**CBSE Class 12 Chemistry**

**Sample paper 03 (2020-21)**

**Maximum Marks: 70**

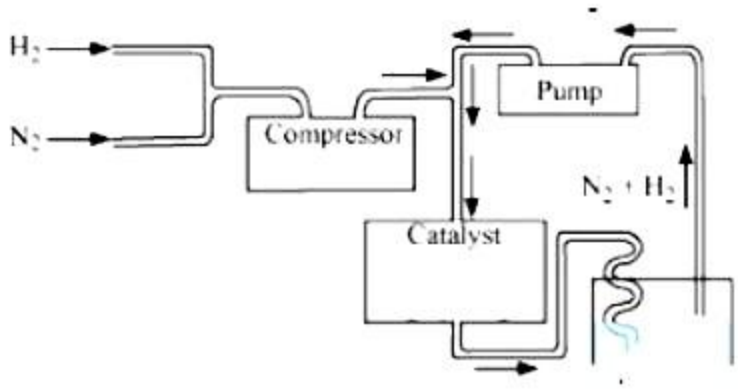
**Time Allowed: 3 hours**

**General Instructions:**

a. There are 33 questions in this question paper. All questions are compulsory.
b. Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
c. Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
d. Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
e. Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
f. There is no overall choice. However, internal choices have been provided.
g. Use of calculators and log tables is not permitted.

## Section A

1. **Read the passage given below and answer any four out of the following questions:**
Ammonia is present in small quantities in air and soil where it is formed by the decay of nitrogenous organic matter e.g., urea. On a large scale, ammonia is manufactured by Haber's process. In accordance with Le Chatelier's principle, high pressure would favour the formation of ammonia. Ammonia is a colourless gas with a pungent odour. Its freezing and boiling points are 198.4 and 239.7 K respectively. In the solid and liquid states, it is associated through hydrogen bonds as in the case of water and that accounts for its higher melting and boiling points than expected on the basis of its molecular mass. Ammonia gas is highly soluble in water. Its aqueous solution is weakly basic due to the formation of $OH^-$ ions. The presence of a lone pair of electrons on the nitrogen atom of the ammonia molecule makes it a Lewis base.




**The following questions are multiple-choice questions. Choose the most appropriate choice**

i. On a small scale, ammonia is obtained from ammonium salts which decompose when treated with
   a. caustic soda
   b. calcium chloride
   c. sodium hydroxide
   d. sodium chloride

ii. The optimum conditions for the production of ammonia are a pressure of
   a. $200 \times 10^5$ Pa
   b. $400 \times 10^5$ Pa
   c. $100 \times 10^5$ Pa
   d. $300 \times 10^5$ Pa

iii. The catalyst which is used in the preparation of $NH_3$ by Haber's process
   a. $Mg_2O_3 + K_2O$
   b. $Al_2O_3 + K_2O$
   c. $NaO_3 + K_2O$
   d. None of these

iv. The ammonium molecule has:
   a. five bond pair and two lone pair
   b. four lone pair and one bond pair
   c. three bond pair and one lone pair
   d. three bond pair and two lone pair

v. A compound reacts with ammonia to form deep colour solution, identify the

compound

a. $Au^{2+}$
b. $Cu^{2+}$
c. $Al^{3+}$
d. $Mg^{2+}$

2. **Read the passage and answer any four out of the following questions:**

A colloid is a heterogeneous system in which one substance is dispersed as very fine particles in another substance called dispersion medium. The essential difference between a solution and a colloid is that of particle size. In a solution, the constituent particles are ions or small molecules. In a colloid, the dispersed phase may consist of particles of a single macromolecule. A colloid is classified on the basis of various criteria. Depending upon the nature of the interaction between the dispersed phase and the dispersion medium, colloidal sols are divided into two categories, namely into lyophilic and lyophobic sols. Depending upon whether the dispersed phase and the dispersion medium are solids, liquids, or gases. The most common division are sols (solids in liquids), gels (liquids in solids), and emulsions (liquids in liquids)

**In these questions, a statement of assertion followed by a statement of the reason is given below. Choose the correct answer out fo the following choices**

a. Assertion and reason both are correct statements and reason is correct explanation for assertion
b. Assertion and reason both are correct statements and reason is not correct explanation for assertion
c. Assertion is correct but reason is wrong statement
d. Assertion is wrong but reason is correct statement

i. **Assertion:** The range of diameters of the colloidal particles is between 1 and 1000 nm.
**Reason:** Colloidal particles are larger than simple molecules but small enough to remain suspended.

ii. **Assertion:** Lyophilic sols are irreversible sols.
**Reason:** Lyophilic sols are quite stable and cannot be easily coagulated.

iii. **Assertion:** Lyophobic sol are prepared only by special methods
**Reason:** Lyophobic sol can not be prepared by simply mixing the substance with the dispersion medium.

iv. **Assertion:** Firefighting foams, used at emergency airplane landings is a colloidal system.

**Reason:** In cell proteins and nucleic acids are colloidal-sized particles.

v. **Assertion:** Whipped cream is a foam, which is a gas dispersed in a liquid.

**Reason:** Lyophobic sols are highly stabilized sol.

3. Which of the following is a $3^{o}$ amine?
   a. N-methylaniline
   b. Tert-butylamine
   c. 1-methylcyclohexylamine
   d. Triethylamine
4. Nucleotides are joined together by
   a. peptide linkage
   b. disulphide linkage
   c. glycosidic linkage
   d. phosphodiester linkage

OR

Fat soluble vitamins are stored in
   a. Eyes
   b. Stomach
   c. Adipose and liver
   d. Pancreas
5. Which among the following is miscible in each other?
   a. Methanol and benzene
   b. Benzene and water
   c. All of these
   d. Methanol and water
6. Which one is the correct increasing order of boiling points of the following compounds?
   1-Bromoethane, 1-Bromopropane, 1-Bromobutane, Bromobenzene
   a. 1-Bromoethane < 1-Bromopropane < 1-Bromobutane < Bromobenzene
   b. Bromobenzene < 1-Bromobutane < 1-Bromopropane < 1-Bromoethane
   c. Bromobenzene < 1-Bromoethane < 1-Bromopropane < 1-Bromobutane
   d. 1-Bromopropane < 1-Bromobutane < 1-Bromoethane < Bromobenzene

OR

Decomposition of benzene diozonium chloride by using $Cu_2Cl_2/HCl$ to form chlorobenzene is:

a. Wurtz – Fittig reaction
b. Friedel – Crafts reaction
c. Sandmeyer's reaction
d. Finkelstein reaction

7. Sec – Butylamine is the common name of which compound?
   a. N – ethylethanamine
   b. 2 – butanamine
   c. N – methyl – 1 – propanamine
   d. 1 – butanamine

OR

Aniline does not undergo Friedel – Crafts reaction because:

a. Anilium ion deactivates any further reaction
b. Aluminium chloride reacts with Aniline
c. All of these
d. $AlCl_3$ act as a catalyst

8. Match the complex ions given in Column I with the hybridisation and number of unpaired electrons given in Column II and assign the correct code :

| **Column I (Complex ion)** | **Column II (Hybridisation, number of unpaired electrons)** |
|---|---|
| (a) $[Cr(H_2O)_6]^{3+}$ | (i) $dsp^2$, 1 |
| (b) $[Co(CN)_4]^{2-}$ | (ii) $sp^3d^2$, 5 |
| (c) $[Ni(NH_3)_6]^{2+}$ | (iii) $d^2sp^3$, 3 |
| (d) $[MnF_6]^{4-}$ | (iv) $sp^3$, 4 |
| | (v) $sp^3d^2$, 2 |

a. (a)-(iii), (b)-(i), (c)-(v), (d)-(ii)

b. (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)

c. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

d. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)

OR

Which of the following species is not expected to be a ligand?

a. $NH_4^+$

b. $NH_2CH_2NH_2$

c. CO

d. NO

9. In the formation of complex entity, the central atom/ion acts as:
   a. Lewis acid
   b. Lewis base
   c. Bronsted acid
   d. Bronsted base
10. Arrange the following in the increasing order of nucleophilicity:

    $I^-$, $Cl^-$, $Br^-$

    a. $Cl^- < Br^- < I^-$

    b. $I^- < Cl^- < Br^-$

    c. $Br^- < Cl^- < I^-$

    d. $I^- < Br^- < Cl^-$
11. Packing efficiency for simple cubic structure is
    a. 74%
    b. 52.36%
    c. 100%
    d. 68%
12. **Assertion:** Linkage isomerism arises in coordination compounds containing ambidentate ligand.

    **Reason:** Ambidentate ligand has two different donor atoms.

    a. Assertion and reason both are true, the reason is the correct explanation of assertion.
    b. Assertion and reason both are true but the reason is not the correct explanation of assertion.

c. The assertion is true, the reason is false.
d. The assertion is false, the reason is true.

13. **Assertion:** Glycine must be taken through diet.

    **Reason:** It is an essential amino acid.

    a. Assertion and reason both are correct statements and reason explain the assertion.
    b. Both assertion and reason are wrong statements.
    c. The assertion is the correct statement and reason is the wrong statement.
    d. The assertion is the wrong statement and reason is the correct statement.

14. **Assertion:** Iodine is more soluble in $CCI_4$ than in water.

    **Reason:** Non-polar solutes are more soluble in non-polar solvents.

    a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
    b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
    c. Assertion is CORRECT but, reason is INCORRECT.
    d. Assertion is INCORRECT but, reason is CORRECT.

OR

**Assertion:** Sodium chloride is used to clear snow on the roads.

**Reason:** Sodium chloride depresses the freezing point of water.

a. Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.
b. Both assertion and reason are CORRECT but, reason is NOT THE CORRECT explanation of the assertion.
c. Assertion is CORRECT but, reason is INCORRECT.
d. Assertion is INCORRECT but, reason is CORRECT.

15. **Assertion:** Bond angle in ethers is slightly less than the tetrahedral angle

    **Reason:** There is a repulsion between the two bulky (-R) groups.

    a. Assertion and reason both are correct and reason is correct explanation of assertion.
    b. Assertion and reason both are wrong statements.
    c. The assertion is a correct statement but the reason is the wrong statement.
    d. The assertion is a wrong statement but the reason is the correct statement.

16. **Assertion:** Phosphorus chlorides (tri and Penta) are preferred over thionyl chloride for

the preparation of alkyl chlorides from alcohol.

**Reason:** Phosphorus chlorides give pure alkyl halides.

a. Assertion and reason both are correct and reason is correct explanation of assertion.
b. Assertion and reason both are wrong statements.
c. The assertion is correct but the reason is the wrong statement.
d. The assertion is wrong but the reason is the correct statement.

**Section B**

17. How will you bring the following conversion?
Ethanol to but-1-yne

OR

How the following conversions can be carried out?

i. tert-Butyl bromide to isobutyl bromide
ii. Aniline to phenylisocyanide

18. 200 $cm^3$ of an aqueous solution of a protein contains 1.26 g of the protein. The osmotic pressure of such a solution at 300 K is found to
be $2.57 \times 10^{-3}$ bar. Calculate the molar mass of the protein.

19. Explain $[Co(NH_3)_6]^{3+}$ is an inner orbital complex whereas $[Ni(NH_3)_6]^{2+}$ is an outer orbital complex.

OR

Draw the structures of isomers, if any and write the names of the following complex.

i. $[Cr\ (NH_3)_4Cl_2]^+$
ii. $[Co(en)_3]^{3+}$

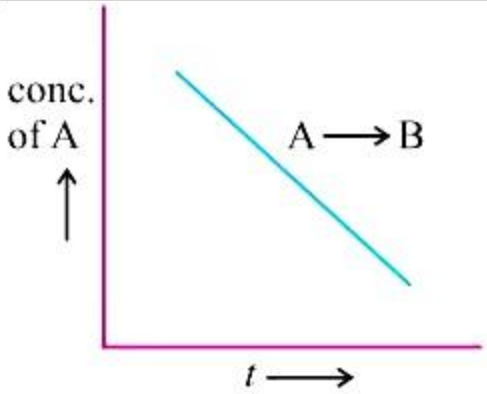
(Atomic no. of Cr = 24, Co = 27)

20. The reaction between A and B is first order with respect to A and zero order with respect to B. Fill in the blanks in the following table:

| **Experiment** | **A/molL$^{-1}$** | **B/molL$^{-1}$** | **Initial rate /molL$^{-1}$min$^{-1}$** |
|---|---|---|---|
| I | 0.1 | 0.1 | $2.0 \times 10 - 2$ |
| II | - | 0.2 | $4.0 \times 10 - 2$ |
| | | | |

| | | | |
|---|---|---|---|
| III | 0.4 | 0.4 | - |
| IV | - | 0.2 | $2.0 \times 10 - 2$ |

21.



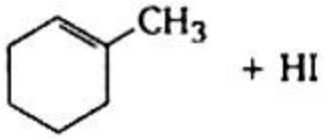

i. What is the order of the reaction?

ii. What is the slope of the curve?

22. What happens when phenol is treated with ice-cold bromine dissolved in $CS_2$?

23. Account for the following statement: Zinc salts are white while $Cu^{2+}$ salts are coloured.
[At. No. Zn = 30, Cu = 29]

24. Draw the structure of the major monohalo product in the following reaction:




25. What are the types of lattice imperfections found in crystals?

**Section C**

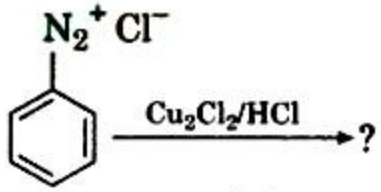
26. Explain the chemistry behind brown ring test for detection of nitrate ions.

OR

What prompted Bartlet to the discovery of noble gas compound?

27. Write major product(s) in the following reactions:

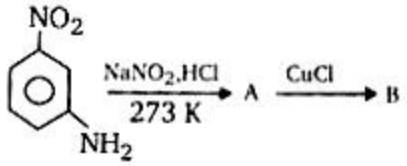
i. $C_6H_5\text{-}NO_2 \xrightarrow{Sn/HCl} ?$

ii. 

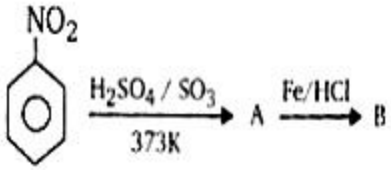

iii. $CH_3CONH_2 \xrightarrow{Br_2/KOH} ?$

OR

Identify A and B in the following reactions:

i. 


ii. $CH_3CH_2CH_2Br \xrightarrow{NaGN} A \xrightarrow{LiAJH_i} B$

iii. 


28. What is the coordination number in:
    a. Square close packing
    b. Hexagonal close packing.
29. Define the following as related to proteins.
    i. Peptide linkage
    ii. Primary structure
    iii. Denaturation
30. How are the following conversion carried out.
    i. Propene to propan-2-ol?
    ii. Benzyl chloride to benzyl alcohol?
    iii. Anisole to p-bromoanisole?

**Section D**

31. The elements of 3d transition series are given as: Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn. Answer the following:
    i. Write the element which shows the maximum number of oxidation states. Give reason.
    ii. Which element has the highest melting point?
    iii. Which element shows only +3 oxidation state?
    iv. Which element is a strong oxidising agent in +3 oxidation state and why?
    v. Write the electronic configuration of Sc and Zn.

OR

a. Account for the following :

i. Manganese shows maximum number of oxidation states in 3d series.

ii. $E^{\circ}$ value for $Mn^{3+}/Mn^{2+}$ couple is much more positive than that for $Cr^{3+}/Cr^{2+}$.

b. Write the chemical equations for the preparation of $KMnO_4$ from $MnO_2$.

32. i. Account for the following :

a. Cl-CH-OOH is a stronger acid than $CH_3COOH$.

b. Carboxylic acids do not give reactions of carbonyl group

ii. Write the chemical equations to illustrate the following name reactions.

a. Rosenumund reduction

b. Cannizzaro' s reaction

iii. Out of

$CH_3CH_2$ - CO- $CH_2$ - $CH_3$ and $CH_3CH_2$- $CH_2$- CO- $CH_3$ which gives iodoform test?

OR

i. Draw the structures of the following compounds:

a. 4-chloropentan-2-one

b. p-nitropropiophenone

ii. Give tests to distinguish between the following pair of compound: Ethanal and propanal.

33. Calculate the equilibrium constant for the reaction.

$$Fe(s) + Cd^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cd(s)$$

Given : $E^0(Cd^{2+}/Cd)$ = 0.40V, $E^0(Fe^{2+}/Fe)$ = -0.44V

OR

i. Define Kohlraush's law.

ii. Suggest a way to determine the $\Lambda_m^{\circ}$ for $CH_3COOH$.

iii. The $\Lambda_m^{\circ}$ for sodium acetate, HCl, NaCl are 91.0, 425.9 and 126.4 S $cm^2$ $mol^{-1}$ respectively at 298 K. Calculate $\Lambda_m^{\circ}$ for $CH_3COOH$.

**CBSE Class 12 Chemistry**

**Sample paper 03 (2020-21)**

**Solution**

**Section A**

1. i. (a) caustic soda

   ii. (a) $200 \times 10^5$ Pa

   iii. (b) $Al_2O_3 + K_2O$

   iv. (c) three bond pairs and one lone pair

   v. (b) $Cu^{2+}$

2. i. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion

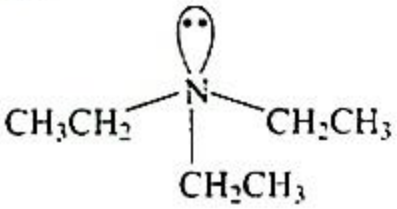
   ii. (d) Assertion is wrong but reason is correct statement

   iii. (a) Assertion and reason both are correct statements and reason is correct explanation for assertion

   iv. (b) Assertion and reason both are correct statements and reason is not correct explanation for assertion

   v. (c) Assertion is correct but reason is wrong statement

3. (d) Triethylamine

   **Explanation:** 

   Triethylamine ($3^o$ amine) - replacement of 3 hydrogens by alkyl/aryl tertiary amine is formed.

4. (d) phosphodiester linkage

   **Explanation:** Nucleotides are together by phosphodiester linkage between 5' and 3' carbon atoms of the pentose sugar.

OR

(c) Adipose and liver

**Explanation:** Vitamins which are soluble in fat and oils but insoluble in water are fat

soluble vitamins. These are vitamins A, D, E and K. They are stored in liver and adipose (fat storing) tissues.

5. (d) Methanol and water

   **Explanation:** Methanol and Water both are Polar. There is intermolecular Hydrogen Bonding interaction.

6. (a) 1-Bromoethane < 1-Bromopropane < 1-Bromobutane < Bromobenzene

   **Explanation:** The boiling point increases with an increase in molecular mass of the alkyl halide and greater in aryl halide.

OR

(c) Sandmeyer's reaction

**Explanation:** $C_6H_5N_2^+Cl^- + Cu_2Cl_2/HCl \rightarrow C_6H_5Cl$

Mixing the solution of the freshly prepared diazonium salt with cuprous chloride or cuprous bromide results in the replacement of the diazonium group by –Cl or –Br. This is called Sandmeyer's reaction.

7. (b) 2 – butanamine

   **Explanation:** Sec – Butylamine is the common name of 2-butanamine ($CH_3CH_2CHNH_2CH_3$).

OR

(b) Aluminium chloride reacts with Aniline

**Explanation:** $AlCl_3$ being a lewis acid reacts with the lone pair of -$NH_2$ group of aniline forming an adduct ($C_6H_5NH_2{}^+AlCl_3$) which deactivates the benzene system hence no friedal craft reaction occurs.

8. (a) (a)-(iii), (b)-(i), (c)-(v), (d)-(ii)

   **Explanation:**

   - [Cr $(H_2O)_6$]3+ - $d^2sp^3$, 3
   - $[Co(CN)_4]^{2-}$ - $dsp^2$, 1
   - $[Ni(NH_3)_6]^{2+}$ - $sp^3d^2$, 2
   - $[MnF_6]^{4-}$ - $sp^3d^2$, 5

OR

(a) $NH_4^+$

**Explanation:** Ligand must donate a pair of electron or loosely held electron pair to metal and from an M-L bond.

9. (a) Lewis acid

   **Explanation:** The central metal atom/ion behaves as a Lewis acid while the ligand acts as a Lewis base. The ligand can be a negatively charged ion or a neutral molecule that donates its electron pair to the central metal atom/ion which acts as an electron pair acceptor (Lewis acid).

10. (a) $Cl^- < Br^- < I^-$

    **Explanation:** Nucleophilicity means the tendency of a nucleophile to attack a center of a positive charge. As the size of the nucleophile increases, its basicity decreases, and hence its nucleophilicity increases. As we move down the group 17 size of the anions increases and thus the nucleophilicity increases as $Cl^- < Br^- < I^-$

11. (b) 52.36%

    **Explanation:** Packing efficiency

    $= \frac{\text{Volume of one atom}}{\text{Volume of cubic unit cell}} \times 100\%$

    $= \frac{\frac{4}{3}\pi r^3}{8r^3} \times 100 = \frac{\pi}{6} \times 100$

    = 52.36% = 52.4%

12. (a) Assertion and reason both are true, the reason is the correct explanation of assertion.

    **Explanation:** Linkage isomerism arises due to two different donor atoms in ambidentate ligand.

13. (b) Both assertion and reason are wrong statements.

    **Explanation:** Glycine can be synthesized by the body and is a non-essential amino acid.

14. (a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

    **Explanation:** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

OR

(a) Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

**Explanation:** Both assertion and reason are CORRECT and reason is the CORRECT explanation of the assertion.

15. (d) The assertion is a wrong statement but the reason is the correct statement.

**Explanation:** The bond angle in ethers is slightly more than the tetrahedral angle due to repulsion between two bulky alkyl group.

16. (b) Assertion and reason both are wrong statements.

**Explanation:** Thionyl chloride is preferred over phosphorous chlorides because along with the alkyl halides formed, the by-products are $SO_2$ and HCl, which are gaseous and hence can escape the reaction leaving pure halides.

**Section B**

17. $\underset{Ethanol}{CH_3CH_2OH} \xrightarrow{SOCl_2,\ Pyridine} \underset{Chloroethane}{CH_3CH_2Cl} + SO_2 + HCl$

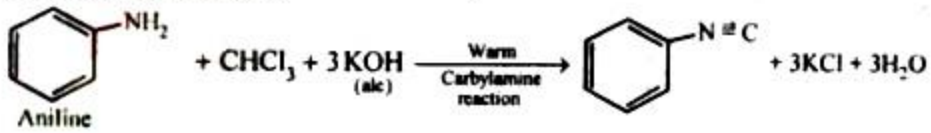
$\underset{Ethyne}{HC \equiv CH} + NaNH_2 \xrightarrow{Liq.NH_3} \underset{Sodium\ acetylide}{HC \equiv \overset{-}{C}\overset{+}{N}a}$

$CH_3CH_2 - Cl + HC \equiv \overset{-}{C}\overset{+}{N}a \rightarrow \underset{But-1-yne}{CH_3CH_2C \equiv CH} + NaCl$

OR

i. $\underset{tert-Butylbromide}{CH_3 - \overset{\overset{CH_3}{|}}{\underset{\underset{Br}{|}}{C}} - CH_3} \xrightarrow[Dehydroha\log enation]{KOH(alc),\Delta} CH_3 - \overset{\overset{CH_3}{|}}{C} = CH_2$

$\xrightarrow[Anti\ Mark.\ Addition]{HBr,Peroxide} CH_3 - \underset{Isobutyl\ bromide}{\overset{\overset{CH_3}{|}}{C}\ H - CH_2Br}$

ii. 


18. The various quantities known to us are as follows osmotic pressure of solution $\Pi$ = 2.57 $\times$ $10^{-3}$ bar.

V = 200 $cm^3$ = 0.200 litre

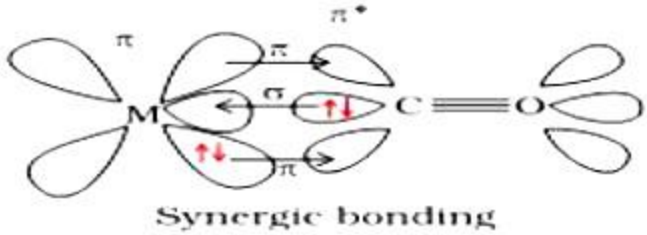
T = 300 K

R = 0.083 L bar $mol^{-1}$ $K^{-1}$

Substituting these values in equation (2.42) we get

$$M_2 = \frac{1.26g \times 0.083 L bar K^{-1} mol^{-1} \times 300K}{2.57 \times 10^{-3} bar \times 0.200 L} = 61.022 \text{ g mol}^{-1}$$

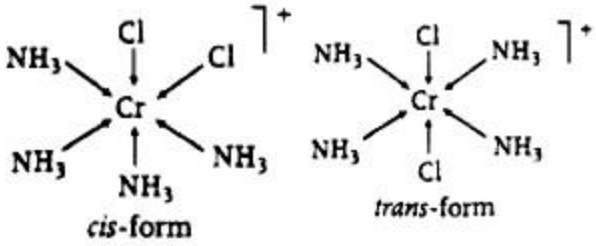
19.




Synergic bonding

OR

i. IUPAC name of $[Cr(NH_3)_4Cl_2]^+$ is tetra ammine dichlorido chromium (III) ion. The two isomers can be represented as :



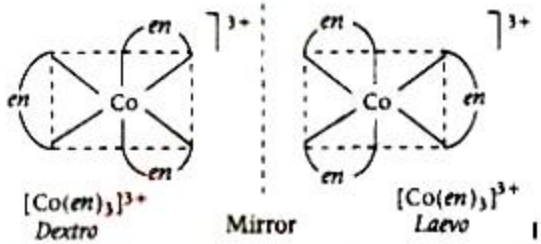

*cis*-form *trans*-form

ii. $[Co(en)_3]^{3+}$

**IUPAC name**

Tris-( ethane -1,2 - diamine) cobalt (Ill) ion

**Structure:** There are two optical isomers of $[Co(en_3]^{3+}$, one is dextro and other is laevo whose structures are:




$[Co(en)_3]^{3+}$ *Dextro* Mirror $[Co(en)_3]^{3+}$ *Laevo*

20. The given reaction is of the first order with respect to A and of zero order with respect to B.

Therefore, the rate of the reaction is given by,

$$Rate = k[A]^1[B]^0$$

Rate = k [A]

From experiment I, we obtain

$$2.0 \times 10^{-2} mol\, L^{-1} \min^{-1} = k(0.1\, mol\, L^{-1})$$

$k = 0.2\text{min}^{-1}$

From experiment II, we obtain

$4.0 \times 10^{-2} mol\, L^{-1}\, \text{min}^{-1} = 0.2\text{min}^{-1}[A]$, so $[A] = 0.2 mol\, L^{-1}$

From experiment III, we obtain

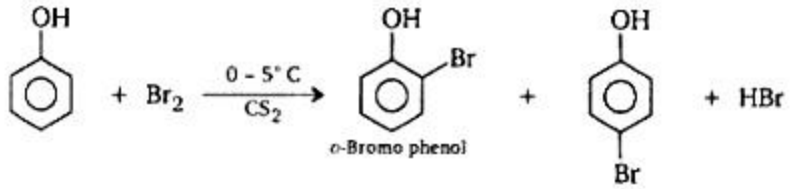
$Rate = 0.2\text{min}^{-1} \times 0.4 mol\, L^{-1} = 0.08\, mol\, L^{-1}\text{min}^{-1}$

From experiment IV, we obtain

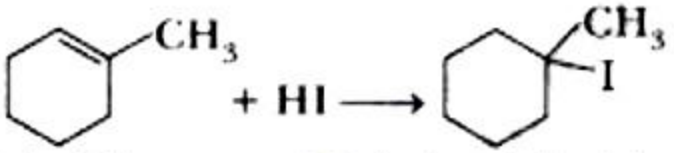
$2.0 \times 10^{-2} mol\, L^{-1}\text{min}^{-1} = 0.2\, \text{min}^{-1}[A]$, so $[A] = 0.1 mol\, L^{-1}$

21. i. Zero order reaction.

ii. $[R] = [R_0] - kt \therefore$ Slope = -k

22. 


23. In zinc salts, $Zn^{2+}$ does not have unpaired electrons, therefore cannot undergo d-d transitions. Whereas in $Cu^{2+}$ ions there is one unpaired electron in d orbital due to which it can undergo d-d transitions and hence $Cu^{+2}$ salts are coloured.

24. 


1-Methylcyclohexene 1-Iodo-1-methylcyclohexane

25. a. Stoichiometric defects i.e., Schottky defect and Frenkel defect.
b. Non-stoichiometric defects i. e., metal excess defect, metal deficiency and
c. Impurity defects

**Section C**

26. The brown ring test for nitrate ions depends on the ability of $Fe^{2+}$ to reduce nitrates to nitric oxide, which reacts with $Fe^{2+}$ to form a brown coloured complex.

In this test, aqueous solution of salt is shaken in a test tube and mixed with an equal volume of freshly prepared ferrous sulphate solution. Now, concentrated sulphuric acid is added dropwise along the walls of the tube without disturbing it till a dark brown fine ring appears at the interface, where the oily layer of sulphuric acid and aqueous layer meet.

The chemical reactions involved are given below:

$NO_3^- + 3Fe^{2+} + 4H^+ \rightarrow NO + 3Fe^{3+} + 2H_2O$

$$[Fe(H_2O)_6]^{2+} + NO \rightarrow [Fe(H_2O)_5NO]^{2+} + H_2O$$

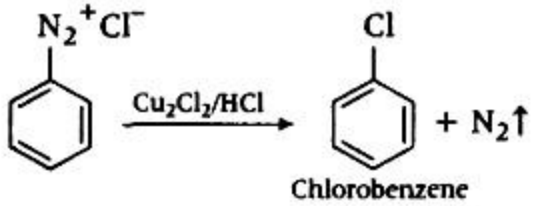
OR

Bartlet (1962) prepared a red compound of formula $O_2^+[PtF_6]^-$ dioxygenyl hexafluoroplatinate (V). He argued that the first ionization energy of oxygen $O_2$ [=1180 kJ $mol^{-1}$] was almost identical with that of xenon (1170 kJ $mol^{-1}$).

He thought that if oxygen could form such compounds, xenon should also forms similar compounds. He prepared $Xe^+[PtF_6]^-$ (a red compound) by mixing $PtF_6$ with xenon.

$Xe + PtF_6 \rightarrow Xe^+[PtF_6]^-$

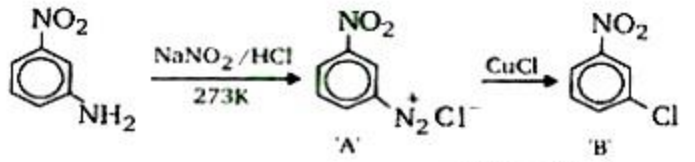
27. i. $C_6H_5\text{-}NO_2 \xrightarrow{Sn/HCl} C_6H_5.NH_2$ (Aniline)

ii. 

Chlorobenzene

iii. $CH_3CONH_2 \xrightarrow[Hofmann\ bromamide\ degradation]{Br_2/KOH} CH_3NH_2 + K_2CO_3 + 2KBr + 2H_2O$

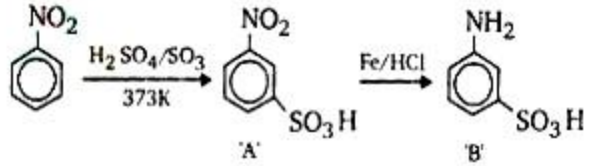
OR

i. 

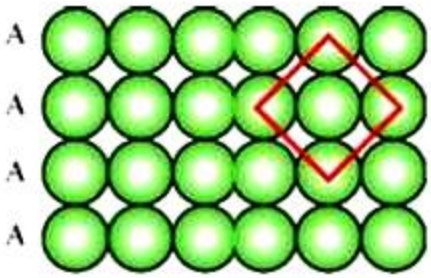
3-Chloronitrobenzene

ii. $CH_3CH_2CH_2Br \xrightarrow{NaGN} \underset{'A'}{CH_3CH_2CH_2C \equiv N} \xrightarrow{LiAJH_4}$

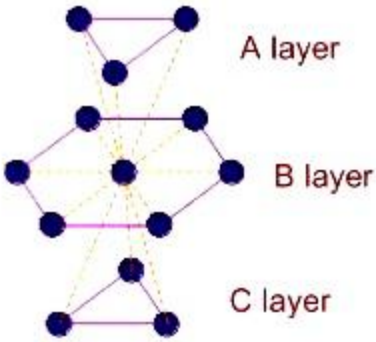
$CH_3CH_2CH_2CH_2NH_2$
$Butanamine$
$'B'$

iii. 


28. a. In square close packing, the coordination no. is 4.




b. In hexagonal close packing, the coordination no. is 12.




29. i. **Peptide linkage.** Amino acids are bifunctional molecules with $NH_2$ group at one end and COOH at the other. Therefore, the COOH of one molecule and $NH_2$ of another molecule interact by elimination of $H_2O$ to form an amide like linkage called peptide bond or peptide linkage.

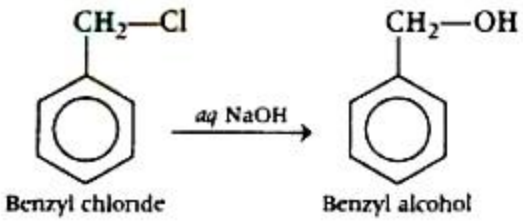
ii. **Primary structure.** The sequence in which amino acids are linked with each other in polypeptide chain form primary structure.

iii. **Denaturation.** The process of by which secondary and tertiary structure of proteins get disturbed on change of pH or temperature and they are not able to perform their functions. This is called denaturation of proteins.

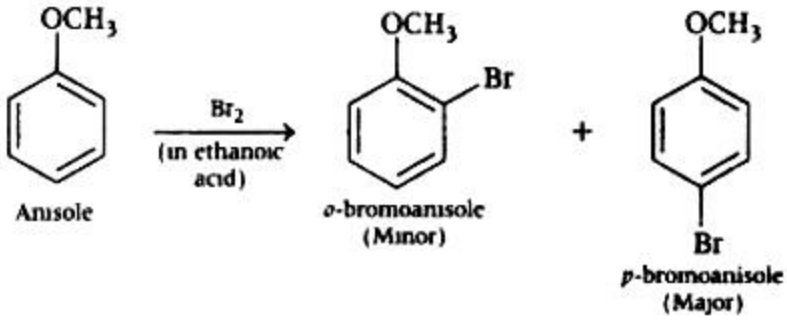
30. i. **Propene to propan-2-ol** Addition of $H_2SO_4$ takes place (in accordance with Markownikoffs rule) while converting propene to propan-2-ol.

$$\underset{\text{Pr}opene}{CH_3CH=CH_2} + H_2O \xrightarrow{H_2SO_4} \underset{\text{Pr}opan-2-ol}{CH_3-\underset{\displaystyle OH}{\underset{|}{C}}H-CH_3}$$

ii.




iii.




## Section D

31. i. Mn shows the highest number of oxidation state. Mn has electronic configuration [Ar] $3d^5 4s^2$. It has the maximum number of unpaired electrons in d orbitals and all the electrons in s-orbital as well as in d-orbital can take part in bond formation, therefore, it shows +7 highest oxidation state.

    ii. Chromium has the highest melting point among all the given elements.

    iii. Scandium shows only +3 oxidation state.

    iv. In the +3 oxidation state, Mn is a strong oxidising agent because in $Mn^{3+}$ ion, Mn exists in $3d^4$ configuration which is less stable and it can reduce to $Mn^{2+}$ giving a more stable $3d^5$ configuration. Hence, it acts as a strong oxidising agent.

    v. The electronic configuration is as follows:

    Sc- $[Ar]4s^2 3d^1$

    Zn- $[Ar]4s^2 3d^{10}$

OR

a. i. Manganese shows maximum number of oxidation states in 3d series due to the presence of maximum number of unpaired electrons.

    ii. $E^o$ value for $Mn^{3+}/Mn^{2+}$ couple is much more positive than that for $Cr^{3+}/Cr^{2+}$ because Cr is more stable in +3 oxidation state due to stable $t^3_{2g}$ configuration whereas Mn is more stable in +2 oxidation state due to half filled $3d^5$ configuration.

b. Preparation of $KMnO_4$ from $MnO_2$ :

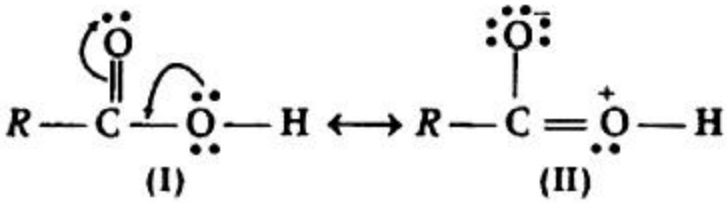
$$2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$$

$$2K_2MnO_4 + 4HCl \rightarrow 2KMnO_4 + MnO_2 + H_2O + 4KCl$$

32. i. a. Cl- $CH_2COOH$ is a stronger acid than $CH_3COOH$. It is because - Cl group exhibits -I-

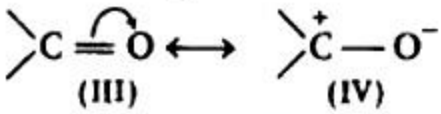
effect which makes the carboxylate ion more stable. Higher the stability of carboxylate ion, easier is the removal of a proton from the carboxylic acid and stronger is the acid. In $CH_3COOH$, - $CH_3$ group has +I-effect which destabilised it. Hence, $CH_3COOH$ is a weaker acid.

b. The carboxylic acids may be regarded as a resonance hybrid of structures I and II as.



(I) (II)

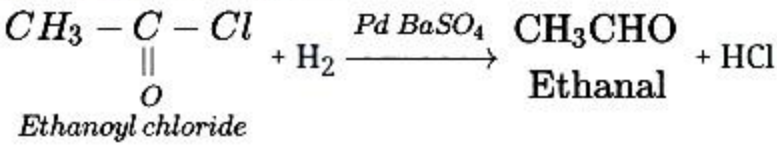
Similarly, the carbonyl group of aldehydes and ketones may be regarded as a resonance hybrid of structures III and IV.



(III) (IV)

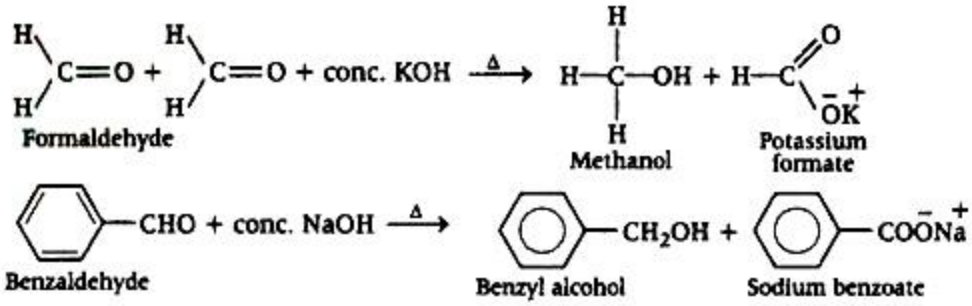
Due to the contribution of structure IV, the carbonyl carbon in aldehydes and ketones is electrophilic. However, due to the contribution of structure II of carboxylic acid, the electrophilic character of carboxyl carbon is reduced.

ii. a. **Rosemund reduction**



*Ethanoyl chloride*

b. **Cannizzaro reaction** Aldehydes which do not have n-H atoms undergo self oxidation and reduction reaction on treatment with cone. alkali this reaction is known as Cannizzaro reaction. In this reaction, one molecule of aldehyde is reduced to alcohol while another molecule is oxidised to the salt of carboxylic acid.



Formaldehyde — Methanol — Potassium formate



Benzaldehyde — Benzyl alcohol — Sodium benzoate

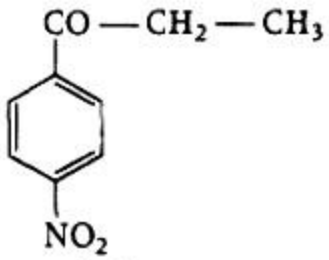
iii. $CH_3CH_2$- $CH_2$- CO - $CH_3$ gives iodoform test as it contains $CH_3CO$- group.

OR

i. a. $\overset{1}{C}H_3 - \overset{2}{C}O - \overset{3}{C}H_2 - \overset{4}{C}H(Cl) - \overset{5}{C}H_3$

$4-chloropentan-2-one$

b.



*p*-nitropropiophenone

ii. i. **Distinguishing test between ethanal and propanal**

Iodoform test Ethanal because of the presence of $CH_3CO$- skeleton gives positive iodoform test whereas propanal due to the absence of such a skeleton does not gives such test.

$CH_3CHO$ Ethanal Or Acetaldehyde $+ 4NaOH + 3I_2 \longrightarrow$ $CHI_3$ (Yellow ppt) Iodoform $+$ $HCO\overline{N}^{+}a$ Sodium formate $+$ $3NaI$ *Sodium iodade* $+ 3H_2O$

$CH_3CH_2CHO$ Propanal $+ 4NaOH + 3I_2 \longrightarrow$ No reaction

33. $E^0_{cell} = [E_{cathode} - E_{anode}]$

= [- 0.40 - (-0.44)]

= [- 0.40 + 0.44] = 0.04 V

Since $E^0_{cell} = \frac{0.059}{n} \log K_c$

$\log K_c = \frac{2 \times 0.04}{0.059} = 1.356$

$K_c$ = anti log

(1.356) = 22.70

OR

i. The molar conductivity at infinite dilution for a given salt can be expressed as the sum of the individual contribution from the ions of electrolytes.

ii. $\Lambda^\circ CH_3COOH = ?$

$\Lambda^\circ CH_3COO^- + \Lambda^\circ H^+ = \Lambda^\circ CH_3COO^- + \Lambda^\circ Na^+ + \Lambda^\circ H^+ + \Lambda^\circ Cl^- - \Lambda^\circ Na^+ - \Lambda^\circ Cl^-$

$\Lambda_m^\circ\ CH_3COOH = \Lambda^\circ CH_3COONa + \Lambda^\circ HCl - \Lambda^\circ NaCl$

iii. $\Lambda_m^\circ\ CH_3COOH = \Lambda^\circ CH_3COONa + \Lambda^\circ HCl - \Lambda^\circ NaCl$

$= 91.0 + 425.9 - 126.4$

$= 390.5\ S\ cm^2\ mol^{-1}$