Class XII Session 2024-25
Subject - Chemistry
Sample Question Paper - 5

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. The best method for the conversion of an alcohol into an alkyl chloride is by treating the alcohol with: **[1]**

a) $SOCl_2$ in presence of pyridine
b) PCl_3
c) Dry HCl in the presence of anhydrous $ZnCl_2$
d) PCl_5

2. Fat soluble vitamins are stored in **[1]**

a) Eyes
b) Stomach
c) Adipose and liver
d) Pancreas

3. Williamson synthesis is used to obtain: **[1]**

a) Ether
b) Primary alcohol
c) Aldehyde
d) Ketone

4. A mixture of benzaldehyde and formaldehyde on heating with aqueous NaOH solution gives: **[1]**

a) Benzyl alcohol and methyl alcohol
b) Benzyl alcohol and sodium formate
c) Sodium benzoate and methyl alcohol
d) Sodium benzoate and sodium formate

5. The rate of reaction A + B $\rightarrow$ Products, is given by the equation r = k[A] [B]. If B is taken in large excess, the order of reaction would be: **[1]**

a) Cannot be predicted
b) 0
c) 2
d) 1

6. Match the items of column I with appropriate entries of column II. **[1]**

Column I	Column II
(a) Non ideal solution with positive deviation	(i) H_2O (57%) + HI (43%)
(b) Maximum boiling azeotrope	(ii) $CHCl_3 + (CH_3)_2CO$
(c) Non ideal solution with negative deviation	(iii) C_2H_5OH (95.4%) + H_2O (4.6%)
(d) Minimum boiling azeotrope	(iv) $CCl_4 + C_6H_5CH_3$

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

7. Which of the following alkyl halides will undergo S_N1 reaction most readily? **[1]**

a) $(CH_3)_3C—I$
b) $(CH_3)_3C—F$
c) $(CH_3)_3C—Br$
d) $(CH_3)_3C—Cl$

8. Which property of transition metals enables them to behave as catalysts? **[1]**

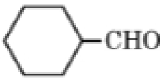
a) Alloy formation
b) High melting point
c) Variable oxidation states
d) High ionisation enthalpy

9. The unit of rate constant for a first order reaction is **[1]**

a) Mol/L
b) Mol/L/s
c) $Mol^2/L^2/s^2$
d) s^{-1}

10. Which of the following does not give aldol condensation reaction? **[1]**

a) CH_3COCH_3
b) 

c) CH_3 - CHO
d) 

11. An organic compound containing oxygen, upon oxidation forms a carboxylic acid as the only organic product with its molecular mass higher by 14 units. The organic compound is ________. **[1]**

a) a ketone
b) a primary alcohol
c) an aldehyde
d) a secondary alcohol

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

a) Trimethylamine
b) Dimethylamine
c) Methylamine
d) Aniline

13. **Assertion (A):** D-glucose and D-mannose form same osazone with phenylhydrazine. **[1]**
Reason (R): Osazone formation involves only the last four carbon atoms.

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):** Reactivity of ketones is more than aldehydes. **[1]**

Reason (R): The carbonyl carbon of ketones is less electrophilic as compared to 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):** Vinyl halides do not give nucleophilic substitution reaction. **[1]**

Reason (R): Vinyl group is electron donating in vinyl 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):** With excess of HI, glycerol ultimately gives isopropyl iodide. **[1]**

Reason (R): The reaction occurs through intermediate formation of allyl iodide and propylene.

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 and draw the structure of coordination entities of $[PtCl(NH_3)_5]Cl_3$. **[2]**

18. Give an explanation for the catalytic properties shown by transition metals. **[2]**

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

(a) Define rate of reaction? **[1]**

(b) For a reaction the rate law expression is represented as follows: **[1]**

Rate = $k[A][B]^{\frac{1}{2}}$

i. Interpret whether the reaction is elementary or complex. Give reason to support your answer.
ii. Write the unit of rate constant for this reaction if concentration of A and B is expressed in moles/L.

20. Sodium chloride or calcium chloride is used to clear snow from the roads. Why? **[2]**

OR

Define molal elevation constant or ebullioscopic constant.

21. What is meant by the Ketal? Give an example. **[2]**

Section C

22. How much charge is required for the following reductions: **[3]**

i. 1 mol of Al^{3+} to Al?
ii. 1 mol of Cu^{2+} to Cu?
iii. 1 mol of MnO_4^- to Mn^{2+}?

23. **[3]**

i. Determine the units of rate constant for first and zero order reaction.
ii. Show that time required for the completion of 99% of the first order reaction is twice the 90% of completion of the reaction.

24. Write the mechanism of acid dehydration of ethanol to yield ethane. **[3]**

OR

How can phenol be converted to aspirin?

25. Predict the products formed when cyclohexanecarbaldehyde reacts with following reagents. **[3]**

i. PhMgBr and then H_3O^+
ii. Tollens' reagent
iii. Semicarbazide and weak acid
iv. Excess ethanol and acid
v. Zinc amalgam and dilute hydrochloric acid

26. Write the Nernst equation and calculate emf of the following cell at 298 K: **[3]**

$Cr | Cr^{3+} (0\cdot1\ M) || Fe^{2+} (0\cdot01\ M) | Fe$

Given : $E^{\ominus}_{\mathrm{Cr^{3+}/Cr}} = -0\cdot75\ V$

$E^{\ominus}_{\mathrm{Fe^{2+}/Fe}} = -0\cdot45\ V$

(log 10 = 1)

27. Tert-Butylbromide reacts with aq. NaOH by S_N1 mechanism while n-butylbromide reacts by S_N2 mechanism. Why? **[3]**

28. Calculate the emf of the cell **[3]**

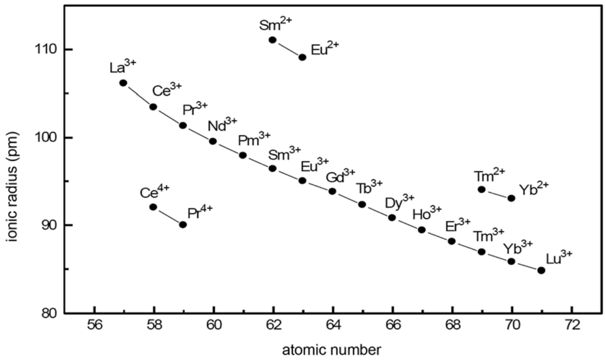
$\mathrm{Mg(s)|Mg^{+2}(0.1M)||Cu^{+2}(1 \times 10^{-3}M|Cu(s))}$

$\mathrm{Given,} E^{\ominus}_{Cu^{2+}/Cu} = +0.34\mathrm{V},\ E^{\ominus}_{Mg^{+2}/Mg} = -2.37\mathrm{V})$

Section D

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

The f-block consists of the two series, lanthanoids (the fourteen elements following lanthanum) and actinoids (the fourteen elements following actinium). Because lanthanum closely resembles the lanthanoids. The chemistry of the actinoids is much more complicated. The complication arises partly owing to the occurrence of a wide range of oxidation states in these elements and partly because their radioactivity creates special problems in their study. The overall decrease in atomic and ionic radii from lanthanum to lutetium (the lanthanoid contraction) is a unique feature in the chemistry of the lanthanoids. In the lanthanoids, La(II) and Ln(III) compounds are predominant species.



i. Which metal in the first transition series (3d series) exhibits +1 oxidation state most frequently and why? (1)
ii. The transition metals (with the exception of Zn, Cd and Hg) are hard and have high melting and boiling points. Give reason. (1)
iii. Both O_2 and F_2 stabilize high oxidation states of transition metals but the ability of oxygen to do so exceeds that of fluorine. Give reason. (2)

OR

The atomic radii of the metals of the third (5d) series of transition elements are virtually the same as those of the corresponding members of the second (4d) series. Give reason. (2)

30. **Read the following text carefully and answer the questions that follow:** **[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? (1)

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? (1)

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 + α) (2)

OR

What do you mean by colligative properties of solutions? (2)

Section E

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

(a) Name the enzyme which convert surcrose into glucose and fructose. **[1]**

(b) i. Name any two bases which are common to both DNA and RNA. **[1]**

ii. Which vitamin deficiency causes:

1. Bone deformities in children?
2. Pernicious anaemia?

(c) What are heterocyclic bases? **[1]**

(d) Write the name of linkage joining two monosaccharides. **[1]**

(e) Name the purines present in DNA. **[1]**

(f) Give an example of fibrous protein. **[1]**

(g) Of the two bases named below, which one is present in RNA and which one is present in DNA? **[1]**

i. Thymine

ii. Uracil

32. Give the oxidation state, d-orbital occupation and coordination number of the central metal ion in the following complexes: **[5]**

i. $K_3\left[Co(C_2O_4)_3\right]$

ii. cis$-\left[Cr(en)_2Cl_2\right]Cl$

iii. $(NH_4)_2\left[CoF_4\right]$

iv. $\left[Mn(H_2O)_6\right]SO_4$

OR

Write the formulas for the following coordination compounds:

a. Tetraammineaquachloridocobalt(III) chloride

b. Potassium tetrahydroxidozincate(II)

c. Potassium trioxalatoaluminate(III)

d. Dichloridobis(ethane-1, 2-diamine)cobalt(III)

e. Tetracarbonylnickel(0)

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

Arrange the following compounds in a decreasing order of basic strength in their aqueous solutions.

NH_3, CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$

Solution

Section A

1. **(a)** $SOCl_2$ in presence of pyridine

   Explanation: The hydroxyl group of an alcohol is replaced by halogen on reaction with concentrated halogen acids, phosphorus halides, or thionyl chloride. Thionyl chloride ($SOCl_2$) is preferred because the other two products SO_2 and HCl are escapable gases. Hence, the reaction gives pure alkyl halides.

   $ROH + SOCl_2 \rightarrow RCl + SO_2 (g) + HCl (g)$

2. **(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.

3. **(a)** Ether

   Explanation: Williamson synthesis is used to obtain ether. For example,

   $$\underset{\substack{\text{Alkyl}\\ \text{halide}}}{\mathrm{R-X}} + \underset{\text{Sodium alkoxide}}{\mathrm{Na-O-R}} \longrightarrow \underset{\text{Ether}}{\mathrm{R-O-R'}} + \mathrm{NaX}$$

4. **(b)** Benzyl alcohol and sodium formate

   Explanation: They will undergo Cannizzaro reaction as neither benzaldehyde nor formaldehyde has alpha hydrogen. HCHO will be more reactive towards Cannizzaro compared to benzaldehyde because of less steric hindrance.

   So, OH^- nucleophile will attack HCHO first, and then the hydride shift from HCHO to benzaldehyde will occur and thus HCHO will oxidize to $HCOO^-$ ion and benzaldehyde will reduce to benzyl alcohol.

5. **(d)** 1

   Explanation: $r=k[A][B]^{\circ}$

   Since [B] is in large excess, so its concentration does not change. So the order of the reaction would be 1.

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

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

7. **(a)** $(CH_3)_3C—I$

   Explanation: S_N1 reactions are generally carried out mainly in polar protic solvents (like H_2O) and they follow first-order kinetics. This means that the rate of reaction depends only on one reactant. This reaction favours tertiary alkyl halides because of the high stability of the formed carbocation. The carbocation forms when the molecule is polarized in water to form a carbocation and halide ion attacked by the nucleophile. The reactivity of the halides are R–I> R–Br>R–Cl>>R–F. Hence, $(CH_3)_3C—I$ will undergo the reaction most readily.

8. **(c)** Variable oxidation states

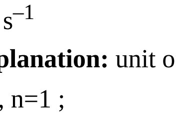
   Explanation: Variable oxidation states

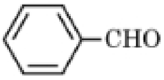
9. **(d)** s^{-1}

   Explanation: unit of rate constant for nth order reaction (k) = $(mol\ L^{-1})^{1-n}\ s^{-1}$

   put, n=1 ;

   unit of rate constant for 1st order reaction(k) = s^{-1}

10. **(b)** 

Explanation: 

11\.

(b) a primary alcohol

Explanation: When –CH_2OH group is replaced by –COOH group then only molecular weight will increase by 14units.

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\.

(c) A is true but R is false.

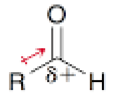
Explanation: A is true but R is false.

14\.

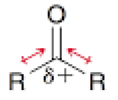
(d) A is false but R is true.

Explanation:

The carbonyl carbon in aldehydes generally has a more partial positive charge than in ketones due to the electron-donating nature of alkyl groups. Aldehydes only have one e-donor group while ketones have two.



An aldehyde
has only one electron-donating alkyl group
that stabilizes the partial positive charge



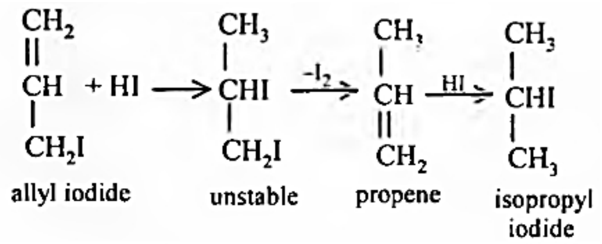
A ketone
has two electron-donating alkyl groups
that stabilize the partial positive charge

15\.

(c) A is true but R is false.

Explanation: A is true but R is false.

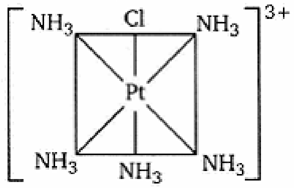
16\. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: 

Section B

17\. IUPAC name. Pentaamminechlorido platinum (IV) chloride.

It has octahedral structure



18. Transition metals show catalytic property because of their ability to adopt multiple oxidation states. Catalysts at a solid surface involve the formation of bond between reactant molecules and atoms of the surface of the catalyst. This has the effect of increasing the concentration of the reactants at the catalyst surface and also weakening of the bonds in the reacting molecules & the activation energy is lowered, moreover transition metals can change their oxidation state. Transition metals have tendency to form reaction intermediates with suitable reactants. The reaction intermediates decompose yielding products and regenerating the original substance. The transition metals form reaction intermediates due to the presence of vacant orbitals.

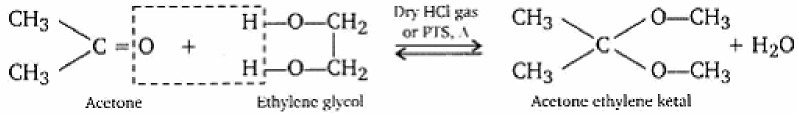
19. Answer the following:
    (i) Rate of reaction is defined as change in concentration of reactants or products per unit time. For example, the reaction A →B has the rate expressed as:
    rate of reaction $= \frac{dx}{dt} = \frac{-[dA]}{dt} = \frac{[dB]}{dt}$
    (ii) i. This is a complex reaction.
    Order of reaction is 1.5 . Molecularity cannot be 1.5, it has no meaning for this reaction. The reaction occurs in steps, so it is a complex reaction.
    ii. Rate = $k[A][B]^{[\frac{1}{2}]}$
    Unit of Rate constant (k)
    $= \frac{\text{Unit of rate}}{\text{Unit of }[A] \times \text{ Unit of }[B]^{\frac{1}{2}}}$
    $= \frac{molL^{-1}s^{-1}}{(molL^{-1})(molL^{-1})^{\frac{1}{2}}}$
    $= mol^{\frac{-1}{2}} L^{\frac{1}{2}} s^{1}$

20. Sodium chloride or calcium chloride depresses the freezing point of water to such extent that it cannot freeze to form ice. Hence it melts off easily at the prevailing temperature. As depression in freezing point is a colligative property which is directly related to number of solute particles. NaCl gives 2 ions in solution while $CaCl_2$ gives 3 ions in solution.

OR

Molal elevation constant is defined as increase in boiling point of the solvent, when one mole of solute is dissolved in 1000g of solvent. The elevation is proportional to the number of particles dissolved and given by $\triangle T_b$ = K_b m, where m is the molal concentration of solute. The constant K_b is the ebullioscopic constant of the solvent.

21. Gem-Dialkoxyalkanes in which the two alkoxy groups are present on the same carbon within the chain are called ketals. These are produced when a ketone is heated with ethylene glycol in presence of dry HCl gas or p-toluenesulphonic acid (PTS).



These are easily hydrolysed by dilute mineral acids to regenerate the original ketones. Therefore, ketals are used for protection of keto groups in organic synthesis.

Section C

22. i. $Al^{3+} + 3e^{-} \rightarrow Al$
    Therefore, Required charge = 3 F
    $= 3 \times 96487C$
    = 289461 C
    ii. $Cu^{2+} + 2e^{-} \rightarrow Cu$
    Therefore, Required charge = 2 F
    $= 2 \times 96487C$
    = 192974 C
    iii. $MnO_4^{-} \rightarrow Mn^{2+}$
    i.e.,$Mn^{7+} + 5e^{-} \rightarrow Mn^{2+}$
    Therefore, Required charge = 5 F
    $= 5 \times 96487C$
    = 482435 C

23. i. K = $(mol)^{1-n} L^{n-1} s^{-1}$
    For zero order, n = 0
    So, K = $(mol)^{1-0} L^{0-1} s^{-1} = s^{-1} mol L^{-1}$

For first order, n = 1

K = $(mol)^{1-n}\ L^{n-1}\ s^{-1}$

So, K = $(mol)^{1-1}\ L^{1-1}\ s^{-1}$

= s^{-1}

ii. For a first order reaction,

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

$[\mathrm{A}]_0 = a, [\mathrm{A}] = a - \frac{a \times 99}{100} = 0.01a$

$t(99\%) = \frac{2.303}{\mathrm{K}} \log \frac{a}{0.01a}$

$= \frac{2.303}{\mathrm{K}} \log 100$

$= \frac{2.303}{\mathrm{K}} \times 2$ ...(i)

For 90% completion of reaction,

$[\mathrm{A}] = a - \frac{a \times 99}{100} = 0.1a$

$t(90\%) = \frac{2.303}{\mathrm{K}} \log \frac{a}{0.1a}$

$= \frac{2.303}{\mathrm{K}} \times 1$ ....(i)

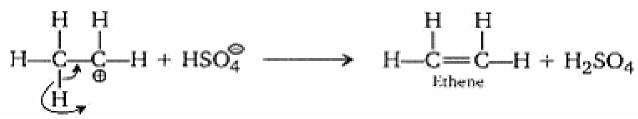
Dividing equation (i) by equation (ii), we get

t(99%) = 2 × t(90%)

Hence, the time taken to complete 9% of the first order reaction is twice the time required for the completion of 90% of the reaction.

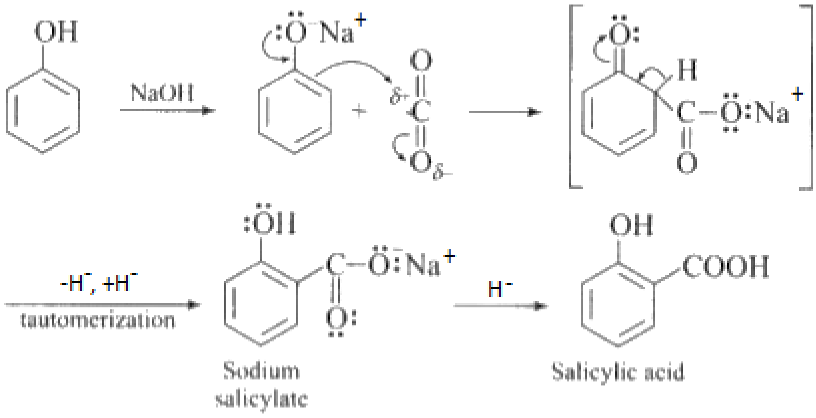
24. i. $\underset{Ethanol}{CH_3CH_2OH} \xrightarrow{H^+} CH_3CH_2\overset{\ominus}{O}H_2$

ii. $CH_3 - CH_2 - \overset{\oplus}{O}H_2 \xrightarrow{-H_2O} CH_3 - \overset{\oplus}{C}H_2$

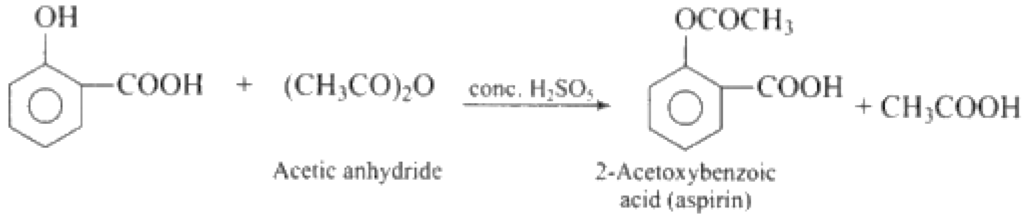
iii. 

OR

Phenol is converted into salicylic acid. The reaction is usually carried out by allowing sodium phenoxide to absorb carbon dioxide and then heating the product to 400 K and 4-7 atm pressure. The first unstable intermediate is formed which undergoes a proton shift to form sodium salicylate. The subsequent acidification of sodium salicylate gives.

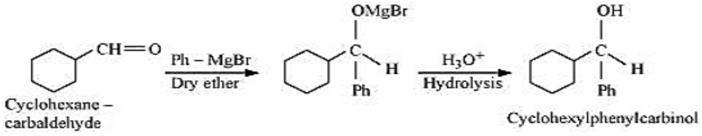


Then aspirin is obtained by acetylating salicylic acid with acetic anhydride and conc. H_2SO_4

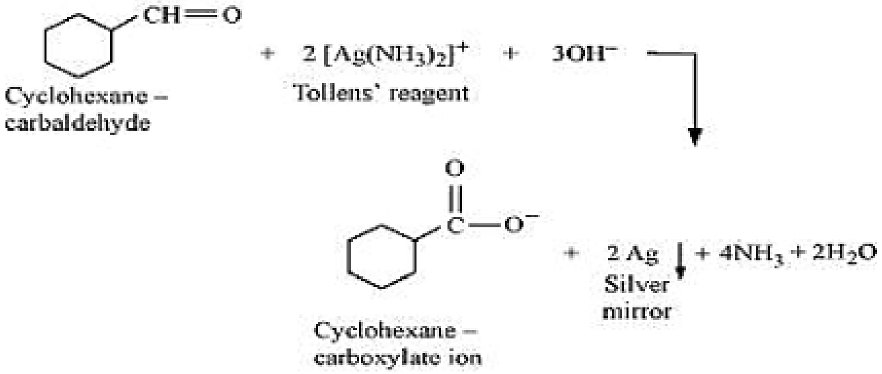


The preparation of Aspirin from salicylic acid is an example of an electrophilic substitution reaction in which carbon dioxide is an electrophile.

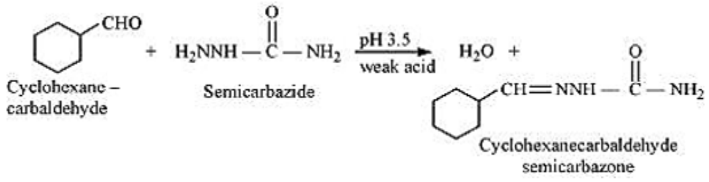
25. i. Formation of Alcohol



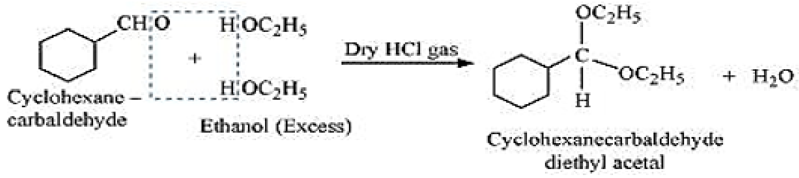
ii. Formation of Carboxylate ion



iii. Formation of Semicarbazone



iv. Formation of acetals



v. Formation of alkanes (Clemmensen Reduction)

26. $E_{cell} = E^0_{\text{cell}} - \frac{0.059}{6}\log\frac{\left[\text{Cr}^{3+}\right]^2}{\left[\text{Fe}^{2+}\right]^3}$

$E^0_{\text{cell}} = -0.45 - (-0.75)$

$= 0.30$ V

$E_{\text{cell}} = 0.3 - \frac{0.059}{6}\log\frac{(0-1)^2}{(0.01)^3}$

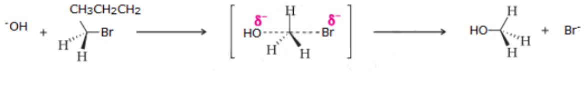
$= 0\cdot 3 - .00985\log\frac{\left(10^{-1}\right)^2}{\left(10^{-2}\right)^3}$

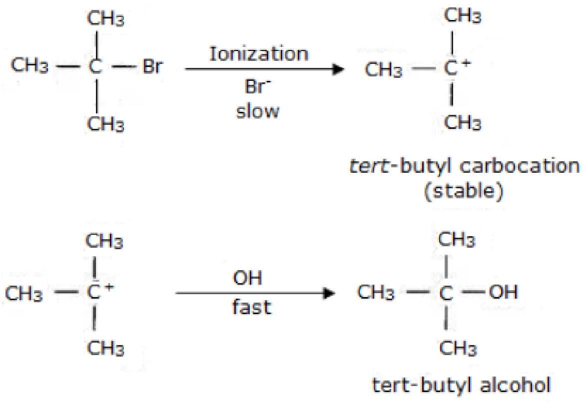
$= 0.3 - .00985 \times 4\log 10$

$= 0.3 - 0.0394$

$= 0.2606$ V

27. Tert-butylbromide undergoes substitution by S_N1 unimolecular substitution mechanism because it is able to form a stable carbocation in the first step after cleavage of the halide group. The carbocation then reacts with the nucleophile OH^-. On the other hand, primary halide n-butylbromide cannot form a stable carbocation so it undergoes S_N2 bimolecular substitution mechanism, which is a one-step substitution that involves the attack of OH^- and simultaneous leaving of X^- to form n-butyl alcohol.





28. We have

$\mathrm{Mg(s)|Mg^{+2}(0.1M)||Cu^{+2}(1\times10^{-3}M|Cu(s))}$

Half cell reactions of this cell are:

At Cathode (Reduction):

$Cu^{2+}(aq)+2e^{-}\rightarrow Cu(s)$

At Anode (Oxidation):

$Mg(s)\rightarrow Mg^{2+}(aq)+2e^{-}$

For this cell, we have, n=2 moles of electrons.

$(\mathrm{Given, E}^{\ominus}_{Cu^{2+}/Cu}=+0.34\ \mathrm{V},\ \mathrm{E}^{\ominus}_{Mg^{+2}/Mg}=-2.37\mathrm{V})$

$E^{\ominus}_{cell}\ =\ E^{\ominus}_{reduction}-E^{\ominus}_{oxidation}$

$E^{\ominus}_{cell}=E^{\ominus}_{(Cu^{2+}/Cu)}-E^{\ominus}_{(Mg^{2+}/Mg)}$

= 0.34 - (-2.37)V

= 2.71V

According to Nernst equation

$E_{cell}=E^{\ominus}_{cell}-\frac{0.059}{n}\log\frac{[Mg^{2+}]}{[Cu^{2+}]}$

$E_{cell}=E^{\ominus}_{cell}\ -\ \frac{0.059}{2}\log\left[\frac{0.1}{10^{-3}}\right]$

= 2.71 - 0.0295 $\log10^2$

$=2.71-0.0295\times2$

= 2.651

$\therefore E_{cell}=2.651\ V$

Section D

29. i. Copper exhibits +1 oxidation state more frequently i.e., Cu^{1+} because of its electronic configuration $3d^{10}4s^1$. It can easily lose $4s^1$ electron to give stable $3d^{10}$ configuration.

ii. Because of stronger metallic bonding and high enthalpies of atomization.

iii. The ability of O_2 to stabilize higher oxidation states exceeds that of fluorine because oxygen can form multiple bonds with metals.

OR

Due to lanthanoid contraction in second series after lanthanum, the atomic radii of elements of second and third series become almost same and hence show similarities in properties.

30. 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) Invertase
    - (ii) i. Adenine, Guanine
        - ii. 1. Vitamin D
            - 2. Vitamin B_{12}
    - (iii) Cyclic compound containing element other than carbon i.e.,N, S, O at ring position are called heterocyclic bases.
    - (iv) Glycosidic linkage
    - (v) Adenine and Guanine.
    - (vi) Keratin and Myosin
    - (vii) i. Thymine is present in DNA.
        - ii. Uracil is present in RNA.

32. i. $K_3\left[Co(C_2O_4)_3\right]$

The central metal ion is Co.

Its coordination number is 6.

The oxidation state can be given as:

x – 6 = –3

x = + 3

The d orbital occupation for $Co^{3+} is, {t_{2g}}^6 {e_g}^0$

ii. cis-$\left[Cr(en)_2Cl_2\right]Cl$

The central metal ion is Cr.

The coordination number is 6.

The oxidation state can be given as:

x + 2(0) + 2(–1) = +1

x – 2 = +1

x = +3

The d orbital occupation for Cr^{3+} is${t_{2g}}^3$.

iii. $(NH_4)_2\left[CoF_4\right]$

The central metal ion is Co.

The coordination number is 4.

The oxidation state can be given as:

x – 4 = –2

x = + 2

The d orbital occupation for
$Co^{2+} is, {e_g}^4 {t_{2g}}^3$.

iv. $\left[Mn(H_2O)_6\right]SO_4$

The central metal ion is Mn.

The coordination number is 6.

The oxidation state can be given as:

x + 0 = +2

x = +2

The d orbital occupation for Mn is
${t_{2g}}^3 {e_g}^2$.

OR

a. The formula of Tetraammineaquachloridocobalt(III) chloride is $[Co(NH_3)_4(H_2O)Cl]Cl_2$.

b. The formula of Potassium tetrahydroxidozincate(II) is $K_2[Zn(OH)_4]$.

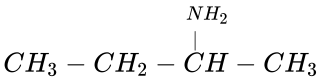
c. The formula of potassium trioxalatoaluminate(III) is $K_3[Al(C_2O_4)_3]$.

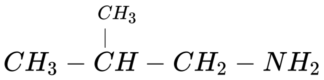
d. The formula of Dichloridobis(ethane-1, 2-diamine)cobalt(III) is $[CoCl_2(en)^2]^+$.

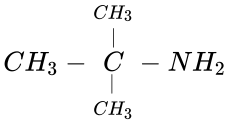
e. The formula of Tetracarbonylnickel(0) is $[Ni(CO)_4]$.

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.

$CH_3-CH_2-\overset{NH_2}{\overset{|}{C}}H-CH_3$
Butan-2-amine (1°)

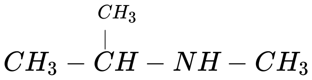
c.

$CH_3-\overset{CH_3}{\overset{|}{C}}H-CH_2-NH_2$
2-Methylpropanamine (1°)

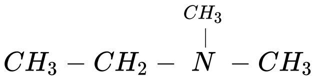
d.

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

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.

$CH_3-\overset{CH_3}{\overset{|}{C}}H-NH-CH_3$
N-Methylpropan-2-amine (2°)

h.

$CH_3-CH_2-\overset{CH_3}{\overset{|}{N}}-CH_3$
N, N- Dimethylethanamine (3°)

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

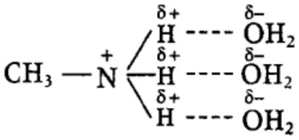
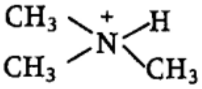
The pairs (a) and (c); (a) and (d); (b) and (c); (b) and (d) exhibit chain isomerism.

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

The relative strength of CH_3NH_2, $(CH_3)_2NH$ and $(CH_3)_3N$ depends upon the stabilisation of their conjugate acids which depend on the number of factors like H-bonding, steric hindrance and +I-effect of the alkyl groups. All these factors are favourable for 2^o amines, therefore $(CH_3)_2NH$ is a stronger base than CH_3NH_2 and $(CH_3)_3N$. Since, $(CH_3)_3N$ does not have H-atom linked to N-atom, therefore, the stabilisation of the conjugate acid-derived from CH_3NH_2 due to H-bonding is greater than that of the conjugate acid derived from $(CH_3)_3N$.


is more stable than

.

Further, in NH_3 no +I- group is linked to N-atom thus, it is least basic among all the given amines. Hence, the order would be:
$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$.