Chemical Equations (Refer to pp. 202 – 215 of BC Science 10)

**A CHEMICAL CHANGE**

* is a change in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and connection between atoms and ions.
* It is the process by which one or more substances are changed into one or more \_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_substances, with NEW \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Clues that a chemical change has occurred are:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* A chemical change involves conversion of one (or more) pure substances (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) into another pure substance (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_).

A + B ---------------------🡪 C

AB + CD ----------------🡪 AC + BD

Reactants --------------------🡪 Products

* One or more chemical changes occurring at the same time is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**CHEMICAL REACTIONS CAN BE REPRESENTED BY CHEMICAL EQUATIONS**

* can be represented in words: A **\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**:

iron(III) chloride + sodium hydroxide 🡪 iron(III) hydroxide + sodium chloride

* or with symbols: A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**:

FeCl3 + NaOH 🡪 Fe(OH)3 + NaCl

Both types of equations show:

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pointing from reactants to products
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ signs

Chemical equations may also show:

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:** integers placed in front of the formula or chemical symbol
* used to determine the \_\_\_\_\_\_\_\_ between the various compounds in the reaction

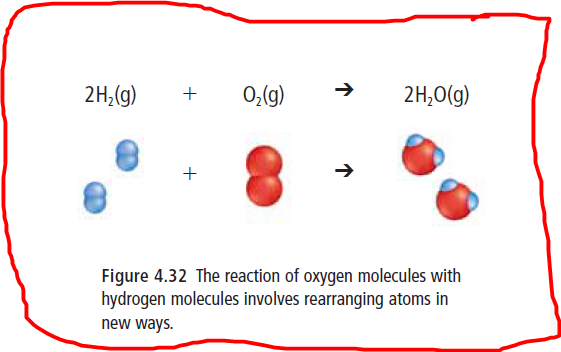
FeCl3 + **3** NaOH 🡪 Fe(OH)3 + **3** NaCl

* **SYMBOLS** indicate **\_\_\_\_\_\_\_\_\_ of matter:** shown byletters written in brackets to the right of the formula or chemical symbol.

FeCl3**(aq)** + NaOH**(aq)** 🡪 Fe(OH)3**(s)** + NaCl**(aq)**

* (**\_\_\_**) for gas
* (\_\_) for liquid
* (**\_\_\_**) for solid
* (**\_\_\_**) for aqueous (dissolved in water).

**Conservation of Mass in Chemical Change**

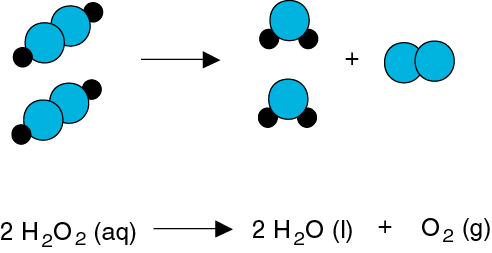
* Chemical change means \_\_\_\_\_\_ compounds are created.
  + No new matter is \_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_; atoms are just \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**All matter in** **reactants = All matter in** **products**

In 1785 French Chemist Antoine Lavoisier and his wife Maire-Anne came up with ….

**The Law of Conservation of Mass: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Total Mass of = Total Mass of

Reactants Products

**John Dalton**, 200 years ago, realized that:

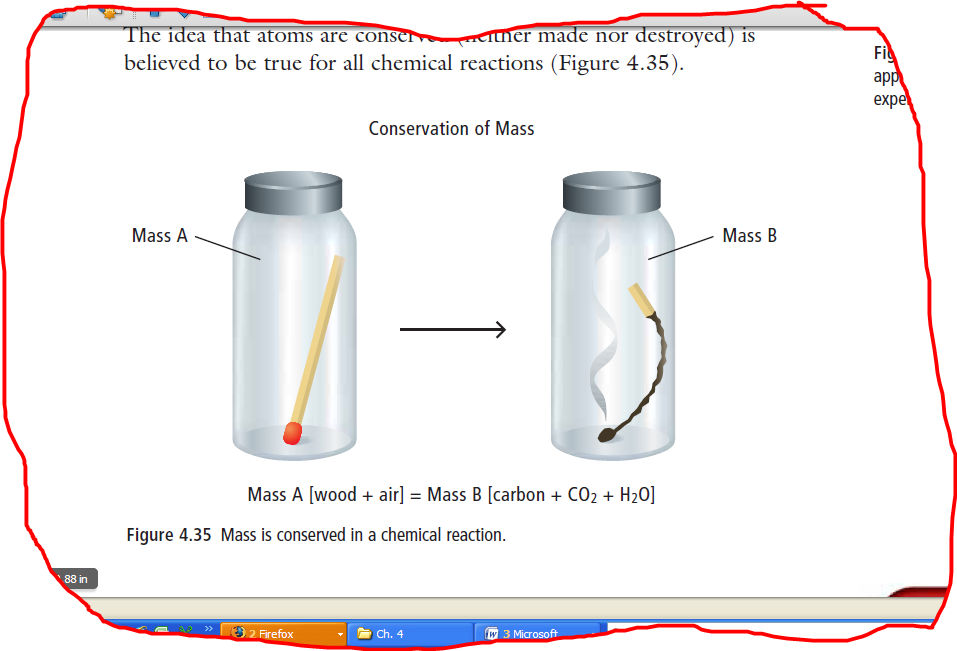
**atoms** simply rearrange themselves during

chemical reactions.

**The law of conservation of mass** states that:

* mass is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a chemical reaction;
  + the total mass of the products is always \_\_\_\_\_\_\_\_\_ to the total mass of the reactants.

**Mass of the reactants = Mass of the products**



**Writing and Balancing Chemical Equations**

* The simplest form of chemical equation is a \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_

sodium carbonate + calcium chloride 🡪 calcium carbonate + sodium chloride

* A more useful way of representing a chemical equation is done by replacing the words with chemical symbols and formulas.
* A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** simply shows the **formulas** of the reactants and products.
  + Shows **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, but not **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Na2­CO3 + CaCl2 🡪 CaCO3 + NaCl

* A **balanced chemical equation** shows types atoms and their quantities.
  + Balancing ensures that the number of each atom is the \_\_\_\_\_\_\_ on both sides of the reaction arrow.
  + Can only add/change \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to balance.
  + Always use the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ whole-number ratio.

Na2­CO3 + CaCl2 🡪 CaCO3 + 2 NaCl

**Complete RC p. 207**

**Counting Atoms**

We count atoms in the following way:

*Reactants*: Na2­CO3 + CaCl2

Na2­CO3 means 1 molecule of Na2­CO3 ( 1 x \_\_\_\_ Na, 1 C, and 1 x\_\_\_\_\_ O)

CaCl2 means 1 molecule of CaCl2 ( 1 x Ca and 1 x \_\_\_\_ Cl)

*Products:* CaCO3 + 2 NaCl

CaCO3 means 1 molecule of CaCO3 ( 1 x \_\_\_\_ Ca, 1 C, and 1 x\_\_\_\_\_ O)

2 NaCl means 2 molecule of NaCl ( 2 x \_\_\_\_ Na and 2 x \_\_\_\_ Cl)

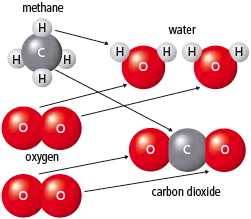
**Complete PP p. 207**

Because of the Law of Conservation of Mass, we can count atoms and use math to balance the number of atoms in chemical equations.

Ex. Word equation: Methane + oxygen → water + carbon dioxide

Skeleton equation: CH4*(g)* + O2 *(g)* → H2O*(l)* + CO2*(g)*

* + - To balance the compounds, take note of how many atoms of each element occur on each side of the reaction arrow.
    - 1 Carbon, 4 Hydrogen, 2 Oxygen → 1 Carbon, 2 Hydrogen, 3 Oxygen



Ex. Zinc metal and hydrochloric acid react to form zinc chloride and hydrogen gas.

**word equation**: zinc + hydrochloric acid 🡪 zinc chloride + hydrogen gas

**Try to write the following chemical reactions as word equation:**

* Aluminium metal and copper(II) chloride solution react to form copper metal and aluminium chloride.

**word equation**:

* Copper(II) chloride solution reacts with sodium hydroxide to form copper(II) hydroxide and sodium chloride.

**word equation**:

**Hints for Writing Word EQUATIONS**

Chemical equations can be written using \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ instead of formulas.

Eg. The chemical reaction of photosynthesis in plants consumes light energy and covnerts it into chemical energy in the form of sugar.

**Word equation**: carbon dioxide + water 🡪 glucose + oxygen

**Hints for Writing SKELETON EQUATIONS**

* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ is used for most elements when they represent a single element.
* Remember the formulas for the three common compounds containing hydrogen; methane (\_\_\_\_\_), ammonia (\_\_\_\_\_), and water (\_\_\_\_\_).
* Be careful of polyatomic ions such as ammonium (\_\_\_\_\_), and carbonate (\_\_\_\_\_).
* Be careful of the diatomic elements:
  + The “special seven” are all diatomic elements
    - * \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_, \_\_\_\_

**word equation**:

zinc + hydrochloric acid 🡪 zinc chloride + hydrogen gas

*Reactants: Products:*

**skeleton equation**: Zn + HCl 🡪 ZnCl2 + H2

**Try to write the following word equation as a skeleton equation:**

1. aluminium + copper(II) chloride solution 🡪 copper + aluminium chloride

**skeleton equation**:

1. copper(II) chloride + sodium hydroxide 🡪 copper(II) hydroxide + sodium chloride

**skeleton equation**:

**counting atoms to balance equations**

*Reactants: Products:*

**skeleton equation**: Zn + HCl 🡪 ZnCl2 + H2

Zn:\_\_\_\_ Zn:\_\_\_\_

H:\_\_\_\_ H:\_\_\_\_

Cl:\_\_\_\_ Cl:\_\_\_\_

**balanced equation**: \_\_\_\_ Zn + \_\_\_\_ HCl 🡪 \_\_\_\_ ZnCl2 + \_\_\_\_\_ H2

**Balance the following: Fe + Br2 → FeBr3**

**Balance the following: Sn(NO2)4 + K3PO4 → KNO2 + Sn3 (PO4)4**

**Try to balance the following equations:**

1. \_\_\_\_Al + \_\_\_\_CuCl­2 🡪 \_\_\_\_Cu + \_\_\_\_AlCl3
2. \_\_\_\_CuCl­2 + \_\_\_\_ NaOH 🡪 \_\_\_\_ Cu(OH)2 + \_\_\_\_ NaCl

**Strategies for Balancing Equations**

Balance chemical equations by following these steps:

(Trial and error will work but can be very inefficient.)

* + 1. Balance \_\_\_\_\_\_\_\_\_\_\_\_\_ first and single\_\_\_\_\_\_\_\_\_\_\_\_\_ last.
    2. Balance \_\_\_\_\_ compound at a time.
    3. Only add \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; NEVER change subscripts.
    4. If H and O appear in more than one place, attempt to balance them \_\_\_\_\_\_\_\_\_.
    5. Polyatomic ions (such as SO42–) can often be balanced as a \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_.
    6. \*\*\*\*Always \_\_\_\_\_\_\_\_\_\_\_-\_\_\_\_\_\_\_\_ after you think you are finished!!

**Try to balance these:**

* + - 1. \_\_\_\_ Fe + \_\_\_\_Br2 → \_\_\_\_FeBr3
      2. \_\_\_\_Sn(NO2)4 + \_\_\_\_K3PO4 → \_\_\_\_KNO2 + \_\_\_\_Sn3(PO4)4
      3. \_\_\_\_C2H6 + \_\_\_\_O2 → \_\_\_\_CO2 + \_\_\_\_H2O

**Complete the PP on p. 211**

**WB 4.3**