CUET UG Chemistry Sample Paper - 15

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. A 0.1 M aqueous solution of K_2SO_4 is found to be 80% dissociated. The Van't Hoff factor (i) for the solution is:

(A) 2.4

(B) 2.6

(C) 3.0

(D) 1.8

Q2. At a constant temperature, the vapor pressure of an ideal solution containing 2 moles of A and 3 moles of B is 500 mm Hg. If 1 mole of A is added, the vapor pressure increases to 550 mm Hg. The vapor pressure of pure A is:

(A) 400 mm Hg

(B) 600 mm Hg

(C) 800 mm Hg

(D) 1000 mm Hg

Q3. Which of the following liquid pairs shows a negative deviation from Raoult's law:2022

(A) Ethanol and Acetone

(B) Benzene and Toluene

(C) Phenol and Aniline

(D) Chloroform and Benzene

Q4. The elevation in boiling point of a 0.01 M aqueous solution of $BaCl_2$ is $0.015°C$. If K_b for water is 0.52 K kg mol^{-1}, the apparent degree of ionization of $BaCl_2$ is:

(A) 85.3%

(B) 94.2%

(C) 75.0%

(D) 100%

Q5. A plant cell shrinks when placed in a solution that is:

(A) Hypotonic

(B) Hypertonic

(C) Isotonic

(D) Pure water

Q6. The molar conductivity of 0.007 M acetic acid is 20 S cm^2mol^{-1}. If Λ_m° for acetic acid is 400 S cm^2mol^{-1}, the dissociation constant (K_a) is:

(A) 1.75×10^{-5}

(B) 2.5×10^{-5}

(C) 1.5×10^{-4}

(D) 1.8×10^{-5}

Q7. For the cell reaction: $Ni(s) + 2Ag^{+}(0.002\,\text{M}) \rightarrow Ni^{2+}(0.160\,\text{M}) + 2Ag(s)$, given $E^{\circ}_{\text{cell}} = 1.05\,\text{V}$. The E_{cell} is: (Take $2.303RT/F = 0.059$)

(A) 0.71 V

(B) 0.91 V

(C) 1.02 V

(D) 0.59 V

Q8. How many coulombs are required for the oxidation of 1 mole of H_2O to O_2?

(A) 96500 C

(B) 1.93×10^5 C

(C) 4.82×10^4 C

(D) 3.86×10^5 C

Q9. Which of the following is used as an electrolyte in a Hydrogen-Oxygen fuel cell?

(A) Aqueous KOH

(B) $LiCl$ in alcohol

(C) Conc. H_2SO_4

(D) MnO_2

Q10. The limiting molar conductivities for $NaCl, KBr$ and KCl are 126, 152 and 150 S $\text{cm}^2\text{mol}^{-1}$ respectively. The Λ°_m for $NaBr$ is:

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

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

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

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

Q11. Lead storage battery is a:

(A) Primary cell

(B) Secondary cell

(C) Fuel cell

(D) Concentration cell

Q12. For a first-order reaction, if the time taken for 50% completion is 20 minutes, the time required for 99.9% completion of the reaction is:

(A) 100 min

(B) 200 min

(C) 150 min

(D) 40 min

Q13. The rate of a reaction triples when the temperature changes from $20^{\circ}C$ to $50^{\circ}C$. The energy of activation for such a reaction will be:

(A) $28.8\,\text{kJ mol}^{-1}$

(B) $34.5\,\text{kJ mol}^{-1}$

(C) $45.2\,\text{kJ mol}^{-1}$

(D) $52.3\,\text{kJ mol}^{-1}$

Q14. In a reaction $2A + B \rightarrow A_2B$, the rate $= k[A][B]^2$. If the concentration of A is doubled and B is halved, the rate will:

(A) Double

(B) Be halved

(C) Remain same

(D) Increase 4 times

Q15. The decomposition of phosphine (PH_3) on tungsten at low pressure is a:

(A) Zero-order reaction

(B) First-order reaction

(C) Second-order reaction

(D) Fractional order reaction

Q16. Which of the following plots is linear for a first-order reaction?

(A) $[A]$ vs t

(B) $\log[A]$ vs t

(C) $1/[A]$ vs t

(D) $\sqrt{[A]}$ vs t

Q17. The magnetic moment of a divalent ion in aqueous solution (Atomic number = 25) is:

(A) 5.92 BM

(B) 2.84 BM

(C) 4.90 BM

(D) 3.87 BM

Q18. The reason for Lanthanoid contraction is:

(A) Negligible screening effect of f-electrons

(B) Increasing nuclear charge

(C) Decreasing nuclear charge

(D) High screening effect of f-electrons

Q19. When $KMnO_4$ is titrated against ferrous ammonium sulfate in acidic medium, the change in oxidation state of Mn is:

(A) $+7 \rightarrow +2$

(B) $+6 \rightarrow +2$

(C) $+7 \rightarrow +4$

(D) $+5 \rightarrow +2$

Q20. Which of the following ions is colorless in aqueous solution?

(A) Ti^{3+}

(B) V^{3+}

(C) Sc^{3+}

(D) Cr^{3+}

Q21. The IUPAC name of $[Co(NH_3)_5(CO_3)]Cl$ is:

(A) Pentaamminecarbonatocobalt(III) chloride

(B) Pentaamminecarbonatocobalt(II) chloride

(C) Carbonatopentaamminecobaltic chloride

(D) Pentaamminecobalt(III) carbonate chloride

Q22. The number of geometrical isomers for $[Pt(NH_3)(NH_2OH)(Py)(NH_2)]$ is:

(A) 2

(B) 3

(C) 4

(D) 6

Q23. According to Crystal Field Theory (CFT), for a d^4 ion in an octahedral field, if $\Delta_o < P$, the electronic configuration is:

(A) $t_{2g}^3 e_g^1$
(B) $t_{2g}^4 e_g^0$
(C) $t_{2g}^2 e_g^2$
(D) $e_g^2 t_{2g}^2$

Q24. Which of the following is an inner orbital complex and is diamagnetic?

(A) $[Fe(CN)_6]^{4-}$
(B) $[FeF_6]^{3-}$
(C) $[CoF_6]^{3-}$
(D) $[NiCl_4]^{2-}$

Q25. The hybridization and shape of $[Ni(CO)_4]$ are:

(A) sp^3, Tetrahedral
(B) dsp^2, Square planar
(C) sp^3d^2, Octahedral
(D) d^2sp^3, Octahedral

Q26. Linkage isomerism is shown by ligands like:

(A) H_2O
(B) NH_3
(C) SCN^-
(D) Cl^-

Q27. Which of the following will undergo S_N1 reaction most readily?

(A) $(CH_3)_3C - Cl$

(B) CH_3CH_2Cl

(C) $(CH_3)_2CH - Cl$

(D) CH_3Cl

Q28. The reaction of an alkyl halide with sodium in dry ether to give a hydrocarbon is known as:

(A) Finkelstein reaction

(B) Wurtz reaction

(C) Sandmeyer reaction

(D) Swarts reaction

Q29. S_N2 reactions proceed with:

(A) Retention of configuration

(B) Inversion of configuration

(C) Racemization

(D) Partial inversion

Q30. Which of the following is an example of an allylic halide?

(A) $CH_2 = CH - CH_2Cl$

(B) $CH_2 = CHCl$

(C) C_6H_5Cl

(D) $CH_3 - CH(Cl) - CH_3$

Q31. Lucas reagent is a mixture of:

(A) Conc. HCl + anhydrous $ZnCl_2$

(B) Conc. H_2SO_4 + anhydrous $ZnCl_2$

(C) Conc. HNO_3 + anhydrous $ZnCl_2$

(D) Conc. HCl + hydrous $ZnCl_2$

Q32. Phenol reacts with $CHCl_3$ and aqueous $NaOH$ to give salicylaldehyde. This reaction is:

(A) Kolbe's reaction

(B) Reimer-Tiemann reaction

(C) Rosenmund reduction

(D) Friedel-Crafts reaction

Q33. Which is the most acidic among the following?

(A) p-Nitrophenol

(B) p-Cresol

(C) Phenol

(D) Ethanol

Q34. In Kolbe's reaction, the electrophile involved is:

(A) CO_2

(B) CHO^+

(C) CCl_2

(D) SO_3

Q35. Anisole on reaction with HI gives:

(A) Phenol and methyl iodide

(B) Iodobenzene and methanol

(C) Phenol and methanol

(D) Iodobenzene and methyl iodide

Q36. Which of the following does NOT undergo aldol condensation?

(A) Acetaldehyde

(B) Acetone

(C) Benzaldehyde

(D) Propanal

Q37. Cannizzaro's reaction is not given by:

(A) Trimethyl acetaldehyde

(B) Benzaldehyde

(C) Formaldehyde

(D) Acetaldehyde

Q38. The order of reactivity of CH_3CHO, CH_3COCH_3 and $HCHO$ towards nucleophilic addition is:

(A) $HCHO > CH_3CHO > CH_3COCH_3$

(B) $CH_3COCH_3 > CH_3CHO > HCHO$

(C) $CH_3CHO > HCHO > CH_3COCH_3$

(D) $HCHO > CH_3COCH_3 > CH_3CHO$

Q39. Which acid is the strongest?

(A) $ClCH_2COOH$

(B) $Cl_2CHCOOH$

(C) Cl_3CCOOH

(D) CH_3COOH

Q40. CH_3CHO and C_6H_5CHO can be distinguished by:

(A) Tollen's reagent

(B) Fehling's solution

(C) Schiff's reagent

(D) 2, 4-DNP

Q41. Rosenmund reduction is used for the preparation of:

(A) Alcohols

(B) Aldehydes

(C) Ketones

(D) Acids

Q42. The correct order of basic strength of methyl amines in aqueous solution is:

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

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

Q43. Gabriel Phthalimide synthesis is used for the preparation of:

(A) Primary aromatic amines

(B) Primary aliphatic amines

(C) Secondary amines

(D) Tertiary amines

Q44. Benzene diazonium chloride reacts with phenol in basic medium to give:

(A) *p*-Hydroxyazobenzene (orange dye)

(B) *p*-Aminoazobenzene (yellow dye)

(C) Chlorobenzene

(D) Benzene

Q45. Hinsberg's reagent is:

(A) Benzene sulfonyl chloride

(B) Benzene sulfonic acid

(C) Phenyl isocyanide

(D) Benzene chloride

Q46. Glucose reacts with Br_2 water to give:

(A) Gluconic acid

(B) Saccharic acid

(C) *n*-Hexane

(D) Sorbitol

Q47. Which of the following is a non-reducing sugar?

(A) Glucose

(B) Fructose

(C) Maltose

(D) Sucrose

Q48. Denaturation of protein leads to the loss of its:

(A) Primary structure

(B) Secondary and tertiary structures

(C) Peptide bonds

(D) Sequence of amino acids

Q49. Deficiency of Vitamin K causes:

(A) Night blindness

(B) Beri-beri

(C) Increase in blood clotting time

(D) Scurvy

Q50. The helical structure of proteins is stabilized by:

(A) Hydrogen bonds

(B) Peptide bonds

(C) Disulphide bonds

(D) Van der Waals forces

Detailed Solutions

Q1.

Solution

Concept: For electrolytes, Van't Hoff factor is given by:

$$i = 1 + (\nu - 1)\alpha$$

where ν = number of ions formed and α = degree of dissociation.

Solution:

Dissociation of K_2SO_4:

$$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$$

Total number of ions:

$$\nu = 3$$

Given:

$$\alpha = 80\% = 0.8$$

Now,

$$i = 1 + (3 - 1)\alpha$$

$$i = 1 + 2 \times 0.8$$

$$i = 1 + 1.6 = 2.6$$

$$\boxed{i = 2.6}$$

Answer: (B)

Q2.

Solution

Concept: Raoult's law:

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

Solution:

Initial:

$$x_A = \frac{2}{5}, \quad x_B = \frac{3}{5}$$

$$500 = \frac{2}{5}P_A^0 + \frac{3}{5}P_B^0 \quad (1)$$

After adding 1 mole A:

$$x_A = \frac{3}{6} = \frac{1}{2}, \quad x_B = \frac{1}{2}$$

$$550 = \frac{1}{2}P_A^0 + \frac{1}{2}P_B^0 \Rightarrow P_A^0 + P_B^0 = 1100 \quad (2)$$

Solve:

$$\frac{2}{5}P_A^0 + \frac{3}{5}(1100 - P_A^0) = 500$$

$$2P_A^0 + 3300 - 3P_A^0 = 2500$$

$$P_A^0 = 800\,\text{mm Hg}$$

$$\boxed{800\,\text{mm Hg}}$$

Answer: (C)

Q3.

Solution

Concept: Negative deviation occurs when intermolecular attraction between unlike molecules is stronger.

Solution:

Phenol and aniline form strong H-bonding.

Phenol and Aniline

Answer: (C)

Q4.

Solution

Concept:

$$\Delta T_b = iK_b m$$

Solution:

$$i = \frac{\Delta T_b}{K_b m} = \frac{0.015}{0.52 \times 0.01} \approx 2.88$$

For $BaCl_2$, $\nu = 3$:

$$i = 1 + 2\alpha$$

$$2.88 = 1 + 2\alpha \Rightarrow \alpha = 0.94 = 94.2\%$$

94.2%

Answer: (B)

Q5.

Solution

Concept: Shrinkage occurs in hypertonic solution due to exosmosis.

Solution:

$$\boxed{\text{Hypertonic}}$$

Answer: (B)

Q6.

Solution

Concept:

$$\alpha = \frac{\Lambda_m}{\Lambda_m^0}, \quad K_a = \frac{C\alpha^2}{1-\alpha}$$

Solution:

$$\alpha = \frac{20}{400} = 0.05$$

$$K_a = \frac{0.007 \times (0.05)^2}{1 - 0.05} = \frac{0.007 \times 0.0025}{0.95} \approx 1.8 \times 10^{-5}$$

$$\boxed{1.8 \times 10^{-5}}$$

Answer: (D)

Q7.

Solution

Concept:

$$E = E^\circ - \frac{0.059}{n} \log Q$$

Solution:

$$Q = \frac{[Ni^{2+}]}{[Ag^+]^2} = \frac{0.160}{(0.002)^2} = 40000$$

$$E = 1.05 - \frac{0.059}{2} \log(40000)$$

$$= 1.05 - 0.0295 \times 4.6 \approx 0.91\,V$$

$$\boxed{0.91\,V}$$

Answer: (B)

Q8.

Solution

Concept:

$$1 \text{ mole } H_2O \rightarrow \frac{1}{2}O_2 + 2e^-$$

Solution:

$$2F = 2 \times 96500 = 1.93 \times 10^5\,C$$

$$\boxed{1.93 \times 10^5\,C}$$

Answer: (B)

Q9.

Solution

Concept: Hydrogen-oxygen fuel cell uses alkaline electrolyte.

Solution:

$$\boxed{\text{Aqueous KOH}}$$

Answer: (A)

Q10.

Solution

Concept: Kohlrausch law:

$$\Lambda^0_m(NaBr) = \Lambda^0_m(NaCl) + \Lambda^0_m(KBr) - \Lambda^0_m(KCl)$$

Solution:

$$= 126 + 152 - 150 = 128$$

$$\boxed{128\, S\, cm^2\, mol^{-1}}$$

Answer: (A)

Q11.

Solution

Concept: Rechargeable cells are secondary cells.

Solution:

Secondary cell

Answer: (B)

Q12.

Solution

Concept: For a first-order reaction:

$$t = \frac{2.303}{k} \log \frac{[A]_0}{[A]}$$

Also,

$$t_{1/2} = \frac{0.693}{k}$$

Solution:

Given:

$$t_{1/2} = 20\,\text{min}$$

For 99.9% completion:

$$\frac{[A]}{[A]_0} = 0.001$$

$$t = \frac{2.303}{k} \log \left(\frac{1}{0.001} \right) = \frac{2.303}{k} \times 3 = \frac{6.909}{k}$$

Now,

$$k = \frac{0.693}{20}$$

$$t = \frac{6.909}{0.693/20} = 200\,\text{min}$$

$$\boxed{200\,\text{min}}$$

Answer: (B)

Q13.

Solution

Concept: Arrhenius equation:

$$\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{T_2 - T_1}{T_1 T_2}\right)$$

Solution:

Given:

$$\frac{k_2}{k_1} = 3, \quad T_1 = 293K, \quad T_2 = 323K$$

$$\log 3 = \frac{E_a}{2.303 \times 8.314} \times \frac{30}{293 \times 323}$$

$$E_a \approx 28.8\,\text{kJ mol}^{-1}$$

$$\boxed{28.8\,\text{kJ mol}^{-1}}$$

Answer: (A)

Q14.

Solution

Concept: Rate law:

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

Solution:

New rate:

$$= k(2[A])\left(\frac{[B]}{2}\right)^2 = k \cdot 2[A] \cdot \frac{[B]^2}{4} = \frac{1}{2}k[A][B]^2$$

$$\boxed{\text{Rate is halved}}$$

Answer: (B)

Q15.

Solution

Concept: Surface-catalyzed reactions at low pressure show zero-order kinetics.

Solution:

$$\boxed{\text{Zero-order reaction}}$$

Answer: (A)

Q16.

Solution

Concept: First-order reaction integrated form:

$$\log[A] = \log[A]_0 - \frac{kt}{2.303}$$

Solution:

$$\boxed{\log[A] \text{ vs } t}$$

Answer: (B)

Q17.

Solution

Concept: Magnetic moment:

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

Solution:

Atomic number = 25 (Mn)

Mn^{2+}: $3d^5 \rightarrow n = 5$

$$\mu = \sqrt{5(5+2)} = \sqrt{35} \approx 5.92\,\text{BM}$$

$$\boxed{5.92\,\text{BM}}$$

Answer: (A)

Q18.

Solution

Concept: Lanthanoid contraction is due to poor shielding of f-electrons.

Solution:

$$\boxed{\text{Negligible screening effect of } f\text{-electrons}}$$

Answer: (A)

Q19.

Solution

Concept: In acidic medium, $KMnO_4$ reduces from +7 to +2.

Solution:

$$\boxed{+7 \rightarrow +2}$$

Answer: (A)

Q20.

Solution

Concept: Ions with d^0 or d^{10} configuration are colorless.

Solution:

$Sc^{3+} \rightarrow d^0$

$$\boxed{Sc^{3+}}$$

Answer: (C)

Q21.

Solution

Concept: Name ligands first, then metal with oxidation state.

Solution:

Ligand: ammine (NH_3), carbonato (CO_3^{2-})

Co oxidation state:

$$x + 0 + (-2) = +1 \Rightarrow x = +3$$

$$\boxed{\text{Pentaamminecarbonatocobalt(III) chloride}}$$

Answer: (A)

Q22.

Solution

Concept: For a square planar complex of the general formula $[Mabcd]$, the number of geometrical isomers is determined by fixing one ligand and rotating the others. There are 3 possible arrangements where a specific ligand is trans to each of the other three.

Solution: The given complex is $[Pt(NH_3)(NH_2OH)(Py)(NH_2)]$.Let:$a = NH_3 b = NH_2OH c = Py d = NH_2^-$In a square planar geometry, we can fix ligand a (NH_3) and place the remaining ligands (b, c, d) in the position trans to it.Isomer 1: NH_3 is trans to NH_2OHIsomer 2: NH_3 is trans to PyIsomer 3: NH_3 is trans to NH_2^-Each of these configurations results in a unique spatial arrangement of the ligands. Therefore, there are a total of 3 geometrical isomers.

Answer: (B)

Q23.

Solution

Concept: For $\Delta_o < P$, high spin configuration.

Solution:

d^4:

$$t_{2g}^3 e_g^1$$

$$\boxed{t_{2g}^3 e_g^1}$$

Answer: (A)

Q24.

Solution

Concept: Inner orbital complexes use d^2sp^3 hybridization and are diamagnetic.

Solution:

$[Fe(CN)_6]^{4-} \rightarrow$ strong field $\rightarrow$ pairing $\rightarrow$ diamagnetic

$$\boxed{[Fe(CN)_6]^{4-}}$$

Answer: (A)

Q25.

Solution

Concept: $Ni(CO)_4$ forms sp^3 hybridization.

Solution:

Shape: tetrahedral

$$\boxed{sp^3, \text{Tetrahedral}}$$

Answer: (A)

Q26.

Solution

Concept: Linkage isomerism occurs with ambidentate ligands, which possess two different donor atoms but coordinate through only one at a time. Examples include SCN^- (coordinates via S or N) and NO_2^- (coordinates via N or O).

Solution: Among the given options, SCN^- is an ambidentate ligand. H_2O, NH_3, and Cl^- are monodentate ligands with only one type of donor atom.

Answer: (C)

Q27.

Solution

Concept: The reactivity of alkyl halides in S_N1 reactions depends on the stability of the carbocation formed. The order of stability is: $3^\circ > 2^\circ > 1^\circ >$ methyl.

Solution:(A) $(CH_3)_3C - Cl$ forms a 3° carbocation (most stable).(B) CH_3CH_2Cl forms a 1° carbocation.(C) $(CH_3)_2CH - Cl$ forms a 2° carbocation.(D) CH_3Cl forms a methyl carbocation.Therefore, $(CH_3)_3C - Cl$ reacts most readily.

Answer: (A)

Q28.

Solution

Concept: The reaction of alkyl halides with metallic sodium in dry ether to form higher alkanes ($2RX + 2Na \rightarrow R - R + 2NaX$) is a standard named reaction.

Solution: This is the Wurtz reaction. Finkelstein and Swarts are halogen exchange reactions, and Sandmeyer is used for aryl halides from diazonium salts.

Answer: (B)

Q29.

Solution

Concept: In an S_N2 reaction, the nucleophile attacks from the side opposite to the leaving group in a single concerted step.

Solution: This "backside attack" leads to a complete change in the spatial arrangement of substituents around the carbon atom, known as Walden Inversion or Inversion of configuration.

Answer: (B)

Q30.

Solution

Concept: An allylic halide is a compound where the halogen atom is bonded to an sp^3 hybridized carbon atom which is adjacent to a carbon-carbon double bond ($C = C$).

Solution:(A) $CH_2 = CH - CH_2Cl$: The Cl is on a carbon next to a double bond (Allylic).(B) $CH_2 = CHCl$: The Cl is on the double bond carbon (Vinylic).(C) C_6H_5Cl: Chlorobenzene (Aryl).(D) $CH_3 - CH(Cl) - CH_3$: 2-chloropropane (Secondary alkyl).

Answer: (A)

Q31.

Solution

Concept: Lucas reagent is used to distinguish between primary, secondary, and tertiary alcohols based on the speed of turbidity formation. **Solution:** The reagent consists of a mixture of concentrated HCl and anhydrous $ZnCl_2$.

Answer: (A)

Q32.

Solution

Concept: The conversion of phenol to salicylaldehyde using chloroform ($CHCl_3$) and alkali ($NaOH$) involves the formation of a dichlorocarbene intermediate.

Solution: This specific organic transformation is the Reimer-Tiemann reaction.

Answer: (B)

Q33.

Solution

Concept: Acidity depends on the stability of the conjugate base (phenoxide ion). Electron-withdrawing groups (EWG) like $-NO_2$ increase acidity, while electron-donating groups (EDG) like $-CH_3$ decrease it. **Solution:**(A) p-Nitrophenol: Contains $-NO_2$ (Strong EWG), most acidic.(B) p-Cresol: Contains $-CH_3$ (EDG), less acidic than phenol.(C) Phenol: Baseline acidity.(D) Ethanol: Alcohols are much less acidic than phenols.

Answer: (A)

Q34.

Solution

Concept: Kolbe's reaction involves the treatment of sodium phenoxide with a weak electrophile to form salicylic acid.

Solution: In this reaction, the phenoxide ion undergoes electrophilic substitution. The electrophile is Carbon dioxide (CO_2), which is a weak electrophile but reacts with the highly reactive phenoxide ring.

Answer: (A)

Q35.

Solution

Concept: The reaction of an ether with HI depends on the stability of the intermediates. With aryl-alkyl ethers, the bond between Oxygen and the aromatic ring is stronger due to partial double bond character.
Solution: In Anisole ($C_6H_5OCH_3$), the $O - CH_3$ bond is broken. The I^- attacks the smaller methyl group (S_N2 mechanism), while the proton attaches to the phenoxide oxygen.

$$C_6H_5OCH_3 + HI \rightarrow C_6H_5OH + CH_3I$$

The products are Phenol and methyl iodide.

Answer: (A)

Q36.

Solution

Concept: Aldol condensation requires the presence of at least one α-hydrogen atom in the aldehyde or ketone.
Solution: Acetaldehyde (CH_3CHO): Has 3 α-hydrogens.Acetone (CH_3COCH_3): Has 6 α-hydrogens.Propanal (CH_3CH_2CHO): Has 2 α-hydrogens.Benzaldehyde (C_6H_5CHO): The -CHO group is attached to a benzene ring carbon that has no hydrogens. Thus, it does not undergo aldol condensation.

Answer: (C)

Q37.

Solution

Concept: Cannizzaro's reaction is given by aldehydes that do not have any α-hydrogen atoms.

Solution: Formaldehyde, Benzaldehyde, and Trimethyl acetaldehyde lack α-hydrogens and give this reaction.Acetaldehyde (CH_3CHO) has α-hydrogens and undergoes Aldol condensation instead.

Answer: (D)

Q38.

Solution

Concept: Reactivity towards nucleophilic addition depends on steric hindrance and the electronic effect (inductive effect) of alkyl groups. Alkyl groups decrease reactivity.

Solution:$HCHO$ (Formaldehyde): No alkyl groups, least hindered, most reactive.CH_3CHO (Acetaldehyde): One methyl group.CH_3COCH_3 (Acetone): Two methyl groups, most hindered, least reactive.Order: $HCHO > CH_3CHO > CH_3COCH_3$.

Answer: (A)

Q39.

Solution

Concept: The acidity of carboxylic acids increases with the presence of electron-withdrawing groups (like Chlorine) due to the $-I$ effect.

Solution: The more Chlorine atoms attached to the α-carbon, the stronger the acid.Cl_3CCOOH (Trichloroacetic acid) has three Cl atoms, making it the strongest.

Answer: (C)

Q40.

Solution

Concept: While both are aldehydes, Fehling's solution can distinguish between aliphatic and aromatic aldehydes.

Solution: CH_3CHO (Aliphatic) reduces Fehling's solution to give a red precipitate, whereas C_6H_5CHO (Aromatic) does not react with Fehling's solution.

Answer: (B)

Q41.

Solution

Concept: Rosenmund reduction involves the hydrogenation of an acyl chloride over a catalyst ($Pd/BaSO_4$) poisoned with sulfur or quinoline.

Solution: This reaction specifically reduces acid chlorides to Aldehydes.

Answer: (B)

Q42.

Solution

Concept: In aqueous solution, basic strength of methyl-substituted amines is governed by the inductive effect, solvation effect, and steric hindrance.

Solution: For methyl amines, the experimental order is:Secondary > Primary > Tertiary > Ammonia$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$.

Answer: (A)

Q43.

Solution

Concept: Gabriel Phthalimide synthesis is a method used to produce pure amines without contamination of secondary or tertiary amines.

Solution: Due to the steric hindrance and the nature of the nucleophilic substitution (S_N2), it is used to prepare Primary aliphatic amines. It cannot be used for aromatic amines because aryl halides do not undergo S_N2 readily.

Answer: (B)

Q44.

Solution

Concept: This is a coupling reaction where diazonium salts react with phenols in mildly basic conditions (pH 9–10).

Solution: The product is p-Hydroxyazobenzene, which is an orange dye.

Answer: (A)

Q45.

Solution

Concept: Hinsberg's reagent is used to distinguish between 1°, 2°, and 3° amines. **Solution:** The chemical name for Hinsberg's reagent is Benzene sulfonyl chloride ($C_6H_5SO_2Cl$).

Answer: (A)

Q46.

Solution

Concept: Bromine water is a mild oxidizing agent that specifically oxidizes the aldehyde group of glucose.

Solution: Glucose ($C_6H_{12}O_6$) is oxidized to Gluconic acid. (Stronger agents like HNO_3 would yield Saccharic acid).

Answer: (A)

Q47.

Solution

Concept: A non-reducing sugar is one that does not have a free aldehyde or ketone group (as they are involved in the glycosidic bond).

Solution: Sucrose is a non-reducing sugar because the reducing groups of glucose and fructose are involved in the glycosidic linkage.

Answer: (D)

Q48.

Solution

Concept: Denaturation involves the disruption of the higher-order folding of a protein due to heat, pH change, or chemicals.

Solution: Denaturation destroys the Secondary and tertiary structures (and quaternary if present), but the Primary structure (sequence of amino acids) remains intact as peptide bonds are not broken.

Answer: (B)

Q49.

Solution

Concept: Different vitamins have specific physiological roles; Vitamin K is essential for the synthesis of proteins needed for blood coagulation.

Solution: Deficiency of Vitamin K leads to an increase in blood clotting time (excessive bleeding).

Answer: (C)

Q50.

Solution

Concept: The α-helix is a common motif in the secondary structure of proteins.

Solution: The helical structure is stabilized by Hydrogen bonds between the $-NH$ group of one amino acid residue and the $> C = O$ group of an adjacent turn of the helix.

Answer: (A)

Answer Key

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