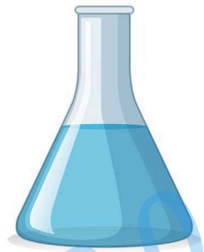
Chemistry

Basic Concepts of chemistry

- Density= mass/volume
- Celsius to Fahrenheit conversion: °F = 9/5(°C) + 32
- Celsius to Kelvin conversion: K= °C + 273.15
- 1 Atomic mass unit(amu)= 1.66056 * 10^-24
- Molarity (M) = $\frac{n\,(\text{moles of solute})}{V\,(\text{volume of solution})}$



- Dilution formula: $M_1V_1 = M_2V_2$

M_1 = initial molarity ("stock solution")
V_1 = initial volume (Liters)
M_2 = final (desired) molarity
V_2 = final volume (Liters)

- Atomic mass of an element= $\frac{\text{mass of one atom of the element}}{\text{mass of } \frac{1}{12} \text{th part of mass of } C^{12} \text{ atom}}$

$\frac{\text{mass of one atom of the element}}{\text{mass of } \frac{1}{16} \text{th part of mass of } O^{16} \text{ atom}}$

$\frac{\text{mass of one atom of the element}}{\text{mass of of one atom of Hydrogen atom}}$

- Relative Atomic mass= $\frac{\text{Average mass of atoms of an element}}{\text{Mass of one atom of carbon-12}} \times 12$
- Number of molecules in n moles of substance= $n \times N_A$
- Mass percentage of an element in a compound=

$$\frac{\text{mass of that element in the compound}}{\text{molar mass of the compound}} \times 100$$

- Mass percent= $\frac{\text{Mass of the sloute}}{\text{Mass of the solution}} \times 100$
- Avogadro's No= 6.022×10^{23}
- Molecular mass =2 * vapour density
- Mole fraction of solute = $\frac{\text{moles of solute}}{\text{total moles in solutions}}$
- Molality(m)= $\frac{\text{mole of solute} \times 1000}{\text{volume of solvent in kg}}$

Chemistry

Structure Of Atom

•Atomic Number(Z)= number of protons in the nucleus of an atom
= number of electrons in a neutral atom

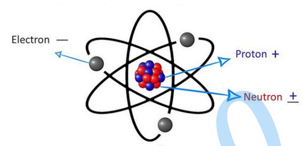
•mass number(A)= number of protons (Z) + number of neutrons(n)

•Relation between frequency, wavelength and velocity of light:

$$c = \lambda\nu$$

$$\nu = \frac{c}{\lambda}$$

•Energy of quantum: $E = h\nu$



•Planck's constant, $h = 6.6262 \times 10^{-34}$ J•s

•The kinetic energy of ejected electron: $h\nu = KE_{max} + W_0$

•Rydberg's formula: $\bar{\nu} = 109677\left(\frac{1}{{n_1}^2} - \frac{1}{{n_2}^2}\right)$

•Energy difference during transition of electron: $\nu = \frac{\Delta E}{h} = \frac{E_2 - E_1}{h}$

•Angular momentum of electron in a stationary state:

$$m_e vr = n.\frac{h}{2\pi} \qquad n = 1,2,3.....$$

•radii of stationary states: $\frac{0.529\, n^2}{Z}$

•Energy of stationary state of electron: $E_n = -R_H\left(\frac{1}{n^2}\right) \qquad n= 1,2,3....$

•de Broglie's wavelength, $\lambda = \frac{h}{mv}$

•Heisenberg's uncertainty principle, $\Delta x\ \Delta p \geq \frac{h}{4\pi}$

Δx = Uncertainty of Position
Δp = Uncertainty of Momentum

•Schrodinger equation

$$\frac{d^2\psi}{dx^2} + \frac{d^2\psi}{dy^2} + \frac{d^2\psi}{dz^2} + \frac{8\pi^2 m}{h^2}(E - V)\psi = 0$$

ψ = wave function
m = mass
h = plank constant
E = total energy
V = potential energy

Chemistry

Periodic classification of elements

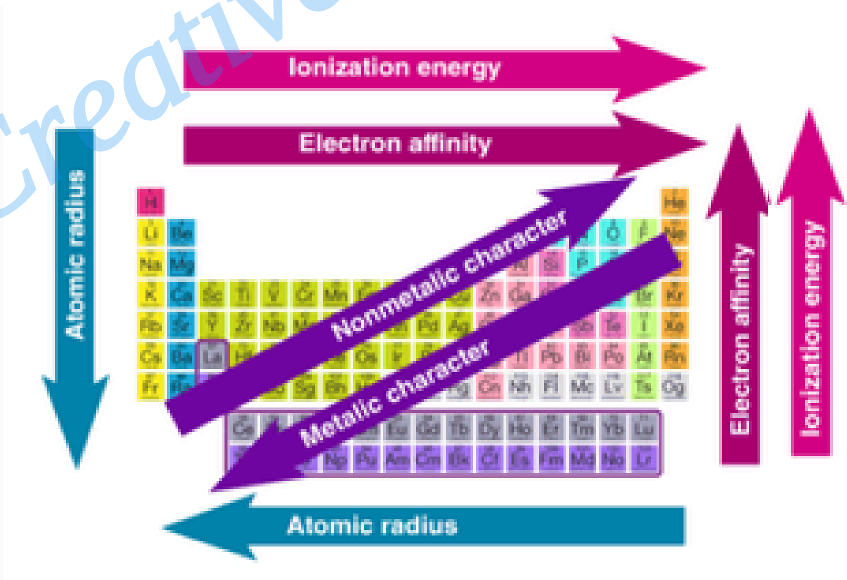
- General electronic configuration of s block: $ns^{1\text{-}2}$
- General electronic configuration of p block: $ns^2, ns^{1\text{-}6}$
- General electronic configuration of d block: $(n-1)d^{1\text{-}10}ns^{0\text{-}2}$
- General electronic configuration of f block: $(n-2)f^{1-14}(n-1)d^{0\text{-}1}ns^2$

P

- Notation of IUPAC nomenclature of elements:

Digit	Name	Abbreviation
0	nil	n
1	un	u
2	bi	b
3	tri	t
4	quad	q
5	pent	p
6	hex	h
7	sept	s
8	oct	o
9	enn	e

- Periodic trends of elements in the Periodic table:



Chemical Bonding

- **Formal charge:** $FC = V - N - \frac{B}{2}$

FC = formal charge
V = number of valence electrons
N = number of nonbonding valence electrons
B = total number of electrons shared in bonds

- **Dipole moment:** (μ) = charge (Q) × distance of separation (r)

- **Repulsive interaction of electron pairs:**

Lone pair (lp) – Lone pair (lp) > Lone pair (lp) – Bond pair (bp) > Bond pair (bp) – Bond pair (bp)

- **Geometry of molecules (VSEPR theory):**

Number of Electron Groups	Lone Pairs = 0	Lone Pairs = 1	Lone Pairs = 2	Lone Pairs = 3	Lone Pairs = 4
2	Linear				
3	Trigonal Planar	Angular or Bent			
4	Tetrahedral	Trigonal Pyramidal	Angular or Bent		
5	Trigonal Bipyramidal	Seesaw	T-shaped	Linear	
6	Octahedral	Square Pyramidal	Square Planar	T-shaped	Linear

Chemistry

States Of Matter

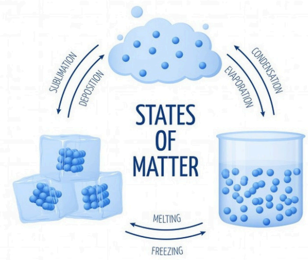
- **Gas Laws**

1. Boyle's Law: $P \propto \frac{1}{V}$

$P_1V_1 = P_2V_2$

$PV = k$

P = pressure
V = volume



2. Charles' Law: $T \propto V$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{V}{T} = k$

V = volume
T = temperature (Kelvin)

3. Gay Lussac's Law: $P \propto T$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{P}{T} = k$

P = pressure
T = temperature (Kelvin)

Avogadro Law : $V \propto n$

$\frac{V_1}{n_1} = \frac{V_2}{n_2}$

$\frac{V}{n} = k$

n = number of moles

5. Ideal gas equation: $PV = nRT$

R = gas constant

6.Relation between density and molar mass of gaseous substance: $d = \frac{m}{V} = \frac{P\mathcal{M}}{RT}$

m is the mass of the gas in g
$\mathcal{M}$ is the molar mass of the gas

- **Dalton's Law of partial pressure:** $P_{total} = \sum_{i=1}^{n} P_i$
- **Partial pressure in terms of mole fraction:** $P_A = X_A P_T$

where $X_A = \frac{\text{moles of gas A}}{\text{total moles of gas}}$

- **Vander Waals equation:** $\left(p + a\left(\frac{n}{V}\right)^2\right)(V - nb) = nRT$

a: Intermolecular attractive force

b: Volume occupied by one mole of the gas

- **Viscous Force** $F = \eta A \frac{dv}{dy}$

$\frac{du}{dy}$ = Rate of shear deformation

Chemistry
Thermodynamics

- **First law of thermodynamics:**

$$\Delta U = Q - W$$

ΔU = change in internal energy
Q = heat added
W = work done by the system

- **Pressure:** $P = \frac{F}{A}$

- **Work done :** W = - P Δ V
- **work done for variable pressure:** w = - ∫ d V P e x t

- **For isothermal irreversible change** $W_{i \to f} = nRT \ln \frac{V_f}{V_i}$

- **For isothermal reversible change:** $W_{i \to f} = p_i V_i \ln \frac{V_f}{V_i}$

- **For adiabatic change:**

$$W_{dv} = pdV = dU = mc_V(T_2 - T_1)$$

- **Ideal gas law:** PV = nRT

- **Heat capacity:**

$$Q = mc\Delta T$$

Q = heat energy
m = mass
c = specific heat capacity
ΔT = change in temperature

- **Relation between heat capacities at constant pressure and volume:** $C_p - C_v = R$

- **Entropy:**

$$S = k_b \ln \Omega$$

S = entropy
k_b = Boltzmann constant
$\ln$ = natural logarithm
Ω = number of microscopic configurations

- **Total entropy change:** ΔStotal=ΔSsystem+ΔSsurr

Ionic equilibrium

- **Equilibrium equation:**

$$K_{eq} = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

- **Equilibrium constant in gaseous systems**

$$K_p = \frac{(P_C{}^c)\,(P_D{}^d)}{(P_A{}^a)\,(P_B{}^b)}$$

- **Ostwald dilution law:**

$$K = \frac{[A^+][B^-]}{[AB]} = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)}$$

$$\boxed{K = \frac{C\alpha^2}{1-\alpha}}$$

- **pH value:**

$$pH = -\log_{10}[H^+]$$

(or)

$$pH = \log_{10}\frac{1}{[H^+]}$$

- **pOH value:**

$$[OH^-] = 10^{-pOH}$$

$$pOH = -\log_{10}[OH^-] \text{ or } \frac{1}{\log_{10}[OH^-]}$$

$$pH + pOH = 14$$

$$pH + pOH = pK_w$$

$$pK_a = -\log_{10}K_a$$

$$pK_a \propto \frac{1}{K_a} \propto \frac{1}{\text{Acidic strength}}$$

$$pK_b = -\log_{10}K_b$$

$$pK_b \propto \frac{1}{K_b} \propto \frac{1}{\text{Basic strength}}$$

- **Ionic product of water:** $K_w = [H_3O^+].[OH^-]$

K_w = ionic product of wate

K_w – Ka x Kb

pKw = pKa + pKb

At 25°C,

$Kw = 1 \times 10^{-14}$

pKw = 14

Chemistry

Ionic equilibrium

Buffer solution:

$$\phi = \frac{\text{Number of moles of acid/base added to 1L of solution}}{\text{Change in pH}}$$

- **Solubility:**

$$(s) \propto \frac{1}{\text{Concentration of common ions}}$$

ar number of common ions

- **Solubility product:** $K_{SP} = (xs)^x (ys)^y = x^x . y^y . (s)^{x+y}$

- **Degree of hydrolysis:**

Salt of weak acid and strong base

k_h	h	pH
$\frac{k_w}{k_a}$	$\sqrt{\frac{k_w}{k_a c}}$	$7+\frac{1}{2}pk_a+\frac{1}{2}\log c$

Salt of strong acid and weak base

k_h	h	pH
$\frac{k_w}{k_b}$	$\sqrt{\frac{k_w}{k_b c}}$	$7-\frac{1}{2}pk_b-\frac{1}{2}\log c$

Salt of weak acid and weak base

k_h	h	pH
$\frac{k_w}{k_a k_b}$	$\sqrt{\frac{k_w}{k_a k_b}}$	$7+\frac{1}{2}pk_a-\frac{1}{2}pk_b$

Salt of strong acid and strong base do not hydrolyse.

- **Relation between equilibrium constant,K Reaction quotient,Q and Gibbs energy,G:**

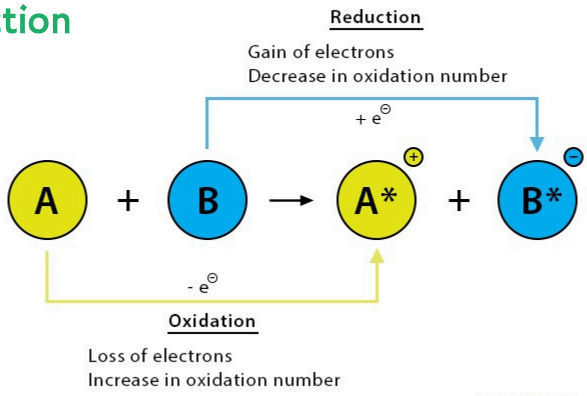
$$\Delta G = RT\ln QK$$

- $$K_w = K_a \times K_b$$

Chemistry

Redox Reactions

- Redox Reaction



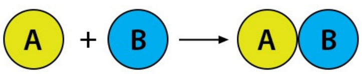
- Oxidising agent: Acceptor of electrons.
- Reducing agent: Donor of electrons.
- Oxidation number calculations, example:

$[CrCl_2(H_20)_4]^+$

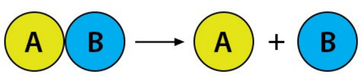
$$x + 2(-1) + 4(0) = 1$$
$$x - 2 = 1$$
$$x = +3$$

- Types of Redox Reaction

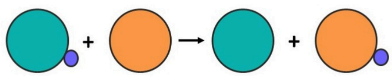
I. Combination reaction:



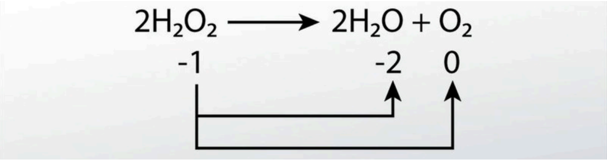
2. Decomposition reaction



3. Displacement reaction:



4. Disproportionation reaction:



Chemistry

Hydrogen

- **Preparation**
- **Laboratory method**

$Zn + 2H^+ \longrightarrow Zn^{2+} + H_2$

$Zn + 2\,NaOH \longrightarrow Na_2ZnO_2 + H_2$

- **Commercial method**

$2H_2O(l) \xrightarrow[\text{Traces of acid/base}]{\text{Electrolysis}} 2H_2(g) + O_2(g)$

by electrolysing warm aqueous barium hydroxide solution between N1 Electrodes.

$C_nH_{2n+2} + nH_2O \xrightarrow[\text{Ni}]{1270K} nCO + (2n+1)H_2$

-CO + H_2 is called water gas.

- Cool Gasification : $C(s) + H_2O(g) \xrightarrow{1270K} CO(g) + H_2(g)$

-Water- gas shift reaction: $CO(g) + H_2O(g) \xrightarrow{673\,K} CO_2(g) + H_2(g)$

- **Chemical properties**

$H_2(g) + X_2(g) \longrightarrow 2HX(g)$ (X= F,Cl, Br, I)

$2H_2(g) + O_2(g) \xrightarrow[\text{Heating}]{\text{Catalyst or}} 2H_2O(l) \quad H = -285.9 KJmol^{-1}$

$3H_2(g) + N_2(g) \xrightarrow[\text{Fe}]{673K,\ 200\ atm} 2NH_3(g) \quad H = -92.6$ KJmol-1

$H_2(g) + Pd^{2+}(aq) \longrightarrow Pd(s) + 2H^+(aq)$

$H_2 + CO + RCH = CH_2 \longrightarrow RCH_2CH_2CHO$

$H_2 + RCH_2CH_2CHO \longrightarrow RCH_2CH_2CH_2OH$

- **Preparation of hydrogen peroxide**

$BaO_2.8H_2O(s) + H_2SO_4(aq) \longrightarrow BaSO_4(s) + H_2O_2(aq) + 8H_2O(l)$

$2HSO_4^-(aq) \xrightarrow{\text{Electrolysis}} HO_3SOOSO_3H(aq) \longrightarrow 2HSO_4^-(aq) + 2H^+(aq) + H_2O_2(aq)$

2- ethylanthraquinol $\underset{H_2/Pd}{\overset{O_2(air)}{\rightleftharpoons}} H_2O_2$ + Oxidised Product

- **Chemical properties**

$PbSO_4(s) + 4H_2O_2(aq) \longrightarrow PbSO_4(s) + 4H_2O(l)$

$HOCl + H_2O_2 \longrightarrow H_3O^+ + Cl + O_2$

$Mn^{2+} + H_2O_2 \longrightarrow Mn^{4+} + 2OH^-$

$I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

Chemistry

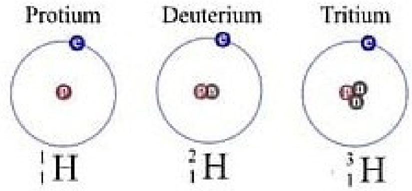
Hydrogen

- Isotopes of hydrogen

Protium: Predominant from. ($^{1}_{1}H$)

Deuterium: ($^{1}_{2}H$)

Tritium: Radioactive ($^{1}_{3}H$)



- Chemical properties of water

$$H_2O(l) + NH_3(aq) \rightleftharpoons OH^-(aq) + NH_4^+(aq)$$

$$2H_2O(l) + 2Na(s) \longrightarrow 2NaOH(aq) + H_2(g)$$

$$6CO_2(g) + 12H_2O(l) \longrightarrow C_6H_{12}O_6(aq) + 6H_2O(l) + 6O_2(g)$$

$$P_4O_{10}(s) + 6H_2O(l) \longrightarrow 4H_3PO_4(aq)$$

S Block

- Chemical properties of alkali metals(group I)

$4Li + O_2 \longrightarrow 2Li_2O; 2Na + O_2 \longrightarrow Na_2O_2; M + O_2(MO_2$ (M= K,Rb, Cs)

$2M + 2H_2O \longrightarrow 2M^+ + 2OH^- + H_2$

$2M + H_2 \longrightarrow 2M^+H^-$

React vigorously with halogens to form ionic halides

$M + (x + y) NH_3 \longrightarrow [M(NH_3) \longrightarrow [M(NH_3)_x]^+ + [e(NH_3)_y]^-$

- Chemical properties of alkaline earth metal (group 2)

· Be and Mg are kinetically inert to O and H_2O

· Mg is more electropositive and burns in Air.

· Ca, Sr and Ba with air form oxide and nitride.

$M + X_2 \longrightarrow MX_2$ (X= F, Cl, Br, I)

$2BeCl_2 + LiAH_4 \longrightarrow 2BeH_2 + LiCl + ACl_3$

$M + 2HCl \longrightarrow MCl_2 + H_2$

$M + (x+y)NH_3 \longrightarrow [M(NH_3)_x]^{2+} + 2[e(NH_3)_y]^-$

- Important compounds of sodium

(I)Sodium Carbonate(preparation)

$2NH_3 + H_2O + CO_2 \longrightarrow (NH_4)2CO_3$

$(NH_4)_2CO_3 + H_2O + CO_2 \longrightarrow 2NH_4HCO_3$

$NH_4HCO_3 + NaCl \longrightarrow NH_4Cl + NaHCO_3$

$2NH_4Cl + Ca(OH)_2 \longrightarrow 2NH_3 + CaCl_2 + H_2O$

Chemistry

S Block

- **Important compounds of sodium**

Properties of sodium Carbonate

$$Na_2CO_3.10H_2O \longrightarrow Na_2CO_3 \times H_2O + 9H_2O$$
$$Na_2CO_3.H_2O \longrightarrow Na_2CO_3 + H_2O$$

(ii)Sodium chloride

(iii)Sodium hydroxide

(iv)Sodium hydrogen Carbonate

preparation

$$Na_2CO_3 + H_2O + CO_2 \longrightarrow 2NaHCO_3$$

- **Important compounds of Calcium**

(I) Quick lime, Cao(preparation)

$$CaCO_3 \longrightarrow CaO + CO_2$$

Properties

$$CaO + H_2O \longrightarrow Ca(OH)_2,\ CaO + CO_2 \longrightarrow CaCO_3$$

(ii) Calcium hydroxide(preparation)

Addition of water to CaO.

properties

$$Ca(OH_2) + CO_2 \longrightarrow CaCO_3 + H2O$$

(iii) Plaster of Paris(

$$2(CaSO_4.2H_2O) \longrightarrow 2(CaSO_4).H_2O + 3H_2O$$

P Block

- **Chemical properties of group 13 elements**

$$2E(s) + 3O_2(g) \xrightarrow{\Delta} 2E_2O_{3(s)}$$
$$2E(s) + N_2(g) \xrightarrow{\Delta} 2EN_{(s)}$$
$$2Al(s) + 6HCl(aq) \longrightarrow 2Al^{3+}(aq) + 6Cl^-(aq) + 3H_2(g)$$
$$2E_{(s)} + 6X_2(g) \longrightarrow 2EX_3(s) \quad (X = F, Cl, Br, I)$$

P Block

• Important compounds of boron

(i) Borax

$$Na_2B_4O_7 + 7H_2O \longrightarrow 2NaOH + 4H_3BO_3$$

$$Na_2B_4O_7.10H_2O \xrightarrow{\Delta} Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$$

Borax bead test is used for identification.

(ii) Orthoboric acid

$$Na_2B_4O_7 + 2HCl + 5H_2O \longrightarrow 2NaCl + 4B(OH)_3$$

$$B(OH)_3 + 2HOH \longrightarrow [B(OH)_4]^- + H_3O^+$$

$$H_3BO_3 \xrightarrow{\Delta} HBO_2 \xrightarrow{\Delta} B_2O_3$$

(iii) Diborane

: $4BF_3 + 3LiAlH_4 \longrightarrow 2B_2H_6 + 3LiF + 3AlF_3$

$$2NaBH_4 + I_2 \longrightarrow B_2H_6 + 2NaI + H_2$$

$$2BF_3 + 6NaH \longrightarrow B_2H_6 + 6NaF$$

properties

$$B_2H_6 + 3O_2 \longrightarrow B_2O_3 + 3H_2O$$

$$B_2H_6(g) + 6H_2O\ (l) \longrightarrow 2B(OH)_3(aq) + 6H_2(g)$$

$$B_2H_6(g) + 6H_2O\ (l) \longrightarrow 2B(OH)_3\ (aq) + 6H_2(g)$$

$$B_2H_6 + 2NMe_3 \longrightarrow 2BH_3.NMe_3$$

$$B_2H_6 + 6NH_3 \longrightarrow 3[BH_2(NH_3)_2]^+ [BH_4]^- \longrightarrow 2B_3N_3H_6 + 12H_2$$

• Important compounds of carboncarbon

(i) Carbon monoxide

$$2C + O_2 \xrightarrow[\text{Limited air}]{\Delta} 2CO$$

$$HCOOH \xrightarrow[\text{Conc. } H_2SO_4]{373\ K} H_2O + CO$$

(ii) Carbon dioxide

$$C + O_2 \xrightarrow{\Delta} CO_2$$

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

• Important compounds of silicon

(i) Silicates

(ii) Silicon dioxide

(iii) Zeolites

Chemistry

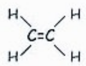
Organic compounds

• Organic reaction mechanism

Organic molecule —Attacking reagent→ [Intemediate] → Products(s)
└→ By Products

• Structural formula

3D Representation: using solid(▲) and dashed (|||||)

(i) Complete ethene 

(ii) Condensed $H_2C{=}CH_2$ ethene

(iii) Bond-line 2-brome butane

• Types of reactions and effects

- Fission of covalent bond
  - Heterolytic Cleavage
  - Homolytic Cleavage
- Nucleophile (Nucleus Seeking)
- Resonance Structure
  - Same positions of nuclei
  - Same number of inpaired electrons
  - Examples: Benzene
- Inductive effects polarisation of bond caused by polarisation of adjacent bond

Hyperconjugation
Delocalisation of electrons of C-H bond of an alkyl group directly attached an atom of unsaturated system.

Electromeric Effects:
Complete transfer of a shared pair of electrons to one of atoms joined by a multiple bond on the demand on an attacking agent

Resonance Effects
Polarity prouced in the molecule by interaction of 2 bonds or between a bond and lone pair of electrons of adjacent atom

• Classification of organic compounds

- Acyclic/Open Chain: consists or straight or branched chain
- Cyclic/Closed Chain/ring: Carbon atoms in a ring
  - Hetrocyclic: Atoms other than C are also present
  - Homocyclic/carbocyclic: Only C atoms are present
    - Alicyclic: Both aliphatic and cyclic
    - Aromatic: Contains conjugated planer ring structure
      - Benzeneoid Example: Benzene, Aniline, Napthalene
      - Non Benzeneoid Example: Tropolene

Hydrocarbon

• Preparation of alkane

$$CH_2=CH_2 + H_2 \xrightarrow{Pt/Pd/Ni} CH_3-CH_3$$

$$CH_3Cl + H_2 \xrightarrow{Zn, H^+} CH_4 + HCl$$

• Wurtz reaction

$$CH_3Br + 2Na + BrCH_3 \xrightarrow{Dry\ ether} CH_3-CH_3 + 2NaBr$$

$$CH_3COO\text{-}Na^+ + NaOH \xrightarrow[\Delta]{CaO} CH_4 + Na_2CO_3$$

$$2CH_3COONa + 2H_2O \longrightarrow C_2H_6 + 2CO_2 + H_2 + 2NaOH$$

• Chemical properties of alkane

$$CH_4 \xrightarrow[h\nu/-HCl]{+Cl_2} CH_3Cl \xrightarrow[h\nu/-HCl]{+Cl_2} CH_2Cl_2 \xrightarrow[h\nu/-HCl]{+Cl_2} CHCl_3 \xrightarrow[h\nu/-HCl]{+Cl_2}$$

$$C_nH_{2n+2} + (3n+1)\,O_2 \longrightarrow nCO_2 + (n+1)H_2O$$

$$2CH_4 + O_2 \xrightarrow{Cu/\ 523\ K\ /100\ atm} 2CH_3OH$$

$$CH_4 + O_2 \xrightarrow[\Delta]{} HCHO + H_2O$$

$$CH_3(CH_2)CH_3 \xrightarrow{Anhyd.\ AlCl_3/HCl} CH_3\text{-}\underset{\displaystyle CH_3}{CH}\text{-}(CH_2)_2\text{-}CH_3 + CH_3\text{-}CH_2\text{-}\underset{\displaystyle CH_3}{CH}\text{-}CH_2\text{-}CH_3$$

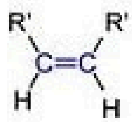
$$CH_4 + H_2O \xrightarrow[\Delta]{Ni} CO + 3H_2$$

$$C_6H_{14} \xrightarrow{733\ K} \begin{cases} C_6H_{12} + H_2 \\ C_4H_8 + C_2H_6 \\ C_3H_6 + C_2H_4 + CH_4 \end{cases}$$

• Alkenes

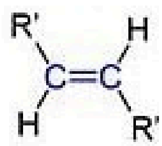
Preparation:

$$RC \equiv CR' + H_2 \xrightarrow{Pd/\ C}$$



Cis- alkene

$$RC \equiv CR' + H_2 \xrightarrow{Na/\ Liquid\ NH_3}$$



Trans- alkene

$$H_3C\text{-}CH_2X \xrightarrow[\Delta]{Alc.\ KOH} H_2C=CH_2$$

$$CH_2Br\text{-}CH_2Br + Zn \longrightarrow CH_2=CH_2 + ZnBr_2$$

$$H_3CCH_2OH \xrightarrow[\Delta]{conc\ H_2SO_4} CH_2=CH_2 + H_2O$$

Chemistry

Hydrocarbon

- **Properties of alkenes**

$$CH_2{=}CH_2 + Br_2 \xrightarrow{CCl_4} BrCH_2\text{-}CH_2Br$$

$$CH_2{=}CH_2 + HBr \longrightarrow CH_3CH_2Br$$

$$CH_3\text{-}CH{=}CH_2 + HBr \xrightarrow[\text{rule}]{\text{Markovnikov}} CH_3\text{-}\underset{\underset{Br}{|}}{CH}\text{-}CH_3 \quad ; \quad CH_3\text{-}CH_2Br$$

$$H_3C\text{-}C{=}CH_2 + H_2O \xrightarrow{H^+} (CH_3)_3C\text{-}OH$$

$$CH_3\text{-}CH{=}CH\text{-}CH_3 \xrightarrow{KMnO_4/H^+} 2CH_3COOH$$

$$n(CH_2{=}CH_2) \xrightarrow[\text{Catalyst}]{\text{High Temp/Pressure}} \text{-}(CH_2\text{-}CH_2)\text{-}n$$

$$n(CH_3\text{-}CH{=}CH_2) \xrightarrow[\text{Catalyst}]{\text{High Temp/Pressure}} (CH\text{-}CH_2)$$

- **Preparation of alkynes**

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

$$CaO + 3C \longrightarrow CaC_2 + CO$$

$$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$$

$$CH_2Br\text{-}CH_2Br + KOH \xrightarrow[-KBr,\ -H_2O]{\text{Alcohol}} H_2C{=}CHBr \xrightarrow[-NaBr,\ -NH_3]{NaNH_2} CH{\equiv}CH$$

- **Properties of alkynes**

$$HC{\equiv}CH + Na \longrightarrow HC{\equiv}CNa + 1/2H_2$$

$$HC{\equiv}CH + H_2 \xrightarrow{Pt/Pd/Ni} [H_2C{=}CH_2] \xrightarrow{H_2} CH_3\text{-}CH_3$$

$$CH_3\text{-}C{\equiv}CH + Br_2 \longrightarrow [CH_3CBr{=}CHBr] \xrightarrow{Br_2} CH_3\text{-}CBr_2\text{-}CHBr_2$$

$$HC{\equiv}C\text{-}H + HBr \longrightarrow [CH_2C{=}CH\text{-}Br] \longrightarrow CHBr_2\text{-}CH_3$$

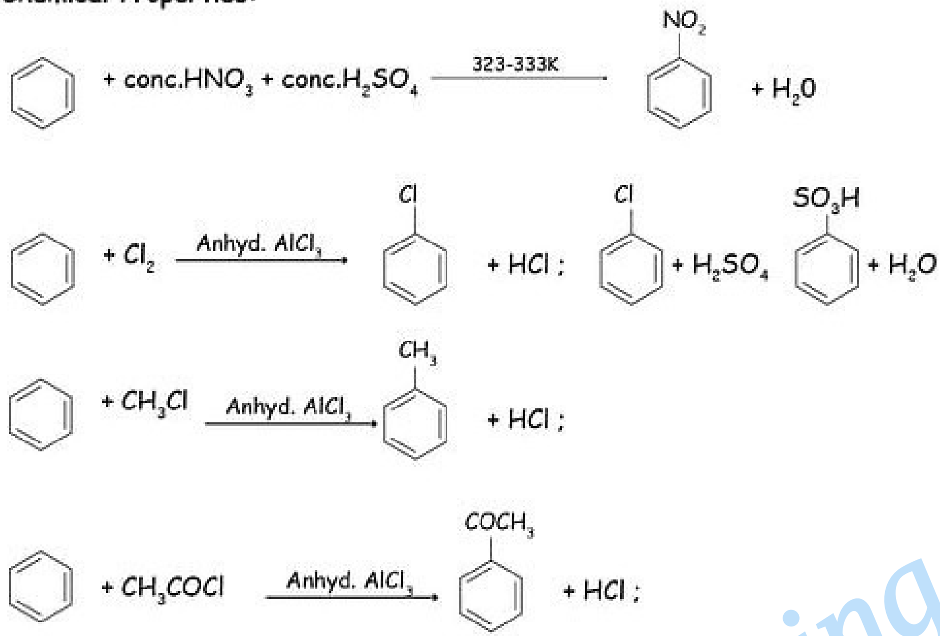
$$HC{\equiv}CH + H_2O \xrightarrow[333\ K]{Hg^{2+}/H^+} [CH_2{=}C\text{-}H] \xrightarrow{\text{Isomerisation}} CH_3\text{-}\underset{\underset{O}{\|}}{C}\text{-}H$$

Chemistry

Hydrocarbon

- Properties of benzene

Chemical Properties:



- Preparation of aromatic compounds

• Cyclic Polymerisation of ethyne

$$C_6H_5COONa + NaOH \longrightarrow C_6H_6 + Na_2CO_3$$

$$C_6H_5OH + Zn \longrightarrow C_6H_6 + ZnO$$

Environmental chemistry

- Stratospheric pollution
- Depletion of ozone layer

$$ClO + NO_2(g) \longrightarrow ClONO_2(g)$$

$$Cl(g) + CH_4(g) \longrightarrow CH_3(g) + HCl\ (g)$$

$$ClONO_2(g) + H_2O(g) \longrightarrow HOCl(g) + HNO_3\ (g)$$

$$HOCl(g) \xrightarrow{h\nu} OH\ (g) + Cl\ (g)$$

$$Cl_2(g) \xrightarrow{h\nu} 2Cl(g)$$