Class XII Session 2023-24
Subject - Chemistry
Sample Question Paper - 3

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

General Instructions:

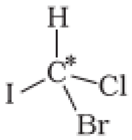
Read the following instructions carefully.

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.**

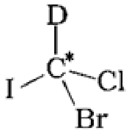
Section A

1. In which of the following molecules carbon atom marked with an asterisk (*) is asymmetric? **[1]**

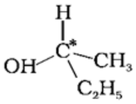
a.



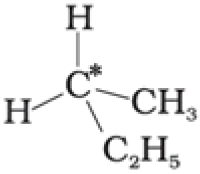
b.



c.



d.



a) (b), (c), (d)

b) (a), (b), (c)

c) (a), (b), (c), (d)

d) (a), (c), (d)

2. Proteins are found to have two different types of secondary structures namely α-helix and β-pleated sheet structure, α-helix structure of protein is stabilized by **[1]**

a) peptide bonds

b) van der Waals forces

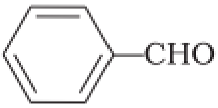
c) dipole-dipole interactions

d) hydrogen bonds

3. An organic compound X is oxidized by using acidified $K_2Cr_2O_7$. The product obtained reacts with Phenyl hydrazine but does not answer the silver mirror test. The possible structure of X is: **[1]**

a) $(CH_3)_2CHOH$
b) None of these
c) CH_3CHO
d) CH_3CH_2OH

4. Cannizaro's reaction is not given by ________. **[1]**

a) CH_3CHO
b)


c)


d) HCHO

5. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion? **[1]**

a) infinite
b) 1.26×10^{15} s
c) 2.52×10^{28} s
d) 2.52×10^{14} s

6. Match the items given in column I with that in column II: **[1]**

Column I	Column II
(a) Hypertonic	(i) NaCl.
(b) Hypotonic	(ii) Solution having higher osmotic pressure than other solution.
(c) Isotonic	(iii) Solution having lower osmotic pressure than other solution.
(d) Electrolyte	(iv) Solutions having same osmotic pressure.

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

7. C - Cl bond in chlorobenzene in comparison to C - Cl bond in methyl chloride is: **[1]**

a) longer and stronger
b) shorter and weaker
c) longer and weaker
d) shorter and stronger

8. The percentage of nickel in the alloy steel that is used for making pendulum is: **[1]**

a) 19%
b) 36%
c) 0%
d) 10%

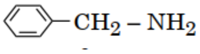
9. For an endothermic reaction where ΔH represents the enthalpy of the reaction in kJ/mol . The minimum value for the energy of activation will be **[1]**

a) Equal to ΔH
b) Zero
c) More than ΔH
d) Less than ΔH

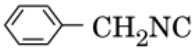
10. Oximes are formed by the reaction of aldehydes and ketones with: **[1]**

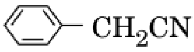
a) NH_2NH_2
b) NH_2OH
c)
d)

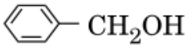
NH_3 $NH_2NHC_6H_5$

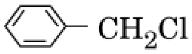
11. 

on heating with $CHCl_3$ and alcoholic KOH gives foul smell of **[1]**

a) 

b) 

c) 

d) 

12. Out of the following, the strongest base in aqueous solution is **[1]**

a) Trimethylamine b) Dimethylamine

c) Methylamine d) Aniline

13. **Assertion (A):** The newly formed RNA dictates the synthesis of protein at the ribosome. **[1]**

Reason (R): DNA has a double-helical structure while RNA has a single-stranded structure.

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):** Oxidation of ketones is easier than aldehydes. **[1]**

Reason (R): C-C bond of ketones is stronger than the C-H bond of aldehydes.

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):** Alkylbenzene is not prepared by Friedel-Crafts alkylation of benzene. **[1]**

Reason (R): Alkyl halides are less reactive than acyl halides.

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):** Glycerol does not react with HI. **[1]**

Reason (R): 2 - Iodopropane can be produced by treatment of glycerol with HI.

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. Write the IUPAC name of the ionization isomer of $[Ni(NH_3)_5NO_3]Cl$. **[2]**

18. Why is the +2 oxidation state of manganese quite stable, while the same is not true for iron? [Mn = 25, Fe = 26] **[2]**

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

(i) The reaction between $H_2(g)$ and $O_2(g)$ is highly feasible yet allowing the gases to stand at room temperature in the same vessel does not lead to the formation of water. Explain **[1]**

(ii) The rate of a reaction is given by rate = k $[N_2O_5]$. In this equation what does k stand for? **[1]**

20. What are maximum boiling azeotropes? Give one example. **[2]**

OR

Why is it advised to add ethylene glycol to water in a car radiator while driving in a hill station?

21. Predict the products formed when CH_3CHO reacts with the following reagents: (Any **two**) **[2]**

   i. CH_3MgBr and then H_3O^+
   ii. Zn(Hg)/Conc. HCl
   iii. Tollens' reagent

Section C

22. i. The cell in which the following reaction occurs: **[3]**

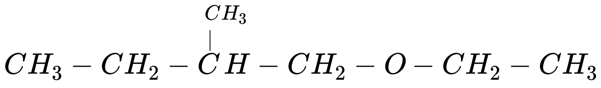
   $2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + l_2(s)$ has $E^\circ_{cell} = 0.236V$ at 298 K.

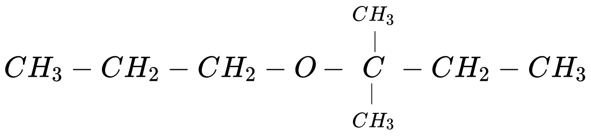
   Calculate the standard Gibbs energy of the cell reaction. (Given, 1F = 96500 C mol^{-1})

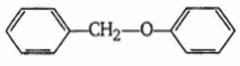
   ii. How many electrons flow through a metallic wire if a current of 0.5 A is passed for 2 h? (given, 1F = 96500 C mol^{-1}).

23. The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times how will it affect the rate of formation of Y? **[3]**

24. Give the major products that are formed by heating each of the following ethers with HI. **[3]**

   i. 
   $CH_3 - CH_2 - \overset{\overset{CH_3}{|}}{C}H - CH_2 - O - CH_2 - CH_3$

   ii. 
   $CH_3 - CH_2 - CH_2 - O - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3$

   iii. 

OR

Write the chemical reaction equations to illustrate the following reactions:

   i. Williamson's synthesis of others
   ii. Reimer-Tiemann reaction.

25. Write the equations involved in the following reactions: **[3]**

   i. Cannizzaro reaction
   ii. Aldol condensation
   iii. Hell-Volhard-Zelinsky reaction

26. Write electrode reactions taking place in Ni - Cd cell. Is it primary or secondary cell? **[3]**

27. Predict the order of reactivity of the following compounds in S_N1 and S_N2 reactions: **[3]**

   i. The four isomeric bromobutanes
   ii. $C_6H_5CH_2Br$, $C_6H_5CH(C_6H_5)Br$, $C_6H_5CH(CH_3)Br$, $C_6H_5C(CH_3)(C_6H_5)Br$

28. The K_{sp} for AgCl at 298 K is 1.0×10^{-10}. Calculate the electrode potential for Ag^+/Ag electrode immersed in 1.0M KCl solution. Given $\mathbf{E}^{\theta}_{\mathbf{Ag^+/Ag}} = 0.80V$. **[3]**

Section D

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

The actinoids include the fourteen elements from Th to Lr. The actinoids are radioactive elements and the earlier members have relatively long half-lives, the latter ones have half-life values ranging from a day to 3 minutes for lawrencium. The latter members could be prepared only in nanogram quantities. Actinoids show a greater range of oxidation states. The elements, in the first half of the series frequently exhibit higher oxidation states. The actinoids resemble the lanthanoids in having more compounds in +3 state than in the +4 state. All the actinoids are believed to have the electronic configuration of $7s^2$ and variable occupancy of the 5f and 6d subshells. The magnetic properties of the actinoids are more complex than those of the lanthanoids. The variation in the magnetic susceptibility of the actinoids with the number of unpaired 5f electrons is roughly parallel to the corresponding results for the lanthanoid.

(i) Actinoid contraction is greater from element to element than lanthanoid contraction. Why?

OR

The magnetic properties of the actinoids are more complex than those of the lanthanoids. Why?

(ii) Actinoids show irregularities in their electronic configuration. Justify?

(iii) The actinoid metals are all silvery in appearance but display a variety of structures than lanthanoid give reason.

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

The colligative properties of electrolytes require a slightly different approach than the one used for the colligative properties of non-electrolytes. The electrolytes dissociate into ions in solution. It is the number of solute particles that determines the colligative properties of a solution. The electron solutions, therefore, show abnormal colligative properties. To account for this effect we define a quantity called the van't Hoft factor, given by

$$i = \frac{Actual\ number\ of\ particles\ in\ solution\ after\ dissociation}{Number\ of\ formula\ units\ initially\ dissolved\ in\ solution}$$

i = 1 (for non-electrolytes);

i > 1 (for electrolytes, undergoing dissociation)

i < 1 (for solutes, undergoing association).

(i) 0.1M $K_4[Fe(CN)_6]$ is 60% ionized. What will be its van't Hoff factor?

(ii) When a solution of benzoic acid dissolved in benzene such that it undergoes in molecular association and its molar mass approaches 244. In which form Benzoic molecules will exist?

(iii) How does van't Hoff factor **i** and degree of association **a** are related if benzoic acid undergoes dimerisation in benzene solution? ($i = 1\frac{-\alpha}{2}$ or $i = 1 + \alpha$)

OR

What do you mean by colligative properties of solutions?

Section E

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

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

(ii) Which of the two components of starch is water soluble? **[1]**

(iii) Why must vitamin C be supplied regularly in diet? **[1]**

(iv) Which sugar is present in milk ? **[1]**

(v) Name the disaccharide which on hydrolysis gives two molecules of glucose. **[1]**

(vi) What are biocatalysts? Give an example. **[1]**

(vii) Aldopentoses named ribose and 2-deoxyribose are found in nucleic acids. What is their relative configuration? **[1]**

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

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

Using IUPAC norms write the formulas for the following:

a. Tetrahydroxozincate(II)
b. Potassium tetrachloridopalladate(II)
c. Diamminedichloridoplatinum(II)
d. Potassium tetracyanonickelate(II)
e. Pentaamminenitrito-O-cobalt(III)
f. Hexaamminecobalt(III) sulphate
g. Potassium tri(oxalato)chromate(III)
h. Hexaammineplatinum(IV)
i. Tetrabromidocuprate(II)
j. Pentaamminenitrito-N-cobalt(III)

33. i. Write structures of different isomeric amines corresponding to the molecular formula, $C_4H_{11}N$. **[5]**

ii. Write IUPAC names of all the isomers.

iii. What type of isomerism is exhibited by different pairs of amines?

OR

Account for the following:

i. Aniline is a weaker base compared to ethanamine.
ii. Aniline does not undergo Friedel-Crafts reaction.
iii. Only aliphatic primary amines can be prepared by Gabriel Phthalimide synthesis.

Solution

Section A

1\.

(b) (a), (b), (c)

Explanation: Asymmetric/chiral carbon atom is that in which all of its four valencies with four different groups or atoms (can not be superimpose). In molecules (i), (ii), and (ii), all have asymmetric carbon as each carbon has satisfied all four valencies with four different groups of atoms.

2\.

(d) hydrogen bonds

Explanation: α-helix structure of the protein is stabilized by hydrogen bonds. A polypeptide chain forms all possible hydrogen bonds by twisting into a right-handed screw helix with the -NH group of each amino acid residue hydrogen-bonded to > C = O of an adjacent turn of the helix.

3\. **(a)** $(CH_3)_2CHOH$

Explanation: Secondary alcohol on oxidation forms ketone which reacts with hydrazine bus doesn't gives a silver mirror test.

4\. **(a)** CH_3CHO

Explanation: Acetaldehyde (CH_3CHO) have alpha hydrogen hence will undergo aldol reaction in presence of base rather than cannizaro reaction. Cannizaro reaction is given when there is no alpha hydrogen present on carbonyl group.

5\. **(a)** infinite

Explanation: The reaction would be 100 % complete only after infinite time which cannot be calculated.

6\.

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

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

7\.

(d) shorter and stronger

Explanation: In chlorobenzene, the hybridization of carbon attached to Cl is $sp^{2,}$ and in methyl chloride hybridization of C attached to Cl is sp^3. In sp^2 hybridization, s-character is 33% and in sp^3 s-character is 25%. The sp^2 hybridized carbon with a greater s-character is more electronegative and can hold the electron pair of C—X bond more tightly than sp^3-hybridized carbon in haloalkane with less s-character resulting in a short bond length of C-Cl bond. Since it is difficult to break a shorter bond than a longer bond, means it is stronger. Also in chlorobenzene, the electron pairs on Cl atom are in conjugation with π-electrons of the ring, so C—Cl bond acquires a partial double bond character due to resonance which makes the bond stronger.

8\.

(b) 36%

Explanation: The percentage of nickel in the alloy steel that is used for making pendulum is 36%. it is a single-phase alloy, consisting of around 36% nickel and 64% iron.

9\.

(c) More than ΔH

Explanation:

$\triangle H = +ve$ for endothermic reaction

, therefore, $E_a > \Delta H$

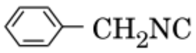
10\.

(b) NH_2OH

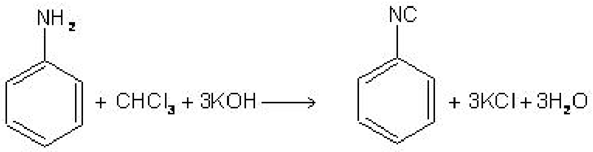
Explanation: Aldehydes and ketones react with NH_2OH (hydroxylamine) to form oximes as shown in the given reaction.

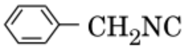
RCOR' + NH_2OH $\rightarrow$ RR'C=NOH (oxime)

11. **(a)**



Explanation:



 gives foul smell.

12.

(b) Dimethylamine

Explanation: NH_3 < primary amine < tertiary amine < secondary amine

This is because:

i. Steric hindrance

The size of an alkyl group is more than that of a hydrogen atom. So, an alkyl group would hinder the attack of a hydrogen atom, thus decreasing the basicity of the molecule. So, the more the number of alkyl groups attached, lesser will be its basicity.

ii. Solvation of ions

When amines are dissolved in water, they form protonated amines. Also, the number of possibilities for hydrogen bonding also increases. More the number of hydrogen bonding more is the hydration that is released in the process of the formation of hydrogen bonds.

13.

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

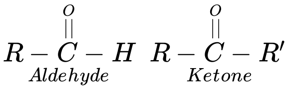
Explanation: Both A and R are true but R is not the correct explanation of A.

14.

(d) A is false but R is true.

Explanation: Oxidation of aldehyde is easier than ketones.

The difference between an aldehyde and ketone is the presence of a hydrogen atom attached to the carbon-oxygen double bond in the aldehyde. Ketone doesn't have that hydrogen attached.



$$\underset{Aldehyde}{R-\overset{\overset{O}{||}}{C}-H} \quad \underset{Ketone}{R-\overset{\overset{O}{||}}{C}-R'}$$

Due to the electron-withdrawing nature of the C=O group, the C−H bond in aldehyde is weak and thus it can be easily oxidised to corresponding Carboxylic acid.

C-C bond ketone is stronger than the C-H bond of aldehydes.

15.

(c) A is true but R is false.

Explanation: Alkyl halides give polyalkylation products.

16.

(d) A is false but R is true.

Explanation: A is false but R is true.

Section B

17. Pentaammine chloridonickel (II) nitrate

18. Mn^{2+} is more stable due to half filled d-orbitals but Fe^{2+} is not stable because it does not have half filled d-orbitals.

Mn^{2+} : [Ar] $3d^5 4s^0$

Fe^{2+} : [Ar] $3d^6 4s^0$

19. Answer the following:

(i) $2 H_2(g) + O_2(g) \rightarrow 2 H_2O(l)$

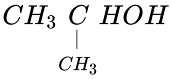
This reaction does not take place at the room temperature because the activation energy of the reaction is very high.

(ii) 'k' stands for rate constant of a reaction.

20. The solutions that show large negative deviation from Raoult's law form maximum boiling azeotrope at a specific composition because they have a composition having maximum boiling point. For example: Nitric acid and water - 68% nitric acid and 32% water by mass with a boiling point of 393.5 K.

OR

It is done to lower the freezing point of water so, that it does not freeze in a hill station.

21. i. 
$CH_3\ \underset{\underset{CH_3}{|}}{C}\ HOH$ (Propan-2-ol)

ii. CH_3 - CH_3 (Ethane)

iii. CH_3COO^- (Acetate ion)

Section C

22. i. Standard Gibbs Free energy is given by

$\Delta G^\circ = -nFE^\circ_{\text{cell}}$ ... (i)

where, n = number of moles of electrons transferred, F = Faraday's constant = 96500 C mol^{-1}

E^o_{cell} = Cell potential

Two half-reactions for the given redox reaction can be written as

$2Fe^{3+}(aq) + 2e^- \longrightarrow 2Fe^{2+}(aq)$

$2I^-(aq) \longrightarrow I_2(s) + 2e^-$

2 moles of electrons are involved in the reaction, hence n = 2

Therefore, by substituting all the values in Eq. we get (i)

$\therefore \Delta_r G^\circ = -(2\text{mol}) \times \left(9\%500\text{Cmol}^{-1}\right) \times (0.236\text{V})$

= -45548 J

$\Delta_r G^\circ = -4555\text{kJ}$

ii. Given, current (I) = 0.5A, time (t) = 2h Quantity of charge (Q) passed= Current (I) × time (t) = (0.5A) × (2 × 60 × 60s) = 3600C

Again, Q = ne^-

where, n = number of electrons

e^- = charge on electron

n = $\frac{Q}{e^-} = \frac{3600\text{C}}{1.6\times10^{-19}\text{C}} = 2250 \times 10^{19}$

Thus, number of electrons= 2.250 × 10^{22}.

23. The reaction $X \rightarrow Y$ follows second order kinetics.

Therefore, the rate equation for this reaction will be:

Rate = $k[X]^2$ (1)

Let [X] = a mol^{-1}, then equation (1) can be written as:

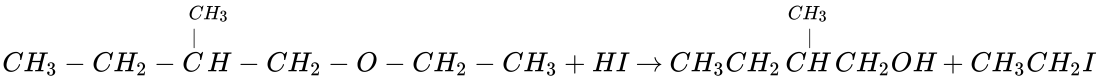
$Rate_1 = k(a)^2 = ka^2$

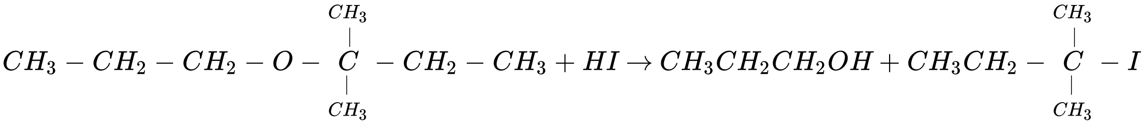
If the concentration of X is increased to three times, then [X] = 3 a mol L^{-1}

Now, the rate equation will be:

Rate = $k(3a)^2 = 9(ka^2)$

Hence, the rate of formation will increase by 9 times.

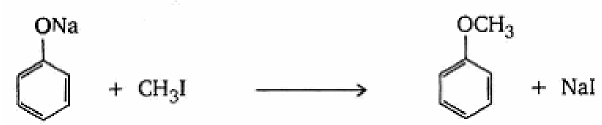
24. i. 
$CH_3 - CH_2 - \overset{\overset{CH_3}{|}}{C}H - CH_2 - O - CH_2 - CH_3 + HI \rightarrow CH_3CH_2\overset{\overset{CH_3}{|}}{C}HCH_2OH + CH_3CH_2I$

ii. 
$CH_3 - CH_2 - CH_2 - O - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3 + HI \rightarrow CH_3CH_2CH_2OH + CH_3CH_2 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - I$

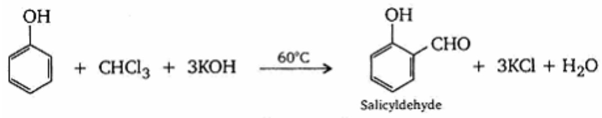
iii. 

OR

i. **Williamson Synthesis.**



ii. **Riemer - Tiemann reaction.**



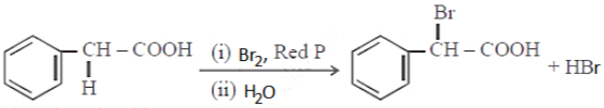
25. i. Cannizzaro reaction

$$2R-\overset{O}{\overset{\|}{C}}-H\xrightarrow{NaOH}R-CH_2OH+R-\overset{O}{\overset{\|}{C}}-ONa$$

ii. Aldol condensation

$$\underbrace{CH_3-\overset{O}{\overset{\|}{\underset{\underset{H}{|}}{C}}}+\overset{H}{\overset{|}{C}}H_2-\overset{O}{\overset{\|}{\underset{\underset{H}{|}}{C}}}}_{2\ molecules\ of\ acetaldehyde}\xrightarrow{Dil.\ NaOH}CH_3-\underset{Acetaldol}{\overset{OH}{\overset{|}{\underset{\underset{H}{|}}{C}}}}-CH_2-\overset{O}{\overset{\|}{C}}-H$$

iii. Hell-Volhard-Zelinsky reaction



Phenyl acetic acid

2-Bromo-2-phenyl acetic acid

26. **Anode:** $Cd(s)+2OH^-(aq)\rightarrow Cd(OH)_2(s)+2e^-$

Cathode: $NiO_2(s)+2H_2O(l)+2e^-\rightarrow Ni(OH)_2(s)+2OH^-(aq)$

Net reaction: $Cd(s)+NiO_2(s)+2H_2O(l)\rightarrow Cd(OH)_2(s)+Ni(OH)_2(s)$

It is secondary cell

27. i. $CH_3CH_2CH_2CH_2Br < (CH_3)_2CHCH_2Br < CH_3CH_2CH(Br)CH_3 < (CH_3)_3CBr$ (S_N1) $CH_3CH_2CH_2CH_2Br > (CH_3)_2CHCH_2Br > CH_3CH_2CH(Br)CH_3 > (CH_3)_3CBr$ (S_N2)

Of the two primary bromides, the carbocation intermediate derived from $(CH_3)_2CHCH_2Br$ is more stable than derived from $CH_3CH_2CH_2CH_2Br$ because of greater electron-donating inductive effect of $(CH_3)_2CH$- group. Therefore, $(CH_3)_2CHCH_2Br$ is more reactive than $CH_3CH_2CH_2CH_2Br$ in S_N1 (unimolecular substitution) reactions. $CH_3CH_2CH(Br)CH_3$ is a secondary bromide and $(CH_3)_3CBr$ is a tertiary bromide. Hence the above order is followed in S_N1 unimolecular substitution reaction. The reactivity in S_N2 (bimolecular substitution) reactions follows the reverse order as the steric hindrance around the electrophilic carbon increases in that order.

ii. $C_6H_5C(CH_3)(C_6H_5)Br > C_6H_5CH(C_6H_5)Br > C_6H_5CH(CH_3)Br > C_6H_5CH_2Br$ (S_N1) $C_6H_5C(CH_3)(C_6H_5)Br < C_6H_5CH(C_6H_5)Br < C_6H_5CH(CH_3)Br < C_6H_5CH_2Br$ (SN_2)

Of the two secondary bromides, the carbocation intermediate obtained from $C_6H_5CH(C_6H_5)Br$ is more stable than obtained from $C_6H_5CH(CH_3)Br$ because it is stabilized by two phenyl groups due to resonance. Therefore, the former bromide is more reactive than the latter in S_N1unimolecular substitution reactions. A phenyl group is bulkier than a methyl group. Therefore, $C_6H_5CH(C_6H_5)Br$ is less reactive than $C_6H_5CH(CH_3)Br$ in S_N2 bimolecular substitution reactions.

28. $\mathrm{AgCl(s)} \rightleftharpoons \mathrm{Ag^+ + Cl^-}$

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

$[Cl^-] = 1.0$ M

$$[\mathrm{Ag^+}]=\frac{k_{sp}}{[\mathrm{Cl^-}]}=\frac{1\times10^{-10}}{1}=1\times10^{-10}\mathrm{M}$$

Now, $Ag^+ + e^- \longrightarrow Ag\ (s)$

$$\mathrm{E}=\mathrm{E}^{\theta}-\frac{0.059}{1}\log\frac{1}{[\mathrm{Ag^+}]}$$

$$=0.80-\frac{0.059}{1}\log\frac{1}{10^{-10}}$$

$= 0.80 - 0.059 \times 10 = 0.21$ V

Section D

29. **Read the text carefully and answer the questions:**

The actinoids include the fourteen elements from Th to Lr. The actinoids are radioactive elements and the earlier members have relatively long half-lives, the latter ones have half-life values ranging from a day to 3 minutes for lawrencium. The latter members could be prepared only in nanogram quantities. Actinoids show a greater range of oxidation states. The elements, in the first half of the series frequently exhibit higher oxidation states. The actinoids resemble the lanthanoids in having more compounds in +3 state than in the +4 state. All the actinoids are believed to have the electronic configuration of $7s^2$ and variable occupancy of the 5f and 6d subshells. The magnetic properties of the actinoids are more complex than those of the lanthanoids. The variation in the magnetic susceptibility of the actinoids with the number of unpaired 5f electrons is roughly parallel to the corresponding results for the lanthanoid.

(i) This is because of relatively poor shielding by 5f electrons in actinoids in comparison with shielding of 4f electrons in lanthanoids.

OR

Magnetic properties of actinoid complexes are borne by 5f open shell orbitals. These orbitals have a marked inner shell character, as in lanthanides, but interact more with the chemical environment than the 4f of lanthanides, leading to unique magnetic properties.

(ii) Actinoids have irregularities in the electronic configuration because of almost equal energy of 5f, 6d and 7s orbitals. Therefore, there are some irregularities in the filling of 5f, 6d, and 7s orbitals. The electron may enter either of these orbitals.

(iii)The structural variability in actinoids is obtained due to irregularities in metallic radii which are far greater than in lanthanoids.

30. **Read the text carefully and answer the questions:**

The colligative properties of electrolytes require a slightly different approach than the one used for the colligative properties of non-electrolytes. The electrolytes dissociate into ions in solution. It is the number of solute particles that determines the colligative properties of a solution. The electron solutions, therefore, show abnormal colligative properties. To account for this effect we define a quantity called the van't Hoft factor, given by

$$i = \frac{Actual\ number\ of\ particles\ in\ solution\ after\ dissociation}{Number\ of\ formula\ units\ initially\ dissolved\ in\ solution}$$

i = 1 (for non-electrolytes);

i > 1 (for electrolytes, undergoing dissociation)

i < 1 (for solutes, undergoing association).

(i) We know, $x = \frac{i-1}{n-1}$

Where, n = 5 and x = 0.6 ($\because$ 60% = $\frac{60}{100}$ = 0.6 ionized)

So, $0.6 = \frac{i-1}{5-1}$

$0.6 \times 4 = i - 1$

$2.4 = i - 1$

$2.4 + 1 = i$

$i = 3.4$

(ii) Benzoic molecules exist as a dimer.

(iii) $i = 1\frac{-\alpha}{2}$

OR

The properties of solutions that depend on the ratio of the number of solute particles to the number of solvent molecules in a solution and not on the nature of the chemical species is termed as colligative properties.

Section E

31. Attempt any five of the following:

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

(ii) A starch has two components: amylose and amylopectin. Amylose is water soluble.

(iii)Vitamin 'C' is water soluble vitamin and hence excess of it is readily excreted in the urine so, it cannot be stored in our body and hence, it should be regularly supplied in the diet.

(iv)Lactose is the type of sugar that occurs naturally in milk. It is found in the milk of animals such as cows and goats, as well as human breast milk.

(v) The disaccharide which gives two molecules of glucose on hydrolysis is maltose.

(vi)The catalysts present in the living organisms which speed down or fastens down the process are known as biocatalysts. Eg:- Hormones in our body.

(vii) Both the aldopentoses(ribose and 2-deoxyribose) have D-configuration.

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

The IUPAC name = Potassium diaquadioxalatochromate (III) trihydrate.

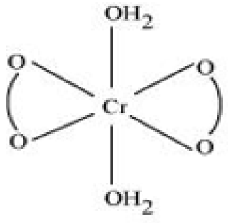
The Oxidation state of chromium = 3

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

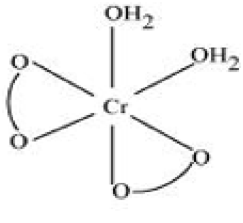
Coordination number od compound = 6

Shape: octahedral

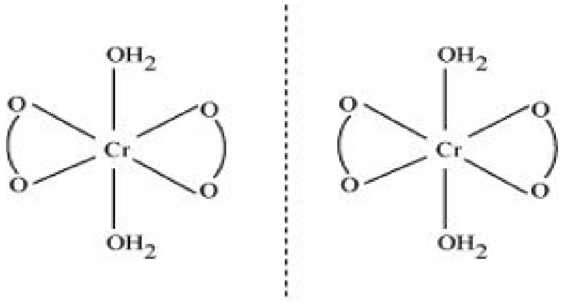
Stereochemistry:



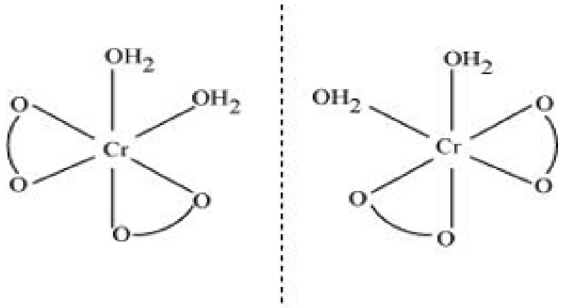
Trans



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

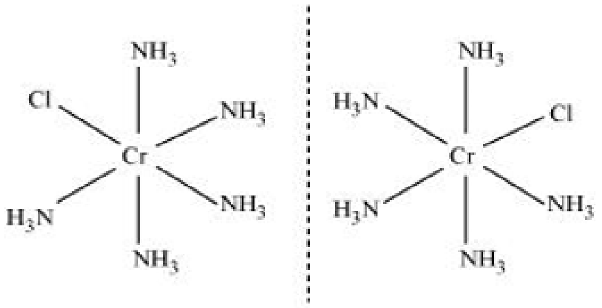
Coordination number of compound = 6

Shape: octahedral.

Electronic configuration:

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

Stereochemistry:



2 isomers

Magnetic Moment = 0

c. $CrCl_3$(py)3

The IUPAC name: Trichloridotripyridinechromium (III)

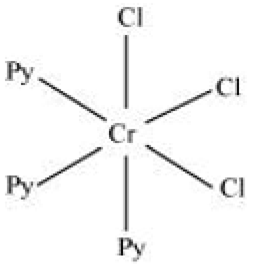
The oxidation state of chromium = +3

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

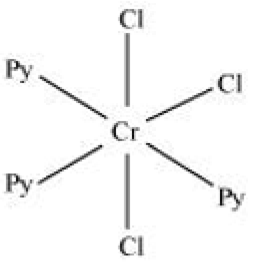
Coordination number of compound = 6

Shape: octahedral.

Stereochemistry:



Facial isomer



Meriodional isomer

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

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

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

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:

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

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

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

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

OR

a. The IUPAC name of Tetrahydroxozincate(II) is $[Zn(OH)_4]^{2-}$

b. The IUPAC name of Potassium tetrachloridopalladate(II) is $K_2[PdCl_4]$

c. The IUPAC name of Diamminedichloridoplatinum(II) is $[Pt(NH_3)_2Cl_2]$

d. The IUPAC name of Potassium tetracyanonickelate(II) is $K_2\left[Ni(CN)_4\right]$

e. The IUPAC name of Pentaamminenitrito-O-cobalt(III) is $\left[Co\,(ONO)\,(NH_3)_5\right]^{2+}$

f. The IUPAC name of Hexaamminecobalt(III) sulphate is $\left[Co(NH_3)_6\right](SO_4)_3$

g. The IUPAC name of Potassium tri(oxalato)chromate(III) is $K_3\left[Cr(C_2O_4)_3\right]$

h. The IUPAC name of Hexaammineplatinum(IV) is $\left[Pt(NH_3)_6\right]^{4+}$

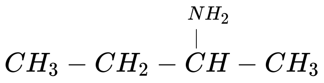
i. The IUPAC name ofTetrabromidocuprate(II) is $\left[Cu(Br)_4\right]^{2-}$

j. The IUPAC name of Pentaamminenitrito-N-cobalt(III) is $\left[Co\,(NO_2)\,(NH_3)_5\right]^{2+}$

33. (i), (ii) The structures and IUPAC names of different isomeric amines corresponding to the molecular formula, $C_4H_{11}N$ are given below:

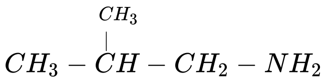
a. $CH_3-CH_2-CH_2-CH_2-NH_2$

Butanamine(1°)

b. 

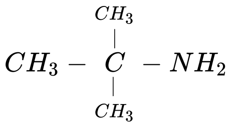
$CH_3-CH_2-\overset{\overset{NH_2}{|}}{C}H-CH_3$

Butan-2-amine (1°)

c. 

$CH_3-\overset{\overset{CH_3}{|}}{C}H-CH_2-NH_2$

2-Methylpropanamine (1°)

d. 

$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-NH_2$

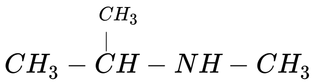
2-Methylpropan-2-amine (1^{o})

e. $CH_3-CH_2-CH_2-NH-CH_3$

N-Methylpropanamine (2°)

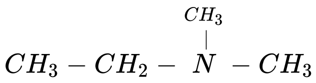
f. $CH_3-CH_2-NH-CH_2-CH_3$

N-Ethylethanamine (2°)

g. 

$CH_3-\overset{\overset{CH_3}{|}}{C}H-NH-CH_3$

N-Methylpropan-2-amine (2°)

h. 

$CH_3-CH_2-\overset{\overset{CH_3}{|}}{N}-CH_3$

N, N- Dimethylethanamine (3°)

(iii) The pairs (a) and (b) and (e) and (g) exhibit position isomerism.

The pairs (a) and (c); (a) and (d); (b) and (c); (b) and (d) exhibit chain isomerism.

The pairs (e) and (f) and (f) and (g) exhibit metamerism.

All primary amines exhibit functional isomerism with secondary and tertiary amines and vice-versa.

OR

i. Aniline is typical of aromatic primary amines - where the -NH_2 group is attached directly to a benzene ring. These are very much weaker bases than ammonia.

Aniline is more basic than ethylamine because of resonance. When aniline loses a proton the resulting ion is more stable than that of ethylamine and hence, aniline is more basic than ethylamine. Hence, aniline looses proton more readily than ethylamine.

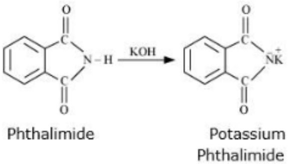
ii. Aniline being a Lewis base reacts with Lewis acid ($AlCl_3$) to form a salt.

$$\mathrm{C_6H_5NH_2} + \mathrm{AlCl_3} \longrightarrow C_6H_5\overset{+}{N}H_2AlCl_3^-$$

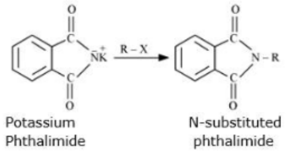
As a result, N acquires a positive charge so, it acts as a strong deactivating group for electrophilic substitution reaction. Thus, aniline does not undergo Friedel-Crafts reaction.

iii. Gabriel phthalimide synthesis is a very convenient method for the preparation of pure aliphatic amines

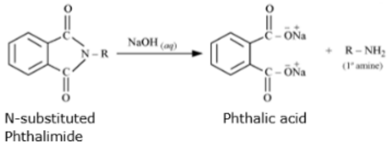
Step 1: Phthalimide is treated with KOH to form potassium phthalimide



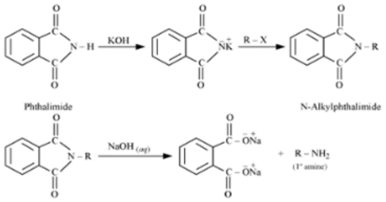
Step 2: Potassium phthalimide is treated with a suitable alkyl halide to form N-substituted phthalimides.



Step 3: N-substituted phthalimides undergoes hydrolysis in the presence of dil. HCl or with alkali(NaOH) to give primary amines.



Overall reaction:



Gabriel phthalimide synthesis results in the formation of primary(1° amine) only. Secondary or tertiary amines are not formed through this synthesis. Hence, Gabriel phthalimide synthesis preferred for the formation of primary amines only.