ISC EXAMINATION PAPER - 2024
CHEMISTRY
Class-12th
(Solved)

Maximum Marks: 70
Time allowed: Three hours
*(Candidates are allowed additional **15 minutes** for only reading the paper.*
*They must **NOT** start writing during this time.)*

This paper is divided into four sections - A, B, C and D.
*Answer **all** questions.*
Section-A *consists of one question **having sub-parts** of **one** mark each.*
Section-B *consists of ten questions of two marks each.*
Section-C *consists of **seven** questions of **three** marks each, and*
Section-D *consists of **three** questions of **five** marks each.*
Internal choices have been provided in one question each in Section B, Section C and Section D.
All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
The intended marks for questions or parts of questions are given in brackets [ ].
Balanced equations must be given wherever possible and diagrams where they are helpful.
When solving numerical problems, all essential working must be shown.
In working out problems, use the following data:
Gas constant $R = 1.987$ cal deg^{-1} mol^{-1} = 8.314 JK^{-1} mol^{-1} = 0.0821 dm^3 atm $K^{-1}mol^{-1}$
11 atm = 1 dm^3 atm = 101.3 J, 1 Faraday = 96500 coulombs,
Avogadro's number = 6.022×10^{23}.

SECTION A - 14 MARKS

Question 1 [4×1]

(A) **Fill in the blanks by choosing the appropriate word(s) from those given below in the brackets.**
[lead poisoning, zero, phosgene, dependent, cancer, independent, diethyl ether, first, ethyl carbonate, ethene]

(i) For a particular reaction, the value of rate constant is 0.05 sec^{-1}. The reaction is of _____ order and will be _____ of the initial concentration.

(ii) EDTA is used in the treatment of _____ while Cisplatin is used in the treatment of _____.

(iii) The addition of small quantity of ethanol to chloroform prevents the formation of _____ and converts it into the harmless compound _____.

(iv) The dehydration of ethyl alcohol with conc. H_2SO_4 at 140°C mainly yields _____ while at 170°C the main product formed is _____.

(B) **Select and write the correct alternative from the choices given below.** [7×1]

(i) Which one of the following statements is correct regarding the dry cell?
(P) Zinc container acts as an anode in dry cell.
(Q) Zinc container touches the paste of MnO_2 and carbon.
(R) Dry cell can be charged easily.
(S) Graphite rod acts as a cathode in dry cell.
(a) Only (P) and (R)   (b) Only (Q) and (R)
(c) Only (P) and (S)   (d) Only (Q) and (S)

(ii) The metal complex ion that is paramagnetic is (Atomic number of Fe = 26, Cu = 29, Co = 27 and Ni = 28)
(a) $[Fe(CN)_4]^{2-}$ (b) $[Co(NH_3)_6]^{3+}$
(c) $[Ni(CN)_4]^{2-}$ (d) $[Cu(NH_3)_4]^{2+}$

(iii) When $KMnO_4$ is heated with acidified oxalic acid, gas bubbles are evolved.

These gas bubbles are evolved due to the formation of
(a) SO_2 (b) CO_2
(c) SO_3 (d) O_2

(iv) The reaction of ethanamide with alcoholic sodium hydroxide and bromine gives
(a) ethylamine.   (b) methylamine.
(c) propylamine.   (d) aniline.

(v) An equimolar solution of non-volatile solutes A and B, shows a depression in freezing point in the ratio of 2:1. If A remains in its normal state in the solution, the state of B in the solution will be:
(a) normal.   (b) hydrolysed.
(c) associated.   (d) dissociated.

(vi) **Assertion (A):** Specific conductivity of all electrolytes decreases on dilution.
Reason (R): On dilution, the number of ions per unit volume decreases.
(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

(vii) **Assertion (A):** Ammonolysis of alkyl halides involves the reaction between alkyl halides and alcoholic ammonia.
Reason (R): Ammonolysis of alkyl halides produces secondary amines only.
(a) Both Assertion and Reason are true and Reason is the correct explanation for Assertion.
(b) Both Assertion and Reason are true but Reason is not the correct explanation for Assertion.
(c) Assertion is true but Reason is false.
(d) Assertion is false but Reason is true.

(C) **Read the passage given below and answer the questions that follow.** **[3×1]**

When two solutions are separated by a semi-permeable membrane, the solvent molecules move from a solution of lower molar concentration to a solution of higher molar concentration through osmosis.

(i) Samar removed the outer hard shell of two different eggs while cooking at home. He then placed one egg in pure water and the other egg in saturated solution of sucrose. What change is he likely to observe in the eggs after few hours?

(ii) Which solution, hypertonic or hypotonic, has a higher amount of solute in same quantity of solution?

(iii) A 5% aqueous solution of glucose (molar mass = 180 g mol^{-1}) is isotonic with 1.66% aqueous solution of urea. Calculate the molar mass of urea.

SECTION B - 20 MARKS

Question 2 **[2]**

(i) Write a chemical test to distinguish between ethanol and phenol.

(ii) Give a chemical reaction to convert acetaldehyde into secondary propyl alcohol.

Question 3 **[2]**

Give a reason for each of the following.

(i) Zinc, cadmium and mercury are considered as d-block elements but not regarded as transition elements.

(ii) Transition metals possess a great tendency to form complex compounds.

Question 4 **[2]**

Convert the following by giving chemical equations for each.

(i) Ethyl bromide to diethyl ether

(ii) Phenol to salicylaldehyde

Question 5 **[2]**

Account for each of the following.

(i) Zirconium (Zr) and Hafnium (Hf) are difficult to separate.

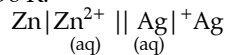**(ii)** Salts of Cupric (Cu^{2+}) ion are coloured whereas salts of Cuprous (Cu^+) ion are colourless.

Question 6 **[2]**

How will you bring the following conversions?

(i) Benzene to biphenyl

(ii) Iodoform to acetylene

Question 7 **[2]**

Calculate the maximum possible electrical work that can be obtained from a galvanic cell under standard conditions at 298 K.

$$Zn\,|\,Zn^{2+}_{(aq)}\,||\,Ag\,|^+Ag_{(aq)}$$

Given $E^0_{(Zn^{2+}/Zn)} = -0.76$ V; $E^0_{(Ag^+/Ag)} = +0.80$ V

Question 8 **[2]**

(i) Give a reason for each of the following.

(a) Ethoxy ethane does not react with sodium, but ethanol does.

(b) Methoxy ethane with conc. HI at 373K gives C_2H_5OH and CH_3I but not CH_3OH and C_2H_5I.

OR

(ii) An organic compound [A] having molecular formula $C_4H_{10}O$ forms a compound [B] with molecular formula C_4H_8O on oxidation. Compound [B] gives a positive iodoform test. The reaction of compound [B] with CH_3MgBr followed by hydrolysis gives compound [C] with molecular formula $C_5H_{12}O$.

Identify the compounds [A], [B] and [C]. Write the reaction for the conversion of compound [A] to compound [B].

Question 9 **[2]**

If 200 cm^3 of an aqueous solution of a protein contains 1.26 g of protein, the osmotic pressure of the solution at 300K is found to be 2.57×10^{-3} atm. Calculate the molar mass of protein.

(R = 0.0821 L atm K^{-1} mol^{-1})

Question 10 **[2]**

(i) Benzaldehyde is less reactive than propanaldehyde. Why?

(ii) In the preparation of ethanal by the oxidation of ethanol, ethanal should be removed immediately as it is formed. Why?

Question 11 **[2]**

(i) Why is Mn^{+2} ion more stable than Fe^{+2} ion? (Atomic number of Mn = 25 and Fe = 26)

(ii) Trivalent Lanthanoid ions such as La^{3+}(Z = 57) and Lu^{3+}(Z = 71) do not show any colour in their solution. Give a reason.

SECTION C - 21 MARKS

Question 12 **[3]**

For the reaction $A + B \rightleftharpoons$ Product, following data was obtained:

Experiment number	Initial concentration of [A] (mol L^{-1})	Initial concentration of [B] (mol L^{-1})	Initial Rate (mol L^{-1} min^{-1})
1	0.15	0.15	9.6×10^{-2}
2	0.30	0.15	3.84×10^{-1}
3	0.15	0.30	1.92×10^{-1}
4	0.30	0.30	7.68×10^{-1}

Calculate the following:

(i) The overall order of the reaction

(ii) The rate law equation

(iii) The value of rate constant

Question 13 **[3]**

(i) Illustrate the following reactions by giving one suitable example in each case.

(a) Coupling reaction

(b) Acetylation of ethylamine

(ii) Aniline does not give Friedel – Crafts reaction. Give a reason.

Question 14 **[3]**

(i) Aradhana visits a physician as she is suffering from rickets and joint pain. Which fat-soluble vitamin should the physician prescribe to her?

(ii) Somesh put few drops of vinegar in milk. What change do you think he observed in the milk after some time? What is this phenomenon known as?

(iii) Name the product of hydrolysis of sucrose. Is it a reducing sugar or a non-reducing sugar?

Question 15 **[3]**

An aqueous solution containing 12.50 g of barium chloride in 1000g of water boils at 373.0834 K. Calculate the degree of dissociation of barium chloride.

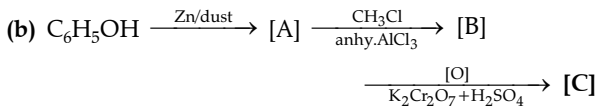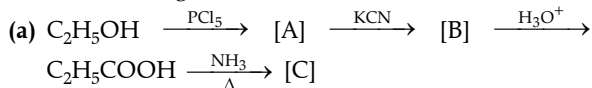Given K_b for H_2O = 0.52 K kg mol^{-1}; molecular mass of $BaCl_2$ = 208.34 g mol^{-1}

Question 16 **[3]**

An organic compound C_2H_4O gives red precipitate when heated with Fehling solution. It also undergoes aldol condensation in the presence of dilute NaOH.

(i) Identify the organic compound and write its IUPAC name.

(ii) Which compound will be formed when this organic compound reacts with hydroxylamine?

(iii) What is observed when the compound, referred to in subpart (i), is heated with ammonical silver nitrate?

Question 17 [3]

(i) Identify the compounds [A], [B] and [C] in each of the following reactions.
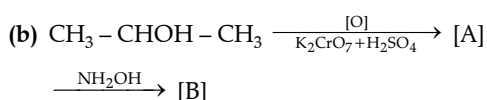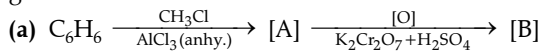
(a) $C_2H_5OH \xrightarrow{PCl_5} [A] \xrightarrow{KCN} [B] \xrightarrow{H_3O^+}$
$C_2H_5COOH \xrightarrow[\Delta]{NH_3} [C]$

(b) $C_6H_5OH \xrightarrow{Zn/dust} [A] \xrightarrow[\text{anhy.AlCl}_3]{CH_3Cl} [B]$
$\xrightarrow[K_2Cr_2O_7 + H_2SO_4]{[O]} [C]$

OR

(ii) Give a chemical test to distinguish between the following pairs of compounds.
   (a) Ethanol and methanol
   (b) Ethanol and Ethanal
   (c) Propan-2-ol and 2-methyl propan-2-ol

Question 18 [3]

(i) The rate constant of a reaction at 500K and 700K are $0.02 \ s^{-1}$ and $0.07 \ s^{-1}$ respectively. Calculate the value of EA. (activation energy)

(ii) A radioactive substance which emits alpha particle follows first order reaction. The half-life period of this radioactive substance is 30 hours. Calculate the fraction in percent (%) of the radioactive substance which remains after 90 hours.

SECTION D - 15 MARKS

Question 19 [5]

(i) An organic compound [A], having a specific smell forms two compounds [B] and [C] by reacting with conc. sodium hydroxide. The molecular formula of compound [B] is C_7H_8O, which forms compound [A] again on oxidation. Compound [C] forms benzene on heating with soda lime.
Write the structures of compounds [A], [B] and [C]. Also, write the reactions involved.

(ii) Identify the compounds [A] and [B] in the reactions given below:

**(a)** $C_6H_6 \xrightarrow[\text{AlCl}_3(\text{anhy.})]{CH_3Cl} [A] \xrightarrow[K_2Cr_2O_7+H_2SO_4]{[O]} [B]$

(b) $CH_3 - CHOH - CH_3 \xrightarrow[K_2CrO_7+H_2SO_4]{[O]} [A]$
$\xrightarrow{NH_2OH} [B]$

Question 20 [5]

(i) A coordination compound has a formula $CoCl_3.4NH_3$. It precipitates silver ions as AgCl and its molar conductance corresponds to a total of two ions.
Based on this information, answer the following questions.
   (a) Deduce structural formula of the complex compound.
   (b) Write the IUPAC name of the complex compound.

(c) Draw the geometrical isomers of the complex compound.

(ii) Give a chemical test to show that $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5SO_4]Cl$ are ionisation isomers.

Question 21 [5]

(i) (a) Study the diagram given below that represents Cu-Ag electrochemical cell and answer the questions that follow.
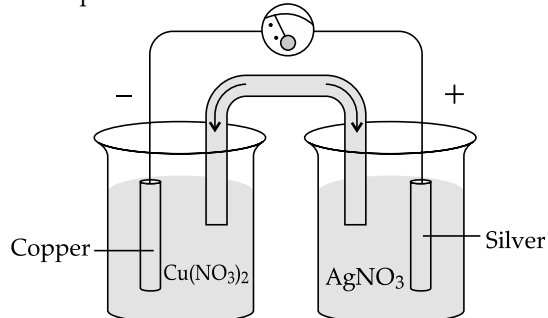

Given $E^0_{(Cu^{2+}/Cu)} = 0.337$ V; $E^0_{(Ag^+/Ag)} = 0.799$ V

(1) Write the cell reaction for the above cell.

(2) Calculate the standard emf of the cell.

(3) If the concentration of $[Cu^{2+}]$ is 0.1 M and E_{cell} is 0.422 V, at 25°C, calculate the concentration of $[Ag^+]$.

(4) Calculate ΔG for the cell.

(b) Calculate $\wedge^0_m$ for $BaCl_2$ and $Al_2(SO_4)_3$ from the following data.
For $\wedge^0_m Ba^{2+} = 127.2 \ S \ cm^2 \ mol^{-1}$,
$\wedge^0_m Al^{3+} = 189 \ S \ cm^2 \ mol^{-1}$
$\wedge^0_m Cl^- = 76.3 \ S \ cm^2 \ mol^{-1}$,
$\wedge^0_m SO_4^{2-} = 160 \ S \ cm^2 \ mol^{-1}$

OR

(ii) (a) A 0.05 M NH_4OH solution offers the resistance of 30.8 ohms to a conductivity cell at 298K. If the cell constant is $0.343 \ cm^{-1}$ and molar conductance of NH_4OH at infinite dilution is $471.4 \ S \ cm^2mol^{-1}$, calculate the following:
   (1) Specific conductance
   (2) Molar conductance
   (3) Degree of dissociation

(b) In the diagram of the electrolytic cell given below, A, B and C are connected in series having electrolytes of $ZnSO_4$, $AgNO_3$ and $CuSO_4$ respectively. A steady current of 1.5 A was passed until 1.45 g of Ag was deposited at the cathode of cell B.
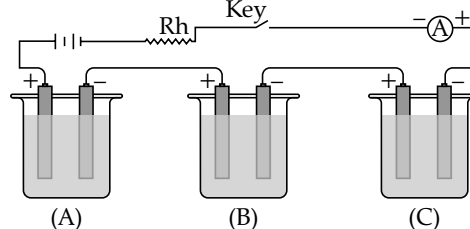
(Atomic mass of Ag= 108, Cu-63.5, Zn-65.3)
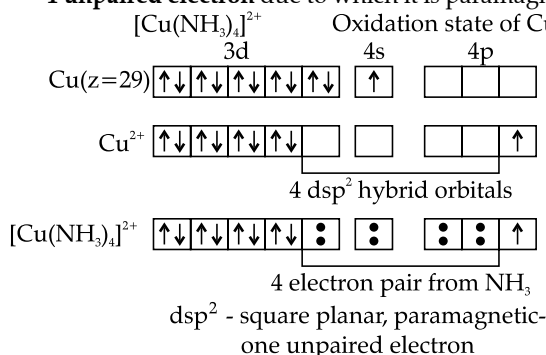Answer the following questions.
(1) How long did the current flow?
(2) What weight of Cu and Zn was deposited at cathode?

ANSWERS

SECTION A

1. (A) (i) First, dependent

(ii) Lead poisoning, cancer

(iii) Phosgene, diethyl carbonate [given wrong as ethyl carbonate]

(iv) diethyl ether, ethene

(B) (i) Option (c) is correct.

(ii) Option (d) is correct.

Explanation: The shape of $[Cu(NH_3)_4]^{2+}$ is square planer Cu^{2+} has electronic configuration $3d^94s^04p^0$. The electronic rearrange to $3d^84s^04p^1$ giving dsp^2 hybridisation i.e., square planer structure. Also it has **1 unpaired electron** due to which it is paramagnetic.
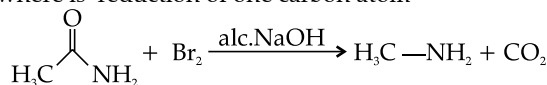
$[Cu(NH_3)_4]^{2+}$ Oxidation state of Cu^{2+}

4 dsp^2 hybrid orbitals

4 electron pair from NH_3

dsp^2 - square planar, paramagnetic- one unpaired electron

(iii) Option (b) is correct.

Explanation: Overall reaction: $2KMnO_4 + 3H_2SO_4 + 5(COOH)_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2\uparrow$

(iv) Option (b) is correct.

Explanation: The reaction is Hoffman bromamide where is reduction of one carbon atom

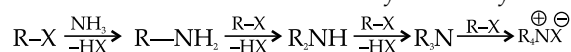

(v) Option (c) is correct.

Explanation: associated as the number of particles decrease and lowering of freezing point being a colligative property also is less reduced.

(vi) Option (a) is correct.

Explanation: On dilution the number of particles per unit volume decreases and the specific conductivity thus decreases.

(vii) Option (c) is correct.

Explanation: Ammonolysis of alkyl halides is brought about by using alcoholic ammonia, but a mixture of secondary, tertiary and quaternary amines are formed. And not only secondary amine.

$$R\text{–}X \xrightarrow[\text{–HX}]{NH_3} R\text{—}NH_2 \xrightarrow[\text{–HX}]{R\text{–}X} R_2NH \xrightarrow[\text{–HX}]{R\text{–}X} R_3N \xrightarrow{R\text{–}X} R_4N\overset{\oplus}{X}\overset{\ominus}{}$$

(C) (i) Osmosis is seen in both cases.

The egg placed in water will swell due to endosmosis. The egg's membrane behaves like a semipermeable membrane, allowing only solvent molecules to pass through.

- Through osmosis, water molecules transfer from the outside (where there's more water) to the inside of the egg (where there's less water).
- As a result, the egg swells.
- The egg in saturated glucose solution will shrink due to exosmosis. The solvent molecules from the boiled egg will migrated to the more concentrated glucose solution.

**(ii)** Hypertonic has the higher amount of solute in the same quantity of a solution.

(iii) For isotonic solutions:

$$\pi_1 = \pi_2$$
$$C_1RT = C_2RT$$
$$\frac{5}{180}RT = \frac{1.66}{M}RT$$
$$M = \frac{1.66 \times 180}{5}$$

Molar mass of urea = 59.76 approximately 60.

SECTION B

2. (i) Phenol give violet colour with dilute ferric chloride solution, whereas ethanol does not show any significant change in the colour of ferric chloride solution. Phenol reacts with bromine water to form white precipitate of 2,4,6 tri bromo phenol. This reaction is not given by ethanol.

2,4,6-tribromophenol

(ii)

Propan-2-ol
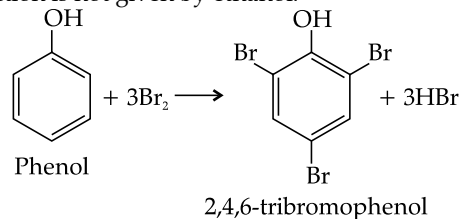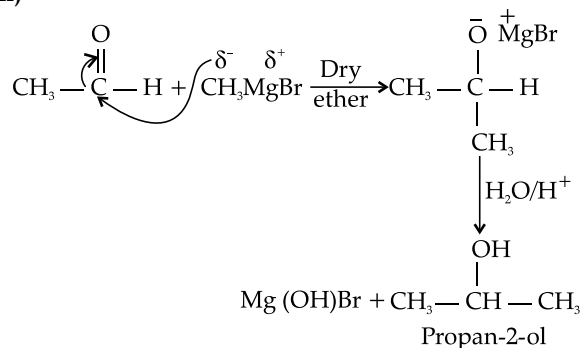
3. (i) $Zn[3d^{10}4s^2]$, $Cd[4d^{10}5s^2]$ and $Hg[5d^{10}6s^2]$ are d-block elements but not Transition elements as they have completely filled d sub shell. Transition elements have partially filled orbitals.

(ii) Transition elements have vacant d-orbitals that serve as seat for coordinate bond formation with the ligands and hence they form complex compounds.

4. (i) The reaction used is Williamson's synthesis.

$C_2H_5Br + C_2H_5ONa \rightarrow C_2H_5OC_2H_5 + NaBr$

**(ii)** The reaction is Reimer Tiemann reaction
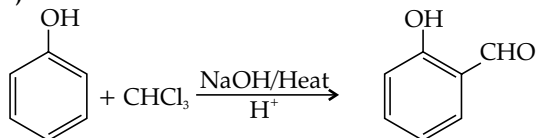
5. (i) Zr and Hf belong to the fifth and sixth period respectively of group 4 in the modern periodic table. Even after the addition of a new shell in Hf, the atomic radius of Zr is almost the same as that of Hf because of lanthanoid contraction. The poor shielding effect of the f orbitals results in contraction of atomic radius that compensates the increase in size in the next period.

(ii) Cu^{+2} has $3d^9$ configuration and due to the presence of unpaired d electron can undergo d-d transition to absorb energy in the visible range and show the complimentary colour. The configuration of Cu^{+1} is $3d^{10}$ and it has a fully filled d shell and cannot show d-d transition.

6. (i) Conversion of benzene to diphenyl
STEP 1:

Benzene   Chlorobenzene

STEP 2:

Chlorobenzene   Diphenyl
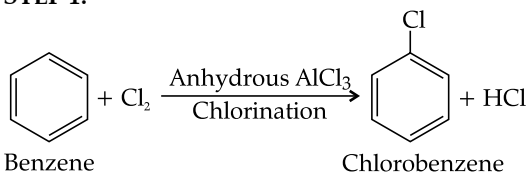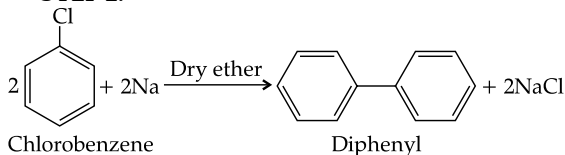
(ii) $CHI_3 + 6Ag + I_3CH \xrightarrow{Heat} H—C \equiv C—H + 6AgI$
   Iodoform   Iodoform   Ethyne
                                   (acetylene)

7. According to the cell:
$$E^0 \text{ anode} = Zn/Zn^{2+} = 0.76V$$
$$E^0 \text{ cathode} = Ag^+/Ag = 0.8 \text{ V}$$
$$E^0 \text{cell} = E_R - E_L$$
or $E^0 \text{cell} = E_{\text{oxidation at anode}} + E_{\text{reduction at cathode}}$
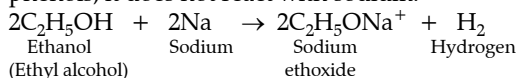$$E^0 \text{ cell} = 0.76 + 0.80 = 1.56$$
$$n = 2$$
$$\text{W electrical} = -n\text{FE}^0\text{cell}$$
$$= -2 \times 96500 \times 1.56$$
$$= -301080$$
$$= -301.08 \text{ KJ}$$

**8. (i) (a)** Since diethyl ether does not contain active hydrogen attached to oxygen like alcohols and phenols, it does not react with sodium.
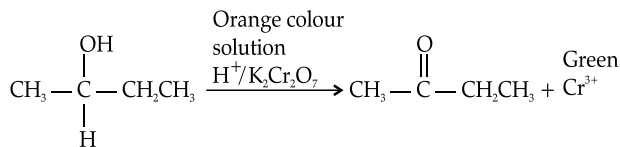$$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa^+ + H_2$$
   Ethanol   Sodium   Sodium   Hydrogen
  (Ethyl alcohol)   ethoxide

(b) $CH_3 – O – C_2H_5 + HI \rightarrow CH_3I + C_2H_5OH$
Ethyl carbocation is stabilised by +I effect and hyperconjugation that's why I^- attacks on methyl of methoxy ethane to form CH_3I and C_2H_5OH

OR

(ii) A =

B =

C =
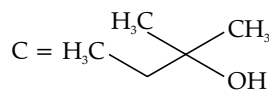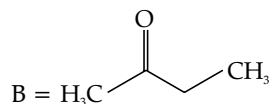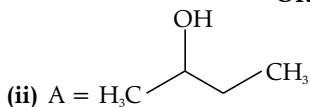
Conversion of A to B

9. Osmotic pressure $\pi = \dfrac{nRT}{V}$

     n = number of moles
     V = volume
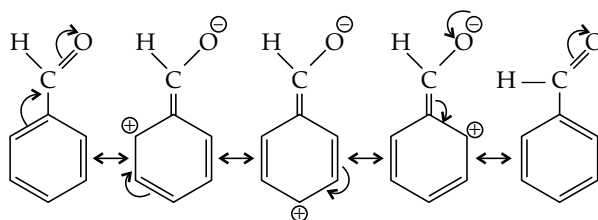 M = molecular mass of solute
     T = temperature
$$M = \dfrac{wRT}{\pi V}$$
$$= \dfrac{1.26 \times 0.0821 \times 300}{2.57 \times 10^{-3} \times 200} \times 1000$$
$$= \dfrac{31033.8}{514 \times 10^{-3}}$$

Molecular mass of protein = 60.38×10^3

10. (i) Benzaldehyde exhibits -R effect and there is double bond character between benzene and carbon of carbonyl group reducing the polarity. This is not seen in propanaldehyde and hence it is more reactive.

(ii) Ethanal is reactive and is susceptible to oxidation in the presence of an oxidizing agent, forming ethanoic acid. It has to be removed as soon as it is formed.
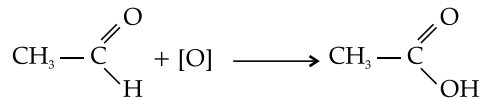
   Ethanal   Ethanoic acid

11. (i) Mn^{2+} had $3d^5$ configuration and is stable because of its half-filed d orbital. Fe^{2+} has $3d^6$ configuration and tends to lose one more electron to attain $3d^5$ configuration of half-filled state. Hence, Fe^{2+} is more reactive
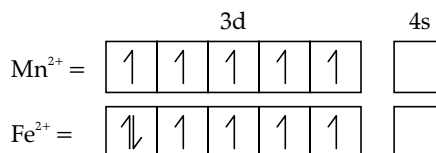
(ii) La^{3+} has the configuration of Xe and Lu^{3+} has the configuration $[Xe]4f^{14}$ and hence they do not have any electron in *d*-orbitals and no *d-d* transition can occur. They do not form colour ions.

SECTION C

12. (i) Suppose if the order is *p* with respect to A and *q* with respect to B

$$Rate = k[A]^p[B]^q$$

Substituting:

$$9.6 \times 10^{-2} = [0.15]^p[0.15]^q \qquad ...(i)$$
$$3.84 \times 10^{-1} = [0.30]^p[0.15]^q \qquad ...(ii)$$

Dividing (ii) by (i):

$$\frac{3.84 \times 10^{-1} = [0.30]^p[0.15]^q}{9.6 \times 10^{-2} = [0.15]^p[0.15]^q}$$

$$4 = 2^p, p = 2$$
$$1.92 \times 10^{-1} = [0.15]^p[0.30]^q \qquad ...(iii)$$

Dividing (iii) by (i)

$$1.92 \times 10^{-1} = [0.15]^p[0.30]^q$$
$$9.6 \times 10^{-2} = [0.15]^p[0.15]^q$$
$$0.2 \times 10 = 2^q, q = 1$$

The overall order of the reaction = 2 + 1 = 3

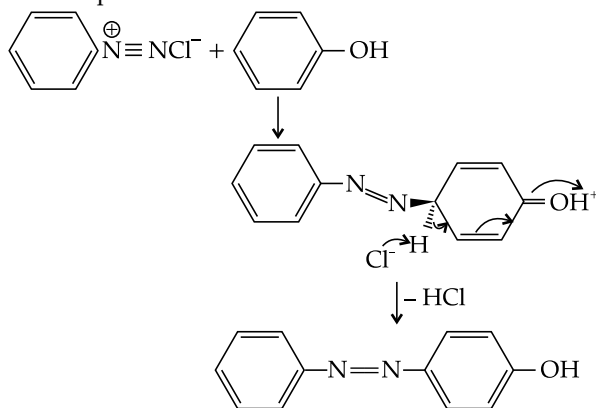**(ii)** Rate equation $= k[A]^2[B]^1$

(iii) The rate constant is calculated as:

$$Rate = k[A]^2[B]^1$$
$$9.6 \times 10^{-2} = k \times [0.15]^2[0.15]^1$$
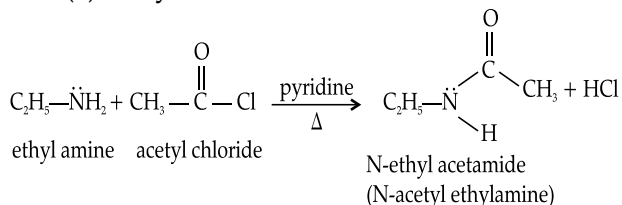$$k = \frac{9.6 \times 10^{-2}}{[0.15]^3}$$
$$= 24.44 \text{ mol}^{-2}L^2s^{-1}$$

13. (i) (a) Coupling reaction using diazonium salt and phenol:

(b) Acetylation:

ethyl amine   acetyl chloride

N-ethyl acetamide
(N-acetyl ethylamine)

(ii) Aniline being a Lewis base reacts with the Lewis acid anhydrous $AlCl_3$ to form coordinate bond, and hence $AlCl_3$ is not available for formation of electrophile.

Aniline   Salt
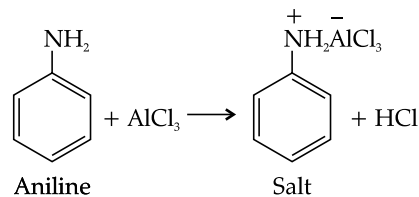
14. (i) Vitamin D

(ii) The milk curdles, this is known as denaturation of protein.

(iii) It gives two monosaccharides, glucose and fructose. It is a non-reducing sugar.

15.

$$\Delta T_b = iK_b m$$
$$m = \frac{W_{BaCl_2}}{M_{BaCl_2}} \times \frac{1000}{W_{H_2O}}$$
$$m = \frac{12.50}{208.34} \times \frac{1000}{1000}$$
$$m = 0.059$$
$$i = \frac{\Delta Tb}{K_b \times m}$$

$$[\Delta Tb = 373.0834 - 373 = 0.0834]$$

$$i = \frac{0.0834}{0.52 \times 0.059}$$
$$i = 2.718 \text{ or } 2.72$$
$$BaCl_2 \rightleftharpoons Ba^{2+} + 2Cl^-$$
$$1-x \qquad x \qquad 2x$$
$$i = 1 - x + x + 2x$$
$$= 1 + 2x = 2.718 \text{ or } 2.72$$
$$x = 0.86$$

85.9% is dissociated.

16. (i) Compound is ethanal – CH_3CHO

(ii) It will form Acetaldoxime

an oxime
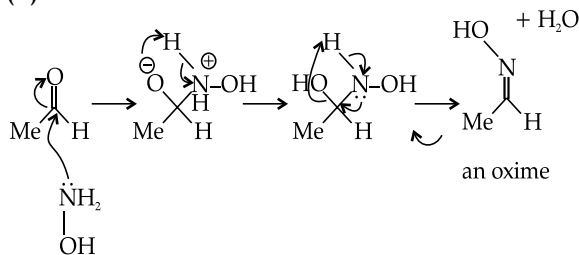
(iii) Reaction with ammoniacal silver nitrate solution.
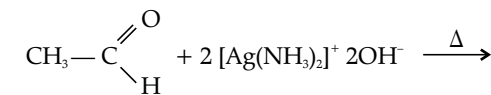
Acetaldehyde   Tollen's reagent
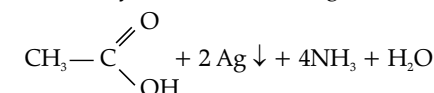
Acetic acid   Greyish black ppt.

17. (i) (a) $A = C_2H_5Cl$ = ethyl chloride
$B = C_2H_5CN$ = ethyl cyanide
$C = C_2H_5CONH_2$ = Propanamide

(b) $A = C_6H_6$ = benzene
$B = C_6H_5CH_3$ = toluene
$C = C_6H_5COOH$ = benzoic acid

OR

(ii) (a) Ethanol reacts with I_2/NaOH to form pale yellow crystals of iodoform, while methanol does not give this test.

(b) Ethanal gives silver mirror with ammoniacal silver nitrate (Tollen's reagent) on heating but ethanol does not respond to this test.

(c) 2-methyl propan-2-ol is a tertiary alcohol and reacts with anhydrous $ZnCl_2$/conc. HCl to form immediate cloudiness, while propan-2-ol being a secondary alcohol, produces cloudiness after 5 minutes.

18. (i) Using Arrhenius equation:

$$\ln\frac{K_2}{K_1} = -\frac{Ea}{R}\left(\frac{1}{T_2}-\frac{1}{T_1}\right)$$

$$\Rightarrow \qquad \ln\frac{0.07}{0.02} = -\frac{E_a}{R}\left(\frac{1}{700}-\frac{1}{500}\right)$$

$$\Rightarrow \qquad \ln 3.5 = +\frac{E_a}{R}\left(\frac{1}{500}-\frac{1}{700}\right)$$

$$\ln 3.5 = \frac{E_a}{R}\times\frac{200}{500\times700}$$

$$E_a = 7.914 \text{ kJ/mole}$$

(ii) Half life = 30 hours

$$k = \frac{0.693}{\text{half life}}$$

$$= \frac{0.693}{30} = 0.0231 \text{ hours}^{-1}$$

For a first order reaction, $k = \dfrac{2.303}{t}\log\dfrac{a}{a-x}$

$$0.0231 = \frac{2.303}{90}\log\frac{N_o}{N}$$

$$\log\frac{N_o}{N} = 0.9027$$

$$\frac{N_o}{N} = 7.99$$

considering $a = 100\%$, amount of alpha particles remaining $= 100-x$

$$\frac{100}{7.99} = N$$

12.51% of alpha particles remain.

19. (i)

$A =$ = Benzaldehyde

$B =$ = Benzyl alcohol

$C =$ = Sodium benzoate

The reaction involves is:

CHO   CHO   CH$_2$OH   COONa

+ $\xrightarrow{50\% \text{ NaOH}}$ +

Benzyl   Sodium
alcohol   benzoate

+ NaOH $\xrightarrow{\text{CaO}}$ + Na_2CO_3

(ii) (a)

$A =$ =toluene

$B =$ = Benzoic acid

[incorrect formula given-$K_2Cr_2O_7$ to be written and not $KrCr_2O_7$]

(b)

$A =$ = acetone

[incorrect formula given-$K_2Cr_2O_7$ to be written and not K_2CrO_7, H_2SO_4 and not H_2SO]

$B =$ —N—OH = acetoxime

20. (i) (a) The formula of the complex is $[Co(NH_3)_4Cl_2]$ Cl.

Since, AgCl is formed on reaction with silver nitrate, chloride ions must be the anion.

As the molar conductance corresponds to two ions per molecule there must be only two entities on ionization.

(b) The IUPAC is: Tetraamminedichloridocobalt(III) chloride

(c) The geometrical isomers are as follows:

Cis   Trans

(ii) They can be distinguished using barium chloride solution.

[Co(NH$_3$)$_5$Cl]SO$_4$ will form white precipitate of barium sulphate which is insoluble in all acids, as it generates sulphate ions on ionization. [Co(NH$_3$)$_5$SO$_4$]Cl will not react as it generates chloride ions on ionization.

21. (i) (a) (1) $Cu_{(s)} + Ag^{+}{}_{(aq)} \rightarrow Cu^{2+}{}_{(aq)} + Ag_{(s)}$

(2) Standard EMF of cell $= E_{cathode} - E_{anode}$
$= 0.799 - 0.337$
$= 0.462\ V$

(3) $\quad E_{cell} = E^0_{cell} - \dfrac{0.0591}{n} \log \dfrac{[Cu^{+2}]}{[Ag^+]^2}$

$n = 2$

$\therefore \quad \dfrac{0.0591}{2} = 0.0299$

$0.422 = 0.462 - 0.0295 \log \dfrac{[0.1]}{[Ag^+]^2}$

$\dfrac{0.04}{0.0295} = \log \dfrac{[0.1]}{[Ag^+]^2}$

$1.3559 = \log \dfrac{[0.1]}{[Ag^+]^2}$

$\dfrac{[0.1]}{[Ag^+]^2} = $ antilog $1.337 = 2.269 \times 10^1$

$[Ag^+]^2 = \dfrac{0.1}{22.69}$

$= 0.00440$

$[Ag^+] = 0.066\ M$

(4) $\quad \Delta G = -nFE_{cell}$
$\Delta G = -2 \times 96500 \times 0.422$
$= -81446\ J/mol$

(b) $\quad BaCl_2 \rightarrow Ba^{2+} + 2Cl^-$
$\Lambda^\infty_m(BaCl_2) = \lambda^\infty_{Ba^{2+}} + 2\lambda^\infty_{Cl^-}$
$= 127.2 + 2 \times 76.3$
$= 279.8\ S\ cm^2/mol$
$Al_2(SO_4)_3 \rightarrow 2Al^{3+} + 3SO_4^{2-}$
$\Lambda^\infty_m[Al_2(SO_4)_3] = 2\lambda^\infty_{Al^{3+}} + 3\lambda^\infty_{SO_4^{2-}}$
$= 2 \times 189 + 3 \times 160$
$= 858\ S\ cm^2/mol$

OR

(ii) (a) (1) Specific conductance $k = \dfrac{1}{R} \times \dfrac{l}{a}$

$= \dfrac{1}{R} \times$ cell constant

$= \dfrac{0.343}{30.8}$

$= 0.011\ ohm^{-1}\ cm^{-1}$

(2) Molar conductance $= \dfrac{k \times 1000}{concentration}$

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

$= 222.72\ ohm^{-1}\ cm^2\ mol^{-1}$

(3) Degree of dissociation

$\alpha = \dfrac{\lambda c}{\lambda \infty}$

$= \dfrac{\text{molar conductance at concentration } c}{\text{molar conductance at infinite dilution}}$

$= \dfrac{222.72}{471.4}$

$= 0.472$

(b) 1. $\quad W = Z \times I \times t$
$W =$ weight of silver deposited
$Z =$ electrochemical equivalent
$I =$ current in ampere
$T =$ time required

To calculate Z:
$Z =$ equivalent mass/ 96500

For silver $= \dfrac{atomic\ weight}{96500}$ [valency = 1]

$= \dfrac{108}{96500}$

$Z = 0.0011$

Substituting the values:
$1.45 = 0.0011 \times 1.5 \times t$

Time required is $= 878.78\ s$

2. $\dfrac{W_{Ag}}{W_{Cu}} = \dfrac{E_{Ag}}{E_{Cu}}$

$\dfrac{1.45}{W_{Cu}} = \dfrac{108}{31.75}$

$W_{Cu} = \dfrac{1.45 \times 31.75}{108}$

$= 0.426\ g$ of Cu is deposited

$\dfrac{W_{Ag}}{W_{Zn}} = \dfrac{E_{Ag}}{E_{Zn}}$

$\dfrac{1.45}{W_{Zn}} = \dfrac{108}{32.65}$

$W_{Zn} = \dfrac{1.45 \times 32.65}{108}$

$= 0.438\ g$ of Zn is deposited

■■