inteli Class

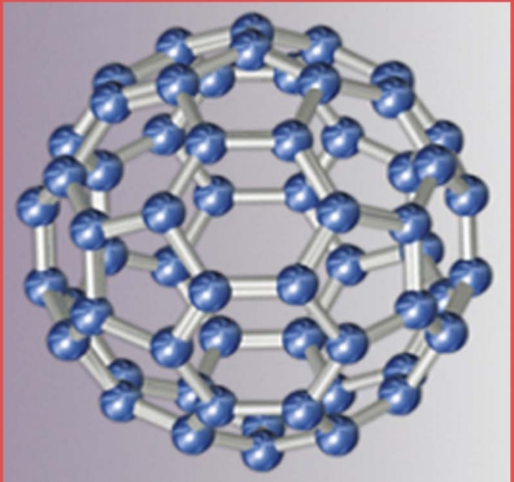
CHEMISTRY

Shortcuts Formulas

IIT- JEE

e-book

© Wordprints.com



Free Edition

TABLE OF CONTENT

PHYSICAL CHEMISTRY

INORGANIC CHEMISTRY

ORGANIC CHEMISTRY

PHYSICAL CHEMISTRY

ATOMIC STRUCTURE

1. $r_n = \frac{n^2h^2}{4\pi^2 mZe^2} = 0.529\left(\frac{n^2}{Z}\right)A, r_n = n^2 \times r_1$

2. $E_T = KE = \frac{PE}{2} = -13.6\frac{Z^2}{n^2}eV$

3. $\Delta E = \frac{hc}{\lambda} = \frac{2\pi^2 me^4}{h^2}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

4. $\bar{v} = \frac{1}{\lambda} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right], \left[R = 1.0968 \times 10^7 m^{-1}\right]$

5. Total no. of spectrum lines= $\frac{n(n-1)}{2}$

6. Heisenberg Uncertainty Principle $(\Delta x)(\Delta p) \geq h/4\pi$

7. Moseley's law : $\sqrt{v} = a(Z-b), E_n = -\frac{13.7}{n^2}eV/atom$

8. Nodes (n -1) = total nodes, l= angular nodes, (n – l – 1) = Radial nodes

9. Photoelectric effect: $hv = hv_0 + \frac{1}{2}mv^2$

10. Orbital angular momentum: $\sqrt{l(l+1)}\frac{h}{2\pi}$

CHEMICAL BONDING

1. $\%\text{ ionic character} = \dfrac{\text{Actual dipole moment}}{\text{Calculated dipole moment}} \times 100$

2. Fajan's Factors: following factors are helpful in including covalent character in ionic compounds

(a) Small cation
(b) Big anion
(c) High charge on cation
(d) High charge on anion
(e) Cation having pseudo inert gas configuration ($ns^2p^6d^{10}$) e.g. Cu+, Ag^+, Zn^{2+}, Cd^{2+}

3. $-\Delta H_f = H_S + \frac{1}{2} H_d + IE + \Delta H_{EG} - E_L$

4. M.O. theory:

(a) $\text{Bond order} = \frac{1}{2}(N_b - N_a)$

(b) Higher the bond order, higher is the bond dissociation energy, greater is the stability, and shorter is the bond length.

(c)

Species	Bond order	Magnetic properties
H_2	1	Diamagnetic
H_2^+	0.5	Paramagnetic
Li_2	1	Diamagnetic

5. $Q = \frac{1}{2}[V + SA - (\pm q)]$

6. $\text{Former charge} = \text{V-}\left(L + \frac{1}{2} S\right)$

7. VSEPR theory

(a) (LP – LP) repulsion > (LP – BP) > (BP – BP)
(b) For NH_3→ Bond Angle $106^0 45'$ because H_2O molecule contains 2LP and 2BP where as NH_3has ILP and 3BP.

8. Bond angle:

Decrease in bond angle down the gp is due to LP – BP repulsion

(a)NH_3> PH_3 > AsH_3
(b)H_2O > H_2S > H_2Se

CHEMICAL EQUILIBRIUM

1. $K_p = K_{c}(RT)^{?n_g}$ where $\Delta n_g = n_p - n_R$

2. Free Energy change($G\Delta$)

(a) If $G\Delta = 0$ then reversible reaction would be equilibrium.
(b) If $G\Delta = (+)$ ve then equilibrium will displace in backward direction.
(C) If $G\Delta = (-)$ ve then equilibrium will displace in forward direction.

3. (a) K_c unit → $(\text{moles/li})^{\Delta n}$
   (b) K_p unit → $(\text{atm})^{\Delta n}$
   (c) Total molecule at equlibrium =[total initial moles $+\Delta n$]
   (d) Time required to establish equlibrium α $1/k_c$
   (e) If in any heterogeneous equilibrium solid substance is also present then its active mass & partial pressure is assumed 1.

4. Le chatelier's principle
(i) Increase of reactant conc. (Shift forward)
(ii) Decrease of reactant conc. (Shift backward)
(iii) Increase of pressure (from more moles to less moles)
(iv) Decrease of pressure (from less moles to more moles)
(v) For exothermic reaction decrease in temp. (Shift forward)
(vi) For endothermic increase in temp. (Shift forward)$_c$Time Total

ACID BASE

1.(a). Lewis Acid (e^- pair acceptor) → CO_2, BF_3, $Alcl_3$, $Zncl_2$, $Fecl_3$, PCl_3, $Sicl_4$, SF_6, normal cation

(b). Lewis Base (e- pair donor) NH_3, ROH, ROR, H_2O, RNH_2, R_2NH, R_3N, normal anion

2. Dissociation of Weak Acid & Weak Base →

(a). Weak Acid → $K_a = Cx^2 / (1\text{-}x)$ or $K_a = Cx^2$

(b). Weak Base → $K_b = Cx^2 / (1\text{-}x)$ or $K_b = Cx^2$

3. **Buffer solution:**

(a) Acidic → $pH = pK_a + \log\{salt / Acid\}$ for Maximum buffer action $pH = pK_a$
Range of Buffer $pH = pK_a \pm 1$

(b) Alkaline → $pOH = pK_b + \log\{Salt/Base\}$ for max.
Buffer range for basic buffer $= pK_b \pm 1$

(c) $$\text{Buffer Capacity} = \frac{\text{Moles/lit of Acid or Base Mixed}}{\text{Change in pH}}$$

$$B = \frac{dCBOH}{dpH} = -\frac{dCHB}{dpH}$$

4. Necessary condition for showing neutral colour of Indicator $pH = pKln$ or $[HIn] = [In^-]$ or $[InOH]=[In^+]$

IONIC EQULIBRIUM

1. Relation between ionisation neutral constant (K_i) & degree of ionisation (α): –

$$Ki = \frac{\alpha^2}{(1\text{-}\alpha)V} = \frac{\alpha^2 C}{(1\text{-}\alpha)} \text{(Ostwald's dilution law)}$$

It is applicable to weak electrolytes for which $\alpha << 1$ then $\alpha = \sqrt{K_i V} = \sqrt{\frac{K_i}{C}} or V \uparrow C \downarrow \alpha \uparrow$

2. Common ion effect : By addition of X mole/ L of a common ion, to a weak acid (or weak base) α becomes equal to $\frac{K_a}{X}\left(or \frac{K_b}{X}\right)$ [where α=degree of dissociation]

3. (A) If solubility product = ionic product then the solution saturates.

(B). If solubility product > ionic product then the solution is unsaturated and more of the substance can be dissolved in it.

(C). Id ionic product > solubility product the solution is super saturated (principle of precipition).

4. Salt of weak acid and strong base:

$$pH = 0.5(pK_w + pK_a + \log c)$$

Salt of weak base and strong acid

$$pH = 0.5(pK_w - pK_b - \log c)$$

Salt of weak acid and weak base:

$$pH = 0.5(pK_w + pK_a - pK_b)$$

CHEMICAL KINETICS

1. **Unit of Rate constant:**

   $K = mol^{1-\Delta n} lit^{\Delta n-1} \sec^{-1}$

2. **First Order reaction:**

   $K = \frac{2.303}{t}\log_{10}\frac{a}{a-x} \ \& \ t_{1/2} = \frac{0.693}{K}$

   $[A]_t = [A]_0 e^{-kt}$

3. **Second Order Reaction:**
   When concentration of A and B taking same.

   $K_2 = \frac{1}{t}\left(\frac{x}{a(a-x)}\right)$

   When concentration of A and b are taking different-

   $K_2 = \frac{2.303}{t(a-b)}\log\frac{b(a-x)}{a(b-x)}$

4. **Zero Order Reaction:**

   $K = \frac{a_0 - a_t}{t}$

   $x = kt \ \& \ t_{1/2} = \frac{a_0}{2K}$

5. **Arrhenius equation:**

   $K = Ae^{-E_a/RT} \ \& \ slope = \frac{-E_a}{2.303RK}$

   $when T \rightarrow \infty, then k = A\left(\therefore e^{-E_a/RT} = 1\right)$

6. $\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$

OXIDATION-REDUCTION

1. Oxidant itself is reduced (gives O_2)
   Or Oxidant → e^-(s) Acceptor
   Reductant itself is oxidised (gives H_2)
   Or reductant → e^-(s) Donor

2. (i) Strength of acid α O.N
   (ii) Strength of base α 1/ O.N

3. (a) Electro Chemical Series:- Li, K, Sr, Ca, Na, Mg, Al, Mn, Zn, Cr, Fe, Cd, Co, Ni, Sn, Pb, H_2, Cu, I_2, Hg, Ag, Br_2, Cl_2, Pt, Au, F_2

   (b)As we move from top to bottom in this series
   - (1) Standard Reduction Potential ↑
   - (2) Standard Oxidation Potential↓
   - (3) Reducing Capacity ↓
   - (4) Ip↑
   - (5) Reactivity↓

4. (a) Formal charge = Group No. – [No. of bonds+ No. of non- bonded e^{-s}]

   (b)At A node → Oxidation, Cathode → Reduction

VOLUMETRIC ANALYSIS

1. $$\text{Equivalent weight of element} = \frac{\text{Atomic wt of the element}}{\text{n factor}}$$

2. $$\text{Equivalent weight of Compound} = \frac{\text{Formula wt of the compound}}{\text{n factor}}$$

3. $$\text{Equivalent weight of an ion} = \frac{\text{Formula wt (or At. Wt.)of ion}}{\text{its valency}}$$

4. The law of dulong and petit
   Atomic wt. × specific heat ≈ 6.4

5. $$\text{Normality (N)} = \frac{\text{Number of equivalents of solute}}{\text{Volume of the solution in liters}}$$

6. $$\text{Molarity (M)} = \frac{\text{Number of moles of solute}}{\text{Volume of the solution in liters}}$$

7. When a solution is diluted
   $N_1 \times V_1 = N_2 \times V_2$
   (before dilution) (after dilution)

8. Common acid- base indicators

Indicator	Colour in acidic medium	Colour in alkaline medium	pH range
Methyl orange	Pink	Yellow	3.0-4.4
Methyl red	Red	Yellow	4.2-6.2
Litmus	Red	Blue	5.5-7.5
Phenolphthalein	Colourless	Pink	8.3-9.8

MOLE CONCEPT

1.Mole concept

GAM $\equiv 1\text{gm atom} \equiv 6.02\times10^{23}$ atom.

GAM $\equiv 1\text{gm molecule} \equiv 6.02\times10^{23}$ molecules.

$N_A = 6.02\times10^{23}$

2.Moles (gases)at NTP=$\dfrac{volume(L)}{22.4}$

3.Molecular mass=$2\times$vapour density

CHEMICAL ENERGETICS

1. First Law: $\Delta E = Q + W$

Expression for pressure volume work $W = -P\Delta V$

Maximum work in a reversible expansion:

$$W = -2.303n\,RT\,\log\frac{V_2}{V_1} = -2.303nRT\log\frac{P_1}{P_2}$$

2. Enthalpy and heat content: $\Delta H = \Delta E + P\Delta V$

$[q_{(p)} = q_{(v)} + \Delta n_g RT]$ $\quad\Delta H = \Delta E + \Delta n_g RT$

$[\Delta n_g = n_{p(g)} - n_{r(g)}]$

3.Kirchoff's equation:

$\Delta E_{T_2} = \Delta E_{T_1} + \Delta C_v(T_2 - T_1)[cons\tan t\,V]$

$\Delta H_{T_2} = \Delta H_{T_1} + \Delta C_p(T_2 - T_1)[cons\tan t\,P]$

4. Entropy(s): Measure of disorder or randomness

$\Delta S = \sum S_p - \sum S_R$

$$\Delta S = \frac{q_{rev}}{T} = 2.303nr\log = \frac{V_2}{V_1} = 2.303nr\log\frac{P_1}{P_2}$$

5. free energy change: $\Delta G = \Delta H - T\Delta S$

$\Delta G < 0$(Spontaneous) [-ve]$\Delta G = 0(equilibrium)$

$\Delta G > 0$(non-spontaneous) [+ve]

$-\Delta G = W$(maximum) $-P\Delta V$

ϕH	ϕS	ϕG	Reaction characteristics
-	+	Always Negative	Reaction is spontaneous at all temperature.
+	-	Always Positive	Reaction is no spontaneous at all temperature.
-	-	Negative at low temperature but positive at high temperature	Spontaneous at low temp. & non spontaneous at high temperature.
+	+	Positive at low temperature but negative at high temperature	Non spontaneous at low temperature & spontaneous at high temperature.

ELECTRO CHEMISTRY

1. M = Z. I.t

2. Degree of dissociation: $\alpha = \frac{\lambda_{eq}}{\lambda_{eq}^{\infty}} = \frac{\text{Equivalent conductance at given concentration}}{\text{equivalent conductance at infinite dilution}}$

3. $Kohlrausch's law: \Delta_m^0 = x\lambda_A^0 + y\lambda_B^0$

4.Nernst Equation

$$E = E^0 - \frac{0.0591}{n}\log_{10}\frac{[Products]}{[Reactants]} \;\&\; E^0{}_{cell} = E^0{}_{anode} + E^0{}_{cathode} \;\&\; Keq = \text{antilog}\left[\frac{nFE^0}{0.0591}\right]$$

$$\Delta G = -nFE_{cell} \;\&\; \Delta G^0 = -nFE^0{}_{cell}$$

$$-\Delta G^0 = 2.303RT\log K_c \;\&\; W_{max} = +nFE^0 \;\&\; \Delta G = \Delta H + T\left(\frac{\partial \Delta G}{\partial T}\right)_p$$

5. Calculation of pH of an electrolyte by using a calomel electrode:

$$pH = \frac{E_{cell} - 0.2415}{0.0591}$$

SOLUTION AND COLLIGATIVE PROPERTIES

1. Raoult's law

$$p = p_A + p_B = p^0{}_A X_A + p^0{}_B X_B = (1 - XB)p^0{}_A + p^0{}_B X_B = (p^0{}_B - P^0{}_A)X_B + p^0 A$$

$$\frac{P_0 - P_S}{P_0} = \frac{n}{n+N} \;\&\; \frac{P_0 - P_S}{P_0} = \frac{w.m}{W.M}$$

2. Colligative α Number of particles
   Properties α Number of molecules (in case of nonelectrolytes)
   α Number of ions (in case of electrolytes)
   α Number of moles of solute
   α Mole fraction of solute

3. Depression of freezing point, $\Delta T_f = K_f m$

4. Elevation in boiling point with relative lowering of vapour pressure

$$\Delta T_b = \frac{1000K_b}{M_1}\left(\frac{p^0 - p}{p^0}\right)(M_1 = mol.wt.of solvent)$$

5. Osmotic pressure (P) with depression in freezing point $_fT\Delta$

$$P = \Delta T_f \times \frac{dRT}{1000K_f}$$

6. $$i = \frac{\text{Normal molar mass}}{\text{Observed molar mass}} = \frac{\text{Observed colligative property}}{\text{Normal colligative property}}$$

$$i = \frac{\text{Observed osmotic pressure}}{\text{Normal osmotic pressure}} = \frac{\text{Actual number of particles}}{\text{No. of particles for no. ionisation}}$$

$$\text{degree of association(a)} = (1\text{-i})\frac{n}{n-1} \;\&\; \text{degree of dissociation}(\alpha) = \frac{i-1}{n-1}$$

NUCLEAR CHEMISTRY

1. Radius of the nucleus: $R = R^0A^{1/3}$

2. The amount N of the radioactive substance left after 'n' half lives = $\frac{N_0 \text{ (initial amount)}}{2^n}$

3. Half-life period $t_{1/2} = \frac{0.693}{\lambda}$

4. Rate of disintegration:

$$-\frac{dN}{dt} = \lambda.N \;\&\; \lambda = \frac{2.303}{t}\log_{10}\frac{N_0}{N} or N = N_0 e^{-\lambda t}$$

5. $$\text{Average life } (t_{AV}) = \frac{\text{Total life time of all the atoms}}{\text{Total number of atoms}}$$

$$= \frac{\int_0^\infty tdn}{N_0} = \frac{1}{\lambda} = 1.44t_{1/2}$$

GASEOUS STATE

1. Ideal gas equation: PV = nRT
    - (i) R = 0.0821 litre atm. K^{-1} $mole^{-1}$
    - (ii) R = 62.4 liters mm Hg K^{-1} $mole^{-1}$
    - (iii) R = 8.314 * 10^7 ergs K^{-1} $mole^{-1}$
    - (iv) R =2 cals K^{-1} $mole^{-1}$
    - (v) R =8.314 J K^{-1} $mole^{-1}$

2. Velocities related to gaseous state

    RMS velocity C = $\sqrt{\frac{3PV}{M}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3P}{d}}$

    Average speed = $\sqrt{\frac{8RT}{\pi M}}$ & Most probable speed = $\sqrt{\frac{2RT}{M}}$

    Average speed = 0.9213 * RMS speed
    MPS = .816 * RMS; RMS = 1.224 MPS
    MPS : A. V. speed : RMS = 1: 1.128 : 1.224

3. Rate of diffusion $\alpha \frac{1}{\sqrt{\text{density of gas}}}$

4. Vander Wall's equation

    $\left(P + \frac{n2a}{V2}\right)(V - nb) = nRT$ for n moles

5. Z (compressibility factor)$= \frac{PV}{nRT}$; $Z = 1$ for ideal gas

SOLID AND LIQUID STATE

1. Available space filled up by hard spheres (packing fraction):

$$\text{Simple cubic} = \frac{\pi}{6} = 0.52$$

$$bcc = \frac{\pi\sqrt{3}}{8} = 0.68 \qquad \text{fcc.} = \frac{\pi\sqrt{2}}{6} = 0.74$$

$$\text{hcp} = \frac{\pi\sqrt{2}}{6} = 0.74 \qquad \text{diamond} = \frac{\pi\sqrt{3}}{6} = 0.34$$

2. Radius ratio and co-ordination number (CN)

Limiting radius ratio	CN	Geometry
[0.155- 0.225]	3	[plane triangle]
[0.255 – 0.414]	4	[tetrahedral]
[0.414 – 0.732]	6	[octahedral]
[0.732 – 1]	8	[bcc]

3. Atomic radius r and the edge of the unit cell:
   Pure elements:

$$\text{Simple cubic} = r = \frac{a}{2}$$

$$\text{bcc } r = \sqrt{\frac{3a}{4}} \qquad \text{fcc} = \sqrt{\frac{2a}{4}}$$

4. Relationship between radius of void (r) and the radius of the sphere (R): r (tetrahedral) = 0.225 R; r(octahedral) = 0.414 R
5. Paramagnetic : Presence of unpaired electrons [attracted by magnetic field]
6. Ferromagnetic: Permanent magnetism [↑↑↑↑]

7. Antiferromagnetic: net magnetic moment is zero [↑↓↑↓]

8. Ferrimagnetic: net magnetic moment is there[↑↓↓↑↑]

SURFACE CHEMISTRY & COLLOIDAL STATE

1. Higher is the valency of active ion, the greater is its coagulating power.

2. Emulsion: Colloidal soln. of two immiscible liquids [O/ Wemulsion, W / O emulsion]

3. Emulsifier: Long chain hydrocarbons are added to stabilize emulsion.

4. Lyophilic colloid: Starchy gum, gelatin have greater affinity for solvent. Solution Can be easily prepared by bringing in contact with solvent and warming.

5. Lyophobic colloid: No affinity for solvent, special methods are used to prepare sol. [e.g. As_2S_3, $Fe(OH)_3$ sol]

6. Preparation of colloidal solution:
   - (i) Dipersion methods
   - (ii) Condensation method.

7. Properties of colloidal solution:
   - (i) Tyndall effect
   - (ii) Brownian movement
   - (iii) Coagulation
   - (iv) Filtrability

INORGANIC CHEMISTRY

PERIODIC TABLE

1. General electronic configuration (of outer orbits)

s- block	ns^{1-2}
p- block	ns^2np^{1-6}
d-block	$(n-1)d^{1-10}ns^{1-2}$
f- block	$(n-2)s^2p^6d^{10}f^{1-14}(n-1)s^2p^6d^0$ or $1\ ns^2$

2.

Properties	Pr(L to R)	Gr (T to B)
(a) Atomic radius	↓	↑
(b) Ionization potential	↑	↓
(c) Electron affinity	↑	↓
(d) Electron negativity	↑	↓
(e)Metallic character or electropositive character	↓	↑
(f) Alkaline character of hydroxides	↓	↑
(g) Acidic character	↑	↓
(h) Density	(i) Firstly increase	↑
	(ii)in between max	
	(iii)then decrease	
(i)Reducing property	↓	↑
(j) Oxidizing property	↑	↓
(k)Non metallic charcter	↑	↓

3. $\text{IP}\ \alpha\ \frac{1}{\text{Metallic character}}\ \alpha\ \frac{1}{\text{Reducing character}}\ \alpha\ \frac{1}{\text{Basic Nature of oxide}}\ \alpha\ \frac{1}{\text{Basic nature of hydroxide}}$

4. $\text{EA}\ \alpha\ \frac{1}{\text{size}}\ \alpha$ neclear charge
Second electron affinity is always positive.
Electron affinity of chlorine is greater than fluorine.

5. The first element of a group has similar properties with the second element of the next group. This is called diagonal relationship.

EXTRACTIVE METALLURGY

1. Floatation is a physical method of separating a mineral from the gangue depending on differences in their wettabilities by a liquid
2. Roasting is the process of heating a mineral in the presence of air.
3. Calcination is the process of heating the ore in the absence of air.
4. Electrolytic reduction: Highly electropositive metals are extracted by the electrolysis of their oxides and hydroxides.

s- BLOCK ELEMENTS

1. Atomic radii: Li < Na < K < Rb < Cs
2. Ionic radii: $Li^+ < Na^+ < K^+ < Rb^+ < Cs^+$
3. Electronegativity: Li > Na > K > Rb < Cs
4. First ionization potential: Li > Na > > K > Rb > Cs
5. Melting point: Li > Na > K > Rb > Cs'
6. Density: Li > Na > K > Rb > Cs
7. Colour of the flame Li- red, Na- Golden, K- Violet, Rb- Red, Cs- Blue, Ca- Brick Red, Sr- Blood red, Ba- Apple green
8. Rb and Cs show photoelectric effect.
9. Stability of hydrides: LiH > NaH > KH > RbH > CsH
10. Basic nature of hydroxides: [LiOH < NaOH < KOH < RbOH < CsOH]

BORON FAMILY

1. Stability of +3 oxidation state: $B > Al > Ga > In > Tl$
2. Stability of +1 oxidation state: $Ga < In < Tl$
3. Reducing nature: $Al > Ga > In > Tl$
4. Basic nature of the oxides and hydroxides:
   $B < Al < Ga < In < Tl$
5. Relative strength of Lewis acid : $BF_3 < BCl_3 < BBr_3 < BI_3$

CARBON FAMILY

1. Reactivity: $C < Si < Ge < Sn < Pb$

2. Metallic character: $C < Si < Ge < Sn < Pb$

3. Acidic character of the oxides:
   $CO_2 > SiO_2 > GeO_2 > SnO_2 > PbO_2$
   Weaker acidic (amphoteric)

4. Thermal stability and volatility of hydrides:
   $CH_4 > SiH_4 > GeH_4 > SnH_4 < PbH_4$

5. Reducing nature of hydrides:
   $CH_4 < SiH_4 > geH_4 > SnH_4 > PbCl_4$

6. Reducing power , covalent nature of
   Hydrides: $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

7. Stability of trihalides of nitrogen: $NF_3 > NCl_3 > NBr_3$

8. Ease of hydrolysis of trichlorides
   $NCl_3 > PCL_3 > AsCl_3 > SbCl_3 > BiCl_3$

9. Lewis and strength of trihalides of P, As and Sb
   $PF_3 > PCl_3 > PBr_3 > PI_3$

10. Lewis acid strength among phosphorus trihalides
    $PF_3 > PCl_3 > PBr_3 > Pi_3$

11. Bond angle, among the halides of phosphorus
    $PF_3 < PCl_3 < PBr_3 < PI_3$

OXYGEN FAMILY

1. Melting and boiling point of hydrides
   $H_2O > H_2Te > H_2Se > H_2S$

2. Volatility of hydrides
   $H_2O > H_2Te > H_2Se > H_2S$

3. Thermal stability of hydrides
   $H_2O > H_2S > H_2Se > H_2Te$

4. Reducing nature of hydrides
   $H_2S < H_2Se < H_2Te$

5. Covalent character of hydrides
   $H_2O < H_2S < H_2Se < H_2Te$

6. Bond angle & dipole moment of hydrides
   $H_2O > H_2S > H_2Se > H_2Te$
   (104^0) (92^0) (91^0) (90^0)

7. Ease of hydrolysis of hexahalides: $SF_6 > SeF_6 > TeF_6$

8. The acidic character of oxides (element in the same oxidation state)

9. Acidic character of oxide of a particular element(e.g. S)
   $AO_2 > SeO_2 > TeO_2 > PoO_2$
   $So_3 > SeO_3 > TeO_3$

10. Stability of dioxides
    $SO_2 > TeO_2 > SeO_2 > PoO_2$

HALOGEN FAMILY

1. Bond energy of halogens: $Cl_2 > Br_2 > F_2 > I_2$

2. Bond length in x_2 molecule: $F_2 > Cl_2 > Br_2 > I_2$

3. Solubility of halogen in water: $F_2 > Cl_2 > Br_2 > I_2$

4. Oxidizing power: $F_2 > Cl_2 > Br_2 > I_2$

5. Enthalpy of hydration of X^- ion: $F^- > Cl^- > Br^- > I^-$

6. Reactivity of halogens: F > Cl > Br > I

7. Ionic character of M – X bond in halide
   M – F > M – Cl > M – Br > M – I

8. Reducing character of X^- ion: $I^- > Br^- > Cl^- > F^-$

9. Thermal stability of hydrides: HF > HCl > HBr > HI

10. Acidic strength of halogen acids: HI > HBr > HCl > HF

11. Conjugate base strength of halogen acids
    $I^- < Br^- < Cl^- < F^-$

12. Reducing power of hydrogen halides
    HF < HCl < HBr < HI

13. Dipole moment of hydrogen halides
    HF > HCl > HBr > HI

14. Oxidising power of oxides of chlorine
    $Cl_2O > ClO_2 > Cl_2O6 > Cl_2O_7$

15. Acidic character of oxyacids of chloride
    $HClO < HClO_2 < HClO_3 < HClO_4$

16. Strength of conjugate bases of oxyacids of chlorine
    $ClO^- > ClO_2^- > ClO_3^- > ClO_4^-$

HALOGEN FAMILY

17. Oxidizing power of oxyacids of chlorine
$HClO < HClO_2 < HClO_3 < HClO_4$

18. Thermal stability of oxyacids of chlorine
$HClO < HClO_2 < HClO_3 < HClO_4$

19. Stability of anions of oxyacids of chlorine
$ClO^- > ClO_2^- > ClO_3^- > ClO_4^-$

TRANSITION ELEMENTS (D-BLOCK ELEMENTS)

1. The element with exceptional configuration are
Cr^{24} [Ar] $3d^5 4s^1$, Cu^{29} [Ar] $3d^{10} 4s^1$
Mo^{42} [Kr] $4d^5 5s^1$, Pd^{46} [Kr] $4d^{10}\ 5s^0$
Ag^{47} [Kr] $4d^{10} 5s^1$, Pt^{78} [Xe] $4f^{14} 5d^{10} 6s^0$
Au^{79} [Xe] $4f^{14} 5d^{10} 6s^1$

2. Ferromagnetic substances are those in which there are large number of electrons with unpaired spins and whose magnetic moments are aligned in the same direction.

COORDINATION COMPOUNDS

1. Coordination number is the number of the nearest atoms or groups in the coordination sphere.

2. Ligand is a Lewis base donor of electrons that bonds to a central metal atom in a coordination compound.

3. Paramagnetic substance is one that is attracted to the magnetic field, this result on account of unpaired electrons present in the atom/molecule/ion.

4. Effective atomic number EAN = (Z – Oxidation number) + (2 * Coordination number)

5. Factors affecting stability of complex
(i) Greater the charge on the central metal ion, greater is the stability.
(ii) Greater the ability of the ligand to donate electron pair (basic strength) greater is the stability.
(iii) Formation of chelate rings increases the stability.

ORGANIC CHEMISTRY

GOC

1. The order of decreasing electro negativity of hybrid orbital's is sp > sp^2 > sp^3

2. Conformational isomers are those isomers which arise due to rotation around a single bond.

3. A meso compound is optically inactive, even though it has asymmetric centers (due to internal compensation of rotation of plane polarized light)

4. An equimolar mixture of enantiomers is called racemic mixture, which is optically inactive

5. Tautomerism is the type of isomerism arising by the migration of hydrogen.

6. Reaction intermediates and reagents:
   Homolytic fission → Free radicals
   Hetrolytic fission → Carbocation and carbanion

7. Nucleophiles – electro rich
   Two types :
   1. Anions 2. Neutral molecules
   With lone pair of electrons(Lewis bases)
   Electrophiles: electron deficient.
   Two types :
   1. Cations 2. Neutral molecules with vacant orbitals (Lewis acids)

8. Inductive effect is due to <u>*s*</u>

9. electron displacement along a chain and is permanent effect.

9. +I (inductive effect) increase basicity, - I effect increases acidity of compounds.

10. Resonance is a phenomenon in which two or more structures can be written for the same compound but none of them actually exists.

ALKANES

1. Pyrolytic cracking is a process in which alkane decomposes to a mixture of smaller hydrocarbons, when it is heated strongly, in the absence of oxygen.

2. Combustion is a process in which hydrocarbons from carbon dioxide and H_2O (l) when they are completely burnt in air/O_2.

ALKENES

1. In dehydration and dehydro halogenations the order for removal of hydrogen is $3^0 > 2^0 > 1^0$ (Saytzeff's rule)

2. The lower the Δh_h (heat of dehydrogenation) the more stable the alkene is.

3. Alkenes undergo anti-Markonikov addition only with HBr in the presence of peroxides.

ALKYNES

1. All o and p-directing groups ring activating groups (expect – X)
   They are: -OH, $-NH_2$, -X, R, -OR etc.

2. All m-directing groups are ring deactivating groups.
   They are: -CHO, -COOH, $-NO_2$, -CN, $-NR_3$ etc.

HALOGEN COMPOUNDS

1. The order of reactivity is
(a) RI > RBr > RCl > RF
(b) Ally halide > Alkyl halide > Vinyl halide
(c) Alkyl halide > Aryl halide

2. S_N1 reaction: mainly 3^0 alkyl halides undergo this reaction and form racemic mixture. S_N1 is favoured by polar solvent and low concentration of nuclephile.

3. S_N2 reaction:Mainly 10 alkyl halides undergo this substitution. S_N^2 reaction is preferred by non-polar solvents and high concentration of nucleophile.

ALCOHOLS

1. Alkenes are converted to alcohol in different ways as follows

Reagent	**Types of addition**
dil H_2SO_4	- Markovnikov
B_2H_6 and H_2O_2	- Anti- Markovnikov
Oxymercuration demercuration	- Markovnikov

2. Oxidation of

1^0 alcohol → aldehyde → carboxylic acid
(with same no. of C atom) (with same no. of C atom)

2^0 alcohol ketone carboxylic acid
(with same no. of C atom) (with less no. of C atom)

3^0 alcohol ketone carboxylic acid
(with less no. of C atom) (with less no. of C atom)

PHENOLS

1. Phenol $\xrightarrow{CHCl3/OH^{\ominus}}$ Salicyaldehyde
(Reimer- Tieman reaction)

2. Phenol $\xrightarrow[\Delta]{CO_2}$ Salicyclic acid (Kolbe reaction)

3. Acidity of phenols
   (a) Increase by electron withdrawing substituents like
   $-NO_2$, -CN, -CHO, -COOH, -X, $-NR_3$
   (b) Decrease by electron releasing substituent's like
   -R , -OH, $-NH_2$, $-NR_2$, OR

ETHERS

1. $2ROH \xrightarrow[250^0c]{Al_2O_3} R - O - R + H_2O$

2. $RONa + X - R' \longrightarrow ROR' + NaX$
   (Williamson's synthesis)

3. $ROR + 2\ H_2SO_4 \xrightarrow[(conc.)]{\Delta} 2RHSO_4 + H_2O$

4. $ROR + H_2O \xrightarrow[\Delta]{dil.\ H_2SO_4} 2ROH$

CARBONYL COMPOUNDS

1. Formation of alcohols using RMgX

   (a) $\text{Formaldehyde} + RMgX \xrightarrow{\text{Hydrolysis}} 1^0\ \text{alcohol}$

   (b) $\text{Aldehyde} + RMgX \xrightarrow{\text{Hydrolysis}} 2^0\ \text{alcohol}$

   (other than HCHO)

   (c) $\text{Ketone} + RMgX \xrightarrow{\text{Hydrolysis}} 3^0\ \text{alcohol}$

2. Cannizzaro reaction (disproportionation)

   $\text{Aldehyde} \xrightarrow[\text{Alkali}]{\text{Hot conc.}} \text{Alcohol} + \text{salt of acid}$

   no α H-atom

   Crossed- cannizzaro reaction gives alcohol with aryl group or bigger alkyl group.

3. Aldol condensation:

   $\text{Carbonyl compound} + \text{dil. alkali} \longrightarrow \beta\text{ - hydroxy carbonyl compound}$

   (With α H-atom)

4. Benzoin condensation

   $\text{Benzaldehyde} \xrightarrow[\text{NaCN}]{\text{ethanolic}} \text{Benzoin}$

CARBOXYLIC ACIDS

1. The rate of esterification decrease when alcohol, acid or both have branched substitutents.

2. Ortho effect: All ortho substituted benzoic acids (irrespective of type of substitutent) are stronger than benzoic acid. As this group decrease outer resonance of ring towards acid which increase acidic nature.

NITROGEN COMPOUNDS

1. Order of basicity: (R = -CH_3 or C_2H_5)
   $2^0 > 1^0 > 3^0 > NH_3$

2. Hofmann degradation
   $$\text{Amides} \xrightarrow{Br_2/KOH} 1^0\ \text{amine}$$

3. The basicity of amines is
   (a) Decreased by electron withdrawing groups
   (b) Increased by electron releasing groups

4. Reduction of nitrobenzene in different media gives different products

Medium	**Product**
Acidic	Aniline
Basic	Azoxy, Azo and finally hydrazobenzene
Neutral	Phenyl hydroxyl amine

CARBOHYHYDRATES, AMINO ACIDS AND POLYMERS

1. Carbohydrates are polyhydroxy aldehydes or ketenes.

2. Oligosaccharides are simple sugars, containing three to nine carbon atoms.

3. Polymer is a chemical species of high molecular weight made up from repeating units of low molecular weight.

CHARACTERISTIC REACTIONS OF DIFFERENT ORGANIC COMPOUNDS

Homologous series	**Type of reactions**
(a) Alkanes	Substitution (Mostly free radical)
(b) Alkenes and alkynes	Electrophilic addition
(c) Arenes	Electrophilic substitution
(d) Alkyl halides	Neucleophilic Substitution
(e) Aldehyde and ketones	Nucleophilic addition

Test to differentiate:

1^0, 2^0, and 3^0 alcohols	Lucas test Victormayer's test
1^0, 2^0, and 3^0 amines	Hinsberg test
1^0, 2^0, and 3^0 nitro compounds	Test with HNO_2 and KOH
Aryl halides and alkyl halides	Test with $AgNO_3$ solution
Aldehydes and ketones aromatic	Tollen's test/ Fehling's test
Aldehydes and aliphatic aldehydes	Fehling's test

IMPORTANT REAGENT

1. DiH_2SO_4 [or Cons. $H_2SO_4 + H_2O$

   Use ⟶ Dehydrating agent (+HOH)

   (a) $CH_2 = CH_2 \xrightarrow{\text{dil. } H_2SO_4} CH_3 - CH_2 - OH$

   (b) $C_2H_5OC_2H_5 \xrightarrow{\text{dil. } H_2SO_4} 2C_2H_5OH$

2. Alc. KOH or Nanh$_2$ (Use ⟶ -Hx

   $CH_3CH_2Cl \xrightarrow[\text{-HCl}]{\text{alc. KOH}} CH_2 = CH_2$

3. Cu or ZnO / 300^{0}C

   $1^0 \text{ alc} \xrightarrow{"} \text{ald, } 2^0 \text{ alc} \xrightarrow{"} \text{ketone, } 3^0 \text{ alc} \xrightarrow{"} \text{alkene (exception)}$

4. Lucas reagent Zncl$_2$ + Conc. HCl

   Use ⟶ for distinction between 1^0, 2^0 & 3^0 alcohol

5. Tiden Reagent NOCl (Nitrosyl chloride)

   $C_2H_5NH_2 \xrightarrow{NOCl} CH_3Cl$

6. Alkaline KMNO$_4$ (Strong oxidant)

   Toluene ⟶ Benzoic acid

7. Bayer's Reagent

   1 % alkaline KMNO$_4$ (Weak oxidant)

   Use: ⟶ for test of $> C = C <$ or $- C \equiv C -$

   $CH_2 = CH_2 + H_2O + [O] \longrightarrow CH_2OH - CH_2OH$

8. Acidic $K_2Cr_2O_7$ (Strong oxidant)

   $RCH_2OH \xrightarrow{[O]} RCHO$

9. $SnCl_2$ / HCl or Sn / HCl use ⟶ for reduction of nitrobenzene in acidic medium.

$$C_6H_5NO_2 \xrightarrow[6H]{SnCl_2 / HCl} C_6H_5NH_2$$

10. Lindlar's catalyst = pd / $CaCO_3$ + in small quantity$(CH_3COO)_2Pb$

$$2\text{ - butyne } + H_2 \xrightarrow{''} \text{Cis - 2 - butene}$$

(main product)

11. Ziegler- Natta Catalyst $(C_2H_5)_3Al + TiCl_4$
Use – In additional polymerization

$$\text{Propene} \xrightarrow{''} \text{Poly propene}$$

MAIN USE OF COMPOUNDS

Alkane ⟶ Fuel, Alkene ⟶ Solvent making westron, Westrosol, General alkyl halide ⟶ as solvents, $CHCl_3$ ⟶ Anaesthetic., Germicide, CCl_4 ⟶ Pyrene & Fire extinguisher, CH_3OH ⟶ Antifreeze, deforming of alcohol, $C_2H_5–O–C_2H_5$ ⟶ Antiseptic, Natellite, HCHO ⟶ Formamint medicine, CH_3CHO ⟶ Antiseptic, CH_3COCH_3 ⟶ as solvent, $CH_3COOC_2H_5$ ⟶ Artificial silk & flavor, CH_3NH_2 ⟶ Refrigerating agent, $C_2H_5NH_2$ ⟶ in development of photography.

SMELL OF SOME COMPOUNDS

$CH_3COOC_2H_5$ ⟶ Fruity
$CHCl_3$, CH_3I, C_2H_5I ⟶ Sweet smell
$C_6H_5NO_2$ & C_6H_5CHO ⟶ Like bitter almonds
CH_3COCl ⟶ Pungent
CH_3NH_2 & $C_6H_5NH_2$ ⟶ Fishy,
Impure CH_3CONH_2 ⟶ mice like,
ROH ⟶ Wine
RNCS ⟶ Mustard oil,
Methyl salicylate ⟶ wintergreen oil,
RNC ⟶ Foul smell.

IDENTIFICATION TESTS

(a) Unsaturated compound (Bayer's reagent) Decolorizing the reagent

(b) Alcohols (Ceric Ammonium nitrate solution) Red coloration.

(c) Phenols (Neutral $FeCl_3$ solution) violet/deep blue coloration.

(d) Aldehydes and ketones (2, 4-D.N.P.) orange Precipitate

(e) Acids ($NaHCO_3$ solution) Brisk effervescence (CO_2 is evolved)

(f) 10 amine ($CHCl_3$ + KOH) Foul smell (isocyanide)

(g)20 amine (NaNO2 + HCI) yellowoily liquid (Nitrosoamine) inteliClass

---

Address

Delhi / NCR
Intelivisto Consulting India Private Limited
C-131, Sector 2
NOIDA- 201301, INDIA
Mobile:- +91-9582000102,
Phone:- 0120-4314666

Mumbai
Intelivisto Consulting India Private Limited
Aekveera Regency, Mr. Aggarwal Residency
Shankar Lane, Kandivli (West), Mumbai - 400067
Mobile:- 9870976534
Phone:- +91 22 65305201

Mail Address
info@inteliclass.com

Join us on
www.facebook.com/inteliclass