PARMAR SSC

CHEMISTRY

ONE SHOT NOTES

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Chemistry

Laws of chemical combination

Democritus = If a matter is further divided, it will break down in its atoms (परमाणु)

Further, laws were given by Lavoisior & J. Proust.

Law of conservation of Mass

↓

In a Reaction, the mass of reactant and the mass of product remains conserved.

amu = atomic mass unit

Law of constant Proportion

↓

When a compound is formed, it will always exist in a fixed Ratio.

H_2O (water)

2×1 : 16×1

2 : 16

1 : 8

- Mineral water
- Rain water
- नाले का पानी

Dalton's Atomic Theory

Elements = made of tiny particles → atoms

all atoms of a given element are identical.

Atoms are indivisible in chemical processes.

Symbols of diff. elements → Proposed by Dalton.

- Hydrogen
- Carbon
- Phosphorus
- Sulphur
- Oxygen
- Hg (Mercury)

Berzelium proposed Symbols as C, H, fe etc.

* IUPAC = gives names to elements

Ion

- (+ve) Cation — e^- lose — Metals
- Anion (-ve) — e^- gain — Non-Metals

Mole concept : SI unit of any Substance.

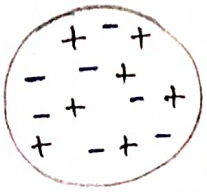
amu = atomic mass unit

Avogadro number (N_A) = 6.02×10^{23} atoms

$$n = \frac{\text{given mass}}{\text{Molar mass}} = \frac{\text{given no. of particle}}{N_A}$$

Structure of Atom

J.J. Thomson – Plum Pudding Model



खीर → मेवा (-ve)

तरबूज → लाल = +ve

काले बीज = -ve (e^-)

Rutherford → Gold foil experiment

Beam of α- particle

(doubly charged He atom)

+ve

→ **Conclusion** : Mass resides in centre (Nucleus)

↓

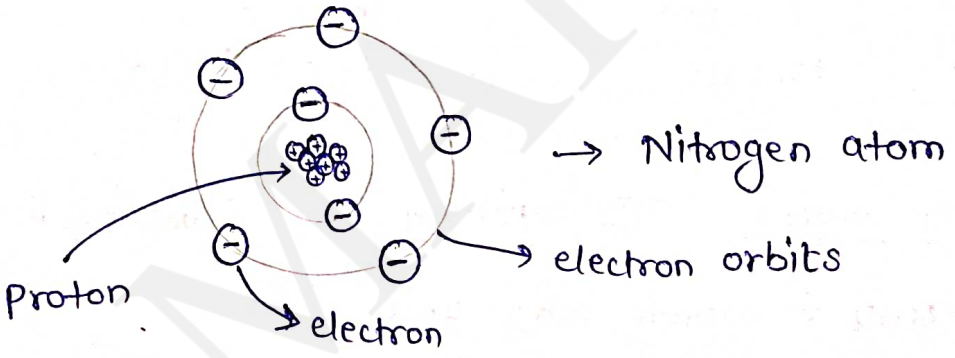
positively charged. → proton + Neutron

Atom → empty.

Nucleon

- e^- revolve in circular orbit around the Nucleus.

Bohr – Discrete orbits/shells = K, L, M, N.



Maximum e^- in a shell = $2n^2$ → no. of shell.

Discovery of Sub Atomic Particle

e^- = JJ Thomson

p^+ = Ernst Rutherford

n = James Chadwick (no charge)

इंट पर नाच

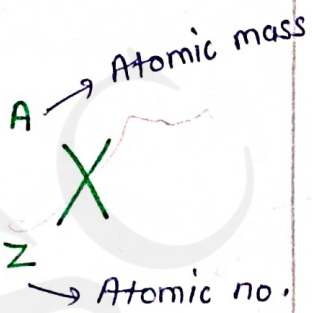
e- T P R n C

Positron = discovered by Carl Anderson

↓

(positive charge)

↳ mass = e^- mass



Isotope - atomic number (Z) = Same

atomic mass = different

$^{1}_{1}H$, $^{2}_{1}H$, $^{3}_{1}H$ → Tritium (Radioactive)

↓ protium

↓ Deuterium

↓ Becquerel (unit)

* Carbon (6) = $^{12}_{6}C$ / $^{13}_{6}C$ / $^{14}_{6}C$ → Carbon Dating [Age of Rock]

$^{35}_{17}Cl$ $^{37}_{17}Cl$ 3 : 1

$^{205}_{92}U$ = Nuclear Energy

I - 131 = Goitre

Co - 60 = Cancer

Isobar - Same atomic mass

Diff. atomic no.

$^{40}_{18}Ar$ ↔ $^{40}_{20}Ca$

Isotone = Same no. of neutron

$^{16}_{8}O$, $^{15}_{7}N$, $^{14}_{6}C$

Atomicity (परमाणुता)

↓

(How many atoms are combining to form Molecule)

Monoatomic	Diatomic	Triatomic
Argon Ar	Hydrogen H_2	Ozone O_3
Helium He	Oxygen O_2	Phosphorus P_4
Sodium Na	Nitrogen N_2	Sulphur S_8
Iron Fe	Chlorine Cl_2	Polyatomic
Aluminium Al		
Copper Cu		

Tetraatomic

Early Developments

- **Dobereiner** = Law of Triads
  1829 (Theory) → Similar chemical properties (elements)
  1817 (Discovery)

- **Newland** = Law of **Octaves** (Musical notes)
  (1865) → Increasing atomic weight
  Sa re ga ma pa da ni
  56 elements were known
  1st : Hydrogen Last : Thorium

- **Lothar Meyer** → 1869
  Atomic wt. vs Volume

- **Mendeleev** : father of modern periodic table
  (1869) → proposed 8 groups
  → 63 elements were known.

eka Aluminium = Gallium
eka Boron = Scandium
eka Silicon = Germanium

* No fix position of 'H'
* element position = atomic mass.

Modern Periodic Table → 118 elements
- group
  Column = 18
- Rows = 7
  periods

Henry Moselay - 1913
element property = Atomic no.

→ 18 Groups (
7 periods (

Blocks in Periodic table

s - Metals

p - (group 13-18)

d - b/w s & p (group 3-12) → Transition Metals

f - La - Lu (Lanthenide) } Inner transition Metals
Ac - Lr (Actenide) }

Groups in Periodic table

I - Alkali Metal

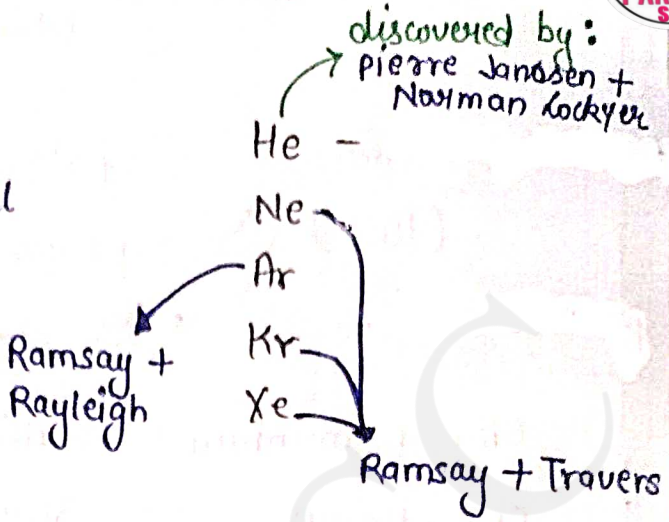
II - Alkaline Earth Metal

XV - pnictogen

XVI - chalcogen

XVII - Halogen

XVIII - Noble / Inert / Zeroth Group



Last element of all periods is Noble element / gas.

* Be = Silvery white metal
  Hg = only liquid metal
  Br = only liquid non-metal

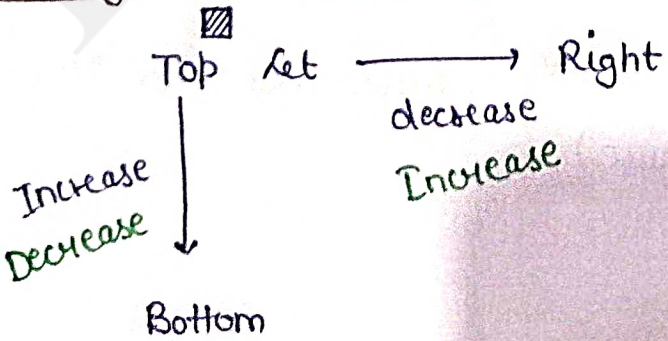
Z - 43 (Technitium) → 1st Artificial made metal

Z - 101 = Mendelivium

Z - 106 = Sea - Borgium

Ga = Lowest Boiling Point

Diagonal Relationship



Metallic character (e^- lose)

→ Increase down the group
→ Decrease Across the period.

Atomic no. & mass

Concept of Valency (संयोजकता)

Combining capacity of an element

(Complete Octet)

8 e^- in last shell.

ex: $_{11}Na$ = K 2, L 8, M (1)

$Na^+ = 2, 8$

Cation

$_{17}Cl$ = K 2, L 8, M (7)

$Cl^- = 2, 8, 8$

anion

Na^+Cl^-

Electronegativity & Electron affinity = ↓ top - bottom decrease → Increase

tendency of an atom to attract shared pair of e^- towards.

energy released when a neutral atom gains an e^-.

Na •—• Cl

Ionisation energy = energy to relase e^-

States of Matter

1. Solid 2. Liquid 3. Gas

- ↓ Kinetic energy
- Rigid
- fixed shape
- fixed volume
- Strong intermolecular force of attraction.

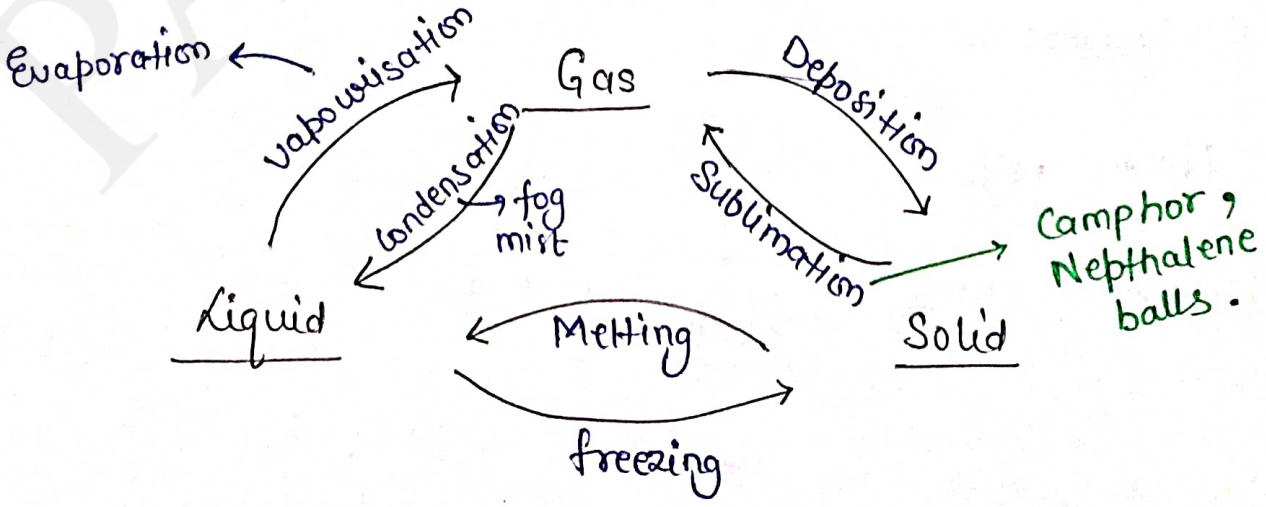
4. Plasma → ionised gas

5. Bose Einstein Condensate → very low density
   cooled to absolute zero (0 Kelvin)
   (-273°C)
   (1924-25)

→ 1995 = Rubidium Atom = Bose Einstein Condensate

Eric Cornells + Carl Weimann

Noble prize in 2001.



What is Pure Substance ? → जो एक तरह के particle का बना

↓

Cannot be physically separated.

Mixture → more than one type of a particle.

- Homogenous (Solution)
  - naked eyes ✗
  - particle size < 1nm
  - Stable
  - → Solid
    - Bronze = Cu + Sn
    - Brass = Cu + Zn
    - Solder = Pb + Sn
- Heterogenous (Suspension)
  - particle size > 10nm
  - unstable
  - naked eyes ✓

Colloidal Solution = particle size b/w 1 - 10 nm.

↓

(Heterogenous mixture)

ex: Milk Sol^n
Starch Sol^n

Mixture = Saturated mixture ⇒ In which no more Solute can be mixed/added.

- Solute (कम मात्रा)
- Solvent (ज्यादा मात्रा)

Salt → water

Sand → water

Tincture of iodine = Iodine (Solute) + Alcohol (Solvent)

↓

used as Antiseptic

$$\% \text{ by mass} = \frac{\text{mass of Solute}}{\text{mass of Sol}^n} \times 100.$$

dispersed phase = Solute

dispersion medium = Solvent

Dispersed Phase	Dispersed Medium	Type	Example
Liquid	Gas	Aerosol	fog, clouds, Mist
Solid	Gas	Aerosol	Smoke, Automobile exhaust
gas	Liquid	foam	Shaving Cream
liquid	liquid	emulsion	Milk, face cream
solid	Liquid	Sol	Milk of Magnesia, Mud
gas	Solid	foam	foam, Rubber, Sponge, pumice
liquid	Solid	Gel	Jelly, cheese, butter
solid	Solid	Solid Sol	Colored gemstone, milky glass.

Tyndall effect (Scientist) : Can be seen in Heterogenous mixture.

Different techniques to Separate mixture

1. Evaporation : To Separate dye from ink.
2. Chromatography : To Separate diff. colors of a dye
   Blood ~~&~~ & Drugs.
3. Centrifugation : Cream from Milk
4. Sublimation : Solid → Gas
   Nepthalene, Camphor, Anthracene, Nitrate.
5. Separating funnel : Immiscible liquids = Oil & water

6. Distillation : Miscible liquids
By Boiling the mixture
Acetone & water

7- fractional Distillation : Components of air
↳ If the boiling point difference is less.

Physical and Chemical Change

Reversible Rxn

State of matter changes

→ water ⇌ Ice

Irreversible Rxn, chemical Rxn

→ Digestion
→ Combustion
→ Rusting
→ Rotting

Burning of Candle

Physical + chemical

Carbon & its Compounds

↓

Versatile Nature.

C (6) = 2, (4) → gain ($4e^-$) or lose ?

↳ small in size, than other elements in its period.

Catenation → Long chains of Carbon.

C — C — C — C — C — C

Octet rule = Lewis + Kossel

Allotropes of Carbon

1. **Diamond**
   - Hardest
   - Bad Conductor of electricity
   - 1 C → 4 C (attached)

2. **Graphite**
   - Slippery
   - Good Conductor of electricity [$1e^-$ free]
   - 1 C → 3 C (attatched)

3. **Buckminsterfu-lerine**
   - Football shape
   - 60 atoms of Carbon

Difference b/w Saturated & Unstaturated Hydrocarbons? (H-C)

Saturated ↓ Low BP
- Alkane (−) Bond
  - Burn in clear Blue flame (LPG) Butane + Propane
  - ↓ Paraffins
  - C_nH_{2n+2}

Unstaturated ↓ High BP
- Alkene (=) Bond
  - Olefins
  - C_nH_{2n}
- Alkyne (≡)
  - C_nH_{2n-2}
  - ⇓ yellow Sooty flame

n = no. of carbon atoms

* Bayer's Test = for Alkane $KMNO_4$.

Meth - 1 Carbon
Eth - 2 C
Prop - 3 C
But - 4 C
Pent - 5 C
Hex - 6 C
Hepta - 7 C
Octa - 8 C
Nona - 9 C
Deca - 10 C
Dodeca - 12 C

CH_4 = Marsh Gas (Methane)

Homologous Series

CH_4 C_2H_6 C_3H_8

(CH_2) (CH_2)

C_2H_4 C_3H_6 C_4H_8

(CH_2) (CH_2)

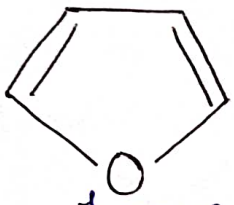
Compound Name	Structure of Compound and functional Group	Suffix / Prefix	Name
alkene	$C=C$		ethene
alkyne	$C\equiv C$		ethyne
alcohol	$R-\ddot{O}-H$ $-OH$	ol	ethanol
ether	$R-\ddot{O}-R'$		diethyl ether
aldehyde	$R-C(=O)-H$ $-CHO$	al	ethanal
ketone	$R-C(=O)-R'$		methyl ethyl Ketone
Carboxylic acid	$R-C(=O)-\ddot{O}-H$ $-COOH$	oic acid	acetic acid
ester	$R-C(=O)-\ddot{O}-R'$		ethyl acetate
amine	$R-\ddot{N}(H)-H$ $R-\ddot{N}(R')-H$ $R-\ddot{N}(R')-R''$		ethylamine
amide	$R-C(=O)-\ddot{N}(H)-R'$		acetamide

CH_3OH = wood Spirit
Methanol

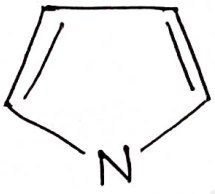
CH_3CH_2OH = Ethanol

CH_3COOH = ethanoic acid

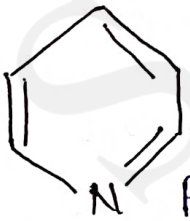
Heterocyclic compounds



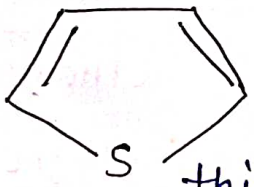
furane
primary amine



pyrrole
secondary amine



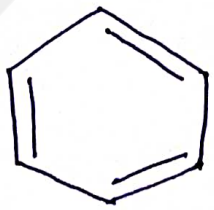
pyridine
Tertiary amine



thiophene

Rule of Aromaticity → smell.

Benzene



Erich Heckel

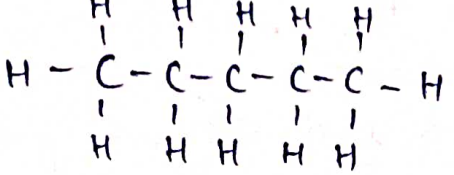
$(4n+2)\ \pi\ e^-$

⇓

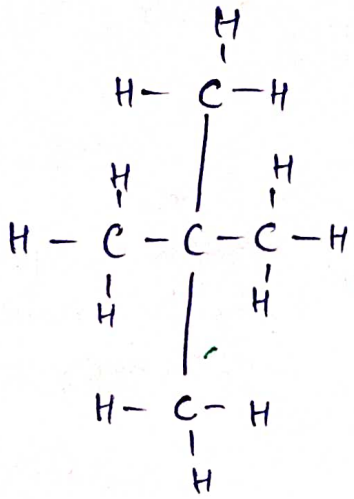
aromatic Compound

Isomer = Same formula, diff structure

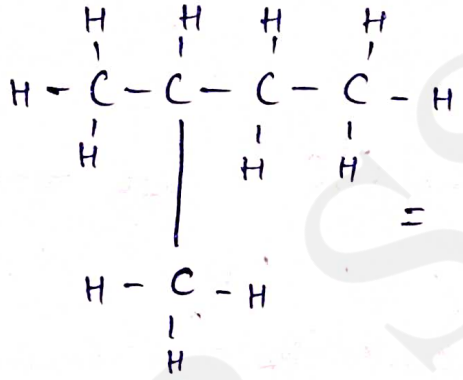
Pentane



= n-pentane

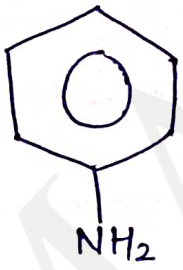


= neopentane

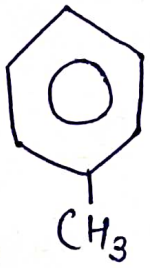


= Isopentane

* Aniline



* Toluene



Combination Reaction - $Mg + O_2 \longrightarrow Mg$

↓

exothermic reaction (heat release)

↓

Δ

(Combustion Reaction)

White compound of Magnesium oxide.

(Quick lime) $CaO + H_2O \longrightarrow Ca(OH)_2 + \Delta$

(Slaked lime)

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3$

{Marble, Chalk, limestone}

Decomposition Reaction = endothermic Reactions.

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + \underbrace{NO_2}_{\text{Brown fumes (Nitrogen Dioxide)}} + O_2$

$2AgBr \longrightarrow 2Ag + Br_2$ [used in Black & white Photography]

Displacement Reaction

$Fe(s) + CuSO_4 \longrightarrow FeSO_4 + Cu(s)$

$Cu(s) + FeSO_4 \longrightarrow \times$ not feasable

Katrina ne Car Mangi Alto Zen ferrari Phirbhi Kya Mila Sil Audi
K Na Ca Mg Al Zn fe Pb Cu Gold

Reactivity Series of Metals

Potassium	K	Cold water → Highly Reactive (kept in Kerosene oil)	Most Reactive Metal
Sodium	Na		
Calcium	Ca	→ floats	
Magnesium	Mg	→ warm water	
Aluminium	Al	Steam	
Zinc	Zn		
Iron	fe		
Tin	Sn		
lead	Pb		
Hydrogen	(H)		
copper	Cu		
Mercury	Hg	Don't react with O_2 (Air)	
Silver	Ag		
Gold	Au		
Platinum	Pt.		Least Reactive Metal

Decreasing chemical reactivity ↓

Au → react with Aqua Regia

HCl : HNO_3
3 : 1

Ag → AgS = Black Coating

Double Displacement = $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$

Oxidation addition of Oxygen.

$2Cu + O \rightarrow 2CuO$

ex: Corrosion [fe = Rusting, Red layer]
Cu = Green Layer
Ag = Black layer

Redox Reaction

Reduction

Oxidation

$$CuO + H_2 \xrightarrow{\Delta} H_2O + Cu.$$

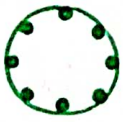
Electrolysis of water :- Indirect Redox Reaction.

→ Discovered by William Nicholson

Cooking of Meat = Maillard Reaction.

Metals & Non-Metals

- e^- lose (cation)
- good conductor of electricity
- Ductile (wire)
- Malleable (thin sheets)
- Lustre (shiny)
- Solidity (except Mercury)
- Sonorous (आवाज़)



Amalgam

(If one component of any alloy is Hg)

- e^- gain (anion)
- bad conductor of electricity
- Brittle (बिखरना)
- Solid (except Bromine)

Reactions of Metal

with O_2 = Metal Oxide

with Acid = $M + A \longrightarrow$ Salt + Hydrogen

Metal + Non-metal

$Na^+ - Cl^-$

→ Ionic / electrovalent Bond
(Compound)
Strong Bond
Transfer of e^-
High B.P.

Covalent Bond : Sharing of e^-
weak bond
low B.P.

Extraction of Metals

Ore
↓
Concentration of ore

- Metals of high Reactivity → Electrolysis of molten ore ↓
- Metals of Medium Reactivity
  - Carbonate ore → Calcination
  - Sulphide ore → Roasting
  - → Oxide of metal ↓ Reduction of metal ↓ Purification of metal
- Metals of low Reactivity → Sulphide ores → Roasting → Metal → Refining

Thermite Reaction = $Fe_2O_3 + Al_2 \longrightarrow Al_2O_3 + 2Fe$

Acid Bases and Salts

Acid ⟶ protone ⟶ donate ⟶ form Conjugate base

Base ⟶ protone ⟶ accept ⟶ form Conjugate Acid

Proposed by :

Acid

Organic

Minerals
H_2SO_4
HNO_3

↳ Vinegar = Acetic Acid → food preservative (Sodium Benzoate, Sodium Nitrate)

Milk = Lactic Acid [Lactobacillus bacteria convert Milk to curd)

Apple = Malic acid (also in Banana)

Ant = formic Acid (Methanoic Acid)

Tomato = Oxalic Acid

Grapes = Tartaric Acid (Tamarind)

Lemon = Citric Acid

Indicators

Litmus paper = formed from Lichen (Thallophyta)

Acid : Blue ⟶ Red

Base : Red ⟶ Blue

Olfactory Indicators

	Acid	Bases
Onion	Smell ✓	Smell X
Vanilla extract	"	"
Clove oil	"	"

Other Indicators

	Acid	Base
Turmeric	No change	Yellow to Red
Red Cabbage	Turns Pink/Red	Turns Blue, Green, Yellow
China Rose (गुड़हल)	Turns Dark Pink	Turns Blue to Green.

Reaction of Acids and Bases with each other.

Acid + Base ⟶ Salt + water

Neutralisation Reaction

Eno = Base

HCl (in Stomach) + Antacid ($Mg(OH)_2$)
(Baking Soda)
(Eno)

Reaction of Acid and Base with Metals & Non-Metals

Metal oxide $\longrightarrow$ Base + Base $\longrightarrow$ X

Non Metal oxide $\longrightarrow$ Acid + Acid $\longrightarrow$ X

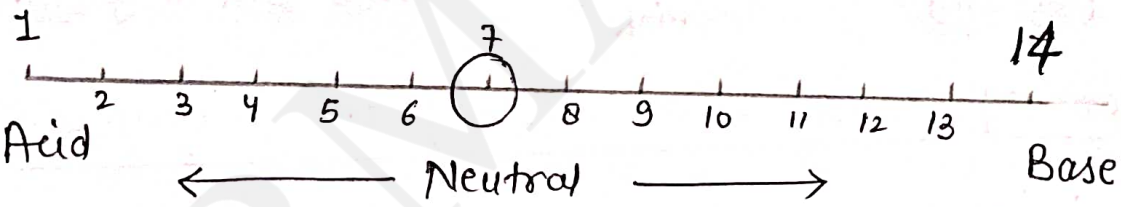
Metal oxide $\longrightarrow$ Base + Acid $\longrightarrow$ Salt + water

Non Metal oxide $\longrightarrow$ Acid + Base $\longrightarrow$ Salt + water

Amphoteric Oxide : Al_2O_3, PbO, ZnO

those oxides which react with both Acid & Base.

pH Scale B/w 1 — 14



water = 7
Saliva = 6.4
Blood = 7.4
Milk = 6
Hand Soap = 10
Milk of Magnesia = 10
Gastric juice = 1
NaOH = 14

Acid Rain

NO_x SO_x

pH less than 5.6

Tooth Decay = $\downarrow$ 5.5
Body decay = 7 - 7.8

pH of Salts

$A\uparrow + B \longrightarrow (S) + H_2O$

- Acidic → Strong Acid, Base weak
- Basic → Strong Base, weak Acid

Chemicals from Common Salt (NaCl)

Rock Salt

Chlor Alkali Process

$2NaCl_{(aq)} + 2H_2O \longrightarrow 2NaOH + Cl_2 + H_2$

- $NaCl_{(aq)}$ ↓ Brine
- Cl_2 → Anode
- $NaOH$ + H_2 → Cathode

Bleaching Powder : $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2$

- Cl_2 → Powerful disinfectant agent
- $CaOCl_2$ → Calcium Hypochlorite
  - → Oxidative agent
  - → used as a Bleaching agent in wood, paper Industry.

Baking Soda & Washing Soda

$NaCl + NH_3 + H_2O + CO_2$

$\boxed{NaHCO_3} + NH_4Cl$

$\boxed{NaHCO_3}$ ↓ Baking Soda

- → Soda acid fire extinguisher
- → Antacid
- + Acid → Baking Powder

$NaHCO_3 \longrightarrow Na_2CO_3 + 10H_2O$

$\downarrow$

$Na_2CO_3 \cdot 10H_2O$ — Washing Soda

→ Glass Industry

→ To remove permanent hardness of water

gypsom = $CaSO_4 \cdot 2H_2O$

$\downarrow$ 373K (dehydration)

$CaSO_4 \cdot \frac{1}{2}H_2O$

PoP.

$MgSO_4 \cdot 7H_2O$ → Epsom Salt

$FeSO_4 \cdot 7H_2O$ → Green Vitriol

$ZnSO_4 \cdot 7H_2O$ → White Vitriol

$CuSO_4 \cdot 5H_2O$ → Blue Vitriol

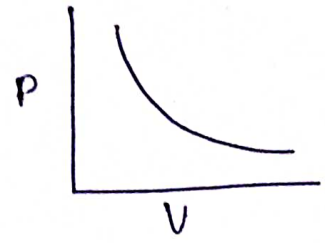
$(NH_4)\ Fe(SO_4)_2 \cdot 6H_2O$ → Mohr's Salt

Alum = $K_2SO_4 \cdot Al_2(SO_4)_2 \cdot 24H_2O$

(फिटकरी)

* Acid must be slowly added to water.

1) Boyle's law (1662) = $P \propto \frac{1}{V}$ (at constant T)



2) Charle's law (1787) = $V \propto T$ (at const P)

3) Gay Lussac's law (1808) $P \propto T$ (at const. V)

↳ Combining volume of gases law

4) Dalton's law of Partial Pressure

$$P = P_1 + P_2 + P_3 + P_4 + \text{- - - - - - - - - -}$$

* Galvanisation = Zn Plating
  Anodising = Al Coating

* $°F = \frac{9}{5}°C + 32$

* $-40° = °F = °C$

* $°C + 273 = K$

=> Heavy water = D_2O
Virtual water = Allan

* Soap
Long chain of Na/K, salt of Carboxylic Acid

* Detergent
long chain of Na/K salt of Sulphuric acid.