

PART - I

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

PART - II

16. Type of ore: -Sulphide ores

Examples: -Zinc blende (ZnS), Galena (PbS)

Reason: -Sulphide ores are hydrophobic and can be separated from gangue by froth flotation.

17. Uses of Silicones: -

- (i) Lubricants: Silicones are used as heat-resistant and water-repellent lubricants.
- (ii) Sealants and adhesives: Used in construction, plumbing, and electronics for sealing and bonding.
- (iii) Medical applications: Used in implants, catheters, and contact lenses because they are biocompatible.
- (iv) Waterproofing: Silicones are used to coat fabrics, glass, and concrete to make them water-repellent.
- (v) Cosmetics: Used in shampoos, skin creams, and deodorants for smooth texture and shine.
- (vi) Electrical insulation: Silicones are heat-resistant insulators in wires and electronic components.

18. - The central atom in a coordination compound is the metal atom or ion to which ligands are directly bonded through coordinate covalent bonds.

Example: In $[\text{Cu}(\text{NH}_3)_4]^{2+}$, Cu^{2+} is the central atom.

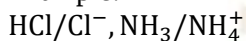
19. For a Face-Centered Cubic (FCC) unit cell: -

- Atoms at corners: $8 \text{ corners} \times 1/8 \text{ per corner} = 1 \text{ atom}$
- Atoms at faces: $6 \text{ faces} \times 1/2 \text{ per face} = 3 \text{ atoms}$
- Total atoms = $1 + 3 = 4$

20. - Conjugate acid-base pair consists of two species that differ by one proton (H^+).

- The acid donates a proton to form its conjugate base, and the base accepts a proton to form its conjugate acid.

Example: -



21. Catalytic poisons are substances that decrease or stop the activity of a catalyst by binding to its active sites.

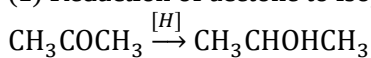
Example: -

- Lead (Pb) poisons the catalyst in catalytic converters.
- Sulfur (S) poisons platinum or nickel catalysts.

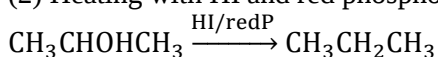
22. Acetone can be converted into propane by reduction followed by heating with HI and red phosphorus.

Steps:

(1) Reduction of acetone to isopropyl alcohol:



(2) Heating with HI and red phosphorus:



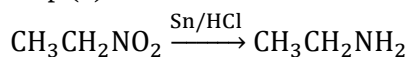
23. Hormones are chemical messengers secreted by endocrine glands that regulate body processes: -

They are transported by the blood to target organs.

Example: -

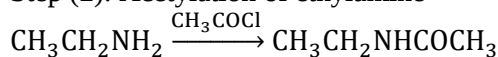
Insulin – regulates blood sugar
Thyroxine – regulates metabolism

24. Step (1): Reduction of nitroethane



Nitro group ($-\text{NO}_2$) is reduced to amine ($-\text{NH}_2$).

Step (2): Acetylation of ethylamine



Amine reacts with acetyl chloride to give acetamide derivative.

Answer:

A: $\text{CH}_3\text{CH}_2\text{NH}_2$ (ethylamine)

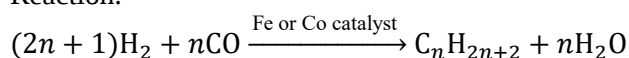
B: $\text{CH}_3\text{CH}_2\text{NHCOCH}_3$ (N-ethylacetamide)

PART - III

25. Fischer-Tropsch synthesis: -

- It is a catalytic process to convert synthesis gas ($\text{CO} + \text{H}_2$) into liquid hydrocarbons.

Reaction: -



Catalysts: Iron (Fe), Cobalt (Co)

Purpose: Production of synthetic fuels from coal, natural gas, or biomass.

26.

Property	Lanthanoids	Actinoids
(1). Electron filling	4f orbitals	5 f orbitals
(2). Occurrence	Naturally abundant	Mostly synthetic
(3). Oxidation states	Mostly +3	Multiple (+3, +4, +5, +6)

27. Given complex: $[\text{Pt}(\text{NO}_2)(\text{H}_2\text{O})(\text{NH}_3)_2]\text{Br}$

(a) Central metal atom/ion: Pt

(b) Coordination number: -

Count the number of ligands attached to Pt: NO_2 (1) + H_2O (1) + 2NH_3 (2) = 4

(c) Oxidation number of Pt: -

Let oxidation number of Pt = x

$x + (0 \text{ for } \text{H}_2\text{O}) + (0 \text{ for } \text{NH}_3) + (-1 \text{ for } \text{NO}_2) = +1 \text{ (from } \text{Br}^-)$

28. Helmholtz Electrical Double Layer: -

- When a solid electrode is placed in an electrolyte, opposite charges are attracted to the surface, forming two layers of charge.

- Inner layer: Ions adsorbed on the electrode surface.

- Outer layer: Oppositely charged ions in the solution.

- Acts like a capacitor storing charge at the interface.

29. Faraday's Laws of Electrolysis: -

(i) First Law:

- The mass of a substance deposited or liberated at an electrode is directly proportional to the quantity of electricity (Q) passed.

$$m \propto Q$$

(ii) Second Law:

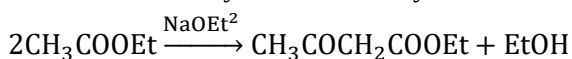
- The masses of different substances deposited or liberated by the same quantity of electricity are proportional to their chemical equivalent weights.

$$m \propto \text{Equivalent weight of substance}$$

30. Zwitterion: Molecule with both positive and negative charges but overall neutral.

Example: $\text{H}_3\text{N}^+-\text{CH}_2-\text{COO}^-$ (glycine)

31. Conversion of Ethyl acetate to Ethyl acetoacetate (Claisen condensation):



Reagent: Sodium ethoxide (NaOEt)

Reaction: Ester + Ester $\rightarrow$ β -keto ester

32. Food preservatives are substances added to food to prevent spoilage caused by microorganisms, oxidation, or chemical changes.

Examples:

(i) Sodium benzoate – prevents microbial growth in soft drinks.

(ii) Sodium nitrite – used in processed meats to prevent bacterial growth.

33. For a first-order reaction, the rate law:

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

Time for 90% completion: $[A] = 0.1[A]_0$

$$t_{90\%} = \frac{1}{k} \ln \frac{[A]_0}{0.1[A]_0} = \frac{\ln 10}{k}$$

Time for 99% completion: $[A] = 0.01[A]_0$

$$t_{99\%} = \frac{1}{k} \ln \frac{[A]_0}{0.01[A]_0} = \frac{\ln 100}{k} = \frac{2 \ln 10}{k} = 2t_{90\%}$$

Hence, $t_{99\%} = 2t_{90\%}$.

PART - IV

34. (a) Zone refining: -

- A method to purify metals by moving a molten zone along a solid metal rod.

- Impurities concentrate in the molten zone and are moved to one end of the rod.

Example:

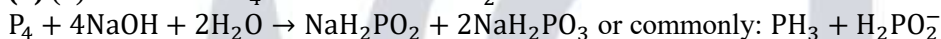
Purification of Silicon for semiconductors.

OR

(b)(i)(1). OF_2 : O = +2

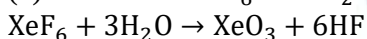
(2). I_2O_4 : I = +4

(ii) (1) Reaction of P_4 with NaOH and H_2O :



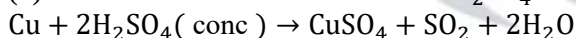
- White phosphorus reacts with hot NaOH to give phosphine (PH_3) and sodium hypophosphite (NaH_2PO_2).

(2) Reaction of XeF_6 with H_2O :



- Xenon hexafluoride reacts with water to give xenon trioxide and hydrogen fluoride.

(3) Reaction of Cu with concentrated H_2SO_4 :



35. (a)(i) Diborane (B_2H_6) structure:

- Diborane has 4 terminal H atoms and 2 bridging H atoms.

- Bridging H atoms form 3-center-2-electron (banana) bonds with two B atoms.

- Geometry:

- Terminal B-H bonds $\rightarrow$ normal 2-center-2-electron bonds

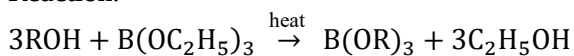
- Bridging B-H-B bonds $\rightarrow$ 3-center-2-electron bonds

- Bond angles: $\sim 120^\circ$ around B (planar B-H-B), $\sim 180^\circ$ H – B – H for terminal H

(ii) Ethyl borate test:

Purpose: To detect the presence of alcohols.

Reaction:



Observation: Fruity smell (due to formation of triethyl borate) indicates alcohol.

OR

(b) Bonding in metallic carbonyls (e.g., $\text{Fe}(\text{CO})_5$, $\text{Ni}(\text{CO})_4$):

(i) σ -bonding:

- Lone pair on C of CO donates to empty d-orbital of metal $\rightarrow \sigma$ bond.

(ii) π -back bonding:

- Filled metal d-orbitals donate electron density to π (antibonding) orbital of $CO^* \rightarrow \pi$ bond.

36. (a) (i) Schottky defect:

- Type: Vacancy defect in ionic solids.

- Description: Equal number of cation and anion vacancies; crystal remains electrically neutral.

- Example: NaCl, KCl

(ii) Frenkel defect:

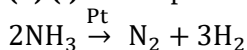
- Type: Interstitial defect in ionic solids.

- Description: Cation leaves its lattice site and occupies an interstitial site; no change in density.

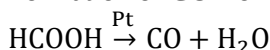
- Example: AgCl, ZnS

OR

(b) (i) Decomposition of ammonia on platinum:



Formation of CO from decomposition of formic acid on Pt:



(ii) Use of colloids in tanning of leather:

- Tanning agents like chrome salts form colloidal solution.

- These penetrate collagen fibers in hides, making leather flexible, durable, and water-resistant.

Use of colloids in rubber industry:

- Natural rubber latex is a colloidal dispersion of rubber particles in water.

- Colloidal properties help in vulcanization, coagulation, and processing of rubber products.

37. (a) For a weak acid $HA \rightleftharpoons H^+ + A^-$

- Let initial concentration = C

- Degree of dissociation = α

At equilibrium:

$$[H^+] = [A^-] = C\alpha, [HA] = C(1 - \alpha)$$

Dissociation constant:

$$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{(C\alpha)(C\alpha)}{C(1 - \alpha)} = \frac{C\alpha^2}{1 - \alpha}$$

For very weak acids ($\alpha \ll 1$):

$$K_a \approx C\alpha^2 \Rightarrow \alpha = \sqrt{\frac{K_a}{C}}$$

Ostwald's Dilution Law:

$$K_a = \frac{C\alpha^2}{1 - \alpha}$$

OR

(b) (i) - Aniline ($C_6H_5NH_2$) does not undergo Friedel-Crafts reaction because:

- The $-NH_2$ group is a strong electron-donating group.

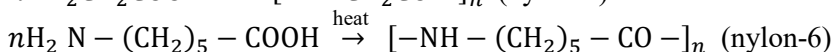
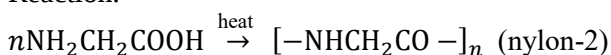
- It reacts with the Lewis acid catalyst ($AlCl_3$) forming a complex, which deactivates the ring.

(ii) Nylon-2-Nylon-6 is prepared by condensation polymerization of:

- Glycine (amino acid, NH_2CH_2COOH) $\rightarrow$ provides $-NH_2$ and $-COOH$ groups

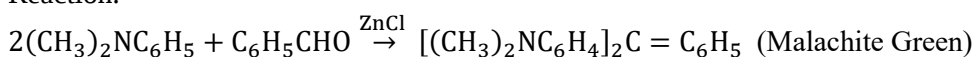
- Caprolactam (or 6-aminohexanoic acid)

Reaction: -



38. (a)(i) Malachite Green is prepared from Benzaldehyde by condensation with dimethylaniline in the presence of $ZnCl_2$ (catalyst).

Reaction: -



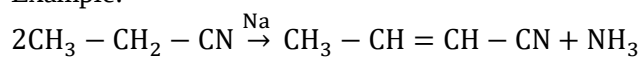
(ii) Thorpe Nitrile Condensation:

It is the base-catalyzed self-condensation of aliphatic nitriles to form α, β -unsaturated dinitriles.

Reaction:



Example:



OR

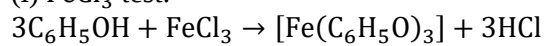
(b) A: C_6H_5OH (Phenol) - gives purple color with $FeCl_3$

B: $C_6H_5ONH_4$ (Ammonium phenoxide) - reaction with NH_3

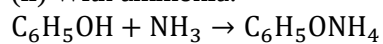
C: C_6H_6 (Benzene) - reduction with Zn

Equations: -

(i) $FeCl_3$ test: -



(ii) With ammonia: -



(iii) With zinc: -

