Class XII Session 2023-24
Subject - Chemistry
Sample Question Paper - 1

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

General Instructions:

Read the following instructions carefully.

1. There are **33** questions in this question paper with internal choice.
2. SECTION A consists of 16 multiple-choice questions carrying 1 mark each.
3. SECTION B consists of 5 very short answer questions carrying 2 marks each.
4. SECTION C consists of 7 short answer questions carrying 3 marks each.
5. SECTION D consists of 2 case-based questions carrying 4 marks each.
6. SECTION E consists of 3 long answer questions carrying 5 marks each.
7. **All questions are compulsory.**
8. **Use of log tables and calculators is not allowed.**

Section A

1. In alkyl halide: **[1]**

   a) All of these

   b) the carbon atom of C-halogen bond bears a partial positive charge

   c) the halogen atom bears a partial negative charge

   d) the carbon-halogen bond of alkyl halide is polarized

2. Maltose is made of: **[1]**

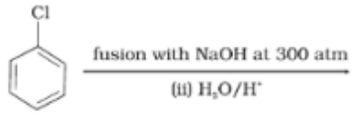
   a) $\propto$ -D-glucose

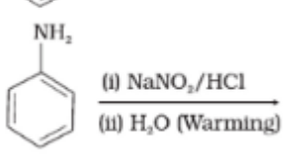
   b) $\propto$ - D-glucose and β - D -glucose

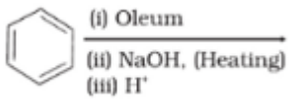
   c) Glucose and fructose

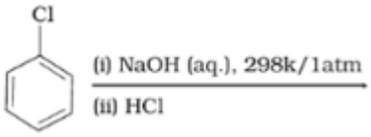
   d) D-fructose

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

   i. 

   ii. 

   iii. 

iv. 

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

4. The molecular formula of ethyl acetate is: **[1]**

a) C_4H_8O
b) $C_4H_8O_2$
c) $C_5H_{10}O_2$
d) $C_5H_8O_2$

5. Order of the photochemical reaction occurring between hydrogen and chlorine is **[1]**

a) Second order
b) Third order
c) Zero order
d) First order

6. Match the column and choose correct option **[1]**

Vant'Hoff factor	**Behaviour of compound**
(a) i = 1	(i) Impossible
(b) i > 1	(ii) Association is the solution
(c) i < 1	(iii) Dissociation in the solution
(d) i = 0	(iv) No dissociation or association

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

7. Which is the correct increasing order of boiling points of the following compounds? **[1]**
1-Iodobutane, 1-Bromobutane, 1-Chlorobutane, Butane

a) Butane < 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane
b) Butane < 1-Chlorobutane < 1-Iodobutane < 1-Bromobutane
c) Butane < 1-Chlorobutane < 1-Bromobutane < 1-Iodobutane
d) 1-Iodobutane < 1-Bromobutane < 1-Chlorobutane < Butane

8. Red hot steel rods on suddenly immersing in water become: **[1]**

a) Soft and malleable
b) Hard and brittle
c) Tough and ductile
d) Fibrous

9. The value of decay constant of a compound having a half life period of 2.95 days is **[1]**

a) $3.0 \times 10^{5}s^{-1}$
b) $2.71 \times 10^{-6}s^{-1}$
c) $2.9 \times 10^{-6}s^{-1}$
d) $2.9 \times 10^{6}s^{-1}$

10. Which of the following does not give silver mirror test? **[1]**

a) CH_3CH_2CHO
b) HCOOH
c) CH_3CHO
d) CH_3COCH_3

11. One mole of an organic compound 'A' with the formula C_3H_8O reacts completely with two moles of HI to form X and Y. When 'Y' is boiled with aqueous alkali forms Z. Z answers the iodoform test. The compound 'A' is _____. **[1]**

a) methoxyethane
b) ethoxyethane
c) Propan – 2 – o1
d) Propan – 1 – o1

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

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

13. **Assertion (A):** Insulin is water-soluble. **[1]**
Reason (R): Insulin is a globular protein.

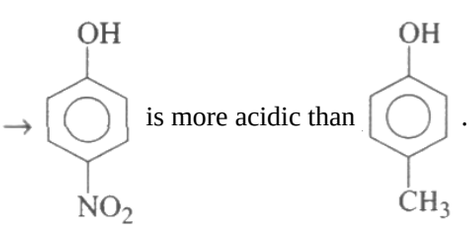
a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

14. **Assertion (A):** Lower aldehydes and ketones are soluble in water but the solubility decreases as the molecular masses increase. **[1]**
Reason (R): Distinction between aldehydes and ketones can be made by Tollen's test.

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):** Isopropyl chloride is less reactive than CH_3Br in S_N2 reactions. **[1]**
Reason (R): S_N2 reactions are always accompanied by inversion of configuration.

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):**  is more acidic than . **[1]**

Reason (R): Electron donating groups (EDG) increase acidity while electron-withdrawing groups (EWG) decrease acidity.

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. For the complex $[NiCl_4]^{2-}$, write, **[2]**

i. the IUPAC name
ii. the hybridisation type

iii. the shape of the complex (Atomic no. of Ni = 28)

18. Write the electronic configuration of the elements with the atomic numbers 61, 91, 101 and 109. **[2]**

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

(i) Consider the following equation: **[1]**

$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$

The rate law for this reaction is first order with respect to H_2 and second order with respect to NO.

Write the rate law for this reaction.

(ii) Oxygen is available in plenty in air yet fuels do not burn by themselves at room temperature. Explain. **[1]**

20. Define the terms: Van't Hoff factor **[2]**

OR

Under what condition do non-ideal solutions show negative deviations?

21. Arrange the following compounds in increasing order of their boiling points : **[2]**

CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$

Section C

22. What are fuel cells? Why we need these types of fuel cells? Explain with an example. **[3]**

23. For a reaction: $H_2 + Cl_2 \xrightarrow{hv} 2HCl$ Rate = k **[3]**

i. Write the order and molecularity of this reaction.

ii. Write the unit of k.

24. An aromatic compound (A) having molecular formula C_6H_6O on treatment with $CHCl_3$ and KOH gives a mixture two isomers B and C both of B & C give same product D when distilled with Zn dust. Oxidation of D gives E of formula $C_7H_6O_2$ The sodium salt of E on heating with soda lime gives F which may also be obtained by distilling A with zinc dust. Identify compounds A to F giving sequence of reactions.? **[3]**

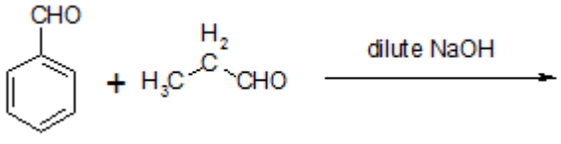
OR

Write the reactions and conditions for the following conversions:

i. 2-Propanone into 2-methyl-2-Proponal

ii. n-Propyl alcohol into hexane

25. Complete each synthesis by giving missing starting material, reagent or products. **[3]**



26. Calculate the maximum work and log Kc for the given reaction at 298 K : **[3]**

Ni (s) + 2 Ag^+ (aq) $\rightleftharpoons$ Ni^{2+} (aq) + 2Ag (s)

Given:

$E^o_{Ni^{2+}/Ni}$ = -0.25 V, $E^O_{Ag^+/Ag}$ = +0.80 V

1F = 96500 C mol^{-1}

27. What are haloarenes? How are they classified? Give one method each for the preparation of nuclear and side chain substituted halorenes. **[3]**

28. The E^0 values at 298 K corresponding to the following two reduction electrodes processes are: **[3]**

i. Cu^+/Cu = +0.52V

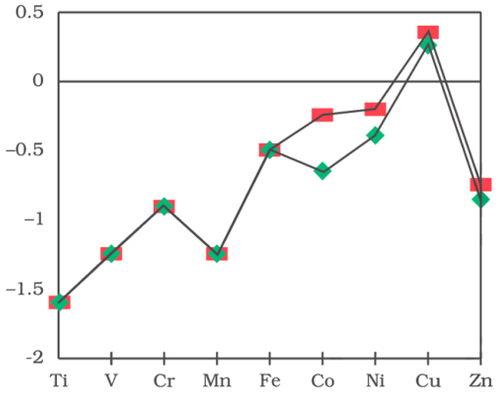
ii. Cu^{2+}/Cu^+ = +0.16V

Formulae the galvanic cell for their combination. What will be the cell potential? Calculate the $\Delta_r G^0$ for the cell reaction. (1 F = 96500 C mol^{-1})

Section D

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

The unique behaviour of Cu, having a positive E° accounts for its inability to liberate H_2 from acids. Only oxidising acids (nitric and hot concentrated sulphuric) react with Cu, the acids being reduced. The stability of the half-filled d sub-shell in Mn^{2+} and the completely filled d^{10} configuration in Zn^{2+} are related to their E° values, whereas E° for Ni is related to the highest negative $\Delta_{hyd}H°$. An examination of the $E^o_{(M^{3+}/M^{2+})}$ values the low value for Sc reflects the stability of Sc^{3+} which has a noble gas configuration. The comparatively high value for Mn shows that $Mn^{2+}(d^5)$ is particularly stable, whereas a comparatively low value for Fe shows the extra stability of Fe^{3+} (d^5). The comparatively low value for V is related to the stability of V^{2+} (half-filled t_{2g} level).



(i) Why Zn has high value for M^{3+}/M^{2+} Standard Electrode Potentials?

OR

Why Cu^{2+} is more stable than Cu^{+}?

(ii) Transition metals, despite high E° oxidation, are poor reducing agents. Justify.

(iii) Why is Cr^{2+} reducing and Mn^{3+} oxidising when both Cr and Mn have d^4 configuration?

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

In order to overcome the scarcity of drinking water in a remote village in Gujarat, Arnav and Aariv two young entrepreneurs still in their high school, have developed a unique water purifier that is capable of converting sea water into drinking water. It works on the principle of concentration difference between two solutions.

(i) Name the phenomenon/process based on which this product is made?

(ii) How difference in concentration of solutions help in converting sea water into drinking water?

(iii) What arrangement they must have created in their product to covert sea water into drinking water?

OR

Equimolar solutions of NaCl and glucose are not isotonic. Why?

Section E

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

(i) Write the full forms of DNA and RNA. **[1]**

(ii) How do enzymes help a substrate to be attacked by the reagent effectively? **[1]**

(iii) Give two examples of reducing sugars. **[1]**

(iv) What type of linkage holds together the monomers of DNA? **[1]**

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

(vi) What are polypeptides? **[1]**

(vii) Define the following term: Anomers. **[1]**

32. i. Ratio of $[Ar(NH_3)_2]^+$ and $[Ar^+]$ in 0.1 M NH_3 solution. **[5]**

ii. Ratio of $[Ag(S_2O_3)_2]^{3-}$ and [Ag+] in 0.1 M $S_2O_3^{2-}$ solution Given that the stability/ formation constant (k_f) for $[Ag(NH_3)_2]^+ a$ and $[Ag(S_2O_3)_2]^{3-}$ are 1.7×10^7 and 1.0×10^{13} respectively.

OR

Give the oxidation state, d-orbital occupation and coordination number of the central metal ion in the following complexes:

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

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

iii. $(NH_4)_2\,[CoF_4]$

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

33. i. Write one chemical reaction for each **[5]**

a. Carbylamine reaction

b. Acetylation reaction

ii. Write structure of N,N-ethylmethylethanamide

OR

i. Write the structures of A and B in the following reactions:

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

Solution

Section A

1. **(a)** All of these
   Explanation: Since halogen atoms are more electronegative than carbon, the carbon-halogen bond of alkyl halide is polarized; the carbon atom bears a partial positive charge whereas the halogen atom bears a partial negative charge.
2. **(a)** $\propto$ -D-glucose
   Explanation: A disaccharide, maltose is composed of two α-D-glucose units in which C_1 of one glucose (I) is linked to C_4 of another glucose unit (II).
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)** $C_4H_8O_2$
   Explanation: Its molecular formula is $C_4H_8O_2$ and its chemical formula is $CH_3COOC_2H_5$.
5. **(c)** Zero order
   Explanation: light-dependent Photochemical reaction between H_2 and Cl_2 [$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$] is 0 (zero) w.r.t. to reactants.
6. **(b)** (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
   Explanation: (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
7. **(c)** Butane < 1-Chlorobutane < 1-Bromobutane < 1-Iodobutane
   Explanation: Due to the polar nature of alkyl halides and the increase in molecular weight compared to their parent alkanes, the boiling points of alkyl halides are higher than that of their parent alkanes. The boiling points of alkyl halides depend on the molecular mass and the size of the halogen atom (decrease from I to F). With the increase in size, mass, and the number of electrons in halogen atoms, the magnitude of Van Der Waals forces increase and the boiling point also increases. The boiling point of alkyl halides reduces in the order RI > RBr > RCl > RF.
   Therefore, the order of increasing order of boiling points should be Butane < 1-Chlorobutane < 1-Bromobutane < 1-Iodobutane.
8. **(b)** Hard and brittle
   Explanation: Red hot steel rods on suddenly immersing in water become hard and brittle.
9. **(b)** $2.71 \times 10^{-6} s^{-1}$

Explanation: Decay constant(k) = $\frac{0.693}{t_{1/2}}$

$k = \frac{0.693}{2.95 \times 24 \times 60 \times 60} = 2.71 \times 10^{-6}\ s^{-1}$

10.

(d) CH_3COCH_3

Explanation: CH_3COCH_3 will not give a silver mirror test (Tollens Test). Tollens test is given by aldehydes only and HCOOH is the only acid that gives tollen's test. Ketones do not give tollen's test.

11. **(a)** methoxyethane

Explanation: Ether reacts with HI to form alcohol and alkyl iodide. Alcohol on oxidation will give the iodoform test.

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.

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

Explanation: Insulin is a globular protein. This protein has a three-dimensional folded structure. These are stabilised by internal hydrogen bonding, hence, they are water-soluble.

14.

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

Explanation: The assertion is true that the aldehydes have an oxygen atom that can form a hydrogen bond with the hydrogen atoms of water. So lower aldehydes are soluble in water. But as the chain length increases, the hydrophobic part (the alkyl chain) dominates over the hydrophilic part (the polar -CHO group). So higher molecular weight aldehydes are insoluble in water but lower molecular weight aldehydes are easily soluble in water.

The reason is also correct because aldehydes form a silver mirror with Tollen reagent but ketones do not.

15.

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

Explanation: As the size of the alkyl groups increases, the S_N2 reactivity decreases, further C - Cl bond is stronger and more difficult to cleave than C - Br bond. So CH_3Br is more reactive than $(CH_3)_2CHCl$.

16.

(c) A is true but R is false.

Explanation: A is true but R is false.

Section B

17. i. The IUPAC name of $[NiCl_4]^{2-}$ is tetra chloridonickelate (II) ion.

ii. sp^3-hybridisation.

iii. Due to sp^3-hybridisation, its shape is tetrahedral.

18. Z = 61 has electronic configuration as $[Xe]^{54}\ 4f^5\ 5d^0\ 6s^2$

Z = 91 has electronic configuration as $[Rn]^{86}\ 5f^2\ 6d^1 7s^2$

Z = 101 has electronic configuration as $[Rn]^{86}\ 5f^{13}\ 6d^0\ 7s^2$

Z = 109 has electronic configuration as $[Rn]^{86}\ 5f^{14}\ 6d^7\ 7s^2$

19. Answer the following:

(i) Rate = $k\ [NO]^2\ [H_2]^1$

(ii) The activation energy for combustion reactions of fuels is very high at room temperature, therefore, they do not burn by themselves at room temperature.

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

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

OR

When the new forces of attraction between components are greater than those in the pure components. That is when two components A and B are mixed, the interactions between A....B is greater than A...A and B...B interaction then the binary non-ideal solution would show negative deviation from Raoult's law.

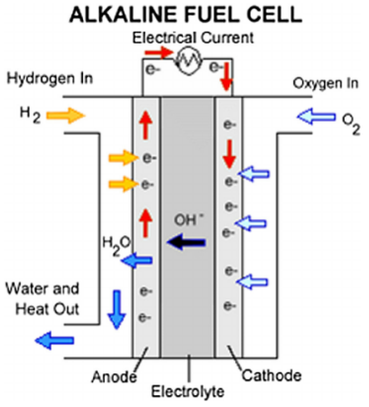
21. Boiling point depends upon the size of the molecules, branching in the molecules and intermolecular forces of attraction between the molecules.

On the basis of this, the increasing order of boiling point are:

$CH_3CH_2CH_3 < CH_3OCH_3 < CH_3CHO < CH_3CH_2OH$

Section C

22. Galvanic cells (or Voltaic cells) that are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol, etc. directly into electrical energy are called fuel cells. In these cells, the reactants are continuously supplied to electrodes. One of the most successful fuel cells uses the reaction of hydrogen with oxygen to form water as shown in the figure.



The cell was used for providing electrical power in the Apollo space programme. The water vapours produced during the reaction were condensed and added to the drinking water supply for the astronauts. In the cell, hydrogen and oxygen are bubbled through porous carbon electrodes into concentrated aqueous sodium hydroxide solution. Catalysts like finely divided platinum or palladium metal are incorporated into the electrodes for increasing the rate of electrode reactions.

The electrode reactions are given below:

Cathode : $O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$

Anode : $2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l)$

Overall reaction being:

$2H_2(g) + O_2(g) \rightarrow 2H_2(g)$

The cell runs continuously as long as the reactants are supplied. Fuel cells produce electricity with an efficiency of about 70% compared to thermal plants whose efficiency is about 40%. There has been tremendous progress in the development of new electrode materials, better catalysts and electrolytes for increasing the efficiency of fuel cells. These have been used in automobiles on an experimental basis. Fuel cells are pollution free and in view of their future importance, a variety of fuel cells have been fabricated and tried.

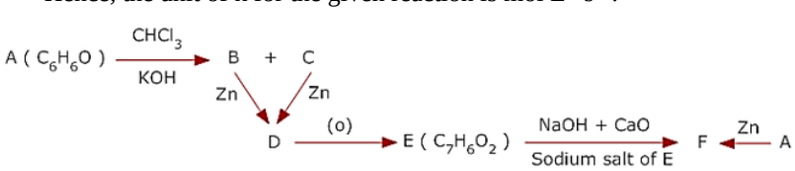
23. i. For a reaction, $H_2 + Cl_2 \xrightarrow{hv} 2HCl$

Rate= k, suggests that the reaction is of zero order. Further, the molecularity of a given reaction is 2 as two molecules are participating in the reaction.

Hence, order = zero and molecularity = two.

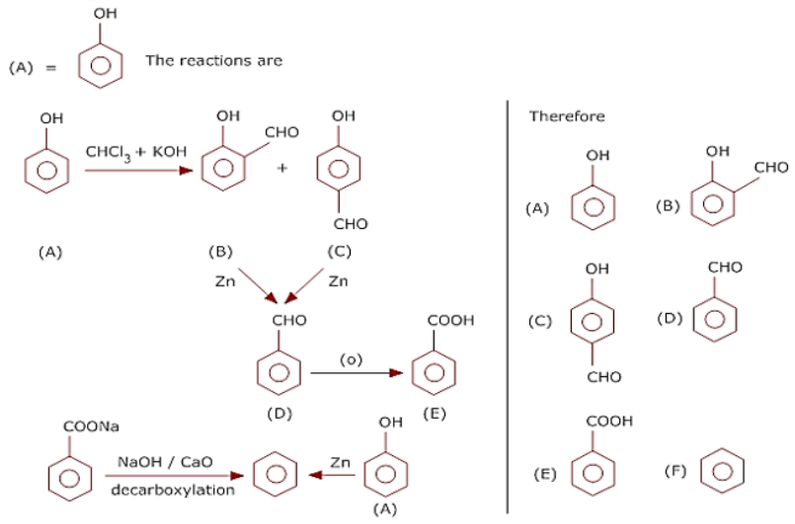
ii. The unit of k for zero order reaction is equal to the rate of a reaction which is mol $L^{-1}s^{-1}$.

Hence, the unit of k for the given reaction is mol $L^{-1}s^{-1}$.

24. 

The aromatic compound having molecular formula C_6H_6O and which gives a mixture of two isomers on reacting with $CHCl_3$ and

KOH is phenol i.e.



OR

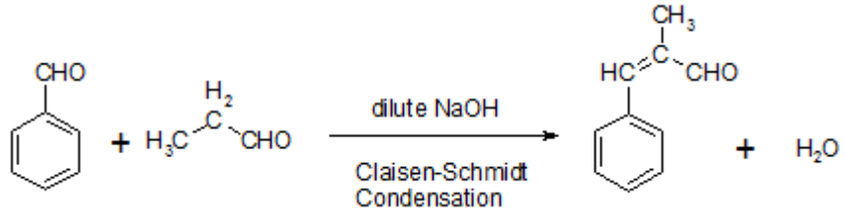
i. $CH_3 - \underset{\underset{2-propanone}{\|}}{C} - CH_3 + CH_3MgBr \xrightarrow[addition]{dry\ ether} \left[CH_3 - \underset{OMgBr}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}} - CH_3\right] \xrightarrow{H_2O/H^+} CH_3 - \underset{\underset{2-methyl-2-propanol}{OH}}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}} - CH_3$

ii. n-Propyl alcohol to hexane

$CH_3CH_2CH_2OH + PCl_5 \rightarrow CH_3CH_2CH_2Cl + POCl_3 + HCl$

$\underset{1-Chloropropane}{2CH_3CH_2CH_2Cl} + 2Na \xrightarrow[either]{Dry} \underset{n-Hexane}{CH_3CH_2CH_2C_2CH_3} + 2NaCl$

25. The reaction between an aldehyde/ketone and an aromatic carbonyl compound lacking an α-hydrogen is called Claisen–Schmidt condensation.



26. $Ni(s) + 2Ag^+(aq) \rightleftharpoons Ni^{+2}(aq) + 2Ag(s)$

Given:

$E^0_{N^{+2}/Ni}$ = -0.25 V, $E^0_{Ag^+/Ag}$ = 0.80 V

$Ni \rightleftharpoons Ni^{+2} + 2e^-$

$2Ag^+ + 2e^- \rightleftharpoons 2Ag$

$E^0_{Cell} = E^0_{Cathode} - E^0_{Anode}$

$E^0_{Cell} = E^0_{Ag^+/Ag} - E^0_{N^{2+}/Ni}$

E^0_{Cell} = 0.80 - (-0.25)

E^0_{Cell} = 1.05 V

$\Delta G = -nFE^0_{Cell}$

= -2 × 96500 × 1.05

= -202650 kJ/mol

$E^0_{Cell} = \frac{2.303RT}{nF}\log K_c$

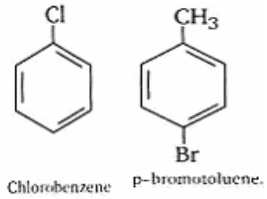
The value of $\log K_c = \frac{nFE^0_{Cell}}{2.303RT}$

$= \frac{2\times 96500\times 1.05}{2.303\times 298\times 8.314}$

= 35.516

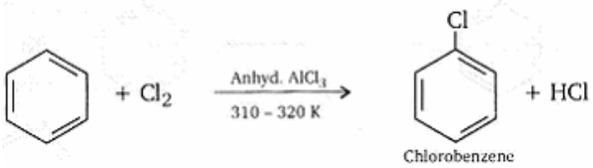
27. **Haloarenes:** The replacement of hydrogen atoms in a aromatic hydrocarbon by halogen atoms results in the formation of aryl halide (haloarene). Haloarenes contain halogen atoms attached to sp^2 hybridized carbon atoms of an aryl group. They are classified as:

i. **Nuclear halogen derivatives:** Halogen derivatives of aromatic hydrocarbons in which the halogen atom (F, Cl, Br, or I) is directly attached to an aromatic ring are called nuclear halogen derivatives. Some examples are:



Chlorobenzene p-bromotoluene.

It is prepared by the direct chlorination of aromatic hydrocarbon.



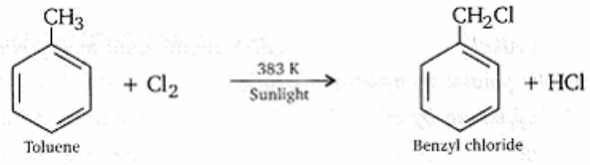
Chlorobenzene

ii. **Side chain halogen derivatives:** Halogen derivatives of aromatic hydrocarbons in which the halogen atom is linked to one of the carbon atoms of the side chain carrying the aryl group are called side chain halogen derivatives. For example,

Benzylchloride
Chlorophenylmethane

Benzaldichloride
1, 1, Dichloro 1-phenylmethane

Preparation: By the direct halogenation of a suitable arenes.



Toluene

Benzyl chloride

28. cell representation is

$Cu^{+}|Cu^{2+}||Cu^{+}|Cu$

$E^0_{cell} = E^0_{reduction(cathode)} - E^0_{oxidation(anode)}$

= $E^0(Cu^{+}/Cu) - E^0(Cu^{2+}/Cu^{+})$

= + 0.52V - 0.16V

= 0.36 V

$Cu^{+} \rightarrow Cu^{2+} + e^{-}$

$Cu^{+} \rightarrow e^{-} \rightarrow Cu$

n = 1

$\Delta_r G^0 = -nE^0F$

$= -1 \times 0.36V \times 96500$

= -34740 $Jmol^{-1}$

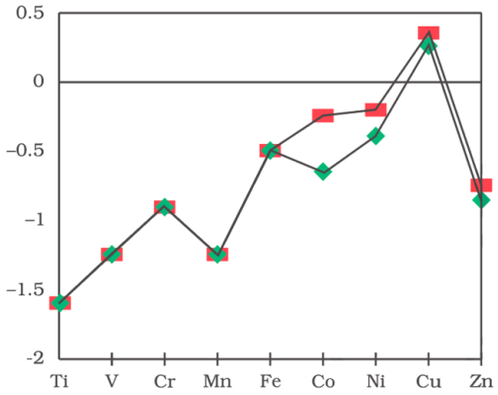
= -34.74 KJ mol^{-1}

Section D

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

The unique behaviour of Cu, having a positive E° accounts for its inability to liberate H_2 from acids. Only oxidising acids (nitric and hot concentrated sulphuric) react with Cu, the acids being reduced. The stability of the half-filled d sub-shell in Mn^{2+} and the completely filled d^{10} configuration in Zn^{2+} are related to their E° values, whereas E° for Ni is related to the highest negative $\Delta_{hyd}H°$. An examination of the $E^o_{(M^{3+}/M^{2+})}$ values the low value for Sc reflects the stability of Sc^{3+} which has a noble gas configuration. The comparatively high value for Mn shows that $Mn^{2+}(d^5)$ is particularly stable, whereas a comparatively low value for Fe shows the extra stability of Fe^{3+} (d^5). The comparatively low value for V is related to the stability of V^{2+} (half-filled

t_{2g} level).



(i) Due to the removal of an electron from the stable d^{10} configuration of Zn^{2+}.

OR

The Stability of Cu^{2+} is more than Cu^{+} as stability depends on the hydration energy of the ions when they bond to the water molecules. The Cu^{2+} ion has a greater charge density than Cu^{+} ion and thus forms much stronger bonds releasing more energy.

(ii) Transition metals despite having high E° oxidation, are poor reducing agents because of their high heat of vaporization, high ionisation energies and low heats of hydration.

(iii) Cr^{2+} is reducing as its configuration changes from d_4 to d_3, the having a half-filled t_{2g} level. On the other hand, the change from Mn^{3+} to Mn^{2+} results in the half-filled (d_5) configuration which has extra stability.

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

In order to overcome the scarcity of drinking water in a remote village in Gujarat, Arnav and Aariv two young entrepreneurs still in their high school, have developed a unique water purifier that is capable of converting sea water into drinking water. It works on the principle of concentration difference between two solutions.

(i) The product is based on the phenomenon of Reverse Osmosis between solutions of two different concentration.

(ii) When solutions of two different concentration are separated by a semipermeable membrane and excess pressure is applied on the solution of higher concentration, solvent flow from higher concentration to lower concentration. This is called Reverse Osmosis and same can be used to treat seawater and convert into drinking water.

(iii) Following arrangement must have been made:

i. Use of a semipermeable membrane.
ii. Separate Compartment having seawater and Drinking Water separated by semipermeable membrane.
iii. Excess pressure applied in compartment having sea water.

OR

NaCl is an electrolyte and gets dissociated to two ions (Na^{+} and Cl^{-}) and exerts almost double osmotic pressure than glucose which is a non-electrolyte and does not dissociate.

Section E

31. Attempt any five of the following:

(i) DNA $\longrightarrow$ Deoxyribonucleic acid
RNA $\longrightarrow$ Ribonucleic acid

(ii) Active site of enzymes holds the substrate molecule in a suitable position so that the enzyme help substrate can be attacked by the reagent effectively.

(iii) Examples of reducing sugars - Maltose and Lactose.

(iv) The 2 strands of DNA are attached to each other by hydrogen bonds that connect the nitrogenous bases of one strand to the bases of the other strand (this is called complementary base pairing) where Adenine pairs with Thymine by 2 hydrogen bonds and Guanine pairs with Cytosine using 3 hydrogen bonds.
While nucleotides of DNA are held together by Phosphodiester linkages. The structure of DNA holds the nucleotides in place using phosphodiester bonds. A phosphodiester bond occurs when exactly two of the hydroxyl group in phosphoric acid react with hydroxyl groups on other molecules to form two ester bonds. The phosphodiester bond is the linkage between the 3' carbon atom of one sugar molecule and the 5 ' carbon atom of another, deoxyribose in DNA.

(v) Invertase

(vi) Polypeptides are formed when several molecules generally more than ten of α-amino acids are joined together by a peptide bond.

(vii) Isomers which differ only in the configuration of hydroxyl group at C_1 are called anomers. e.g. α and β form of glucose.

32. i. The equilibrium is:

$Ag^+ + 2NH_3 [Ag(NH_3)_2]^+$

$\therefore$ Stability constant,

$K_f = \frac{[Ag(NH_3)_2]^+}{[Ag^+][NH_3]^2}$

$= 1.7 \times 10^7$ (Given)

or $\frac{[Ag(NH_3)_2]^+}{[Ag^+]}$

$= 1.7 \times 10^7 \times [NH_3]^2$

$= 1.7 \times 10^7 \times (0.1)^2$

$= 1.7 \times 10^5$

ii. The equilibrium is

$Ag^+ + 2S_2O_3^{2-} \overset{k_f}{\rightleftharpoons} [Ag(S_2O_3)_2]^{3-}$

$\therefore$ Stability constant,

$\therefore \quad \frac{[Ag(S_2O_3)_2]^{3-}}{[Ag^+]} = 1.0 \times 10^{13} \times [S_2O_3^{2-}]^2 = 1.0 \times 10^{13}(0.1)^2 = 1 \times 10^{11}$

$\therefore \frac{[Ag(S_2O_3)_2]^{3-}}{[Ag^+]} = 1.0 \times 10^{13} \times [S_2O_3^{2-}]^2 = 1.0 \times 10^{13}(0.1)^2 = 1 \times 10^{11}$

OR

i. $K_3 [Co(C_2O_4)_3]$

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-$[Cr(en)_2 Cl_2]\, Cl$

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. $(NH_4)_2 [CoF_4]$

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. $[Mn(H_2O)_6]\, SO_4$

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

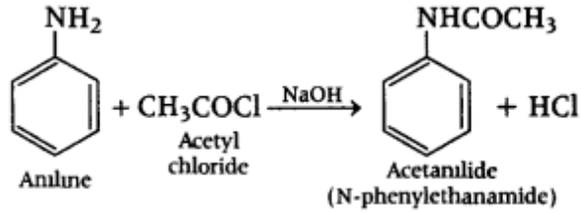
${t_{2g}}^3 {e_g}^2$.

33. i. **Carbylamine reaction:** Aliphatic or aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamine which are foul smelling substances. This reaction is known as carbylamine reaction.

$$\underset{\text{Aniline}}{C_6H_5NH_2} + CHCl_3 + 3KOH \xrightarrow{\Delta} C_6H_5NC + 3KCl + 3H_2O$$

This reaction is used as a test for primary aliphatic and aromatic amine.

ii. **Acetylation:**



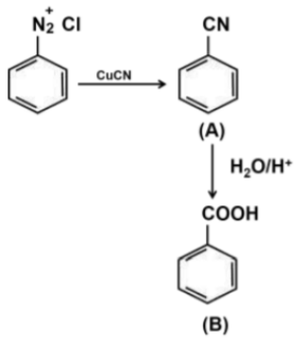
iii. The structure of N,N-ethylmethylethanamide is:

$$C_2H_5 - \underset{\underset{CH_3}{|}}{\overset{\cdot\cdot}{N}} - \underset{\underset{O}{||}}{C} - CH_3$$

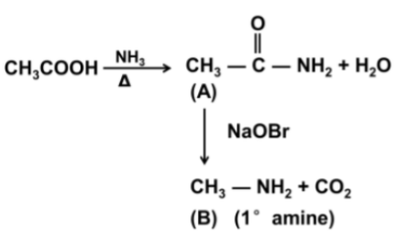
OR

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

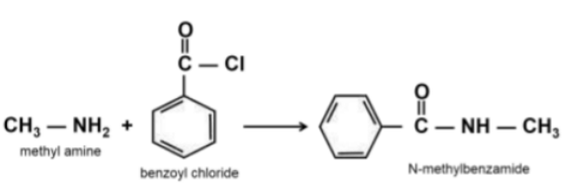
a.



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

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