS **ONE**

Putting the Two Together

- If you have coefficients AND subscripts, You need to multiply (times) the coefficient by the subscript.
- Examples:

$2MnO_4$ (2 x 1)=2 Manganese atoms and (2 x 4)=8 Oxygen atoms

$3H_3PO_4$ (3 x 3)= 9 Hydrogen atoms, (3 x 1)= 3 Phosphorous atoms, and (3 x 4)= 12 Oxygen atoms

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Brackets

- If there are brackets within your molecule...
- A) The coefficient applies to ALL atoms in the molecule, bracket or not.
- B) A subscript OUTSIDE the bracket applies to ALL atoms INSIDE the bracket

Examples:

$Al(NO_3)_3$
1 Aluminum atom, 3 Nitrogen atoms, and 9 (3 x 3) Oxygen atoms

3$Au_2(SeO_4)_3$
6 Gold atoms (2 x 3), 9 Selenium atoms (3 x 3),
and 36 Oxygen atoms (4 x 3 x 3).

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Practice Counting Atoms

1) H_2O

2) $MgCl_2$

3) Li_2SO_4

4) $Mg(C_2H_3O_2)_2$

5) $(NH_4)_2S$

6) $5Al(NO_3)_3$

7) $4HNO_3$

8) $4Li_2O$

9) $3H_2O$

10) $3Al_2O_3$

11) $2Ca(OH)_2$

12) $3C_6H_{12}O_6$

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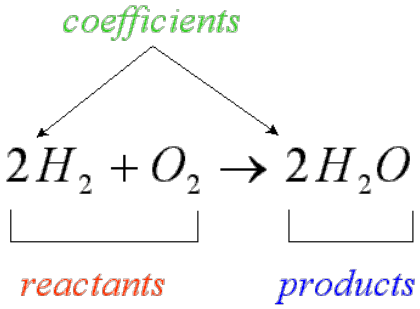
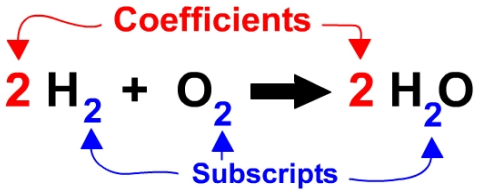
Chemical reactions are represented by chemical equations.





- The '+' is read as 'reacts with' and the arrow means 'yields'.
- The chemical formulas on the left represent the starting substances, called **reactants**.
- The substances produced by the reaction are shown on the right, and are called **products**.
- The numbers in front of the formulas are called **coefficients** (the number '1' is usually omitted).

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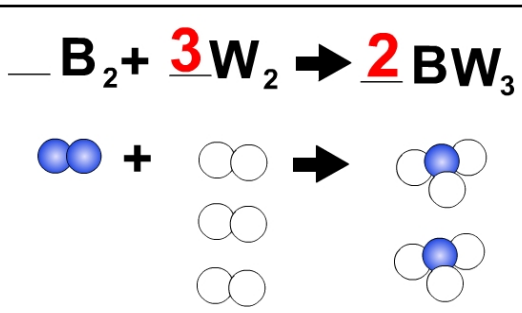
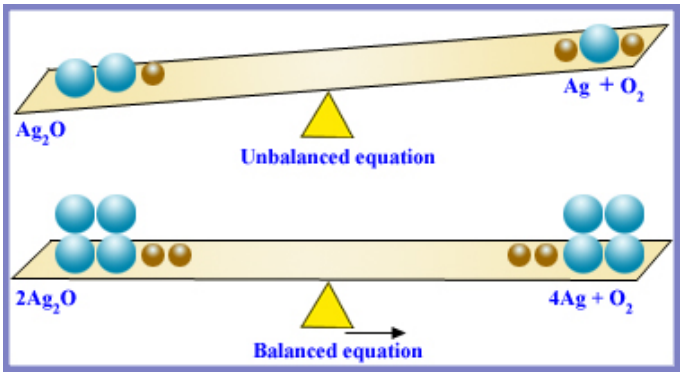


Because atoms are neither created nor destroyed in a reaction, a chemical equation must have an equal number of atoms of each element on each side of the arrow (i.e. the equation is said to be '**balanced**').



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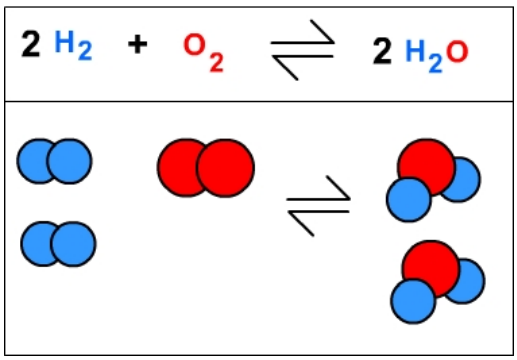

$$2H_2 + O_2 \rightarrow 2H_2O$$

4H, 2O = 4H, 2O

Note! <u>Subscripts should never be changed when trying to balance a chemical equation</u>.
Changing a subscript changes the actual identity of a product or reactant.
Balancing a chemical equation only involves changing the relative amounts of each product or reactant.

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Practice Balancing problems.

1. Al + N_2 → AlN

2. Fe + O_2 → Fe_3O_4

3. $CaCO_3$ → CaO + CO_2

4. KI + Cl_2 → KCl + I_2

5. BaO_2 → BaO + O_2

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6. $NH_4NO_3 \rightarrow N_2O + H_2O$

7. $Pb(NO_3)_2 + HCl \rightarrow PbCl_2 + HNO_3$

8. $Al + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2$

9. $MgCl_2 + NaOH \rightarrow Mg(OH)_2 + NaCl$

10. $AgNO_3 + CuCl_2 \rightarrow AgCl + Cu(NO_3)_2$

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Combustion: A combustion reaction is when oxygen combines with another compound to form water and carbon dioxide. These reactions are exothermic, meaning they produce heat.

$$CxHy + O_2 \text{ --> } CO_2 + H_2O$$

CH_4 methane $2O_2$ oxygen CO_2 carbon dioxide $2H_2O$ water

___$C_{10}H_8$ + ___O_2 --->___ CO_2 + ___H_2O

___C_2H_6 + ___O_2 ----> ___CO_2 + ___H_2O

___$C_6H_{12}O_6$ + ___O_2 ----> ___CO_2 + ___H_2O

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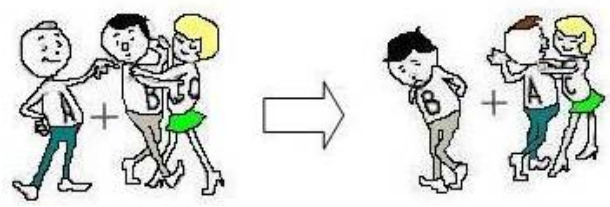
SINGLE REPLACEMENT: an element reacts with a compound to form a new element & a new compound
* To recognize a SINGLE REPLACEMENT reaction, look for one element and one compound as the reactants. *



$A + BC \rightarrow B + AC$

$Cl_{2\,(g)} + NaBr_{(aq)} \rightarrow$ _____ + _____

$Ca_{(s)} + HOH_{(l)} \rightarrow$ _____ + _____

$Zn_{(s)} + CuSO_{4\,(aq)} \rightarrow$? + ??

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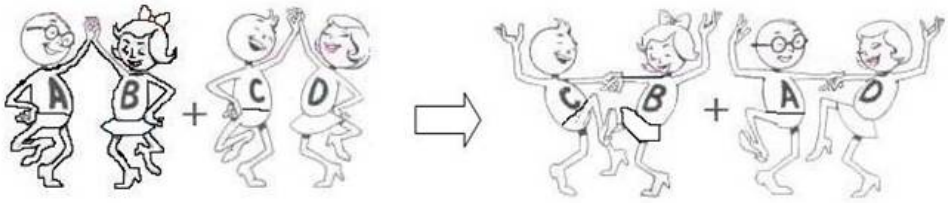
DOUBLE REPLACEMENT: a compound reacts with another compound to form 2 new compounds
* To recognize a DOUBLE REPLACEMENT reaction, look for 2 compounds as the reactants. *



$AB + CD \rightarrow AD + CB$

$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow$ _____ + _____

$CaCl_{2(aq)} + Na_2CO_{3(aq)} \rightarrow$ _____ + _____

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Attachments

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