PART - I

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

PART - II

16. Minerals: -
Naturally occurring compounds of metals found in the earth's crust; may or may not be useful for metal extraction.
Ores: -
Those minerals from which a metal can be extracted economically and conveniently.

17. Fe^{3+} is more stable than Fe^{2+}.
Reason: -
Fe^{3+} has the electronic configuration [AR] $3d^5$, which is a half-filled d-subshell and hence more stable due to extra exchange energy.
Fe^{2+} has configuration [AR] $3d^6$, which is less stable.
Therefore, Fe^{3+} is more stable than Fe^{2+}.

18. Coordination number is defined as the number of ligand donor atoms directly bonded to the central metal ion or atom in a coordination complex.

19. Covalent solids are solids in which the constituent atoms are held together throughout the crystal lattice by strong covalent bonds, forming a giant network structure (e.g., diamond, SiO_2).

20. Examples of first-order reactions:
- Radioactive decay of nuclei
- Decomposition of hydrogen peroxide
$2H_2O_2 \rightarrow 2H_2O + O_2$
- Hydrolysis of ethyl acetate in acidic medium
- Decomposition of nitrogen pentoxide
$2\ N_2O_5 \rightarrow 4NO_2 + O_2$

21. Limitations of Arrhenius concept (short):
- Applicable only to aqueous solutions.
- Cannot explain acid–base reactions in non-aqueous or gaseous phase.
- Fails to explain the basic nature of substances without OH^- (e.g., NH_3).
- Cannot explain acid–base reactions without H^+ or OH^- ions (e.g., $HCl + NH_3 \rightarrow NH_4Cl$).

22. Electrophoresis is the phenomenon in which colloidal particles move towards the oppositely charged electrode when an electric field is applied.
- Positively charged particles move towards the cathode.
- Negatively charged particles move towards the anode.
It is used to determine the charge on colloidal particles and in the purification of colloids.

23. **(a)** The structure shows a central carbon attached to three methyl groups and one –OH group (tert-butyl alcohol).
IUPAC name: 2-Methylpropan-2-ol
(b) The structure shows a benzene ring attached to $–CH_2–CH_2–OH$.

IUPAC name: 2-Phenylethan-1-ol

24. Step (1):

$CH_3Br \xrightarrow{NaN_3} CH_3\ N_3$

So, A = methyl azide ($CH_3\ N_3$).

Step (2):

$CH_3\ N_3 \xrightarrow{LiAlH_4} CH_3NH_2 + N_2$

So, B = methylamine (CH_3NH_2).

Answer:

A - Methyl azide

B - Methylamine

PART - III

25. Interhalogen compounds are compounds formed between two different halogen elements.

Examples:

- ClF, BrF_3, IF_5, ICl_3

These compounds are generally more reactive than halogens (except fluorine).

26. Properties of interstitial compounds (short):

- They are hard and rigid.
- Have high melting points.
- Retain metallic conductivity.
- Show non-stoichiometric composition.
- Chemically inert compared to pure metals.

27. Arrhenius equation:

$k = Ae^{-E_a/RT}$

Where: -

- k = rate constant of the reaction
- A = frequency (pre-exponential) factor
- E_a = activation energy
- R = gas constant
- T = absolute temperature (in kelvin)

28. Factors affecting electrolytic conductance:

- Nature of electrolyte (strong or weak)
- Concentration of electrolyte
- Temperature
- Nature of solvent (viscosity and dielectric constant)

29. Homogeneous catalysis is a type of catalysis in which the catalyst and reactants are in the same physical state (phase).

Example:

Hydrolysis of sucrose in the presence of dilute HCl, where all are in the aqueous phase.

30. Preparation of diethyl ether (short):

By dehydration of ethanol using concentrated H_2SO_4 at 413 K :

$2C_2H_5OH \xrightarrow{\text{conc. } H_2SO_4, 413\ K} C_2H_5OC_2H_5 + H_2O$

31. Haloform reaction (short):

Methyl ketones ($R - CO - CH_3$) on heating with halogen ($Cl_2/Br_2/I_2$) and alkali give haloform (CHX).

Example (iodoform reaction):

$CH_3COCH_3 + 3I_2 + 4NaOH \rightarrow CHI_3 + CH_3COONa + 3NaI + 3H_2O$

32. Epimers are diastereomers that differ in configuration at only one chiral (asymmetric) carbon atom.

Example: -

D-Glucose and D-Mannose are epimers as they differ in configuration at the C-2 carbon atom.

33. For the complex $[Ag(NH_3)_2]^+$:

(a) Ligand:

Ammonia (NH_3, ammine ligand)

(b) Central metal ion:

Silver (Ag^+)

(c) IUPAC name:
Diamminesilver(I) ion

PART – IV

34. (a) (i) Gravity separation method (Hydraulic washing):
It is a method used to concentrate ores based on the difference in densities of the ore and gangue.
The powdered ore is washed with a stream of water; lighter gangue particles are washed away, while heavier ore particles settle down.
(ii) Mond's process (Refining of nickel - short):
Impure nickel is heated with carbon monoxide at $50 - 60°C$ to form volatile nickel carbonyl:
$Ni + 4CO \rightarrow Ni(CO)_4$
Nickel carbonyl is then heated at $180 - 200°C$, where it decomposes to give pure nickel:
$Ni(CO)_4 \rightarrow Ni + 4CO$

OR

(b)(i) Inert pair effect is the tendency of the outermost s-electrons (ns^2) of heavy p-block elements to remain unshared or inert during bond formation.
(ii) Uses of boric acid (short):
- Used as a mild antiseptic (eye wash).
- Used in the manufacture of glass and ceramics.
- Used as an insecticide.
- Used as a buffer solution.

35. (a) (i) Uses of oxygen (short):
- Used for respiration and in medical oxygen therapy.
- Used in welding and cutting of metals (oxy-acetylene flame).
- Used in steel manufacture.
- Used as an oxidizer in rocket fuels.

(ii) Preparation of bleaching powder (short):
Bleaching powder is prepared by passing dry chlorine gas over dry slaked lime $Ca(OH)_2$.
$Ca(OH)_2 + Cl_2 \rightarrow Ca(OCl)Cl + H_2O$

OR

(b) Postulates of Werner's Coordination Theory (short):
- A metal shows two types of valencies: primary and secondary.
- Primary valency corresponds to oxidation state and is ionisable.
- Secondary valency corresponds to coordination number and is non-ionisable.
- Secondary valencies are fixed in number and have definite spatial arrangement.
- Ions satisfying secondary valency are directly attached to the metal ion.

36. (a) Crystalline solids:
- Have long-range ordered arrangement of particles
- Possess definite shape and sharp melting point
- Are anisotropic
- Example: NaCl, diamond

Amorphous solids:
- Have random arrangement of particles
- Do not have a sharp melting point
- Are isotropic
- Example: glass, rubber

OR

(b) (i) pH is defined as the negative logarithm (base 10) of the hydrogen ion concentration in a solution.
$pH = -\log[H^+]$
(ii) Example:
- Weak acid: $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$
- If we add sodium acetate (CH_3COONa), which contains the common ion CH_3COO^-, the dissociation of acetic acid decreases.

Reason: -
- According to Le Chatelier's principle, adding a common ion shifts the equilibrium to the left, reducing the concentration of H^+ ions.

Effect: -
- pH increases slightly for weak acids.
- Solubility of salts decreases in the presence of a common ion.

37. **(a)** Nernst Equation Derivation (Short Version)

(i) Start with Glbbs free energy change:

$\Delta G = \Delta G^\circ + RT\ln Q$

Where: -
- $\Delta G =$ Gbbs free energy
- $\Delta G^\circ =$ Standard Gbbs free energy
- $R = G$ as constant, $T =$ Temperature (K)
- $Q =$ Resction quotient

(ii) Relate Gibbs free energy to cell potential:

$\Delta G = -nFB$ and $\Delta G^\circ = -nFE^\circ$

Where: -
- $n =$ number of electrons
- $F =$ Faraday constant
- $E =$ Cell potential

(iii) Subatitute into AG equation:

$-nFB = -nFE^\circ + FT\ln Q$

(iv) Solve for E:

$$E = E^\circ - \frac{RT}{nF}\ln Q$$

(v) Convert Into loge (common log):

$$E = E^\infty - \frac{0.0591}{n}\log_{10} Q \text{ at } 298K$$

Nernst Equation:

$$\boxed{E = E^\circ - \frac{0.0501}{n}\log Q}$$

OR

(b) Characteristics of a Catalyst:

(i) Increases reaction rate without being consumed.
(ii) Does not change the equilibrium position of the reaction.
(iii) Lowers the activation energy of the reaction.
(iv) Regenerated at the end of the reaction, so it can be reused.
(v) Specific in action – usually works for a particular reaction.

38. **(a)** Reducing Action of Formic Acid (ceHCOOH)

Reason: -Formic acid can donate electrons and is easily oxidized to CO_2, so it acts as a reducing agent.

Example (1): Reduction of Tollens' reagent

$HCOOH + 2[Ag(NH3)2]^+ + OH^- \rightarrow CO2 + 2Ag\downarrow + 3NH3 + H2O$

Observation: -Silver mirror is formed.

Example (2): Reduction of Fehling's solution

$HCOOH + 2Cu^{2+} + 5OH^- \rightarrow CO_2 + Cu_2O\downarrow + 3H_2O$

Observation: Red precipitate of Cu2O is formed.

OR

(b) (i) Carbylamine Reaction

Definition: When a primary amine (RNH_2) is heated with chloroform $(CHCl_3)$ and alkali (KOH), it forms an isocyanide ($R-NEC$) with a foul odor.

$RNH_2+CHCl_3+3KOH \rightarrow R\text{-}N\equiv C+3KCl+3H_2O$

Use: Test for primary amines (positive test: foul-smelling isocyanide).

(ii) Gabriel Phthalimide Synthesis

Purpose: Preparation of primary amines (RNH_2) from alkyl halides.

Steps: -

(i) Formation of potassium phthalimide:

$C_6H_4(CO)_2NH+KOH \rightarrow C_6H_4(CO)_2NK+H_2O$

(ii) Alkylation: Potassium phthalimide reacts with alkyl halide $(R-X) \rightarrow$ N-alkyl phthalimide

$C_6H_4(CO)_2NK+R\text{-}X \rightarrow C_6H_4(CO)_2N\text{-}R+KX$

(iii) Hydrolysis: N-alkyl phthalimide hydrolyzed → primary amine

$C_6H_4(CO)_2$ N-R+$_2H_2O$+KOH→R-NH_2+$C_6H_4(CO)_2K$

Key Point: Produces only primary amines, avoiding secondary/tertiary amines.