Class XII Session 2024-25
Subject - Chemistry
Sample Question Paper - 9

Time Allowed: 3 hours   **Maximum Marks: 70**

General Instructions:

Read the following instructions carefully.

1. There are **33** questions in this question paper with internal choice.

2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.

3. SECTION B consists of 5 very short answer questions carrying 2 marks each.

4. SECTION C consists of 7 short answer questions carrying 3 marks each.

5. SECTION D consists of 2 case-based questions carrying 4 marks each.

6. SECTION E consists of 3 long answer questions carrying 5 marks each.

7. **All questions are compulsory.**

8. **Use of log tables and calculators is not allowed.**

Section A

1. Which one of the following is a synthetic halogen compound?   **[1]**

   a) Chloramphenicol   b) Diphenyl hydramine

   c) Chloroquine   d) Omeprazole

2. On hydrolysis, which of the following carbohydrates gives glucose and fructose?   **[1]**

   a) Starch   b) Maltose

   c) Lactose   d) Sucrose

3. The major product of acid catalysed dehydration of 1-methylcyclohexanol is: **[1]**

   a) 1-methylenecyclohexane   b) 1-methylcyclohexene

   c) 1-methylcyclohexane   d) 1-cyclohexylmethanol

4. Give the products of the reaction   **[1]**

   $$PhC \equiv CMe \xrightarrow{H_3O^+, Hg^{2+}} ?$$

   a) $PhCH_2CH_2CHO$ b) $PhCOCH_2CH_3$

   c) $PhCOCOMe$ d) $PhCH_2COCH_3$

5. A reaction follows second order kinetics. How is the rate of reaction affected if the concentration of the reactant is reduced to half? Choose the correct value from the following: **[1]**

   a) four times   b) $\frac{1}{4}$ of the original value

   c) three times   d) eight times

6. Match the types of solutions given Column I to the examples given in Column II. **[1]**

Column I	Column II
(a) Solution of gas in gas	(i) Brass
(b) Solution of solid in solid	(ii) Air
(c) Solution of liquid in gas	(iii) Zinc amalgam
(d) Solution of liquid in solid	(iv) Chloroform in Nitrogen

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

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

7. Which of the following compounds has the highest boiling points? **[1]**

    a) $CH_3CH_2CH_2Cl$ b) $CH_3CH_2CH_2CH_2Cl$

    c) $(CH_3)_3Cl$ d) $CH_3CH(CH_3)CH_2Cl$

8. Interstitial compounds are formed when small atoms are trapped inside the crystal lattice of metals. Which of the following is not the characteristic property of interstitial compounds? **[1]**

    a) They retain metallic conductivity.   b) They have high melting points in comparison to pure metals.

    c) They are chemically very reactive.   d) They are very hard.

9. Rate of reaction does not remain constant throughout because **[1]**

    a) The density of reactants keep on changing   b) Concentration of reactants keep on changing

    c) Volume of reactants keep on changing   d) Temperature of reactants keep on changing

10. Iodoform test is given by **[1]**

    a) Ethanoic acid   b) Pentan-3-one

    c) Methoxymethane   d) Pentan-2-one

11. The reaction $C_2H_5ONa + C_2H_5I \rightarrow C_2H_5OC_2H_5 + NaI$ is known as: **[1]**

    a) Williamson's synthesis   b) Grignard's synthesis

    c) Wurtz's synthesis   d) Kolbe's synthesis

12. Aniline reacts with sodium nitrite and hydrochloric acid at 273-278K to give: **[1]**

    a) Chlorobenzene   b) Benzene diazonium chloride

    c) o-chloroaniline   d) Benzene

13. **Assertion (A):** At isoelectric point, the amino group does not migrate under the influence of electric field. **[1]**

    Reason (R): At isoelectric point, amino acid exists as a zwitterion.

    a) Both A and R are true and R is the correct explanation of A.   b) Both A and R are true but R is not the correct explanation of A.

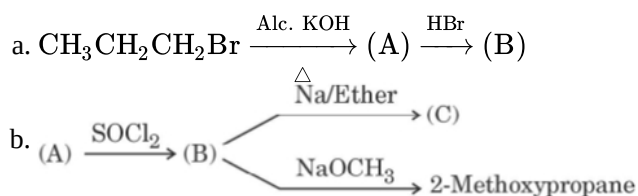   c) A is true but R is false.   d) A is false but R is true.

14. **Assertion (A):** Halogen acids do not add on to carbonyl bond. **[1]**

    Reason (R): Addition depends upon the polarisation of HX and carbonyl bond.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

15. **Assertion (A):** In comparison to ethyl chloride it is difficult to carry out nucleophilic substitution on vinyl chloride. **[1]**

Reason (R): Vinyl group is electron-donating.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

16. **Assertion (A):** Ortho-nitrophenol is more acidic than phenol. **[1]**

Reason (R): Nitro group is electron donating group and therefore stabilizes ortho-nitrophenoxide ion.

a) Both A and R are true and R is the correct explanation of A.

b) Both A and R are true but R is not the correct explanation of A.

c) A is true but R is false.

d) A is false but R is true.

Section B

17. Complete the following reactions: **[2]**

a. $CH_3CH_2CH_2Br \xrightarrow{\text{Alc. KOH}} (A) \xrightarrow{\text{HBr}} (B)$

b. $(A) \xrightarrow{\text{SOCl}_2} (B) \begin{cases} \xrightarrow{\overset{\triangle}{\text{Na/Ether}}} (C) \\ \xrightarrow{\text{NaOCH}_3} \text{2-Methoxypropane} \end{cases}$

18. Transition metals can act as catalysts because these can change their oxidation state. How does Fe(III) catalyze the reaction between iodide and persulphate ions? **[2]**

19. **Answer the following:** **[2]**

(a) Give two examples of non-chemical process which obeys the first order kinetics. **[1]**

(b) The following results have been obtained during the kinetic studies for the reaction: **[1]**

P + 2Q → R + 2S
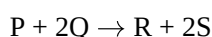
Exp.	Initial P(mol/L)	Initial Q (mol/L)	Init. Rate of Formation of R(M min^{-1})
1	0.10	0.10	3.0×10^{-4}
2	0.30	0.30	9.0×10^{-4}
3	0.10	0.30	3.0×10^{-4}
4	0.20	0.40	6.0×10^{-4}

Determine the rate law expression for the reaction.

20. A person suffering from high blood pressure should take less common salt, why? **[2]**

OR

Define the terms: Van't Hoff factor

21. What happens when calcium ethanoate is dry distilled? **[2]**

Section C

22. What is the difference between Galvanic cell (Electrochemical cell) and Electrolytic cell. **[3]**

23.   i. Define rate constant of reaction. **[3]**

   ii. A first order reaction takes 40 mins for 30% decomposition. Calculate $t_{1/2}$.

24. While separating a mixture of ortho and para nitrophenols by steam distillation, name the isomer which will be **[3]** steam volatile. Give reason.
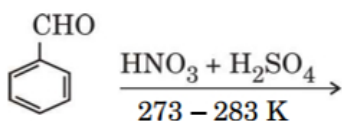
<div align="center">OR</div>

Give the structures and IUPAC names of the products expected from the following reactions:

   a. Catalytic reduction of butanol.

   b. Hydration of propene in the presence of dilute sulphuric acid.

   c. Reaction of propanone with methyl magnesium bromide followed by hydrolysis.

25. Write the major products in the following: **[3]**

   i.

   ii.

   iii.

$$CH_3 - \underset{\underset{H}{|}}{C} = O \xrightarrow{NH_2OH}$$
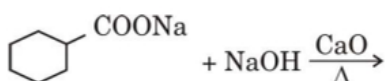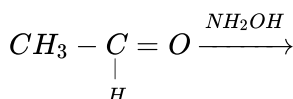
26. Calculate the emf of the following cell at 25°C. **[3]**

   $Fe\,|Fe^{2+}(0.001M)\|H^+(0.01M)|H_2(g)(1\text{ bar })|Pt(s)$

   Given that, $E^o_{Fe^{2+}/Fe}$ = -0.44 V; $E^o_{H^+/H_2}$ = 0.00 V

27. What are ambident nucleophiles? Explain with an example. **[3]**

28. Explain with examples the terms weak and strong electrolytes. **[3]**

<div align="center">**Section D**</div>

29. **Read the following text carefully and answer the questions that follow:** **[4]**

   The d-block of the periodic table contains the elements of the groups 3 to 12 and are known as transition

   elements. In general, the electronic configuration of these elements is $(n - 1)d^{1-10} ns^{1-2}$. The d-orbitals of the

   penultimate energy level in their atoms receive electrons giving rise to the three rows of the transition metals i.e.

   3d, 4d and 5d series. However, Zn, Cd and Hg are not regarded as transition elements. Transition elements

   exhibit certain characteristic properties like variable oxidation stables, complex formation, formation of coloured

   ions, alloys, catalytic activity etc. Transition metals are hard (except Zn, Cd and Hg) and have a high melting

   point.

   i. Why are Zn, Cd and Hg non-transition elements? (1)

   ii. Which transition metal of 3d series does not show variable oxidation state? (1)

   iii. Why do transition metals and their compounds show catalytic activity? (2)

   OR

   Why are melting points of transition metals high? (2)

30. **Read the following text carefully and answer the questions that follow:** **[4]**

   Raoult's law states that for a solution of volatile liquids, the partial vapour pressure of each component of the

solution is directly proportional to its mole fraction present in solution. Dalton's law of partial pressure states that the total pressure (P_{total}) over the solution phase in the container will be the sum of the partial pressures of the components of the solution and is given as: $P_{total} = P_1 + P_2$
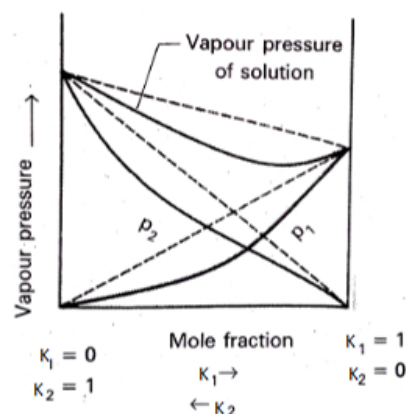
i. Is the above-mentioned Raoult's law applicable for non-volatile liquids? (1)

ii. What type of deviation from Raoult's law does the above graph represent? (1)

iii. Give an example of such system. (2)

OR

A solution of two liquids boils at a temperature more than the boiling point of either of them. What type of deviation will be shown by the solution formed in terms of Raoult's law? (2)

Section E

31. **Attempt any five of the following:** **[5]**

   (a)   Why are polysaccharides considered non-sugars? **[1]**

   (b)   What is meant by invert sugars? **[1]**

   (c)   Write the name of the component of starch which is water-soluble. **[1]**

   (d)   Write the products obtained after hydrolysis of DNA. **[1]**

   (e)   Name the deficiency disease resulting from lack of vitamin A and E in the diet. **[1]**

   (f)   Which vitamin is linked with anti-sterility? **[1]**

   (g)   a. What is the difference between a nucleoside and nucleotide? **[1]**

   b. What products would be formed when a nucleotide from DNA containing thymine is hydrolysed?

32. Write down the IUPAC name for each of the following complexes and indicate the oxidation state, electronic **[5]** configuration, and coordination number. Also, give stereochemistry and magnetic moment of the complex:

   a. $K[Cr(H_2O)_2\}(C_2O_4)_2].3H_2O$

   b. $[Co(NH_3)_5Cl]Cl_2$

   c. $CrCl_3(py)_3$

   d. $Cs[FeCl_4]$

   e. $K_4[Mn(CN)_6]$

   OR

Indicate the types of isomerism exhibited by the following complexes and draw the structures for these isomers:

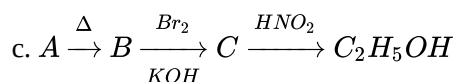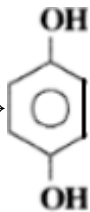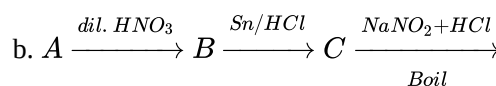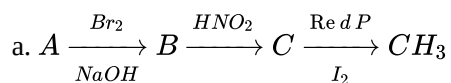   i. $k\ [Cr(H_2O)_2(C_2O_4)_2]$

   ii. $[Co(en)_3]\ Cl_3$

   iii. $[Co(NH_3)_5\ (NO_2)\ (NO_3)_2]$

iv. [Pt(NH$_3$ (H$_2$O) Cl$_2$

33.   i. How will you convert: **[5]**

     a. Nitrobenzene to phenol,

     b. Aniline to chlorobenzene

  ii. Identify the compounds A, B and C in the following reactions:

     a. $A \xrightarrow[NaOH]{Br_2} B \xrightarrow{HNO_2} C \xrightarrow[I_2]{\text{Re}\,d\,P} CH_3$

     b. $A \xrightarrow{dil.\,HNO_3} B \xrightarrow{Sn/HCl} C \xrightarrow[Boil]{NaNO_2 + HCl}$ (OH–benzene ring–OH)

     c. $A \xrightarrow{\Delta} B \xrightarrow[KOH]{Br_2} C \xrightarrow{HNO_2} C_2H_5OH$

<div align="center">OR</div>

  i. Write the structure of main products when aniline reacts with the following reagents :

     a. Br$_2$ water

     b. HCl

     c. (CH$_3$CO)$_2$O/pyridine

  ii. Arrange the following in the increasing order of their boiling point: C$_2$H$_5$NH$_2$, C$_2$H$_5$OH, (CH$_3$)$_3$N

  iii. Give a simple chemical test to distinguish between the following pair of compounds : (CH$_3$)$_2$NH and (CH$_3$)$_3$N.

Solution

1.

    (c) Chloroquine

    Explanation: Chloroquine is a synthetic halogen compound. It is used for the treatment of malaria.

2.

    (d) Sucrose

    Explanation: When hydrolyzed sucrose gives two products that is: glucose and fructose.

3.

    (b) 1-methylcyclohexene

    Explanation: According to Saytzeff rule, i.e., highly substituted alkene is major product. Here dehydration reaction takes place, alkene is formed due to the removal of a water molecule

    l-Methylcyclohexanol l-Methylcyclohexene l-Methylene
                          (Major product)   cyclohexane
                                               (Minor product)
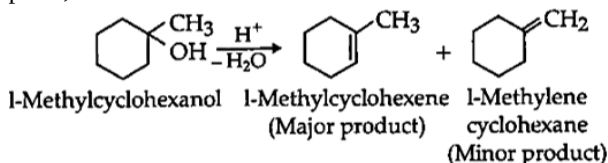
4.

    (b) PhCOCH$_2$CH$_3$

    Explanation: Hydration of given alkyne will occur according to Markovnikoff's rule leading to the formation of enol which will tautomerise to give keto form.

    The general reaction of alkyne hydrations shown below:
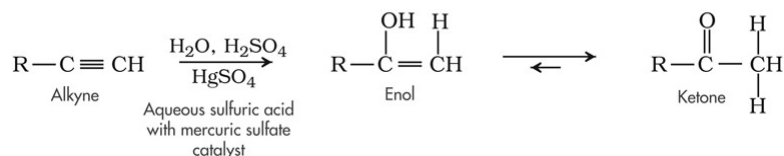
    Same reaction will occur with

    $$PhC \equiv CMe \xrightarrow{H_3O^+, Hg^{2+}} ? \, PhC(OH) = CHCH_3 \Leftrightarrow PhCOCH_2CH_3 \;.$$
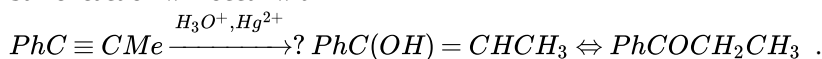
5.

    (b) $\frac{1}{4}$ of the original value

    Explanation: $\frac{1}{4}$ of the original value

6.

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

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

7.

    (b) CH$_3$CH$_2$CH$_2$CH$_2$Cl

    Explanation: The forces of attraction between the molecules of a compound get stronger as they get bigger in size and have more electrons. Also, for a straight-chain compound, the points of interaction between the molecules are more than for a branched compound having the same molecular formula. Thus CH$_3$CH$_2$CH$_2$CH$_2$Cl has the highest melting point since it is the longest chain compound among the given options.

8.

    (c) They are chemically very reactive.

    Explanation: Interstitial compounds are chemically inert not reactive.

9.

    (b) Concentration of reactants keep on changing

Explanation: Rate of reaction is dependent on the concentration of reactants if the concentration of reactants change then the rate of reaction become non-uniform.
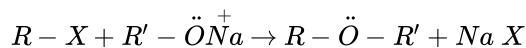
10.

(d) Pentan-2-one

Explanation: Pentan-2-one

11. **(a)** Williamson's synthesis

Explanation: Williamson's synthesis: When an alkyl halide reacts with sodium alkoxide, ether is formed. This reaction is known as Williamson's synthesis. The reaction generally follows the S_N2 mechanism for primary alcohols.

$$R - X + R' - \overset{+}{\ddot{O}Na} \rightarrow R - \ddot{O} - R' + Na\ X$$

$$\textit{Williamson's synthesis}$$

12.

(b) Benzene diazonium chloride

Explanation: Benzene diazonium chloride

13. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

14. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: The high degree of polarity in HX as well as in carbonyl bond shows the easy addition of HX on carbonyl bond but as soon as the addition products are formed, the products loses HX to show the backward reaction.

15.

(c) A is true but R is false.

Explanation: $CH_2=CH-Cl$ has some partial double bond character between carbon and a chlorine atom. So, nucleophilic substitution is difficult to carry as it is difficult to break the partial double bond in vinyl chloride than ethyl chloride CH_3CH_2 $-Cl$ where there is no double bond character.

The vinyl group is not electron-donating. The carbon halogen bond in vinyl halides has some double-bond character and thus a little difficult to break.

16.

(c) A is true but R is false.

Explanation: A is true but R is false.
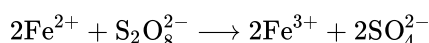
Section B

17. Compound

a. (A) = CH_3-CH=CH_2,

(B) =
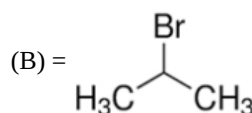
b. $(A) = CH_3 - \underset{OH}{CH} - CH_3$, $(B) = CH_3 - \underset{Cl}{CH} - CH_3$, $(B) = CH_3 - \underset{CH_3-CH-CH_3}{CH} - CH_3$

18. Transition metals can act as catalysts because these can change their oxidation state. The reaction between iodide and persulphate ions catalyzes by Fe is as follows:

$$2I^- + S_2O_8^{2-} \xrightarrow{\text{Fe(III)}} I_2 + 2SO_4^{2-}$$

Role of Fe(III) ions:

$$2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$$

$$2Fe^{2+} + S_2O_8^{2-} \longrightarrow 2Fe^{3+} + 2SO_4^{2-}$$
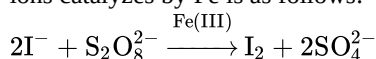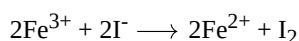
19. Answer the following:

(i)   i. Rate of growth of population, if there is no change of birth and death rates.

ii. Radioactive decay in which the number of nuclei disintegrating is proportional to the number of nuclei present.

(ii) Let the rate law expression be rate = $k[P]^x [Q]^y$ from the table we know that

Rate 1 = 3.0×10^{-4} = k $(0.10)^x (0.10)^y$

Rate 2 = 9.0×10^{-4} = $k(0.30)^x (0.30)^y$

Rate 3 = 3.0 × 10⁻⁴ = k (0.10)^x (0.30)^y

$\frac{Rate 1}{Rate 3} = \left(\frac{1}{3}\right)^y$ or $1 = \left(\frac{1}{3}\right)^y$

So y = 0

$\frac{Rate 2}{Rate 3} = (3)^x$ or $3 = (3)^y$

So x = 1

Rate = k [P]

20. Common salt contains Na^+ and Cl^- which increase osmotic pressure of blood, therefore increase blood pressure. So an increase in salt intake retains the fluids which raises the blood pressure by increasing the blood volume and can increase the work load on the heart.

OR

Van't Hoff factor: Van't hoff factor 'i' is a correction factor defined as the ratio between the actual concentration of particles produced when the substance is dissolved and the concentration of a substance as calculated from its mass.

$i = \frac{\text{Observed value of colligative property}}{\text{Normal value of colligative property}}$

21. Calcium ethanoate on dry distillation gives propanone.
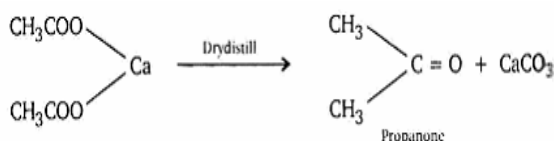
Section C

22.

Electrochemical cell	Electrolytic cell
(1) It is a device to convert chemical energy into electrical energy.	(1) It is a device to convert electrical energy into chemical energy.
(2) It is based upon the redox reaction which is spontaneous.	(2) The redox reaction is non-spontaneous and takes place only when electric energy is supplied.
(3) To set up this cell, a salt bridge or porous pot is used.	(3) No salt bridge is used in this case.

23. i. **Rate constant :** It is the rate of chemical reaction when the concentration of reactant taken as unity at a given temperature.

ii. Let initial conc. = a

conc. after 40 mins. $= a - \frac{a \times 30}{100}$

= 0.70 a

$K = \frac{2.303}{t} \log \frac{[A]_0}{[A]}$

$= \frac{2.303}{40} \log \frac{a}{0.70a}$

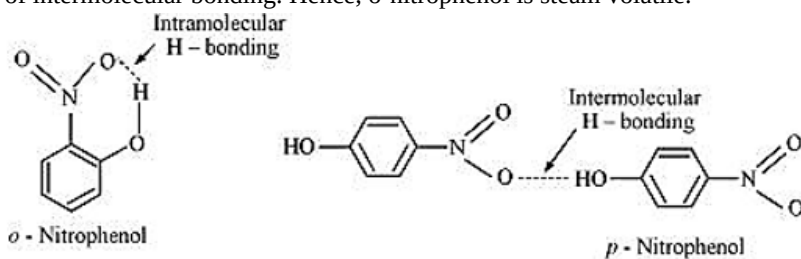$= \frac{2.303}{40} \log \frac{1}{0.70}$

$= \frac{2.303}{40} \times 0.1549$
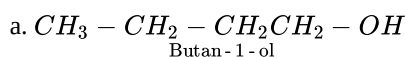
$= 8.92 \times 10^{-3} \text{min}^{-1}$

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

$= \frac{0.693}{8.92 \times 10^{-3}}$

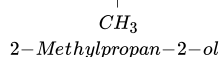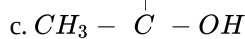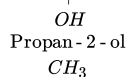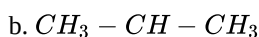= 77.7 min

24. Intramolecular H-bonding is present in o-nitrophenol. In p-nitrophenol, the molecules are strongly associated due to the presence of intermolecular bonding. Hence, o-nitrophenol is steam volatile.
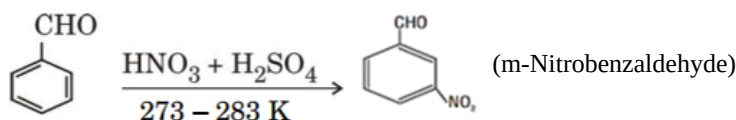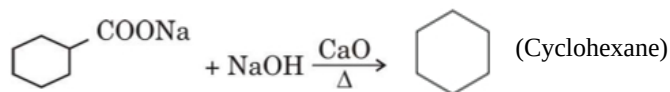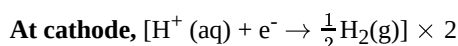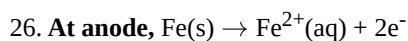

OR

a. $CH_3 - CH_2 - CH_2CH_2 - OH$
Butan - 1 - ol

b. $CH_3 - CH - CH_3$
           |
          OH
        Propan - 2 - ol

            CH_3
            |
c. $CH_3 - \;\; C \;\; - OH$
            |
            CH_3
     $2-Methylpropan-2-ol$

25. i.

  $\xrightarrow[273-283\ K]{HNO_3 + H_2SO_4}$ (m-Nitrobenzaldehyde)

ii.

$+ NaOH \xrightarrow[\Delta]{CaO}$ (Cyclohexane)

iii.

$CH_3 - \underset{H}{C} = O \xrightarrow{NH_2OH} \underset{\underset{H}{|}}{CH_3-C}=N-OH$ (Ethanal oxime)

26. **At anode,** $Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$

At cathode, $[H^+ (aq) + e^- \rightarrow \frac{1}{2}H_2(g)] \times 2$

Overall reaction:

$Fe(s) + 2H^+(aq) \rightarrow Fe^{2+}(aq) + H_2(g)$

Given, $E^o_{Fe^{2+}/Fe}$ = -0.44 V and $E^o_{H^+/H_2}$ = 0.00 V

E^o(cell) = E^o(cathode) - E^o(anode) = [0.00- (-0.44)] = 0.44V
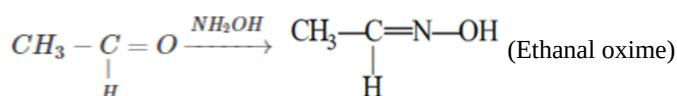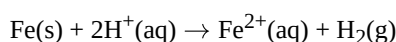
Now, Applying Nernst equation:

$E_{cell} = E^o_{cell} - \frac{0.00591}{2}\log\frac{[Fe^{2+}]}{[H^+]^2} = 0.44 - \frac{0.00591}{2}\log\frac{10^{-3}}{(10^{-2})^2}$

$= 0.44 - \frac{0.00591}{2} = 0.4104$ V

27. Ambident nucleophiles are nucleophiles having two nucleophilic sites. Thus, ambident nucleophiles have two sites through which they can attack.

For example, nitrite ion is an ambident nucleophile.

$\left[^-O - \ddot{N} = O \right]$
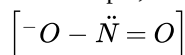
Nitrite ion can attack through oxygen resulting in the formation of alkyl nitrites. Also, it can attack through nitrogen resulting in the formation of nitroalkanes.
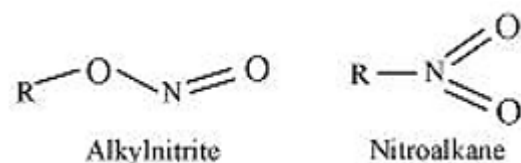
28. **Weak electrolytes:** Weak electrolytes are those which do not dissociate into ions completely in aqueous solution e.g. CH_3COOH

Strong electrolytes : Strong electrolytes are those which dissociate into ions completely in aqueous solution e.g. NaCl

Section D

29. i. It is because neither they nor their ions have incompletely filled d-orbitals.

ii. Scandium (Sc) and Zinc (Zn).

iii. It is because they show variable oxidation state, can form intermediate complexes and have large surface area for adsorption of gases.

OR

It is due to strong interatomic forces of attraction due to presence of unpaired electrons.

30. i. KCl in a kg of water would be expected to increase the boiling point by 2 × 0.52 K = 1.04 K. This could led us to conclude that mass of 2 moles of particles is 74.5 g hence mass of 1 mole of KCl would be 37.25 g. Hence, in case of KCl where dissociation occurs experimentally determined molar mass is always lower than true value.

ii. Negative Deviation.

iii. A liquid mixture consisting of 20 % acetone and 80%. chloroform by mass.

OR

Negative Deviation.

Section E

31. Attempt any five of the following:

(i) Polysaccharides are not sweet in taste & hence are called non-sugars.

(ii) Hydrolysis of sucrose brings about a change in sign of rotation from dextro (+) to laevo (-) and hence, it is known as invert sugar.

(iii)The component of starch which is water-soluble - Amylose.

(iv)Hydrolysis of DNA gives 2-deoxyribose, nitrogen containing heterocyclic base(Adenine, Guanine, Cytosine and Thymine), phosphoric acid.

(v) Deficiency of A cause Xerophthalmia and E causes muscular weakness.

(vi)Vitamin E.

(vii) a. Nucleoside $\rightarrow$ Nitrogenous base + Sugar whereas

   Nucleotide $\rightarrow$ Nitrogenous base + Sugar + Phosphate group.

b. Thymine base, 2-Deoxyribose sugar, and a Phosphoric acid.

32. a. $K[Cr(H_2O)_2\}(C_2O_4)_2].3H_2O$

The IUPAC name = Potassium diaquadioxalatochromate (III) trihydrate.
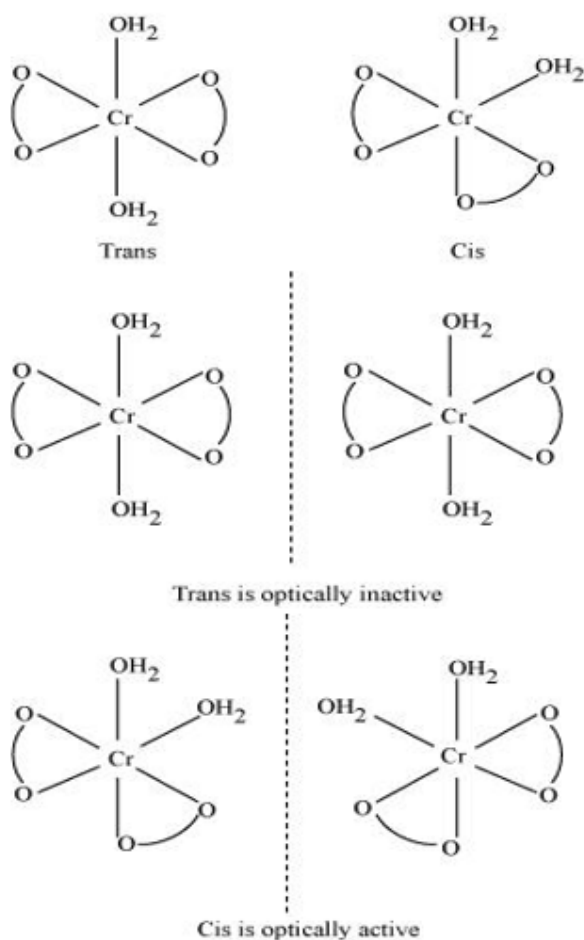
The Oxidation state of chromium = 3

Electronic configuration: $3d^3 : t_{2g}^3$

Coordination number od compound = 6

Shape: octahedral

Stereochemistry:

Trans

Cis

Trans is optically inactive

Cis is optically active

Magnetic moment, $\mu = \sqrt{n\,(n+2)}$

$= \sqrt{3\,(3+2)}$

$= \sqrt{15} \sim 3.87 BM$

b. $[Co(NH_3)_5Cl]\,Cl_2$

The IUPAC name: Pentaamminechloridocobalt(III) chloride
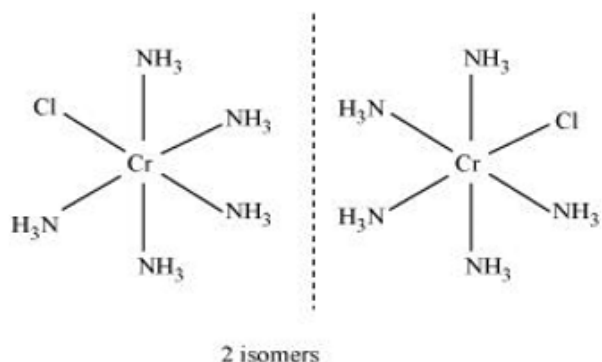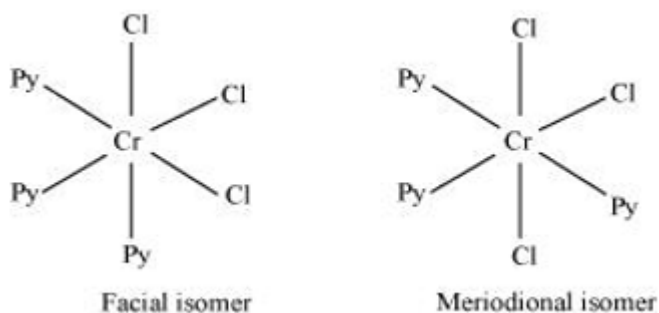
The oxidation state of Co = +3

Coordination number of compound = 6

Shape: octahedral.

Electronic configuration:

$d^6 : t_{2g}{}^6$

Stereochemistry:

2 isomers

Magnetic Moment = 0

c. CrCl₃(py)3

The IUPAC name: Trichloridotripyridinechromium (III)

The oxidation state of chromium = +3

Electronic configuration for $d^3 = t_{2g}{}^3$

Coordination number of compound = 6

Shape: octahedral.

Stereochemistry:

Facial isomer　　　　　Meriodional isomer

Both isomers are optically active. Therefore, a total of 4 isomers exist. Magnetic moment,

$\mu = \sqrt{n\,(n+2)} = \sqrt{3\,(3+2)}$

$= \sqrt{15} \sim 3.87\,BM$

d. $Cs\,[FeCl_4]$

The IUPAC name : Caesium tetrachloroferrate (III)

The oxidation state of Fe = +3

Electronic configuration of $d^6 = e_g{}^2 t_{2g}{}^3$

Coordination number of compound = 4

Shape: tetrahedral

Stereochemistry: optically inactive

Magnetic moment:

$\mu = \sqrt{n\,(n+2)} = \sqrt{5\,(5+2)}$

$= \sqrt{35} \sim 6\,BM$

e. K₄[Mn(CN)₆]

The IUPAC name = Potassium hexacyanomanganate (II)

The oxidation state of manganese = +2

Electronic configuration: $d^{5+} : t_{2g}{}^5$

Coordination number of compound = 6
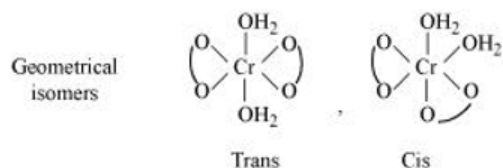
Shape: octahedral.

Stereochemistry: optically inactive Magnetic moment, $\mu = \sqrt{n(n+2)}$
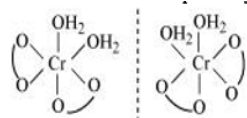
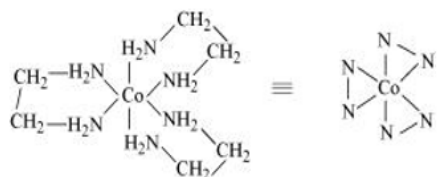$= \sqrt{1(1+2)} = \sqrt{3}$

= 1.732

<div align="center">OR</div>

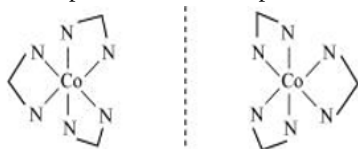i. Both geometrical (cis-, trans-) isomers for k [Cr(H$_2$O)$_2$(C$_2$O$_4$)$_2$] can exist. Also, optical isomers for cis-isomer exist.

Trans-isomer is optically inactive. On the other hand, cis-isomer is optically active.
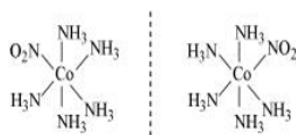

ii. Two optical isomers for [Co(en)$_3$]Cl$_3$ exist.
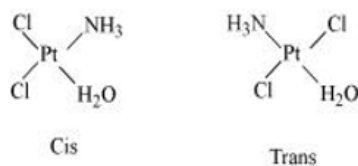

Two optical isomers are possible for this structure.

iii. $[CO(NH_3)_5(NO_2)](NO_3)_2$ [Co(NH$_3$)$_5$ (NO$_2$) (NO$_3$)$_2$] A pair of optical isomers:

It can also show linkage isomerism. [Co(NH$_3$)$_5$ (NO$_2$) (NO$_3$)$_2$] and [CO(NH$_3$)$_5$ (ONO)] (NO$_3$)$_2$ It can also show ionization isomerism. [Co(NH$_3$)$_5$ (NO$_2$) (NO$_3$)$_2$] [CO(NH$_3$)$_5$ (NO$_3$)] (NO$_3$) (NO$_2$)

iv. Geometrical (cis-, trans-) isomers of [Pt (NH$_3$ (H$_2$O) Cl$_2$ can exist.

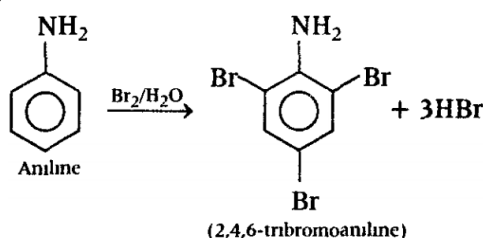

33. i. Steps involved in the conversions are given below:

a.

b.

Aniline + NaNO$_2$ + HCl $\xrightarrow{273-278\ K}$

Benzene diazonium $\xrightarrow[CuCl]{HCl}$ Chlorobenzene + N$_2$
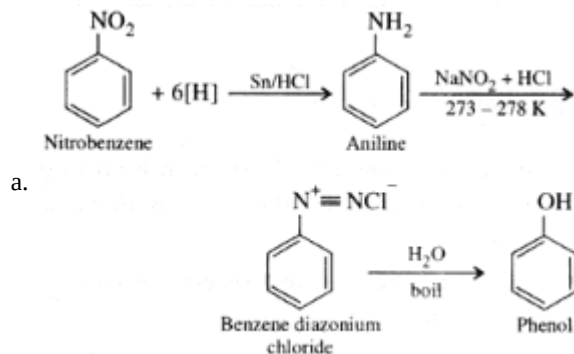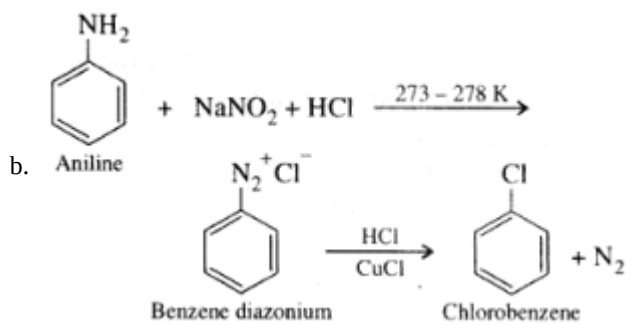
ii. A, B and C are identified as under:

a. $CH_3CONH_2 \xrightarrow[NaOH]{Br_2} CH_3NH_2 \xrightarrow{HNO_2} CH_3OH \xrightarrow{P/I_2} CH_3I$

$\underset{Ethanamide}{'A'}$ $\underset{Methana\min e}{'B'}$ $\underset{Methaonol}{'C'}$ $\underset{Iodomethane}{}$

b.

Phenol 'A' $\xrightarrow[HNO_3]{dil.}$ 4-Nitrophenol 'B' $\xrightarrow{Sn/HCl}$

4-Aminophenol 'C' $\xrightarrow[(2)\ boil]{(1)\ NaNO_2 + HCl,\ 0-5\ ^\circ C}$ Quinol (1, 2-Dihydroxybenzene)

c. $CH_3CH_2COONH_4 \xrightarrow{Heat} CH_3CH_2CONH_2 \xrightarrow[KOH]{Br_2} CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH$

$\underset{A\min ophenol}{'A'}$ $\underset{\Pr opana\mi de}{'B'}$ $\underset{\Pr opana\min e}{'C'}$ $\underset{Ethanol}{}$

OR

i. a.

Aniline $\xrightarrow{Br_2/H_2O}$ (2,4,6-tribromoaniline) + 3HBr

b.

Aniline + HCl $\longrightarrow$ (Anilinium chloride)

c.

$\xrightarrow[Pyridine]{(CH_3CO)_2O}$ (Acetanilide)

ii. Increasing order of boiling point $(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH$ Alcohols have a higher boiling point as compared to that of amines because oxygen being more electronegative forms stronger hydrogen bond as compared to that of nitrogen. In tertiary amine, there is no hydrogen bond formation due to the absence of H-atoms and hence, has the lowest boiling point.

iii. $(CH_3)_2NH$ and $(CH_3)_3N$ are secondary and tertiary amines respectively. These are distinguished by Hinsberg's reagent which gives sulphonamide with secondary amines and no reaction with tertiary amines. $(CH_3)_2NH$ reacts with benzene sulphonyl

chloride to give N, N-dimethyl benzene sulphonamide, which is insoluble in alkali. The reaction is as follows:

N,N-dimethylbenzene sulphonamide
(insoluble alkali)