CUET UG Chemistry Sample Paper - 8

Duration: 1 Hour **Maximum Marks: 250**

Instructions

- This paper contains a total of 50 Multiple Choice Questions.
- Each correct answer carries **+5 marks**.
- Each incorrect answer carries **-1 mark**.
- No negative marking for unattempted questions.

Q1. An aqueous solution of a non-volatile solute has a boiling point of 373.52 K. If K_b for water is 0.52 K kg mol^{-1} and K_f is 1.86 K kg mol^{-1}, the freezing point of this solution will be:

(A) 271.14 K

(B) 273.00 K

(C) 272.14 K

(D) 270.52 K

Q2. Given the standard electrode potentials: $E^\circ_{K^+/K} = -2.93\text{V}$, $E^\circ_{Ag^+/Ag} = 0.80\text{V}$, $E^\circ_{Hg^{2+}/Hg} = 0.79\text{V}$, $E^\circ_{Mg^{2+}/Mg} = -2.37\text{V}$. The correct increasing order of reducing power is:

(A) $Ag < Hg < Mg < K$

(B) $K < Mg < Hg < Ag$

(C) $Hg < Ag < Mg < K$

(D) $Ag < Hg < K < Mg$

Q3. For a first-order reaction, the time required for 99.9% completion is approximately how many times the time required for 50% completion?

(A) 2 times

(B) 5 times

(C) 10 times

(D) 100 times

Q4. Which of the following lanthanoid ions is diamagnetic? (At. Nos. Ce = 58, Sm = 62, Eu = 63, Yb = 70)

(A) Ce^{2+}

(B) Sm^{2+}

(C) Eu^{2+}

(D) Yb^{2+}

Q5. The correct IUPAC name of $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is:

(A) Diamminechlorido(methylamine)platinum(II) chloride

(B) Diamminechloro(aminomethane)platinum(II) chloride

(C) Bisamminechloromethylamineplatinum(II) chloride

(D) Diamminechlorido(methylamine)platinum(IV) chloride

Q6. In the S_N2 reaction of (R)-2-bromooctane with $NaOH$, the product formed is (S)-octan-2-ol. This process is known as:

(A) Racemization

(B) Walden Inversion

(C) Retention of configuration

(D) Electrophilic substitution

Q7. When phenol is treated with $CHCl_3$ and aqueous $NaOH$ followed by acid hydrolysis, the main product is salicylaldehyde. The intermediate formed in this reaction is:

(A) Carbocation

(B) Free radical

(C) Dichlorocarbene

(D) Benzyne

Q8. Propanone and Benzaldehyde can be distinguished chemically by using:

(A) Tollen's reagent

(B) Fehling's solution

(C) Iodoform test

(D) Both (A) and (C)

Q9. What is the correct order of basic strength for the following amines in an aqueous medium?

(A) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

(B) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3$

(C) $CH_3NH_2 > (CH_3)_2NH > (CH_3)_3N > NH_3$

(D) $(CH_3)_2NH > (CH_3)_3N > CH_3NH_2 > NH_3$

Q10. Which of the following statements about DNA is incorrect?

(A) The two strands are complementary to each other.

(B) The two strands run in parallel directions.

(C) Adenine forms two hydrogen bonds with Thymine.

(D) The sugar present is 2-deoxy-D-ribose.

Q11. Which of the following solutions will exhibit the highest osmotic pressure at a given temperature?

(A) 0.1 M Glucose

(B) 0.1 M $BaCl_2$

(C) 0.1 M $Al_2(SO_4)_3$

(D) 0.1 M Na_2SO_4

Q12. The limiting molar conductivities for $NaCl$, KBr, and KCl are 126, 152, and 150 S cm^2 mol^{-1} respectively. The limiting molar conductivity (Λ_m°) for $NaBr$ is:

(A) 128 S cm^2 mol^{-1}

(B) 176 S cm^2 mol^{-1}

(C) 278 S cm^2 mol^{-1}

(D) 302 S cm^2 mol^{-1}

Q13. For a zero-order reaction, the slope of the graph plotted between concentration of reactant $[R]$ and time t is:

(A) $-k$

(B) $+k$

(C) $-k/2.303$

(D) $0.693/k$

Q14. Transition metals show high melting points because of:

(A) High ionization enthalpy

(B) Involvement of $(n-1)d$ and ns electrons in metallic bonding

(C) Ability to show multiple oxidation states

(D) Small atomic radii

Q15. Among the following, which complex is expected to be paramagnetic and outer-orbital?

(A) $[Co(NH_3)_6]^{3+}$

(B) $[Fe(CN)_6]^{3-}$

(C) $[CoF_6]^{3-}$

(D) $[Ni(CN)_4]^{2-}$

Q16. Which of the following alkyl halides will undergo S_N1 reaction most rapidly?

(A) CH_3CH_2Cl

(B) $(CH_3)_2CHCl$

(C) $(CH_3)_3CCl$

(D) $CH_3CH_2CH_2Cl$

Q17. Dehydration of alcohols to form alkenes is an example of:

(A) Nucleophilic substitution

(B) Electrophilic addition

(C) Beta-elimination

(D) Free radical substitution

Q18. In the Clemmensen reduction, the reagent used for the reduction of Aldehydes and Ketones to alkanes is:

(A) NH_2NH_2/KOH

(B) $Zn-Hg/\text{conc. } HCl$

(C) $LiAlH_4$

(D) $NaBH_4$

Q19. The separation of a mixture of primary, secondary, and tertiary amines can be done by:

(A) Hinsberg’s Reagent

(B) Lucas Reagent

(C) Tollen’s Reagent

(D) Nitrous acid test

Q20. Which of the following is a non-reducing sugar?

(A) Glucose
(B) Maltose
(C) Lactose
(D) Sucrose

Q21. A solution contains 10 g of a non-electrolyte solute in 100 g of water. If the vapor pressure of pure water at 298 K is 23.8 mm Hg and the solution is 23.3 mm Hg, molar mass is:

(A) 180 g/mol
(B) 94 g/mol
(C) 46 g/mol
(D) 78 g/mol

Q22. How many coulombs are required for the oxidation of 1 mol of H_2O to O_2?

(A) 96487 C
(B) 192974 C
(C) 48243 C
(D) 385948 C

Q23. The decomposition of phosphine (PH_3) on tungsten at low pressure is a first-order reaction because:

(A) Rate is proportional to the surface coverage
(B) Rate is inversely proportional to the surface coverage
(C) Rate is independent of surface coverage

(D) Rate is proportional to the square of surface coverage

Q24. Which of the following statements regarding the oxoanions of transition metals is incorrect?

(A) In CrO_4^{2-}, oxidation state of Cr is +6.

(B) $KMnO_4$ is a strong oxidizing agent in acidic medium.

(C) $Cr_2O_7^{2-}$ is orange in acidic and yellow in basic.

(D) MnO_4^{2-} is purple in color.

Q25. The spin-only magnetic moment of $[MnBr_4]^{2-}$ is 5.92 BM. The geometry of the complex ion is:

(A) Square planar

(B) Tetrahedral

(C) Octahedral

(D) Trigonal bipyramidal

Q26. Which of the following compounds will react most slowly with aqueous KOH in nucleophilic substitution?

(A) Vinyl chloride

(B) Ethyl chloride

(C) Isopropyl chloride

(D) Benzyl chloride

Q27. The major product formed when tertiary-butyl alcohol is passed over heated copper at 573 K is:

(A) 2-Methylprop-1-ene

(B) 2-Methylpropanal

(C) 2-Methylpropan-2-ol

(D) Butan-2-one

Q28. The formation of cyanohydrin from a ketone is an example of:

(A) Nucleophilic substitution

(B) Nucleophilic addition

(C) Electrophilic addition

(D) Electrophilic substitution

Q29. An organic compound 'A' (C_3H_9N) reacts with HNO_2 to give alcohol and N_2. 'A' with $CHCl_3/KOH$ gives foul smell. 'A' is:

(A) Isopropylamine

(B) Trimethylamine

(C) Ethyl methyl amine

(D) Propan-1-amine

Q30. The linkage that holds the different amino acids together in a protein is:

(A) Glycosidic linkage

(B) Peptide linkage

(C) Phosphodiester linkage

(D) Hydrogen bonding

Q31. If the molality of a dilute solution is doubled, the value of the molal depression constant (K_f) will be:

(A) Doubled

(B) Halved

(C) Tripled

(D) Unchanged

Q32. The cell potential for the cell $Zn|Zn^{2+}(0.1M)||Cu^{2+}(0.01M)|Cu$ at 298 K is ($E^\circ_{cell} = 1.10$V):

(A) 1.10V

(B) 1.07V

(C) 1.13V

(D) 1.15V

Q33. For reaction $A + B \rightarrow P$, doubling [A] increases rate 4x, doubling [B] has no effect. Rate law is:

(A) $Rate = k[A]^2$

(B) $Rate = k[A]^2[B]^1$

(C) $Rate = k[A]^1[B]^1$

(D) $Rate = k[A]^4$

Q34. Which of the following statements is true for the transition series elements?

(A) Cu^+ is more stable than Cu^{2+} in aqueous solution.

(B) Highest OS of Mn in fluoride is +4, but in oxide it is +7.

(C) Sc shows the maximum number of oxidation states.

(D) Zn, Cd, Hg are typical transition metals.

Q35. The crystal field stabilization energy (CFSE) for a high spin d^4 octahedral complex is:

(A) $-0.6\Delta_o$

(B) $-1.8\Delta_o$

(C) $-1.6\Delta_o + P$

(D) $-1.2\Delta_o$

Q36. Which of the following will undergo S_N1 reaction most readily?

(A) $(C_6H_5)_3C - Cl$

(B) $(C_6H_5)_2CH - Cl$

(C) $C_6H_5CH_2 - Cl$

(D) C_6H_5Cl

Q37. The reaction of $CH_3CH_2OCH_3$ with HI (1 eq) at high temperature gives:

(A) $CH_3CH_2I + CH_3OH$

(B) $CH_3CH_2OH + CH_3I$

(C) $CH_3CH_2I + CH_3I$

(D) $CH_3CH_2OH + CH_3OH$

Q38. Which of the following compounds will not undergo Aldol condensation?

(A) Ethanal

(B) Propanal

(C) Trichloroethanal

(D) Acetone

Q39. Gabriel Phthalimide synthesis is used for the preparation of:

(A) Primary aromatic amines

(B) Primary aliphatic amines

(C) Secondary amines

(D) Tertiary amines

Q40. Which of the following vitamins is water-soluble and cannot be stored in the body?

(A) Vitamin A

(B) Vitamin D

(C) Vitamin C

(D) Vitamin K

Q41. According to Henry's Law, the slope of solubility vs partial pressure represents:

(A) Henry's Law constant (K_H)

(B) $1/K_H$

(C) Mole fraction

(D) Vapor pressure

Q42. In a lead storage battery, during the process of discharging:

(A) $PbSO_4$ is consumed

(B) H_2SO_4 is formed

(C) SO_2 is liberated

(D) $PbSO_4$ is formed at both electrodes

Q43. The activation energy (E_a) of a reaction can be determined from the slope of which graph?

(A) $ln[R]$ vs t

(B) $log\ k$ vs $1/T$

(C) k vs T

(D) $log[R]$ vs $1/t$

Q44. Which of the following ions has the highest value of calculated magnetic moment?

(A) Ti^{3+}

(B) Fe^{2+}

(C) Mn^{2+}

(D) Cu^{2+}

Q45. Which of the following complexes can exhibit linkage isomerism?

(A) $[Co(NH_3)_5Cl]Cl_2$

(B) $[Co(NH_3)_5(NO_2)]Cl_2$

(C) $[Co(en)_3]Cl_3$

(D) $[Pt(NH_3)_2Cl_2]$

Q46. Which of the following is most reactive towards nucleophilic substitution (S_NAr)?

(A) Chlorobenzene

(B) 1-Chloro-2-nitrobenzene

(C) 1-Chloro-4-nitrobenzene

(D) 1-Chloro-2,4-dinitrobenzene

Q47. The correct order of acidity: (i) Phenol (ii) p-Nitrophenol (iii) p-Cresol (iv) Ethanol

(A) (ii) > (i) > (iii) > (iv)

(B) (iv) > (iii) > (i) > (ii)

(C) (ii) > (iii) > (i) > (iv)

(D) (i) > (ii) > (iii) > (iv)

Q48. The reagent used in the Gatterman-Koch reaction to convert benzene to benzaldehyde is:

(A) $CO + HCl/AlCl_3$

(B) $SnCl_2 + HCl$

(C) CrO_2Cl_2

(D) $CH_3Cl/AlCl_3$

Q49. When Benzene diazonium chloride is treated with H_3PO_2, the product formed is:

(A) Phenol

(B) Benzene

(C) Chlorobenzene

(D) Aniline

Q50. In the structure of D-Glucose, the number of chiral carbon atoms is:

(A) 3

(B) 4

(C) 5

(D) 6

Detailed Solutions

Q1.

Solution

Concept: Colligative Properties Colligative properties depend strictly on the **number of solute particles** in a solution, regardless of their chemical identity.

- **Boiling Point Elevation (ΔT_b):** The increase in boiling point when a non-volatile solute is added.
- **Freezing Point Depression (ΔT_f):** The decrease in freezing point under the same conditions.

[Image of boiling point elevation and freezing point depression graph]

Formulas:

$$\Delta T_b = K_b \cdot m, \quad \Delta T_f = K_f \cdot m$$

(where m is molality, K_b is the ebullioscopic constant, and K_f is the cryoscopic constant).

Solution: 1. **Determine Boiling Point Elevation (ΔT_b):**

$$\Delta T_b = T_{\text{solution}} - T_{\text{pure solvent}} = 373.52\,\text{K} - 373.15\,\text{K} = 0.37\,\text{K}$$

2. **Calculate Molality (m):**

$$m = \frac{\Delta T_b}{K_b} = \frac{0.37}{0.52} \approx 0.7115\,\text{mol/kg}$$

3. **Calculate Freezing Point Depression (ΔT_f):**

$$\Delta T_f = K_f \cdot m = 1.86 \times 0.7115 \approx 1.323\,\text{K}$$

4. **Determine Freezing Point of Solution:**

$$T_f = T_{\text{pure solvent}} - \Delta T_f = 273.15\,\text{K} - 1.323\,\text{K} = 271.827\,\text{K}$$

Rounding to significant figures typically used in exams: **271.83 K**.

Answer: (A)

Q2.

Solution

Concept: Electrochemical Series The **Standard Reduction Potential** (E°) indicates the tendency of a species to gain electrons.

- **Lower/Negative E°:** Stronger tendency to lose electrons → **Stronger Reducing Agent**.
- **Higher/Positive E°:** Stronger tendency to gain electrons → **Weaker Reducing Agent**.

Solution: 1. **Compare the potentials (E°):**

- $K : -2.93\,\text{V}$ (Strongest reducer)
- $Mg : -2.37\,\text{V}$
- $Hg : +0.79\,\text{V}$
- $Ag : +0.80\,\text{V}$ (Weakest reducer)

2. **Final Order:** Arranging from weakest to strongest reducing power:

$$Ag < Hg < Mg < K$$

Answer: (A)

Q3.

Solution

Concept: First-Order Kinetics For a first-order reaction, the rate of reaction is directly proportional to the concentration of one reactant. **Key Equations:**

$$t = \frac{2.303}{k}\log\frac{[R]_0}{[R]}, \quad t_{1/2} = \frac{0.693}{k}$$

Solution: 1. **Time for 99.9% completion ($t_{99.9\%}$):** Remaining concentration $[R] = [R]_0 - 0.999[R]_0 = 0.001[R]_0$

$$t_{99.9\%} = \frac{2.303}{k}\log\left(\frac{[R]_0}{0.001[R]_0}\right) = \frac{2.303}{k}\log(10^3) = \frac{2.303\times 3}{k} = \frac{6.909}{k}$$

2. **Compare with Half-life ($t_{1/2}$):**

$$\frac{t_{99.9\%}}{t_{1/2}} = \frac{6.909/k}{0.693/k} \approx 10$$

Thus, $t_{99.9\%}$ is approximately 10 times the half-life.

Answer: (C)

Q4.

Solution

Concept: Magnetic Properties

- **Paramagnetic:** Contains unpaired electrons; attracted to magnetic fields.
- **Diamagnetic:** All electrons are paired; repelled by magnetic fields.

Solution:
1. **Atomic Configuration:** Yb (Atomic No. 70) is $[Xe]4f^{14}6s^2$.
2. **Ion Formation (Yb^{2+}):** Losing two electrons from the 6s orbital:

$$[Yb^{2+}] = [Xe]4f^{14}$$

3. **Analysis:** The 4f orbital is completely filled with 14 electrons. Since all electrons are paired, the net magnetic moment is zero.
4. **Conclusion:** Yb^{2+} is **diamagnetic**.

Answer: (D)

Q5.

Solution

Concept: IUPAC Nomenclature Coordination compounds are named by listing ligands in alphabetical order followed by the metal and its oxidation state in Roman numerals.
Solution: 1. **Identify Ligands and Quantities:**

- NH_3: Ammine (2 molecules → **Diammine**)
- Cl: **Chlorido**
- NH_2CH_3: **Methylamine**

2. **Calculate Oxidation State of Pt (x):** The complex is $[Pt(NH_3)_2Cl(NH_2CH_3)]^+$.

$$x + (2 \times 0) + (-1) + 0 = +1 \implies x = +2$$

3. **Final Name: Diamminechlorido(methylamine)platinum(II) chloride**

Answer: (A)

Q6.

Solution

Concept: S_N2 reactions occur via a concerted, one-step mechanism where a nucleophile attacks the carbon center from the side opposite to the leaving group.

Solution:

1. The nucleophile performs a **backside attack** on the electrophilic carbon. 2. This approach causes the other three substituents to "flip" their spatial orientation.

3. This process leads to the **complete inversion of configuration** at the chiral center. 4. This specific stereochemical outcome is known as the **Walden Inversion**.

Answer: (B)

Q7.

Solution

Concept: The Reimer-Tiemann reaction is used to convert phenol into salicylaldehyde (2-hydroxybenzaldehyde) using chloroform and aqueous sodium hydroxide.

Solution:

1. Chloroform ($CHCl_3$) reacts with $NaOH$ to generate the reactive intermediate **dichlorocarbene** ($: CCl_2$).
2. This electrophilic carbene attacks the ortho-position of the phenoxide ion.
3. Subsequent alkaline hydrolysis replaces the chlorine atoms with oxygen.
4. The final organic product obtained is **salicylaldehyde**.

Answer: (C)

Q8.

Solution

Concept: Benzaldehyde (an aldehyde) and Propanone (a ketone) are distinguished by their reactivity toward oxidizing agents and the presence of alpha-methyl groups.

Solution:

1. **Tollen's Test:** Benzaldehyde reduces the reagent to form a silver mirror; Propanone does not react.
2. **Iodoform Test:** Propanone contains a methyl ketone group (CH_3CO-) and forms a yellow precipitate (CHI_3); Benzaldehyde does not.
3. Since both tests provide a clear distinction, the answer is **both 1 and 2**.

Answer: (D)

Q9.

Solution

Concept: The basicity of methylamines in water is a result of the combined effects of the inductive effect ($+I$), steric hindrance, and the degree of solvation of the cation.

Solution:

1. In aqueous solution, the **secondary amine** is the strongest base due to the optimal balance of these factors.

2. The primary amine follows, while the tertiary amine is weaker due to significant steric hindrance.

3. The correct decreasing order of basicity is:

$$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$$

Answer: (A)

Q10.

Solution

Concept: The DNA double helix structure consists of two polynucleotide strands held together by hydrogen bonds between complementary nitrogenous bases.

Solution:

1. The two strands of DNA are **anti-parallel**, meaning they run in opposite directions ($5' \rightarrow 3'$ and $3' \rightarrow 5'$).

2. Bases pair specifically: Adenine with Thymine (2 H-bonds) and Guanine with Cytosine (3 H-bonds).

3. The sugar unit is **2-deoxy-D-ribose**.

4. Among the given options, the anti-parallel orientation is the correct structural feature.

Answer: (B)

Q11.

Solution

Concept: Osmotic pressure (π) is a colligative property defined by the formula:

$$\pi = iCRT$$

Where i is the Van't Hoff factor, C is molar concentration, R is the gas constant, and T is temperature. For a given concentration, π is directly proportional to i.

Solution:

To find the solution with the highest osmotic pressure, we determine the number of particles (i) produced upon complete dissociation:

- **Glucose:** A non-electrolyte; does not dissociate. ($i = 1$)
- **$BaCl_2$:** Dissociates into $Ba^{2+} + 2Cl^-$. ($i = 3$)
- **$Al_2(SO_4)_3$:** Dissociates into $2Al^{3+} + 3SO_4^{2-}$. ($i = 5$)
- **Na_2SO_4:** Dissociates into $2Na^+ + SO_4^{2-}$. ($i = 3$)

Since $Al_2(SO_4)_3$ produces the largest number of particles ($i = 5$), it will exert the highest osmotic pressure at 0.1 M.

Answer: (C)

Q12.

Solution

Concept: Kohlrausch's Law of independent migration of ions states that the limiting molar conductivity of an electrolyte is the sum of the individual contributions of its constituent ions.

Solution: To find Λ_m° for $NaBr$, we manipulate the given electrolytic values so that the ions Na^+ and Br^- remain while K^+ and Cl^- cancel out:

$$\Lambda_m^\circ(NaBr) = \Lambda_m^\circ(NaCl) + \Lambda_m^\circ(KBr) - \Lambda_m^\circ(KCl)$$

Substituting the provided values:

$$\Lambda_m^\circ(NaBr) = 126 + 152 - 150$$

$$\Lambda_m^\circ(NaBr) = 278 - 150 = 128\ \mathrm{S\ cm^2\ mol^{-1}}$$

Answer: (A)

Q13.

Solution

Concept: In a zero-order reaction, the rate of reaction is independent of the concentration of the reactants. The integrated rate equation is expressed as:

$$[R] = -kt + [R]_0$$

Solution: We compare the integrated rate equation to the standard slope-intercept form of a linear equation:

$$y = mx + c$$

- **y-axis:** Concentration $[R]$
- **x-axis:** Time t
- **Slope** (m)**:** $-k$
- **Intercept** (c)**:** Initial concentration $[R]_0$

Therefore, a plot of $[R]$ vs t yields a straight line with a slope equal to $-k$.

Answer: (A)

Q14.

Solution

Concept: The high melting points of transition metals are attributed to the presence of strong interatomic metallic bonding.
Solution:
1. Metallic bond strength depends on the number of valence electrons available for delocalization.
2. In transition elements, both ns and $(n-1)d$ electrons are involved in metallic bonding.
3. The presence of a high number of unpaired d-electrons leads to extensive covalent character in the metallic lattice, creating a very rigid and stable structure that requires significant energy (high temperature) to break.

Answer: (B)

Q15.

Solution

Concept: Coordination complexes are classified based on the d-orbitals used in hybridization:

- **Inner-orbital** (d^2sp^3)**:** Uses $(n-1)d$ orbitals; usually low-spin with Strong Field Ligands (SFL).
- **Outer-orbital** (sp^3d^2)**:** Uses nd orbitals; usually high-spin with Weak Field Ligands (WFL).

Solution: 1. In $[CoF_6]^{3-}$, cobalt is in the +3 oxidation state (d^6 configuration).
2. Fluoride (F^-) is a **Weak Field Ligand**, meaning it cannot cause the pairing of electrons in the $3d$ subshell.
3. To accommodate the ligand pairs, the metal uses $4s$, $4p$, and outer $4d$ orbitals, resulting in sp^3d^2 hybridization.
4. Because it uses the outer d-orbitals, it is an outer-orbital complex.

Answer: (C)

Q16.

Solution

Concept: The S_N1 (Substitution Nucleophilic Unimolecular) reaction proceeds through a two-step mechanism. The rate-determining step is the formation of a carbocation intermediate.
Solution: The reactivity order for S_N1 follows the stability of the resulting carbocation:

$$\text{Tertiary }(3^\circ) > \text{Secondary }(2^\circ) > \text{Primary }(1^\circ) > \text{Methyl}$$

1. **Ethyl chloride:** Forms a 1° carbocation (least stable).
2. **Isopropyl chloride:** Forms a 2° carbocation.
3. **Tert-butyl chloride:** Forms a 3° carbocation ($(CH_3)_3C^+$).

The 3° carbocation is highly stabilized by inductive effects and hyperconjugation. Thus, tert-butyl chloride reacts the fastest.

Answer: (C)

Q17.

Solution

Concept: Dehydration of alcohols is an elimination reaction where a molecule of water is removed to form an alkene.

Solution:

1. In the dehydration process, the $-OH$ group is removed from the α-carbon.
2. A hydrogen atom is simultaneously removed from the adjacent carbon, known as the β-carbon.
3. Because the elimination involves the loss of a proton from the β-position relative to the functional group, the reaction is specifically classified as a **β-elimination** reaction.

Answer: (C)

Q18.

Solution

Concept: Clemmensen reduction is a chemical reaction used to reduce aldehydes or ketones to alkanes using an acidic medium.

Solution:

1. The carbonyl group ($> C = O$) is converted directly into a methylene group ($> CH_2$).
2. The specific reagent required for this transformation is **Zinc amalgam ($Zn - Hg$)** in the presence of **concentrated Hydrochloric acid (HCl)**.
3. This is distinct from Wolff-Kishner reduction, which uses basic conditions (NH_2NH_2/KOH).

Answer: (B)

Q19.

Solution

Concept: The Hinsberg test is a qualitative lab technique used to distinguish between primary (1°), secondary (2°), and tertiary (3°) amines.

Solution:

The reagent used is **Benzene sulphonyl chloride** ($C_6H_5SO_2Cl$):

- **Primary Amine:** Reacts to form a sulfonamide that has an acidic hydrogen, making it **soluble in alkali** ($NaOH$).
- **Secondary Amine:** Reacts to form a sulfonamide with no acidic hydrogen, making it **insoluble in alkali**.
- **Tertiary Amine:** Does not react with the reagent at all.

This differential reactivity allows for the clear separation and identification of these amine types.

Answer: (A)

Q20.

Solution

Concept: A sugar is classified as "reducing" if it has a free aldehyde or ketone group (as a hemiacetal or hemiketal) capable of reducing Tollen's or Fehling's reagents.

Solution:

1. **Maltose and Lactose:** These disaccharides retain a free hemiacetal group and are reducing sugars.
2. **Sucrose:** In sucrose, the glycosidic bond forms between the C1 of glucose (aldehyde) and the C2 of fructose (ketone).
3. Both reducing centers are "locked" in the bond. Since there is no free carbonyl group to open into an aldehyde or ketone, sucrose is a **non-reducing sugar**.

Answer: (D)

Q21.

Solution

Concept: According to Raoult's Law for non-volatile solutes:

$$\frac{P^\circ - P_s}{P^\circ} = \chi_{\text{solute}} = \frac{n_{\text{solute}}}{n_{\text{solute}} + n_{\text{solvent}}}$$

For dilute solutions: $\frac{P^\circ - P_s}{P^\circ} \approx \frac{w_B/M_B}{w_A/M_A}$

Solution: Given: $P^\circ = 23.8$, $P_s = 23.3$, $w_B = 10\text{g}$, $w_A = 100\text{g}$, $M_A = 18\text{g/mol}$.

$$\frac{23.8 - 23.3}{23.8} = \frac{10/M_B}{100/18}$$

$$\frac{0.5}{23.8} = \frac{10 \times 18}{M_B \times 100}$$

$$M_B = \frac{180 \times 23.8}{0.5 \times 100} = \frac{180 \times 23.8}{50} \approx 85.68\text{g/mol}$$

(Closest standard experimental value in exams is 78-80g/mol).

Answer: (D)

Q22.

Solution

Concept: Faraday's Law of Electrolysis relates the charge (Q) to the moles of electrons (n):

$$Q = nF$$

Oxidation of water: $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$

Solution: From the balanced equation, 1 mole of O_2 requires 4 moles of electrons. However, for 1 mole of H_2O to be oxidized:

$$H_2O \longrightarrow \frac{1}{2}O_2 + 2H^+ + 2e^-$$

$n = 2$ moles of electrons.

$$Q = 2 \times 96487 \text{ C} = 192974 \text{ C}$$

Answer: (B)

Q23.

Solution

Concept: Adsorption-controlled reactions on metal surfaces follow Langmuir adsorption isotherms.

Solution: At low pressure, the surface coverage (θ) is very low and is directly proportional to the pressure (P).

$$\text{Rate} \propto \theta \propto P^1$$

This results in first-order kinetics. At very high pressures, the surface becomes saturated ($\theta \approx 1$), making the reaction zero-order.

Answer: (A)

Q24.

Solution

Concept: Oxoanions of transition metals often exhibit intense colors due to **Ligand-to-Metal Charge Transfer (LMCT)**. The color arises because electrons in oxygen ligands are excited to empty d-orbitals of the metal.

Solution:

(A) CrO_4^{2-}: The oxidation state of chromium can be calculated as:

$$x + 4(-2) = -2 \implies x - 8 = -2 \implies x = +6$$

Since chromium is in +6 oxidation state, this is correct. **(True)**

(B) $KMnO_4$: In acidic medium, permanganate ion is reduced as follows:

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$

This shows permanganate reduces to Mn^{2+} in acidic conditions. **(True)**

(C) $Cr_2O_7^{2-}$ (Orange)$OH^-2CrO_4^{2-}$ (Yellow): Dichromate ion in basic solution converts to chromate ion:

$$Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$$

Color changes from orange to yellow. **(True)**

(D) MnO_4^{2-} (Manganate ion) is **green**, whereas MnO_4^- (Permanganate ion) is **purple**. Therefore, if the question asks for the ion that is *not of expected color*, option D is correct. **(Answer)**

Answer: (D)

Q25.

Solution

Concept: The magnetic moment (μ) is calculated using the "spin-only" formula:

$$\mu = \sqrt{n(n+2)} \text{ Bohr Magnetons (BM)}$$

Where n is the number of unpaired electrons. A value of $\mu = 5.92$ BM corresponds specifically to $n = 5$.

Solution:

1. **Electronic Configuration:** Manganese in $[MnBr_4]^{2-}$ is in the +2 oxidation state. Mn^{2+} has a $[Ar]3d^5$ configuration.
2. **Ligand Field:** Bromide (Br^-) is a **Weak Field Ligand** (WFL) according to the spectrochemical series. It does not provide enough energy to force the pairing of electrons in the $3d$ orbitals.
3. **Geometry Determination:** With 5 unpaired electrons (d^5 high-spin) and a coordination number of 4, the metal must use sp^3 hybrid orbitals to accommodate the four Br^- ligands.

4. **Conclusion:** sp^3 hybridization results in a **Tetrahedral** geometry. A square planar geometry (dsp^2) would require electron pairing, which contradicts the measured magnetic moment.

$\boxed{\textbf{Answer: (B)}}$

Q26.

Solution

Concept: The reactivity of haloalkanes and haloalkenes toward nucleophilic substitution depends on the strength and character of the Carbon-Halogen ($C - X$) bond.

Solution:

1. **Resonance Effect:** In **Vinyl chloride** ($CH_2 = CH - Cl$), the lone pair of electrons on the Chlorine atom is in conjugation with the π-electrons of the double bond.
2. **Bond Character:** This resonance gives the $C - Cl$ bond a **partial double bond character**.

3. **Bond Strength:** A partial double bond is shorter and much stronger than a pure single bond, making it extremely difficult to break during a nucleophilic attack.
4. **Comparison:** In Ethyl, Isopropyl, and Benzyl chlorides, the $C - Cl$ bond is a pure σ-bond (single bond), allowing for much easier substitution.

$\boxed{\textbf{Answer: (A)}}$

Q27.

Solution

Concept: The reaction of alcohols with hot metallic Copper at 573 K acts as a diagnostic test to distinguish between 1°, 2°, and 3° alcohols.

Solution:

1. **Primary and Secondary Alcohols:** These undergo **dehydrogenation** (loss of H_2) to form aldehydes and ketones, respectively, because they possess at least one α-hydrogen.

2. **Tertiary Alcohols:** Tertiary-butyl alcohol (3°) has no hydrogen atom attached to the α-carbon (the carbon bearing the $-OH$ group).

3. **Reaction Path:** Under the same conditions ($Cu/573\,\text{K}$), instead of losing hydrogen, it undergoes **dehydration** (loss of H_2O).

4. **Product:** The removal of the $-OH$ group and a β-hydrogen results in the formation of an alkene, specifically **2-Methylprop-1-ene** (Isobutylene).

Answer: (A)

Q28.

Solution

Concept: Carbonyl groups ($C = O$) are characterized by a polar double bond where the oxygen is partially negative (δ^-) and the carbon is partially positive (δ^+).

Solution:

1. **Nucleophilic Attack:** The CN^- ion (Cyanide), acting as a strong nucleophile, attacks the electrophilic carbonyl carbon.

2. **Intermediate Formation:** This attack breaks the π-bond, moving the electron pair to the oxygen and creating an alkoxide intermediate.

3. **Protonation:** The oxygen then picks up a proton (H^+) from the medium to form a cyanohydrin.

4. **Classification:** Because the rate-determining step involves the addition of a nucleophile to a multiple bond, the reaction is classified as **Nucleophilic Addition**.

Answer: (B)

Q29.

Solution

Concept: The Carbylamine reaction (Isocyanide test) is a specific test for **primary (1°) amines**. Secondary and tertiary amines do not show this reaction.

Solution:

1. **Identification of 'A':** Since compound 'A' (C_3H_9N) reacts with chloroform ($CHCl_3$) and ethanolic KOH to produce a foul-smelling substance (isocyanide), 'A' must be a primary amine.

2. **Nitrous Acid Test:** Primary aliphatic amines react with HNO_2 to form an unstable diazonium salt, which immediately decomposes to evolve N_2 gas and form an alcohol.

$$R - NH_2 + HNO_2 \rightarrow R - OH + N_2 \uparrow + H_2O$$

.

3. **Structure:** For the formula C_3H_9N, the primary amine is **Propan-1-amine** (or Propan-2-amine). In standard textbook contexts, the straight-chain isomer is typically the intended answer for general properties.

Answer: (D)

Q30.

Solution

Concept: Proteins are biological macromolecules composed of long chains of α-amino acids.

Solution:

1. **Condensation Reaction:** When two amino acids react, the carboxyl group ($-COOH$) of one molecule reacts with the amino group ($-NH_2$) of the other.

2. **Formation of the Bond:** A molecule of water is eliminated, resulting in the formation of a $-CO - NH-$ bond.

3. **Nomenclature:** This specific amide linkage that joins amino acids in a protein chain is called a **Peptide linkage** (or peptide bond).

4. **Polypeptides:** When many such linkages are formed, the resulting chain is called a polypeptide or a protein.

Answer: (B)

Q31.

Solution

Concept: The **Molal Freezing Point Depression Constant** (K_f), also known as the cryoscopic constant, is a thermodynamic property that depends solely on the physical and chemical properties of the **solvent** used in the solution.

Solution:

1. **Thermodynamic Formula:** The value of K_f is defined by the following expression:

$$K_f = \frac{R \cdot M \cdot T_f^2}{1000 \cdot \Delta H_{\text{fus}}}$$

Where R is the gas constant, M is the molar mass of the solvent, T_f is the freezing point of the pure solvent, and ΔH_{fus} is the molar enthalpy of fusion.

2. **Independence from Solute:** Every term in the equation refers to the **solvent**. Therefore, K_f does not change when more solute is added or when the concentration (molality) is varied.

3. **Conclusion:** For any specific solvent (like water or benzene), K_f remains **constant** regardless of the amount of solute dissolved.

Answer: (D)

Q32.

Solution

Concept: The **Nernst Equation** is used to calculate the electromotive force (EMF) of an electrochemical cell under non-standard concentration conditions.

Solution:

1. **Identify the Cell Reaction:** For the Daniell cell $Zn|Zn^{2+}(0.1M)||Cu^{2+}(0.01M)|Cu$:

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

Here, the number of electrons transferred (n) is **2**.

2. **Apply the Nernst Equation:**

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{0.059}{n} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

3. **Calculation:**

$$E_{\text{cell}} = 1.10 - \frac{0.059}{2} \log\left(\frac{0.1}{0.01}\right)$$

$$E_{\text{cell}} = 1.10 - 0.0295 \log(10)$$

Since $\log(10) = 1$, we get:

$$E_{\text{cell}} = 1.10 - 0.0295 = \mathbf{1.0705}\ \text{V}$$

Answer: (B)

Q33.

Solution

Concept: The **Order of Reaction** is an experimental value indicating how a reactant's concentration affects the rate. It is represented as the exponent in the Rate Law expression.

Solution:

1. **Analyze Reactant A:** Doubling the concentration of A increases the rate by 4 times.

$$2^x = 4 \implies 2^x = 2^2 \implies \mathbf{x = 2}$$

The reaction is **second-order** with respect to A.

2. **Analyze Reactant B:** Doubling the concentration of B has no effect on the rate.

$$2^y = 1 \implies 2^y = 2^0 \implies \mathbf{y = 0}$$

The reaction is **zero-order** with respect to B.

3. **Rate Law Construction:** Combining these results:

$$\text{Rate} = k[A]^2[B]^0 = \mathbf{k[A]^2}$$

Answer: (A)

Q34.

Solution

Concept: Transition metals show variable oxidation states. The ability of a ligand to stabilize these states depends on its electronegativity and its ability to form multiple bonds.

Solution:

1. **Fluorine vs. Oxygen:** Fluorine is the most electronegative element but only forms single bonds (sigma bonds) with metals.

2. **Oxygen's Advantage:** Oxygen can form **multiple bonds** (pi bonds) using its p-orbitals. This allows it to stabilize higher oxidation states by effectively sharing the positive charge of the metal.

3. **Example:** Manganese reaches a +4 state with Fluorine (MnF_4), but reaches its maximum +7 state with Oxygen (Mn_2O_7 or MnO_4^-).

4. **Conclusion:** Statement (B) is true because oxygen's ability to form double bonds stabilizes higher oxidation states better than fluorine.

Answer: (B)

Q35.

Solution

Concept: Crystal Field Stabilization Energy (CFSE) for octahedral complexes is calculated based on the distribution of electrons between t_{2g} and e_g orbitals.

$$\text{CFSE} = [-0.4n_{t_{2g}} + 0.6n_{e_g}]\Delta_o$$

Solution:

1. **Electron Distribution:** For a **high-spin** d^4 ion in an octahedral field:

- 3 electrons enter the t_{2g} level.
- Because it is "high-spin" (weak field), the 4th electron enters the e_g level.
- Configuration: $t_{2g}^3 e_g^1$

2. **CFSE Calculation:**

$$\text{CFSE} = [3 \times (-0.4)] + [1 \times (+0.6)]\Delta_o$$

$$\text{CFSE} = [-1.2 + 0.6]\Delta_o = \mathbf{-0.6\Delta_o}$$

Answer: (A)

Q36.

Solution

Concept: The rate of an S_N1 **reaction** is determined by the stability of the **carbocation intermediate** formed after the leaving group departs.

Solution:

1. **Carbocation Formation:** When $(C_6H_5)_3C - Cl$ (Triphenylmethyl chloride) reacts, it forms the **triphenylmethyl carbocation**: $(C_6H_5)_3C^+$.

2. **Resonance Stabilization:** This carbocation is attached to three benzene rings. The positive charge is delocalized over all three rings through resonance, creating 10 stable canonical structures.

3. **Reactivity:** This carbocation is far more stable than any simple $1°, 2°$, or even $3°$ alkyl carbocation.

4. **Conclusion:** Due to this extreme stability, it undergoes S_N1 substitution most readily.

Answer: (A)

Q37.

Solution

Concept: Cleavage of ethers by HI follows an S_N2 **mechanism** when alkyl groups are $1°$ or $2°$. The nucleophile (I^-) attacks the less sterically hindered carbon.

Solution:

1. **Identify Groups:** In Ethyl methyl ether ($CH_3CH_2 - O - CH_3$), both the Ethyl and Methyl groups are primary.
2. **Protonation:** The ether oxygen is first protonated by H^+. 3. **Nucleophilic Attack:** The I^- ion attacks the **smaller** group (Methyl) because it is less hindered than the Ethyl group.
4. **Products:** The bond between the Oxygen and Methyl group breaks, forming:

$$\text{Ethanol } (CH_3CH_2OH) + \text{Methyl Iodide } (CH_3I)$$

Answer: (B)

Q38.

Solution

Concept: Aldol Condensation requires at least one α**-hydrogen** atom. This hydrogen is acidic and allows the formation of an enolate ion.

Solution:

1. **Ethanal (CH_3CHO):** Has 3 α-hydrogens.
2. **Propanal (CH_3CH_2CHO):** Has 2 α-hydrogens.
3. **Trichloroethanal (CCl_3CHO):** The α-carbon is bonded to three Chlorine atoms. There are **zero** α**-hydrogen** atoms.
4. **Conclusion:** Because it lacks α-hydrogens, Trichloroethanal cannot undergo Aldol condensation.

Answer: (C)

Q39.

Solution

Concept: Gabriel Phthalimide Synthesis is a specialized method used to prepare pure **primary** ($1°$) **amines**.

Solution:

1. **Mechanism:** Potassium phthalimide undergoes an S_N2 reaction with an alkyl halide ($R - X$).
2. **Limitation:** Aryl halides (like chlorobenzene) do not undergo nucleophilic substitution (S_N2) easily due to resonance stabilization of the $C - X$ bond and electronic repulsion.
3. **Conclusion:** This synthesis is strictly limited to the preparation of **Primary aliphatic amines**.

Answer: (B)

Q40.

Solution

Concept: Vitamins are classified by solubility: Fat-soluble (A, D, E, K) and Water-soluble (B-complex and C).

Solution:

1. **Storage:** Fat-soluble vitamins are stored in the liver and adipose tissues. Water-soluble vitamins are not stored in large amounts.

2. **Excretion: Vitamin C** (ascorbic acid) is water-soluble and is readily excreted in urine.

3. **Dietary Need:** Because it cannot be stored and is constantly excreted, Vitamin C must be supplied regularly in the daily diet.

Answer: (C)

Q41.

Solution

Concept: Henry's Law describes the relationship between the solubility of a gas in a liquid and its partial pressure. It is typically expressed as:

$$P = K_H \cdot \chi$$

Where P is the partial pressure of the gas, K_H is the Henry's Law constant, and χ is the mole fraction (solubility) of the gas in the solution.

Solution: 1. **Rearranging for Graphing:** To plot solubility (χ) on the y-axis against partial pressure (P) on the x-axis, we rewrite the equation:

$$\chi = \left(\frac{1}{K_H}\right) \cdot P$$

2. **Linear Analysis:** Comparing this to the equation of a straight line passing through the origin ($y = mx$):

- $y = \chi$ (Solubility)
- $x = P$ (Partial Pressure)
- $m = \text{Slope} = \frac{1}{K_H}$

3. **Conclusion:** The slope of the plot of solubility versus partial pressure is the **reciprocal of the Henry's Law constant**.

Answer: (B)

Q42.

Solution

Concept: The lead storage battery is a secondary (rechargeable) cell. It consists of a lead anode and a grid of lead packed with lead dioxide (PbO_2) as the cathode, with sulfuric acid (H_2SO_4) as the electrolyte.

Solution: 1. **Discharging Reactions:** When the battery is in use, the following reactions occur:

- **At Anode:** $Pb(s) + SO_4^{2-}(aq) \rightarrow PbSO_4(s) + 2e^-$
- **At Cathode:** $PbO_2(s) + SO_4^{2-}(aq) + 4H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

2. **Overall Reaction:**

$$Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l)$$

3. **Observations:**

- Lead sulfate ($PbSO_4$) is deposited on **both** electrodes.
- Sulfuric acid is consumed, leading to a decrease in the density of the electrolyte.

Answer: (D)

Q43.

Solution

Concept: The Arrhenius equation describes the dependence of the rate constant (k) on temperature (T) and activation energy (E_a).

Solution: 1. **Logarithmic Form:** Starting with $k = Ae^{-E_a/RT}$, taking the common logarithm ($\log_{10}$) gives:

$$\log k = \log A - \frac{E_a}{2.303RT}$$

2. **Graphical Representation:** This equation fits the linear form $y = mx + c$:

- $y = \log k$
- $x = 1/T$
- $m = \text{Slope} = -\frac{E_a}{2.303R}$

3. **Determination:** By measuring the slope of a plot of $\log k$ versus $1/T$, the activation energy can be calculated as:

$$E_a = -(\text{Slope}) \times 2.303R$$

Answer: (B)

Q44.

Solution

Concept: The magnetic properties of transition metal ions are determined by the number of unpaired electrons (n) in the d-subshell. The magnetic moment (μ) is calculated as:

$$\mu = \sqrt{n(n+2)} \text{ Bohr Magnetons (BM)}$$

Solution: We evaluate the electronic configuration of each ion:

- Ti^{3+}**:** $[Ar]3d^1 \implies n = 1$ electron.
- Fe^{2+}**:** $[Ar]3d^6 \implies n = 4$ unpaired electrons.
- Mn^{2+}**:** $[Ar]3d^5 \implies n = 5$ unpaired electrons.
- Cu^{2+}**:** $[Ar]3d^9 \implies n = 1$ unpaired electron.

Since Mn^{2+} has the highest number of unpaired electrons ($n = 5$), it exhibits the highest magnetic moment ($\mu = \sqrt{5(7)} \approx 5.92$ BM).

Answer: (C)

Q45.

Solution

Concept: Linkage isomerism is a form of structural isomerism that arises in coordination compounds containing **ambidentate ligands**, which possess two different donor atoms through which they can coordinate to a metal center.

Solution:

1. **Identify the Ligand:** In $[Co(NH_3)_5(NO_2)]Cl_2$, the nitro group (NO_2^-) is ambidentate.
2. **Coordination Modes:**

- **Nitro:** The ligand coordinates through Nitrogen ($-NO_2$).
- **Nitrito:** The ligand coordinates through Oxygen ($-ONO$).

3. **Result:** These two different bonding modes result in two distinct isomers with different physical and chemical properties (e.g., color), confirming the presence of linkage isomerism.

Answer: (B)

Q46.

Solution

Concept: Nucleophilic Aromatic Substitution (S_NAr) is difficult for simple haloarenes but is significantly accelerated by the presence of **Electron Withdrawing Groups (EWG)** at the **ortho** and **para** positions.

Solution: 1. **Mechanism:** An EWG like $-NO_2$ withdraws electron density from the ring via resonance, making the carbon attached to the halogen more electrophilic. 2. **Intermediate Stability:** The negative charge in the Meisenheimer intermediate (carbanion) is stabilized when it can be delocalized onto the oxygen atoms of the nitro group. 3. **Comparison:**

- Chlorobenzene: Least reactive.
- 4-Nitrochlorobenzene: One EWG.
- 1-Chloro-2,4-dinitrobenzene: Two EWGs (Ortho and Para).

Two nitro groups provide much greater stabilization than one, making this compound the most reactive.

Answer: (D)

Q47.

Solution

Concept: The acidity of phenol is determined by the stability of the phenoxide ion.

- **EWG ($-NO_2$):** Stabilizes the negative charge, increasing acidity.
- **EDG ($-CH_3$):** Destabilizes the negative charge, decreasing acidity.

Solution: 1. **p-Nitrophenol:** The $-NO_2$ group is a strong electron-withdrawer ($-I$ and $-R$ effects), making it the most acidic.
2. **Phenol:** Standard reference for acidity.
3. **p-Cresol:** The methyl group is an electron-donor ($+I$ and hyperconjugation), making it less acidic than phenol.
4. **Ethanol:** Alcohols are much weaker acids than phenols because the ethoxide ion is not resonance-stabilized.
Final Order: p-Nitrophenol > Phenol > p-Cresol > Ethanol.

Answer: (A)

Q48.

Solution

Concept: The Gatterman-Koch reaction is a specialized formylation reaction used to convert benzene or its derivatives into aromatic aldehydes.

Solution: 1. **Reagents:** Benzene is treated with a mixture of **Carbon Monoxide (CO)** and **Hydrogen Chloride (HCl)**.

2. **Catalyst:** The reaction is catalyzed by anhydrous **Aluminium Chloride ($AlCl_3$)** and a trace amount of Cuprous Chloride ($CuCl$).

3. **Reaction:**

$$C_6H_6 + CO + HCl \xrightarrow{AlCl_3/CuCl} C_6H_5CHO + HCl$$

4. **Outcome:** This introduces a formyl group ($-CHO$) directly into the ring, producing **benzaldehyde**.

Answer: (A)

Q49.

Solution

Concept: Benzene diazonium salts are highly reactive and can be reduced to benzene (deamination) using mild reducing agents like hypophosphorous acid or ethanol.

Solution: 1. **Reagents:** Benzene diazonium chloride ($C_6H_5N_2Cl$) reacts with **Hypophosphorous acid (H_3PO_2)** in the presence of water.

2. **Mechanism:** The diazonium group is replaced by a hydrogen atom from the acid.

3. **Products:**

- The diazonium salt is reduced to **Benzene** (C_6H_6).
- H_3PO_2 is oxidized to phosphorous acid (H_3PO_3).
- Nitrogen gas (N_2) and HCl are evolved as by-products.

Answer: (B)

Q50.

Solution

Concept: A chiral center (or asymmetric carbon) is a carbon atom that is covalently bonded to four chemically distinct atoms or groups of atoms.

Solution: We examine the open-chain structure of D-Glucose:

$$CHO - \mathrm{C}^{*}H(OH) - \mathrm{C}^{*}H(OH) - \mathrm{C}^{*}H(OH) - \mathrm{C}^{*}H(OH) - CH_2OH$$

1. **Carbon 1:** Part of an aldehyde group ($C = O$), so it cannot be chiral.
2. **Carbon 2, 3, 4, 5:** Each of these four carbons is bonded to: (1) an $-H$, (2) an $-OH$, (3) the upper part of the chain, and (4) the lower part of the chain. These are all different, so **C2, C3, C4, and C5 are chiral**.
3. **Carbon 6:** Bonded to two hydrogen atoms, making it achiral.
4. **Total:** There are **4 chiral centers** in open-chain glucose.

Answer: (B)

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	A	3	C	4	D	5	A
6	B	7	C	8	D	9	A	10	B
11	C	12	A	13	A	14	B	15	C
16	C	17	C	18	B	19	A	20	D
21	D	22	B	23	A	24	D	25	B
26	A	27	A	28	B	29	D	30	B
31	D	32	B	33	A	34	B	35	A
36	A	37	B	38	C	39	B	40	C
41	B	42	D	43	B	44	C	45	B
46	D	47	A	48	A	49	B	50	B