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- ✓→ Stucture of Atom (4hrs) · Carbon & its Compound.
- → Periodic properties
- ✓→ Chemical Bonding
- → Water Chemistry.

Basic Concept of Chemistry

- Mole concept :
- Empirical formulae.
- Oxidation State -
-

Eng = (Force × dist travelled)

- lenght

$A^\circ = 10^{-10} m$ $1nm = 10^{-9} m$ $1pm = 10^{-2} m$

- Mass

$1mg = 10^{-3} g$ $1 \mu g$ (micro-gram) $= 10^{-6} g$.

$1 amu = \frac{1}{12}$ th mass of an atom of C^{12} (isotope).

Volume

✓ $1L = (10 cm)^3 = 10^{-3} m^3 = 1 dm^3$

$1 mL = 1 cm^3$

SC − (ice) pt
(BP)$_{st}$ − (ice) point

Temp:-

SI unit → Kelvin.

$0^\circ K = -273.15^\circ C$.

$K = ^\circ C + 273.15$

Celcius Scale

$0^\circ C$ → Ice point

$100^\circ C$ → Stem point

$\Delta T = 100$

Fahrenheit ·

$32^\circ F$ → Freezing point

$212^\circ F$ → BP.

180° — ΔT

· C → F

$^\circ C = \frac{5}{9} \times (F - 32)$

$^\circ F = \frac{9}{5} (^\circ C) + 32$

Pressure.

1 Atm = Pressure exerted by a column of mercury of 760mm at 0°C.

Torr → 1 mm column of mercury.

∴ 1 atm = 760 torr = 760mm of Hg = 1.01325×10^5 Pa

Energy

Calorie → Amt of heat req to raise temp of 1 gram of water from 14.5°C – 15.5°C.

1 C = 4.184 J.

1 J = 0.2390 Cal.

Solid — Melt → liquied — Boil → Gas

Solid ← Freez — liquied ← Condense — Gas

$\text{Solid} \underset{-\text{eng}}{\overset{+\text{eng}}{\rightleftharpoons}} \text{liq} \underset{-\text{eng}}{\overset{+\text{eng}}{\rightleftharpoons}} \text{gas}$.

latin names of element.

1 • Na – Sodium → Natrium.
2 • Au – gold → Aurum.
3 • Cu – Copper → Cuprum.
4 • K – Potassium → (Kalvin).
5 • Fe – Iron → (Ferrum).
6 • Hg – Mercury – (Hydrargyrum).
7. • Ag – Silver – (Argentum).
8. W – Tungston – (Wolfram)
9. Pb → lead (Plumbum).

Transuranic elements → Man-made

Non-metals – Solid → C, B, P, S, selenium & Id.

liq → Bromine.

→ Metals → rarely combine with each other

- Components in mixture are present without loss of identity.

Mixture ~~Components~~

• Homogeneous	• Heterogenous
→ Mixture – Uniform & in single Phase.	– Not uniform.
→ Isotropic in Nature (every portion of it has same composition & properties).	– Can have two or more phase.
ex – Air, gasoline, Alloy.	– Component can be seen
• Component can't be seen with naked eye/microscope.	• Anisotropic properties – properties are not uniform throughout mix.
	ex – Soil, Smoke

Laws:-

1.) Law of Conservation of Mass

Lavoisier – 1774 – law of Indestructibility of Matter.

- In a chemical reacⁿ, mass is neither created nor destroyed.
- Tested by Landolt.

$$NaCl\,(aq) + AgNO_3\,(aq) \longrightarrow AgCl\,(s) + NaNO_3\,(aq).$$

Total mass of reactants = Total mass of products.

Total mass of ~~pr~~ reactants = total mass of product + Mass of unreacted reactants.

2) Law of Definite or Constant Proportion

Proust – 1799

A Chemical Compound (CC) always contains, the same elements combined together in fixed proportion by mass.

or//

A CC has fixed composition & it does not depend upon method of its preparation or the source from which it is obtained.

CO_2 → heating $CaCO_3$
→ heating Na_2CO_3 (Sodium bicarbonate)
→ burning C in O.

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12 : 32 ⇒ 3 : 8 → Reaction of $CaCO_3$ with HCl
C O

Converse is not true
when same elements combine in same proportion, same Compound will form.
C, H, O → If combine in ratio 12:3:8 Can form C_2H_5OH or (CH_3OCH_3) → C_2H_6O (di-methyl ether)

→ limitations ex → CO_2 → C^{12} ⇒ C : O :: 12 : 32 } Isotopes - diff atomic mass.
CO_2 → C^{14} C : O :: 14 : 32
ex - H_2O^{16} & H_2O^{18} → H : O → 1:8 & 1:9.

★ Multiple Proportion
→ Dalton - 1808.
→ If two elements Combine to form more than 1 compound then diff masses of 1 element - which combine with fixed mass of other element, bear a simple ratio, to one another.

fixed mass.
N / O

ex		
N_2O	Nitrogen → 28 parts	Oxygen → 16 parts.
N_2O_2	" "	O → 32
N_2O_3	" "	O → 48 parts.
N_2O_4	" "	O → 64 part
N_2O_5	" "	O → 80 parts.

ex		
CO	Carbon - 12	Oxygen → 16 parts
CO_2	" "	" → 32 parts

→ Limitation → for Non - stoichiometric Compound.

★ law of gaseous Vol → Gay-Lussac -
Gases react with each other in simple ratio of their volume & if product is also in gaseous state.

$H_2 + Cl_2 = 2HCl$ 1 : 1 : 2
1 vol 1 vol 2 vol

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Non-stoichiometric Compound

→ The compound which do not follow law of constant proportion

ex- $C_{12}H_{22}O_{11}$ (ratio of C & H → Not integral).

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Molecule - Smallest particle of an compound or an element that can have a stable & independent existence.

★ Some compounds are composed of ions rather than molecules.

Ions are electrically charged particles of matter. Charge can be +VE or -VE.

Positive Charge → Cations Negative Charge - Anions.

Simple cations and anion comes into existence by loss of electrons by neutral atom.

- When ions are present in a compound, Nm of positive charges on cation must balance with negative charge on anion to produce electrically neutral matter.

ex

H^+ — Hydrogen

Ag^+ Silver

Na^+ - Chloride

F^- → Fluoride

Ba^{+2} → Barium

Fe^{2+} → Ferrous

Cu^{2+} → Cupric

S^{2-} → Sulphide

CO_3^{2-} → Carbonate.

Al^{3+} → Aluminium.

Fe^{3+} → Feric

Au^{3+} → Auric

BO_3^{3-} → Borate

Atomic & M. Mass:-

Atomic mass. — ① Hydrogen → oxygen → C-12

... of element)

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Atomic mass of an element can be defined as Nm which indicates how many times the mass of one atom of element is heavier in comparision to $\frac{1}{12}$ th part of mass of one-atom of Carbon-12.

$$A = \left[\frac{\text{Mass of one atom of element}}{\left(\frac{1}{12}\right)^{th} \text{ of mass of one atom of Carbon-12}}\right]$$

Atomic Mass Unit (Amu) → the quantity $\left(\frac{1}{12}\right)^{th}$ mass of an atom of C-12.

Actual mass of 1 atom of C-12 = 1.9924×10^{-23} g.

$$\boxed{1\,AMU = \left(\frac{1.9924 \times 10^{-23}}{12}\right) = 1.66 \times 10^{-24} g}$$

$$A = \left(\frac{\text{Mass of one atom of element}}{1\,AMU}\right).$$

There are avg Relative mass

Actual mass of an atom of element = (At. mass in Amu) $\times 1.66 \times 10^{-24}$ g

ex Hydrogen → 1.008 amu. = $1.008 \times 1.66 \times 10^{-24}$ g = 1.6736×10^{-24} g

Oxygen → 16.00 amu = $16 \times \cancel{1.008}\ 1.66 \times 10^{-24}$ g = 2.656×10^{-23} g.

Isotopes → Atom of same element - having different atomic masses.

Gram-Atomic Mass → Atomic mass of an element - when expressed in grams.

→ Absolute mass of 1 O atom = 16 amu = $16 \times 1.66 \times 10^{-24}$ g.

Mass of 6.022×10^{23} atoms = $16 \times 1.66 \times 10^{-24} \times 6.022 \times 10^{23}$

= 16 g.

→ GAM - of an element - can be defined as - mass of 6.022×10^{23} atom in gram of any element.

Molecular Mass → It is a nm which indicates - how many times 1 molecule of substance is heavier in comparision to

① $\frac{1}{16}$ th mass of an oxygen-atom or

② $(1/12)^{th}$ mass of one-atom of carbon-12.

H_2O = MM = (2×1.008)amu + 16.00 = 18.016 amu.

H_2SO_4 = (2×1.008)amu + 32.00 amu + (4×16.00) = 98.016 amu.

Gram Molecular Mass

O_2 = 32 amu. (MM). ('Actual mass of 1 molecule of O_2)

GMM = 32g. $= 32\times1.66\times10^{-24}$ g

No of gm molecules = $\dfrac{\text{Mass of Sub (in gram)}}{\text{Molecular Mass of Sub (gram)}}$.

Mole Concept :— A mol is defined as no of atoms in 12.00g of Carbon-12.

The no of atoms in 12.00g of carbon-12, experimentally found to be 6.022×10^{23}.

A mole contains 6.022×10^{23} units. — (atoms, molecules, ions, electrons)

→ How much does one mole weight?

The mass of 1 mole of any atoms-elements - is exactly equal to atomic mass in grams of that element.

→ Mass of 1 atom of Al = 27 amu = $27\times1.66\times10^{-24}$g

Mass of 1 mole of Al = $27\times1.66\times6.022\times10^{23}$ = 27 g.

→ Molecular mass of water = 18 amu

Mass of 1 mole of water = $18\times1.66\times10^{-24}\times6.022\times10^{23}$

= 18 g.

For ionic Compounds - As these compound does not contains molecules Formula of ionic compound represent ratio b/w its constituent ions.

The mass of 6.022×10^{23} formulae units - represent one mole of ionic compound.

NaCl, $BaCl_2$

One mole of $BaCl_2$ = 6.022×10^{23} units = 208.2g of $BaCl_2$

6.022×10^{23} Ba^{2+} ions + $2 \times 6.02 \times 10^{23}$ Cl^- ions.

★ One mole = 6.022×10^{23} Molecules of any gaseous Substance occupies 22.4 litre of Volume at NTP.

$$\text{No of moles} = \frac{\text{No of particles}}{N_A} \qquad N_A = 6.022 \times 10^{23}$$

$$\text{No of moles} = \left[\frac{\text{Given Weight}}{\text{Molar Mass (in grams)}}\right]$$

$$\text{Mass of one atom of element} = \left(\frac{\text{Gr atom of element}}{N_A}\right).$$

$$= (\text{Atomic Mass})_{amu} \times 1.66 \times 10^{-24} \text{ g.}$$

Mass of 1 molecules of substance

$$= \frac{\text{Gram-molecular mass}}{N_A}$$

$$= (\text{Molecular Mass}) \text{ in Amu} \times 1.66 \times 10^{-24} \text{ g.}$$

◎. No of molecules present in V litres of gas at NTP.

$$= \left\{\frac{\text{Vol of gas (in litres)} \times 6.022 \times 10^{23}}{22.4 \text{ litres}}\right\}$$

Q. Calculate mass of single atom of Sulphur & single molecule of CO_2.

G-Atomic mass of S = 32 g.

$$\text{Mass of 1 atom of S} = \frac{32}{6.022 \times 10^{23}} = 5 \times 3.1 \times 10^{-23} \text{ g.}$$

CO_2 = 44 g. (GMM)

$$\text{Mass of 1 molecules} = \frac{44 \text{ g}}{6.022 \times 10^{23}} = 7.038 \times 10^{-23} \text{ g.}$$

Q. given weight = 0.9 g.

Molar mass = 18 g/mol.

H_2O.

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$n = \frac{0.9}{18} = \frac{1}{20}$ moles.

$= 0.05 \times 6.022 \times 10^{23} = 3.01 \times 10^{22}$

~~1 mole → of H_2O~~ · 1 molecule of H_2O → 1 oxygen atom.

~~for~~ $\frac{1}{20}$ molecules of H_2O = $\frac{1}{20}$ moles of oxygen atom.

Q. $N = 3.01 \times 10^{22}$ molecules of NH_3.

$n = \left(\frac{N}{N_A}\right) =$

$NH_3 = 17g$. ($17g$ of $NH_3 \xrightarrow{\text{contains}} 6.022 \times 10^{23}$ Molecules).

1 Molecules $= \left(\frac{17}{N_A} g\right)$.

for 3.01×10^{22} molecules $= \frac{\cancel{17}\ 0.85}{\cancel{6.022} \times \cancel{10^{23}}\ \cancel{2}} \times \cancel{3.01} \times \cancel{10^{22}}$

$\Rightarrow 0.85g$.

Q. from 200mg of CO_2, 10^{21} molecules are removed, how many moles of CO_2 are left?

200mg of CO_2 = 200×10^{-3} g of CO_2.

44g of CO_2 molecules $= 6.022 \times 10^{23}$ molecules.

for 1g $= \left(\frac{6.022 \times 10^{23}}{44}\right)$

for 200mg $= \left(\frac{6.022 \times 10^{23}}{44_{22}} \times \cancel{2}00 \times 1000\right)$

No of molecules $= \frac{6.022 \times 10^{28}}{22} - 10^{21} = 2.737 \times 10^{27}$

no of moles =

given weight = 200mg of CO_2 = 0.2g.

Gram molecular mass of CO_2 = 44g.

Mass of 1 molecule of $CO_2 = \frac{44}{6.022 \times 10^{23}}$

Mass of 10^{21} mole $= \frac{44}{6.022 \times \cancel{10^{23}}_{10^2}} \times \cancel{10^{21}} = 0.07$

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Mass of CO_2 left $= (0.2g - 0.073g)$
$= 0.127 g.$

No of moles of CO_2 left
$= \left(\frac{0.127}{44}\right) =$

) How many molecules & atoms of oxygen present in 5.6 litres of O_2 at NTP?

$22.4 L \longrightarrow 6.022 \times 10^{23}$ Molecules
$5.6 L = \left(\frac{6.022 \times 10^{23}}{22.4} \times 5.6\right) = 1.505 \times 10^{23}$ molecules

No of atoms in 5.6 Litres
1 molecule $= O_2 = 2$ atom.
1.505×10^{23} molecules $= 2 \times 1.505 \times 10^{23}$
$= 3.01 \times 10^{23}$ atoms.

~~5.6 A~~

How many electrons are present in 1.6g of methane.
$W = 1.6 g.$
Gr-MM of $CH_4 = 12 + 4 \times 1 = 16 g.$
~~No of moles = 1.6/16~~

$16 g \rightarrow 1$ mole
$1.6 g \rightarrow \frac{1}{16} \times 1.6 = 0.1$ mole.

No of methane molecules
$= 0.1 \times 6.022 \times 10^{23} = 6.022 \times 10^{22}$

1 molecule of $CH_4 = 4 + 6 = 10$ electrons.
6.022×10^{22} Molecules $= 6.022 \times 10^{23} = N_A$ electrons.

2. Calculate no of moles in 25g of $CaCO_3$ of oxygen atoms.
Formulae mass of $CaCO_3 = 100.$
No of moles of $CaCO_3 = \frac{\text{Mass (in gram)}}{\text{formulae Mass}}$

$CaCO_3 \Rightarrow$ 3 oxygen atom.

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$= \frac{25}{100} = 0.25$ mole.

No of oxygen atom in 1 mole = 3 NA.

For 0.25 ~~m~~mole = $0.25 \times 3 \times N_A$

Atomic Nm (Z

38 24 8

(32) Calculate total no of atoms in 0.5 mol of $K_2Cr_2O_7$.

Molecular mass =

Q. Total nm of electrons in 1.4 g Nitrogen gas :- (14g — 1 mole, $1g = \frac{1}{14}$

(2.15) N_2 gas ⇒ 14 electron.

~~1 mole of N_2 gas =~~ No of moles $= \frac{1.4}{14} = 0.1$ mole.

No of molecules in 0.1 mole

$= 0.1 \times 6.022 \times 10^{23} = 6.022 \times 10^{22}$

~~6~~ ~~1 mole of molecules = 6.022 × 10^{23} NA~~

From Physics Wallah

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$M_{P_{Proton}} = 1.67 \times 10^{-24}$ g. $\rightarrow$ 1 Amu.

~~$M_{neutron} = 1.6 \times 10^{-24}$ g.~~

$M_{ele} = 9.1 \times 10^{-27}$ g.

$$m_e = \frac{1}{1837} M_{Prot}.$$

for 1 C atom

$= 6p + 6n + 6e = 6p + 6n$

$= 12p = 12 \times 1.67 \times 10^{-24}$

1 atom of C = 12 amu.

1 amu = $\left(\frac{1}{12}\right)^{th}$ of mass of 1 atom of C.

6.022×10^{23} atoms of C = 1 mole of C atoms.

mass " " " = $12 \times 1.67 \times 10^{-24} \times 6.022 \times 10^{23}$

= 12 g. (Molar Mass)

→ Gram Atomic Mass.

Molar Mass → Mass of 1 mole of atoms.

O_8

$8p + 8n = 16 \times 1.67 \times 10^{-24}$ g = 16 amu

1 mole of O_2 atom = $16 \times 1.67 \times 10^{-24} \times 6.022 \times 10^{24}$

= 16 g.

For Molecules

N_2 = 2 atoms of N ($N = 7p + 7n$)

$= 2 \times (7p + 7n)$ $p = n$.

$\Rightarrow 28p$

$\Rightarrow 28 \times 1.67 \times 10^{-24}$ g

= 28 amu (Molecular mass)

Q. Find in 98 g of H_2SO_4.

① moles of H_2SO_4 molecules

G-Molecular mass = 2+32+64 = 98 g.

$$n = \frac{\text{Given weight}}{\text{Molar mass}} = 1.$$

Gram atom → Mole of atom.
Gram molecules → " " Molecules.

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b) moles of S atom
H_2SO_4 – 1 S atom (∵ 1 Mole of H_2SO_4 = 1 mole of S atom)
⇒ G-AM of S = 32 g.
$n = \cancel{\frac{W}{GAM}} = \cancel{\frac{98g}{32g}} = 1.$

c) no of S atom = N_A atom.

d) moles of H atom = 2 mole of H atoms

e) Gram atom / Mole of H = 2 moles.

f) Mass of S atom
⇒ 1 Mole = 32 g.

Q. Find the nm of atoms of each type present in 3.42g of Sugar-Cane → $C_{12}H_{22}O_{11}$.

Gram-Molecular Mass – 144 + 22 + 176
= 342g.

no of moles = $\frac{3.42}{342}$ = 0.01 mole.

1 mole of $C_{12}H_{22}O_{11}$ molecules – contains 12 C atom, 22 H atom & 11 O atom.

In 0.01 mole
Carbon atom = $0.01 \times 12 \times 6.022 \times 10^{23}$
$= 7.22 \times 10^{22}$

H atom = $22 \times 6.022 \times 10^{23} \times 0.01$
O atom = $11 \times 0.01 \times 6.022 \times 10^{23}$

Q How many atoms and molecules are present in 64g of Sulpher S_8.
$n = \frac{64}{32 \times 8} = 0.25$ mole.

No of atom = $8 \times 0.25 = 2 N_A$
No of molecules of S_8 = $0.25 \times N_A$

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Methods of Expressing Conc of (2014) Soln.

① Mass percentage by Mass
$\Rightarrow \left[\frac{\text{Mass of solute}}{\text{Mass of Solution}} \times 100\right] = \left(\frac{\text{Mass of solute}}{\text{Mass of Solvent + Mass of solute}}\right) \times 100$

$\frac{\text{Mass of solute}}{(V \times \rho)\,\text{soln}} \times 100$

◦ Solid – Solid
→ Alloys.

$\frac{\text{Mass of solute}}{\text{Mass fraction}}$ = Mass fraction.

10% of sugar → 10 g of sugar present in 100gram of soln.

② Percent by Vol = Vol of solute present in 100 mL of soln.
$= \left(\frac{\text{Volume of Solute}}{\text{Vol of Soln}} \times 100\right)$. (liq – liq).

③ Percent Mass by Vol (Solid – liq)
$\Rightarrow \left(\frac{\text{Mass of Solute}}{\text{Vol of soln}}\right) \times 100$

④ Strenght of Conc (Gram per litre) → Amount of solute in gram present in 1 L of soln.
$= \frac{\text{Mass of solute (in gram)}}{\text{Vol of soln (in litre)}}$ $\frac{W}{V}\ gL^{-1}$.

⑥ (PPm) $= \frac{\text{Mass of solute}}{\text{Mass of soln}} \times 10^6$

Volume of pollutant in 10^6 units of volume.
ex 10 ppm of SO_2 in 10^6 mL of Air.

⑦ Mole-fraction – It is used when soln is constituted by mixing two or more components.
$X = \left(\frac{\text{No of moles of one Component}}{\text{Total no of Moles of soln}}\right)$

Components	A	B	C
Mass (in gram)	ω_1	ω_2	ω_2
Molecular Mass	M_1	M_2	M_3

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No of g moles = $\frac{w_1}{m_1}$ $\frac{w_2}{m_2}$ $\frac{w_3}{m_3}$

Total no of g molee = $\cancel{\frac{m_1}{w_1}} + \cancel{\frac{m_2}{w_2}} + \cancel{n}$ $\frac{w_1}{m_1} + \frac{w_2}{m_2} + \frac{w_3}{m_3}$

$$\frac{w_1/m_1}{\left(\frac{w_1}{m_1}+\frac{w_2}{m_2}+\frac{w_3}{m_3}\right)} = f_A \quad \frac{w_2/m_2}{\left(\frac{w_1}{m_1}+\frac{w_2}{m_2}+\frac{w_3}{m_3}\right)} \quad \frac{w_3/m_3}{\left(\frac{w_1}{m_1}+\frac{w_2}{m_2}+\frac{w_3}{m_3}\right)}$$

$\cancel{X_A + X_B + X_C = 1}$. $f_A + f_B + f_C = 1$.

for binary soln

Mole-fraction of solute + Mole-fraction of solvent = 1.

$$x_{solute} = \frac{n_B}{n_A+n_B} = x_B$$

$$x_{solvent} = \left(\frac{n_A}{n_A+n_B}\right) = x_A$$

$x_A + x_B = 1$.

Molality (m) = $\left(\frac{\text{No of molee of solute}}{\text{No of kg of solvent}}\right)$

$$m = \left[\frac{w_B}{m_B \times W_A} \times 1000\right]$$

let w_B grams of solute of molecular mass m_B present in w_A grams of solvent.

$$m = \left(\frac{w_B}{m_B \times W_B}\right) \times 1000.$$

$$n_A = \left(\frac{w_B}{m_B}\right)$$

$$m = \left(\frac{n_{solute}}{W_{solvent}}\right)$$

→ Independent of temp variation.

Molarity (Molar Concentration) = No of molee of solute present ~~per~~ per litre of soln.

W_B → g of solute of mmass M_B – dissolved in V Litre of soln.

$$\text{Molarity} = \left(\frac{w_B/m_B}{V}\right)$$

$$\text{Molarity} \times m_B = \frac{W_B}{V}$$

Molarity × m_B = Strenght of soln.

→ It depend upon temp.

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Avg / relative Atomic Mass of an elemt

$$\% \left(\frac{\text{Abundance}}{100} \times \text{Atomic Mass} \right)$$

↓

· Isotopic mass.

Chemical eqn.

Gases – always written in molecular form.

↑ → gaseous product – evolve

Chemical eqn

· Molecular

· Ionic

$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

$Ba^{2+} + 2Cl^- + 2Na^+ + SO_4^{2-} = BaSO_4 + 2Na^+ + 2Cl^-$.

Balancing

– Law of conservation – of mass → Dalton theory.

- Hit & trial
- Oxidation nm method.
- Ion-electron method.
-