Chap-01 - Some Basic Concepts of Chemistry

Formulae Chart

1. $T(K) = T(^\circ C) + 273.15$
2. $T(^\circ F) = \frac{9}{5}T(^\circ C) + 32$
3. $\text{Relative atomic mass} = \dfrac{\text{Mass of an atom of the element}}{\frac{1}{12} \times \text{Mass of an atom of carbon (C-12)}}$
4. $\text{Number of gram atoms} = \dfrac{W(g)}{GAM}$ (GAM → gram atomic mass)
5. $\text{Number of gram molecules} = \dfrac{W(g)}{\text{Gram molecular mass}}$
6. Avogadro's No. $N_A = 6.022 \times 10^{23}$
7. $\text{Mass of 1 atom of element} = \dfrac{GAM}{N_A}$
8. $\text{Mass of 1 molecule of substance} = \dfrac{GMM}{N_A}$ (MM → Molar mass)
9. $\text{Number of molecules in W(g) of substance} = \dfrac{W(g) \times N_A}{GMM}$
10. $\text{Number of molecules in V litre of gas at S.T.P.} = \dfrac{VN_A}{22.4}$
11. Number of molecules in n moles of substance = $n \times N_A$
12. $\text{Mass \% of an element in a compound} = \dfrac{\text{Mass of that element in 1 mole of the compound}}{\text{Molar mass of the compound}} \times 100$
13. $\text{Mass percent} = \dfrac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$
14. $\text{Mole fraction of A} = \dfrac{\text{No. of moles of A}}{\text{No. of moles of solution}}$
15. $\text{Molarity}(M) = \dfrac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$ mole/L
16. Dilution formula : $M_1V_1 = M_2V_2$

    For mixing two solutions of the same substance

    $M_1V_1 + M_2V_2 = M_3(V_1 + V_2)$

    Molarity can be directly calculated from % by mass (W/W) if density is known

    $\text{Molarity} = \dfrac{\% \times 10 \times d}{GMM}$
17. $\text{Molality}(m) = \dfrac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$
18. Molecular mass = 2 × vapour density
19. $\dfrac{X_B}{1 - X_B} = \dfrac{\text{molality} \times M_A}{1000}$ where M_A - mass of solvent

Chap-02 - Structure of Atom

Formulae Chart

1. **Atomic number (Z)** = Number of protons in the nucleus of an atom
   = Number of electrons in a neutral atom
2. **Mass number (A)** = Number of protons + Number of neutrons
3. **Number of neutrons** = A – Z
4. Speed of light is equal to the product of frequency and wavelength of light

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

5. Energy of quantum of radiation according to Planck's quantum theory $\boxed{E = h\nu}$.
6. $\boxed{h\nu = h\nu_0 + \frac{1}{2}m_e v^2}$. Einstein's photoelectric equation
7. **Line spectrum of hydrogen**

   $\bar{\nu} = 109677\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ cm^{-1} where $\bar{\nu}$ is wave number and $\bar{\nu} = \frac{1}{\lambda}$.

   where $n_1 = 1, 2, ...$

   $n_2 = n_1 + 1, n_1 + 2, ...$

8. **Bohr's model of hydrogen atom**

   (a) **Frequency** of radiation absorbed or emitted during transition; $\nu = \frac{\Delta E}{h}$

   $\nu = \frac{E_2 - E_1}{h}$

   E_1 = Energy of lower energy state

   E_2 = Energy of higher energy state

   (b) **Orbit angular momentum** of an electron, $\boxed{m_e vr = n \cdot \frac{h}{2\pi}}$; $n = 1, 2, 3, ...$

   (c) **Energy** of stationary states $\boxed{E_n = -2.18 \times 10^{-18}\left(\frac{Z^2}{n^2}\right) J}$

   (d) **Radii** of the stationary states/orbits $\boxed{r_n = 52.9 \times \left(\frac{n^2}{Z}\right) pm}$

9. Energy gap between the two orbits

   $\boxed{\Delta E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right)}$ where $R_H = 2.18 \times 10^{-18}$

   Where, n_i = initial orbit

   n_f = final orbit

10. Wavelength of matter wave

    $\boxed{\lambda = \frac{h}{mv}}$; $\lambda = \frac{h}{p}$ $\lambda = \frac{h}{\sqrt{2Em}}$ where E = Kientic Energy

11. Heisenberg's uncertainty principle

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}; \quad \boxed{\Delta x \times m\Delta v \geq \frac{h}{4\pi}}$$

12. Number of subshells in n^{th} shell = n

Number of orbitals in n^{th} shell = n^2

Number of electrons in n^{th} shell = $2n^2$

Number of orbitals in subshell = $2l + 1$

Number of electrons in subshell = $2(2l + 1)$

13. Total number of nodes = $n - 1$

Radial nodes = $n - l - 1$

Angular nodes = l

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Chap-03 - State of Matter

Formulae Chart

1. **Boyle's Law :** $P_1V_1 = P_2V_2$ (at constant T and n)
2. **Charles' Law :** $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ (at constant P and n)
3. **Avogadro's Law :** V = kn (at constant P and T)
4. **Ideal gas equation :** PV = nRT

$$M = \frac{dRT}{P}$$

5. **Combined Gas Equation :** $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$; (n, R constant)
6. **Dalton's Law of partial pressures :** $P_{Total} = P_1 + P_2 + P_3 + \ldots$
7. **Partial Pressure in Terms of Mole Fraction :** $P_i = x_i P_{total}$
8. **van der Waals Equation :** $\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$
9. Compressibility factor $Z = \frac{PV}{RT}$ (for 1 mole of Gas)

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Chap-04 - Thermodynamics

Formulae Chart

- **Energy changes**

  $\Delta U = q_v$, $\Delta H = q_p$

  $q_v \rightarrow$ heat exchange at constant volume

  $q_p \rightarrow$ heat exchange at constant pressure

- **Enthalpy**

  $H = U + pV$

- **Relation between ΔH and ΔU**

  $\Delta H = \Delta U + p\Delta V$

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

- **Heat capacity**

  $C = \dfrac{q}{\Delta T}$

  specific heat capacity $c_s = \dfrac{q}{m\Delta T}$

  molar heat capacity $c_m = \dfrac{q}{n\Delta T}$

- **First law of thermodynamics**

  $\Delta U = q + W$

- **Enthalpy of reaction**

  $\Delta H = \Sigma\Delta_f H^\circ$ (products) $- \Sigma\Delta_f H^\circ$ (reactants)

  By convention heat of formation of every element in its standard state is arbitrarily assumed to be zero.

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

- $C_p - C_v = R$

  $\Delta S = \dfrac{q_{rev}}{T}$

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

  $\Delta G^\circ = -RT \ln K$

Atomicity	γ	Cp	Cv
Monoatomic	5/3	5R/2	3R/2
Diatomic	7/5	7R/2	5R/2
Triatomic non linear	4/3	4R	3R

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Chap-05 - Equilibrium

1. Equilibrium constant, Keq = $\dfrac{K_f}{K_b}$

2. $K_p = K_c(RT)^{\Delta n}$

3. Concentration quotient, Q = $\dfrac{[C]^c\,[D]^d}{[A]^a\,[B]^b}$

4. $\Delta G^\circ = -2.303\ RT\ \log K$

5. $K_i = \dfrac{[A^+][B^-]}{[AB]}$

6. $K_w = [H^+][OH^-] = 10^{-14}$ at 25°C

7. $pH = -\log\,[H^+]$

8. $pK_w = pH + pOH = 14$ at 25°C

9. $K_a = \dfrac{[A^-][H_3O^+]}{[HA]}$

$K_b = \dfrac{[B^-][OH^-]}{[BOH]}$

10. K_a or $K_b = c\alpha^2$

11. $K_w = K_a \times K_b$

12. Hydrolysis of salts

    (i) For a salt of strong acid and weak base

    $$pH = \frac{1}{2}[pK_w - pK_b - \log c]$$

    (ii) For a salt of weak acid and strong base

    $$pH = \frac{1}{2}[pK_w + pK_a + \log c]$$

    (ii) For salts of weak acid and weak base

    $$pH = \frac{1}{2}[pK_w + pK_a - pK_b]$$

13. $K_{sp} = [A^{y+}]^x\ [B^{-x}]^y$

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Chap-06 - Solid State

1. **Packing Fraction (p.f.)** $= \dfrac{\text{Volume occupied by particles (per unit cell)}}{\text{Volume of unit cell}}$

Contribution of each atom present on the corner $= \dfrac{1}{8}$

Contribution of each atom present on the centre of face $= \dfrac{1}{2}$

Contribution of each atom present on the body centre = 1

Contribution of each atom present on the edge centre $= \dfrac{1}{4}$

2.

Crystal	**Radius of atom(r)**	**No. of atoms per unit cell**	**p.f.**
Simple Cubic	$\dfrac{a}{2}$	1	52.4%
F.C.C.	$\dfrac{a}{2\sqrt{2}}$	4	74%
B.C.C.	$\dfrac{\sqrt{3}}{4}a$	2	68%

3. Density of Cubic Crystal Systems

$$\rho \text{ (or } d) = \frac{Z \times M}{a^3 \times N_A} \text{ g.cm}^{-3}$$

Z = number of atoms per unit cell

N_A = Avogadro's Number

M = Gram atomic weight of element (g.mol^{-1})

a = edge - length

5. **Radius-ratio in ionic solids**

Voids	**Triangular**	**Tetrahedral**	**Octahedral**	**Cubical**
Radius-ratio	$0.155 \le \dfrac{r^+}{r^-} < 0.225$	$0.225 \le \dfrac{r^+}{r^-} < 0.414$	$0.414 \le \dfrac{r^+}{r^-} < 0.732$	$0.732 \le \dfrac{r^+}{r^-} < 0.999$

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Chap-07 - Solutions

Formulae Chart

1. Molality (m) $= \dfrac{\text{Number of moles of solute}}{\text{Weight of solvent (kg)}}$ mole / Kg

Molarity (M) $= \dfrac{\text{Number of moles of solute}}{\text{Volume of solution (L)}}$ mole / L

Normality (N) $= \dfrac{\text{Number of gram equivalent of solute}}{\text{Volume of solution (L)}}$ g equiv / L

Formality (F) $= \dfrac{\text{Number of gram formula mass}}{\text{Volume of solution (L)}}$

PPM = mole fraction × 10^6 = mass fraction × 10^6

2. **Henry's law**

$$p = K_H.X \quad \begin{cases} p = \text{partial pressure of gas in vapour phase} \\ K_H = \text{Henry's law constant} \\ X = \text{Mole fraction of gas} \end{cases}$$

3. $$\left.\begin{aligned} P_{sol} &= P_A^o X_A + P_B^o X_B \\ &= (P_B^o - P_A^o)X_B + P_A^o \end{aligned}\right\} \text{Raoult's Law}$$

4. $$Y_A = \frac{P_A}{P_T}; Y_B = \frac{P_B}{P_T}$$

where Y_A and Y_B are mole fractions in vapour phase and $P_A = P_A^\circ X_A$; $P_B = P_B^\circ X_B$

5. $$\frac{1}{P_{sol}} = \frac{Y_A}{P_A^o} + \frac{Y_B}{P_B^o}$$

6. **Relative lowering of vapour pressure**

$$\frac{P_A^o - P}{P_A^o} = \chi_B \qquad \{\chi_B = \text{mole fraction of solute}\}$$

7. **Osmotic pressure**

$\pi = CRT$

For isotonic solution, $\pi_1 = \pi_2$

8. **Elevation of boiling point**

$\Delta T_b = K_b \times m$

$$K_b = \frac{RT_0^2}{1000\, l_{vapour}} = \frac{M_A RT_0^2}{1000\, \Delta H_{vapour}}$$

where m = molality,

M_A = molecular mass of sovlent

9. **Depression in freezing point**

$\Delta T_f = K_f \times m$

$$K_f = \frac{RT_0^2}{1000\, l_{fusion}} = \frac{M_A RT_0^2}{1000\, \Delta H_{fusion}}$$

10. **van't Hoff factor**

$$i = \frac{\text{Experimental colligative property (observed)}}{\text{Calculated (normal) colligative property}}$$

$$\frac{P_A^o - P}{P_A^o} = \frac{(i \times n_B)}{(i \times n_B) + n_A}$$

$\Delta T_b = i \times K_b \times m$

$\Delta T_f = i \times K_f \times m$

$\pi = iCRT$

11. **Association of solute**

$nA \to (A)_n$

$$i = \frac{(1-\alpha) + \frac{\alpha}{n}}{1} \qquad \{\alpha = \text{degree of association}\}$$

12. **Dissociation of solute**

$(A)_n \to nA$

$$i = \frac{1 + (n-1)\alpha}{1} \qquad \{\alpha = \text{degree of dissociation}\}$$

Chap-08 - Electrochemistry

Formulae Chart

1. **Ohm's law** ⇒ $V = RI$

$$R = \rho\frac{\ell}{a}$$

V = Potential difference

R = Resistance

I = Current

ρ = Specific resistance (resistivity)

ℓ, a = length and cross-section area of conductor

2. **Conductance** $G = \frac{1}{R}$

Specific conductance (conductivity) $\kappa = \frac{1}{\rho}$

3. **Cell constant** $\sigma = \frac{\ell}{a}$

$$\kappa = G.\sigma$$

4. **Molar conductance** $\Lambda_M \text{ (or } \phi_C) = \frac{1000 \times \kappa}{C \text{ (or M)}}$ {C = concentration of electrolyte in terms of molarity}

5. **Equivalent conductance** $\Lambda_M \text{ (or } \Lambda_C) = \frac{1000 \times \kappa}{C \text{ (or N)}}$ {C = concentration (normality)}

$\Lambda_M = \Lambda_N \times \text{(n-factor)}$

$\Lambda_0 = \lim\limits_{C \to 0} \Lambda_C$ {Λ_0 = equivalent conductance at infinite dilution (or zero concentration)}

6. For **weak** electrolyte, $\Lambda_C \propto \frac{1}{\sqrt{C}}$

For **strong** electrolyte, $\Lambda_C = \Lambda_0 - B(C)^{1/2}$ {B = constant}

7. **At infinite dilution,** for an electrolyte A_xB_y,

$$A_xB_y \rightleftharpoons xA^{y+} + yB^{x-}$$

$\Lambda^{\circ}_{A_xB_y} = x\lambda^{\circ}_{A} + y\lambda^{\circ}_{B}$ {$\lambda^{\circ}_{A}, \lambda^{\circ}_{B}$ = equivalent conductance at infinite dilution of cation and anion}

$$= x\lambda^{\circ}_{+} + \lambda^{\circ}_{-}$$

$\lambda^{\circ}_{C} = k\mu^{\circ}_{C}$ {μ = ionic mobility, K = 96500 coulomb}

$$\mu = \frac{\text{Ionic velocity}}{\text{Potential gradient}}$$

8. For a **weak** electrolyte, ($CH_3COOH \rightleftharpoons CH_3COO^- + H^+$)

Degree of dissociation, $\alpha = \frac{\Lambda_M}{\Lambda_0}$, $K_{eq} = \frac{C(\Lambda_M/\Lambda_0)^2}{1-(\Lambda_M/\Lambda_0)}$

9. For **solubility** of a salt ($AgCl \rightleftharpoons Ag^+ + Cl^-$)

$$K_{sp} = \left(\frac{1000\,K}{\Lambda_0}\right)^2$$

10. For a **cell reaction** in an electrochemical cell,

$Zn + CuSO_4 \rightleftharpoons Cu + ZnSO_4$

Cell representation $\Rightarrow$ $\underset{\text{Anode }(-)}{Zn|Zn^{2+}(aq.)}||\underset{\text{Cathode }(+)}{Cu^{2+}(aq.)|Cu}$

11. **For half cell reaction** $M \rightarrow M^{n+}(aq.) + ne^{(-)}$; $E_{OX} = E_{M/M^{n+}}$

$$M^{n+}(aq) + ne^- \rightarrow M;\ E_{red} = E_{M^{n+}/M}$$

emf of cell, $E^o_{cell} = E^o_{right} - E^o_{left}$

$$= \underset{(R.P.)}{E^o_{cathode}} - \underset{(R.P.)}{E^o_{anode}}$$ {R.P. = Reduction potential}

12. $\Delta G = -nFE_{cell}$

$= -W$

$= \Delta G^o + 2.303\ RT \log Q$

$\Delta G^o = -nFE^o_{cell}$

$E_{cell} = E^o_{cell} - \frac{2.303\,RT}{nF}\log Q$

At room temperature (25°C)

$\Rightarrow$ **Nernst's equation** $\Rightarrow$ $E_{cell} = E^o_{cell} - \frac{0.0591}{n}\log Q$

ΔG = Change in free energy
W = Useful work done
n = Number of electrons exchanged
F = Faraday constant (96500 coulomb)
Q = Reaction quotient

13. **For electrode concentration cell,** $(\underset{\text{anode}}{Pt, H_2(P_1)}|H^+||\underset{\text{cathode}}{H_2(P_2), Pt})$

$$E_{cell} = \frac{0.0591}{2}\log\frac{P_1}{P_2}$$ (P = Pressure)

For **electrolyte concentration cell** $(Cu|\underset{\text{anode }(-)}{Cu^{2+}(C_1)}||\underset{\text{cathode }(+)}{Cu^{2+}(C_2)}|Cu)$

$$E_{cell} = \frac{0.0591}{2}\log\frac{C_2}{C_1}$$

For **concentration cells,** $E^o_{cell} = 0$

14. **At equilibrium,** $E_{cell} = 0$ (as $\Delta G = 0$)

15. **Temperature coefficient** (T.C.) = $\left(\frac{\partial}{\partial T}E_{cell}\right)_P$

Change in entropy, $\Delta S = +nF \times$ (T.C.) {ΔH = heat of cell-reaction}

$$E_{cell} = \left(\frac{-\Delta H}{nF}\right) + T.(T.C.)$$

T.C. > 0 ⇒ Cell-reaction is endothermic and vice-versa.

16. **Faraday's 1st law of electrolysis**

$m = Zit$

m = mass of substance deposited

Z = electrochemical equivalent

i = current

t = time

$$Z = \frac{\text{Atomic mass}}{n \times F}$$

Faraday's 2nd law of electrolysis

$$\frac{m_1}{m_2} = \frac{E_1}{E_2} \qquad \text{(E = equivalent weight)}$$

17. **Oxidation potential** for half-cell reaction : $M \rightarrow M^{+n} + ne^-$

$$E_{ox} = E^o_{ox} - \frac{2.303}{nF} \log [M^{n+}]$$

Reduction potential for half-cell reaction : $M^{n+} + ne^- \rightarrow M$

$$E_{red} = E^o_{red} + \frac{2.303\,RT}{nF} \log[M^{n+}]$$

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Chap-09- Chemical Kinetics and Nuclear Chemisty

Formulae Chart

1. For a general chemical transformation

$nA + mB \rightarrow pC + qD$

$$\text{Rate} = \frac{-1}{n}\frac{d[A]}{dt} = \frac{-1}{m}\frac{d[B]}{dt} = +\frac{1}{p}\frac{d[C]}{dt} = \frac{1}{q}\frac{d[D]}{dt}$$

2. For elementry chemcial reaction

$mA + nB \longrightarrow \text{products}$

$$\text{Theoretical rate} = \frac{dx}{dt} = k[A]^m \times [B]^n$$

3. For a general reaction: $aA + bB \longrightarrow \text{Products}$

$$\text{Rate} = \frac{dx}{dt} = k[A]^m \times [B]^n$$

Order of reaction w.r.t. A = m overall order of reaction = (m + n)

Order of reaction w.r.t. B = n

4. Unit of rate constant = $(\text{mole})^{1-n}\,(\text{litre})^{n-1}\,\text{time}^{-1}$

where, n = order of reaction

5. For a zero order reaction: $A \longrightarrow B$

$$\text{Rate} = \frac{-d[A]}{dt} = k[A]^0 = k \text{ (constant)} \qquad \boxed{K = \frac{[A_o]-[A]}{K}}$$

6. For a first order reaction: $A \longrightarrow B$

$$\text{Rate} = \frac{-d[A]}{dt} = k[A]$$

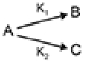
$$k = \frac{2.303}{t}\log_{10}\frac{[A]_0}{[A]_t} = \frac{2.303}{t}\log_{10}\left(\frac{a}{a-x}\right)$$

7. For a zero order reaction, $t_{1/2} = \frac{[A]_0}{2k}$

For a first order reaction, $t_{1/2} = \frac{0.693}{k}$

For an nth order reaction, $t_{1/2} \propto \frac{1}{[A]_0^{n-1}}$ (for $n \geq 2$)

8. For a parallel reaction



$$\frac{-d[A]}{dt} = (k_1 + k_2)[A]$$

9. For a first order reaction : $A \longrightarrow B + C$, a reagent reacts with all A, B and C

$$k = \frac{2.303}{t}\log_{10}\left(\frac{V_\infty - V_0}{V_\infty - V_t}\right) \quad \{V = \text{vol. of reagent}\}$$

10. Temperature coefficient = $\frac{k_{T+10^\circ C}}{k_T}$

Arrhenius equation, $k = Ae^{-E_a/RT}$

$$\log_{10}\frac{k_2}{k_1} = \frac{E_a}{(2.303\,R)}\left(\frac{T_2 - T_1}{T_2T_1}\right)$$

$$\log_{10} k = \log_{10} A - \frac{E_0}{2.303\,RT}$$

{ A = Arrhenius's constant

E_a = Activation energy

12. Binding energy, B.E. = $\Delta m \times 931.5$ MeV
Δm = mass defect = calculated At. mass – observed At. mass

B.E. per nucleon = $\frac{\text{B.E. (total)}}{\text{mass number}}$

1 MeV = 9.6×10^{10} Joule mol^{-1}

13. Packing fraction, P.F. = $\frac{\text{Isotopic atomic mass} - \text{mass no.}}{\text{mass numer}} \times 10^4$

14. In a radioactive decay, $N_t = N_0e^{-\lambda t}$
Amount of radioactive substance after 'n' half-life periods

$$N = \left(\frac{1}{2}\right)^n N_0$$

15. Activity, $A_t = A_0e^{-\lambda t}$, $A = \lambda N$

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Chap-10 - Surface Chemistry

Formulae Chart

1. **Freundlich Adsorption Isotherem**

$$\left(\frac{x}{m}\right) = Kp^{\left(\frac{1}{n}\right)};\ n \geq 1$$

2. **Langmuir Adsorption Isotherm**

$$\theta = \frac{KP_A}{1+KP_A}$$

or, $\frac{x}{m} = \frac{aP}{1+bP}$ or $\frac{m}{x} = \frac{1}{aP} + \frac{b}{a}$

3. $\frac{x}{m} = KC^{\left(\frac{1}{n}\right)}$; C = Concentration of solute in solution.

4. Zeta potential, $Z = \frac{4\pi\eta\mu}{D}$

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Chap-11 - Hydrogen

Formulae Chart

1. At. wt. of $H = \frac{\%\ {}_1^1H \times 1 + \%\ {}_1^2H \times 2 + \%\ {}_1^3H \times 3}{100}$

2. Vapour density of a gas = $\frac{\text{molar mass of gas}}{\text{molar mass of } H_2}$

   LHS and RHS both are unitless

3. Molecular wt. = 2 × (V.D.)

4. Vol. strength of H_2O_2 = Molarity × 11.2

   = Normality × 5.6

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Chap-12 - S-Block Elements

Formulae Chart

1. General Electronic Configuration ns^{1-2}
2. Atomic Radii increases down the group
3. Hydration enthalpy decreases down the group
4. Ionisation enthalpy decreases down the group
5. On reaction with oxygen give oxide, peroxide and superoxides.
6. On reaction with water produces hydroxide and hygrogen
7. Some important compounds and their general names.

Name	Chemical Formula	Prepared by
Caustic Soda	$NaOH$	Electrolysis in costner kellner cell
Washing Soda	$Na_2CO_3.10H_2O$	Solvay's Process
Baking Soda	$NaHCO_3$	Solvay's Process
Glauber's Salt	$Na_2SO_4.10H_2O$	$NaCl + H_2SO_4$
Microcosmic salt	$Na(NH_4) HPO_4$	$NH_4Cl + Na_2HPO_4$
Potash or Pearl Ash	K_2CO_3	Leblanc Process
Caustic Potash	KOH	Electrolysis of KCl
Quick Lime	CaO	Decomposition of $CaCO_3$
Slaked lime	$Ca(OH)_2$	Hydrolysis of CaO
Gypsum	$CaSO_4.2H_2O$	$CaCl_2 + H_2SO_4$
Plaster of Paris	$CaSO_4.\frac{1}{2}H_2O$	by heating gypsum

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Chap-13 - P-Block Elements

Formulae Chart

1. In general metallic character, electropositive character, atomic radii, basic character, reducing character decreases on moving left to right in a period and increases down the group.
2. Some important compounds of p-block elements

Borax (Tincal)	$Na_2B_4O_7.10H_2O$
Colomonite	$Ca_2B_6O_{11}.5H_2O$
Kernite	$Na_2B_4O_7.4H_2O$
Sassolite or boric acid	H_3BO_3

Diborane	B_2H_6
Borazole	$B_3N_3H_6$
Alumina	Al_2O_3
Lithium aluminium hydride	$LiAlH_4$
Potash Alum	$K_2SO_4.Al_2(SO_4)_3.24H_2O$

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Chap-14 - Coordination Compound

Formulae Chart

1. **Magnetic moment,** $\mu = \sqrt{n(n+2)}$ B.M.

2. $\Delta_0(\text{CFSE}) = \left[\left(-4\times \underset{(t_{2g})}{n_{e^-}}\right)+\left(+6\times \underset{(e_g)}{n_{e^-}}\right)\right]$ Dq

3. $\Delta_t(\text{CFSE}) = \left[\left(+4\times \underset{(t_{2g})}{n_{e^-}}\right)+\left(-6\times \underset{(e_g)}{n_{e^-}}\right)\right]$ Dq

4. $\Delta_t = \frac{4}{9}\Delta_0$

5. For the reaction : $M + 4L \rightleftharpoons ML_4$, overall stability constant of complex (ML_4) is $\beta_4 = \frac{[ML_4]}{[M][L]^4}$

6. $\underset{\text{(of metal atom/ion)}}{\text{EAN}} = Z - \text{O.N.} + 2(\text{C.N.})$

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Chap-15_Organic Chemistry

Formulae Chart

Relations for the estimation of elements in organic compounds.

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

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

$$\underset{\text{(Duma's method)}}{\% \text{ of N}} = \frac{28}{22400} \times \frac{\text{Volume of } N_2 \text{ at NTP}}{\text{Mass of compound}} \times 100$$

$$\underset{\text{(Kjeldahl's method)}}{\% \text{ of N}} = \frac{1.4 \times \text{Normality of acid used} \times \text{Volume of acid used}}{\text{Mass of the compound}}$$

$$\% \text{ of X(Halogens)} = \frac{\text{At. mass of X}}{(108 + \text{At. mass of X})} \times \frac{\text{Mass of Agx formed}}{\text{Mass of the compound}} \times 100$$

$$\% \text{ of S} = \frac{32}{233} \times \frac{\text{Mass of } BaSO_4 \text{ formed}}{\text{Mass of the compound}} \times 100$$

$$\% \text{ of P} = \frac{62}{222} \times \frac{\text{Mass of } Mg_2P_2O_7 \text{formed}}{\text{Mass of the compound}} \times 100$$

1. Inductive effect

   (+I efffect) $CH_3 < C_2H_5 < C_3H_7 < R_2CH < R_3C < -\dot{O}-R$

   (–I efffect) $R_4N > NO_2 > -CN > SO_3H > COOH > -F > Cl > 1 > -OR > -OH > -NH_2 > -C_6H_5$

2. Relative basic strength in aqueous medium.

$R = CH_3$	$2^\circ > 1^\circ > 3^\circ > NH_3$
$R = C_2H_5$	$2^\circ > 3^\circ > 1^\circ > NH_3$
Me_2CH^-	$1^\circ > NH_3 > 2^\circ > 3^\circ$
M_3C	$NH_3 > 1^\circ > 2^\circ > 3^\circ$

3. Stability of free radical

   $\underset{3^\circ}{Me_3\dot{C}} > \underset{2^\circ}{Me_2\dot{C}H} > \underset{1^\circ}{Me\dot{C}H_2} > \underset{1^\circ}{Me^{\bullet}}$

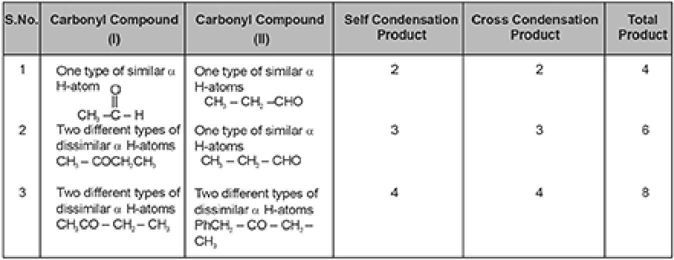
4. Heat of hydrogentation of alkenes

   1-butene > cis-2-butene > trans-2-butene

5. Leaving nature in, Nucleophilic substitution reaction

   $ArSO_3^- > ROSO_2^- > CH_3COO^- > CN^- > O^-H > MeO^- > H^- > R^-$

6. Number of product formed during crossed aldol condensation



S.No.	Carbonyl Compound (I)	Carbonyl Compound (II)	Self Condensation Product	Cross Condensation Product	Total Product
1	One type of similar α H-atom $CH_3-\overset{\overset{O}{\|}}{C}-H$	One type of similar α H-atoms CH_3-CH_2-CHO	2	2	4
2	Two different types of dissimilar α H-atoms $CH_3-COCH_2CH_3$	One type of similar α H-atoms CH_3-CH_2-CHO	3	3	6
3	Two different types of dissimilar α H-atoms $CH_3CO-CH_2-CH_3$	Two different types of dissimilar α H-atoms $PhCH_2-CO-CH_2-CH_3$	4	4	8

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