# JKBOARD PATTERN TEST PAPER CLASS – XII SUBJECT CHEMISTRY ANSWER & SOLUTIONS

ANSWER KEY SECTION A

| 1	2	3	4	5	6	7	8	9	10
3	1	1	3	3	3	4	4	2	4

Section B:

1. 0.5 molal solution is the solution in which 0.5 moles of solute are present per Kg of the solvent . In other words , it is the solution whose molality is equal to 0.5 .

2. (i) Ligand : A ligand is an ion or molecule which donates a pair of electrons to the central metal atom or ion to form a coordination complex.

    (ii) Coordination sphere : The coordination sphere is the non-ionizable part of a complex compound, which consists of a central transition metal ion surrounded by neighbouring atoms or groups enclosed in a square bracket.

    For example: $K_3[Fe(CN)_6]$

    In the given coordination compound,

    $\overset{\ominus}{C}N$ ions act as Ligand $[Fe(CN)_6]^{3-}$ is the coordination sphere:

3. i) Hydrogen hexachloridoplatinate (iv)

    ii) Potassiumhexacyanoferrate(iii)

4. Markonikoff's rule: When an unsymmetrical reagent is added to an unsymmetrical alkene, the negative part of the reagent is attached to the unsaturated C atom having less number of hydrogen atoms.

    Thus, when HBr is added to propene, isopropyl bromide is obtained as major product.
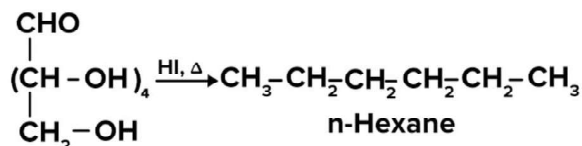
    $$CH_3 - CH = CH_2 + HBr \rightarrow CH_3 - \underset{\underset{Br}{|}}{CH} - CH_3$$
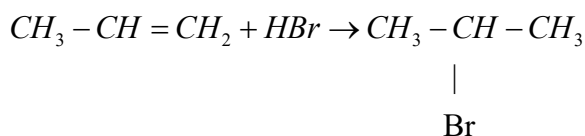
5. Ethanoic acid , on heating with soda-lime , undergoes decarboxylation to form Methane .
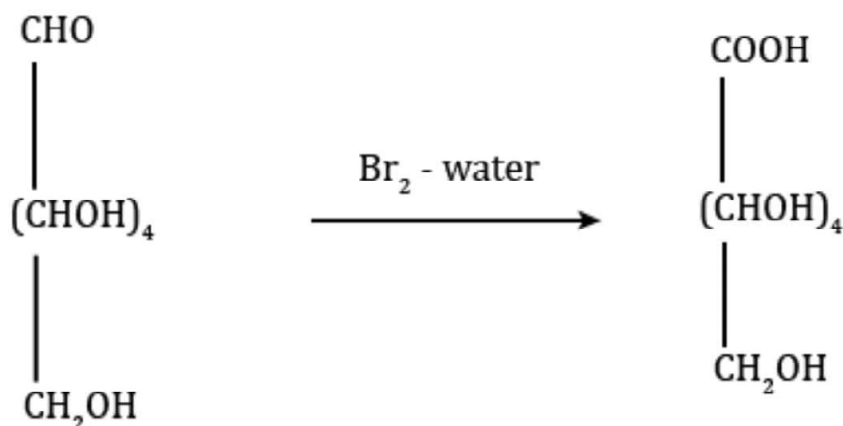
    $$CH_3 - COOH \xrightarrow[\Delta]{NaOH+CaO} CH_4$$
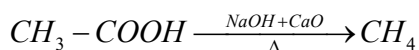
ANSWER AND SOLUTIONS

6. i) Reaction of glucose with HI forms hexane. This reaction shows the presence of six carbons linked linearly in glucose.

$$\underset{\underset{CH_2-OH}{|}}{\overset{\overset{CHO}{|}}{(CH-OH)_4}} \xrightarrow{HI, \Delta} CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$$

n-Hexane

ii) When glucose reacts with Bromine water, it undergoes oxidation to form Gluconic acid as a product.

$$\underset{\underset{CH_2OH}{|}}{\overset{\overset{CHO}{|}}{(CHOH)_4}} \xrightarrow{Br_2 - water} \underset{\underset{CH_2OH}{|}}{\overset{\overset{COOH}{|}}{(CHOH)_4}}$$

7. i) Nitro compounds are converted to amines by chemical reduction in presence of a metal and mineral acid.
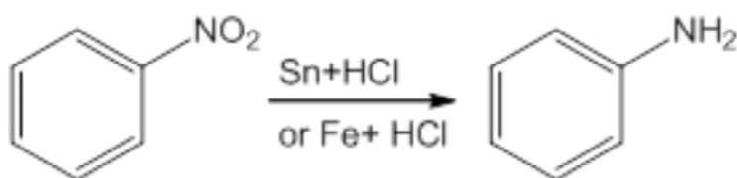
ii) Primary amines are formed when nitriles are reduced with lithium aluminium hydride (LiAlH$_4$) or catalytically hydrogenated.

$$R - C \equiv N \xrightarrow[ii) H_2O]{i) LiAlH_4} R - CH_2 - NH_2$$
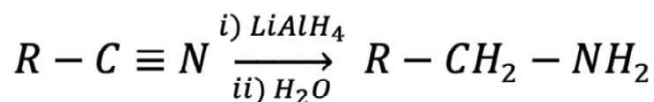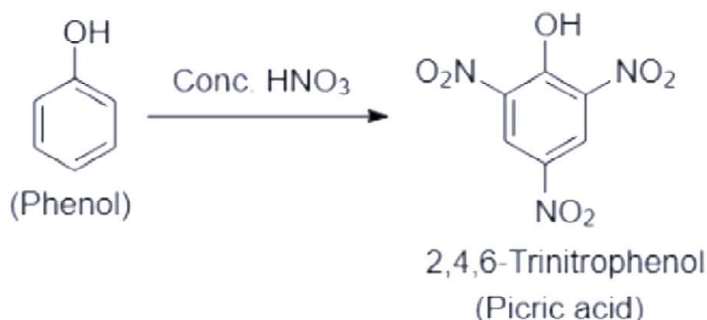
8. The reaction of alkyl halides with Sodium alkoxide or Sodium phenoxide to form symmetrical or unsymmetrical Ethers by SN2 mechanism is called Williamson's ether synthesis.
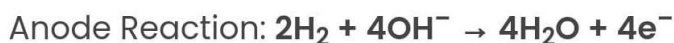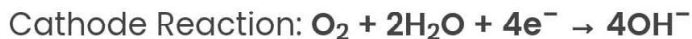
$$R-X + R'-\overset{..}{\underset{..}{O}}{}^{-} \; \overset{+}{Na} \longrightarrow R-\overset{..}{\underset{..}{O}}-R' + NaX$$

9. Phenol on reaction with conc. Nitric acid forms picric acid .

(Phenol)   Conc. HNO₃   →   2,4,6-Trinitrophenol (Picric acid)

Section C

1. A fuel cell can be defined as an electrochemical cell that generates electrical energy from fuel via an electrochemical reaction.

   Fuel cells require a continuous input of fuel and an oxidizing agent (generally oxygen) in order to sustain the reactions that generate the electricity. Therefore, these cells can constantly generate electricity until the supply of fuel and oxygen is cut off.

   The reaction between hydrogen and oxygen can be used to generate electricity via a fuel cell.The working of this fuel cell involves the passing of hydrogen and oxygen into a concentrated solution of sodium hydroxide via carbon electrodes. The cell reaction can be written as follows:

   Cathode Reaction: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$

   Anode Reaction: $2H_2 + 4OH^- \rightarrow 4H_2O + 4e^-$

   Net Cell Reaction: $2H_2 + O_2 \rightarrow 2H_2O$

2. "Half life period " of a reaction is defined as the time required to reduce the concentration of a reactant to one half of its initial value.

   $$k_1 = \frac{2.303}{t}\log\left(\frac{a}{a-x}\right)$$

   if amount reacted $x = \frac{a}{2}$ then $t = t_{1/2}$

   $$\therefore t_{1/2} = \frac{2.303}{t}\log\left(\frac{a}{a-a/2}\right)$$

   $$t_{1/2} = \frac{2.303\log(2.0)}{k_1} \Rightarrow t_{1/2} = \frac{0.693}{k_1}\text{secs}$$

Thus half life period of a first order reaction is independent of the initial concentration of the reactant.

3.

Molecularity	Order
(1) It is the number of reacting species undergoing simultaneous collision.	It is the sum of the powers of the concentration terms in the rate law expression.
(2) It is a theoretical concept.	It is experimentally determined.
(3) It has integral values only.	It can have fractional values also
(4) It cannot be zero.	It can be zero.

4. Lanthanide Contraction: The steady decrease in the size of lanthanide ions (M^{3+}) with the increase in atomic no. is called lanthanide contraction.
    Causes:As we move down the group from left to right in a lanthanide series, the atomic no. increases and for every proton in the nucleus the extra electron goes to 4f orbital. The 4f orbital is too diffused to shield the nucleus effectively, thus there is a gradual increase in the effective nuclear charge experienced by the outer electrons. Consequently , the attraction of the nucleus for the electrons in the outermost shell increases with the increase of atomic number, thus size decreases.

5. The d block elements exhibit various magnetic properties due to the presence of unpaired electrons in their d-orbitals. These properties can be categorized into three main types: paramagnetism, diamagnetism, and ferromagnetism.
   Paramagnetism: Paramagnetic substances are attracted to an external magnetic field due to the presence of unpaired electrons.
    Daimagnetism : Diamagnetic substances have all their electrons paired, resulting in the cancellation of magnetic moments.
    Ferromagnetism: Ferromagnetic substances exhibit strong attraction to an external magnetic field and can retain their magnetization even after the field is removed.

6.

Six pairs of electrons from six CN⁻ ion
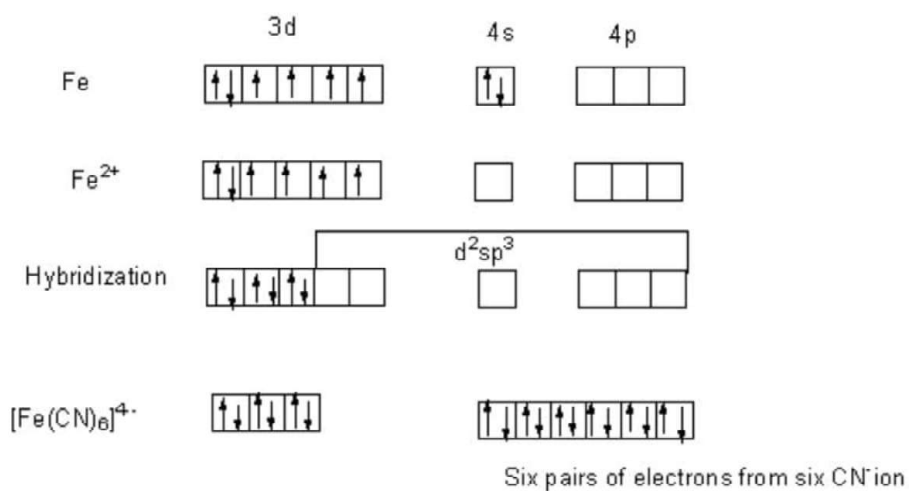
Therefore Hybridisation = d^2sp^3
Geometry = Octahedral

7.

Related Concepts	S_N1 Reaction	S_N2 Reaction
Rate law	Unimolecular	Bimolecular
Haloalkane reactivity (electrophile)	$3° > 2° > 1°$	$3° < 2° < 1°$
Solvent	Polar solvent (protic solvent)	Polar aprotic solvent
Nucleophile	Weak nucleophile	Strong nucleophile
Stereochemistry	A mix of retention and inversion	Inversion

8. Primary (1°) structure :
The primary protein structure is the simplest way to describe a protein, and is simply the linear sequence of amino acids that makes up the peptide chain.
Secondary (2°) Structure
The secondary protein structure describes the first step in how the amino acid sequence starts to fold in three dimensional space. There are two main secondary structures that occur, both of which are governed by hydrogen bonding between carbonyl and amino groups of the amino acids in the peptide chain. These are alpha helices and beta sheets.
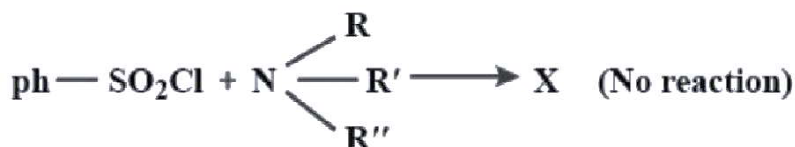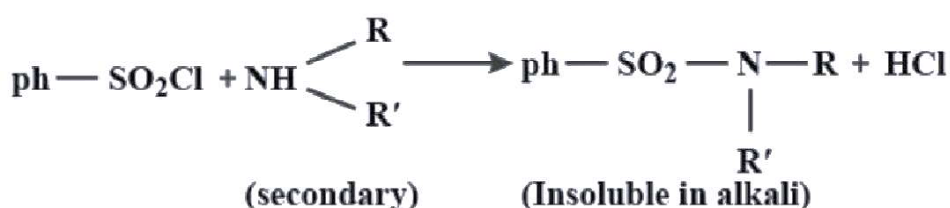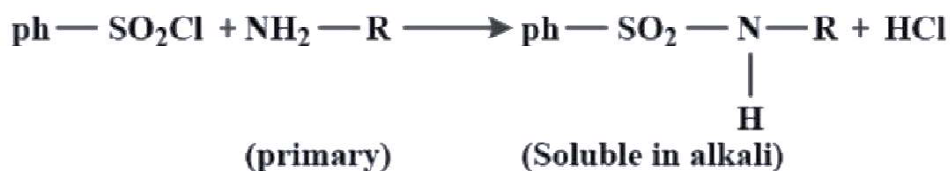Tertiary (3°) Structure
The tertiary protein structure describes how the secondary structure elements interact together to form a complex three dimensional protein structure (also known as a domain). These interactions are generally between the R groups of the amino acids and include many non covalent interactions; hydrogen bonding, ionic bonding (forming salt bridges), dipole-dipole interactions, and London dispersion forces. Disulphide bridges can also form through a covalent bond between two sulphur atoms of the cysteine R group.

9. The mixture of amines is treated with benzene sulphonyl chloride (Hinsberg's reagent) and shaken with alkali solution.
(1) Primary amine forms alkyl benzenesulphonamide which dissolves in alkali to form sodium or potassium salt of monoalkylbenzenesulphonamide.
Secondary amine forms alkyl sulphonamide which does not form salt with alkali and hence remains insoluble (solid) in alkali solution.
Tertiary amines does not react with Hinsberg's reagent.

$$ph - SO_2Cl + NH_2 - R \longrightarrow ph - SO_2 - \underset{\underset{H}{|}}{N} - R + HCl$$

$$\text{(primary)} \qquad \text{(Soluble in alkali)}$$

$$ph - SO_2Cl + NH \overset{R}{\underset{R'}{\diagdown}} \longrightarrow ph - SO_2 - \underset{\underset{R'}{|}}{N} - R + HCl$$

$$\text{(secondary)} \qquad \text{(Insoluble in alkali)}$$

$$ph - SO_2Cl + N \overset{R}{\underset{R''}{\underset{\diagdown}{\diagup}}} - R' \longrightarrow X \quad \text{(No reaction)}$$

Section D

Q1. Methods of preparation of aldehydes :
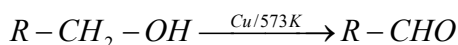
i) Oxidation of primary alcohols :

Primary alcohols are oxidised to aldehydes upon oxidation using PCC or PDC or Collin's reagent .
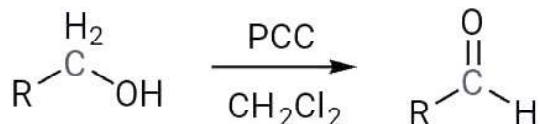

1° Alcohol　　　　**Aldehyde**

ii) Catalytic dehydrogenation of primary alcohols : In this method, a primary alcohol is passed over metal catalysts like Copper which results in the formation of an aldehyde.

$$R - CH_2 - OH \xrightarrow{Cu/573K} R - CHO$$

iii) Rosenmund's reduction : Rosenmund reduction is a reaction where acid chlorides are converted into aldehydes by employing hydrogen gas over palladium poisoned by barium sulfate.

Acid chloride　　　　　Aldehyde

iv) Stephen's reduction : Alkyl nitriles on reduction with stannous chloride and hydrochloric acid in dry ether give corresponding imine hydrochlorides which on acid hydrolysis, give corresponding aldehydes. This reaction is known as Stephen's reaction.
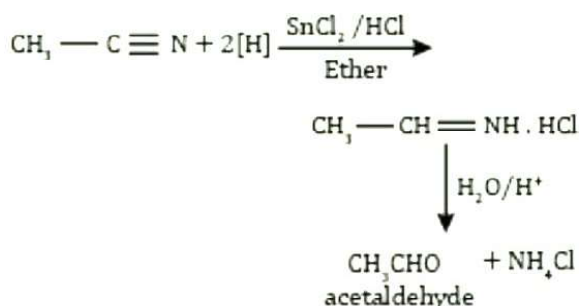
v) Reduction of esters : Esters undergo reduction with DIBAL-H to form aldehydes.


Ester　　　　　Aldehyde　　Alcohol
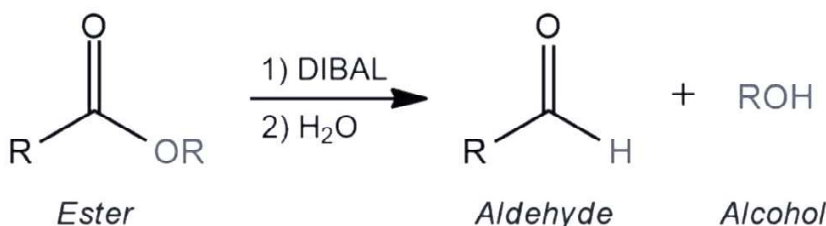
OR

i) Aldol Condensation : Two molecules of an aldehyde or a ketone react in presence of a base to yield a β-hydroxyaldehyde or a β-hydroxyketone which upon acid catalysed or base catalysed dehydration forms an unsaturated aldehyde or a ketone . This reaction is called aldol condensation .

If the condensation reaction occurs between two different carbonyl compounds it is called crossed aldol condensation. One of the common examples for base-catalyzed aldol condensation is stated below in which catalyst generally used is hydroxide ion.

$$CH_3CHO \xrightarrow[\text{H}_2\text{O, } \Delta]{\text{catalyst: NaOH}} CH_3CH = CHCHO$$
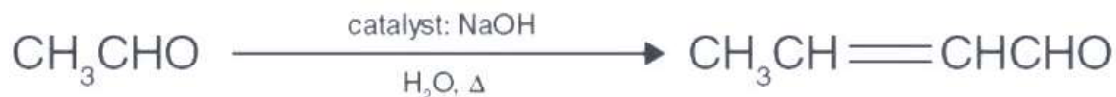
ii) HVZ reaction : In the presence of phosphorus, aliphatic carboxylic acids react smoothly with chlorine or bromine to yield a compound in which a-hydrogen has been replaced by halogen. Such a reaction is known as Hell Volhard Zelinsky reaction .

$$R-CH_2COOH \xrightarrow[X_2]{\text{Re}d\,P} R-CH-COOH$$
$$|$$
$$X$$
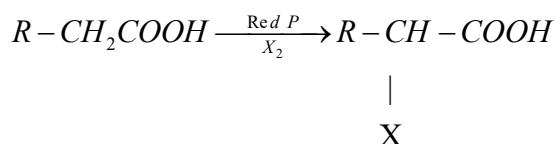
iii) Rosenmund's Reaction : Rosenmund reduction is a reaction where acid chlorides are converted into aldehydes by employing hydrogen gas over palladium poisoned by barium sulfate. An example of this catalytic hydrogenation of acyl chlorides forming aldehydes is shown below.

$$R-\overset{O}{\underset{}{C}}-Cl \xrightarrow{\text{H}_2, \text{Pd/BaSO}_4} R-\overset{O}{\underset{}{C}}-H + HCl$$
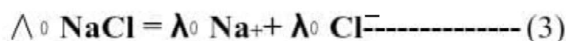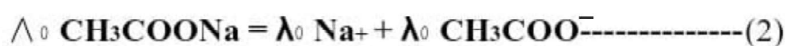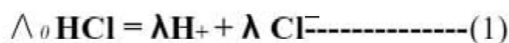
Acid chloride   Aldehyde

Q2.   Kohlrauch's law refers to an electrolyte's limiting molar conductivity to its constituent ions. It states that an electrolyte's limiting molar conductivity equals the sum of the individual limiting molar conductivities of the cations and anions that make up the electrolyte.
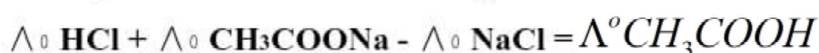
Applications of Kohlrausch Law

1-Calculation of molar conductivity of a weak electrolyte at infinite dilution

It is not possible to determine the value of Λ_m^∞ for weak electrolytes since we cannot obtain the limiting value of the molar conductivity for a weak electrolyte. This is done indirectly by the molar ionic conductance for the individual ions of the weak electrolyte as follows:

For e.g. molar conductance of acetic acid at infinite dilution can be calculated from the molar conductance at infinite dilution of hydrochloric acid, sodium acetate and sodium chloride as follows:

$\wedge_0 HCl = \lambda H_+ + \lambda\ Cl^-$-------------(1)

$\wedge_0\ CH_3COONa = \lambda_0\ Na_+ + \lambda_0\ CH_3COO^-$--------------(2)

$\wedge_0\ NaCl = \lambda_0\ Na_+ + \lambda_0\ Cl^-$-------------(3)

Add eq. 1 and 2 and subtract 3 we get:

$\wedge_0\ HCl + \wedge_0\ CH_3COONa - \wedge_0\ NaCl = \Lambda^o CH_3COOH$

b.   Solubility of Sparingly Soluble Salts
     The sparingly soluble salts are those salts that do not dissolve very well in water (or has very little dissolution in water). Examples of such salts include $AgCl$, $PbSO_4$, $BaSO_4$, etc. Since they are very less dissolved, they are at infinite dilution. And their solubility and concentration are the same. So, using the total molar conductivities $\left(\pi_m^0\right)$ (through Kohlrausch's law) and specific conductivity (K) of these salts, one can find their solubility.

     Solubility = $\dfrac{K \times 100}{\Lambda° m}$

ANSWER AND SOLUTIONS

* Moreover, for weak electrolytes like acetic acid it is possible to determine the value of its dissociation constant once we know the Λ_m^o and Λ_m at a given concentration c.

$$\kappa_a = \frac{c\alpha^2}{1-\alpha} = \frac{c\Lambda_m^2}{\Lambda_m^\circ(\Lambda_m^\circ - \Lambda_m)}$$

Degree of dissociation of weak electrolyte:

$$(\alpha) = \frac{\Lambda_m}{\Lambda_m^\circ}.$$

OR

From Thermodynamics we have

$$\Delta G = \Delta G^\circ + RT lnQ$$

We can rewrite this equation using the definitions of $\Delta G = -nFE$ and $\Delta G^\circ = -nFE^\circ$.

$$-nFE = -nFE^\circ + RT lnQ$$

To simplify, we divide each side by $-nF$ and arrive at the Nernst equation as it is commonly written.

$$E_{\text{Cell}} = E^0 - \left(\frac{RT}{nF}\right) lnQ$$

$$E_{cell} = E_{cell}^{\circ} - \frac{2.303RT}{nF}\log Q$$

Fro $T = 298F$

$F = 96,500C$

$R = 8.314 J.\,mol^{-1}K^{-1}$

$$E_{cell} = E_{ccll}^{\circ} - \frac{0.059}{n}\log Q$$

For Galvanic cell ,

Overall reaction:

$$Zn(s) + Cu^{2+}(aq) \to Zn^{2+}(aq) + Cu(s)$$
n=2

$$E_{cell} = E_{cell}^{0} - \frac{0.059}{2}\log\frac{[Zn^{2+}]}{[Cu^{2+}]}$$

Q3. The boiling point of a liquid is the temperature at which the vapour pressure is equal to atmospheric pressure.When we add a non-volatile liquid (solute) to a pure solvent, the vapour pressure of the solution decreases. So, to make the vapour pressure equal to the atmospheric pressure, the temperature of the solution needs to be increased. This variation in the boiling point of the pure solvent and the solution is called the elevation in boiling point.

If T^0b is the boiling point of the pure solvent and Tb is the boiling point of the solution, then elevation in boiling point is given as

$\Delta Tb = T^0b - Tb$

Experimental results show that there is a relation between elevation in boiling point and molality 'm' of the solute present in the solution.

$\Delta Tb \propto m$

$\Delta Tb = kb\, m$

Where,

kb = molal elevation constant

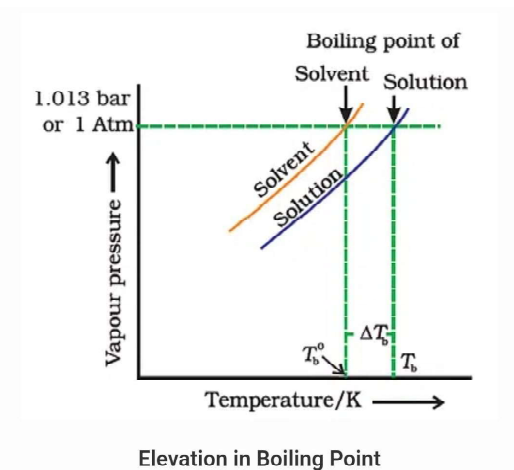Substituting the value of 'm' in the above relation, we get

$\Delta Tb = 1000 \times kb \times m2\, /\, M2 \times m1$

Where,

m_2 = mass of solvent in g

M_1 = mass of solvent in kg

M_2 = molar mass of solute

Elevation in Boiling Point

ANSWER AND SOLUTIONS

OR

Raoult's law for a solution containing volatile components can be stated as:

"In a solution, the vapour pressure of a component at a given temperature is equal to the mole fraction of that component in the solution multiplied by the vapour pressure of that component in the pure state."

Suppose a binary solution contains nA moles of a volatile liquid A and nB moles of a volatile liquid B, if PA and PB are partial pressure of the two liquid components, the according to Raoult's law

$$P_A = x_A . P_A^0 \quad \text{and} \quad P_B = x_B . P_B^0$$

Where XA is the mole fraction of the component A given by nA/nA+ nB; xB is the mole fraction of the component B, given by nB/nA+nB and P_A^0 and P_B^0 are the vapour pressures of pure components A and B respectively.

If the vapour behaves like an ideal gas, then according to Dalton's law of partial pressures, the total pressure P is given by

$$P = P_A + P_B = x_A P_A^0 + x_B P_B^0$$

=

$$\frac{n_A . P_A^0}{n_A + n_B} + \frac{n_B . P_B^0}{n_A + n_B}$$

$$\frac{n_A . P_A^0 + n_B . P_B^0}{n_A + n_B}$$