PART – I

1. (b)
2. (a)
3. (d)
4. (c)
5. (c)
6. (c)
7. (c)
8. (b)
9. (c)
10. (d)
11. (b)
12. (c)
13. (d)
14. (a)
15. (c)

PART – II

16. Method of Bleaching powder preparation: -
- Dry slaked lime is spread in chambers.
- Dry chlorine gas is passed over it at about 303 K.
- Bleaching powder is formed as a white powder.

17. <u>d-block elements: -</u>
- (i) Tungsten (W)
- (ii) Ruthenium (Ru)

These elements have their last electron entering the d-subshell.
<u>f-block elements: -</u>
- (iii) Promethium (Pm)
- (iv) Einsteinium (Es)

18. (i) $[Cr(H_2O)_6]Cl_3$
(All 6 water molecules are coordinated to Cr^{3+})
(ii)$[Cr(H_2O)_5Cl]Cl_2H_2O$
(5 water molecules and 1 Cl^- coordinated; 1 water outside)

19. Number of close-packed spheres = 6
<u>Calculations: -</u>
- Octahedral voids = 6
- Tetrahedral voids = $2 \times 6 = 12$

20. Lewis Acid: -
A Lewis acid is a substance that accepts an electron pair.
Example: -
- $AlCl_3$ (Aluminium chloride) – accepts an electron pair
- H^+ (also a Lewis acid)

Lewis Base: -
A Lewis base is a substance that donates an electron pair.
Example: -
- NH_3 (Ammonia) – donates a lone pair of electrons
- OH^- (Hydroxide ion)

21. Butter is an example of a water-in-oil (W/O) emulsion.
- Dispersed phase: -Water
- Dispersion medium: -Fat (oil)

22. Catalyst used in Rosenmund reduction:
Palladium on barium sulphate ($Pd/BaSO_4$)
Importance of the catalyst:

- The catalyst is poisoned (often with sulfur or quinoline) to reduce its activity.
- This controlled activity ensures that acid chlorides are reduced only to aldehydes and not further to alcohols.

Thus, $Pd/BaSO_4$ helps in the selective preparation of aldehydes from acid chlorides.

23. Chloropicrin (Trichloronitromethane, CCl_3NO_2) is prepared by the action of bleaching powder on nitromethane.

Preparation: -

When nitromethane (CH_3NO_2) is treated with bleaching powder ($Ca(OCl)Cl$), chloropicrin is formed.

Chemical equation: -

$$CH_3NO_2 + 3Cl_2 \xrightarrow{\text{bleaching powder}} CCl_3NO_2 + 3HCl$$

24. In ethers, the C–O–C bond angle is slightly greater than the tetrahedral angle (109.5°) due to lone pair–bond pair repulsion on the oxygen atom.

Explanation: -

- Oxygen in ethers is sp^3 hybridized and has two lone pairs.
- Lone pair–lone pair and lone pair–bond pair repulsions are stronger than bond pair–bond pair repulsions.
- To minimize these repulsions, the C–O bonds spread apart, increasing the C–O–C bond angle slightly beyond 109.5° (≈ 111°).

PART – III

25. Chromyl Chloride Test (Test for Chloride ion, Cl^-)

Principle: -

When a chloride salt is heated with potassium dichromate ($K_2Cr_2O_7$) and concentrated sulphuric acid, red fumes of chromyl chloride (CrO_2Cl_2) are produced.

Procedure: -

- Take a small amount of the dry chloride salt.
- Add solid $K_2Cr_2O_7$.
- Add a few drops of conc. H_2SO_4.
- Heat the mixture gently.

Observation: -

- Red-brown vapours of chromyl chloride evolved.

Chemical reactions: -

(i)Formation of chromyl chloride: -

$4NaCl+K_2Cr_2O_7+6H_2SO_4 \rightarrow 2CrO_2Cl_2+2KHSO_4+4NaHSO_4+3H_2O$

(ii) Confirmation: -

- The vapours are absorbed in NaOH forming yellow sodium chromate.
- On adding lead acetate, a yellow precipitate of $PbCrO_4$ confirms chloride.

26. $[Sc(H_2O)_6]^{3+}$ is colourless because Sc^{3+} has no d–d electronic transitions.

Explanation: -

- Scandium (Z = 21) has electronic configuration:

Sc: $[Ar]3d^14s^2$

- In the Sc^{3+} ion, all three valence electrons are lost:

Sc^{3+}: $[Ar]3d^0$

- Since d-orbitals are empty (d^0 configuration), d–d transitions are not possible.
- Without absorption of visible light, the complex appears colourless.

Hence, $[Sc(H_2O)_6]^{3+}$ is colourless.

27. Derivation of Henderson (Henderson–Hasselbalch) Equation

Consider an acidic buffer consisting of a weak acid (HA) and its salt (NaA).

Step 1:- Ionization of weak acid

$HA \rightleftharpoons H^+ + A^-$

The acid dissociation constant is: -

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

Step 2: - Rearranging

$$[H^+] = K_a \frac{[HA]}{[A^-]}$$

Step 3: - Taking logarithm (base 10)

$$\log[H^+] = \log K_a + \log\frac{[HA]}{[A^-]}$$

Step 4: -Convert to pH and pKa

$$-\log[H^+] = -\log K_a + \log\frac{[A^-]}{[HA]}$$

Since: -

$$pH = -\log[H^+], pK_a = -\log K_a$$

$$\boxed{pH = pK_a + \log\frac{[\text{ Salt }]}{[\text{ Acid }]}}$$

28. Cathodic Protection Method: -

In the cathodic protection method, the metal to be protected is made the cathode of an electrochemical cell, so it does not undergo oxidation and hence does not corrode.

There are two ways to achieve this:

(i). Sacrificial Anode Method: -

- A more reactive metal such as zinc, magnesium, or aluminium is attached to the metal to be protected (e.g., iron).
- The attached metal acts as the anode and gets oxidized (corrodes) instead of the protected metal.

Example: -

Iron pipes connected to zinc blocks.

$Zn \rightarrow Zn2{+}{+}2e-$

Thus, iron remains protected.

(ii). Impressed Current Method: -

- The metal to be protected is connected to the negative terminal of an external DC power source.
- An inert anode (graphite or platinum) is used.
- The supplied electrons prevent oxidation of the metal.

29. As_2S_3 (Arsenic sulphide sol): - Irregular or amorphous. The particles are generally not spherical and lack a specific geometric shape.

Blue gold sol: - Disc-shaped or larger spherical. Gold sols can be red (spherical, small particles) or blue/purple (larger spherical or disc-shaped particles). The user specified "blue" gold sol, which indicates the non-spherical or larger spherical shape.

Tungstic acid sol: - Platelike. The colloidal particles of tungstic acid have a plate-like shape and can form long-range-ordered structures. They may also be described as having various irregular or amorphous shapes depending on the preparation method.

30. Formic acid reduces Tollen's reagent, whereas acetic acid does not, due to their different oxidation behaviour.

Explanation: -

- Formic acid (HCOOH) contains a hydrogen atom directly attached to the carbonyl carbon.

It behaves like an aldehyde in reactions and is easily oxidized to CO_2.

$HCOOH \rightarrow CO_2 + 2H^+ + 2e^-$

- During this oxidation, Ag^+ ions in Tollen's reagent are reduced to metallic silver, giving the silver mirror test.
- Acetic acid (CH_3COOH) does not have such a hydrogen attached to the carbonyl carbon.

It is already relatively stable and not easily oxidized, so it cannot reduce Tollen's reagent.

Conclusion: -

- Formic acid reduces Tollen's reagent because it can be oxidized.
- Acetic acid does not reduce Tollen's reagent because it resists oxidation.

31. Proteins are classified on the basis of their structure (shape) into two main types:

(i). Fibrous Proteins: -

- Have long, thread-like or rod-shaped structures.
- Generally insoluble in water.
- Provide structural support and strength.

Examples: -

- Keratin – present in hair, nails, skin
- Collagen – found in connective tissues
- Myosin – present in muscles

(ii). Globular Proteins: -

- Have a compact, spherical shape.

- Generally soluble in water.
- Perform biological functions such as catalysis and transport.

Examples: -
- Enzymes
- Hemoglobin
- Insulin
- Albumin

Conclusion: -
- Fibrous proteins → structural role
- Globular proteins → functional role

32. Any three advantages of food additives are:

(i) Increase shelf life: – Prevent spoilage by inhibiting the growth of microorganisms.
(ii) Improve taste and flavour: – Enhance or maintain the flavour and palatability of food.
(iii) Improve appearance: – Add or restore colour, making food more attractive.

33. The decrease in ionisation enthalpy from Aluminium (Al) to Thallium (Tl) is only marginal due to the poor shielding effect of d and f electrons.

Explanation: -
- As we move down Group 13 (Al → Ga → In → Tl), the atomic size increases, which should normally cause a significant decrease in ionisation enthalpy.
- However, in Ga, In, and Tl, filled d (and f in Tl) orbitals are present.
- d- and f-electrons shield the nuclear charge very poorly, so the effective nuclear charge experienced by the outermost electron increases.
- This increased nuclear attraction offsets the effect of increased atomic size.

Conclusion: -
Because of poor shielding by d- and f-electrons, the ionisation enthalpy of Tl does not decrease much compared to Al, resulting in only a marginal difference.

PART – IV

34. (a) Zone refining is a method used to obtain ultra-pure metals (purity ≈ 99.9999%), especially semiconductors.

Principle: -
Impurities are more soluble in molten metal than in the solid state.

Process: -
- A rod of impure metal (e.g., Si, Ge, Ga) is taken.
- A narrow circular heater is passed slowly along the length of the rod.
- The metal melts only in a small zone.
- Impurities concentrate in the molten zone.
- As the heater moves forward, the molten zone carries impurities to one end of the rod.
- The impure end is cut off, leaving behind pure metal.

Diagram idea (for exam): -
Rod → Moving heater → Molten zone → Impurities collected at one end

Uses: - Purification of silicon and germanium used in transistors, diodes, and ICs.

Conclusion: - Zone refining gives very high purity metals based on the difference in solubility of impurities in solid and molten states.

(b) (i) Catenation is the property of an element to form covalent bonds with itself, producing chains or rings.
Two conditions for catenation are: -

(I) High bond energy of element–element bond: - The bond between identical atoms (e.g., C–C) must be strong so that chains are stable.

(II) Small atomic size: - Smaller atoms form stronger covalent bonds, fevering self-linking.

(ii) Hydrofluoric acid (HF) cannot be stored in glass bottles because it reacts with glass.

Explanation: - Glass is mainly composed of silicon dioxide (SiO_2).
- HF reacts with SiO_2, forming silicon tetrafluoride (SiF_4) or hex fluorosilicic acid (H_2SiF_6), which corrodes the glass.

Chemical reactions: -

$$SiO_2+4HF \rightarrow SiF_4+2H_2O$$

(or)

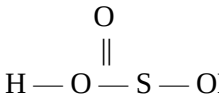
$$SiO_2+6HF \rightarrow H_2SiF_6+2H_2O$$

Conclusion: - Since HF dissolves glass, it is stored in plastic or wax-lined containers, not glass.

35. (a) (i) Here are the details for the two acids: -

(I). Sulphurous Acid: -

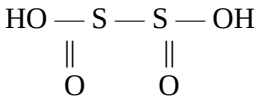
- Molecular formula: H_2SO_3
- Structure:



- Sulphurous acid is weak and unstable, usually exists only in aqueous solution.

(II). Marshall's Acid: -

- Molecular formula: $H_2S_2O_5$ (also called disulphurous acid or pyrosulphurous acid)
- Structure:



It is the acid form of metabisulphites, used as a reducing agent in bleaching and photography.

(ii) The IUPAC names are (A) Diamminesilver(I) ion for [Ag(NH3)2]+ and (B) Pentaamminechloridocobalt(III) ion for [Co(NH3)5Cl]2+. Both are complex ions, naming ligands alphabetically (ammine before chloro) and indicating the metal's oxidation state in Roman numerals.

(A) $[Ag(NH_3)_2]^+$:-

- Ligands: Two NH_3 (ammine).
- Metal: Silver (Ag).
- Charge: +1.
- Name: Diamminesilver(I) ion

(B) $[Co(NH_3)_5Cl]^{2+}$:-

- Ligands: Five NH_3 (ammine) and one Cl (chloro).
- Metal: Cobalt (Co).
- Charge: +2 (Cobalt is +3, as 5 neutral ammines + 1 chloride (-1) = +2).
- Name: Pentaamminechloridocobalt(III) ion

OR

(b) (i) The magnetic moment for $[CoF_6]^{3-}$ is approximately 4.90 BM, and the complex is paramagnetic.

Step 1:- Determine Cobalt oxidation state and configuration

The oxidation state of Cobalt (Co) in the complex ion $[CoF_6]^{3-}$ is determined by the overall charge and the charge of the fluoride ligands (F^-)Each fluoride ion has a charge of -1.

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

Thus, the cobalt ion is Co^{3+} . The electron configuration of neutral Co is $[Ar]3d^74s^2$ For Co^{3+} the 4s electrons are lost first, then one 3d electron, resulting in a configuration of $[Ar]3d^6$

Step 2:-Determine number of unpaired electrons

Fluoride (F^-) is a weak field ligand, which causes high spin complexes in octahedral fields. The crystal field splitting energy ($\boldsymbol{\Delta_\rho}$) is less than the pairing energy (P), so electrons occupy all available orbitals singly before pairing up. The 6d-electrons are filled into the t_{2g} and e_g orbitals as follows: three electrons in $t_{2g'}$ two in $e_{g'}$ and the final electron pairs in t_{2g°

The electron configuration is $(t_{2g})^4(e_g)^2$, leading to $n = 4$ unpaired electrons.

Step 3: - Calculate magnetic moment and determine property

The spin-only magnetic moment (μ_s) is calculated using the formula $\mu_s = \sqrt{n(n+2)}$, where n is the number of unpaired electrons. With $n = 4$:-

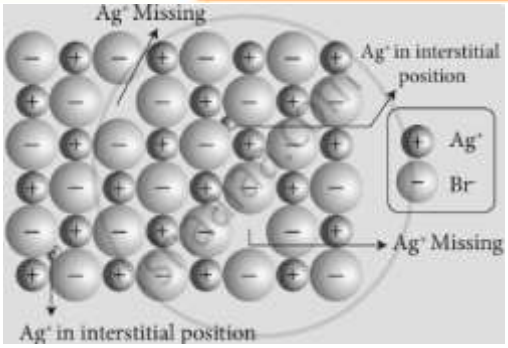
$\mu_s = \sqrt{4(4+2)} = \sqrt{24} \approx 4.90BM$

Since there are unpaired electrons, the complex is paramagnetic.

The magnetic moment is approximately 4.90 BM (Bohr magnetons), and the complex is paramagnetic.

(ii) Frenkel defect arises due to the dislocation of ions from its crystal lattice. The ion which is missing from the lattice point occupies an interstitial position. This defect is shown by ionic solids in which cation and anion differ in size.

Unlike Schottky defect, this defect does not affect the density of the crystal. For example AgBr , in this case, a small Ag^+ion leaves its normal site and occupies an interstitial position as shown in the figure.



Frenkel Defect

36. **(a)** Derivation of Integrated Rate Law for a First-Order Reaction

Consider a first-order reaction:

$A \rightarrow$ Products

Let $[A] =$ concentration of A at time t

$[A]_0 =$ initial concentration of A

Step 1: Rate law for first-order reaction

$$\text{Rate} = -\frac{d[A]}{dt} = k[A]$$

Where $\mathbf{k}$ = rate constant $(\mathbf{s^{-1}})$.

Step 2: Separate variables

$$\frac{d[A]}{[A]} = -kdt$$

Step 3: Integrate

Integrate both sides from $t = 0$ to $t = t$ and $[A] = [A]_0$ to $[A] = [A]$:

$$\int_{[A]_0}^{[A]} \frac{d[A]}{[A]} = -\int_0^t kdt$$

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

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

Step 4: Express in convenient form

$$[A] = [A]_0 e^{-kt}$$

or in logarithmic form:

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

$$\text{or } \log_{10}[A]_0 - \log_{10}[A] = \frac{kt}{2.303}$$

Step 5: Half-life for first-order reaction

The half-life $(t/2)$ is the time when $[A] = [A]_0/2$:

$$t_{1/2} = \frac{0.693}{k}3$$

(b) (i) Here are the approximate pH values for the requested substances: -

- Vinegar: pH 2-3. It is an acidic substance.
- Black coffee: pH 4.5-5.5. It is a weak acid.
- Baking soda: pH 8-9. When dissolved in water, it forms a slightly alkaline (basic) solution.
- Soapy water: pH 9-12. It is a basic (alkaline) substance.

(ii) Given: -

- Distance between electrodes: $l = 1.5\ cm = 0.015\ m$
- Cross-sectional area of electrodes: $A = 4.5\ cm^2 = 4.5 \times 10^{-4}\ m^2$
- Resistance: $R = 15\Omega$

Formula for specific conductance (κ):

$$\kappa = \frac{1}{R} \cdot \frac{l}{A}$$

Where: -

- $l =$ distance between electrodes (m)
- $A =$ area of cross-section (m^2)

- R = resistance (Ω)

Step 1: Convert units

- Already done: $l = 0.015\ m, A = 4.5 \times 10^{-4}\ m^2$

Step 2: Substitute values

$$\kappa = \frac{1}{R} \cdot \frac{l}{A} = \frac{1}{15} \cdot \frac{0.015}{4.5 \times 10^{-4}}$$

Step 3: Calculate fraction

(1). Calculate $\frac{0.015}{4.5 \times 10^{-4}}$:

$$\frac{0.015}{0.00045} = 33.33$$

(2). Divide by 15:

$$\kappa = \frac{33.33}{15} \approx 2.22\ S/m$$

37. (a) (i) Physisorption involves weak Van der Waals forces, is reversible, non-specific, and forms multi-layers at low temperatures with low heat of adsorption; while chemisorption involves strong chemical bonds, is often irreversible, specific, forms uni-layers at high temperatures, and has a high heat of adsorption.

Here are three key differences: -

(1). Nature of Forces & Layer: Physisorption is due to weak Van der Waals forces, allowing multiple layers (multi-molecular) to form, whereas chemisorption involves strong chemical bonds (covalent/ionic) forming only a single layer (uni-molecular).

(2). Temperature Dependence: Physisorption decreases with increasing temperature (favors low temp), while chemisorption often increases with temperature (favors high temp) as it needs activation energy for bond formation.

(3). Specificity & Reversibility: Physisorption is non-specific and easily reversible, while chemisorption is highly specific (depends on chemical nature) and often irreversible.

(ii) Vulcanization is a chemical process, most famously involving heating rubber with sulfur, that creates strong cross-links between polymer chains, transforming soft, sticky raw rubber into a durable, elastic, and heat-resistant material used for tires,
hoses, and more. This process improves rubber's strength, elasticity, and resistance to swelling and abrasion, making it suitable for a wide range of applications.

Key Aspects: -

- Process: Raw rubber (natural or synthetic) is mixed with sulfur and other additives, then heated.
- Chemical Reaction: Sulfur atoms form bridges (cross-links) between the long rubber molecules, creating a more stable network.
- Benefits: The resulting vulcanized rubber is much stronger, more elastic, less temperature-sensitive, and more resistant to chemicals and wear.
- Origin: Named after Vulcan, the Roman god of fire, by Charles Goodyear, who discovered the process.
- Applications: Essential for making tires, seals, belts, and bonding rubber to metal.

OR

(b)(i) Coupling Reaction of Phenol

Phenol can undergo azo coupling reaction with diazonium salts to form azo dyes.

Reaction with Diazonium Salt: -

- Phenol acts as a coupling component because the $-OH$ group activates the benzene ring toward electrophilic substitution (especially at ortho and para positions).

General Reaction: -

$$C_6H_5OH + ArN_2^+Cl^- \rightarrow \text{p-Hydroxyazobenzene} + HCl$$

Example: Coupling with Benzene Diazonium Chloride

$$C_6H_5OH + C_6H_5\ N_2^+Cl^- \rightarrow p - HO - C_6H_4 - N = N - C_6H_5 + HCl$$

- The azo group ($-N = N-$) links the two aromatic rings.
- Product is p-hydroxyazobenzene, a colored compound.

Key Points: -

(1). Coupling occurs mainly at the para position of phenol.

(2). Reaction is performed in alkaline medium.

(3). Used in the synthesis of azo dyes.

(ii) Both propan-1-ol and propan-2-ol can be prepared by reacting a suitable Grignard reagent with an appropriate carbonyl compound, followed by acid hydrolysis.

(a) Preparation of Propan-1-ol: -

Propan-1-ol is a primary alcohol and can be prepared by reacting ethyl magnesium bromide (CH_3CH_2MgBr) (or another 2-carbon Grignard reagent) with formaldehyde (HCHO) (methanal), the simplest aldehyde. Alternatively, reacting methyl magnesium bromide (CH_3MgBr) with ethylene oxide followed by hydrolysis yields propan-1ol.

Step 1: - Reaction of ethyl magnesium bromide with formaldehyde in dry ether to form an intermediate adduct (magnesium alkoxide).

$$CH_3CH_2MgBr + HCHO \xrightarrow{\text{dry ether}} CH_3CH_2CH_2OMgBr$$

Step 2: -Acid hydrolysis of the intermediate to yield propan-1-ol.

$$CH_3CH_2CH_2OMgBr + H_2O \xrightarrow{H^+} CH_3CH_2CH_2OH + Mg(OH)Br$$

(b) Preparation of Propan-2-ol: -

Propan-2-ol is a secondary alcohol and can be prepared by reacting methyl magnesium bromide (CH_3MgBr) (or another 1-carbon Grignard reagent) with acetaldehyde (CH_3CHO) (ethanal). It can also be prepared by reacting ethyl magnesium bromide with an appropriate carbonyl compound, but the methyl magnesium bromide and acetaldehyde route is the standard approach for this specific product.

Step 1: - Reaction of methyl magnesium bromide with acetaldehyde in dry ether to form an intermediate adduct.

$$CH_3CH_2MgBr + HCHO \xrightarrow{\text{dry ether}} CH_3CH_2CH_2OMgBr$$

Step 2: - Acid hydrolysis of the intermediate to yield propan-2-ol.

$$CH_3CH_2CH_2OMgBr + H_2O \xrightarrow{H^+} CH_3CH_2CH_2OH + Mg(OH)Br$$

38. (a)(i) Formalin Definition: -

Formalin is an aqueous solution of formaldehyde (HCHO) in water, usually containing 37-40% formaldehyde by weight, often stabilized with 2-3% methanol to prevent polymerization.

$$\text{Formalin} = HCHO\ (aq.) + H_2O + CH_3OH\ (\text{stabilizer})$$

Uses of Formalin: -

(1). Preservative / Disinfectant

- Used to preserve biological specimens and in medical laboratories.

(2). Manufacture of resins

- Used in making Bakelite, urea-formaldehyde, and phenol-formaldehyde resins.

(3). Sterilization

Acts as a disinfectant in hospitals and laboratories.

(4). Treatment of drinking water (small amounts)

- Helps prevent microbial growth.

Key Point: -

Formalin is not the same as pure formaldehyde; it is formaldehyde in aqueous solution.

(ii) A glycosidic linkage (or bond) is a strong covalent bond that connects a carbohydrate (sugar) molecule to another atom or molecule, often another sugar, forming disaccharides (like sucrose, maltose) or polysaccharides (like starch, cellulose). It forms 'via a' dehydration reaction, where a water molecule (H_2O) is removed, linking two sugar units through an oxygen atom.

Key Characteristics: -

- Formation: A hydroxyl (-OH) group from one sugar reacts with the anomeric carbon (the hemiacetal/hemiketal carbon) of another sugar, losing water.
- Type: It's essentially an ether linkage ($C-O-C$) between carbohydrate units.
- Function: It's crucial for building larger carbohydrates (oligosaccharides and polysaccharides) and attaching sugars to non-sugar molecules (forming glycosides).

Examples: -

- Maltose: Two glucose units joined by an alpha-glycosidic bond.
- Sucrose: Glucose and fructose linked by a glycosidic bond.
- Glycogen: Glucose units linked by both alpha-1,4 and alpha-1,6 glycosidic bonds.

OR

(b) (i) The Gomberg reaction (or Gomberg-Bachmann reaction) is a basepromoted radical coupling where an arene (like benzene) reacts with an aryl diazonium salt to form a biaryl (two linked aromatic rings), proceeding via an aryl radical intermediate. Discovered by Moses Gomberg, this reaction provided early evidence for organic

free radicals and is used to synthesize complex aromatic compounds, though it often yields low amounts due to side reactions.

How it works (Mechanism): -

(1). Initiation (Diazonium Salt Decomposition): An arenediazonium salt ($Ar - Na_2 + Cl^-$) is treated with a base (like NaOH) in the presence of an arene (like benzene). The base helps decompose the diazonium salt, releasing nitrogen gas (N_2) and forming an aryl radical (Ars).

(2). Propagation (Radical Coupling): The highly reactive aryl radical then attacks the second aromatic ring (the arene), abstracting a hydrogen atom to form a new C-C bond, creating a biaryl (Ar-Ar') and regenerating another aryl radical.

(3.) Example: When benzene diazonium chloride reacts with benzene in a basic medium, biphenyl is formed.

Key Points: -

- Reactants: Arenediazonium salt + Arene + Base.
- Product: Biaryl (two aryl groups joined).
- Intermediate: Aryl radical (Ar°).
- Significance: Demonstrated the existence and reactivity of organic free radicals, a fundamental concept in organic chemistry.

(ii) Step 1: - Recognize the reagent

- $Na(Hg)/C_2H_5OH$ = Clemmensen reduction → reduces $C = O$ groups (aldehydes or ketones) to $-CH_2$ -
- 4[H] also indicate reduction
- The products have $-NH_2$ or $-NHCH_3$, so the reaction involves reductive amination: -

$R - CHO + NH_3 -> R - CH = NH -> [Na(Hg)]R - CH_2 - NH_2$

OR

$R - CHO + CH_3NH_2 -> R - CH = N - CH_3 -> [Na(Hg)]R - CH_2 - NH - CH_3$

Step 2: Identify A

$A = CH_2 - CH_2 - CH_2 - NH_2$

- This is a primary amine.
- Formed from aldehyde $+NH_3$ → Schiff base → Clemmensen reduction
- The aldehyde must have been $CH_3 - CH_2 - CHO$ (propanal)

$A =$ Propylamine $(CH_3 - CH_2 - CH_2 - NH_2)$

Step 3: Identify B

$B = CH_3 - NH - CH_3$

- This is a secondary amine, formed by reaction of an aldehyde with CH_3NH_2 (methylamine) followed by Clemmensen reduction
- The aldehyde must have been formaldehyde (H-CHO)

$H - CHO + CH_3NH_2 -> H - CH = N - CH_3 -> [Na(Hg)/C_2H_5OH]C_3 - NH - CH_3$

B = Dimethylamine ($CH_3 - NH_4 - CH_3$)