ESSENTIAL CONCEPTS OF PHYSICAL CHEMISTRY

Get well-prepared for exams with quick revision of important concepts of physical chemistry.

CONCEP
MAF
CLASS XII

Solid State

Packing efficiency

$$= \frac{\text{Volume occupied by two spheres in the unit cell}}{\text{Total volume of the unit cell}} \times 100$$

- Mass of the atoms of unit cell = Number of atoms in a unit cell (Z) $\times$ Mass of atom (M_{atom})
- Mass of one atom = $\frac{\text{Molar mass } (M)}{\text{Avogadro's constant } (N_A)}$
- Density (ρ) of unit cell of a cubic crystal = $\frac{ZM}{V \times N_A} = \frac{ZM}{a^3 N_A}$

- Bragg's equation : $2d \sin\theta = n\lambda$
- Number of octahedral voids = No. of particles present in the close packing
- Number of tetrahedral voids = 2 × No. of octahedral voids

Characteristics of Different Types of Unit Cells

Crystal	No. of atom(s)/ unit cell	Packing efficiency	C.No.	Relation in d, a and r
scc	1	52.4%	6	$r = d/2 = a/2$
bcc	2	68%	8	$r = d/2 = \sqrt{3}a/4$
fcc	4	74%	12	$r = d/2 = a/2\sqrt{2}$

Void	Radius Ratio
Triangular	$0.155 \le r^+/r^- < 0.225$
Tetrahedral	$0.225 \le r^+/r^- < 0.414$
Octahedral	$0.414 \le r^+/r^- < 0.732$
Body-centred cubic	$0.732 \le r^+/r^- < 1$

Solids on the Basis of Electrical Properties

- **Conductors :** Electrical conductivity, 10^4 to 10^7 ohm^{-1} m^{-1}
- **Insulators :** Electrical conductivity, 10^{-20} to 10^{-10} ohm^{-1} m^{-1}
- **Semiconductors :** Electrical conductivity, 10^{-6} to 10^4 ohm^{-1} m^{-1}
  - ***n*-type semiconductors :** Group 14 elements doped with group 15 elements, free electrons increase conductivity.
  - ***p*-type semiconductors :** Group 14 elements doped with group 13 elements, holes increase conductivity.

Solutions

- Molality (m) = $\frac{M}{\rho - \frac{MM_2}{1000}}$
- Molarity (M) = $\frac{n_1}{(n_1M_1 + n_2}$

- **Henry's law :** $p_A = K_H \cdot x_A$: K_H increases with increa temperature implying that solubility decreases with incre temperature at the same pressure.
- **Raoult's law :** $p_1 = p_1^\circ x_1$, this law is applicable only if th components form a homogeneous mixture.
- **Dalton's law of partial pressure :** $p_{total} = p_1 + p_2 + ... p_n$ a two components system, $p_{total} = p_1^\circ + (p_2^\circ - p_1^\circ)x_2$

Ideal and Non-ideal Solutions

Ideal Solutions	Non-ideal Solutions
$p_1 = x_1p_1^\circ$; $p_2 = x_2p_2^\circ$ $\Delta H_{mix} = 0, \Delta V_{mix} = 0$ $A - B$ interactions $\approx A - A$ and $B - B$ interactions.	$p_1 \ne x_1p_1^\circ$; $p_2 \ne x_2p_2^\circ$ $\Delta H_{mix} \ne 0, \Delta V_{mix} \ne 0$ $A - B$ interactions $\ne A$ and $B - B$ interactions

Non-ideal Solutions Showing Positive and Negative Deviations from Raoult's Law

Solutions showing positive deviation	Solutions showing negative deviation
$A - B << A - A$ or $B - B$ interactions. $\Delta H_{mix} > 0, \Delta V_{mix} > 0$ $p_1 > p_1^\circ x_1$	$A - B >> A - A$ or $B -$ interactions. $\Delta H_{mix} < 0, \Delta V_{mix} < 0$ $p_1 < p_1^\circ x_1$

Colligative Properties

- **Relative lowering of vapour pressure :** $(p_A^\circ - p_A)/p_A^\circ = x_B$
- **Elevation in boiling point :** $\Delta T_b = T_b - T_b^\circ = K_b m$
- **Depression in freezing point :** $\Delta T_f = T_f^\circ - T_f = K_f m$
- **Osmotic pressure :** $\pi = CRT = (n/V)RT$

van't Hoff Factor and its Significance

$$i = \frac{\text{Observed value of colligative property}}{\text{Calculated value of colligative property}}$$

- **For association of solute :** $nA \rightarrow (A)_n$
  Degree of association (α) = $(1 - i)\, n/n - 1; i < 1$
- **For dissociation of solute :** $(A)_n \rightarrow nA$
  Degree of dissociation (α) = $i - 1/n - 1; i > 1$
- **Modified colligative properties :**
  $p_A^\circ - p_A/p_A^\circ = ix_B$; $\Delta T_b = iK_b m$; $\Delta T_f = iK_f m$; $\pi = iCRT$

ONCEPT MAP

LASS XI

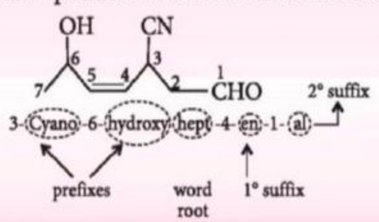
ESSENTIAL CONCEPTS OF ORGANIC CHEMISTRY

Get well-prepared for exams with quick revision of important concepts of organic chemistry.

Organic Chemistry - Some Basic Principles and Techniques

IUPAC Nomenclature

C name = prefixes + word root + 1° suffix + 2° suffix



Order of Species Showing Inductive Effect

effect: $R_3\overset{+}{N}- > -NO_2 > -SO_2R > -CN > -COOH >$ $> -Cl > -Br > -I > -OR > -COR > -OH > -C_6H_5 >$ $-CH=CH_2 > -H$

effect: $(CH_3)_3C- > (CH_3)_2CH- > CH_3CH_2- > CH_3- >$ $-D > -H$

der of Species Showing Resonance or Mesomeric Effect

effect : $-Cl, -Br, -I, -NH_2, -NHR, -NR_2, -NHCOR,$ $H, -OR, -SR, -SH, -OCH_3, -OCOR$

effect : $-NO_2, -CN, >C=O, -CHO, -COOH, -COOR$

d order in compounds which exhibit resonance

$$= \frac{\text{otal number of bonds between two atoms in all the structures}}{\text{Total number of resonating structures}}$$

Hyperconjugation

er of hyperconjugating structures $\propto$ number of α-hydrogens

ility $\propto$ 1/heat of hydrogenation $\propto$ polarity $\propto$ dipole moment

nd length

Stability of Free Radicals

ility of free radicals $\propto +I\text{-effect} \propto \frac{1}{-I\text{-effect}} \propto +R\text{-effect} \propto \frac{1}{-R\text{-effect}}$

$> Ph_2\dot{C}H > Ph\dot{C}H_2 > \text{Allyl} > 3° > 2° > 1° > \dot{C}H_3 > CH_2=\dot{C}H$

Stability of Carbocations

ility of carbocations $\propto +I\text{-effect} \propto \frac{1}{-I\text{-effect}} \propto +R\text{-effect} \propto \frac{1}{-R\text{-effect}}$

$> Ph_2\overset{+}{C}H > Ph\overset{+}{C}H_2 > \text{Allyl} > 3° > 2° > 1° > \overset{+}{C}H_3$

Stability of Carbanions

- Stability of carbanions $\propto -I\text{-effect} \propto \frac{1}{+I\text{-effect}} \propto -R\text{-effect} \propto \frac{1}{+R\text{-effect}}$

$Ph_3\bar{C} > Ph_2\bar{C}H > Ph\bar{C}H_2 > \text{Allyl} > \bar{C}H_3 > 1° > 2° > 3°$

Stability of Carbene

Triplet > Singlet

Thin Layer Chromatography

Retention factor (R_f)

$$= \frac{\text{Distance travelled by the compound from base line } (x)}{\text{Distance travelled by the solvent from base line } (y)}$$

Quantitative Analysis

- $\% \text{ of C} = \frac{12}{44} \times \frac{\text{mass of } CO_2 \text{ formed}}{\text{mass of compound taken}} \times 100$
- $\% \text{ of H} = \frac{2}{18} \times \frac{\text{mass of } H_2O \text{ formed}}{\text{mass of compound taken}} \times 100$

(Liebig's combustion method)

- $\% \text{ of N} = \frac{28}{22400} \times \frac{\text{vol. of } N_2 \text{ at STP}}{\text{mass of compound taken}} \times 100$
- $\% \text{ of N} = \frac{1.4 \times \text{normality of acid} \times \text{vol. of acid used}}{\text{mass of compound taken}}$

(Dumas method)

- $\% \text{ of N} = \frac{1.4 \times \text{molarity of acid} \times \text{vol. of acid used} \times \text{basicity of acid}}{\text{mass of compound taken}}$

(Kjeldahl's method)

- $\% \text{ of Cl} = \frac{35.5}{143.5} \times \frac{\text{mass of AgCl formed}}{\text{mass of compound taken}} \times 100$
- $\% \text{ of Br} = \frac{80}{188} \times \frac{\text{mass of AgBr formed}}{\text{mass of compound taken}} \times 100$
- $\% \text{ of I} = \frac{127}{235} \times \frac{\text{mass of AgI formed}}{\text{mass of compound taken}} \times 100$
- $\% \text{ of S} = \frac{32}{233} \times \frac{\text{mass of } BaSO_4 \text{ formed}}{\text{mass of compound taken}} \times 100$

(Carius method)

- $\% \text{ of P} = \frac{62}{222} \times \frac{\text{mass of } Mg_2P_2O_7 \text{ formed}}{\text{mass of compound taken}} \times 100$

(Ignition method)

- $\% \text{ of O} = \frac{32}{88} \times \frac{\text{mass of } CO_2 \text{ formed}}{\text{mass of compound taken}} \times 100$
- $\% \text{ of O} = \frac{5 \times 16}{2 \times 127} \times \frac{\text{mass of } I_2 \text{ formed}}{\text{mass of compound taken}} \times 100$

(Iodine method)