

The Language of Chemistry



Pure Substance

A pure substance is one which is made up of molecules containing same kind of atoms.

Pure Substance

Element

An element is a simple and pure form of matter which cannot be decomposed into simpler substances.

For example:
H, C, O etc.

Compound

A compound is a substance formed by the chemical combination of two or more elements in a fixed proportion.

For example:
 H_2O , CO_2 , NO_2 etc.

Molecule :

A molecule is the smallest particle that has the capability to exist independently.

For example: H_2 , O_2 , CO_2 etc.

Symbols of Elements

Dalton's Symbols

Hydrogen \odot

Berzelius Symbols

Hydrogen H

Carbon \bullet

Sulphur \oplus

Carbon C

Sulphur S



Symbols of certain elements based on latin names:

Gold

Silver

Mercury

Copper

Potassium

Iron

Aurum

Argentum

Hydrargyrum

Cuprum

Kalium

Ferrum

Valency of Elements

The valency of an element is a measure of its combining power with other elements.

For example:

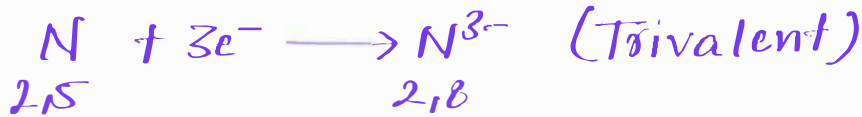
Ammonia (NH_3), Valency of N = 3

Methane (CH_4), Valency of C = 4

Modern definition:

The number of electrons that an atom can lose, gain or share during a chemical reaction is called its valency.

For example:



Variable valency:

Certain elements exhibit more than one valency i.e., they show variable valency.

For example:

Iron Valency: 2, 3 (Ferrous, Ferric)

Copper Valency: 1, 2 (Cuprous, Cupric)

Radicals

A radical is an atom or a group of atoms of the same or of different elements that behaves as a single unit with a positive or negative charge.

Types of radicals:

1. Simple radical $\Rightarrow \text{Na}^+, \text{Mg}^{2+}$ etc
2. Compound radical $\Rightarrow \text{SO}_4^{2-}, \text{NO}_3^-$ etc
3. Acid radical $\Rightarrow \text{Cl}^-, \text{HCO}_3^-$ etc
4. Basic radical $\Rightarrow \text{Ca}^{2+}, \text{K}^+$ etc

Chemical Formula Writing

Based on the steps (Criss-cross method), formulae can be written in the following way

Compound	Symbols with valencies and charge	Exchange of valency	Formula
Magnesium chloride	Mg^{2+} Cl^{-}	$Mg \begin{matrix} \swarrow \\ 2 \end{matrix} \begin{matrix} \searrow \\ 1 \end{matrix} Cl$	$MgCl_2$
Calcium oxide	Ca^{2+} O^{2-}	$Ca \begin{matrix} \swarrow \\ 2 \end{matrix} \begin{matrix} \searrow \\ 2 \end{matrix} O$	$Ca_2O_2 \Rightarrow CaO$

Naming of Compounds

1. A metal and a non-metal

Non-metal \Rightarrow Prefix
Metal \Rightarrow Suffix

Calcium Nitride
 Ca_3N_2

2. Two non-metals

Prefixes \Rightarrow tri = 3
tetra = 4
penta = 5

Phosphorous
trichloride
 PCl_3

3. Two elements and oxygen

Prefix \Rightarrow Hypo (Oxygen < 2)

Sodium hypochlorite
 $NaClO$

Suffix \Rightarrow ite (Oxygen = 2)

Sodium chlorite
 $NaClO_2$



Suffix \Rightarrow ate (Oxygen = 3)

Sodium chlorate
 NaClO_3

Prefix \Rightarrow per (Oxygen > 3)

Sodium perchlorate
 NaClO_4

4. Naming of acids

Prefix \Rightarrow Hydro

Suffix \Rightarrow ic

Hydrochloric acid



Hydrofluoric acid



Sulphuric acid



Sulphurous acid



(less oxygen)

5. Trivial names

Nitrogen trihydride



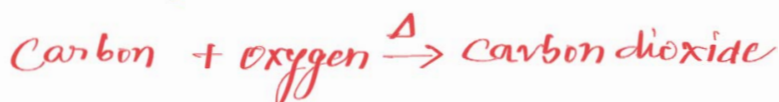
Dihydrogen oxide



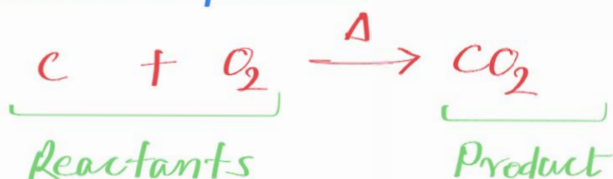
Chemical Equation

A chemical equation is the symbolic representation of a chemical reaction using the symbols and formulae of the substances involved in the reaction.

Word Equation



Chemical Equation



Skeleton Equation

It is an equation that represents a chemical change but is unbalanced.

For example:



Balanced Equation

It is an equation in which the total number of atoms of each element in the reactants is equal to the number in the products.

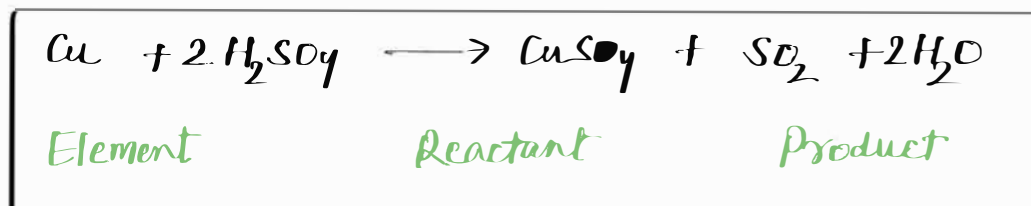
For example:



There are two methods of balancing an equation

1. Hit and Trial method
2. Partial equation method

For example:





Cu	1	1
H	4	4
S	2	2
O	8	8

Information conveyed by a balanced Equation

1. About the actual result of chemical change.
2. About the reactants involved and products formed.
3. About the chemical composition of each molecule.
4. It also proves the Law of conservation of mass.

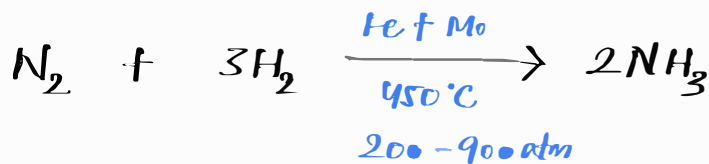
Limitations of a chemical equation

A chemical equation does not tell us

1. the physical states of reactants and products.
2. the time taken for the completion of reaction.
3. the respective concentration of reactants and products.
4. the rate at which the reaction proceeds.

A chemical Equation can be made more informative

1. informing about temperature, pressure, catalyst etc.



2. informing about physical states



3. informing about precipitate by downward arrow (↓).



Relative atomic weight or mass (RAM)

Relative atomic mass = $\frac{\text{Mass of 1 atom of element}}{\frac{1}{12} \text{th the mass of one C-12 atom}}$

Atomic mass unit (amu)

It is defined as the $\frac{1}{12}$ th the mass of C-12 atom.

$$1 \text{ amu or } 1 \text{ u} = 1.66 \times 10^{-24} \text{ g}$$

Relative molecular mass

Relative molecular mass of ...

Relative molecular mass of an element or a compound is the number that represents how many times one molecule of the substance is heavier than $1/12$ of the mass of an atom of carbon -12.

For example: Relative molecular mass of H_2SO_4

$$= (2 \times 1) + 32 + (16 \times 4)$$

$$= 98$$

Percentage composition

Percentage composition of a compound is the percentage by weight of each element present in it.

%. composition of element in a compound

$$= \frac{\text{Total weight of element in one molecule} \times 100}{\text{Gram molecular weight of compound}}$$

Empirical formula of a compound

It is the formula which gives the simplest whole number ratio of atoms of different elements present in one molecule of the compound.

For example:
The empirical formula of hydrogen peroxide (H_2O_2) is 'HO'.

$$\text{Molecular formula} = n \times \text{Empirical formula}$$

$$n = \frac{\text{Molecular formula mass}}{\text{Empirical formula mass}}$$

11 - Molecular formula mass
Empirical formula mass



Molecular mass = 2 X Vapour density