PUC PYQ 2024

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CHEMISTRY

Q1 If the process of dissolution of a solid in liquid is an endothermic, its solubility: **[PUC march 2024]**
(A) decrease with increase in temperature
(B) remains same at all temperature
(C) increase with increase in temperature
(D) increase with decrease in temperature

Q2 When the concentration of electrolyte solution approaches zero, the limiting molar conductivity is known as: **[PUC march 2024]**
(A) specific conductance
(B) resistivity
(C) conductivity
(D) limiting molar conductivity

Q3 During discharging of lead storage battery the correct half-cell reaction is: **[PUC march 2024]**
(A) At anode, Pb is converted into PbO_2
(B) At anode, Pb is converted into $PbSO_4$
(C) At anode, PbO_2 is converted into $PbSO_4$
(D) At cathode, Pb is converted into $PbSO_4$

Q4 The catalyst in a chemical reaction provides an alternate pathway or reaction mechanism by decreasing: **[PUC march 2024]**
(A) Activation energy
(B) Kinetic energy
(C) Normal energy of reacting species
(D) Potential energy

Q5 Which of the following pair of metal oxides are amphoteric? **[PUC march 2024]**
(A) V_2O_5, Cr_2O_3
(B) Mn_2O_7, CrO_3
(C) V_2O_5, V_2O_4
(D) CrO, V_2O_5

Q6 The correct IUPAC name of $[Pt(NH_3)_2Cl_2]$ is: **[PUC march 2024]**
(A) Diamminedichloridoplatinum (II)
(B) Dichloridodiammineplatinum (0)
(C) Dichloridodiammineplatinate (II)
(D) Diamminedichloridoplatinate (0)

Q7 The stereoisomers related to each other as non-superimposable mirror images are called: **[PUC march 2024]**
(A) Enantiomers
(B) Diastereomers
(C) Anomers
(D) Racemic mixture

Q8 Anisole on treatment with CH_3Cl in the presence of anhydrous $AlCl_3$ gives: **[PUC march 2024]**
(A) Toluene
(B) O–chloroanisole
(C) Ortho and para-methylanisoles
(D) p–chloroanisole

Q9 The enzyme which can catalyse the conversion of glucose to ethanol is: **[PUC march 2024]**
(A) Invertase (B) Maltase
(C) Zymase (D) Sucrase

Q10 Nucleophilic attack on carbonyl carbon atom changes its hybridization from: **[PUC march 2024]**
(A) sp to sp^2 (B) sp^2 to sp^3
(C) sp^3 to sp^2 (D) sp to sp^3

Q11 Decarboxylating reagent is a mixture of: **[PUC march 2024]**

(A) Alc. KOH + H_2O_2

(B) NaOH + CO_2

(C) NaOH + CaO

(D) Conc. HCl + $ZnCl_2$

Q12 To prepare p-Nitroaniline as a major product from aniline, the amino group is protected by: **[PUC march 2024]**

(A) Acetylation (B) Alkylation

(C) Halogenation (D) Sulphonation

Q13 The reagents used to separate the mixture of methylamine and dimethylamine are: **[PUC march 2024]**

(A) $CHCl_3$ and HCl

(B) $C_6H_5SO_2Cl$ and KOH

(C) $C_6H_5SO_2Cl$ and HCl

(D) $CHCl_3$ and KOH

Q14 The carbohydrate which is also known as animal starch and stored in animal body is: **[PUC march 2024]**

(A) Starch (B) Sucrose

(C) Glycogen (D) Cellulose

Q15 Which vitamin deficiency causes the disease cheilosis ? **[PUC march 2024]**

(A) Vitamin B_1 (B) Vitamin B_2

(C) Vitamin B_6 (D) Vitamin B_{12}

Q16 The number of moles of solute present in one kilogram of the solvent is called _____. **[PUC march 2024]**

Q17 The number of collisions per second per unit volume of the reaction mixture is known as _____. **[PUC march 2024]**

Q18 Transition metals form large number of complex compounds due to high _____. **[PUC march 2024]**

Q19 The common name of alkyl magnesium halide is _____. **[PUC march 2024]**

Q20 The formula of benzenediazonium chloride is _____. **[PUC march 2024]**

Q21 What type of deviation from Raoult's law is observed, when equal volume of ethanol and acetone are mixed together? Mention the reason for it. **[PUC march 2024]**

Q22 Mention any two differences between order and molecularity of a reaction. **[PUC march 2024]**

Q23 (a) What is spectrochemical series ?

(b) Between $[Co(en)_3]^{3+}$ and $[Co(NH_3)_6]^{3+}$ complex ions which is more stable? **[PUC march 2024]**

Q24 Write the IUPAC name of product obtained when ethyl bromide reacts with sodium iodide in dry acetone. Name the reaction. **[PUC march 2024]**

Q25 Explain Haloform reaction with chemical equation. **[PUC march 2024]**

Q26 Name two hormones which regulate the glucose level in the blood. **[PUC march 2024]**

Q27 Write the balanced chemical equations in the manufacture of potassium dichromate from chromite ore. **[PUC march 2024]**

Q28 (a) Give a reason for each of the following:

(i) The spin only magnetic moment of Sc^{3+} is zero.

(ii) Alloys are readily formed by transition metals.

(b) Write the structure of manganate ion $\left(MnO_4^{2-}\right)$. **[PUC march 2024]**

Q29 What is Lanthanoid Contraction? Mention two consequences of it. **[PUC march 2024]**

Q30 (a) Draw the geometrical isomers of $[CoCl_2(en)_2]$.

(b) Give an example for ambidentate ligand. **[PUC march 2024]**

Q31 On the basis of Valence Bond Theory (VBT), explain hybridisation and magnetic property of $[Co(NH_3)_6]^{3+}$ ion. (Atomic number of cobalt is 27) **[PUC march 2024]**

Q32 (a) Draw the energy level diagram for the splitting of d-orbitals in an octahedral crystal field.

(b) If $\Delta_0 < P$, on the basis of crystal field theory (CFT), write the electronic configuration of d^4– ion in octahedral complexes. **[PUC march 2024]**

Q33 (a) What is reverse osmosis? Mention one of its applications.

(b) State Henry's Law. **[PUC march 2024]**

Q34 Draw a neat labelled diagram of Standard Hydrogen Electrode (SHE). Write its half-cell reaction. **[PUC march 2024]**

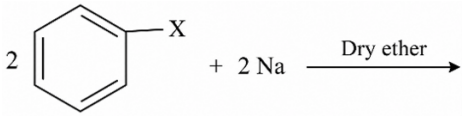
Q35 Write the anodic, cathodic and overall reactions of corrosion of iron occurring in the presence of water and air. **[PUC march 2024]**

Q36 Derive Integrated rate equation for rate constant of a zero order reaction. **[PUC march 2024]**

Q37 (a) Write the mechanism for the conversion of methyl chloride to methylethanol. Mention the order.

(b) Complete the equations:

(i)



_____ +2 NaX.

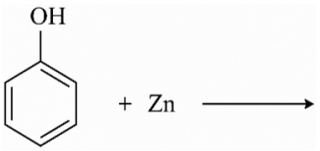
(ii) $H_2C = CH_2 + Br_2 \xrightarrow{CCl_4}$ _____ **[PUC march 2024]**

Q38 (a) Explain the mechanism involved in the acid catalysed dehydration of ethanol to ethene.

(b) What is Lucas reagent? Which class of alcohols do not produce turbidity with it at room temperature? **[PUC march 2024]**

Q39 (a) Write the chemical equations in the manufacture of phenol by cumene process.

(b) Complete the equation:

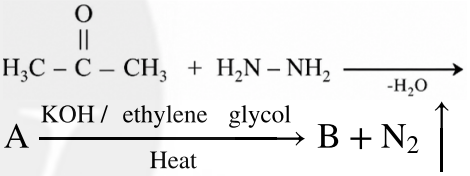


_____ + ZnO

(c) Explain Williamson's reaction for the preparation of methoxy methane. **[PUC march 2024]**

Q40 (a) How does methanal react with hydroxylamine? Explain with equation.

(b) Identify A and B in the reaction:



(c) Write any one reagent used to distinguish between aldehyde and ketone. **[PUC march 2024]**

Q41 (a) When methyl magnesium iodide reacts with dry ice forms an intermediate, which on acidification gives compound 'A'.

(i) Write the equation for the above reaction.

(ii) Write the IUPAC name of compound 'A'.

(b) Between acetic acid and monochloroacetic acid, which is more acidic? Give reason. **[PUC march 2024]**

Q42 (a) Write the chemical equations involved in the Gabriel phthalimide synthesis of methanamine.

(b) Explain the coupling reaction of benzenediazonium chloride with phenol using chemical equation. **[PUC march 2024]**

Q43 (a) Write the Haworth structure of sucrose.
(b) (i) What are essential amino acids?
(ii) Give an example for fibrous proteins.
(c) Name the nitrogenous base present in DNA but not in RNA. **[PUC march 2024]**

Q44 Calculate the mole fraction of benzene in solution containing 30% by mass carbon tetrachloride.
[Given: Molar mass of Benzene = 78 g/mol, Molar mass of carbon tetrachloride = 154 g/mol] **[PUC march 2024]**

Q45 1.00 g of a non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point by 0.40 K. The freezing point depression constant of benzene is 5.12 K kg mol^{-1}. Find the molar mass of the solute. **[PUC march 2024]**

Q46 Calculate the emf of the cell in which the following reaction takes place: $Ni_{(s)} + 2Ag^{+}$ (0.002 M) Ni^{2+}(0.160 M) + $2Ag_{(s)}$
Given that = 1.05 V at 298 K. **[PUC march 2024]**

Q47 A solution of $CuSO_4$ is electrolysed for 10 minutes with a current of 1.5 ampere. What is the mass of copper deposited at the cathode?
[Molar mass of copper = 63 g/mol, 1F = 96487 C] **[PUC march 2024]**

Q48 A first order reaction has a rate constant 1.16 × 10^{-3} s^{-1}. How long will 5 g of this reactant take to reduce to 3 g? **[PUC march 2024]**

Q49 The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the temperature coefficient E_a of the reaction assuming it does not change with temperature. **[PUC march 2024]**

Answer Key

Q1	C
Q2	D
Q3	B
Q4	A
Q5	A
Q6	A
Q7	A
Q8	C
Q9	C
Q10	B
Q11	C
Q12	A
Q13	B
Q14	C
Q15	B
Q16	(H & S)
Q17	(H & S)
Q18	(H & S)
Q19	(H & S)
Q20	(H & S)
Q21	(H & S)
Q22	(H & S)
Q23	(H & S)
Q24	(H & S)
Q25	(H & S)
Q26	(H & S)
Q27	(H & S)
Q28	(H & S)
Q29	(H & S)
Q30	(H & S)
Q31	(H & S)
Q32	(H & S)
Q33	(H & S)
Q34	(H & S)
Q35	(H & S)
Q36	(H & S)
Q37	(H & S)
Q38	(H & S)
Q39	(H & S)
Q40	(H & S)
Q41	(H & S)
Q42	(H & S)
Q43	(H & S)
Q44	(H & S)
Q45	(H & S)
Q46	(H & S)
Q47	(H & S)
Q48	(H & S)
Q49	(H & S)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

According to Le Chatelier's Principle, for an endothermic dissolution process ($\Delta H_{sol} > 0$), adding heat (increasing temperature) shifts the equilibrium toward the forward direction (dissolution), thereby increasing the solubility.

Q2 Text Solution:

Molar conductivity (Λ_m) increases with dilution. When the concentration approaches zero (infinite dilution), the molar conductivity reaches a maximum limiting value, designated as limiting molar conductivity (Λ_m°).

Q3 Text Solution:

During discharge, oxidation occurs at the anode where metallic Lead (Pb) reacts with sulphate ions to form Lead Sulphate: $Pb_{(s)} + SO_{4(aq)}^{2-} \rightarrow PbSO_{4(s)} + 2e^-$

Q4 Text Solution:

A catalyst speeds up a reaction by providing an alternative reaction pathway that possesses a lower activation energy (E_a), allowing more reactant molecules to clear the energy barrier per unit time.

Q5 Text Solution:

In the first transition series, oxides in low oxidation states are basic (CrO), intermediate oxidation states are amphoteric (Cr_2O_3, V_2O_5), and high oxidation states are predominantly acidic (Mn_2O_7, CrO_3).

Q6 Text Solution:

1. Ligands ordered alphabetically: 'ammine' (NH_3) before 'chlorido' (Cl^-) → diamminedichlorido.
2. Central metal: Since the complex is neutral, the name remains platinum.
3. Oxidation State calculation : x + 2(0) + 2(–1) = 0 → x = +2. Thus, written as (II).

Q7 Text Solution:

Enantiomers are optical stereoisomers that are non-superimposable mirror images of one another and rotate plane-polarized light in opposite directions.

Q8 Text Solution:

This is a Friedel-Crafts Alkylation reaction. The methoxy group (OCH_3) on the benzene ring of anisole is strongly ortho/para-directing and activating, guiding the incoming methyl group to the ortho and para positions.

$$C_6H_5\,OCH_3 + CH_3\,Cl \xrightarrow{\text{Anhydrous } AlCl_3} 0-\text{methylanisole} + \text{p}-\text{methylanisole}$$

Q9 Text Solution:

Yeast secretes the enzyme complex known as zymase, which ferments simple sugars like glucose into ethanol and carbon dioxide:

$$C_6H_12O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + 2\,CO_2$$

Q10 Text Solution:

The carbonyl carbon initially forms 3 σ-bonds in a planar geometry (sp^2). When a nucleophile attacks, the π-bond breaks, converting the geometry into a tetrahedral intermediate containing 4 σ-bonds (sp^3).

Q11 Text Solution:

Soda-lime, a 3:1 mixture of Sodium Hydroxide (NaOH) and Calcium Oxide (CaO), is used to eliminate carbon dioxide from sodium salts of carboxylic acids to yield alkanes.

Q12 Text Solution:

Direct nitration of aniline can oxidize the highly reactive $-NH_2$ group or cause meta-substitution due to aniline protonation. Protecting it via acetylation with acetic anhydride generates acetanilide, which moderates activation and directs nitration selectively to the para position.

Q13 Text Solution:

Hinsberg's reagent $C_6H_5SO_2Cl$) distinguishes primary and secondary amines. Methylamine (primary) reacts to give a sulfonamide containing an acidic N-H that dissolves in KOH. Dimethylamine (secondary) forms a sulfonamide lacking an acidic hydrogen, making it insoluble in KOH.

Q14 Text Solution:

Glycogen acts as the primary storage carbohydrate in animals. Because its highly branched structure resembles starch, it is commonly called animal starch.

Q15 Text Solution:

Deficiency of Vitamin B_2 (Riboflavin) causes cheilosis, which is characterized by localized inflammation and painful fissuring at the corners of the mouth.

Q16 Text Solution:

Molality

Q17 Text Solution:

Collision frequency

Q18 Text Solution:

ionic charge

Q19 Text Solution:

Grignard reagent

Q20 Text Solution:

$C_6H_5N_2^+ Cl^-$

Q21 Text Solution:

1. Type of Deviation : It shows a positive deviation from Raoult's Law.

2. Reason : In pure ethanol, molecules are strongly bound together by intermolecular hydrogen bonding. When acetone is introduced, its molecules fit between the ethanol molecules, disrupting and breaking a portion of these hydrogen bonds. Consequently, the intermolecular attractive forces between ethanol and acetone become weaker than those in the pure components (A – B < A – A or B – B), increasing the total vapor pressure over the mixture.

Q22 Text Solution:

Property	Order of a Reaction	Molecularity of a Reaction
1. Definition	It is the sum of the powers of the concentrations of reactants in the experimentally determined rate law equation.	It is the total number of reacting species (atoms, ions, or molecules) taking part in an elementary chemical step.
2. Determination	It is an experimental value.	It is a theoretical value derived from the reaction mechanism.
3. Values	It can be zero, fractional, or an integer.	It must always be a non-zero positive whole integer (1, 2, 3).

Q23 Text Solution:

(a) A spectrochemical series is an arrangement of ligands in increasing order of their crystal field splitting energy (Δ) values.

(b) $[Co(en)_3]^{3+}$ is more stable. This stability stems from the chelate effect, as ethylenediamine (en) acts as a didentate chelating ligand that coordinates to create stable ring structures.

Q24 Text Solution:

- Reaction Equation:

$$CH_3CH_2Br + NaI \xrightarrow{\text{dry acetone}} CH_3CH_2I + NaBr\downarrow$$

- IUPAC Name of the product: Iodoethane (Ethyl iodide).
- Name of the reaction: Finkelstein Reaction.

Q25 Text Solution:

Methyl ketones (or alcohols possessing the structure $CH_3 - CH(OH) -$) react with a halogen (X_2) in the presence of excess aqueous sodium hydroxide (NaOH) to produce a haloform (CHX_3) along with the sodium salt of the corresponding carboxylic acid.Chemical Equation (using Acetone and Iodine as an example):

$$CH_3 - \overset{\overset{O}{\|}}{C} - CH_3 + 3I_2 + 4NaOH \rightarrow CH_3 - \overset{\overset{O}{\|}}{C} - ONa + CHI_3\downarrow (\text{Yellow ppt}) + 3NaI + 3H_2O$$

Q26 Text Solution:

1. Insulin (lowers blood glucose concentration).
2. Glucagon (elevates blood glucose concentration).

Q27 Text Solution:

The industrial synthesis involves three consecutive phases:

1. Conversion of Chromite ore to Sodium Chromate :

$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

2. Conversion of Sodium Chromate to Sodium Dichromate:

$2Na_2CrO_4 + H_2SO_4 \text{ (conc.)} \rightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$

3. Conversion of Sodium Dichromate to Potassium Dichromate:

$Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 + 2NaCl$

Q28 Text Solution:

(a) (1) Scandium has an atomic electronic configuration of $[Ar]3d^14s^2$. Upon losing 3 electrons to form the Sc^{3+} ion, its configuration becomes $[Ar]3d^0$. Since the count of unpaired electrons (n) is 0, the calculated magnetic moment $\left(\mu = \sqrt{n(n+2)} = 0\right)$ evaluates to zero.

(2) Transition elements feature remarkably similar atomic and ionic radii. Consequently, atoms of one transition metal can easily step into and substitute positions within the crystal lattice of another transition metal without inducing significant structural strain, yielding stable solid solutions known as alloys.

(b) Structure of Manganate Ion $\left(MnO_4^{2-}\right)$: It forms a tetrahedral geometry with a green color profile.

Tetrahedral manganate (green) ion

Q29 Text Solution:

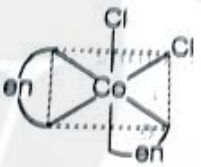
- **Definition :** Lanthanoid contraction refers to the steady, progressive decrease in the atomic and ionic radii of lanthanoid elements with an increasing atomic number, caused by the poor shielding effect of the inner 4f electrons.
- **Consequences :**

(1) Similarity in the sizes of 4d and 5d transition series elements: Pairs such as Zr/Hf and Nb/Ta possess nearly identical atomic radii, giving them closely matched chemical behaviors.

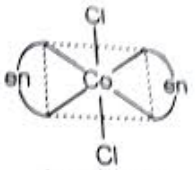
(2) Trend in basic strength: The basic strength of the lanthanoid hydroxides decreases linearly from $La(OH)_3$ to $Lu(OH)_3$ due to the progressive rise in covalent character.

Q30 Text Solution:

(a) Geometrical Isomers:



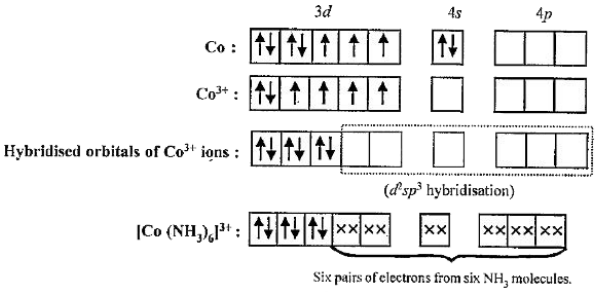
cis-Isomer (Optically active)



trans-Isomer (Optically inactive)

(b) Example of an ambidentate ligand: NO_2^- (Nitrito-N or Nitrito-O) or SCN^- (Thiocyanato or Isothiocyanato).

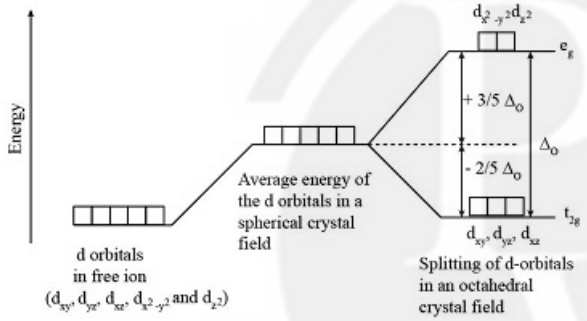
Q31 Text Solution:



Hybridization : d^2sp^3 (Inner orbital complex).
Geometry : Octahedral.
Magnetic Character : Since all electrons are fully paired up (n = 0), the complex is Diamagnetic.

Q32 Text Solution:

(a) Splitting Diagram :



(b) When Δ_0 < P (Weak field/High spin complex), the splitting energy is less than the pairing energy. The fourth electron avoids pairing penalties by populating the higher energy e_g shell, yielding a configuration of $t_{2g}^3 e_g^1$.

Q33 Text Solution:

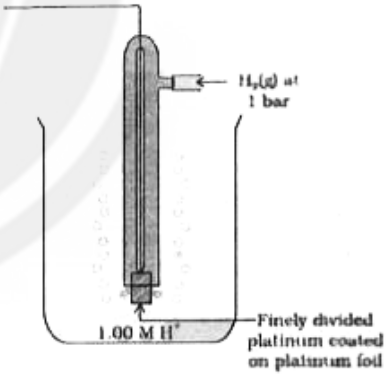
(a) Reverse Osmosis : If a hydrostatic pressure greater than the characteristic osmotic pressure is exerted directly onto the more concentrated solution side, pure solvent molecules reverse direction and cross back through the semi-permeable membrane toward the dilute side.

- **Application :** Used widely in the desalination of seawater to produce drinking water.

(b) Henry's Law : At a constant temperature, the solubility of a gas dissolved inside a liquid medium scales directly with the partial pressure exerted by that specific gas over the liquid boundary. ($P = K_H.x$)

Q34 Text Solution:

A glass jacket immersed inside an aqueous 1 M HCl solution at 298 K. Pure Hydrogen gas is continually bubbled through at a pressure of 1bar over a platinum plate coated with platinum black.



- **Half-cell reaction:**
  $2H^+_{(aq)} + 2e^- \rightleftharpoons H_{2(g)}$

Q35 Text Solution:

- Anodic Reaction: Metallic iron is oxidized to ferrous state:
  $2\,Fe_{(s)} \rightarrow 2\,Fe^{2+}$
  $+ 4e^- \quad \left(E^\circ_{Fe^{2+}/Fe^\circ} = -0.44\ V\right)$

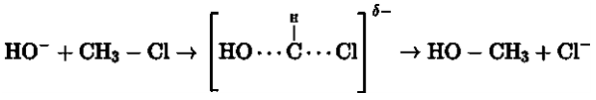
- Cathodic Reaction: Dissolved oxygen gas is reduced in an acidic environment created by dissolved CO_2 : $O_{2(g)} + 4H^+_{(aq)} + 4e^- \rightarrow 2H_2O_{(l)} \quad (E^\circ = 1.23\ V)$
- Overall Net Cell Reaction: $2\,Fe_{(s)} + O_{2(g)} + 4H^+_{(aq)} \rightarrow 2\,Fe^{2+}_{(aq)} + 2H_2O_{(l)}$

Q36 Text Solution:

- Consider a generalized zero-order chemical reaction: R → P
- By definition, the instantaneous reaction velocity is independent of the reactant concentration: $\text{Rate} = -\frac{d[R]}{dt} = k[R]^0 = k$
- Rearranging the differential expression: d[R] = –k.dt
- Integrating both sides of the equation: $\int d[R] = -k \int dt \Rightarrow [R] = -kt + I - (\text{Equation } 1)$
- Where I represents the integration constant. To compute I, evaluate at initial time conditions (t = 0), where [R] = $[R]_0$: $[R]_0 = -k(0) + I \Rightarrow I = [R]_0$
- Substituting the value of I back into Equation 1: $[R] = -kt + [R]_0$
- Rearranging to isolate the velocity constant (k) gives the integrated rate expression: $k = \frac{[R]_0 - [R]}{t}$

Q37 Text Solution:

(a) **Mechanism (S_N2):** Methyl chloride reacts via a single-step bimolecular nucleophilic substitution mechanism. The incoming hydroxide ion nucleophile attacks the electrophilic carbon from the rear side, opposite to the chlorine leaving group, forming a pentacoordinate transition state.



- Reaction Order: 2nd Order (Kinetic rate = $k[CH_3Cl][OH^-]$).

(b) (1) Fitting Reaction: Produces Diphenyl(C_6H_5 –C_6H_5)

(2) Halogen Addition: Yields 1, 2-Dibromoethane (CH_2Br –CH_2Br).

Q38 Text Solution:

(a) Mechanism Steps:

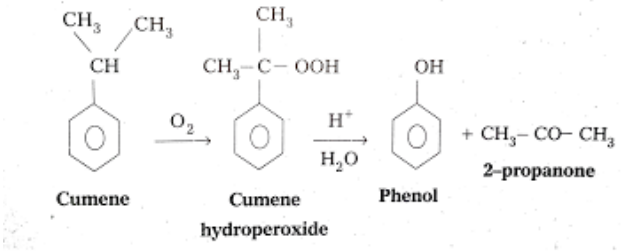
- Step 1: Protonation of ethanol to form oxonium ion: $CH_3\,CH_2\,OH + H^+ \rightleftharpoons CH_3\,CH_2 - \overset{+}{O}H_2$
- Step 2: Carbocation formation (Slow rate-determining step): $CH_3\,CH_2 - \overset{+}{O}H_2 \rightleftharpoons CH_3\overset{+}{C}H_2 + H_2O$
- Step 3: Deprotonation to eliminate a proton and yield ethene: $H - CH_2 - \overset{+}{C}H_2 \rightarrow CH_2 = CH_2 + H^+$

(b) Lucas Reagent: A solution of equimolar anhydrous $ZnCl_2$ and concentrated HCl.

- Alcohol behavior: Primary alcohols do not produce turbidity at room temperature unless heated.

Q39 Text Solution:

(a) Cumene Process equations: Cumene (isopropylbenzene) undergoes auto-oxidation to form cumene hydroperoxide, which is then decomposed with dilute acid to produce phenol and acetone.



(b) Zinc Reduction: $C_6H_5OH + Zn \rightarrow C_6H_6$ (Benzene) + ZnO.

(c) Williamson's Synthesis : Sodium methoxide undergoes an S_N2 nucleophilic substitution reaction with methyl chloride to yield methoxymethane.

$$CH_3\ ONa + CH_3\ Cl \rightarrow CH_3 - O - CH_3 (Methoxymethane) + NaCl$$

Q40 Text Solution:

(a) Methanal reacts with hydroxylamine (NH_2OH) via a condensation process to form formaldoxime gas and water.

$H_2C = O + H_2N - OH \quad H_2C = N - OH$ (Formaldoxime) + H_2O

(b) Wolff-Kishner Reduction Identification:

- A = Acetone hydrazone ($(CH_3)_2C = N - NH_2$).
- B = Propane ($CH_3 - CH_2 - CH_3$).

(c) Reagent: Tollens' reagent (Ammoniacal silver nitrate solution) or Fehling's solution. (Aldehydes reduce these reagents while ketones do not).

Q41 Text Solution:

(a) 1. Grignard Carboxylation Equation:

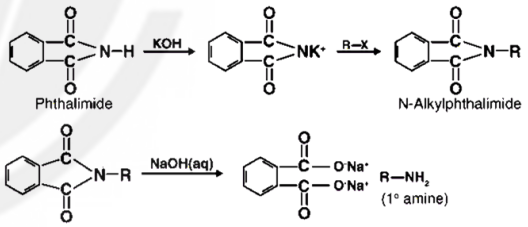
$$CH_3MgI + O = C = O \xrightarrow{\text{dry ether}} \left[CH_3 - \overset{O}{\overset{\|}{C}} - OMgI\right] \xrightarrow{H_3O^+} CH_3\ COOH\left(A\right) + Mg\left(OH\right)I$$

2. IUPAC name of Compound A: Ethanoic acid.

(b) Monochloroacetic acid is significantly more acidic than pure acetic acid. The highly electronegative chlorine atom exerts a powerful electron-withdrawing inductive effect (–I effect), which disperses the negative charge of the conjugate base and stabilizes the carboxylate anion, favoring proton release.

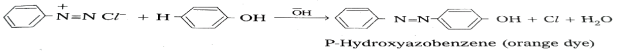
Q42 Text Solution:

(a) Gabriel Phthalimide Steps: Phthalimide reacts with ethanolic KOH to form potassium phthalimide, which is alkylated with methyl chloride and then hydrolyzed to yield methanamine.



R=CH_3

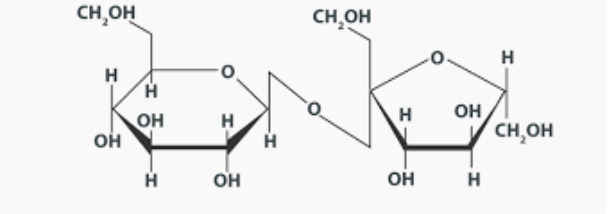
(b) Diazonium Coupling Reaction: Benzenediazonium chloride couples with phenol at the para position in a mildly basic environment (pH 9–-10) to form p-hydroxyazobenzene, an orange azo dye.



$$C_6H_5 - N_2^+\ Cl^- + H - C_6H_4 - OH \xrightarrow{OH^-} C_6H_5 - N = N - C_6H_4 - OH (p - hydroxyazobenzene) + HCl$$

Q43 Text Solution:

(a) Haworth Structure representation: Sucrose contains an α-D-glucopyranose ring coupled via a glycosidic C_1 – O – C_2 link to a β-D-fructofuranose ring.



Sucrose

(b) 1. Essential amino acids are those that cannot be synthesized by the human body and must be acquired through dietary intake.

2. Example: Keratin (found in hair/nails) or myosin (found in muscles).

(c) Base: Thymine.

Q44 Text Solution:

Mass of Benzene (w_1) = 30 g

Mass of Carbon Tetrachloride (w_2) = 100 - 30 = 70 g

$$\text{Moles of Benzene } (n_1) = \frac{\text{Mass}}{\text{Molar Mass}}$$

$$= \frac{30\text{ g}}{78\text{ g/mol}} = 0.3846\text{ mol}$$

$$\text{Moles of } CCl_4 (n_2) = \frac{70\text{ g}}{154\text{ g/mol}} = 0.4545\text{ mol}$$

Calculate Mole Fraction ($x_{benzene}$):

$$x_{benzene} = \frac{n_1}{n_1+n_2} = \frac{0.3846}{0.3846+0.4545} = \frac{0.3846}{0.8391} = 0.458$$

Q45 Text Solution:

- O Mass of solute (w_B) = 1g
- Mass of solvent benzene (w_A) = 50g
- Depression in freezing point (ΔT_f) = 0.4K
- Cryoscopic constant (K_f) = 5.12 K kg mol^{-1}

Formula: $\Delta T_f = \frac{K_f \cdot w_B \cdot 1000}{M_B \cdot w_A}$

$$M_B = \frac{5.12 \cdot 1.00 \cdot 1000}{0.40 \cdot 50} = \frac{5120}{20} = 256\text{ g/mol}$$

Q46 Text Solution:

n = 2 electrons transferred.

$$E_{cell} = E^\circ_{cell} - \frac{0.0591}{n}\log\frac{[Ni^{2+}]}{[Ag^+]^2}$$

$$\frac{[Ni^{2+}]}{[Ag^+]^2} = \frac{0.160}{(0.002)^2} = \frac{0.160}{4\times10^{-6}} = 40,000 = 4 \times 10^4$$

$$\log(4\times10^4) = \log 4 + \log 10^4 = 0.6021 + 4 = 4.6021$$

$$E_{cell} = 1.05 - \left(\frac{0.0591}{2} \times 4.6021\right) = 1.05 - (0.02955 \times 4.6021)$$

$$E_{cell} = 1.05 - 0.136 = 0.914\text{ V}$$

Q47 Text Solution:

Current (I) = 1.5 A, Time (t) = 10 × 60 = 600 seconds

$$Q = I \cdot t = 1.5 \times 600 = 900\text{ Coulombs}$$

Cathode conversion:

$$Cu^{2+} + 2e^- \rightarrow Cu_{(s)}\ (n=2)$$

$$\text{Mass}(w) = \frac{\text{Molar Mass} \cdot Q}{n \cdot F}$$

$$= \frac{63\cdot900}{2\cdot96487} = \frac{56700}{192974} = 0.2938\text{ g}$$

Q48 Text Solution:

Initial amount ($[R]_0$) = 5 g

Final amount ([R]) = 3 g

Rate constant (k) = 1.15×10^{-3} s^{-1}

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

$$\log\frac{5}{3} = \log(1.667) = 0.2218$$

$$t = \frac{2.303}{1.15\times10^{-3}} \times 0.2218$$

$$= 2002.6 \times 0.2218 = 444.18\text{ seconds}$$

Q49 Text Solution:

given

$$T_1 = 293\text{ K}, T_2 = 313\text{ K}, \frac{k_2}{k_1} = 4, R = 8.314\text{ J K}^{-1}\text{ mol}^{-1}.$$

$$\log\frac{k_2}{k_1} = \frac{E_a}{2.303\cdot R}\left[\frac{T_2-T_1}{T_1\cdot T_2}\right]$$

$$\log(4) = \frac{E_a}{2.303\times8.314}\left[\frac{313-293}{293\times313}\right]$$

$$0.6021 = \frac{E_a}{19.147}\left[\frac{20}{91709}\right]$$

$$0.6021 = E_a \times 1.139 \times 10^{-5}$$

$E_a = \frac{0.6021}{1.139\times10^{-5}} = 52862 \text{ J/mol} = 52.86 \text{ kJ/mol}$