Class XII Session 2024-25
Subject - Chemistry
Sample Question Paper - 8

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 of the following has highest boiling point? **[1]**

a) C_2H_5-I b) C_2H_5-F

c) C_2H_5-Cl d) C_2H_5-Br

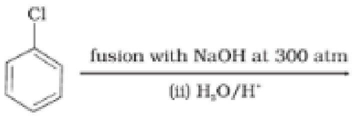
2. Amino acid is. **[1]**

a) $H_2N.CH_2.COOH$ b) Cl - CH_2. COOH

c) HO. CH_2COOH d) CH_3COONH_4

3. Which of the following reactions will yield phenol? **[1]**

i.



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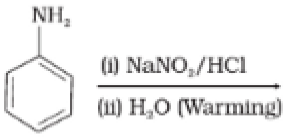

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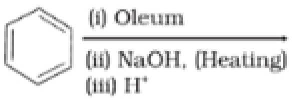

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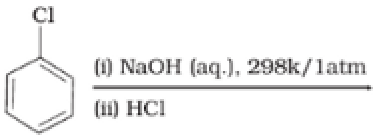


a) i, iii, iv
b) ii, iii, iv
c) i, ii, iii
d) i, ii, iv

4. Acetone is treated with excess of ethanol in the presence of hydrochloric acid. The product obtained is: **[1]**

a) $(CH_3)_2C(OH)(OC_2H_5)$
b) $(CH_3)_2C(OC_2H_5)(OC_2H_5)$
c) CH_3COOH
d) $(CH_3)_2CH(OH)$

5. For the reaction A + 2B $\rightarrow$ C + D, the rate law is given by $r = k[A]\,[B]^2$, the concentration of A is kept constant while that of B is doubled. The rate of the reaction will: **[1]**

a) not change
b) become half
c) quadruple
d) double

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. A dibromo derivative of an alkane reacts with sodium metal to form an alicyclic hydrocarbon. The derivative is **[1]**

a) 1, 1 – dibromopropane
b) 2, 2 – dibromobutane
c) 1, 2 – dibromoethane
d) 1, 4 – dibromobutane

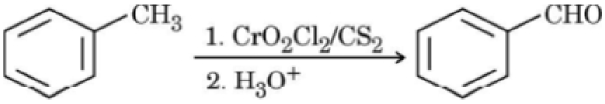
8. Oxidation state of central metal atom in the given complex is: **[1]**
$[Co(NH_3)_4(H_2O)_2]Cl_3$

a) +1
b) +3
c) +4
d) +2

9. The rate of the first-order reaction is $0.69 \times 10^{-2} mol\, L^{-1} \min^{-1}$ and the initial concentration is $0.2 mol\, L^{-1}$ the half-life period is: **[1]**

a) 1200 s
b) 600 s
c) 0.33 s
d) 1 s

10. **[1]**



This reaction is known as:

a) Rosenmund reduction
b) Etard reaction
c) Cannizzaro reaction
d) Aldol condensation

11. IUPAC name of m-cresol is ________. **[1]**

a) 3-chlorophenol
b) benzene-1, 3-diol
c) 3-methoxyphenol
d) 3-methylphenol

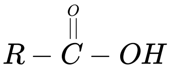
12. Hinsberg's reagent is: **[1]**

a) Benzene sulphonic acid
b) Benzene sulphonamide
c) Phenyl isocyanide
d) Benzene sulphonyl chloride

13. **Assertion (A):** A solution of sucrose in water is dextrorotatory but on hydrolysis in presence of little hydrochloric acid it becomes laevorotatory. **[1]**

Reason (R): Sucrose on hydrolysis gives unequal amounts of glucose and fructose as a result of which change in sign of rotation is observed.

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):** RMgX on reaction with CO_2 gives  $R-\overset{O}{\overset{||}{C}}-OH$ **[1]**

Reason (R): RMgX on reaction with carbonyl compounds give alcohols.

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):** $(CH_3)_3$ C–O–CH_3 gives $(CH_3)_3$ C–I and CH_3OH on treatment with HI. **[1]**

Reason (R): The reaction occurs by S_N1 mechanism.

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):** Di-tert-butyl ether cannot be prepared by Williamson's synthesis. **[1]**

Reason (R): tert-Butyl bromide on treatment with sodium lert-butoxide preferentially undergoes elimination to form isobutylene and rert-butyl alcohol.

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. How is stability of coordination compounds determined in aqueous solution? **[2]**

18. Consider the standard electrode potential values $\left(\frac{M^{2+}}{M}\right)$ of the elements of the first transition series. **[2]**

Ti	**V**	**Cr**	**Mn**	**Fe**	**Co**	**Ni**	**Cu**	**Zn**
-1.63	-1.18	-0.90	-1.18	-0.44	-0.28	-0.25	+0.34	-0.76

Explain:

i. E^o value for copper is positive.

ii. E^o value of Mn is more negative as expected from the trend.

iii. Cr^{3+} is a stronger reducing agent than Fe^{2+}.

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

(a) The time required to decompose SO_2Cl_2 to half of its initial amount is 60 min. If the decomposition is a first order reaction, calculate the rate constant of the reaction? **[1]**

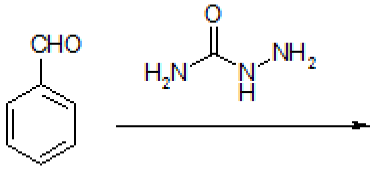
(b) The decomposition reaction of ammonia gas on platinum surface has a rate constant k = 2.5 $\times 10^{-4}$ mol L^{-1} s^{-1}. What is the order of the reaction? **[1]**

20. What is expected Van't Hoff factor for $K_4[Fe(CN)_6]$? **[2]**

OR

A solution is prepared by dissolving 11 g glucose in $200 cm^3$ water at $30^0 C$. What is the mass Percentage of glucose in solution? The density of water $30^0 C$ is $0.996 g/cm^3$

21. Complete each synthesis by giving missing starting material, reagent or products:- **[2]**



Section C

22. 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]**

23. For the reaction: **[3]**

$2A + B \rightarrow A_2B$

the rate = $k[A][B]^2$ with k = 2.0×10^{-6} mol^{-2} L^2 s^{-1}. Calculate the initial rate of the reaction when [A] = 0.1 mol L^{-1}, [B] = 0.2 mol L^{-1}. Calculate the rate of reaction after [A] is reduced to 0.06 mol L^{-1}.

24. Give the structure of the products you would except when each of the following alcohol reacts with (i) Butan-l-ol (ii) 2- Methylbutan-2-ol **[3]**

a. HCl - $ZnCl_2$
b. HBr
c. $SOCl_2$

OR

Name the reagents which are used in the following conversions:

i. A primary alcohol to an aldehyde
ii. Butan-2-one to butan-2-ol
iii. Phenol to 2, 4, 6-tribromophenol

25. Describe the following: **[3]**

i. Acetylation
ii. Cannizzaro reaction
iii. Cross aldol condensation
iv. Decarboxylation

26. In the button cell widely used in watches and other devices the following reaction takes place: **[3]**

$Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$

Determine $\Delta_r G^{(-)}$ and $E^{(-)}$ for the reaction

Given $Zn \rightarrow Zn^{2+} + 2e^-$, E^0 = 0.76V

Given $Ag \rightarrow Ag^+ + 2e^-$, E^0 = 0.344V

27. What happens when **[3]**

  i. n-butyl chloride is treated with alcoholic KOH.
  ii. bromobenzene is treated with Mg in the presence of dry ether.
  iii. chlorobenzene is subjected to hydrolysis.

28. The conductivity of 2.5 × 10^{-4} M methanoic acid is 5.25 × 10^{-5} S cm^{-1} and its $\wedge_m^0$ has a value 400 S cm^2 mol^{-1}. Calculate its molar conductivity and degree of dissociation. **[3]**

Section D

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

$KMnO_4$ and $K_2Cr_2O_7$ are most important chemicals which are used as oxidising agents and disinfectants. K_2MnO_4 is prepared by fusing MnO_2 with KOH in presence of O_2. $K2MnO_4$ is electrolysed to get purple coloured $KMnO_4$. Na_2CrO_4 is prepared by heating chromite ore with Na_2CO_3 in presence of O_2. Na_2CrO_4 is converted into $Na_2Cr_2O_7$ by reacting with concentrated H_2SO_4. $Na_2Cr_2O_7$ is reacted with KCl to get $K_2Cr_2O_7$, orange coloured solid, soluble in water, changes to yellow coloured $\mathrm{CrO_4^{2-}}$ in basic medium, $KMnO_4$ acts as oxidising agent in acidic, neutral as well basic medium. In acidic medium, it converts Fe^{2+} to Fe^{3+}, Sn^{2+} to Sn^{4+}, COO^- to CO^2. In basic medium it converts I^- to IO^{3-}. $K_2Cr_2O_7$ acts as oxidising agent only in acidic medium, converts H_2S to S, SO_2 to $SO4^{2-}$, I^- to I_2. Lanthanoids and actinoids belong to f-block elements with general electronic configuration (n - 2) $f^{1 \text{ to } 14}$ (n - 1) d^{0-2} ns^2. All actinoids are radioactive. Both show contraction in atomic and ionic radii but actinoid contraction is more than lanthanoid contraction. Lanthanoid show +3 oxidation state, few elements show +2 and +4 oxidation states also. Actinoids show +3, +4, +5, +6, +7 oxidation states.

  i. Which lanthanoid shows +4 oxidation state and why? (1)
  ii. Give two similarities between lanthanoids and actinoids. (1)
  iii. Complete the equation and balance: (2)

$\mathrm{Cr_2O_7^{2-}}$ + Fe^{2+} + H^+ → ?

OR

Convert sodium chromate to sodium dichromate. Give chemical equation. (2)

$2Na_2CrO_4$ + H_2SO_4 (conc.) → ?

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

Raoult's law for volatile liquids states that the partial vapour pressure of each component in the solution is directly proportional to its mole fraction, whereas for a non-volatile solute, it states that the vapour pressure of a solution of a non-volatile solute is equal to the vapour pressure of the pure solvent at that temperature multiplied by its mole fraction. Two liquids A and B are mixed with each other to form a solution, the vapour phase consists of both components of the solution. Once the components in the solution have reached equilibrium, the total vapour pressure of the solution can be determined by combining Raoult's law with Dalton's law of partial pressures. If a non-volatile solute B is dissolved into a solvent A to form a solution, the vapour pressure of the solution will be lower than that of the pure solvent. The solutions which obey Raoult's law over the entire range of concentration are ideal solutions, whereas the solutions for which vapour pressure is either higher or lower than that predicted by Raoult's law are called non-ideal solutions. Non-ideal solutions are identified by determining the strength of the intermolecular forces between the different molecules in that particular solution. They can either show positive or negative deviation from Raoult's law depending on whether the A - B interactions in solution are stronger or weaker than A - A and B - B interactions.

i. 20 mL of a liquid A was mixed with 20 mL of liquid B. The volume of resulting solution was found to be less than 40 mL. What do you conclude from the above data? (1)

ii. Which of the following show positive deviation from Raoult's law? Carbon disulphide and Acetone; Phenol and Aniline; Ethanol and Acetone. (1)

iii. The vapour pressure of a solution of glucose in water is 750 mm Hg at 100^{o}C. Calculate the mole fraction of solute. (2)

(Vapour pressure of water at 373 K = 760 mm Hg)

OR

The boiling point of solution increases when 1 mol of NaCl is added to 1 litre of water while addition of 1 mol of methanol to one litre of water decreases its boiling point. Explain the above observations. (2)

Section E

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

(a) What type of protein is present in keratin? **[1]**

(b) Write the reactions showing the presence of following in the open structure of glucose: **[1]**

i. an aldehyde group
ii. a primary alcohol

(c) What products would be formed when a nucleotide from DNA containing thymine is hydrolysed? **[1]**

(d) Amino acids show amphoteric behaviour. Why? **[1]**

(e) What are α Amino Acids? Give examples. **[1]**

(f) a. How can you explain the absence of an aldehyde group in the pentaacetate of D-glucose? **[1]**

b. Name the bases present in RNA. Which one of these is not present in DNA?

(g) Which monosaccharide units are present in starch, cellulose and glycogen and which linkages link these units? **[1]**

32. Explain on the basis of valence bond theory that $[Ni(CN)_4]^{2-}$ ion with square planar structure is diamagnetic and the $[NiCl_4]^{2-}$ ion with tetrahedral geometry is paramagnetic. **[5]**

OR

Draw the structures of optical isomers of:

i. $[Cr(C_2O_4)_3]^{3-}$
ii. $[PtCl_2(en)_2]^{2+}$
iii. $[Cr(NH_3)_2Cl_2(en)]^{+}$

33. I. Show how p-aminoazobenzene can be obtained from aniline. **[5]**

II. Write structures for the following compounds:

a. Benzene diazonium chloride
b. p-Nitrotoluene
c. SuIphanilic acid

OR

i. Give reasons:

  a. Although – NH_2 group is o/p directing in electrophilic substitution reactions, yet aniline, on nitration gives good yield of m-nitroaniline.
  b. $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.
  c. Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

ii. Distinguish between the following:

  a. $CH_3CH_2NH_2$ and $(CH_3CH_2)_2NH$
  b. Aniline and CH_3NH_2

Solution

Section A

1. **(a)** C_2H_5-I

   Explanation: For the same alkyl group the boiling points of haloalkanes are in the order of RF < RCl < RBr < RI as with the increase in size of halogen atom the magnitude of van der Waals forces of attraction increases, resulting in higher boiling points.

2. **(a)** $H_2N.CH_2.COOH$

   Explanation: Amino acids contain amino ($–NH_2$) and carboxyl (–COOH) functional groups.

3. **(c)** i, ii, iii

   Explanation:

   - **Preparation of phenols from haloarenes**: Chlorobenzene is an example of haloarenes which is formed by monosubstitution of the benzene ring. When chlorobenzene is fused with sodium hydroxide at 623K and 320 atm sodium phenoxide is produced. Finally, sodium phenoxide on acidification gives phenols.
   - **Preparation of phenols from diazonium salts:** When an aromatic primary amine is treated with nitrous ($NaNO_2$ + HCl) acid at 273 - 278 K, diazonium salts are obtained. These diazonium salts are highly reactive in nature. Upon warming with water, these diazonium salts finally hydrolyse to phenols. Phenols can also be obtained from diazonium salts by treating it with dilute acids.
   - **Preparation of phenols from benzene sulphonic acid**: Benzenesulphonic acid can be obtained from benzene by reacting it with oleum. Benzenesulphonic acid thus formed is treated with molten sodium hydroxide at high temperature which leads to the formation of sodium phenoxide. Finally, sodium phenoxide on acidification gives phenols.

4. **(b)** $(CH_3)_2C(OC_2H_5)(OC_2H_5)$

   Explanation: Ketones or aldehydes react with alcohols to form acetals. This reaction of alcohol on aldehydes or ketones is catalyzed in the presence of acid and is a reversible reaction. Firstly a hemiacetal $(CH_3)_2C(OH)(OC_2H_5)$ is formed which further reacts with alcohol to give acetal.

   $(CH_3)_2C(OC_2H_5)(OC_2H_5)\ CH_3COCH_3 + 2C_2H_5OH \overset{H^+}{\rightleftarrows} (CH_3)_2C(OC_2H_5)(OC_2H_5)$

5. **(c)** quadruple

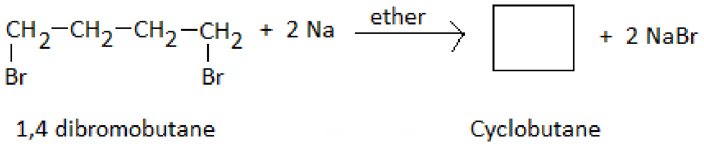
   Explanation: The rate of the reaction is quadruple.

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

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

7. **(d)** 1, 4 – dibromobutane

   Explanation: Of all the given options, it is possible with 1,4-dibromobutane to form cyclobutane as shown by intramolecular wurtz reaction.



8. **(b)** +3

   Explanation: +3

9. **(a)** 1200 s

Explanation: rate of first-order = k[R]

$k = \frac{rate}{[R]} = \frac{0.69\times10^{-2} molL^{-1}min^{-1}}{0.2molL^{-1}}$

$k = 3.45\times10^{-2}min^{-1} = \frac{3.45\times10^{-2}\ s^{-1}}{60}$

now,

$t_{1/2} = \frac{0.69}{k} = \frac{0.69\times60}{3.45\times10^{-2}} = 1200s$

the half-life period is = 1200s

10.

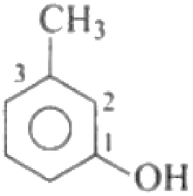
(b) Etard reaction

Explanation: Etard reaction

11.

(d) 3-methylphenol

Explanation:



-OH is a functional group and -CH_3 is the substituent.

We start numbering from the side of the main functional group -OH.

IUPAC name: 3-methyl phenol

12.

(d) Benzene sulphonyl chloride

Explanation: Benzene sulphonyl chloride, $C_6H_5SO_2Cl_2$, is called Hinsberg reagent. It is used to distinguish between primary, secondary and tertiary amines.

13.

(c) A is true but R is false.

Explanation: A is true but R is false.

14.

(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.

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

Explanation: $(CH_3)_3$-C-O-CH_3 is an ether with two different alkyl groups, of which $(CH_3)_3$-C-I, tertiary alkyl group, on reaction with hydrogen halide (HI) forms a tertiary halide.

This occurs as the reaction is an S_N1 reaction. The reaction involves the formation of a stable carbocation. If the ether has a primary alkyl group, then the reaction follows the S_N2 mechanism.

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

Explanation: Williamson's synthesis is not applicable to tert. alkyl halides because alkoxide ions being both powerful nucleophiles and bases would bring dehydro-halogenation of the tert. alkyl halides to form alkenes preferentially.

Section B

17. The stability of coordination compound is measured in terms of stability constant.

Thus if we have a reaction of the type

$M + 4L \rightleftharpoons\ ML_4$

$\beta_4 = \frac{[ML_4]}{[M][L]^4}$

18. i. The high energy to transform Cu(s) to Cu^{2+}(aq) is not balanced by its hydration enthalpy.

ii. Mn^{2+} has d^5 configuration (stable half-filled configuration)

iii. d^5 to d^3 occurs in case of Cr^{2+} to Cr^{3+}. (More stable t_{2g}^3) while it changes from d^6 to d^5 in case of Fe^{2+} to Fe^{3+}.

19. Answer the following:

(i) For first order reaction, $t_{1/2} = 0.693/k$

it is provided that $t_{1/2}$ = 60 min

then, k = 0.693/60 = 0.01386 min-1

(ii) Zero order of reaction.

20. $K_4[Fe(CN)_6] \Leftrightarrow 4K^+ + [Fe(CN)_6]^{4-}$

$\therefore$ Van't Hoff factor (i) = 5, as 5 ions are formed on dissociation.

OR

Density = $\frac{mass}{volume} = 0.996\text{g/cm}^3$

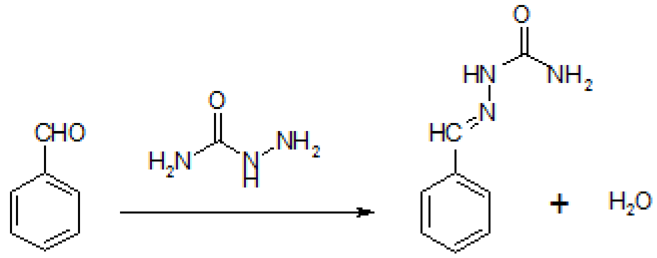
0.996 = $\frac{mass}{200\ cm^3}$

$Mass = 0.996 \times 200$ = 199.2 g

Mass% of glucose = $\frac{mass\text{ of volume}}{mass\text{ of water+mass of glucose}} \times 100$

$= \frac{11}{199.2+11}100 = 5.23\%$

21. More nucleophilic NH_2NH part of $H_2NNHCONH_2$ reacts with carbonyl carbon to form semicarbazone:



Section C

22. $\text{AgCl(s)} \rightleftharpoons \text{Ag}^+ + \text{Cl}^-$

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

$[Cl^-]$ = 1.0 M

$\left[\text{Ag}^+\right] = \frac{k_{sp}}{\left[\text{Cl}^-\right]} = \frac{1\times10^{-10}}{1} = 1 \times 10^{-10}\text{M}$

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

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

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

= 0.80 - 0.059 × 10 = 0.21 V

23. The initial rate of the reaction is:

Rate = $k[A][B]^2$

$= \left(2.0 \times 10^{-6} mol^{-2}L^2s^{-1}\right)\left(0.1 mol L^{-1}\right)\ \left(0.2 mol L^{-1}\right)^2 = 8.0 \times 10^{-9} mol^{-2}L^2s^{-1}$

When [A] is reduced from 0.1mol L^{-1} to 0.06 mol^{-1}, the concentration of A reacted

$= (0.1 - 0.06)\, mol\, L^{-1} = 0.004\, mol\, L^{-1}$

Therefore, concentration of B reacted $= \frac{1}{2} \times 0.04\, mol\, L^{-1} = 0.02 mol\, L^{-1}$

Then, concentration of B available, $[B] = (0.2 - 0.02) mol\, L^{-1}$

= 0.18 mol L^{-1}

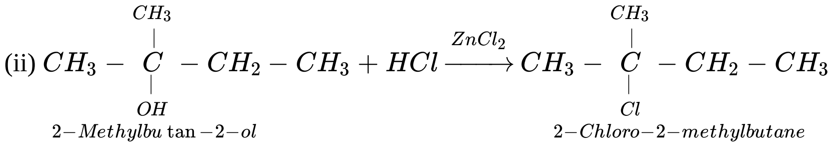
After [A] is reduced to 0.06 mol^{-1}, the rate of the reaction is given by,

Rate = $k[A][B]^2$

$= \left(2.0 \times 10^{-6} mol^{-2}L^2s^{-1}\right)\left(0.06 mol L^{-1}\right)\ (0.18\ )^2$

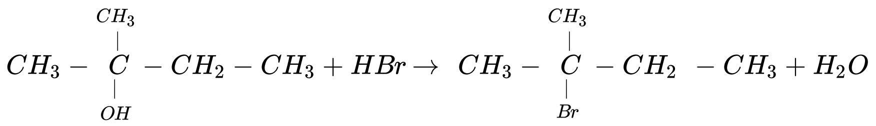
= 3.89 × 10^{-9} mol^{-1} $L^{-1}s^{-1}$

24. a. (i) $\underset{Butan-1-ol}{CH_3CH_2CH_2CH_2OH} + HCl \xrightarrow{ZnCl_2}$ No reaction at room temperature



(ii) $\underset{2-Methylbu\tan-2-ol}{CH_3 - \overset{\overset{CH_3}{|}}{\underset{\underset{OH}{|}}{C}} - CH_2 - CH_3} + HCl \xrightarrow{ZnCl_2} \underset{2-Chloro-2-methylbutane}{CH_3 - \overset{\overset{CH_3}{|}}{\underset{\underset{Cl}{|}}{C}} - CH_2 - CH_3}$

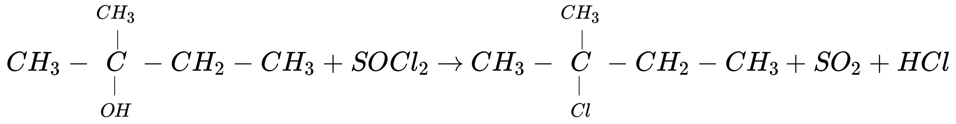
b. (i) $CH_3CH_2CH_2CH_2OH + HBr \rightarrow \underset{1-Bromobu\tan e}{CH_3CH_2CH_2CH_2Br} + H_2O$



(ii) $CH_3 - \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3 + HBr \rightarrow CH_3 - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3 + H_2O$

2 - Bromo - 2 - methylbutane

c. (i) $CH_3 - CH_2 - CH_2 - CH_2OH + SOCl_2 \rightarrow \underset{1-Chlorobutane}{CH_3CH_2CH_2Cl} + SO_2 + HCl$



(ii) $CH_3 - \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3 + SOCl_2 \rightarrow CH_3 - \underset{\underset{Cl}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3 + SO_2 + HCl$

$2-Chloro-2-methylbutane$

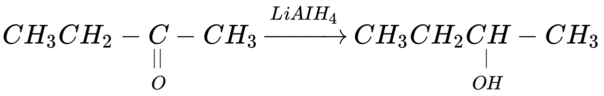
OR

i. CrO_3 or PCC (Pyridinium chlorochromate)

$RCH_2OH \xrightarrow{CrO_3} RCHO$

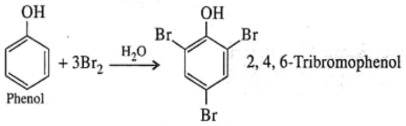
$CH_3 - CH = CH - CH_2OH \xrightarrow{PCC} CH_3 - CH = CH - CHO$

ii. Ni/H_2 or $LiAIH_4$

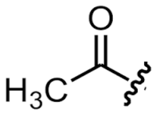


$\underset{\text{Butan - 2 - one}}{CH_3CH_2 - \underset{\underset{O}{||}}{C} - CH_3} \xrightarrow{LiAIH_4} \underset{\text{Butan - 2 - ol}}{CH_3CH_2\underset{\underset{OH}{|}}{CH} - CH_3}$

iii. Aqueous bromine or bromine water:



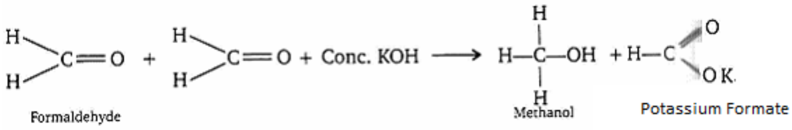
25. i. **Acetylation:** Acetylation simply involves the addition of an acetyl group to a compound. An acetyl group is made up of a carbonyl group, or carbon double bonded to oxygen, with a methyl group ($-CH_3$) on the end. The part of the acetyl group that's attached to the compound is often represented with 'R'.



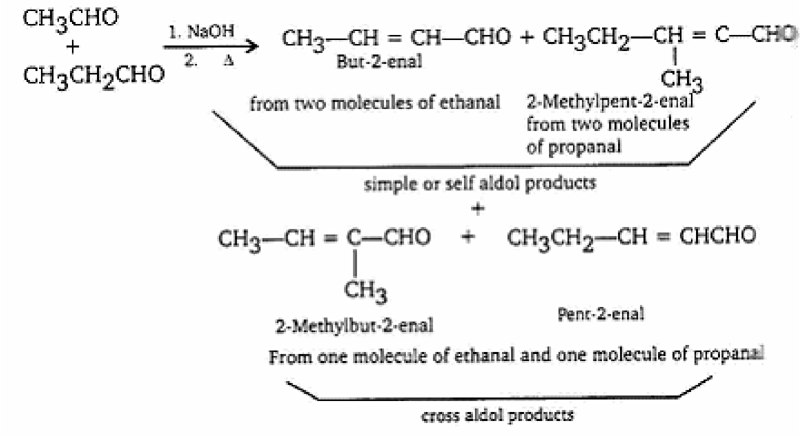
Example:

$\underset{\text{Acetyl chloride}}{CH_3COCl} + \underset{\text{ethyl alcohol}}{CH_3CH_2OH} \xrightarrow{Pyridine} \underset{\text{ethyl acetate}}{CH_3COOC_2H_5} + HCl$

ii. **Cannizzaro reaction:** Aldehydes which do not have an alpha-hydrogen atom, undergo self oxidation and reduction (disproportionation) reaction on treatment with concentrated alkali. In this reaction, one molecule of the aldehyde is reduced to alcohol while another is oxidized to carboxylic acid salt.



iii. **Cross aldol condensation:** When aldol condensation is carried out between two different aldehydes and / or ketones, it is called cross aldol condensation. If both of them contain alpha-hydrogen atoms, it gives a mixture of four products. This is illustrated below by aldol reaction of a mixture of ethanal and propanal.



iv. **Decarboxylation:** Carboxylic acids lose carbon dioxide to form hydrocarbon when their sodium salts are heated with soda lime (NaOH and CaO in the ratio of 3 : 1). This reaction is known as decarboxylation.

$$R-COONa\xrightarrow[Heat]{NaOH\ and\ CaO}R-H+Na_2CO_3$$

26. Zn is oxidized and Ag_2O is reduced (as Ag^+ions change to Ag)

$E_{cell}^0=E^0[Ag_2O/Ag](red)+E^0[Zn/Zn^{2+}](ox)$

= 0.344 + 0.76

= 1.104 V

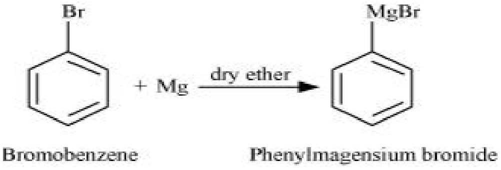
$\Delta_rG^0=-nFE^0cell=-2\times96500\times1.104J$

$=-2.13\times10^5J$

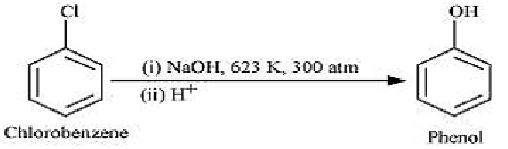
27. i. When n - butyl chloride is treated with alcoholic KOH, the formation of but - 1 - ene takes place. This reaction is a dehydrohalogenation reaction.

$$\underset{\text{n − Butyl chloride}}{CH_3-CH_2-CH_2-CH_2-Cl}\xrightarrow[\text{(dehydrohalogenation)}]{KOH(alc)/\Delta}\underset{But-1-ene}{CH_3-CH_2-CH=CH_2}+KCl+H_2O$$

ii. When bromobenzene is treated with Mg in the presence of dry ether, (Grignard reagent) phenylmagnesium bromide is formed.



iii. The chlorobenzene does not undergo hydrolysis under normal conditions. However, it undergoes hydrolysis when heated in an aqueous sodium hydroxide solution at a temperature of 623 K and a pressure of 300 atm form phenol(replacement by hydroxyl group).



28. $\Lambda_m = \frac{1000\times K}{M}$ S cm^2 mol^{-1}

$\Lambda_m = \frac{1000\times5.25\times10^{-5}}{2.5\times10^{-4}}$ - S cm^2 mol^{-1}

= 210 S cm^{2}mol^{-1}

$\wedge_m^0$HCOOH = $\lambda^\circ\text{HCOO}^-+\lambda^\circ\text{H}^+$

= (50.5 + 349.5) S cm^{2}mol^{-1}

= 400 S cm^{2}mol^{-1}

$\alpha = \frac{\Lambda_m}{\Lambda_m^\circ}$

$\alpha = \frac{210}{400}$

= 0.525

Section D

29. i. ‘Ce’ shows +4 oxidation state because it has stable noble gas electronic configuration.

ii. i. Both show contraction, lanthanoid and actinoid contraction.

ii. Both form-coloured ions and undergo f-f transition.

iii. $Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 7H_2O + 6Fe^{3+}$

OR

$2Na_2CrO_4 + H_2SO_4$ (conc.) $\rightarrow Na_2Cr_2O_7 + Na_2SO_4 + H_2O$

30. i. Solution shows a negative deviation from Raoult's law / A-A and B-B interactions are weaker than A-B interactions.

ii. Carbon disulphide and acetone, Ethanol and acetone.

iii. According to Raoult's law:

$p_1 = p_1^0 x_1$ or $x_1 = \frac{p_1}{p_1^0}$

$x_1 = \frac{750}{760} = 0.987$

$x_2 = 1 - x_1$

$= 1 - 0.987 = 0.013$

OR

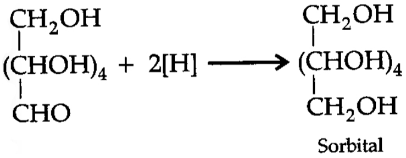
NaCl is a non-volatile solute, when it is added to water the vapour pressure decreases and hence boiling point increases. Methanol is a volatile solute and its addition to water increases the total vapour pressure of the solution and hence boiling point decreases.

Section E

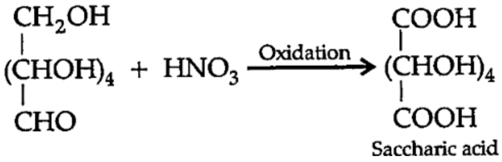
31. Attempt any five of the following:

(i) Fibrous Proteins

(ii) i. **An aldehyde group:** On reduction with sodium amalgam and water, the aldehydic group is reduced to primary alcohol.



ii. **A primary alcohol:** (with nitric acid) On reaction with nitric acid, a primary alcohol group present in glucose is converted into carboxylic acid (-COOH) group.



(iii) When a nucleotide from the DNA containing thymine is hydrolyzed, thymine β -D-2-deoxyribose and phosphoric acid are obtained as products.

(iv) Amino acids contain both amino ($-NH_2$) and carboxyl (-COOH) groups, thus they react with both acids and bases. Hence, amino acids are amphoteric in nature.

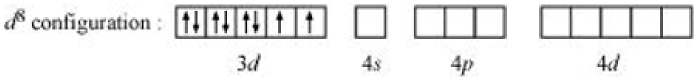
(v) Those amino acids in which $-NH_2$ group and -COOH group are attached to same carbon are called α-amino acids. These are obtained by hydrolysis of proteins. e.g., glycine.

(vi) a. The pentaacetate of glucose does not react with hydroxylamine / HCN / Schiff's reagent indicating the absence of free -CHO group.

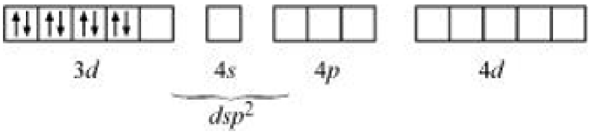
b. Adenine, Guanine, Uracil and Cytosine Uracil

(vii) In starch α-glucose units are present, in cellulose β -D glucose units are present. In starch and glycogen glycosidic α-linkage is present between C1-C4 and in cellulose glycosidic β -linkage is present between glucose units.

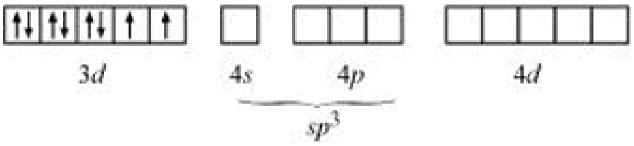
32. Ni is in the +2 oxidation state i.e., in d^8 configuration.



There are 4 CN^- ions. Thus, it can either have a tetrahedral geometry or square planar geometry. Since CN^- ion is a strong field ligand, it causes the pairing of unpaired 3d electrons.



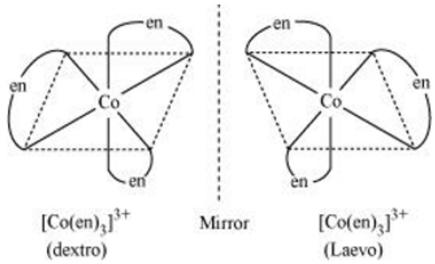
It now undergoes dsp^2 hybridization. Since all electrons are paired, it is diamagnetic. In case of $[NiCl_4]^{2-}$, CN^- ion is a weak field ligand. Therefore, it does not lead to the pairing of unpaired 3d electrons. Therefore, it undergoes sp^3 hybridization.



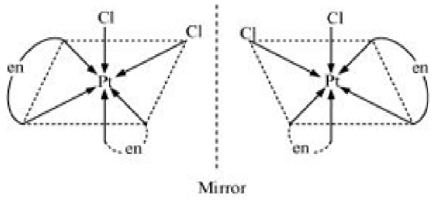
Since there are 2 unpaired electrons in this case, it is paramagnetic in nature.

OR

i. $[Cr(C_2O_4)_3]^{3-}$

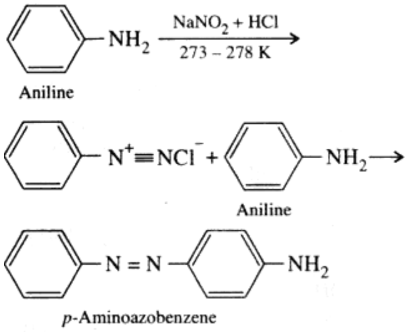


ii. $[PtCl_2(en)_2]^{2+}$

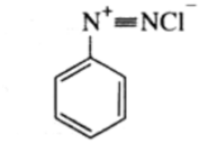


iii. $[Cr(NH_3)_2Cl_2(en)]^+$

33. I. Steps involved in the conversion are given below:

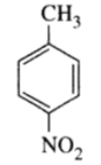


II. a.



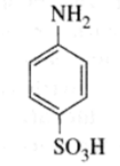
Benzene diazonium chloride

b.



p-Nitrotoluene

c.



Sulphanilic acid

OR

i. a. Nitration is carried out in acidic medium. In an acidic medium, aniline is protonated to form the anilinium ion which is meta directing. That is why besides the ortho and para derivatives, a substantial amount of meta derivative (m-nitroaniline) is also formed.

b. $(CH_3)_2NH$ is a secondary amine and $(CH_3)_3N$ is a tertiary amine. Tertiary amine due to the presence of three alkyl groups is more hindered than secondary amine which has only two alkyl groups attached to it. Therefore formation of ammonium ion is easier in secondary amine than the tertiary amine. Therefore, it makes secondary amine less basic than the tertiary amine.

c. The ammonolysis of alkyl halide leads to the formation of the mixture of primary, secondary and tertiary amine along with the formation of quaternary salt. It is very difficult to separate pure primary amine from this mixture.

ii. a.

Test	**$CH_3CH_2NH_2$**	**$(CH_3CH_2)_2NH$**
Carbylamine test (add chloroform and alcoholic KOH to both the compounds separately in a test tube)	Forms a foul-smelling compound (gives positive test)	No reaction take place (gives negative test)

b.

Azo dye Test	**Aniline**	**Methyl Amine (CH_3NH_2)**
Add a small amount of nitrous acid with aq. HCl	Forms a yellow coloured dye (gives positive test)	No dye is formed(gives negative test)