CAREERS 360
PRACTICE Series

MP Board Class 12

Chemistry

Previous Year Questions with Detailed Solution

MP Board Class 12 Chemistry Question with Solution - 2023

Choose and write the correct options :

(i) The formula of Osmotic pressure is -

(a) $\pi=\frac{nRT}{\mathrm{V}}$

(b) $P=\frac{KT}{V}$

(c) $\mathrm{P}=\frac{\mathrm{RT}}{\mathrm{M}}$

(d) $\pi=\frac{PV}{T}$

Solution: The formula for osmotic pressure is:

$$\pi=\frac{nRT}{V}$$

This equation represents osmotic pressure (π) in terms of the number of moles of solute (n), the ideal gas constant (R), the temperature (T), and the volume of the solution (V). It is derived from the ideal gas law applied to solutions.

Hence, the answer is option (a).

(ii) Order of reaction for rate $=K[A]^{1/2}[B]^{3/2}$ **is -**

(a) $2\frac{1}{2}$

(c) 2.5

(b) $\frac{4}{3}$

(d) 2

Solution: The order of the reaction is the sum of the exponents of the concentration terms in the rate equation. Here, it is $\frac{1}{2}+\frac{3}{2}=2.5$.

Hence, the answer is option (b).

(iii) Inner transition element is -

(a) Sc

(b) Ilg

(c) V

(d) Ce

Solution: Cerium (Ce) is an inner transition element, specifically a lanthanide.

Hence, the answer in option (d).

(iv) The oxidation number of lee in $\mathrm{K}_2\left[\mathrm{Fe}(\mathrm{CN})_6\right]$ **is -**

(a) +6

(b) -4

(c) +4

(d) +3

Solution: To determine the oxidation number of Fe in $K_2[Fe(CN)_6]$:

1. Potassium (K) has an oxidation number of +1, and there are 2 K atoms, contributing +2.
2. Cyanide (CN) has an oxidation number of -1, and there are 6 CN groups, contributing -6.
3. The sum of oxidation numbers must equal zero for the neutral compound: $2+x-6=0$. Solving for x, the oxidation number of Fe is +3.

Hence, the answer in option (d).

(v) Alkyl iodides are often prepared by the reaction of alkyl chloride/bromides with NaI in dry acetone. This reaction is known as -
(a) Finkelstein reaction
(b) Sandmeyer's reaction
(c) Coupling reaction
(d) Kolbe's reaction

Solution: Alkyl iodides are often prepared by the reaction of alkyl chloride/bromides with NaI in dry acetone.

Hence, the answer is option (a).

(vi) Alcohols react with sodium to form -
(a) $R-O-R$
(b) RONa
(c) $R-H$
(d) RCHO..

Solution: When alcohols react with sodium, they form alkoxides and hydrogen gas. For example, ethanol (an alcohol) reacts with sodium to form sodium ethoxide (RONa) and hydrogen gas (H):

$$2\text{R-OH}+2\text{Na}\rightarrow 2\text{RONa}+H_2$$

Hence, the answer is option (b).

(vii) Which of the following is most acidic?
(a) CF_3COOH
(b) CCl_3COOH
(c) $CHCl_2COOH$
(d) CH_3COOH.

Solution: Trifluoroacetic acid (CF_3COOH) is the most acidic among the given compounds because the highly electronegative fluorine atoms stabilize the negative charge on the carboxylate anion through inductive effects, making it easier to donate the proton.

Hence, the answer is option (a).

Q 2. Fill in the blanks:
(i) Molarity of water is ________.

Solution: The molaritybenzene diazoniumWhereWhereWherecan'tathe dimethyl pentaneethoxy propaneaWhere of water is approximately $55.5\,\mathrm{M}$.

This is calculated based on the density of water (approximately $1\,\mathrm{g/mL}$ or $1000\,\mathrm{g/L}$) and the molar mass of water ($18.015\,\mathrm{g/mol}$):

$$\text{Molarity} = \frac{\text{mass of water in 1 L}}{\text{molar mass of water}} = \frac{1000\,\mathrm{g/L}}{18.015\,\mathrm{g/mol}} \approx 55.5\,\mathrm{M}$$

(ii) The value of the potential of the standard hydrogen electrode is ________.

Solution: The value of the potential of the standard hydrogen electrode (SHE) is defined as $0\,\mathrm{V}$. This electrode serves as the reference point for measuring electrode potentials in electrochemistry, allowing the comparison of the tendencies of different electrodes to gain or lose electrons.

(iii) The colour of Ni^{2+} is __________.

Solution: The color of Ni^{2+} is green.

Nickel(II) ions typically form green-colored complexes in aqueous Solutions.

(iv) The chemical name of EDTA is _________.

Solution: The chemical name of EDTA is Ethylenediaminetetraacetic acid. It is a chelating agent that binds to metal ions, forming stable complexes and is widely used in various applications including medicine, industry, and biochemistry.

(v) Anisole read a mixture of ___________.

Solution: Anisole is a mixture of methoxybenzene ($C_6H_5OCH_3$). It consists of a benzene ring attached to a methoxy group (–OCH_3).

(vi) Methyl amine is an ___________.

Solution: Methylamine is an organic compound with the formula CH_3NH_2. It is a simple aliphatic amine and acts as a weak base.

(vii) Chemical name of vitamin basic $\mathrm{HNO_3}$ to yield a_________.

Solution: The chemical name of vitamin C is ascorbic acid. When vitamin C is treated with basic $\mathrm{HNO_3}$ (nitric acid), it yields dehydroascorbic acid.

Q 3. Match the Pair correctly:

A	**B**
(i) Mn	**(a) Ether**
(ii) Primary valence	**(b) Primary amine**

(iii) R-O-R	**(c) Lactose**
(iv) Hoffmann bromide	**(d)** $C_{12}H_{22}O_{11}$
(v) Milk sugar-	**(e) Glucose-**
(vi) Sucrose.	**(f) Negative ions**
(vii) Aldohexose	**(g)** $C_6H_5SO_2Cl$
	(h) +7

Solution:

A	B
(i) Mn	(h) +7
(ii) Primary valence	(f) Negative ions
(iii) R-O-R	(a) Ether
(iv) Hoffmann bromide	(b) Primary amine
(v) Milk sugar	(c) Lactose
(vi) Sucrose	(d) C12H22O11
(vii) Aldohexose	(e) Glucose

Q 4. Answer in one word/sentence:
(i) Write the formula of molar conductivity.

Solution: The formula of molar conductivity (Λ_m) is:

$\Lambda_m = \frac{\kappa}{C}$

where κ is the conductivity of the Solution and C is the molar concentration of the solute.

(ii) Write the unit of the rate constant for zero order of reaction.

Solution: The unit of the rate constant for a zero-order reaction is $\mathrm{mol\,L^{-1}\,s^{-1}}$.

(iii) Write the electronic configuration of Scandium.

Solution: The electronic configuration of Scandium (Sc, atomic number 21) is:

$1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2\,3d^1$

(iv) Write the chemical name of DDT.

Solution: The chemical name of DDT is Dichlorodiphenyltrichloroethane.

(v) Write the chemical reaction of the coupling reaction.

Solution: In a coupling reaction, a diazonium salt (e.g., benzenediazonium chloride) reacts with an aromatic compound like aniline to form an azo compound. For example, benzenediazonium chloride ($\mathrm{C_6H_5N_2^+Cl^-}$) reacts with aniline ($\mathrm{C_6H_5NH_2}$) to form p-aminoazobenzene ($\mathrm{C_6H_5N_2C_6H_4NH_2}$) and HCl.

(vi) Write the formula of Hinsberg's reagent.

Solution: The formula of Hinsberg's reagent is $\mathrm{C_6H_5SO_2Cl}$ (benzenesulfonyl chloride).

(vii) Write the name of the monomer of proteins.

Solution: The monomers of proteins are called amino acids.

Q 5. Write the definition of mole fraction.

Solution: The mole fraction is defined as the ratio of the number of moles of a component to the total number of moles of all components in a mixture. It is represented by x_i and is calculated using the formula:

$x_i = \frac{n_i}{n_{\text{total}}}$

where n_i is the number of moles of the component and n_{total} is the total number of moles of all components in the mixture.

OR

Write the definition of the Solution.

Solution: A Solution is a homogeneous mixture composed of two or more substances, where one substance (the solute) is uniformly dispersed at the molecular or ionic level within another substance (the solvent).

Q 6. Write the functions of the salt bridge.

Solution: The functions of a salt bridge in an electrochemical cell are:

1. To maintain electrical neutrality by allowing the flow of ions between the two half-cells, preventing charge buildup.
2. To complete the electrical circuit, enabling the flow of electrons through the external circuit.

OR

Write the first law of Faraday of electrolysis.

Solution: The first law of Faraday of electrolysis states that the amount of substance deposited or liberated at an electrode during electrolysis is directly proportional to the quantity of electric charge passed through the electrolyte. Mathematically, it is expressed as:

$$m = Z \cdot Q$$

where m is the mass of the substance deposited or liberated, Z is the electrochemical equivalent of the substance, and Q is the total electric charge passed through the electrolyte.

Q 7. Write any two differences between the Molecularity of reaction and Order of reaction.

Solution:

Aspect	Molecularity	Order of Reaction
Definition	Number of reactant molecules involved in a single step of a reaction mechanism.	The sum of the powers of the concentration terms in the rate law expression of the reaction.
Nature	Always a whole number (1, 2, 3, etc.).	Can be a whole number, fraction, or zero.
Determination	Determined from the reaction mechanism and is a theoretical concept.	Determined experimentally from the rate law of the reaction.

OR

Write any two differences between the Rate of reaction and Rate constant.

Solution:

Aspect	Rate of Reaction	Rate Constant
Definition	The change in concentration of reactants or products per unit time.	A proportionality constant in the rate law equation of the reaction.

Dependence	Depends on the concentration of reactants, temperature, and catalyst.	Independent of the concentration of reactants; depends on temperature and catalyst.

Q 8. Write the IUPAC names of the following coordination compounds -
(i) $[Co(NH_3)_6]Cl_3$
(ii) $K_z\,[Ni(CN)_4]$

Solution: Here are the IUPAC names of the given coordination compounds:

(i) $[Co(NH_3)_6]Cl_3$

IUPAC Name: Hexaamminecobalt(III) chloride

(ii) $K_2\,[Ni(CN)_4]$

IUPAC Name: Potassium tetracyanonickelate(II)

OR

Define the oxidation number of the central metal atom with an example.

Solution: The oxidation number (or oxidation state) of the central metal atom in a coordination compound is the charge that the atom would have if all the ligands and electron pairs shared with the central atom were removed.

Example:

In the coordination compound $[Fe(CN)_6]^{3-}$:

1. The cyanide ion (CN^-) has a charge of -1.
2. There are six cyanide ligands, contributing a total charge of $6 \times (-1) = -6$.
3. The overall charge of the complex is -3.

Let x be the oxidation number of the central metal atom (Fe). The sum of the oxidation number of Fe and the charges of the ligands equals the overall charge of the complex:

$$x + 6(-1) = -3$$

$$x - 6 = -3$$

$$x = +3$$

Therefore, the oxidation number of the central metal atom (Fe) in $[Fe(CN)_6]^{3-}$ is +3.

Q 9. Define the coordination number with an example.

Solution: The coordination number of a central metal atom in a coordination compound is defined as the number of ligand atoms directly bonded to the metal atom. It indicates the total number of coordinate bonds formed between the central metal atom and the ligands.

Example:

In the coordination compound $[Co(NH_3)_6]^{3+}$:

- The central metal atom is cobalt (Co).
- There are six ammonia (NH_3) ligands directly bonded to the cobalt atom.

Therefore, the coordination number of cobalt in $[Co(NH_3)_6]^{3+}$ is 6.

OR

Write the definition of hydrate isomerism with an example.

Solution: Hydrate isomerism (also known as solvate isomerism) occurs in coordination compounds when water molecules (or other solvent molecules) can occupy different positions within the coordination complex, either as ligands directly bonded to the metal ion or as water of crystallization within the crystal lattice.

Example:

Consider the compound $CrCl_3 \cdot 6H_2O$. This compound can exhibit hydrate isomerism, resulting in different isomers depending on how many water molecules are directly bonded to the chromium ion:

1. $[Cr(H_2O)_6]Cl_3$ - All six water molecules are directly bonded to the chromium ion.
2. $[Cr(H_2O)_5Cl]Cl_2 \cdot H_2O$ - Five water molecules are bonded to the chromium ion, one chloride ion is bonded, and one water molecule is in the crystal lattice.
3. $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$ - Four water molecules are bonded to the chromium ion, two chloride ions are bonded, and two water molecules are in the crystal lattice.

These different isomers show how the water molecules can occupy different positions, leading to hydrate isomerism.

Q 10. Write the Etard reaction with the chemical reaction.

Solution: The Etard reaction involves the oxidation of aromatic methyl groups to form aldehydes using chromyl chloride (CrO_2Cl_2). A classic example is the oxidation of toluene to benzaldehyde.

Chemical Reaction:

$$C_6H_5CH_3 + CrO_2Cl_2 \rightarrow C_6H_5CHO + CrO_2 + 2HCl$$

In this reaction, toluene ($C_6H_5CH_3$) is oxidized by chromyl chloride (CrO_2Cl_2) to form benzaldehyde (C_6H_5CHO), with chromyl chloride being reduced to chromium dioxide (CrO_2) and hydrochloric acid (HCl) as byproducts.

OR

Write two uses of Carboxylic Acid.

Solution: Carboxylic acids have various applications in different fields. Here are two uses:

1. Production of Pharmaceuticals: Carboxylic acids are used as intermediates in the synthesis of various pharmaceuticals. For example, acetylsalicylic acid (aspirin) and ibuprofen are widely used carboxylic acid derivatives for their analgesic and anti-inflammatory properties.

2. Food Industry: Carboxylic acids such as acetic acid (vinegar) are used as preservatives and flavoring agents. Acetic acid is commonly used in the preparation of pickles and condiments, providing both preservation and a distinct sour taste.

Q 11. Write only the chemical equation for the following conversion.

$CH_3 - CH_2 - Cl$ to $CH_3 - CH_2 - CH_2 - NH_2$

Solution: The chemical equation for the conversion of $CH_3 - CH_2 - Cl$ to $CH_3 - CH_2 - CH_2 - NH_2$ is:

$$CH_3 - CH_2 - Cl + KCN \rightarrow CH_3 - CH_2 - CN \xrightarrow[\text{Reduction}]{H_2/Ni} CH_3 - CH_2 - CH_2 - NH_2$$

OR

Write the reason, Ethylamine is more basic than Ammonia.

Solution: Ethylamine is more basic than ammonia due to the electron-donating effect of the ethyl group. The ethyl group ($-C_2H_5$) is an alkyl group, which has a +I (inductive) effect that pushes electron density towards the nitrogen atom. This increase in electron density on the nitrogen atom makes it more capable of donating its lone pair of electrons to accept a proton (H^+), thus increasing its basicity compared to ammonia (NH_3), which lacks this electron-donating alkyl group.

Q 12. Write any two differences between Fibrous Protein and Globular Protein.

Solution:

Aspect	Fibrous Proteins	Globular Proteins
Structure	Long, thread-like, and elongated; typically insoluble in water.	Compact, spherical, or globular shape; usually soluble in water.
Function	Provide structural support and strength to cells and tissues (e.g., collagen, keratin).	Involved in a variety of functions such as catalysis (enzymes), transport (hemoglobin), and regulation (hormones).

OR

Write any two differences between DNA and RNA.

Solution:

Aspect	DNA (Deoxyribonucleic Acid)	RNA (Ribonucleic Acid)

Sugar Component	Contains deoxyribose sugar (lacks an oxygen atom on the 2' carbon).	Contains ribose sugar (has an oxygen atom on the 2' carbon).
Strand Structure	Typically double-stranded and forms a double helix.	Usually single-stranded.

Q 13. The vapor pressure of pure benzene at a certain temperature is 0.850 bar. A non-volatile non-electrolyte solid weighing 0.5 gm . when added to 39.0 gm . of benzene (Molar mass $78 \mathrm{gmmol}^{-1}$) then, the vapor pressure of the Solution is 0.845 bar. What is the molar mass of the solid substance?

Solution: To find the molar mass of the non-volatile non-electrolyte solid substance, we can use Raoult's Law. Raoult's Law for a Solution of a non-volatile solute is given by:

$$P_{\text{Solution}} = P_{\text{pure}} \times X_{\text{solvent}}$$

Where:
- P_{Solution} is the vapor pressure of the Solution.
- P_{pure} is the vapor pressure of the pure solvent (benzene in this case).
- X_{solvent} is the mole fraction of the solvent in the Solution.

Given data:
- $P_{\text{pure}} = 0.850 \text{ bar}$
- $P_{\text{Solution}} = 0.845 \text{ bar}$
- Mass of benzene (m_{benzene}) = 39.0 g
- Molar mass of benzene (M_{benzene}) = 78 g/mol
- Mass of solute (m_{solute}) = 0.5 g

First, calculate the mole fraction of benzene in the Solution:

$$X_{\text{benzene}} = \frac{n_{\text{benzene}}}{n_{\text{benzene}} + n_{\text{solute}}}$$

Where:
- n_{benzene} is the number of moles of benzene.
- n_{solute} is the number of moles of the solute.

Calculate n_{benzene}:

$$n_{\text{benzene}} = \frac{m_{\text{benzene}}}{M_{\text{benzene}}} = \frac{39.0 \text{ g}}{78 \text{ g/mol}} = 0.5 \text{ mol}$$

Using Raoult's Law, we have:

$$\frac{P_{\text{Solution}}}{P_{\text{pure}}} = X_{\text{benzene}}$$

$$\frac{0.845}{0.850} = X_{\text{benzene}}$$

$$X_{\text{benzene}} = 0.9941$$

Now, let's express X_{benzene}:

$$X_{\text{benzene}} = \frac{n_{\text{benzene}}}{n_{\text{benzene}} + n_{\text{solute}}}$$

$$0.9941 = \frac{0.5 \text{ mol}}{0.5 \text{ mol} + n_{\text{solute}}}$$

Rearrange to find n_{solute}:

$$0.9941(0.5 \text{ mol} + n_{\text{solute}}) = 0.5 \text{ mol}$$

$$0.49705 + 0.9941 n_{\text{solute}} = 0.5$$

$$0.9941 n_{\text{solute}} = 0.5 - 0.49705$$

$$0.9941 n_{\text{solute}} = 0.00295$$

$$n_{\text{solute}} = \frac{0.00295}{0.9941}$$

$$n_{\text{solute}} \approx 0.00297 \text{ mol}$$

Finally, calculate the molar mass of the solute (M_{solute}):

$$M_{\text{solute}} = \frac{m_{\text{solute}}}{n_{\text{solute}}} = \frac{0.5 \text{ g}}{0.00297 \text{ mol}}$$

$$M_{\text{solute}} \approx 168.35 \text{ g/mol}$$

Therefore, the molar mass of the solid substance is approximately 168.35 g/mol.

OR

18 gm glucose $(C_6H_{12}O_6)$ is dissolved in 1 kg of water in a saucepan. At what temperature will water boil at 1.013 bar? K_b for water is $0.52 \text{ K kg mol}^{-1}$.

Solution: To find the boiling point elevation of water when 18 g of glucose is dissolved in it, we use the formula for boiling point elevation:

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

Where:
- ΔT_b is the boiling point elevation.
- i is the can'ta dimethyl pentaneethoxy propanecan'tchemistWhere Hoff factor (for glucose, a non-electrolyte, $i = 1$).
- K_b is the ebullioscopic constant of the solvent (water in this case).
- m is the molality of the Solution.

Given:
- Mass of glucose (solute) = 18 g
- Molar mass of glucose ($C_6H_{12}O_6$) = 180 g/mol
- Mass of water (solvent) = 1 kg = 1000 g
- K_b for water = 0.52 K kg mol^{-1}

First, we calculate the number of moles of glucose:

$$\text{Moles of glucose} = \frac{\text{Mass of glucose}}{\text{Molar mass of glucose}} = \frac{18\,\text{g}}{180\,\text{g/mol}} = 0.1\,\text{mol}$$

Next, we calculate the molality of the Solution:

$$m = \frac{\text{Moles of solute}}{\text{Mass of solvent in kg}} = \frac{0.1\,\text{mol}}{1\,\text{kg}} = 0.1\,\text{mol/kg}$$

Now, we calculate the boiling point elevation:

$$\Delta T_b = i \cdot K_b \cdot m = 1 \cdot 0.52\,\text{K kg mol}^{-1} \cdot 0.1\,\text{mol/kg} = 0.052\,\text{K}$$

The normal boiling point of water is 373.15 K (100°C). Therefore, the new boiling point is:

$$\text{New boiling point} = 373.15\,\text{K} + 0.052\,\text{K} = 373.202\,\text{K}$$

Converting the temperature back to Celsius:

$$\text{New boiling point} = 373.202\,\text{K} - 273.15\,\text{K} = 100.052\,^{\circ}\text{C}$$

Thus, the water will boil at approximately 100.052°C at 1.013 bar when 18 g of glucose is dissolved in 1 kg of water.

Q 14. Write the unit of rate constant for the first order of reaction and the second order of reaction.

Solution: Here are the units for the rate constant for first-order and second-order reactions:

1. First-order reaction: The rate constant (k) has units of time^{-1}, typically expressed as s^{-1}.

2. Second-order reaction: The rate constant (k) has units of $\text{concentration}^{-1}\text{time}^{-1}$, typically expressed as $\text{M}^{-1}\text{s}^{-1}$ or $\text{L mol}^{-1}\text{s}^{-1}$.

OR

Write the following with the definition -
(i) Rate determining step
(ii) Order of reaction

Solution: Here are the definitions for the rate-determining step and the order of reaction:

(i) Rate-determining step:
The rate-determining step is the slowest step in a reaction mechanism that determines the overall rate of the reaction. This step has the highest activation energy and acts as a bottleneck for the reaction, meaning the overall reaction cannot proceed faster than this slowest step.

(ii) Order of reaction:
The order of the reaction is the sum of the powers of the concentration terms in the rate law expression of a chemical reaction. It indicates how the rate of reaction depends on the concentration of the reactants. The order can be an integer or a fraction and is determined experimentally. For a reaction with rate law $\text{rate} = k[A]^m[B]^n$, the order of reaction is $m + n$.

Q 15. Write any three differences between d-block and f-block elements.

Solution:

Aspect	d-block Elements	f-block Elements
Location in the Periodic Table	Located in groups 3 to 12, in the center of the periodic table.	Located in the lanthanide and actinide series, often placed separately at the bottom.
Electron Configuration	Involves the filling of (n−1)d orbitals. Example: [Ar]3dn4s2	Involves the filling of (n−2)f orbitals. Example: [Xe]4fn6s2
Typical Properties	Exhibit variable oxidation states, form colored compounds, and are often good conductors of electricity.	Also exhibit variable oxidation states, often form complex ions, and are typically less conductive than d-block elements.

OR

Write any three differences between Lanthanoid and Actinoid.

Solution:

Aspect	Lanthanoids	Actinoids
Electron Configuration	Involves the filling of 4f orbitals. Example: [Xe]4fn6s2	Involves the filling of 5f orbitals. Example: [Rn]5fn7s2
Oxidation States	Primarily exhibit a +3 oxidation state, with some +2 and +4 states.	Exhibit a wider range of oxidation states, from +3 to +7.

Occurrence and Stability	Generally more abundant and stable, with fewer radioactive elements.	Many are radioactive, and some are not found naturally, requiring synthetic production.
4o		

Q 16. Write only the chemical equation of the following reactions :
(i) Alkyl halide reacts with sodium alkoxide.
(ii) Phenol heated with Zn (zinc) powder.
(iii) Ethyl alcohol is treated with H_2SO_4 at 413 K .

Solution: Here are the chemical equations for the given reactions:

(i) Alkyl halide reacts with sodium alkoxide:

$$R - X + R' - ONa \rightarrow R - O - R' + NaX$$

(ii) Phenol heated with Zn (zinc) powder:

$$C_6H_5OH + Zn \rightarrow C_6H_6 + ZnO$$

(iii) Ethyl alcohol is treated with H_2SO_4 at 413 K:

$$C_2H_5OH \xrightarrow[\Delta]{H_2SO_4} C_2H_4 + H_2O$$

OR

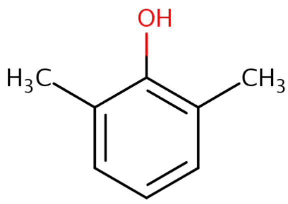
Write the structure of the following compound :
(i) 4-chloro 2, 3 dimethyl pentane-1-ol
(ii) 2-ethoxy propane
(iii) 2, 6 dimethyl phenol

Solution: Here are the structures of the given compounds:

(i) 4-chloro 2,3-dimethylpentane-1-ol:
$CH_3 - CH\,(CH_3) - CH(Cl) - CH_2OH$

(ii) 2-ethoxypropane:
$CH_3 - CH\,(OC_2H_5) - CH_3$

(iii) 2,6-dimethylphenol:



Q 17. Write the mechanism of SN_1 and SN_2 reaction.

Solution: Here are the mechanisms for SN_1 and SN_2 reactions:

SN_1 Mechanism (Unimolecular Nucleophilic Substitution)

The SN_1 reaction mechanism proceeds through two main steps:

1. Formation of the Carbocation:
   - The leaving group (L) departs, resulting in the formation of a carbocation intermediate.
   - This step is slow and rate-determining.
   - It involves only the substrate (hence unimolecular).

$$\text{R-L} \rightarrow \mathrm{R}^{+} + \mathrm{L}^{-}$$

2. Nucleophilic Attack:
   - The nucleophile (Nu) attacks the carbocation to form the final product.
   - This step is fast.

$$\mathrm{R}^{+} + \mathrm{Nu} \rightarrow \text{R-Nu}$$

SN_2 Mechanism (Bimolecular Nucleophilic Substitution)

The SN_2 reaction mechanism proceeds through a single concerted step:

1. Nucleophilic Attack and Departure of the Leaving Group:
   - The nucleophile (Nu) attacks the carbon atom bonded to the leaving group (L) from the opposite side (backside attack).
   - Simultaneously, the leaving group departs.
   - This process involves a transition state where the carbon is partially bonded to both the nucleophile and the leaving group.
   - The rate of this reaction depends on both the substrate and the nucleophile (hence bimolecular).

$$\mathrm{Nu} + \text{R-L} \rightarrow [\mathrm{Nu} \cdots \mathrm{R} \cdots \mathrm{L}]^{\ddagger} \rightarrow \text{R-Nu} + \mathrm{L}^{-}$$

Key Differences

- Rate Determining Step:
  - SN_1: Rate depends only on the concentration of the substrate.
  - SN_2: Rate depends on the concentrations of both the substrate and the nucleophile.

- Reaction Pathway:
  - SN_1: Involves a carbocation intermediate.
  - SN_2: Proceeds through a single transition state without intermediates.

- Sterean ochemistry:
  - SN_1: Can lead to racemization due to the planar nature of the carbocation.
  - SN_2: Results in inversion of configuration at the carbon center (Walden inversion).

OR

Write the following reactions with chemical equation -
(i) Sandmeyer's reaction
(ii) Fittig reaction

Solution: Here are the chemical equations for the given reactions:

(i) Sandmeyer's Reaction:
The Sandmeyer's reaction involves the replacement of an amino group in an aromatic ring with a halogen using a diazonium salt and a copper(I) halide.

Example:

$$C_6H_5N_2^+Cl^- + CuCl \rightarrow C_6H_5Cl + N_2 + CuCl_2$$

(ii) Fittig Reaction:
The Fittig reaction involves the coupling of two aryl halides in the presence of sodium metal to form a biaryl compound.

Example:

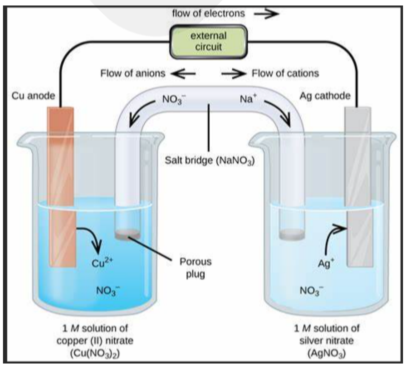
$$2C_6H_5Cl + 2Na \rightarrow C_6H_5\text{-}C_6H_5 + 2NaCl$$

These reactions illustrate the replacement of an amino group with a halogen in the Sandmeyer's reaction and the coupling of aryl halides to form biaryls in the Fittig reaction.

Q 18. Draw the labeled diagram of the Electrochemical cell and write its structure and chemical reaction.

Solution: Electrochemical Cell Diagram

Below is a labeled diagram of a simple electrochemical cell (galvanic cell) consisting of a zinc (Zn) electrode and a copper (Cu) electrode:



Structure

1. Anode (Zn electrode):
   - The zinc electrode is immersed in a Solution of zinc sulfate ($ZnSO_4$).
   - Zinc undergoes oxidation (loses electrons) at the anode.

2. Cathode (Cu electrode):
   - The copper electrode is immersed in a Solution of copper sulfate ($CuSO_4$).
   - Copper undergoes reduction (gains electrons) at the cathode.

3. Salt Bridge:
   - The salt bridge contains a salt Solution, typically potassium nitrate (KNO_3) or potassium chloride (KCl), which allows the flow of ions to maintain electrical neutrality in the cell.

4. External Circuit:
   - Connects the zinc electrode to the copper electrode, allowing electrons to flow from the anode to the cathode.

Chemical Reactions

Oxidation at the Anode:

$$\mathrm{Zn}(s) \rightarrow \mathrm{Zn}^{2+}(aq) + 2\mathrm{e}^{-}$$

Reduction at the Cathode:

$$\mathrm{Cu}^{2+}(aq) + 2\mathrm{e}^{-} \rightarrow \mathrm{Cu}(s)$$

Overall Cell Reaction:

$$\mathrm{Zn}(s) + \mathrm{Cu}^{2+}(aq) \rightarrow \mathrm{Zn}^{2+}(aq) + \mathrm{Cu}(s)$$

In this electrochemical cell, zinc is oxidized to zinc ions, releasing electrons, while copper ions are reduced to copper metal by gaining electrons. The salt bridge completes the circuit by allowing the flow of ions to balance the charge.

OR

Write and derive the Nernst equation.

Solution: Nernst Equation

The Nernst equation relates the reduction potential of an electrochemical reaction to the standard electrode potential, temperature, and activities (or concentrations) of the chemical species involved. It provides a way to calculate the cell potential under non-standard conditions.

Derivation of the Nernst Equation

The standard electrode potential (E°) is measured under standard conditions: 1 M concentration for each ion participating in the reaction, a pressure of 1 atmosphere for any gases involved, and a temperature of 298 K (25°C).

For a general redox reaction:

$$aA + bB \rightleftharpoons cC + dD$$

The Nernst equation is derived from the Gibbs free energy change for the reaction and is given by:

$$E = E^\circ - \frac{RT}{nF} \ln Q$$

where:
- E is the cell potential (electrode potential) at non-standard conditions.
- E° is the standard electrode potential.
- R is the universal gas constant (8.314 J·mol^{-1}·K^{-1}).
- T is the temperature in Kelvin.
- n is the number of moles of electrons transferred in the redox reaction.
- F is the Faraday constant (96485 C·mol^{-1}).
- Q is the reaction quotient, which is a ratio of the concentrations (or activities) of the products to the reactants, each raised to the power of their respective coefficients in the balanced equation.

#Steps to Derive the Nernst Equation:

1. Relation between Gibbs Free Energy and Cell Potential:

The change in Gibbs free energy (ΔG) for the reaction is related to the cell potential (E) by:

$$\Delta G = -nFE$$

For standard conditions:

$$\Delta G^\circ = -nFE^\circ$$

2. Gibbs Free Energy and Reaction Quotient:

The change in Gibbs free energy is also related to the standard Gibbs free energy change and the reaction quotient (Q):

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

3. Combine the Two Expressions for ΔG:

$$-nFE = -nFE^{\circ} + RT \ln Q$$

4. Solve for the Cell Potential (E):

$$E = E^{\circ} - \frac{RT}{nF} \ln Q$$

5. Simplify for Room Temperature:

At room temperature (298 K), the equation can be simplified. Using the values for R and F:

$$E = E^{\circ} - \frac{(8.314\,\mathrm{J{\cdot}mol^{-1}{\cdot}K^{-1}})(298\,\mathrm{K})}{n(96485\,\mathrm{C{\cdot}mol^{-1}})} \ln Q$$

$$E = E^{\circ} - \frac{0.0257\,\mathrm{V}}{n} \ln Q$$

Alternatively, using logarithms base 10:

$$E = E^{\circ} - \frac{0.0592\,\mathrm{V}}{n} \log Q$$

Final Form of the Nernst Equation

For a redox reaction at any temperature:

$$E = E^{\circ} - \frac{RT}{nF} \ln Q$$

At 298 K (25°C), it can be written as:

$$E = E^{\circ} - \frac{0.0592\,\mathrm{V}}{n} \log Q$$

Application

The Nernst equation allows us to calculate the potential of an electrochemical cell under any conditions, not just standard-state conditions. This is particularly useful in determining the cell potential for reactions involving concentrations that differ from 1 M, varying pressures, or different temperatures.

Q 19. How will you prepare the following from acetic acid (CH_3COOH)? Write the chemical equations -

(i) Acetic anhydride

(ii) Ethyl acetate

(iii) Acety! chloride

(iv) Acetamide

(v) Ethyl alcohol

Solution: Here are the chemical equations for the synthesis of the given compounds:

(i) Acetic Anhydride:

$$2CH_3COOH \xrightarrow{\Delta} CH_3COOCOCH_3 + H_2O$$

(ii) Ethyl Acetate:

$$CH_3COOH + CH_3CH_2OH \xrightarrow{H_2SO_4} CH_3COOCH_2CH_3 + H_2O$$

(iii) Acetyl Chloride:

$$CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$$

(iv) Acetamide:

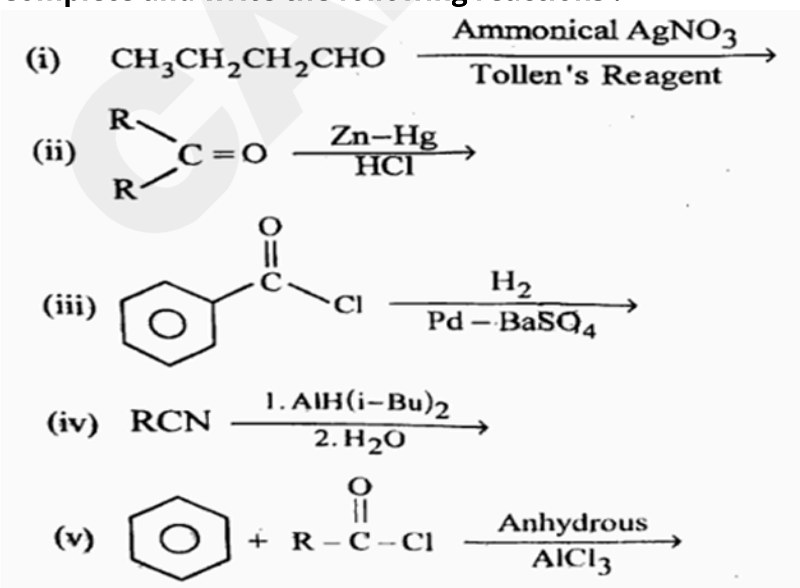
$$CH_3COOH + NH_3 \rightarrow CH_3CONH_2 + H_2O$$

(v) Ethyl Alcohol:

$$C_2H_4 + H_2O \xrightarrow{H_3PO_4} C_2H_5OH$$

OR

Complete and write the following reactions :



Solution:

(i) $CH_3CH_2CH_2CHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow CH_3CH_2CH_2COO^- + 2Ag + 4NH_3 + 2H_2O$

(ii) $R_1COR_2 + Zn(Hg) + HCl \rightarrow R_1CH_2R_2 + H_2O$

(iii) $C_6H_5COCl + H_2 \xrightarrow{Pd/BaSO_4} C_6H_5CHO + HCl$

(iv) $RCN \xrightarrow[2 \cdot H_2O]{1.AlH(i\text{-}Bu)_2} RCHO$

(v) $C_6H_6 + CH_3COCl \xrightarrow{AlCl_3} C_6H_5COCH_3 + HCl$

MP Board Class 12 Chemistry Question with Solution - 2022

Q 1. Choose and write the correct options :

(i) Dry ice is -

(a) Ionic

(b) Molecular

(c) Metallic

(d) Covalent

Solution: Dry ice is the solid form of carbon dioxide (CO). It consists of discrete CO molecules held together by weak intermolecular forces (van der Waals forces), making it a molecular solid.

Hence, the answer is option (b).

(ii) Which compound has a $8:8$ coordination number?

(a) MgO

(b) Al_2O_3

(c) CsCl

(d) NaCl

Solution: CsCl (Cesium Chloride) has a $8:8$ coordination number, meaning each cesium ion is surrounded by 8 chloride ions, and each chloride ion is surrounded by 8 cesium ions. This arrangement forms a simple cubic lattice structure.

Hence, the answer is option (c).

(iii) Sol which acts as protective colloids is -

(a) $As_2\ S_3$

(b) Gelatine

(c) Au

(d) $Fe(OH)_3$

Solution: Gelatine is a protective colloid that stabilizes colloidal dispersions by preventing the particles from aggregating or settling. It adsorbs onto the surface of colloidal particles, providing a protective layer.

Hence, the answer is option (b).

(iv) Calomel is -

(a) Hg_2Cl_2

(b) $HgCl_2$

(c) $Hg_2Cl_2 + Hg$

(d) $HgCl_2 + Hg$

Solution: Calomel is the common name for mercurous chloride, Hg_2Cl_2. It is a white crystalline solid used historically as a purgative and in calomel electrodes in electrochemistry.

Hence, the answer is option (a).

(v) In which compound does oxygen give a +2 oxidation state?
(a) H_2O
(b) Na_2O
(c) OF_2
(d) MgO

Solution: In OF_2 (oxygen difluoride), oxygen has an oxidation state of $+2$ because fluorine is more electronegative and has an oxidation state of -1 each, resulting in $2 \times (-1) + x = 0 \Rightarrow x = +2$.

Hence, the answer is option (c).
(vi) Nylon is an example of -
(a) Polyamide
(b) Polythene
(c) Polyester
(d) Polysaccharide

Solution: Nylon is a type of synthetic polymer known as a polyamide. It is formed by the condensation polymerization of diamines and dicarboxylic acids or by the polymerization of amino acids. The amide groups ($-CONH-$) in the backbone of the polymer chain characterize polyamides.

Hence, the answer is option (a).
(vii) Which is Tranquilizer in the following?
(a) Seconal
(b) Streptomycin
(c) Morphine
(d) Paracetamol

Solution: Seconal, also known as secobarbital, is a barbiturate that acts as a sedative and hypnotic, commonly used to treat insomnia and anxiety. It functions as a tranquilizer by depressing the central nervous system, inducing a calming effect.

Hence, the answer is option (a).

Q 2. Fill in the blanks :
(i) Crystal systems are total _______ types.

Solution: Seven

Explanation: There are seven crystal systems in crystallography: cubic, tetragonal, orthorhombic, hexagonal, trigonal (or rhombohedral), monoclinic, and triclinic. Each system is defined by specific lattice parameters and symmetries.
(ii) The reaction rate is __________of reactant concentration.

Solution: dependent

Explanation: The rate of a chemical reaction typically depends on the concentration of the reactants, as described by the rate law. Increasing the concentration of reactants usually increases the reaction rate.

(iii) Coagulation is the opposite of __________.

Solution: peptization.

Explanation: Coagulation is the process of particles in a colloid aggregating to form larger particles and eventually precipitate out of the Solution. Peptization is the reverse process, where precipitated particles are dispersed back into a colloidal state.

(iv) The formula of Fluorspar is ________.

Solution: CaF2.

Explanation: Fluorspar, also known as fluorite, is a mineral composed of calcium fluoride with the chemical formula CaF2_22. It is used in various industrial applications, including as a flux in steelmaking and in the production of hydrofluoric acid.

(v) The highest electron affinity has ______ element.

Solution: Chlorine

Explanation: Although fluorine is more electronegative, chlorine has the highest electron affinity due to less electron-electron repulsion in its larger atomic size compared to fluorine.

(vi) Teflon is a polymer of ________.

Solution: tetrafluoroethylene (C_2F_4

Explanation: Teflon, also known as polytetrafluoroethylene (PTFE), is created by the polymerization of tetrafluoroethylene monomers, resulting in a highly durable and non-reactive polymer.

(vii) Furacin is ______ drug.

Solution: an antibacterial

Explanation: Furacin, also known as nitrofurazone, is used topically to prevent or treat infections in wounds, burns, and ulcers due to its antibacterial properties.

Q 3. Match the following

A	**B**
(i) Glass	**(a)** $\mathrm{XeF_4}$
(ii) Slag	**(b)** $\mathrm{C_6H_{12}O_6}$
(iii) Square planer	**(c)** $\mathrm{RNH_2}$
(iv) Neutral ligand	**(d) CO**

(v) Sprit of wine	**(e)** $CaSiO_3$
(vi) Primary Amine	**(f)** $1H_2SO_4$
(vii) Glucose	**(g) Amorphous solid**
	(h) C_2H_5OH

Solution:

A	B
(i) Glass	(g) Amorphous solid
(ii) Slag	(e) CaSiO3
(iii) Square planar	(a) XeF4
(iv) Neutral ligand	(d) CO
(v) Spirit of wine	(h) C2H5OH
(vi) Primary Amine	(c) RNH2
(vii) Glucose	(b) C6H12O6

Q 4. Answer in one word/sentence :
(i) Write the Arrhenius equation.
(ii) Write the name of a noble gas that is used in the therapy of cancer.
(iii) Write the name of the condensation reaction of benzaldehyde with KCN.
(iv) Why do tertiary amines not give acylation reactions?
(v) Write the name of the protein present in hair, wool, and silk.
(vi) Write the monomer of polythene.
(vii) Write the name of anyone antipyretic.

Solution:

(i) Arrhenius Equation: The Arrhenius equation is $k = Ae^{-E_a/RT}$.

(ii) Noble Gas Used in Cancer Therapy: Radon (Rn).

(iii) Condensation Reaction of Benzaldehyde with KCN: Benzoin Condensation.

(iv) Reason Tertiary Amines Do Not Give Acylation Reactions: Tertiary amines lack a hydrogen atom on the nitrogen, which is necessary for acylation.

(v) Protein Present in Hair, Wool, and Silk: Keratin.

(vi) Monomer of Polythene: Ethylene (Ethene), C_2H_4.

(vii) Name of an Antipyretic: Paracetamol (Acetaminophen).

Q 5. Calculate the molality of water.

Solution: To calculate the molality of water, we use the formula:

$$\text{Molality} = \frac{\text{moles of solute}}{\text{mass of solvent in kg}}$$

For pure water, with a molar mass of 18 g/mol, 1 kg of water contains approximately 55.56 moles. Thus, the molality of water is 55.56 mol/kg.

OR

Define the Molarity.

Solution: Molarity (M) is defined as the number of moles of solute dissolved in one liter of Solution. It is expressed as:

$$M = \frac{\text{moles of solute}}{\text{volume of Solution in liters}}$$

Q 6. Write two differences between adsorption and absorption.

Solution:

Aspect	Adsorption	Absorption
Nature of Process	Surface phenomenon; molecules accumulate on the surface	Bulk phenomenon; molecules penetrate and distribute uniformly
Rate of Process	Initially high, then decreases as equilibrium is reached	Generally uniform throughout the process

OR

Define the Brownian movement.

Solution: Brownian Movement:

Brownian movement is the random, erratic motion of microscopic particles suspended in a fluid (liquid or gas) caused by continuous collisions with the fast-moving molecules of the fluid. This phenomenon was first observed by Robert Brown in 1827 and is a result of thermal energy in the fluid.

Q 7. Why ammonia has a high boiling point?

Solution: Ammonia has a high boiling point because its molecules form strong hydrogen bonds with each other due to the lone pair of electrons on nitrogen and hydrogen atoms bonded to it. These hydrogen bonds require significant energy to break, resulting in a higher boiling point compared to similar-sized molecules without hydrogen bonding.

OR

Why is sulphur found solid state in nature?

Solution: Sulphur is found in a solid state in nature because its molecules form stable, cyclic S_8 rings. These rings are held together by strong van der Waals forces, resulting in a crystalline structure that is solid at room temperature.

Q 8. Why halogens are colored?

Solution: Halogens are colored because their molecules absorb visible light, promoting electrons to higher energy levels. The specific wavelengths of light absorbed correspond to the energy gaps between molecular orbitals, and the remaining transmitted or reflected light gives halogens their characteristic colors.

OR

Why noble gases are inert?

Solution: Noble gases are inert because they have a complete valence electron shell, typically containing eight electrons. This stable electron configuration means they have little tendency to gain, lose, or share electrons, making them chemically unreactive.

Q 9. Write two differences between double salt and complex compound.

Solution:

Aspect	Double Salt	Complex Compound
Dissociation in Solution	Dissociates completely into ions in Solution, showing the properties of all constituent ions.	Does not dissociate completely; retains complex ion structure in Solution.

Example	Potash alum (KAl(SO4)2·12H2O)	Hexaamminecobalt(III) chloride ([Co(NH3)6]Cl3)

OR

Write IUPAC names of the following coordination compounds :
(i) $K_4\left[Fe(CN)_6\right]$
(ii) $\left[\mathrm{Co}\left(\mathrm{NH}_3\right)_6\right]\mathrm{Cl}_3$

Solution: IUPAC Names of Coordination Compounds:

(i) $K_4\left[Fe(CN)_6\right]$:
- The complex ion $[Fe(CN)_6]^{4-}$ is called hexacyanoferrate(II) because iron is in the +2 oxidation state.
- Potassium is the cation.

IUPAC Name: Potassium hexacyanoferrate(II)

(ii) $\left[\mathrm{Co}\left(\mathrm{NH}_3\right)_6\right]\mathrm{Cl}_3$:
- The complex ion $[Co(NH_3)_6]^{3+}$ is called hexaamminecobalt(III) because cobalt is in the +3 oxidation state.
- Chloride is the anion.

IUPAC Name: Hexaamminecobalt(III) chloride

Q 10. Write examples of primary and secondary amines.

Solution: Examples of Amines:

Primary Amine:---Methylamine (CHNH)

Secondary Amine:--- Dimethylamine ((CH)NH)

OR

Why amines are soluble in water?

Solution: Amines are soluble in water because they can form hydrogen bonds with water molecules. The nitrogen atom in amines has a lone pair of electrons, which can interact with the hydrogen atoms of water (which are slightly positive due to the polar nature of the water molecule). This interaction between the amine and water molecules allows amines to dissolve readily in water, especially for lower molecular weight amines.

Q 11. Write the definition of Zwitter ion.

Solution: Zwitterion:

A zwitterion is a molecule that contains both positive and negative charges but is overall electrically neutral. These ions typically form in amino acids, where the amino group ($-NH_3^+$) is positively charged and the carboxyl group ($-COO^-$) is negatively charged at a specific pH, usually around the isoelectric point.

OR

Write two differences between DNA and RNA.

Solution:

Aspect	DNA (Deoxyribonucleic Acid)	RNA (Ribonucleic Acid)
Sugar Component	Contains deoxyribose sugar	Contains ribose sugar
Structure	Typically double-stranded with a helical structure	Typically single-stranded
Bases	Contains adenine (A), thymine (T), cytosine (C), guanine (G)	Contains adenine (A), uracil (U), cytosine (C), guanine (G)

Q 12. Write the names of any two antibiotics.

Solution: Two common antibiotics are:

1. Penicillin
2. Tetracycline

OR

Write the names of any two artificial sweeteners.

Solution: Two common artificial sweeteners are:

1. Aspartame
2. Saccharin

Q 13. 5.85 gm Nacl dissolve in 250 gm water. Calculate the molality of the Solution.

Solution: To calculate the molality of the Solution, we need to use the formula:

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

Given:
- Mass of NaCl = 5.85 g
- Mass of water = 250 g = 0.250 kg (since 1000 g = 1 kg)
- Molar mass of NaCl (Na: 23 g/mol, Cl: 35.5 g/mol) = 23 + 35.5 = 58.5 g/mol

1. Calculate the moles of NaCl:

$$\text{Moles of NaCl} = \frac{\text{mass of NaCl}}{\text{molar mass of NaCl}} = \frac{5.85 \text{ g}}{58.5 \text{ g/mol}} = 0.1 \text{ moles}$$

2. Calculate the molality:

$$m = \frac{0.1 \text{ moles}}{0.250 \text{ kg}} = 0.4 \text{ mol/kg}$$

Therefore, the molality of the NaCl Solution is 0.4 mol/kg.

OR

Calculate the osmotic pressure of 5% Solution of glucose at 25°C.
$\text{R} = 0.0821$ **lit. atm. M.W. of glucose** $= 180$

Solution: To calculate the osmotic pressure of a 5% glucose Solution at 25°C:

1. Molarity Calculation: A 5% Solution means 5 g of glucose in 100 mL. The molar mass of glucose is 180 g/mol, so:

$$\text{Moles} = \frac{5 \text{ g}}{180 \text{ g/mol}} = 0.02778 \text{ moles}$$

$$\text{Molarity} = \frac{0.02778 \text{ moles}}{0.1 \text{ L}} = 0.2778 \text{ M}$$

2. Osmotic Pressure Calculation: Using the formula $\Pi = MRT$:

$$\Pi = 0.2778 \text{ M} \times 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1} \times 298 \text{ K}$$

$$\Pi = 6.79 \text{ atm}$$

So, the osmotic pressure is 6.79 atm.

Q 14. Explain zero-order reaction with an example.

Solution: Zero-Order Reaction:

A zero-order reaction is a chemical reaction where the rate is independent of the concentration of the reactant(s). This means that the rate of the reaction is constant and does not change as the concentration of the reactant decreases over time. The rate law for a zero-order reaction is given by:

$$\text{Rate} = k$$

where k is the rate constant.

Example: Decomposition of Ammonia on a Platinum Surface

One common example of a zero-order reaction is the decomposition of ammonia (NH_3) on a platinum surface:

$$2NH_3 \xrightarrow{Pt} N_2 + 3H_2$$

In this reaction, the rate of decomposition of ammonia is constant and does not depend on the concentration of ammonia. This behavior occurs because the reaction is catalyzed by the platinum surface, and once the surface is saturated with ammonia molecules, the rate of reaction depends only on the properties of the surface and not on the concentration of ammonia in the gas phase.

Mathematical Representation:

For a zero-order reaction, the integrated rate law is:

$$[A] = [A]_0 - kt$$

where:
- $[A]$ is the concentration of the reactant at time t.
- $[A]_0$ is the initial concentration of the reactant.
- k is the zero-order rate constant.
- t is the time.

OR

Explain pseudo-order reaction with an example.

Solution: Pseudo-Order Reaction:

A pseudo-order reaction is a reaction that appears to follow a different order than the actual molecularity due to the concentration of one or more reactants being in large excess compared to others. In such cases, the concentration of the reactant(s) in excess remains almost constant throughout the reaction, simplifying the rate law to depend primarily on the concentration of the limiting reactant(s).

Example: Hydrolysis of Ethyl Acetate

The hydrolysis of ethyl acetate ($CH_3COOC_2H_5$) in the presence of a large excess of water can be considered a pseudo-first-order reaction.

$$CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH + C_2H_5OH$$

In this reaction, water is present in a large excess. As a result, its concentration remains essentially constant during the reaction. The rate law for the reaction can be written as:

$$\text{Rate} = k[CH_3COOC_2H_5][H_2O]$$

Since $[H_2O]$ is constant, we can combine it with the rate constant k to give a new constant k':

$$\text{Rate} = k'[CH_3COOC_2H_5]$$

where $k' = k[H_2O]$.

Thus, the reaction behaves as a first-order reaction with respect to ethyl acetate, even though it is actually a second-order reaction overall. This simplification is why it is referred to as a pseudo-first-order reaction.

Q 15. Write only chemical equations for the following conversions :
(i) Ethanol to diethyl ether
(ii) Diethyl ether to ethanol
(iii) Ethanol to ethyl acetate

Solution:

(i) Ethanol to diethyl ether:

$$2C_2H_5OH \xrightarrow{H_2SO_4} C_2H_5OC_2H_5 + H_2O$$

(ii) Diethyl ether to ethanol:

$$C_2H_5OC_2H_5 + H_2O \xrightarrow{H_2SO_4} 2C_2H_5OH$$

(iii) Ethanol to ethyl acetate:

$$C_2H_5OH + CH_3COOH \xrightarrow{H_2SO_4} CH_3COOC_2H_5 + H_2O$$

OR

Write any three differences between phenol and alcohol.

Solution:

Aspect	Phenol	Alcohol
Functional Group	Contains a hydroxyl group (-OH) directly attached to an aromatic ring (CHOH)	Contains a hydroxyl group (-OH) attached to a saturated carbon atom (R-OH)
Acidity	More acidic due to resonance stabilization of the phenoxide ion	Less acidic as the alkoxide ion is not resonance stabilized
Reaction with FeCl	Forms a violet complex with ferric chloride (FeCl)	Typically no reaction with ferric chloride (FeCl)

Q 16. Write the IUPAC names of the following :
(i) $CH_3CH\left(CH_3\right)CH_2CH_2CHO$

(ii) $CH_3CH = CHCHO$
(iii) $(CH_3)_3CCH_2COOH$

Solution:

(i) $CH_3CH(CH_3)CH_2CH_2CHO$:

The longest carbon chain contains 5 carbon atoms and there is a methyl group at the 2nd carbon. The compound is an aldehyde.

IUPAC Name: 3-Methylpentanal

(ii) $CH_3CH = CHCHO$:

The longest carbon chain contains 3 carbon atoms with a double bond between carbon 2 and carbon 3, and an aldehyde group at the end.

IUPAC Name: But-2-enal

(iii) $(CH_3)_3CCH_2COOH$:

The longest carbon chain contains 5 carbon atoms, with a tert-butyl group at the 3rd carbon. The compound is a carboxylic acid.

IUPAC Name: 3,3-Dimethylbutanoic acid

OR

Write chemical equations of the following reactions :
(i) Perkin reaction
(ii) Cannizaro reaction
(iii) Rosenmund reaction

Solution:

(i) Perkin Reaction:

The Perkin reaction involves the condensation of an aromatic aldehyde with an anhydride in the presence of a base to form α,β-unsaturated carboxylic acids.

$$C_6H_5CHO + (CH_3CO)_2O \xrightarrow{NaOAc} C_6H_5CH{=}CHCOOH + CH_3COOH$$

(ii) Cannizzaro Reaction:

The Cannizzaro reaction involves the reaction of an aldehyde without an α-hydrogen in the presence of a strong base to yield an alcohol and a carboxylic acid.

$$2C_6H_5CHO + NaOH \rightarrow C_6H_5CH_2OH + C_6H_5COONa$$

(iii) Rosenmund Reaction:

The Rosenmund reaction involves the reduction of an acyl chloride to an aldehyde using hydrogen gas in the presence of a palladium catalyst poisoned with barium sulfate.

$$RCOCl + H_2 \xrightarrow{Pd/BaSO_4} RCHO + HCl$$

Q 17. What happens when : (Give only chemical equation)
(i) n-Butyl chloride reacts with alcoholic KOH.
(ii) Methyl bromide reacts with sodium in the presence of dry ether.
(iii) Bromo benzene reacts with Mg in the presence of dry ether.
(iv) Methyl chloride reacts with alcoholic KCN.

Solution:

(i) n-Butyl chloride reacts with alcoholic KOH:

$$C_4H_9Cl + KOH\ (alc.) \rightarrow C_4H_8 + KCl + H_2O$$

(ii) Methyl bromide reacts with sodium in the presence of dry ether:

$$2CH_3Br + 2Na \xrightarrow{\text{dry ether}} C_2H_6 + 2NaBr$$

(iii) Bromo benzene reacts with Mg in the presence of dry ether:

$$C_6H_5Br + Mg \xrightarrow{\text{dry ether}} C_6H_5MgBr$$

(iv) Methyl chloride reacts with alcoholic KCN:

$$CH_3Cl + KCN\ (alc.) \rightarrow CH_3CN + KCl$$

OR

Write chemical equations of the following reactions :
(i) Fittig reaction
(ii) Hunsdiecker reaction
(iii) Sandmeyer's reaction
(iv) Friedel Crafts reaction

Solution:

(i) Fittig Reaction:

The Fittig reaction involves the coupling of aryl halides (usually bromides or iodides) with sodium in the presence of dry ether to form biaryls.

$$C_6H_5Br + 2Na + BrC_6H_5 \rightarrow C_6H_5\text{-}C_6H_5 + 2NaBr$$

(ii) Hunsdiecker Reaction:

The Hunsdiecker reaction involves the conversion of silver salts of carboxylic acids to alkyl halides in the presence of halogens.

$$RCOOAg + Br_2 \rightarrow RBr + CO_2 + AgBr$$

(iii) Sandmeyer's Reaction:

The Sandmeyer reaction involves the conversion of an aryl diazonium salt to an aryl halide or other substituted benzene derivatives using copper(I) salts.

$$C_6H_5N_2^+Cl^- + CuCl \rightarrow C_6H_5Cl + N_2$$

(iv) Friedel-Crafts Reaction:

The Friedel-Crafts reaction involves the alkylation or acylation of an aromatic ring using an alkyl or acyl halide in the presence of a Lewis acid catalyst like aluminum chloride (AlCl).

Alkylation:

$$C_6H_6 + RCl \xrightarrow{AlCl_3} C_6H_5R + HCl$$

Acylation:

$$C_6H_6 + RCOCl \xrightarrow{AlCl_3} C_6H_5COR + HCl$$

Q 18. Explain Kohlraush law with an example and write its two applications.

Solution: Kohlrausch's Law:

Kohlrausch's Law states that the limiting molar conductivity of an electrolyte (Λ_m^0) at infinite dilution can be represented as the sum of the individual contributions of its anions and cations. Mathematically, it is expressed as:

$$\Lambda_m^0 = \lambda_+^0 + \lambda_-^0$$

where λ_+^0 and λ_-^0 are the limiting molar conductivities of the cation and anion, respectively.

Example:

For sodium chloride (NaCl), the limiting molar conductivity can be expressed as:

$$\Lambda_{m,\mathrm{NaCl}}^0 = \lambda_{\mathrm{Na}^+}^0 + \lambda_{\mathrm{Cl}^-}^0$$

If the limiting molar conductivities of Na^+ and Cl^- are known, $\Lambda_{m,\mathrm{NaCl}}^0$ can be calculated by simply summing these values.

Applications of Kohlrausch's Law:

1. Determination of Limiting Molar Conductivities:
   - Kohlrausch's Law allows for the determination of the limiting molar conductivity of weak electrolytes. By extrapolating the values obtained from the conductivities of strong electrolytes and using the law, the limiting molar conductivity of a weak electrolyte can be estimated.

2. Calculation of Degree of Dissociation:
   - The law is used to calculate the degree of dissociation (α) of weak electrolytes. By knowing the molar conductivity at a given concentration and the limiting molar conductivity, the degree of

dissociation can be determined using the formula:

$$\alpha = \frac{\Lambda_m}{\Lambda_m^0}$$

This information is crucial in understanding the behavior of weak electrolytes in Solution.

OR

Define the following :
(i) Specific conductivity
(ii) Equivalent conductivity
(iii) Molar conductivity
(iv) Cell Constant
(v) Specific resistance

Solution:

(i) Specific Conductivity (κ): Specific conductivity, also known as conductivity, is the measure of a material's ability to conduct electric current. It is the conductance of a unit volume of the material and is expressed in siemens per meter (S/m).

(ii) Equivalent Conductivity (Λ): Equivalent conductivity is the conductivity of an electrolyte Solution divided by the concentration of the electrolyte in equivalents per liter. It is expressed in siemens meter squared per equivalent (S·m^2·eq^1) and gives the conductivity contribution per equivalent of electrolyte.

(iii) Molar Conductivity (Λ): Molar conductivity is the conductivity of an electrolyte Solution divided by the concentration of the electrolyte in moles per liter. It is expressed in siemens meter squared per mole (S·m^2·mol^1) and indicates the contribution of each mole of electrolyte to the conductivity of the Solution.

(iv) Cell Constant (G*): The cell constant is a factor that relates the measured conductance of an electrolytic Solution to its specific conductivity. It depends on the geometry of the electrodes used in the measurement and is expressed in reciprocal meters (m^1).

(v) Specific Resistance (ρ): Specific resistance, also known as resistivity, is the measure of a material's ability to resist electric current. It is the resistance of a unit volume of the material and is expressed in ohm meters (Ω·m).

Q 19. Write any five differences between Lanthanoids and Actinoids.

Solution:

Aspect	Lanthanoids	Actinoids
Electron Configuration	Typically involve filling of 4f orbitals	Typically involve filling of 5f orbitals

Oxidation States	Mostly exhibit +3 oxidation state	Exhibit multiple oxidation states, commonly +3, +4, +5, +6
Magnetic Properties	Generally less paramagnetic due to lower unpaired electrons	More paramagnetic due to higher unpaired electrons
Occurrence	Most are naturally occurring and relatively abundant	Most are synthetic with a few exceptions (e.g., uranium, thorium)
Radioactivity	Generally not radioactive except for promethium	All actinoids are radioactive

OR

Write a general electronic configuration of transition elements and explain any four characteristic properties of transition elements.

Solution:

General Electronic Configuration of Transition Elements:

The general electronic configuration of transition elements is $[\text{noble gas}]\ (n-1)d^{1-10}\, ns^{0-2}$.

Four Characteristic Properties of Transition Elements:

1. Variable Oxidation States:
- Transition elements exhibit multiple oxidation states because they can lose electrons from both the n-th and $(n-1)$-th energy levels. For example, iron can exhibit oxidation states of +2 and +3.

2. Formation of Colored Compounds:
- Many transition metal compounds are colored due to d-d electron transitions. The absorption of specific wavelengths of light excites electrons from one d-orbital to another, resulting in the characteristic colors.

3. Paramagnetic Behavior:
- Transition elements often have unpaired electrons in their d-orbitals, leading to paramagnetic properties. This means they are attracted to magnetic fields. For instance, manganese (Mn) with its unpaired electrons exhibits strong paramagnetism.

4. Catalytic Properties:
- Transition metals and their compounds often act as catalysts in chemical reactions. They provide a surface for the reaction to occur and can change their oxidation states to facilitate the reaction. For example, iron is used as a catalyst in the Haber process for ammonia synthesis.