

PART - I

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

PART - II

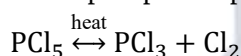
16. Reason: -

Sulphide ore particles are preferentially wetted by oil and rise with the froth, while gangue is wetted by water and sinks.

Example: -

- Zinc blende (ZnS)
- Galena (PbS)

17. When phosphorus pentachloride (PCl₅) is heated, it dissociates into phosphorus trichloride and chlorine gas:



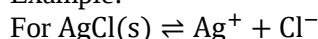
18. Zirconium (Zr) and Hafnium (Hf) exhibit similar properties because of lanthanoid contraction.

Due to poor shielding by 4f electrons, the atomic and ionic radii of hafnium become almost the same as those of zirconium. As a result, both elements have nearly identical sizes and chemical behavior, leading to very similar properties.

19. Solubility product (K_{sp}) is defined as:

The product of the molar concentrations of the ions in a saturated solution of a sparingly soluble salt, each raised to the power of its stoichiometric coefficient, at a given temperature.

Example:



$$K_{sp} = [\text{Ag}^+][\text{Cl}^-]$$

20. Equivalent conductance is defined as: -

The conductance of all the ions produced by one gram-equivalent of an electrolyte when dissolved in solution.

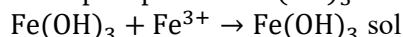
21. A peptising agent is a substance added to a fresh precipitate to convert it into a colloidal solution.

Explanation:

The peptising agent supplies ions that get adsorbed on the surface of precipitate particles, giving them the same charge. Due to electrostatic repulsion, the particles separate and disperse into colloidal size.

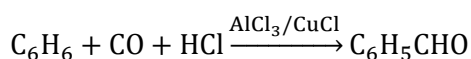
Example:

Fresh precipitate of Fe(OH)₃ when treated with FeCl₃ gets converted into a colloidal sol:



22. Gattermann-Koch reaction is used to introduce a -CHO (aldehyde) group into an aromatic ring.

Reaction:



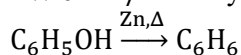
23. Drugs are classified on the following bases:

- (i) On the basis of pharmacological effect
 - e.g., analgesics, antipyretics, antibiotics.

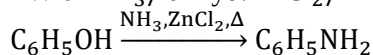
- (ii) On the basis of chemical structure
 - e.g., β -lactam antibiotics, sulphonamides.
- (iii) On the basis of action on a particular biochemical system
 - e.g., antacids, antihistamines.
- (iv) On the basis of molecular targets
 - e.g., enzyme inhibitors, receptor blockers.

24. Starting compound: Phenol (C_6H_5OH)

– With $Zn/\Delta \rightarrow$ oxygen is removed $\rightarrow$ Benzene



– With NH_3 / anhyd. $ZnCl_2/\Delta \rightarrow -OH$ replaced by $-NH_2 \rightarrow$ Aniline

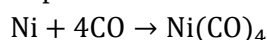


Answer:

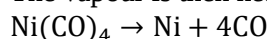
$X =$ Benzene, $Y =$ Aniline

PART - III

25. Impure nickel is heated with CO at $50 - 60^\circ C$ to form volatile nickel carbonyl:



The vapour is then heated at $180 - 200^\circ C$, where it decomposes to give pure nickel:



26. Bleaching action of Sulphur Dioxide (SO_2) – Short Notes:

- Agent: Sulphur dioxide (SO_2) is a reducing agent.
- Mechanism: It bleaches colored substances by reducing them to colorless compounds.
- Example with dye:
Colored dye (e.g., methylene blue) + $SO_2 \rightarrow$ colorless compound.
- Action on wood pulp/bleaching powder: SO_2 can bleach starch, wood pulp, and vegetable fibers.
- Reversibility: The bleaching is temporary if exposed to air, as the reduced compounds can re-oxidize

27. Definition: -

Hydrate isomers are compounds that have the same chemical formula, but different numbers of water molecules of crystallization or water molecules attached differently.

Example: -

- $[Cu(H_2O)_6]SO_4$ (blue) and $[Cu(H_2O)_4]SO_4 \cdot 2H_2O$ (blue green)
- Both have same $CuSO_4 \cdot xH_2O$ formula but differ in how water molecules are coordinated or present in the crystal.

28. Tetrahedral vs Octahedral Voids: -

Tetrahedral void: CN = 4, smaller, formed by 4 atoms.

Octahedral void: CN = 6, larger, formed by 6 atoms.

29. Limitations of Freundlich Adsorption Isotherm – Short Solution:

- (i) Not applicable at high pressure – Deviates at high gas pressures.
- (ii) Empirical – Lacks theoretical basis.
- (iii) Cannot predict saturation – Fails to show maximum adsorption.
- (iv) Limited to heterogeneous surfaces – Works best for heterogeneous adsorbents only.

30. A: $C_6H_5NH_2$ (Aniline)

B: $C_6H_5N_2^+Cl^-$ (Benzene diazonium chloride)

C: C_6H_5CN (Benzonitrile)

31. Condensation Polymer: A polymer formed by the repeated condensation reaction between monomers, usually releasing a small molecule like water, HCl, or methanol.

Examples:

- (i) Nylon-6,6 (from hexamethylenediamine + adipic acid)
- (ii) Polyester (Terylene) (from ethylene glycol + terephthalic acid)

32. Functions of Lipids in Living Organisms: -

- (i) Energy storage – Lipids store more energy per gram than carbohydrates.
- (ii) Structural role – They are key components of cell membranes (phospholipids).
- (iii) Insulation and protection – Provide thermal insulation and protect organs.

33. For a first-order reaction, the half-life ($t_{1/2}$) is given by:

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

Given $k = 1.54 \times 10^{-3} \text{ s}^{-1}$,

$$t_{1/2} = \frac{0.693}{1.54 \times 10^{-3}}$$

Step-by-step:

$$t_{1/2} = \frac{0.693}{0.00154} \approx 450 \text{ s}$$

PART - IV

34. (a)(i) (1) Cryolite: Lowers melting point of Al_2O_3 and increases electrolyte conductivity in aluminium extraction.

(2) Iodine: Forms volatile ZrI_4 to separate pure zirconium from impurities.

(ii) Properties of Interhalogen Compounds:

- Usually more reactive than halogens.
- Exist as gases, liquids, or solids depending on size.
- Polar molecules with higher electronegativity difference, making them good oxidizing agents.

OR

(b)(i) Identification of Borate (BO_3^{3-}) radical: -

- Add concentrated H_2SO_4 to the sample and heat.
- Boron compounds give a green flame in the presence of methanol (or form boric acid ester) $\rightarrow$ characteristic test for borate.

(ii) Uses of Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$): -

- Glass and enamel manufacture – improves durability and shine.
- Cleaning agent – used in soaps and detergents.
- Flux in metallurgy – helps in welding and soldering metals.
- Preservative – in food and leather.

35. (a) Chromite ore is fused with $\text{Na}_2\text{CO}_3 + \text{air} \rightarrow \text{Na}_2\text{CrO}_4$

Acidified with $\text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{Cr}_2\text{O}_7$

Treated with $\text{KCl} \rightarrow \text{K}_2\text{Cr}_2\text{O}_7$ (crystallises)

OR

(b) Postulates of Werner's Theory: -

- Primary valency = ionizable valency (oxidation state), satisfied by negative ions.
- Secondary valency = non-ionizable valency (coordination number), satisfied by ligands.
- Coordination number = number of ligands attached to the metal ion.
- Ligands are arranged in definite geometry around the central metal ion.

36. (a)(i) Metal Excess Defect: -

Occurs when a crystal has extra metal ions in its lattice, usually in interstitial sites.

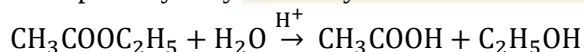
Causes: Missing anions or extra cations.

Example: CaF_2 – some Ca^{2+} occupy F^- sites $\rightarrow$ cation vacancies.

(ii) Pseudo First Order Reaction: -

- A reaction that is actually of higher order but appears first order because one reactant is in large excess.

Example: -Hydrolysis of ethyl acetate in excess water.



OR

(b) Given:

$$[\text{CH}_3\text{COOH}] = 0.1\text{M}, K_a = 1.8 \times 10^{-5}$$

For a weak acid:

$$K_a = \frac{[\text{H}^+]^2}{[\text{CH}_3\text{COOH}]} \Rightarrow [\text{H}^+] = \sqrt{K_a \cdot C}$$

$$[\text{H}^+] = \sqrt{1.8 \times 10^{-5} \times 0.1} = \sqrt{1.8 \times 10^{-6}} \approx 1.34 \times 10^{-3}\text{M}$$

$$\text{pH} = -\log[\text{H}^+] = -\log(1.34 \times 10^{-3}) \approx 2.87$$

37. (a) Nernst Equation: -

$$\Delta G = \Delta G^0 + RT \ln Q, \Delta G = -nFE$$

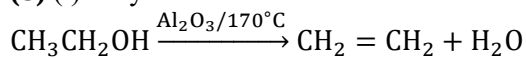
$$-nFE = -nFE^0 + RT \ln Q \Rightarrow E = E^0 - \frac{RT}{nF} \ln Q$$

At 25°C :

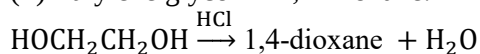
$$E = E^0 - \frac{0.0591}{n} \log Q$$

OR

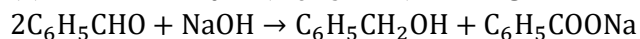
(b) (i) Ethyl alcohol $\rightarrow$ Ethene:



(ii) Ethylene glycol $\rightarrow$ 1,4-Dioxane:



38. (a) A: Benzaldehyde ($\text{C}_6\text{H}_5\text{CHO}$) - undergoes Cannizzaro reaction



B: p-Chlorobenzaldehyde ($\text{C}_6\text{H}_4\text{ClCHO}$) - $\text{Cl}_2/\text{FeCl}_3$

C: Benzyl chloride ($\text{C}_6\text{H}_5\text{CHCl}_2$) - Cl_2 , no catalyst

OR

(b) (i) Nitro vs Aci form: Nitro form gives no color with alkali; aci form gives red color.

(ii) Types of RNA: -

- mRNA – carries code from DNA
- tRNA – transfers amino acids
- rRNA – forms ribosomes

