Class XII Session 2026-27
Subject - Chemistry
Sample Question Paper - 10

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.**

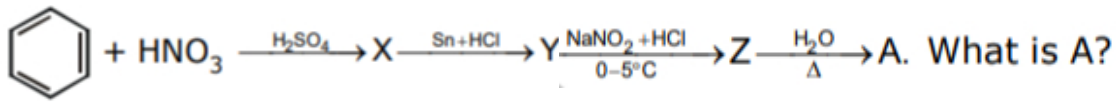
Section A

1. Which reagents are required for one step conversion of Chlorobenzene to Diphenyl? **[1]**

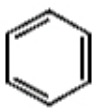
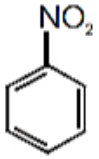
   a) Chlorobenzene, Na, Dry ether
   b) Chlorobenzene/Fe, Dark
   c) Benzene, Anhydrous $AlCl_3$
   d) $NaNO_2 + HCl$

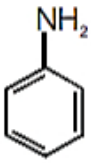
2. In the ring structure of glucose, the anomeric carbon is: **[1]**

   a) C-1
   b) C-3
   c) C-4
   d) C-2

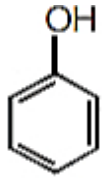
3. 

[1]

   a) 
   b) 

   c) 

   d)



4. $CH_3 - C \equiv CH \xrightarrow[1\%HgSO_4]{40\%H_2SO_4} A \xrightarrow{\text{Isomerisation}} CH_3 - \underset{\underset{O}{\|}}{C} - CH_3$ **[1]**

The structure of A and type of isomerism in the above reaction are respectively.

a) Prop-2-en-2-ol, geometrical isomerism

b) Prop–1–en–2–ol, metamerism

c) Prop-1-en-2-ol, tautomerism

d) Prop-1-en-1-ol, tautomerism

5. For a first order reaction, the time required for 99.9% of the reaction to take place is nearly **[1]**

a) 10 times that required for half of the reaction

b) 100 times that required for two-thirds of the reaction

c) 20 times that required for half of the reaction

d) 10 times that required for one-fourth of the reaction

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

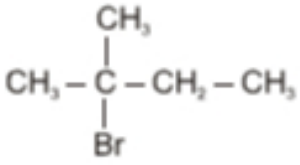
b) (a) - (i), (b) - (ii), (c) - (iii), (d) - (iv)

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

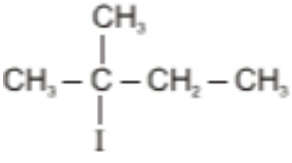
d) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

7. Which one of the following compounds undergoes E1 reaction most readily? **[1]**

a) $CH_3 - CH_2 - CH_2 - I$

b) 

c) $CH_3 - CH_2 - CH_2 - Br$

d) 

8. Out of Ti^{3+}, Cr^{3+}, Mn^{2+} and Ni^{2+} ions, the one which has the highest magnetic moment is: **[1]**

[Atomic number : Ti = 22, Cr = 24, Mn = 25, Ni = 28]

a) Ti^{3+} b) Ni^{2+}

c) Mn^{2+} d) Cr^{3+}

9. The order of the reaction **[1]**

$H_2(g) + Cl_2(g) \xrightarrow{h\nu} 2HCl(g)$ is:

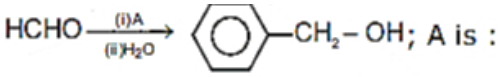
a) 2 b) 0

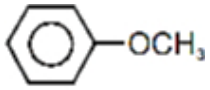
c) 1 d) 3

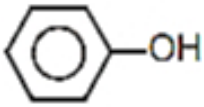
10. Benzaldehyde and acetone can be best distinguished by using: **[1]**

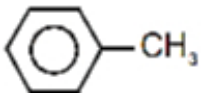
a) Sodium hydroxide solution b) 2, 4 – DNP reagent

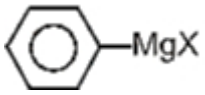
c) Hydrazine d) Tollen's reagent

11.  **[1]**

a) 

b) 

c) 

d) 

12. Hoffmann Bromamide degradation reaction is given by- **[1]**

a) $ArCH_2NH_2$ b) $ArCONH_2$

c) $ArNH_2$ d) $ArNO_2$

13. **Assertion (A):** Cellulose can be easily converted into fibres. **[1]**

Reason (R): Cotton contains about 90% cellulose.

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:** p-O_2N - $C_6H_5COCH_3$ is prepared by Friedel Crafts acylation of nitrobenzene. **[1]**

Reason: Nitrobenzene easily undergoes electrophilic substitution reaction.

a) If both Assertion & Reason are true and the reason is the correct explanation of the assertion.

b) If both Assertion & Reason are true but the reason is not the correct explanation of the assertion.

c) If Assertion is true statement but Reason is false.

d) If both Assertion and Reason are false statements.

15. **Assertion (A):** Chlorobenzene is resistant to nucleophilic substitution reaction at room temperature. **[1]**

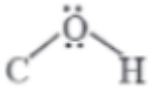
Reason (R): C–Cl bond gets weaker due to resonance.

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):**  bond angle is less than the normal tetrahedral bond angle. **[1]**

Reason (R): Lone pair-lone pair repulsion decreases bond angle.

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. a. What will be the van't Hoff factor for a dilute solution of K_2SO_4, assuming complete dissociation? **[2]**

b. 1.00 g of non-electrolyte solute dissolved in 50 g of benzene lowered the freezing point of benzene by 0.40 K. Find the molar mass of the solute. (K_f for benzene = 5.12 K kg mol^{-1})

OR

How is relative lowering of vapour pressure defined for a solution consisting of volatile solvent and non-volatile solute? How is this function related to the mole fraction of the solute in the solvent?

18. a. On the basis of crystal field theory write the electronic configuration for d^5 ion with a strong field ligand for which $\Delta_0 > P$. **[2]**

b. $[Ni(CO)_4]$ has tetrahedral geometry while $[Ni(CN)_4]^{2-}$ has square planar yet both exhibit dimagnetism. Explain.

[Atomic number : Ni = 28]

19. Give reasons for the following: **[2]**

a. Transition metals have high enthalpies of atomization.

b. Manganese has lower melting point even though it has a higher number of unpaired electrons for bonding.

c. Ce^{4+} is a strong oxidizing agent.

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

i. The rate constant of a reactant is $2 \times 10^{-2} L\,mol^{-1} s^{-1}$. What is the order of the reaction. **[1]**

ii. For a zero order reaction will the molecularity be equal to zero? Explain. **[1]**

21. a. Butan-1-ol has a higher boiling point than diethyl ether. Why? **[2]**

b. Write the mechanism of the following reaction:

$$2CH_3CH_2OH \xrightarrow[413\ K]{H^+} CH_3CH_2 - O - CH_2 - CH_3$$

Section C

22. Calculate $\Delta_r G^\circ$ and $\log K_C$ of the reaction. **[3]**

$2Cr(s) + 3Cd^{2+}(aq) \longrightarrow 2Cr^{3+}(aq) + 3Cd(s)$

Given $E^\circ_{Cr^{3+}/Cr} = -0.74\ V$

$E^\circ_{Cd^{2+}/Cd} = -0.40\ V$

$\left[R = 8.314\ J\ K^{-1}\ mol^{-1},\ F = 96500 C mol^{-1}\right]$

23. The rate of a reaction: **[3]**

$A + B \longrightarrow$ product

is given below as a function of different initial concentrations of A and B.

Experiment	$[A]/molL^{-1}$	$[\ B]/molL^{-1}$	**Initial Rate/mol L^{-1} min^{-1}**
1	0.01	0.01	5×10^{-3}
2	0.02	0.01	1×10^{-2}
3	0.01	0.02	5×10^{-3}

Calculate the order of the reaction with respect to A and B. Determine the rate constant of the reaction.

24. **[3]**

i. Write the mechanism of the following reaction:

$$2CH_3CH_2OH \xrightarrow[413K]{H^+} CH_3CH_2OCH_2CH_3 + H_2O$$

ii. Write the preparation of phenol from cumene.

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

i. Cannizzaro reaction

ii. Aldol condensation

iii. Hell-Volhard-Zelinsky reaction

26. Write the name of the cell which is generally used in inverters. Write the reactions taking place at anode and cathode of this cell, when it is in use. **[3]**

27. Account for the following: **[3]**

a. The $C - Cl$ bond length in chlorobenzene is shorter than that in methyl chloride.

b. Grignard reagents should be prepared under anhydrous conditions.

c. In case of optically active alkyl halides, S_N1 reactions are accompanied by racemisation.

28. The electrical resistance of a column of 0.05 M KOH solution of cell constant $60 cm^{-1}$ is 5.4×10^3 ohm. Calculate its resistivity, conductivity and molar conductivity. **[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 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)

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

OR

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

$2Na_2CrO_4 + H_2SO_4$ (conc.) $\rightarrow$?

30. The cause for deviation from Raoult's law in the colligative properties of non-ideal solutions lie in the nature of interactions at the molecular level. These properties show deviations from Raoult's law due to difference in interactions between solute - solvent, solute - solute and solvent - solvent. Some liquids on mixing, form azeotropes which are binary mixtures having the same composition in liquid and vapour phase and boil at a constant temperature. In such cases, it is not possible to separate the components by fractional distillation. There are two types of azeotropes called minimum boiling azeotrope and maximum boiling azeotrope. **[4]**

Based on the above passage, answer the following questions:

a. Pure ethanol cannot be prepared by fractional distillation of ethanol - water mixture. Comment. **(1)**

b. Why does a mixture of chloroform and acetone show deviation from ideal behaviour? **(1)**

c. i. The vapour pressure of pure benzene at a certain temperature is 1.25 atm. When 1.2 g of non-volatile, non-electrolyte solute is added to 60 g of benzene ($M = 78\ g\ mol^{-1}$), the vapour pressure of the solution becomes 1.237 atm. Calculate the molar mass of the non-volatile solute. **(2)**

OR

ii. The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is $2.53\ K\ kg\ mol^{-1}$. **(2)**

Section E

31. **Attempt either A or B** **[5]**

i. **Answer the following questions:** **[1]**

i. Name purines present in DNA?

ii. How do you explain the presence of all six carbon atoms in glucose in a straight chain?

iii. Write the products obtained after hydrolysis of lactose.

iv. Define denaturation of protein. What is the effect of denaturation on the structure of protein?

v. Name the linkage connecting monosaccharide units in polysaccharides.

ii. **Answer the following questions:** **[1]**

i. Why are polysaccharides considered non-sugars?

ii. α-Helix is a secondary structure of proteins formed by twisting of the polypeptide chain into right-handed screw like structures. Which type of interactions is responsible for making the α-helix structure stable?

iii. What are α Amino Acids? Give examples.

iv. Account for the following:

a. There are 5 -OH groups in glucose.

b. Glucose is a reducing sugar

v. i. What is the difference between a nucleoside and nucleotide?

ii. Write one difference between α-helix and β-pleated sheet structures of protein.

32. **Attempt either A or B** **[5]**

i. **Answer the following questions:** **[1]**

i. Arrange the following complex ions in increasing order of their crystal field splitting energy (Δ_o):

$[Co(NH_3)_6]^{3+}$, $[CoF_6]^{3-}$, $[Co(CN)_6]^{3-}$

ii. Enlist the common shapes of Werner's complexes.

iii. Write IUPAC names of the following coordination entities:

a. $[Cr(NH_3)_3(H_2O)_3]Cl_3$

b. $K_3[Al(C_2O_4)_3]$

iv. Using IUPAC norms write the formula of Hexaamminecobalt(III) sulphate.

v. Using IUPAC norms write the formulae for the following:

i. Pentaamminenitrito-O-cobalt(III) chloride

ii. Potassium tetracyanidonickelate(II)

ii. **Answer the following questions:** **[1]**

i. Give an example of coordination isomerism.

ii. Write the IUPAC name of $[N:(H_2O)_6](ClO_4)_2$

iii. i. Write the IUPAC name of the following complex:
$[Co(NH_3)_4CI(NO_2)]CI$

ii. Write the formula for the following:
Dichloridobis(ethane-1,2-diamine)cobalt(III) chloride

iv. Out of $[Co(NH_3)_6]^{3+}$ and $[Co(NH_3)_4Cl_2]^+$, which complex is heteroleptic and why?

v. Indicate the types of isomerisms shown by the complex : $K[Fe(H_2O)_2(en)_2Cl_2]$?

33. i. Write the structures of A and B in the following reactions: **[5]**

a. $C_6H_5N_2^+Cl^- \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B$

b. $CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{NaOBr} B$

ii. Write the chemical reaction of methyl amine with benzoyl chloride and write the IUPAC name of the product obtained.

iii. Arrange the following in the increasing order of their pK_b values: $C_6H_5NH_2$, NH_3, $C_2H_5NH_2$, $(C_2H_5)_2$ NH

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. $(CH_3)_2$ NH is more basic than $(CH_3)_3$ N 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 $(CH_3CH_2)_2$ NH

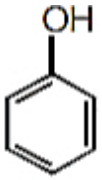
b. Aniline and CH_3NH_2

Solution

Section A

1. **(a)** Chlorobenzene, Na, Dry ether
   Explanation:
   Chlorobenzene, Na, Dry ether

2. **(a)** C-1
   Explanation:
   C-1

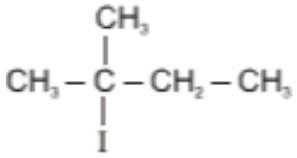
3. **(d)** 
   Explanation:
   The solution is correct because option meets the criteria or requirements set by the question. It aligns with the context or parameters provided, making it the most appropriate choice among the options listed.

4. **(c)** Prop-1-en-2-ol, tautomerism
   Explanation:
   $$CH_3 - C \equiv CH \xrightarrow[1\%HgSO_4]{40\%H_2SO_4} \underset{\underset{(A)}{\text{Pr}\,op-1-en-2-ol}}{CH_3 - \underset{\underset{OH}{|}}{C} = CH_2} \xrightarrow{Isomerisation} \underset{Acetone}{CH_3 - \underset{\underset{O}{||}}{C} - CH_3}$$
   Prop-1-en-2-ol (A) acetone are tautomers.

5. **(a)** 10 times that required for half of the reaction
   Explanation:
   The solution is correct because, for a first-order reaction, the relationship between the time required for a certain percentage of the reaction to occur and the half-life is well established. The time taken to reach 99.9% completion is significantly longer than the time taken to reach 50% completion. Specifically, it can be shown mathematically that the time for 99.9% completion is approximately 10 times the half-life. This is due to the exponential nature of first-order kinetics, where each successive half-life takes the same amount of time, leading to a cumulative effect for larger percentages of completion.

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

7.

(d) 

Explanation:
The compound that undergoes an E1 reaction most readily is typically one that can form a stable carbocation. In this case, the compound in option likely has a structure that allows for the formation of a more stable carbocation compared to the others. E1 reactions proceed through a two-step mechanism where the first step involves the formation of a carbocation. The stability of the carbocation is crucial; tertiary carbocations are more stable than secondary, which are more stable than primary. Therefore, the compound in option must have a structure that leads to a stable carbocation, making it more favorable for the E1 reaction to occur.

8.

(c) Mn^{2+}
Explanation:
Mn^{2+}

9.

(b) 0
Explanation:
The reaction is zero order reaction. The order of all photochemical reactions is zero as it does not depend upon the concentration of reactants.

10.

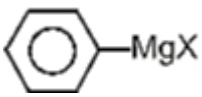
(d) Tollen's reagent
Explanation:
Tollen's Test is used to distinguish between aldehyde and ketone. It uses the fact that aldehydes are easily oxidised to their corresponding acids while ketones are not.
Tollen's reagent is aqueous ammonical silver nitrate solution which reacts with aldehydes as shown.

$RCHO + 2Ag^{+} + 2OH^{-} \rightarrow RCOO^{-} + Ag + H_2O.$

$RCOR + 2Ag^{+} + 2OH \rightarrow$ No reaction

If this test is carried in a glass tube, the Ag formed forms a mirror on the sides of the test tube so the test is also known as the silver mirror test.
Aldehydes show Tollen's test while acetone which is a ketone does not give Tollen's test.

11.

(d) 

Explanation:
The solution is correct because it identifies option as the answer based on the analysis of the given problem. The reasoning likely involves evaluating the conditions or requirements stated in the question and determining that option meets those criteria while the other options do not. This conclusion is drawn from a logical assessment of the information provided.

12.

(b) $ArCONH_2$
Explanation:

$ArCONH_2$

13. **(b)** Both A and R are true but R is not the correct explanation of A.
Explanation:
Cellulose is a linear condensation polymer of β-glucose. Because of linear structure, cellulose can be easily converted into fibres.

14. **(d)** If both Assertion and Reason are false statements.
Explanation:
In an electrophilic substitution reaction, the nitro group strongly deactivates the benzene ring. Nitrobenzene does not undergo Friedel Craft acylation reaction.

15. **(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).

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

Section B

17. a. i = 3(2 for K^+ and 1 for SO_4^{2-})

b. $M = \frac{K_f X w_2 X 1000}{\Delta T_f X w_1}$

$= \frac{5.12 \times 1 \times 1000}{0.40 \times 50}$

$= 256\ g\ mol^{-1}$

OR

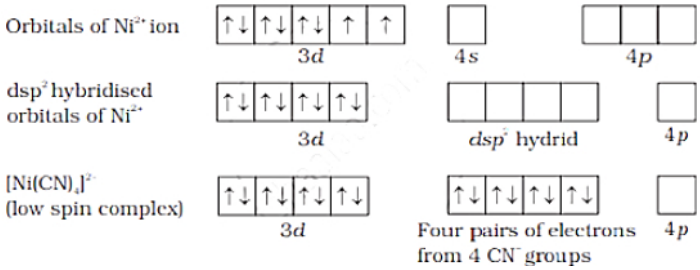
Relative lowering of vapour pressure of an ideal solution containing the non volatile solute is equal to the mole fraction of solute at a given temperature. Here the solute is non volatile and solvent is volatile.

$\frac{P_A^0 - P_A}{p_A^0} = x_B$

where P_A^0 is vapour pressure of pure solvent and P_A is vapour pressure of solution and x_B is mole fraction of solute.

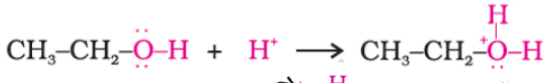
18. a. If $\Delta_0 > P$, it becomes more energetically favourable for the fourth electron to occupy a t_{2g} orbital with electronic configuration $t_{2g}^5 e_g^0$. Ligands which produce this effect are known as strong field ligands and form low-spin complexes.

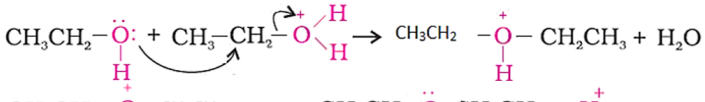
b. In $[Ni(CN)_4]^{2-}$, nickel is in a + 2 oxidation state and the ion has the electronic configuration $3d^8$. The hybridisation scheme is shown in the diagram.

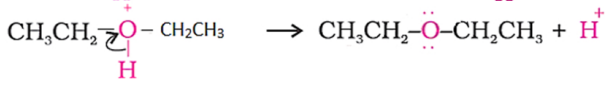


Whereas in $[Ni(CO)_4]$, Ni has + 2 oxidation state and shows sp^2 hybridisation due to which its geometry is tetrahedral hence diamagnetic.

19. i. Because of strong interatomic interactions/Strong metallic bonding between atoms.
    ii. Due to stable $3d^5$ configuration, interatomic interaction is poor between unpaired electrons.
    iii. Because Ce is more stable in +3 oxidation state.
20. Answer the following:
    (a) Second order reaction
    (b) Molecularity of a reaction can never be equal to zero as it shows the number of reactants taking part in a reaction, which can never be zero.
21. a. Both are functional isomers. However, **intermolecular hydrogen bonding is present in butan-1-ol molecules while it is absent in the molecules of diethyl ether**.Therefore, boiling point of alcohol (390 K) is higher as compared to that of ether (308 K)

    b. i. 

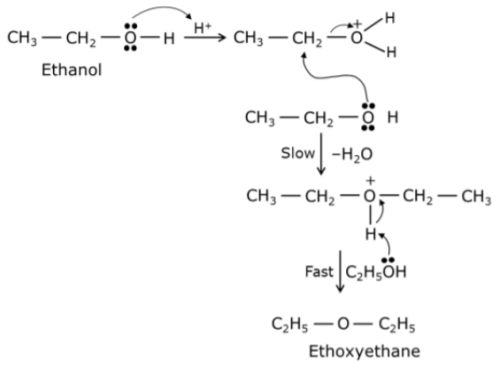
    ii. 

    iii. 

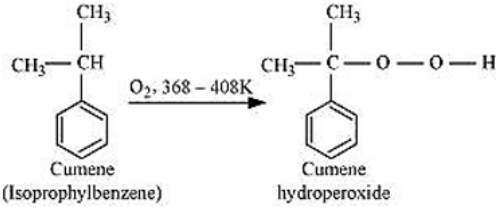
Section C

22. $E^\circ C_{ell} = E^\circ_{cathode} - E^\circ_{anode}$
    $= -0.40 - (-0.74)$
    $= +0.34\ V$
    $\Delta G^0 = -n\ F\ E^\circ_{cell}$
    $= -(6 \times 96500 \times 0.34)J$
    $= -196860\ J/mol$
    $\Delta G^0 = -2.303RT \log Kc$
    $\log Kc = (196860)/2.303 \times 8.314 \times 298$
    = 34.576
23. Rate $= k[A]^p[B]^q$
    $5.0 \times 10^{-3} = k[0.01]^p[0.01]^q \ldots$ Eq 1
    $1.0 \times 10^{-2} = k[0.02]^p[0.01]^q \ldots .$ Eq 2
    $5 \cdot 0 \times 10^{-3} = k[0.01]^p[0.02]^q \ldots$ Eq 3
    On Comparing (eq1) and (eq3)
    $1 = (2)^q$
    $q = 0$
    On Comparing (eq1) and (eq2)
    $(2)^1 = (2)^p$
    $p = 1$
    Order $w \cdot r \cdot t\ A = 1$
    Order $w \cdot r \cdot t\ B = 0$
    From eq 1
    $5.0 \times 10^{-3} = k[0.01]^1[0.01]^0$
    $k = 0.5\ min^{-1}$

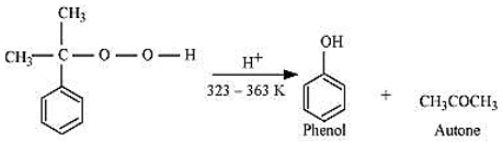
24. i. $2CH_3CH_2OH \xrightarrow[413K]{H^+} CH_3CH_2OCH_2CH_3 + H_2O$



ii. To prepare phenol, cumene is first oxidized in the presence of air of cumene hydro-peroxide.



Then, cumene hydroxide is treated with dilute acid to prepare phenol and acetone as by-products.



25. i. Cannizzaro reaction

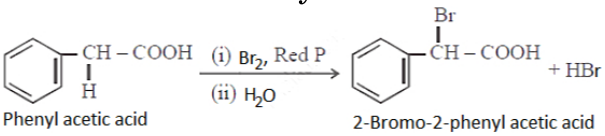
$$2R-\overset{O}{\overset{\|}{C}}-H \xrightarrow{NaOH} R-CH_2OH + R-\overset{O}{\overset{\|}{C}}-ONa$$

ii. Aldol condensation

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

Acetaldol

iii. Hell-Volhard-Zelinsky reaction



26. Lead storage battery

Anode: $Pb(\ s) + SO_4^{2-}(aq) \rightarrow PbSO_4[\ s] + 2e^-$

Cathode: $PbO_2[\ s] + SO_4^{2-}(aq] + 4H^+\ (aq) + 2e^- \rightarrow PbSO_4[\ s] + 2H_2O(1]$

27. a. Due to resonance in chlorobenzene leading to partial double bond character of $C-Cl$ bond but there is no resonance in CH_3Cl/sp^2 hybridised carbon atom having shorter bond length between $C-Cl$ in chlorobenzene than sp^3 hybridized carbon in methyl chloride.

b. Grignard reagent react with water to form corresponding hydrocarbon

c. Due to the formation of planar carbocation, nucleophile may attack from either side of carbocation.

28. $R^= \rho\frac{l}{A}$

Resistivity:

$\rho = R\frac{A}{l}$

$\rho = \frac{5.4 \times 10^3}{60}$

$\rho = 0.09 \times 10^3 \Omega\ cm$ or $90 \Omega\ cm$

Conductivity:

$k = 1/\rho$

= 1/ 90

$k = 0.011 \Omega^{-1}\ cm^{-1}$ or $0.011\ S\ cm^{-1}$

Molar Conductivity

$\Lambda_m = \frac{k}{c} \times 1000$

$= \frac{0.011}{0.05} \times 1000$

$= 220 \Omega^{-1}\ cm^2\ mol^{-1}$ or $220\ S\ cm^2\ mol^{-1}$

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. a. Ethanol-water forms azeotropic mixture.

b. Due to the formation of hydrogen bond between chloroform and acetone.

c. i. $\frac{P^0 - P}{P^0} = x_2 = \frac{w_2}{M_2} \times \frac{M_1}{w_1}$

$\frac{1.25 - 1.237}{1.25} = \frac{1.2}{M_2} \times \frac{78}{60}$

$M_2 = \frac{1.2}{M_2} \times \frac{78}{60} \times \frac{1.25}{0.013}$

$M_2 = 150\ g\ mol^{-1}$

OR

ii. The elevation (ΔT_b) in the boiling point $= 354.11\ K - 353.23\ K = 0.88\ K$

$M_2 = \frac{2.53\ K\ kg\ mol^{-1} \times 1.8\ g \times 1000\ g\ kg^{-1}}{0.88\ K \times 90\ g}$

$M_2 = 57.5\ g\ mol^{-1} \approx 58\ g\ mol^{-1}$

Section E

31. Attempt either A or B

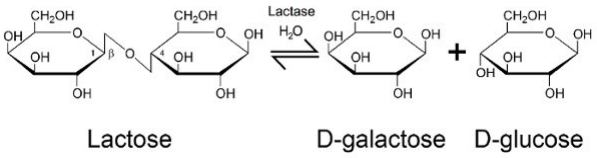
(a) Answer the following questions:

i. Adenine and guanine

ii. Glucose on prolonged heating with HI and red phosphorus gives n-hexane HI (excess) suggest that all six carbon atom are in straight chain.

$\underset{\text{Glucose}}{C_6H_{12}O_6} \xrightarrow[\Delta]{HI(excess)} \underset{n-Hexane\ (straight\ chain)}{CH_3CH_2CH_2CH_2CH_2CH_3}$

iii. Hydrolysis of Lactose gives D-galactose and D-glucose.



iv. When a protein is subjected to a change in temperature or chemical change then it loses its biological activity.

2° and 3° structures are destroyed but 1° structure remains intact.

v. The monosaccharide units are linked through the glycosidic linkage in the polysaccharide.

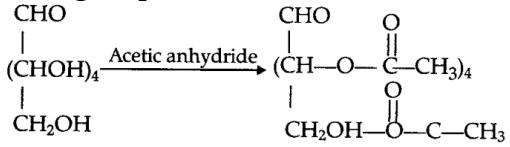
(b) Answer the following questions:

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

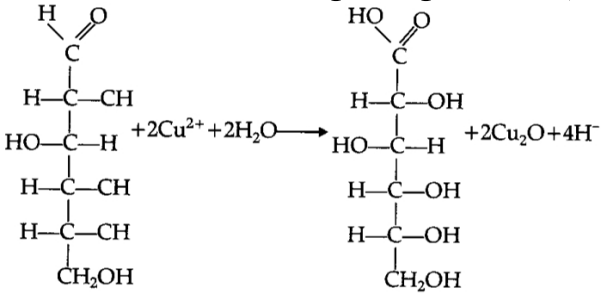
ii. In α-helix structure of the protein, a polypeptide chain is stabilized by the formation of intramolecular H-bonding by twisting into right-handed screw with -NH- group of amino acids in one turn with the >C = O groups of amino acids belonging to adjacent turn.

iii. 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.

iv. a. Acetylation of glucose with acetic anhydride gives glucose pentaacetate which confirms the presence of five -OH groups. Since, it exists as a stable compound, five -OH groups should be attached to different carbon atoms.



b. Glucose reduces Fehling's reagent. Thus, it is considered as reducing sugar.



v. i. **Nucleoside:** It is formed when pentose sugar combines with nitrogen base.
Nucleotide: When nucleoside bonds with phosphate group.

ii. α-helix has intramolecular hydrogen bonding while β-pleated has intermolecular hydrogen bonding / α-helix results due to regular coiling of polypeptide chains while in α-pleated all polypeptide chains are stretched and arranged side by side.

32. Attempt either A or B

(a) Answer the following questions:

i. $[CoF_6]^{3-} < [Co(NH_3)_6]^{3+} < [Co(CN)_6]^{3-}$

ii. The common shapes given by Werner were – octahedeal, tetrahedral and square planar.

iii. a. Triamminetriaquachromium (III) chloride
b. Potassium trioxalatoaluminate (III)

iv. $[Co(NH_3)_6]_2 (SO_4)_3$

v. i. $[Co(NH_3)_5ONO]Cl_2$
ii. $K_2[Ni(CN)_4]$

(b) Answer the following questions:

i. Example of coordination isomerism is $[Cr(NH_3)_6][Co(CN)_6]$ and $[Co(NH_3)_6][Cr(CN)_6]$.

ii. Hexaqua nickel (II) chloride

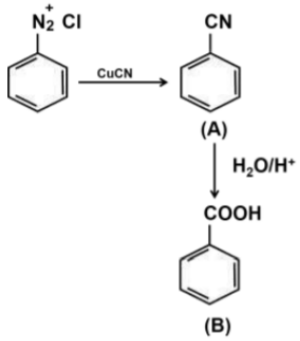
iii. i. Tetraaminechloridonitrito- N-cobalt (III) chloride.
ii. $[CoCI_2(en)_2]CI$

iv. $[Co(NH_3)_4\ Cl_2]^+$, as the metal is bound to more than one donor group(ligand).

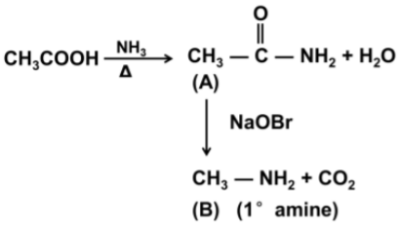
v. Both geometrical and optical isomerisms will be present.

33. i. The structure of A and B on following reaction is:

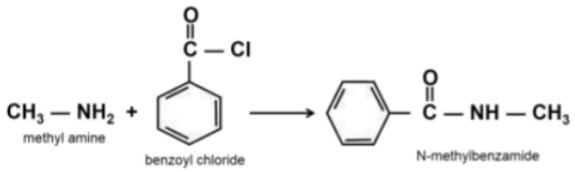
a.



b.



ii. The chemical reaction of methyl amine with benzoyl chloride and IUPAC name of the product form is as follows:



iii. Increasing order of pK_b values

$$(C_2H_5)_2\ddot{N}H < C_2H_5NH_2 < \ddot{N}H_3 < C_6H_5\ddot{N}H_2$$

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)