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 $[Cu(NH_3)_4]^{2+}$, Cu^{2+} is the central atom.

19. For a Face-Centered Cubic (FCC) unit cell: -
- Atoms at corners: 8 corners $\times$ 1/8 per corner $= 1$ atom
- Atoms at faces: 6 faces $\times$ 1/2 per face $= 3$ 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: -
$HCl/Cl^-, NH_3/NH_4^+$

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:
$CH_3COCH_3 \xrightarrow{[H]} CH_3CHOHCH_3$
(2) Heating with HI and red phosphorus:
$CH_3CHOHCH_3 \xrightarrow{HI/redP} CH_3CH_2CH_3$

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

$CH_3CH_2NO_2 \xrightarrow{Sn/HCl} CH_3CH_2NH_2$

Nitro group ($-NO_2$) is reduced to amine ($-NH_2$).
Step (2): Acetylation of ethylamine

$CH_3CH_2NH_2 \xrightarrow{CH_3COCl} CH_3CH_2NHCOCH_3$

Amine reacts with acetyl chloride to give acetamide derivative.
Answer:
A: $CH_3CH_2NH_2$ (ethylamine)
B: $CH_3CH_2NHCOCH_3$ (N-ethylacetamide)

PART - III

25. Fischer-Tropsch synthesis: -

- It is a catalytic process to convert synthesis gas $(CO + H_2)$ into liquid hydrocarbons.

Reaction: -

$(2n+1)H_2 + nCO \xrightarrow{\text{Fe or Co catalyst}} C_nH_{2n+2} + nH_2O$

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: $[Pt(NO_2)(H_2O)(NH_3)_2]Br$

(a) Central metal atom/ion: Pt
(b) Coordination number: -
Count the number of ligands attached to Pt: $NO2\ (1) + H_2O(1) + 2NH_3(2) = 4$
(c) Oxidation number of Pt: -
Let oxidation number of Pt = x
$x + (0 \text{ for } H_2O) + (0 \text{ for } NH_3) + (-1 \text{ for } NO_2) = +1(\text{ from } Br^-)$

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.

$m \propto$ Equivalent weight of substance

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

Example: $H_3N^+–CH_2–COO^-$ (glycine)

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

$$2CH_3COOEt \xrightarrow{NaOEt^2} CH_3COCH_2COOEt + EtOH$$

Reagent: Sodium ethoxide (NaOEt)

Reaction: Ester + Ester → 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 :

$P_4 + 4NaOH + 2H_2O \rightarrow NaH_2PO_2 + 2NaH_2PO_3$ or commonly: $PH_3 + H_2PO_2^-$

- 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 :

$XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

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

(3) Reaction of Cu with concentrated H_2SO_4 :

$Cu + 2H_2SO_4(\text{ conc }) \rightarrow CuSO_4 + SO_2 + 2H_2O$

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 → normal 2-center-2-electron bonds
- Bridging B-H-B bonds → 3-center-2-electron bonds
- Bond angles: $\sim 120°$ around B (planar B-H-B), $\sim 180° H-B-H$ for terminal H

(ii) Ethyl borate test:

Purpose: To detect the presence of alcohols.

Reaction:

$$3ROH + B(OC_2H_5)_3 \xrightarrow{heat} B(OR)_3 + 3C_2H_5OH$$

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

OR

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

(i) σ-bonding:

- Lone pair on C of CO donates to empty d-orbital of metal → σ 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:

$2NH_3 \xrightarrow{Pt} N_2 + 3H_2$

Formation of CO from decomposition of formic acid on Pt:

$HCOOH \xrightarrow{Pt} CO + H_2O$

(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 $= \alpha$

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: -

$nNH_2CH_2COOH \xrightarrow{heat} [-NHCH_2CO-]_n$ (nylon-2)

$nH_2\,N-(CH_2)_5-COOH \xrightarrow{heat} [-NH-(CH_2)_5-CO-]_n$ (nylon-6)

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

Reaction: -

$2(CH_3)_2NC_6H_5 + C_6H_5CHO \xrightarrow{ZnCl} [(CH_3)_2NC_6H_4]_2C = C_6H_5$ (Malachite Green)

(ii) Thorpe Nitrile Condensation:

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

Reaction:

$2R-CN \xrightarrow{Na \text{ or } K} R-CH=CH-CN+NH_3$

Example:

$2CH_3-CH_2-CN \xrightarrow{Na} CH_3-CH=CH-CN+NH_3$

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: -

$3C_6H_5OH+FeCl_3 \rightarrow [Fe(C_6H_5O)_3]+3HCl$

(ii) With ammonia: -

$C_6H_5OH+NH_3 \rightarrow C_6H_5ONH_4$

(iii) With zinc: -

$C_6H_5OH+Zn \xrightarrow{heat} C_6H_6+ZnO$