

PART - I

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

PART - II

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

- (i) In glass and ceramic industry – used in making borosilicate glass and enamels.
- (ii) As a flux – in metallurgy for soldering and welding metals.
- (iii) In qualitative analysis – used in the borax bead test for identification of metal ions.
- (iv) In detergents and soaps – acts as a cleaning and bleaching agent.
- (v) As a water softener – removes temporary hardness of water.
- (vi) In medicinal preparations – mild antiseptic (in limited use).

17. d-block elements exhibit variable oxidation states because:

- (i) Small energy difference between $(n-1)d$ and ns orbitals
Both ns and $(n-1)d$ electrons have nearly the same energy, so different numbers of electrons can participate in bonding.
- (ii) Participation of d-electrons in bond formation
Besides ns electrons, d-electrons can also be lost or shared, leading to different oxidation states.
- (iii) Stability from different electronic configurations
Some oxidation states are stabilized by half-filled or fully filled d-subshells.

18. A unit cell is the smallest repeating structural unit of a crystal lattice which, when repeated periodically in three dimensions, generates the entire crystal structure.

19. Ostwald's dilution law: -

For a weak electrolyte, the degree of ionization increases with dilution and is related by

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

where K is the dissociation constant, C the concentration, and α the degree of ionization.

20. Equivalent conductance:

It is the conductance of all the ions produced by one gram-equivalent of an electrolyte when placed between two electrodes 1 cm apart.

Unit: $\text{ohm}^{-1} \text{cm}^2 \text{equivalent}^{-1}$

21. Two factors affecting electrolytic conductance:

- (i) Concentration (or dilution) of the electrolyte
- (ii) Nature of the electrolyte / mobility of ions

22. Electro-osmosis: -

It is the movement of a liquid through a porous membrane or capillary under the influence of an applied electric field, while the solid particles remain stationary.

23. Peptide bond: -

A peptide bond is an amide linkage ($-\text{CO}-\text{NH}-$) formed when the carboxyl group of one amino acid reacts with

the amino group of another amino acid with elimination of a water molecule.
It links amino acids together to form proteins.

24. Starting compound: Nitromethane ($\text{CH}_3\text{-NO}_2$)

- With Sn/HCl ($6[\text{H}]$) $\rightarrow$ complete reduction of nitro group to amine

$\text{A} = \text{CH}_3\text{NH}_2$ (methylamine)

- With $\text{Zn/NH}_4\text{Cl}$ ($4[\text{H}]$) $\rightarrow$ partial reduction of nitro group to hydroxylamine

$\text{B} = \text{CH}_3\text{NHOH}$ (N-methylhydroxylamine)

PART – III

25. Coordination number:

It is the number of nearest neighbouring atoms surrounding a given atom in a crystal lattice.

Coordination number in bcc structure:

In a body-centred cubic (bcc) lattice, each atom is surrounded by 8 nearest neighbours.

26. Interhalogen compounds:

These are compounds formed between two different halogen elements.

Examples: -

- ClF_3

- BrF_5

27. Difference between double salts and coordination compounds:

Double salts: -

Dissociate completely into all constituent ions in aqueous solution and lose their identity.

Example: Mohr's salt $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$

Coordination compounds: -

Do not dissociate into all ions; the complex ion retains its identity in solution.

Example: $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$

28. Factors responsible for anomalous behaviour of first p-block elements:

(i) Small atomic size

(ii) High electronegativity

(iii) High ionization energy

(iv) Absence of vacant d-orbitals

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 passed through the electrolyte.

(ii) Second law: -

When the same quantity of electricity is passed through different electrolytes, the masses of substances deposited are proportional to their equivalent weights.

30. (i) Ethylene glycol $\rightarrow$ Acetaldehyde

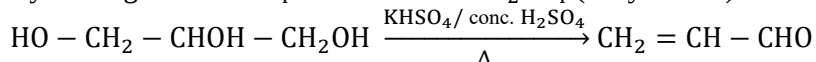
By heating with concentrated H_2SO_4 (dehydration).



CH_3CHO

(ii) Glycerol $\rightarrow$ Acrolein

By heating with KHSO_4 or concentrated H_2SO_4 (dehydration).



31. Tests for carboxylic acid ($-\text{COOH}$) group: -

(i) Sodium bicarbonate test:

Carboxylic acids react with NaHCO_3 giving brisk effervescence of CO_2 .



(ii) Litmus test: -

Turns blue litmus red due to acidic nature.

32. Differences between DNA and RNA (any three):

Sugar: -

DNA contains deoxyribose, while RNA contains ribose.

Nitrogen base: -

DNA has thymine, whereas RNA has uracil instead of thymine.

Structure: -

DNA is double-stranded, while RNA is single-stranded.

33. Classification of solids: -

Covalent (network) solids:

(i) Diamond, (vi) SiO₂

Metallic solids:

(ii) Brass

Ionic solids:

(iii) NaCl

Molecular solids:

(iv) Naphthalene, (v) Glucose

PART - IV

34. (a) Froth flotation process: -

It is a concentration method for sulphide ores, based on the difference in wettability of ore and gangue.

- The finely powdered ore is mixed with water to form a slurry.

- Collectors (e.g., xanthates) are added to make the sulphide ore particles hydrophobic.

- Frothing agents (e.g., pine oil) are added to produce stable froth.

- Air is blown through the mixture; the ore particles attach to air bubbles and rise as froth.

- The froth containing the ore is skimmed off, while the gangue remains in water.

Thus, the ore is separated and concentrated.

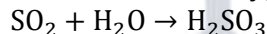
OR

(b)(i) Bleaching action of sulphur dioxide (SO₂):

Sulphur dioxide bleaches by reduction.

- In the presence of moisture, SO₂ forms sulphurous acid (H₂SO₃).

- This acid removes oxygen from coloured substances, converting them into colourless compounds.



Coloured substance + H₂SO₃ → Colourless substance

- The bleaching is temporary, because the colour may reappear on exposure to air due to re-oxidation.

Hence, SO₂ acts as a reducing agent and shows temporary bleaching action.

(ii) Two uses of Helium: -

(i) Used in airships and weather balloons because it is light and non-inflammable.

(ii) Used as an inert shielding gas in arc welding.

35. (a)(i) Interstitial compounds: -

These are compounds formed when small atoms (such as H, B, C, or N) occupy the interstitial spaces in the crystal lattice of transition metals.

Examples: -

- Titanium carbide (TiC)

- Iron nitride (Fe₄N)

They are usually hard, have high melting points, and retain metallic conductivity.

(ii) Ti³⁺

- Ti (Z = 22) : [Ar]3d²4s²

- Ti³⁺: [Ar]3d¹

- Unpaired electrons $n = 1$

$$\mu = \sqrt{1(1+2)} = \sqrt{3} = 1.73 \text{ BM}$$

Mn²⁺

- Mn (Z = 25) : [Ar]3d⁵4s²

- Mn²⁺: [Ar]3d⁵

- Unpaired electrons $n = 5$

$$\mu = \sqrt{5(5+2)} = \sqrt{35} = 5.92 \text{ BM}$$

OR

(b) (i) Limitations of Valence Bond (VB) theory:

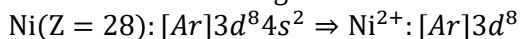
- Fails to explain the colour and electronic spectra of coordination compounds.

- Cannot account for the magnetic properties (strong vs weak field ligands) accurately.

- Does not explain the relative stability of complexes quantitatively.
- Fails to explain the inner orbital and outer orbital complexes clearly in all cases.

(ii) $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic (VB theory explanation):

- Ni^{2+} electronic configuration:



- CN^- is a strong field ligand, so it causes pairing of 3 d electrons in Ni^{2+} .
- After pairing, one 3d orbital becomes vacant.
- The complex uses dsp^2 hybridisation (one 3 d, one 4 s, two 4 p orbitals) forming a square planar structure.
- Since all electrons are paired, the complex shows diamagnetic behaviour.

36. (a) (i) Differences between rate and rate constant of a reaction:

Dependence: -

- Rate of reaction depends on the concentration of reactants.
- Rate constant (k) is independent of concentration at a given temperature.

Nature: -

- Rate changes as the reaction proceeds.
- Rate constant remains constant for a given reaction at fixed temperature.

(ii) For a zero-order reaction

$\text{A} \rightarrow \text{Products}$

Rate law: -

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

Integrating: -

$$\int_{[\text{A}]_0}^{[\text{A}]} d[\text{A}] = -k \int_0^t dt$$

$$[\text{A}] - [\text{A}]_0 = -kt$$

$$[\text{A}] = [\text{A}]_0 - kt$$

This is the integrated rate law for a zero-order reaction.

OR

(b) This is an acidic buffer (acetic acid + sodium acetate).

Use Henderson-Hasselbalch equation: -

$$\text{pH} = \text{p}K_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$

Given: -

$$K_a = 1.8 \times 10^{-5} \Rightarrow \text{p}K_a = -\log(1.8 \times 10^{-5}) \approx 4.74$$

$$[\text{salt}] = 0.20\text{M}, [\text{acid}] = 0.18\text{M}$$

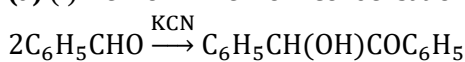
$$\text{pH} = 4.74 + \log \left(\frac{0.20}{0.18} \right)$$

$$\log \left(\frac{0.20}{0.18} \right) = \log(1.11) \approx 0.045$$

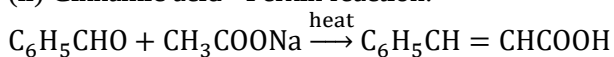
$$\text{pH} = 4.74 + 0.045 = 4.79$$

$$\text{pH of the buffer} \approx 4.79$$

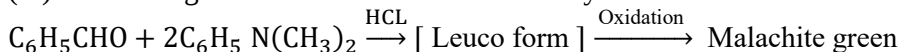
37. (a) (i) Benzoin - Benzoin condensation: -



(ii) Cinnamic acid - Perkin reaction: -



(iii) Malachite green - Condensation with dimethylaniline + oxidation



OR

(b) (i) 3° Alcohol (Tertiary): - Clear solution turns cloudy (turbid) instantly.

Reason: Forms a stable tertiary carbocation quickly.

2° Alcohol (Secondary): - Turbidity appears after 3-5 minutes.

Reason: Forms a moderately stable secondary carbocation.

1° Alcohol (Primary): - Remains clear at room temperature; turbidity only appears upon heating.

Reason: Forms a highly unstable primary carbocation, requiring energy (heat) to react.

Procedure Summary: -

- (1) Add the alcohol to a test tube.
- (2) Add freshly prepared Luca's reagent (conc. HCl + anhydrous ZnCl_2).
- (3) Observe the time taken for the solution to become cloudy (turbid) at room temperature.

(ii) Here's a concise list of uses of diethyl ether ($\text{C}_2\text{H}_5\text{--O--C}_2\text{H}_5$):

- (1) As a solvent – widely used for fats, oils, resins, and some organic reactions.
- (2) As an anesthetic – previously used in surgery (now mostly replaced by safer anesthetics).
- (3) In Grignard reactions – as a reaction medium because it stabilizes the Grignard reagent.
- (4) As an extraction agent – for separating organic compounds from aqueous solutions.
- (5) As a starting fluid for engines – due to its high volatility and flammability.

Short version: Solvent, anesthetic, Grignard reagent medium, extraction, engine starter.

38. (a) Adsorption Theory of Catalysis (Short Solution):

Concept: Catalyst increases reaction rate by adsorbing reactant molecules on its surface.

Steps: -

- (i) Adsorption: Reactants stick to catalyst surface.
- (ii) Reaction: Bonds in reactants are weakened → reaction occurs on surface.
- (iii) Desorption: Products leave the surface, catalyst is regenerated.

Summary: Reaction occurs on the catalyst surface via adsorption → bond weakening → faster reaction.

OR

(b) Given: -

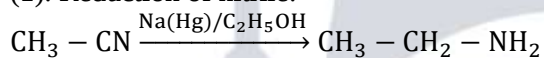
- A: $\text{C}_2\text{H}_3\text{N}$ → on reduction gives B: $\text{C}_2\text{H}_7\text{N}$ → reacts with nitrous acid to give C: $\text{C}_2\text{H}_6\text{O}$

Step 1: -Identify compounds

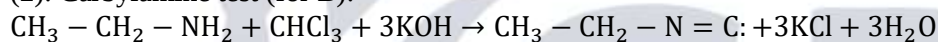
- A = $\text{CH}_3\text{--CN}$ (Acetonitrile)
- B = $\text{CH}_3\text{--CH}_2\text{--NH}_2$ (Ethylamine, primary amine)
- C = $\text{CH}_3\text{--CH}_2\text{--OH}$ (Ethanol)

Step 2: -Reactions

(1). Reduction of nitrile: -



(2). Carbylamine test (for B):



(3). Reaction with nitrous acid: -

