

2025  
2026



# CHEMISTRY FORMULA SHEET

CLASS - 11





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**NOTE** - कुछ लोगों ने ये नोट्स शेयर किये थे या इन्हें गलत तरीके से बेचा था तो उनके खिलाफ कानून कार्यवाही की जा रही है इसलिए आप अपने नोट्स किसी से भी शेयर न करें।

# Class XI - 2025 - 2026

NCERT KAKSHA  
UMESH VAISHALI

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NCERT KAKSHA  
UMESH VAISHALI

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Umesh Bhaiya ❤  
Always with you



Vaishali Didi ❤  
Always with you

# UNIT - 1

## Some Basic Concepts of Chemistry

→ Density =  $\frac{\text{Mass}}{\text{Volume}}$

📍 Note :- 1 amu =  $1.66056 \times 10^{-24}$  g

→ Temperature

$$K = {}^{\circ}\text{C} + 273$$

Celsius to Fahrenheit,

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

Fahrenheit to Celsius,

$${}^{\circ}\text{C} = \frac{5}{9}[{}^{\circ}\text{F} - 32]$$

→ Velocity ( $v$ ) =  $\frac{\text{Displacement } (x)}{\text{time } (t)}$

→ Acceleration ( $a$ ) =  $\frac{\text{Velocity}}{\text{time}}$

→ Force ( $F$ ) = mass  $\times$  acceleration

→ Pressure ( $P$ ) =  $\frac{\text{Force}}{\text{Area}}$

→ Vapour density OR Relative density =  $\frac{\text{Molar mass}}{2}$

→ Atomic mass =  $\frac{\text{Mass of an atom}}{\frac{1}{12} \text{th mass of } {}^{12}\text{C}}$

→ Molecular Mass =  $\frac{\text{Mass of an molecule}}{\frac{1}{12} \text{th mass of } {}^{12}\text{C}}$

→ Mass % of an element =  $\frac{\text{Mass of element in 1 mole of compound}}{\text{Molar mass}} \times 100$

→ Mass percentage

$$\text{Mass percentage of A} = \frac{\text{Mass of A}}{\text{Mass of A} + \text{Mass of B}} \times 100$$

→ Volume percentage

$$\text{Volume percentage of A} = \frac{\text{Volume of A}}{\text{Volume of A} + \text{Volume of B}} \times 100$$

→ Parts per million

$$\text{PPM} = \frac{\text{Mass of component A}}{\text{Total mass of solution}} \times 10$$

→ Molarity of a solution

$$\text{Molarity (M)} = \frac{\text{Moles of solute}}{\text{Volume of solution in (Litres)}}$$

OR

$$\text{Molarity (M)} = \frac{\text{Moles of solute}}{\text{Volume of solution in (mL)}} \times 1000$$

→ Molality of a solution

$$\text{Molality (m)} = \frac{\text{Moles of solute}}{\text{mass of solvent in (kg)}}$$

OR

$$\text{Molality (m)} = \frac{\text{Moles of solute}}{\text{mass of solvent in (g)}} \times 1000$$

→ Mole fraction

$$\text{Mole fraction of solute } (x_A) = \frac{n_A}{n_A + n_B}$$

$$\text{Mole fraction of solvent } (x_B) = \frac{n_B}{n_A + n_B}$$

📍 Note :- The sum of mole fraction of all the component in solution is always equal to 1.  $x_A + x_B = 1$

→ Normality =  $\frac{\text{No. of gram equivalents of solute}}{\text{Volume of solution in (litres)}}$

OR

$$\text{Normality} = \frac{\text{No. of gram equivalents of solute}}{\text{Volume of solution in (mL)}} \times 1000$$

→ Gram equivalents of solute =  $\frac{\text{Mass of solute}}{\text{Equivalent of mass}}$

→ Relationship between Normality and Molality of solutions

→ Normality = Molality  $\times \frac{\text{Molar mass}}{\text{Equivalent of mass}}$

For acids,

$$\text{Normality} = \text{Molarity} \times \text{Basicity}$$

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For bases,

$$\text{Normality} = \text{Molarity} \times \text{Acidity}$$

→ Normality Equation

$$N_1 V_1 = N_2 V_2$$

$N_1$  = initial normality  
 $N_2$  = Normality of new solution  
 $V_1$  = initial Volume  
 $V_2$  = Volume of new solution  
 $M_1$  = initial molarity  
 $M_2$  = molarity of new solution

→ Molarity Equation

$$M_1 V_1 = M_2 V_2$$

📍 Note :- One moles of atoms =  $6.022 \times 10^{23}$  atoms = Gram atomic mass of the elements

→ Moles of an element =  $\frac{\text{Mass of element}}{\text{Atomic mass}}$

→ Mass of one atom =  $\frac{\text{Atomic mass}}{6.022 \times 10^{23}}$

📍 Note :- One moles of molecules =  $6.022 \times 10^{23}$  molecules = Gram molecular mass

→ Moles of a compound =  $\frac{\text{Mass of compound}}{\text{Molar mass}}$

→ Mass of one molecule =  $\frac{\text{Molecular mass}}{6.022 \times 10^{23}}$

📍 Note :- Volume occupied by 1 mole of a gas at N.T.P. = 22.4 L

→ Molecular formula =  $n$  (Empirical formula)

and

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

Believe in yourself and  
ANYTHING is possible .

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## UNIT - 2

# Structure of Atom

→ Charge to mass ratio ( $e/m$ ) of electrons

$$\text{charge/mass} = \frac{e}{m} = 1.76 \times 10^{11} \text{ C/kg}$$

$m_e$  = Mass of the electron in K    Magnitude of the charge on the electron

Particle	Mass (kg)	Relative mass (u)	Approximate mass (u)	charge	Relative charge
Electron (e)	$9.10939 \times 10^{-31}$	$5.4858 \times 10^{-4}$	0	$-1.6022 \times 10^{-19} \text{ C}$	-1
Proton (p)	$1.67262 \times 10^{-27}$	1.00737	1	$+1.6022 \times 10^{-19} \text{ C}$	+1
Neutron (n)	$1.67493 \times 10^{-27}$	1.00867	1	0	0

→ Mass number  $\overset{A}{X}$     Symbol of the element  
 Atomic number  $\underset{Z}{\text{X}}$     ← Symbol of the element

Atomic number (Z) = Number of protons (p) = Number of electrons (e)

Mass number (A) = Number of protons (p) + Number of neutrons (n)

→ Note :- One unit charge =  $4.80298 \times 10^{-10}$  esu or =  $1.60210 \times 10^{-19}$  Coulombs

One u =  $\frac{1}{12}$  th the mass of C-12 or =  $1.66056 \times 10^{-27}$  kg

→  $c = \lambda \times v$  and  $v = c/\lambda$

$\lambda$  = wavelength     $v$  = velocity     $c$  = Speed of light

→  $v = \frac{1}{\lambda}$

Wave number

→ Energy of Photon  $E = hv = \frac{hc}{\lambda} = hc\nu$

$h$  = planck's constant =  $6.626 \times 10^{-34} \text{ J}$   
 $\nu$  = frequency of Light

→ Einstein equation for Photoelectric Effect

$$\frac{1}{2}mv^2 = hv - h\nu_0$$

$\nu_0$  = threshold frequency

Work Function

→ De-Broglie Equation OR Matter waves

$$\lambda = \frac{h}{mv}$$

$p$  = momentum

$$\lambda = \frac{h}{p}$$

→ Relationship between K.E. and  $\lambda$  of moving particle

$$\lambda = \frac{h}{\sqrt{2 \times \text{K.E.} \times m}}$$

→ Heisenberg uncertainty principle

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

$$\Delta x \times \Delta v \geq \frac{h}{4\pi m}$$

$\Delta x$  = uncertainty in position

$\Delta p$  = uncertainty in momentum

### → Rydberg Equation

$$\frac{1}{\lambda} = \bar{V} = R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right]$$

Hydrogen like ions are those which contain only one electron,

$$\frac{1}{\lambda} = \bar{V} = R \left[ \frac{1}{n_1^2} - \frac{1}{n_2^2} \right] z^2$$

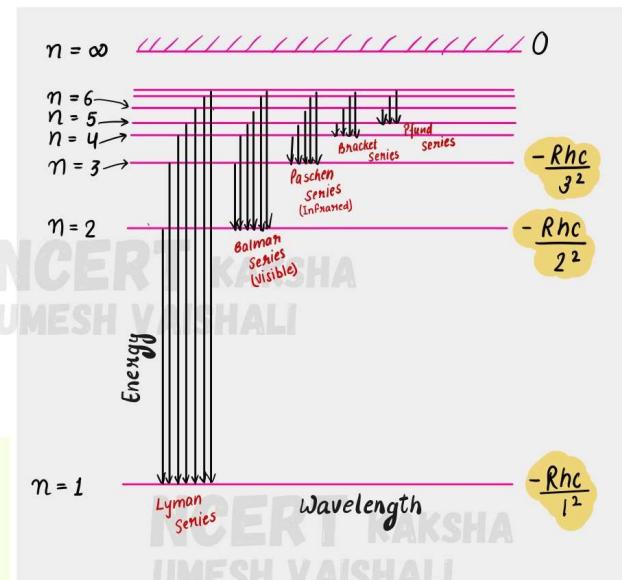
$R$  = Rydberg constant ( $109677 \text{ cm}^{-1}$ )

$n_1, n_2$  = integers,  $n_2 > n_1$

$z$  = nuclear charge or Atomic number

### → Spectral lines of H-atom

Lyman	$n_1 = 1$	$n_2 = 2, 3, 4, 5 \Rightarrow$ ultraviolet
Balmer	$n_1 = 2$	$n_2 = 3, 4, 5, 6 \Rightarrow$ visible
Paschen	$n_1 = 3$	$n_2 = 4, 5, 6 \Rightarrow$ infrared
Brackett	$n_1 = 4$	$n_2 = 5, 6, 7 \Rightarrow$ infrared
Pfund	$n_1 = 5$	$n_2 = 6, 7, 8 \Rightarrow$ infrared



📍 Note :-

Value of $l$	0	1	2	3	4	5	...
Designation	s	p	d	f	g	h	...

n	1	2	3	4	...
shell	K	L	M	N	....

Name	Symbol	Information provided	Permitted values
Principal	$n$	shell	1, 2, 3, 4...
Azimuthal	$l$	Subshell	0, 1, 2, 3...( $n-1$ )
Magnetic	$m_l$	orbital	- $l$ ... 0 ... + $l$
Spin	$m_s$	spin	+ $\frac{1}{2}$ - $\frac{1}{2}$

### → Bohr model

- Angular momentum quantized

$$mv\alpha = \frac{nh}{2\pi}$$

- Energy of the electron in a particular orbit of hydrogen atom

$$E_n = -R_H \left[ \frac{1}{n^2} \right]$$

OR

$$E_n = \frac{-2\pi^2 me^4}{n^2 h^2}$$

$$R_H = \text{Rydberg constant} = \frac{2\pi^2 me^4}{h^2}$$

$n = 1, 2, 3, \dots$

- Bohr radius

$$r_n = \frac{n^2 h^2}{4\pi^2 me^2 Z}$$

$$r_n = a_0 n^2$$

For hydrogen atom  $Z=1$ ,  $a_0 = 52.9 \text{ pm}$

- Velocity of electron in any orbit

$$v = \frac{2.19 \times 10^6 Z}{n} \text{ ms}^{-1}$$

- Number of revolution =  $\frac{2\pi m v z e^2}{n^2 h^2}$

→ Schrodinger wave equation

$$\frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} + \frac{\partial^2 \psi}{\partial z^2} + \frac{8\pi^2 m}{h^2} [E - V] \psi = 0$$

OR  $\hat{H}\psi = E\psi$

Hamiltonian operator

→ Angular momentum =  $\frac{\hbar}{2\pi} \sqrt{l(l+1)}$

→ Spin angular momentum =  $\frac{\hbar}{2\pi} \sqrt{s(s+1)}$

→ Volume of shell =  $4\pi r^2 dr$

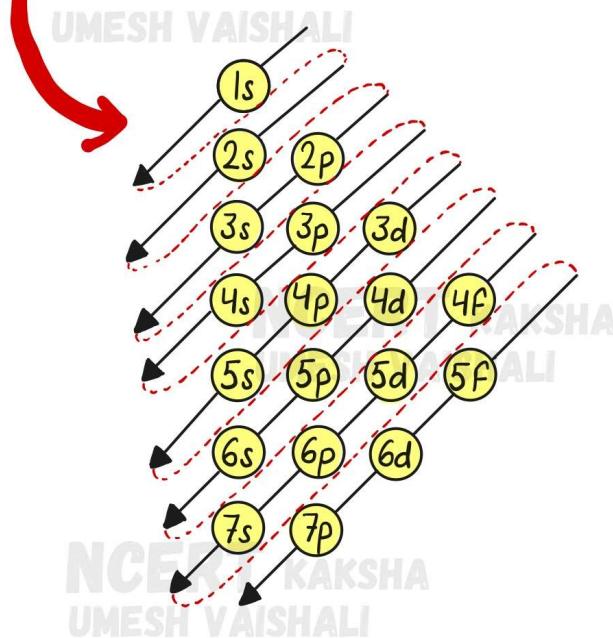
→ Total number of nodes =  $n-l$

→ Nodal planes or angular nodes =  $l$

→ Radial nodes =  $n-l-1$

• Note :- Sequence of energy levels

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s, 5f, 6d, 7p



Good Luck ..

## UNIT - 3

# Classification of Elements and Periodicity in Properties

→ Atomic number and Modern Periodic Law  $\sqrt{J} = a(Z-b)$

$J$  = Frequency of the emitted X-Ray

$a, b$  = Constants

$Z$  = atomic number

→ Covalent Radius  $r_{\text{covalent}} = \frac{\text{Inter nuclear distance between two-bonded atoms}}{2}$

→ Effective Nuclear charge  $Z^* = (Z-\sigma)$

$Z^*$  = Effective nuclear charge

$Z$  = actual nuclear charge

$\sigma$  = Screening constant

→ Mulliken's scale  $\text{Electronegativity} = \frac{\text{Ionization potential} + \text{Electron affinity}}{2}$

→ Allred - Rochow scale  $X = \frac{0.359 Z}{r^2} + 0.744$

Covalent radius of the atom in Å

Effective nuclear charge

$X$  = Electronegativity

→ Pauling's Scale  $X_A - X_B = 0.208 \sqrt{\Delta E}$   $\Delta E = \text{Actual bond energy} - \sqrt{(E_{A-A} \times E_{B-B})}$

Electronegativities of the atoms A and B

→ Relation between Pauling and Mulliken values of electronegativities

$$(\text{Pauling}) X = 0.34 X (\text{Mulliken}) - 0.2$$

→ Atomic volume  $\text{Atomic volume} = \frac{\text{Gram atomic weight}}{\text{Density in solid state}}$

📍 Note :- S-block General Electronic configuration =  $ns^{1-2}$

P-block General Electronic configuration =  $ns^2 np^{1-6}$

d-block General Electronic configuration =  $(n-1) d^{1-10} ns^{0-2}$

f-block General Electronic configuration =  $(n-2) f^{2-14} (n-1) d^{0-2} ns^2$

# UNIT - 4

# Chemical Bonding and Molecular Structure

→ Formal charge on an atom in a lewis structure  $FC = V - L - \frac{1}{2}S$

Where,  $FC$  = Formal charge on an atom

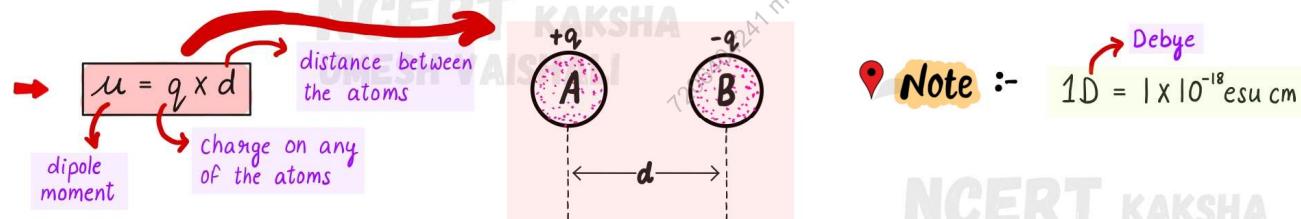
$V$  = Total number of valence electrons in the free atom

$L$  = Total number of electrons present as non-bonding (lone pair)

$S$  = Total number of bonding (shared) electron

→ Bond length  $R = r_A + r_B$   $r_A, r_B$  = covalent radii

→ Resonance energy = Actual bond Energy - Energy of the most stable of resonating structures



→ % ionic character =  $\frac{\text{observed dipole moment}}{\text{Dipole moment for complete ionic character}} \times 100$

→ Addition of wave functions (bonding molecular orbital)  $\Psi(\text{MO}) = \Psi_A + \Psi_B$   $\sigma = \Psi_A + \Psi_B$

→ Subtraction of wave functions (anti bonding molecular orbital)  $\Psi^*(\text{MO}) = \Psi_A - \Psi_B$   $\sigma^* = \Psi_A - \Psi_B$

→ Bond order =  $\frac{N_b - N_a}{2}$  Where  $N_b$  = Number of electrons in bonding MO  
 $N_a$  = Number of electrons in anti-bonding MO

→ Hybridization  $H = \frac{1}{2} [V + M - C + A]$

$H$  = number of orbitals involved in hybridization  
 $V$  = number of electrons in valence shell of the central atom  
 $M$  = number of monovalent atom  
 $C$  = charge on cation  
 $A$  = charge on anion

→ Note :- Bond order  $\propto$  stability of molecule  $\propto$  Dissociation energy  $\propto \frac{1}{\text{Bond length}}$

# UNIT - 5

## Chemical Thermodynamics

→ For isothermal irreversible change

$$q = -w = p_{ex} (V_f - V_i)$$

$V_i$  = initial volume

$V_f$  = final volume

$p_i$  = initial pressure

$p_f$  = final pressure

→ For isothermal reversible change

$$q = -w = nRT \ln \frac{V_f}{V_i} = 2.303 nRT \log \frac{V_f}{V_i} = 2.303 nRT \log \frac{P_i}{P_f}$$

→ Difference between internal Energies

$$\Delta U = U_A - U_B$$

$U_A, U_B$  = Internal Energies in states A and B

→ Work

$$W = F \times dl$$

$dl$  = displacement of the point of the application in the direction which force acts.

→ Law of conservation of Energy (First Law of Thermodynamics)

$$\Delta U = q + w$$

OR

Change in internal energy = [Heat added to the system] + [Work done on the system]

→ Enthalpy

$$H = U + PV$$

$U$  = internal energy

$V$  = Volume

$P$  = pressure

→ Enthalpy change

$$\Delta H = H_B - H_A$$

$H_A$  = Enthalpy of state A

$H_B$  = Enthalpy of state B

change in the no. of gaseous moles

→ Relation between  $\Delta H$  and  $\Delta U$

$$\Delta H = \Delta U + \Delta n_g RT$$

OR

$$P\Delta V = \Delta n_g RT$$

→ Note :-

Exothermic reaction

$$H_p < H_R$$

$\Delta U$  OR  $\Delta H$  = - ve

Endothermic reaction

$$H_p > H_R$$

$\Delta U$  OR  $\Delta H$  = + ve

→ Heat capacity

$$C = \frac{Q}{\Delta T}$$

heat  
temperature

→ Specific heat capacity OR Simply heat capacity

$$C_s = \frac{q}{m \times \Delta t}$$

→ Molal heat capacity

$$C_m = \frac{C}{n}$$

→ Relationship between  $C_p$  and  $C_v$

$$C_p - C_v = R$$

→ Standard Enthalpy

$$\Delta_n H^\circ = \sum_i a_i \Delta_f H^\circ (\text{products}) - \sum_i b_i \Delta_f H^\circ (\text{reactants})$$

→ Hess's Law

$$\Delta_n H = \Delta_n H_1 + \Delta_n H_2 + \Delta_n H_3 + \dots$$

$\Delta_{\text{hyd}} H^\circ$  = hydration enthalpy

$\Delta_{\text{lattice}} H^\circ$  = lattice enthalpy

$$\Delta_{\text{sol}} H^\circ = \Delta_{\text{lattice}} H^\circ + \Delta_{\text{hyd}} H^\circ$$

$\Delta_a H^\circ$  = Enthalpy of atomization

$\Delta_{\text{eg}} H^\circ$  = Electron gain Enthalpy

$\Delta_i H^\circ$  = ionisation Enthalpy

→ Standard Enthalpy of fusion

$$\Delta_{\text{fus}} H^\circ = H^\circ_{\text{liquid}} - H^\circ_{\text{solid}}$$

→ Enthalpy of Sublimation

$$\Delta_{\text{sub}} H^\circ = \Delta_{\text{fus}} H^\circ + \Delta_{\text{vap}} H^\circ$$

$\Delta_{\text{vap}} H^\circ$  = Enthalpy of vapourisation

→ Bond Enthalpy

$$B.E. = \frac{1}{4}(\Delta_a H^\circ)$$

→ Entropy

$$\Delta S = S(\text{final state}) - S(\text{initial state})$$

→ For reversible process,

$$\Delta S = \frac{q_{\text{rev}}}{T}$$

→ Total Entropy change

$$\Delta S_{\text{total}} = \Delta S_{\text{sys}} + \Delta S_{\text{sur}}$$

→ Entropy change during Phase transition

$$\Delta_{\text{trans}} S = \frac{q_{\text{rev}}}{T}$$

→ Entropy of fusion

$$S^\circ_{\text{water}} - S^\circ_{\text{ice}} = \Delta_{\text{fus}} S^\circ = \frac{\Delta_{\text{fus}} H^\circ}{T_f}$$

$\Delta_{\text{fus}} H^\circ$  = Enthalpy of fusion

$T_f$  = fusion temperature

→ Entropy of Vapourisation

$$\Delta_{\text{vap}} S^\circ = \frac{\Delta_{\text{vap}} H^\circ}{T_b}$$

$\Delta_{\text{vap}} S^\circ$  = Standard Enthalpy of vapourisation  
 $T_b$  = boiling point

→ Entropy of Sublimation

$$\Delta_{\text{sub}} S^\circ = \frac{\Delta_{\text{sub}} H^\circ}{T}$$

$\Delta_{\text{sub}} H^\circ$  = Enthalpy of sublimation

→ Gibbs Energy OR Gibbs function

$$G = H - TS$$

→ Gibbs Energy change

$$\Delta G = \Delta H - T \Delta S$$

$$\Delta G = -nFE$$

F = Faraday constant  
= 96500 C

E = e.m.f. of the cell

$\Delta_n G^\circ$  = Standard Gibbs Energy

$$\Delta G = \sum \Delta_f G^\circ (\text{products}) - \sum \Delta_f G^\circ (\text{reactants})$$

$$\Delta_n G = \Delta_n G^\circ + RT \ln Q$$

$$\text{OR } \Delta_n G^\circ = -2.303 RT \log K$$

→ Utility of Third Law of Thermodynamics

$$S = \int_0^T \frac{C_p}{T} dT$$

→ Standard Molar Entropy

$$\Delta_n S^\circ = \sum S^\circ (\text{products}) - \sum S^\circ (\text{reactants})$$

📍 Note :- Conditions of  $\Delta G$

$$\Delta G = -ve$$

Spontaneous process

$$\Delta G = 0$$

Equilibrium state

$$\Delta G = +ve$$

Non-Spontaneous process

- Mechanical work = Force (F) X Displacement (d)
- Electrical work = Potential Difference (V) X charge (q)
- Gravitational work = mgh

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UMESH Vaishali Didi ❤️  
Always with you

7206404241 mittaltarun712@gmail.com

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# UNIT - 6

## Equilibrium

→ Law of mass action

$$\text{Rate of reaction, } r = k [A]^a [B]^b [C]^c$$

$k$  = Rate constant OR Velocity constant

→ Law of Chemical Equilibrium

Rate of forward reaction = Rate of backward reaction

$$K = \frac{k_f}{k_b} = \text{Equilibrium constant}$$

OR  $\frac{k_f}{k_b} = \frac{[C][D]}{[A][B]}$

OR  $K = \frac{[C][D]}{[A][B]}$

→ Relationship between  $K_p$  and  $K_c$

$$K_p = K_c (RT)^{\Delta n_g}$$

→ Temperature dependence of Equilibrium constant (Vant Hoff Equation)

$$\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303 R} \left[ \frac{1}{T_1} - \frac{1}{T_2} \right]$$

$K_1, K_2$  = Equilibrium constant

$T_1, T_2$  = Temperature

$\Delta H$  = Enthalpy change

(i) If  $\Delta H = 0$  then  $K_2 = K_1$

(ii) If  $\Delta H = +ve$  then  $K_2 > K_1$

(iii) If  $\Delta H = -ve$  then  $K_2 < K_1$

📍 Note :- Equilibrium constant decreases with increase in temperature.

→ Relationship between  $K$ ,  $Q$  and  $\Delta G_r$

$$\Delta G_r = \Delta G_r^\circ + RT \ln Q$$

and

$$\Delta G_r^\circ = -2.303 RT \log K_c$$

→  $pH = -\log [H_3O^+]$

$pH = -\log [OH^-]$

$pH + pOH = pK_w = 14$

→ Henderson's equation for buffer solution

For acidic buffer,

$$pH = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

For basic buffer,

$$pH = 14 - pK_a - \log \frac{[\text{Salt}]}{[\text{Base}]}$$

→ Dissociation constants of acids

$$K_a = \frac{c \alpha^2}{1-\alpha} \approx c \alpha^2$$

$$\alpha = \sqrt{\frac{K_a}{c}}$$

$$[H_3O^+] = \sqrt{K_a \cdot c}$$

→ Dissociation constants of Base

$$K_b = \frac{c\alpha^2}{1-\alpha} \approx c\alpha^2$$

$$\alpha = \sqrt{\frac{K_b}{c}}$$

$$[\text{OH}^-] = \sqrt{K_b \cdot c}$$

📍 Note :-

$$pK_a = -\log K_a$$

Langen the value of  $pK_a$  weaken the acid is

$$pK_b = -\log K_b$$

Langen the value of  $pK_b$  weaken the base is

Salt	Example	$(K_H)$ Hydrolysis constant	$(h)$ Degree of Hydrolysis	pH of solution
Weak acid and strong Base	$\text{CH}_3\text{COONa}$	$\frac{K_w}{K_a}$	$\sqrt{\frac{K_w}{K_a \cdot c}}$	$\frac{1}{2} pK_w + \frac{1}{2} pK_a + \frac{1}{2} \log c$
Strong acid and Weak Base	$\text{NH}_4\text{Cl}$	$\frac{K_w}{K_a}$	$\sqrt{\frac{K_w}{K_b \cdot c}}$	$\frac{1}{2} pK_w - \frac{1}{2} pK_b - \frac{1}{2} \log c$
Weak acid and Weak Base	$\text{CH}_3\text{COONH}_4$	$\frac{K_w}{K_a \cdot K_b}$	$\sqrt{\frac{K_w}{K_a \cdot K_b}}$	$\frac{1}{2} pK_w + \frac{1}{2} pK_a - \frac{1}{2} pK_b$
Strong acid and strong Base	$\text{NaCl}$			Does not undergo hydrolysis

Never give up 

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## UNIT - 7

# Redox Reactions

### Oxidation & Reduction

#### Electronic concept

**Oxidation:** A process in which one or more electrons are lost.

**Reduction:** A process in which one or more electrons are gained.

**Oxidising agent OR oxidant:** A substance which can accept one or more electrons.

**Reducing agent or reductant:** A substance which can give one or more electrons.

### In terms of oxidation number

**Oxidation:** A process which involves increase in oxidation number.

**Reduction:** A process which involves decrease in oxidation number.

**Oxidising agent:** A substance whose oxidation number decreases.

**Reducing agent:** A substance whose oxidation number increases.

## Oxidation Number

- For elementary state, O.N. is zero.  
e.g., He (O.N. = 0), H<sub>2</sub> (O.N. = 0), S<sub>8</sub> (O.N. = 0)
- Oxidation number of hydrogen is +1 except in hydrides NaH, LiH, CaH<sub>2</sub> (-1).
- Oxidation number of oxygen is always -2 except  
in peroxides, H<sub>2</sub>O<sub>2</sub>, Na<sub>2</sub>O<sub>2</sub> (-1)  
in superoxides KO<sub>2</sub> (-1/2)  
in OF<sub>2</sub> (+2)  
O<sub>2</sub>F<sub>2</sub> (+1)
- Combination reaction 2Mg + O<sub>2</sub> → 2MgO
- Decomposition reaction 2KC1O<sub>3</sub> → 2KC1 + 3O<sub>2</sub>
- Displacement reaction CuSO<sub>4</sub> + Zn → Cu + ZnSO<sub>4</sub>  
Sn + 2HCl → SnCl<sub>2</sub> + H<sub>2</sub>  
Br<sub>2</sub> + 2I<sup>-</sup> → 2Br<sup>-</sup> + I<sub>2</sub>

## → Equivalent Weight (E) of oxidant and Reductant

$$\text{Equivalent Weight} = E = \frac{M_0}{X}$$

where  $M_0$  = molecular mass

$X$  = number of electrons transferred (loss or gain) by one mole of oxidising or reducing agent as given by their balanced ionic half reaction

## → Equivalent Mass

$$\text{equivalent mass} = \frac{\text{molar mass}}{n - \text{Factor}}$$

- Element

$$E = \frac{\text{Atomic mass of element}}{\text{Valence of element}}$$

- Ion

$$E = \frac{\text{Formula mass of ion}}{\text{charge on ion}}$$

- Salt

$$E = \frac{\text{Formula mass of salt}}{\text{Total positive or negative charge on cationic or anionic part}}$$

- Acid

$$E = \frac{M_{\text{acid}}}{\text{Basicity}}$$

- Base

$$E = \frac{M_{\text{base}}}{\text{Acidity}}$$

- Acid salt

$$E = \frac{M}{\text{Replaceable 'H' left in the salt}}$$

- Redox change

$$E = \frac{\text{M}_{\text{oxidant or reductant}}}{\text{Number of electrons lost or gained by one molecule of oxidant or reductant}}$$

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# UNIT - 8

# Organic Chemistry - Some Basic Principles and Techniques

→ IUPAC System of Naming Organic Compounds

(i) Word root

Chain length	Word root	chain length	word root
C <sub>1</sub>	Meth	C <sub>8</sub>	Oct
C <sub>2</sub>	Eth	C <sub>9</sub>	Non
C <sub>3</sub>	Prop	C <sub>10</sub>	Dec
C <sub>4</sub>	But	C <sub>11</sub>	Undec
C <sub>5</sub>	Pent	C <sub>12</sub>	Dodec
C <sub>6</sub>	Hex	C <sub>20</sub>	Icosane
C <sub>7</sub>	Hept	C <sub>30</sub>	Triacontane

(ii) Suffix

(a) Primary suffix

ane — for single bonded compounds, C—C

ene — for double bonded compounds, C=C

yne — for triple bonded compounds, C≡C

(b) Secondary suffix

Class of organic compound

Functional group

Secondary suffix

Alcohols

-OH

-ol

Aldehydes

-CHO

-al

Ketones

>C=O

-one

Carboxylic acid

-COOH

-oic acid

Esters

-COOR

alkyl.....oate

Acid chlorides

-COCl

-oyl chloride

Acid amides

-CONH<sub>2</sub>

-amide

Nitriles

-C≡N

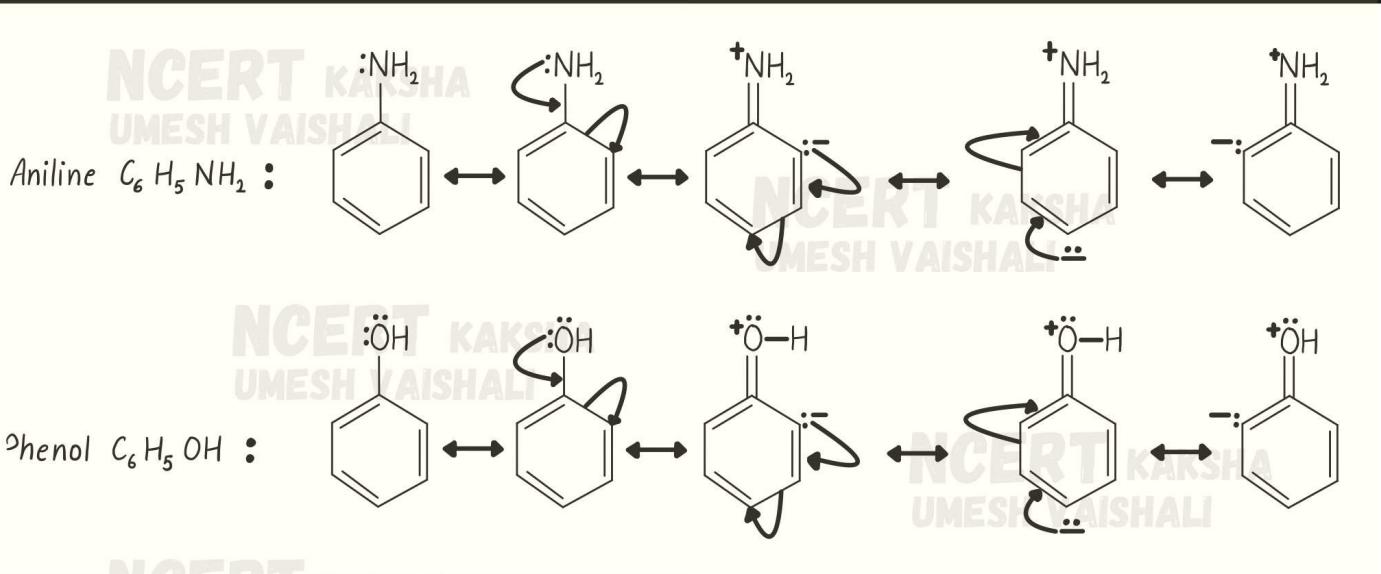
-nitrile

Amines

-NH<sub>2</sub>

-amine

## → Resonance



## Estimation of Elements

$$\% C = \frac{12}{44} \times \frac{\text{Mass of } CO_2}{\text{Mass of compound}} \times 100$$

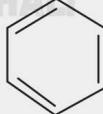
$$\% H = \frac{2}{18} \times \frac{\text{Mass of } H_2O}{\text{Mass of compound}} \times 100$$

$$\% N = \frac{28}{22400} \times \frac{\text{Vol. of } N_2 \text{ at STP}}{\text{Mass of compound}} \times 100 \quad (\text{Duma's method})$$

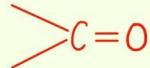
$$= \frac{1.4 \times \text{Molarity of acid} \times \text{Basicity} \times \text{Vol. of acid used}}{\text{Mass of compound}} \times 100 \quad (\text{Kjeldahl's method})$$

$$\% X_{(\text{halogen})} = \frac{\text{At. mass of } X \times \text{Mass of } AgX}{(108 + \text{At. mass of } X) \times \text{Mass of compound}} \times 100$$

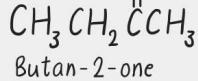
$$\% S = \frac{32}{233} \times \frac{\text{Mass of } BaSO}_4 \times 100$$

Class of Compounds	Functional group	General Formula	Suffix or Prefix	Examples
Alkenes	$-C=C-$	Suffix-ene $C_nH_{2n}$	Replace 'ane' of alkane by 'ene'	$CH_3CH_2CH=CH_2$ But-1-ene $CH_3CH=CHCH_3$ But-2-ene
Alkynes	$-C\equiv C-$	$C_nH_{2n-2}$	Suffix-yne Replace 'ane' of alkane by 'yne'	$HC\equiv CCH_2CH_3$ But-1-yne $H_3CC\equiv CCH_3$ But-1-yne
Arenes				 Benzene
Haloalkanes	$-X$ ( $X=F, Cl, Br, I$ )	$RX$	Prefix-halo named as haloalkanes	$CH_3CH_2CH_2CH_2Cl$ 1-Chlorobutane $CH_3CH(CH_3)CH_2CH_3$ $\begin{array}{c}   \\ Cl \end{array}$ 2-Chlorobutane
Alcohols	$-OH$	$R-OH$	Suffix-ol Replace 'e' of alkane by 'ol'	$CH_3CH_2CH_2CH_2OH$ Butan-1-ol $CH_3CH_2CH(OH)CH_3$ $\begin{array}{c}   \\ OH \end{array}$ Butan-2-ol
Thiols	$-SH$	$R-SH$	Suffix-thiol Replace 'e' of alkane by 'thiol'	$CH_3CH_2CH_2CH_2SH$ Butan-1-thiol
Ethers	$-O-$	$R-O-R'$ ( $R'$ may be R)	Prefix-alkoxy named as 'alkoxy' alkane	$CH_3CH_2OCH_2CH_3$ Ethoxy ethane $CH_3OCH_2CH_2CH_3$ Methoxy propane
Aldehydes	$\begin{array}{c} H \\   \\ C=O \end{array}$	$R-C\begin{array}{c} H \\    \\ O \end{array}$	Suffix-al Replace 'e' of alkane by 'al'	$CH_3CH_2CH_2CHO$ Butanal

## Ketones

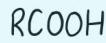
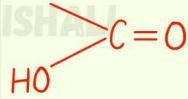


Suffix - one  
Replace 'e' of alkane by 'one'

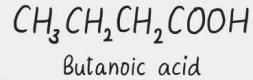


Butan-2-one

## Carboxylic acid



Suffix -oic acid  
Replace 'e' of alkane by 'oic' acid

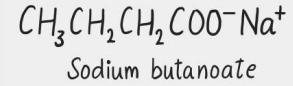


Butanoic acid

## Carboxylate ion



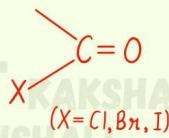
Suffix -oate  
Replace 'ie' acid of the



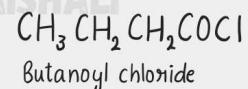
Sodium butanoate

## Carboxylic acid derivatives

### (i) Acetyl halides

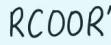
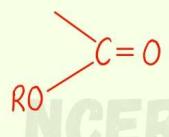


Suffix -oyl halide  
Replace -ic of the corresponding acid by 'yl' halide

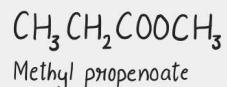


Butanoyl chloride

### (ii) Esters

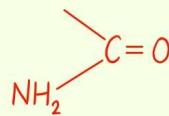


Prefixing name of the alkyl group and replacing '-ic' acid of the corresponding acid by 'ate'.

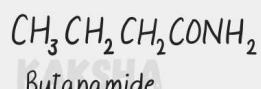


Methyl propenoate

### (iii) Amides

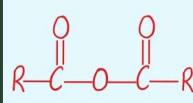
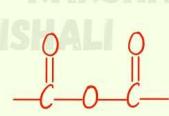


Suffix - amide  
Replace 'oic' acid of corresponding acid by 'amide'

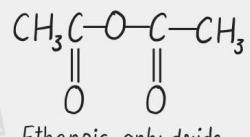


Butanamide

### (iv) Acid anhydrides

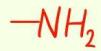


Add anhydride to the name of corresponding acid

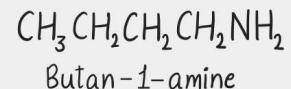


Ethanoic anhydride

## Amines



Suffix - amine  
prefix amino named as 'amino alkane' or 'alkanamine'.



Butan-1-amine

## Cyanides

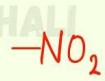


Suffix - nitrile  
Add nitrile after the name of alkane

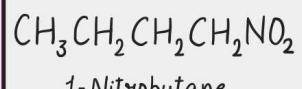


Butanenitrile

## Nitro



Prefix nitro  
Add nitro before the name of alkane



1-Nitrobutane

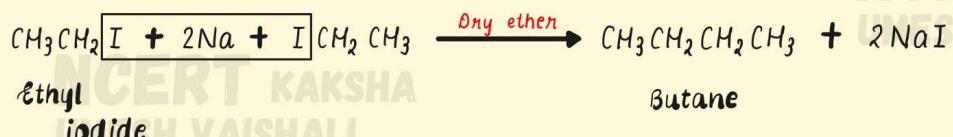
UNIT - 9

# Hydrocarbons

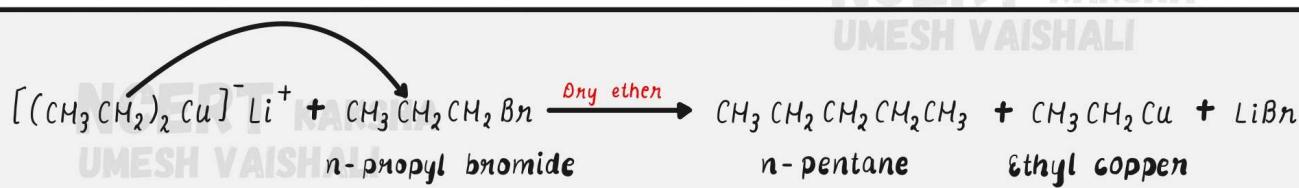
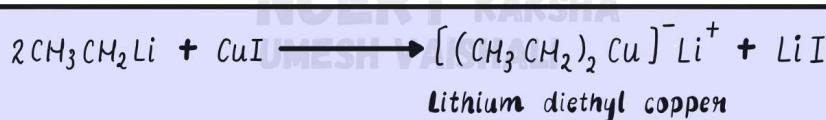
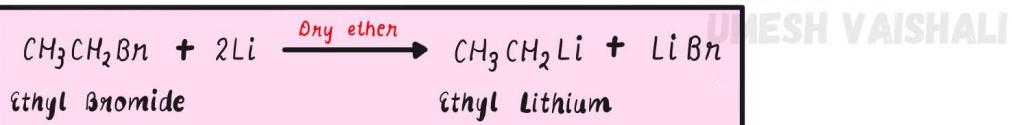
## Nomenclature of Alkanes

No. of carbon atoms	Formula	Name
1	$\text{CH}_4$	Methane
2	$\text{C}_2\text{H}_6$	Ethane
3	$\text{C}_3\text{H}_8$	Propane
4	$\text{C}_4\text{H}_{10}$	Butane
5	$\text{C}_5\text{H}_{12}$	Pentane
6	$\text{C}_6\text{H}_{14}$	Hexane
7	$\text{C}_7\text{H}_{16}$	Heptane
8	$\text{C}_8\text{H}_{18}$	Octane
9	$\text{C}_9\text{H}_{20}$	Nonane
10	$\text{C}_{10}\text{H}_{22}$	Decane
11	$\text{C}_{11}\text{H}_{24}$	Undecane
12	$\text{C}_{12}\text{H}_{26}$	Dodecane
20	$\text{C}_{20}\text{H}_{42}$	Eicosane
30	$\text{C}_{30}\text{H}_{62}$	Triacontane

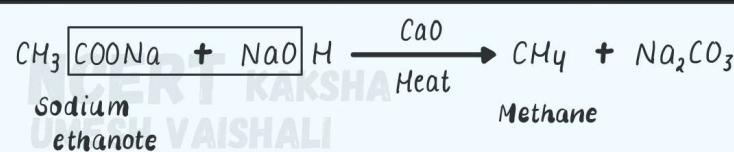
## → Wurtz Reaction :-



## **→ Coney - Mous Reaction :-**



## → Decarboxylic Reaction :-



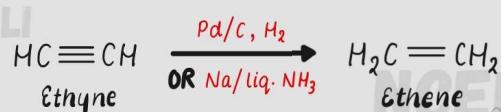
## → Swarts Reaction :-



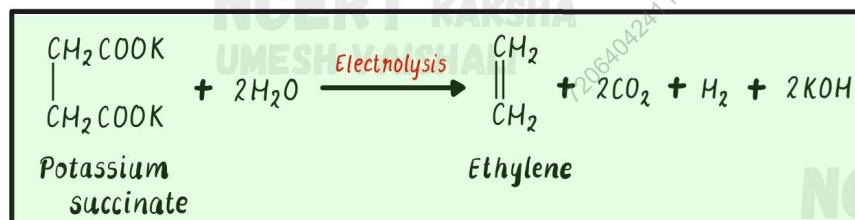
 **Note :-** • The reactivity of halogenation is therefore,

fluorine > chlorine > bromine > iodine

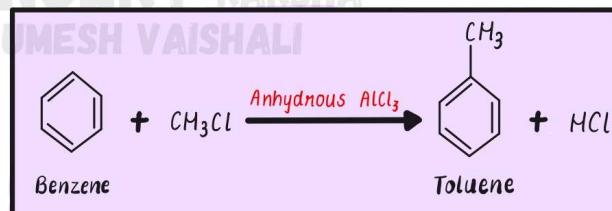
## Birch Reduction



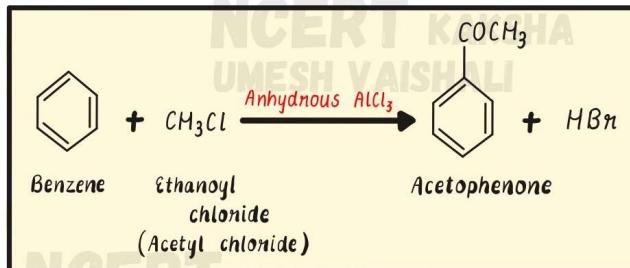
### → Kolbe's Reaction :-



## **Friedel-Crafts Alkylation reaction :-**



## **→ Friedal - Crafts Acylation reaction :-**



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## IUPAC Names of some unbranched Saturated Hydrocarbons

## Common Names of some unbranched Organic Hydrocarbons

Name	Molecular Formula
Methane	$\text{CH}_4$
Ethane	$\text{C}_2\text{H}_6$
Propane	$\text{C}_3\text{H}_8$
Butane	$\text{C}_4\text{H}_{10}$
Pentane	$\text{C}_5\text{H}_{12}$
Hexane	$\text{C}_6\text{H}_{14}$
Heptane	$\text{C}_7\text{H}_{16}$
Octane	$\text{C}_8\text{H}_{18}$
Nonane	$\text{C}_9\text{H}_{20}$
Decane	$\text{C}_{10}\text{H}_{22}$

Compound	Common Name
$\text{CH}_4$	Methane
$\text{H}_3\text{CCH}_2\text{CH}_2\text{CH}_3$	<i>n</i> - butane
$(\text{H}_3\text{C})_2\text{CHCH}_3$	Isobutane
$(\text{H}_3\text{C})_4\text{C}$	Neopentane
$\text{H}_3\text{CCH}_2\text{CH}_2\text{OH}$	<i>n</i> - propyl alcohol
$\text{HCHO}$	Formaldehyde
$(\text{H}_3\text{C})_2\text{CO}$	Acetone
$\text{CHCl}_3$	Chloroform
$\text{CH}_3\text{COOH}$	Acetic acid
$\text{C}_6\text{H}_6$	Benzene
$\text{C}_6\text{H}_5\text{OCH}_3$	Anisole
$\text{C}_6\text{H}_5\text{NH}_2$	Aniline
$\text{C}_6\text{H}_5\text{COCH}_3$	Acetophenone
$\text{CH}_3\text{OCH}_2\text{CH}_3$	Ethyl Methyl Ether

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# PERIODIC TABLE

		Periodic Table																																			
		GROUP 1		Periodic Table														GROUP 18																			
		1 H		2 Li Be		Periodic Table												18 He																			
		1 Hydrogen 1.008	2 Lithium 6.94	3 Beryllium 9.012	4 Boron 10.81	5 Carbon 12.01	6 Nitrogen 14.01	7 Oxygen 16.00	8 Fluorine 19.00	9 Neon 20.18	10 Helium 4.003	11 Sodium 22.99	12 Magnesium 24.31	13 Aluminum 26.98	14 Silicon 28.09	15 Phosphorus 30.97	16 Sulfur 32.06	17 Chlorine 35.45	18 Argon 39.95																		
		Alkali Metals	Non-metals	Alkaline Earth Metals	Halogens	Transition Metals	Noble Gases	Other Metals	Lanthanides	Metalloids	Actinides																										
		Potassium 39.10	Chromium 52.00	Manganese 54.94	Iron 55.85	Cobalt 58.93	Nickel 58.69	Copper 63.55	Zinc 65.39	Gallium 69.72	Germanium 72.64	Silicon 74.92	Asenic 74.92	Antimony 75.96	Bromine 79.90	Krypton 83.81																					
		Calcium 40.08	Titanium 47.98	Vanadium 50.94	Chromium 52.00	Manganese 54.94	Iron 55.85	Cobalt 58.93	Nickel 58.69	Copper 63.55	Zinc 65.39	Gallium 69.72	Germanium 72.64	Silicon 74.92	Asenic 74.92	Antimony 75.96	Bromine 79.90	Krypton 83.81																			
		Sodium 22.99	Magnesium 24.31	Scandium 44.96	Titanium 47.98	Vanadium 50.94	Chromium 52.00	Manganese 54.94	Iron 55.85	Cobalt 58.93	Nickel 58.69	Copper 63.55	Zinc 65.39	Gallium 69.72	Germanium 72.64	Silicon 74.92	Asenic 74.92	Antimony 75.96	Bromine 79.90	Krypton 83.81																	
		Rubidium 85.47	Samarium 87.62	Yttrium 88.91	Zirconium 91.22	Niobium 92.91	Molybdenum 95.96	Technetium 98.00	Ruthenium 101.1	Rhenium 102.9	Palladium 106.4	Silver 107.9	Indium 114.8	Tin 118.7	Antimony 121.8	Tellurium 127.6	Iodine 128.9	Xenon 131.3																			
		Cesium 133.9	Barium 137.3	Lanthanides	Hafnium 178.5	Tantalum 181.9	Tungsten 183.9	Rhenium 186.2	Osmium 190.2	Iridium 192.2	Platinum 195.1	Gold 197.0	Mercury 204.58	Thallium 204.38	Lead 207.2	Bismuth 209.0	Poison (209)	Astatine (210)																			
		Francium (223)	Radium (226)	Actinides	Rutherfordium (265)	Dubnium (268)	Sesquiboron (271)	Borium (270)	Hassium (277)	Metavelmum (278)	Darmstadtium (281)	Roentgenium (289)	Copernium (285)	Nihonium (284)	Flerovium (289)	Moscovium (288)	Livermorium (293)	Tennessine (294)	Oganesson (294)																		
		Lanthanum 138.9	Cerium 140.1	Praseodymium 141.9	Neodymium 144.2	Promethium (145)	Samarium 150.4	Europeum 152.0	Gadolinium 157.2	Terbium 158.9	Dysprosium 162.5	Holmium 164.9	Erbium 161.9	Thulium 168.9	Ytterbium 173.0	Lutetium 175.0																					
		Actinium (227)	Thorium (232.0)	Protactinium (231.0)	Uranium 238.0	Neptunium (237)	Plutonium (244)	Americium (243)	Curium (247)	Berkelium (247)	Californium (251)	Einsteinium (252)	Fermium (257)	Mendelevium (258)	Nobelium (259)	Lawrencium (262)																					

f-block

l

b-block

g-block

d-block

p-block

# SOME CHEMICAL COMPOUND NAMES & MOLECULAR FORMULAS

Compound Name	Molecular Formula	Compound Name	Molecular Formula
Acetic acid	$\text{CH}_3\text{COOH}$	Potassium Nitrate	$\text{KNO}_3$
Hydrochloric acid	$\text{HCl}$	Ammonium chloride	$\text{NH}_4\text{Cl}$
Sulfuric acid	$\text{H}_2\text{SO}_4$	Ammonium hydroxide	$\text{NH}_4\text{OH}$
Acetate	$\text{CH}_3\text{COO}^-$	Calcium nitrate	$\text{Ca}(\text{NO}_3)_2$
Ammonia	$\text{NH}_3$	Hydrogen Peroxide	$\text{H}_2\text{O}_2$
Nitric acid	$\text{HNO}_3$	Silver chloride	$\text{AgCl}$
Phosphoric acid	$\text{H}_3\text{PO}_4$	Barium Sulphate	$\text{BaSO}_4$
Sodium Phosphate	$\text{Na}_3\text{PO}_4$	Magnesium Sulphate	$\text{MgSO}_4$
Calcium carbonate	$\text{CaCO}_3$	Sodium sulphite	$\text{Na}_2\text{SO}_3$
Sodium Bicarbonate	$\text{NaHCO}_3$	Oxalic acid	$\text{H}_2\text{C}_2\text{O}_4$
Sodium Hydroxide	$\text{NaOH}$	Potassium dichromate	$\text{K}_2\text{Cr}_2\text{O}_7$
Calcium Hydroxide	$\text{Ca}(\text{OH})_2$	Zinc chloride	$\text{ZnCl}_2$
Ethanol	$\text{C}_2\text{H}_5\text{OH}$	Zinc hydroxide	$\text{Zn}(\text{OH})_2$
Nitrous Acid	$\text{HNO}_2$	Zinc Sulphate	$\text{ZnSO}_4$
Potassium Hydroxide	$\text{KOH}$	Phosphorus Pentachloride	$\text{PCl}_5$
Silver nitrate	$\text{AgNO}_3$	Sodium nitrite	$\text{NaNO}_2$
Sodium carbonate	$\text{Na}_2\text{CO}_3$	Potassium Permagnate	$\text{KMnO}_4$
Magnesium Hydroxide	$\text{Mg}(\text{OH})_2$	Boric acid	$\text{H}_3\text{BO}_3$
Methane	$\text{CH}_4$	Potassium nitrite	$\text{KNO}_2$
Sodium chloride	$\text{NaCl}$	Tartaric acid	$\text{C}_4\text{H}_6\text{O}_6$
Carbon tetrachloride	$\text{CCl}_4$	Aluminium Hydroxide	$\text{Al}(\text{OH})_3$
Sodium Sulphate	$\text{Na}_2\text{SO}_4$	Iron oxide	$\text{Fe}_2\text{O}_3$