Sample Paper 7 Solutions

Class XII 2023-24

Chemistry

Time: 3 Hours **Max. Marks: 70**

General Instructions:

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

Directions (Q. Nos. 1-16) : The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. Adenosine is an example of

(a) Nucleotide (b) Pyrimidine base

(c) Nucleoside (d) Purine base

Ans : (d) Purine base

Adinosine is an example of Purine nitrogen base. It consist of a sixmembered and five membered nitrogen containg rings, fused together.

2. If 2 gm of NaOH is present in 200 ml of its solution, its molarity will be :

(a) 0.25 (b) 0.5

(c) 5 (d) 10

Ans : (a) 0.25

We know that,

$$\text{Molarity } (C) = \frac{\text{moles of solution}\,(n)}{\text{volume of solution}\,V(\text{mL})}$$

and $$n = \frac{w(\text{moles of solute})}{m(\text{molar mass of solute})}$$

$$\text{Molar mass of NaOH} = 23 + 16 + 1 = 40$$

or, $$(C) = \frac{W_B}{M_B} \times \frac{1000}{V(\text{in ml})}$$

Hence, $$C = \frac{2 \times 1000}{40 \times 200}$$

$$\text{Molarity of solution} = 0.25\,\text{M}$$

3. The hybridisation of Fe in $K_4[Fe(CN)_6]$ is :

(a) dsp^2 (b) sp^3

(c) d^2sp^3 (d) sp^3d^2

Ans : (c) d^2sp^3

Iron (Fe) has atomic number 26 when ligands CN approach to the central metal atom the electrons remains in the inner orbital (because CN is a strong ligand). And 6 electron pairs of 6 CNs are filled in 3d, 4s and 4p orbitals. Thus, hybridisation is d^2sp^3.

4. If 96500 coulomb of electricity is passed through $CuSO_4$ solution, it will liberate

(a) 63.5 g Cu (b) 31.76 g Cu

(c) 96500 g Cu (d) 100 g Cu

Ans : (b) 31.76 g Cu

As we know that,

Molar mass of copper = 63.5

As Copper (Cu) contain (+) 2 charge in $CuSO_4$, it requires $2F\,(= 2 \times 96500\,C)$ charge to give one mole i.e. 63.5 g of copper. Thus on giving 96500 C of electricity, we get $63.5/2 = 31.76$ g of copper.

Hence, (b) is the correct option.

5. Which of the following alcohols gives 2-butene on dehydration by concentration H_2SO_4 ?

(a) 2-Methyl propene-2-ol (b) 2-Methyll 1-propanol

(c) Butane-2-ol (d) Butane-1-ol

Ans : (c) Butane-2-ol

When Butane -2-ol is heated with concentrated sulphuric acid at 443 K, dehydration takes place and 2-butene is formed. In this reaction concentrated sulphuric acid acts as a dehydrating agent.

6. The rate constant of a reaction depends on

(a) temperature

(b) initial concentration of the reactants

(c) time of reaction

(d) extent of reaction

Ans : (a) temperature

It is a constant of a particular reaction at a given temperature. It does not depend upon initial concentration of the reactants, time of reaction and extent of reaction.

7. Methylamine can be prepared by :

(a) Wurtz reaction

(b) Hofmann's bromamide reaction

(c) Friedel-Crafts reaction

(d) Kolbe reaction

Ans : (b) Hofmann's bromamide reaction

When an amide is treated with bromine in alkali solution, it is converted to a primary amine that has one carbon atom less than the starting amide. Thus reaction is known as Hoffmann's bromamide degradation reaction:

$$C_6H_5CONH_2 \xrightarrow{Br_2+NaOH} C_6H_5NH_2$$

8. The most common oxidation state shown by 1st row of transition elements is :

(a) (+II) (b) (+III)

(c) (+IV) (d) all of these

Ans : (a) (+II)

The most common oxidation state shown by first row of transition elements is (+II). Every elements have different Ionic enthalpy in the periodic table.

9. Avogardr's number (N) is equal to :

(a) 6.023×10^{24} (b) 6.023×10^{23}

(c) 6.023×10^{-23} (d) 11.2

Ans : (b) 6.023×10^{23}

One mole of any substance contain 6.023×10^{23} number of particles is known as Avogadro's number (N). In other words, 6.023×10^{23} number of any particle is known as one mole.

10. What is the coordination number of Cr in $[K_3Cr(OX)_3]$

(a) 6 (b) 5

(c) 4 (d) 3

Ans : (a) 6

The coordination number of Cr in $K_3Cr(Ox)_3$ is 6 as Ox is a bidentate ligand.

11. The reaction is called :
$RCOCl + H_2 \xrightarrow{Pd/BaSO_4} RCHO + HCL$

(a) Cannizzaro Reaction

(b) Rosenmund's Reaction

(c) Haloform Reaction

(d) Clemensen's Reaction

Ans : (b) Rosenmund's Reaction

The Rosenmund's reduction is a hydrogenation process in which anacyl chloride is selectively reduced to an aldehyde.

$$RCOCl + H_2 \xrightarrow{Pd/BaSO_4} RCHO + HCl$$

12. Alkyl halide is converted into an alcohol by :

(a) Addition reaction

(b) Substitution reaction

(c) Elimination reaction

(d) Dehydrogenation reaction

Ans : (b) Substitution reaction

Alkyl halides are converted into alcohols by substitution reaction. When alkyle halides are treated with aqueous KOH, alcohols are formed. This is a nucleophilic substitution reaction. Equation for the reaction is as follows :

$$R - X \xrightarrow{aq.\,KOH} R - OH$$

Directions (Q. Nos. 13-16) : Each of the following questions consists of two statements, one is Assertion and the other is Reason. Give answer :

13. **Assertion :** Carboxypeptidase is an exopeptidase.
Reason : It cleaves the N-terminal bond.

(a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : (c) Assertion is correct but Reason is incorrect.

It is true that carboxypeptidase is an exopeptidase because it cleaves the peptide chain at carboxy terminal amino acids.

14. **Assertion :** Reimer-Tiemann reaction of phenol with CCl_4 in NaOH at 340 K gives salicylic acid as the major product.
Reason : The reaction occurs through intermediate formation of di-chlorocarbene.

(a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : (c) Assertion is correct but Reason is incorrect.

Dichlorocarbene (CCl_2) attacks on the orthodox-position of the phenol-ate ion to form an intermediate which on hydrolysis gives salicylic acid.

15. **Assertion :** The order of a reaction can have fractional value.
Reason : The order of a reaction cannot be written from balanced equation of a reaction.

(a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

The order of a reaction can have fractional value. Assertion is true.
The order of a reaction can not be written from balanced equation of a reaction because its value changes with pressure, temperature and concentration. It can only be determined experimentally. Thus the reason is also correct, but the reason is not the correct explanation of assertion.

16. **Assertion :** Proteins on hydrolysis produce amino acids.
Reason : Amino acids contain-NH_2 and $-COOH$ group.

(a) Both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.

(b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

(c) Assertion is correct but Reason is incorrect.

(d) Both the Assertion and Reason are incorrect.

Ans : (b) Both Assertion and Reason are correct but Reason is not the a correct explanation of the Assertion.

Proteins are polyamides so, on hydrolysis, give amino acids. Further it is a fact that amino acids contain both- NH_2 as well as $-COOH$ group. So assertion and reason, although both are correct but reason is not correct explanation of assertion.

SECTION-B

Directions (Q. Nos. 17-21) : This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17. Explain why aquatic species are more comfortable in cold water rather than in warm water.

Ans :

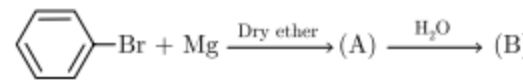
Increases in temperature decreases the solubility of oxygen in water. The amount of oxygen dissolved in water decreases at higher temperature. As a result, it becomes more difficult to breathe less oxygen. Hence, the aquatic species are not comfortable in warm water.

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

Ans :

Cr^{2+} is reducing because after the loss of one electron its configuration changes from d^4 to d^3, the latter having a half filled t_{2g} level (see next unit). Mn^{3+} is oxidising because after taking one electron its configuration changes form d^4 to d^5(Mn^{3+} to Mn^{2+}) configuration which has extra stability transition elements.

19. Identify A and B in the following:



Ans :

20. What are phenols?

Ans :

Phenols are the hydroxy derivatives of aromatic hydrocarbons in which the hydroxyl group is directly attached to the carbon atom of the aromatic ring.
Phenol is formed when one or more hydrogen atom (s) in an aromatic hydrocarbon is replaced by hydroxyl (OH) group (s). Phenol is represented as $Ar-OH$.

or

What are ethers?

Ans :

Ether can be visualised as a compound formed by substituting the hydrogen atom of hydroxyl group of an alcohol or phenol by an alkyl or aryl group.
Ether is formed when one or more hydrogen atoms(s) in a hydrocarbon is replaced by an alkoxy ($RO-$) or aryloxy ($ArO-$) group. Ether is represented as $R-OR$ or $R-OAr$.

21. Write the general form of reactions:
(i) Wurtz reaction
(ii) Swarts reaction

Ans :

(i) $R-X+2Na+R-X \xrightarrow{\text{Dry Ether}} R-R+2NaX$

(ii) $R-Br+AgF \longrightarrow RF+AgBr$

SECTION-C

Directions (Q. Nos. 22-28) : This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each.

22. Differentiate between average and instantaneous rate of reaction.

Ans :

Average rate of reaction : Change in concentration of reactant or product in unit time (Time interval).
For a reaction : $R \longrightarrow P$
Average rate of reaction (r_{av})

$$= \frac{-\Delta[R]}{\Delta t} = \frac{+\Delta[P]}{\Delta t}$$

Instantaneous rate of reaction : Change in concentration of reactant or product at the particular instant of time
Instantaneous rate of reaction (r_{inst})

$$\frac{-d[R]}{dt} = \frac{+d[P]}{dt}$$

23. Why Zinc, Cadmium and Mercury are not regarded as transition elements?

Ans :

Zinc (Zn), Cadmium (Cd) and Mercury (Hg) have filled d^{10} configuration in their ground state as well as in the common oxidation states. Hence they are not regarded as transition elements.

24. Why does vapour pressure of a liquid decrease with addition of a non volatile solid solute?

Ans :

In a solution containing non-volatile solute, the surface of solution contains both volatile solvent molecules and non-volatile solute molecules. As the solute is non-volatile, the number of molecules that escapes from the liquid surface as vapours, decreases. This results, less number of molecules are now in the vapour state at a given temperature and results the decrease in vapour pressure of the solvent.
More the amount of non-volatile solute added, more the lowering in vapour pressure.

25. What are the products obtained at the cathode and anode during the electrolysis of the following when platinum electrodes are used in the electrolysis
(a) Molten KCl
(b) Aq. $CuSO_4$ solution
(c) Aq. K_2SO_4 solution

Ans :

(a) During the electrolysis of molten KCl using platinum electrodes. Potassium is obtained at cathode and chlorine at anode.

$$2\,KCl \longrightarrow 2K^+ + 2Cl^-$$
$$2\,Cl^- \longrightarrow Cl_2 + 2e^- \text{ (anode)}$$
$$2K^+ + 2e^- \longrightarrow 2K \text{ (cathode)}$$

(b) During the electrolysis of aq. $CuSO_4$ solution using platinum electrodes, O_2 gas liberated at anode and Cu deposited at cathode.

$$2\,CuSO_4 \longrightarrow 2\,Cu^{+2} + 2\,SO_4^{-2}$$
$$2\,Cu^{+2} + 4e^- \longrightarrow 2\,Cu \text{ (cathode)}$$
$$2\,H_2O - 4e^- \longrightarrow O_2 + 4H^+ \text{ (anode)}$$

During the electrolysis of aq. K_2SO_4 using pt-anode and pt-cathode hydrogen gas liberated at cathode and oxygen gas at anode.

$$K_2SO_4 \longrightarrow 2K^+ + SO_4^{-2}$$
$$4\,H_2O \xrightarrow{+4e^-} 2\,H_2 + 4\,OH^- \text{ (cathode)}$$
$$2H_2O \xrightarrow{-4e^-} O_2 + 4H^+ \text{ (anode)}$$

26. Transition elements form coloured compound. Explain.

Ans :

Most of the compounds of transition metals are coloured due to d-d transition, structure defects and charge transfer. Transition metal ions having d^0 configuration are colourless. The explanation is that in d-d transition, free metal ions has degenerate d-orbital which splits into two levels according to the geometry of complex. Compounds absorb light of visible range for the excitation of electrons from lower to higher level and thus show complementary colour of light is seen.

27. What happens when :
1. ethanol is oxidised with acidified $KMnO_3$ solution?
2. ethanol is treated with PCl_5?

Ans :

1. $CH_3CH_2OH \xrightarrow{KMnO_4} CH_3COOH$

   When ethanol is added to alkaline $KMnO_4$ solution, the ethanol get oxidise to ethanoic acid due to formation of nascent oxygen. $KMnO_4$ act as an oxidising agent. The pink colour of the $KMnO_4$ vanishes, as it is being used up in oxidation process.
2. Chloroethene will be formed.
   $C_2H_5OH + PCl_5 \rightarrow C_2H_5Cl + POCl_3 + HCl$

   Solid phosphorus chloride reacts violently with alcohols at room temperature, producing clouds of hydrogen chloride gas.

28. Explain two important uses of formalin.

Ans :

Aqueous solution of Formaldehyde (H.CHO). is known as formalin. It contain about 35-40% of water.
It is used as:
1. Strong disinfectant
2. Tissue hardener

3. Preservative for biological and anatomical specimens.
4. An antiseptic for sterilising the surgical instruments.

or

Give reasons for the following :

1. Ethyne is more acidic than ethane.
2. Lower members of aldehyde are more soluble in water.

Ans :

1. **Ethyne is more acidic than ethane :** More be the s -character of the hybrid orbitals of the carbon, more it will be acidic in nature.
   As in $CH \equiv CH$, both the carbon atoms are sp-hybrid, so has 50% S-character, while in $CH_3 - CH_3$, Both the carbon atoms are sp^3-hybrid, So has 25% S-character. Therefore $CH \equiv CH$ is more acidic in nature.
2. **Lower members of aldehyde are more soluble in water:** In lower aldehydes, a single small alkyl group (R) can not hinder the oxygen atom of -CHO group, thus It can form the intermolecular hydrogen bond with H_2O (water) molecule and is therefore soluble in water. On the other hand, longer alkyl group can hinder the oxygen atom of aldehydes, thus they can not able to form the intermolecular hydrogen bonds with water and therefore are not soluble in water.

SECTION-D

Directions (Q. Nos. 29-30) : The following questions are case-based questions. Each question has an internal choice and carries 4 marks each. Read the passage carefully and answer the questions that follow.

29. In the 1880s, French chemist François-Marie Raoult discovered that when a substance is dissolved in a solution, the vapor pressure of the solution will generally decrease. This observation depends on two variables:
(i) the mole fraction of the amount of dissolved solute present and
(ii) the original vapor pressure (pure solvent).
At any given temperature for a particular solid or liquid, there is a pressure at which the vapor formed above the substance is in dynamic equilibrium with its liquid or solid form. This is the vapor pressure of the substance at that temperature. At equilibrium, the rate at which the solid or liquid evaporates is equal to the rate that the gas is condensing back to its original form. All solids and liquids have a vapor pressure, and this pressure is constant regardless of how much of the substance is present.
Answer the following questions :
(a) What is the value of ΔH_{mixing} and ΔV_{mixing} for an ideal solution?
(b) Do the intermolecular forces between A and B are weaker or stronger than that between $A - A$ and $B - B$ in an non-ideal solution with positive deviation ?
(c) Give an example of non-ideal solution with negative deviation. Give an example of ideal solution.

or

(d) Write the expression for the pressure of non ideal solution with positive and negative deviations.

Ans :

(a) $\Delta H_{mixing} = 0$, $\Delta V_{mixing} = 0$
(b) Weaker
(c) Chloroform-Acetone
Benzene-Toluene

or

(d) $P_S > x_A P_A^\circ + x_B P_B^\circ$
Positive deviations
$P_S < x_A P_A^\circ + x_B P_B^\circ$
Negative deviations.

30. The sequence of bases along the DNA and RNA chain establishes its primary structure which controls the specific properties of the nucleic acid. An RNA molecule is usually a single chain of ribose-containing nucleotide. On the basis of X-ray analysis of DNA, J.D., Watson and F.H.C. Crick (shared noble prize in 1962) proposed a three dimensional secondary structure for DNA. DNA molecule is a long and highly complex, spirally twisted, double helix, ladder like structure. The two polynucleotide chains or strands are linked up by hydrogen bonding between the nitrogeneous base molecules of their nucleotide monomers. Adenine (purine) always links with thymine (pyrimidine) with the help of two hydrogen bonds and guanine (purine) with cytosine (pyrimidine) with the help of three hydrogen bonds. Hence, the two strands extend in opposite directions, i.e., are antiparallel and complimentary.
Answer the following questions :
(a) What information is given by primary structure of DNA?
(b) Name the types of nitrogeneous bases present in nucleic acids.
(c) Write the structural and functional difference between DNA and RNA.

or

(d) Name the bases present in RNA. Which one of these is not present in DNA?

Ans :

(a) Primary structure gives information regarding the sequence of nucleotides in the chain of nucleic acids.
(b)
   (i) Purines,
   (ii) Pyrimidines
(c) Structural differences between DNA and RNA :
   (i) The sugar in DNA is deoxyribose while that in RNA is ribose.
   (ii) DNA has a double-stranded helical structure, while RNA has a single-stranded helical structure.
   Functional differences between DNA and RNA.
   Functional differences between DNA and RNA.

(i) DNA is the chemical basis of heredity and is responsible for maintaining the identity of different species.

(ii) RNA molecules are responsible for protein synthesis but the message for the synthesis of a particular protein is present in DNA.

or

(d) The bases present in RNA are adenine (A), guanine (G) cytosine (C) and Uracil (U). Uracil is not present in DNA.

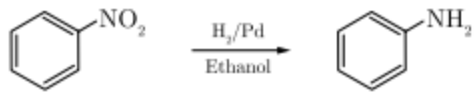
SECTION-E

Directions (Q. Nos. 31-33) : The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

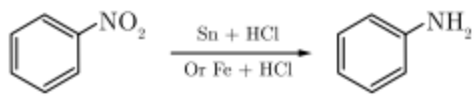
31. Write following methods of preparation of amines:
(i) Reduction of nitro compounds.
(ii) Ammonolysis
(iii) Reduction of nitriles
(iv) Reduction of amides
(v) Gabriel phthalimide synthesis
(vi) Hoffmann bromamide degradation reaction.
(vii) Schmidt reaction

Ans :

(i) **Reduction of nitro compounds :** Nitro compounds are reduced to amines by passing hydrogen gas in the presence of finely divided mickel (Ni), palladium (Pd) or platinum (Pt) and also be reduction with metals in acidic medium.



Nitrobenzene Aniline

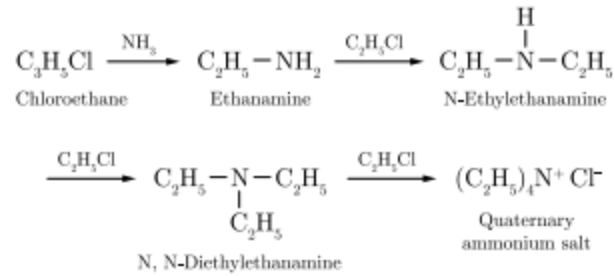


Nitrobenzene Aniline

Reduction with iron scrap and HCl id preferred because $FeCl_2$ formed gets hydrolysed to release hydrochloric acid during the reaction. Thus only a small amount of HCl is required to initiate the reaction.

(ii) **Ammonolysis :** An alkyl or benzyl halide on reaction with an ethanoic solution of ammonia undergoes nucleophinic susbstitution reaction in which the halogen atom is replaced by an amino ($-NH_2$) group. This process of cleavage of the $C-X$ bond by ammonia molecule is known as **ammonolysis**.

A mixture of primary, secondary and tertiary amine along with some quaternary ammonium halides is obtained.

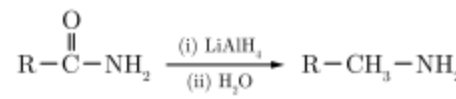


(iii) **Reduction of nitriles :** Nitriles on reduction with lithium aluminium hyride ($LiAlH_4$) or catalytic hydrogenation produce primary amines. (This reaction is used for ascent of amine series) i.e., for preparation of amines containing one carbon atom more than the starting alkyl halide.

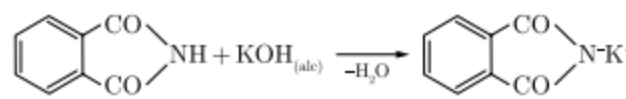
$$R-C\equiv N \xrightarrow[Na(Hg)/C_2H_5OH]{H_2/Ni} R-CH_2-NH_2$$

(refuction with sodium and alcohol is called **Mendius reduction**)

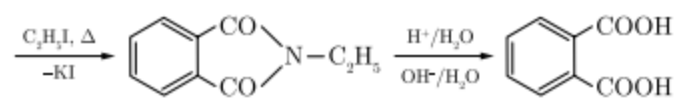
(iv) **Reduction of amides :** The amides on reduction with $LiAlH_4$ give amines.



(v) **Gabriel phthalimide synthesis :** (To prepare primary amines)



Phthalimide Pot. Phthalimide



N-Ethylphthalimide Phthalic acid

$+ C_2H_5NH_2$

Ethylamine

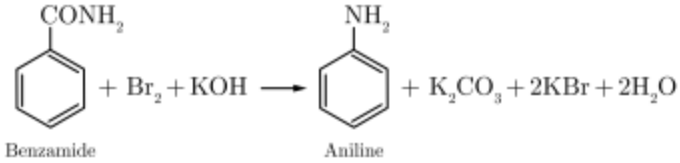
(vi) **Hoffmann bromamide degradation reaction :** (to prepare primary amine)- When a primary amide is treated with an aqueous or ethanolic solution of KOH and bromine (Br_2) it gives a primary amine which has one carbon less than the original amide.

$$CH_3CH_2CONH_2 + Br_3 + KOH \longrightarrow$$

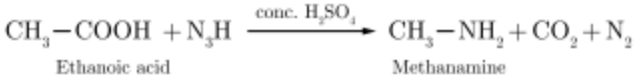
Propanamide

$$CH_3CH_2NH_2 + K_2CO_3 + 2KBr + 2H_2O$$

Ethanamine



(vii) **Schmidt reaction :** Carboxylic acid react with hydrazoic acid (N_3H) in presence of conc, H_2SO_4 to form 1° amines.



32. Define the following :

1. Resistance
2. Conductance
3. Conductivity
4. Equivalent conductivity
5. Molar conductivity

Ans :

1. **Resistance** (R) **:** Resistance (R) is the obstruction to the $\left(R = \frac{E}{I}\right)$ flow of electric current through the conductor. It is directly proportional to its length (l) and inversely proportional to its area of cross section (A).

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

   The constant of proportionality ρ(rho) is called specific resistance or resistivity. Resistance is measured is measured in Ohm (Ω), which is terms of SI base units is equal to $(\text{kg m}^2/\text{S}^3\text{A}^2)$. SI units of resistivity is ohm metre (Ωm).
2. **Conductance :** The inverse of resistance, R is called conductance, G

   $$G = \frac{1}{R} = \frac{A}{\rho l} = \kappa\frac{A}{l}$$

   The SI unit of conductance is siemens, represented by the symbol S and is equal to ohm$^-$ (or mho) or Ω^-
3. **Conductivity :** The inverse of resistivity is called conductivity (specific conductance) is represented by symbol κ (Greek kappa). Unit $= \text{ohm}^{-1}\text{cm}^{-1}$

   The SI units of conductivity are Sm^{-1}

   $G = \kappa\frac{A}{l}$ when $A = 1\,\text{m}^2$, $1 = 1\,\text{m}$

   $G = \kappa$

   Conductivity of a material is its conductance when it is 1 m long and its area of cross section is 1 m^2.
4. **Equivalent Conductivity :** Equivalent conductivity is the conductivity of all the ions produced by dissolving one gram-equivalent of an electrolyte in its aqueous solution. It is denoted by Λ_{eq} (Greek lambda)

   Equivalent conductivity= Specific conductivity $\times$ V

   $$\Lambda_{eq} = \kappa \times V$$

   If the solution has a concentration of c gram equivalent per litre then the volume of the solution containing one gram equivalent will be $\frac{1000}{c}$ i.e., $V = \frac{1000}{c}$

   $$\Lambda_{eq} = \kappa \times \frac{1000}{c_{eq}} = \kappa \times \frac{1000}{\text{Normality}}$$

   Units : $\text{ohm}^{-1}\text{cm}^2(\text{g})\,(\text{eq})^{-1}$ or $\Omega^{-1}\text{cm}^2\text{eq}^{-1}$

   or $S\,\text{cm}^2\ \text{eq}^{-1}$ or $\text{Sm}^2\ \text{eq}^{-1}$ in SI units
5. **Molar Conductivity :** Molar conductivity is the conductivity of all the ions produced by dissolving one gram mole of an electrolyte in solution.

   It is denoted by Λ_m

   $$\Lambda_m = \kappa \times V \text{ or } \Lambda_m = \kappa \times \frac{1000}{C}$$

   $$= \kappa \times \frac{1000}{\text{Molarity}}$$

   Units : $\text{ohm}^{-1}\ \text{cm}^2\,\text{mol}^{-1}$ or $S\ \text{cm}^2\ \text{mol}^{-1}$

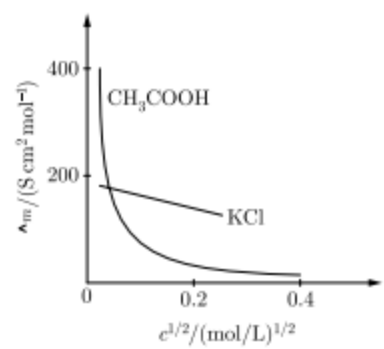
   or $\Omega^{-1}\text{cm}^2\text{mol}^{-1}$ or $S\ \text{m}^2\text{mol}^{-1}$ in SI units

or

1. How Molar conductivity of strong and weak electrolyte vary with concentration?
2. How conductivity of solution vary with concentration.

Ans :

1. In case of strong electrolytes the molar conductivity increase slightly with dilution, as mobility of ions increases. In case of weak electrolytes the degree of ionisation increases with dilution therefore, there is a large increase in molar conductivity with dilution.
2. Conductivity is conductance between two opposite faces of one centimetre cube. On dilution, number of ions per cm^3 decreases therefore conductivity decreases on dilution.



Here, Λ_m = Molar Conductivity

It is the conductance of the electrolytic solution kept between the electrodes of conductivity cell at unit distance but having one mole of the electrolyte

Λ_m^o = Limiting molar conductivity

When concentration approaches zero, the molar conductivity is known as limiting molar conductivity.

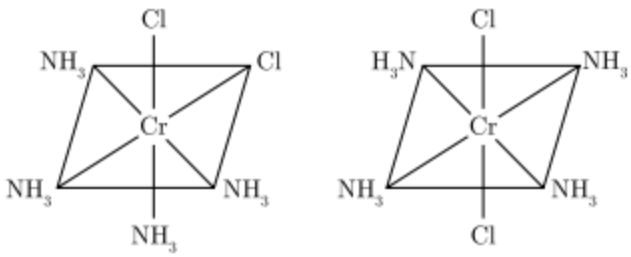
33. (i) Draw all the possible isomers having the formula $Cr[(NH_3)_4Cl_2]^+$.

(ii) Illustrate the following with an example:
(a) Linkage isomerism
(b) Coordination isomerism.

(iii) Why is $[NiCl_4]^{2-}$ is paramagnetic (Ni = 28)?

Ans :

(i)



cis-(violet) trans-(green)

(ii)

(a) **Linkage Isomerism :** The isomerism in which a ligand can form linkage with metal through different atoms, e.g., nitro group $(-NO_2)$ can link to metal either through nitrogen atom or through oxygen atom, e.g. $[Co(NH_3)_5ONO]Cl_2$

IUPAC Name : Pentaamminenitrito-o-cobalt (III) chloride.

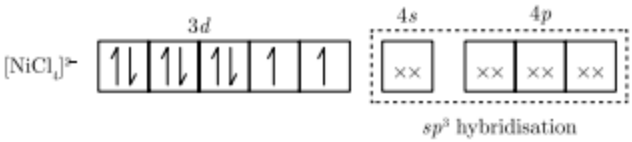
$[Co(NH_3)_5NO_2]Cl_2$

IUPAC Name : Pentaamminenitrito-N-cobalt (III) chloride.

(b) **Coordination Isomerism :** This type of isomerism occurs when both the cations and anions are complexes and they differ in the coordination of ligands.
e.g. $[Co(NH_3)_6][Cr(C_2O_4)_3]$ and

$[Cr(NH_3)_6][Co(C_2O_4)_3]$ are coordination isomers.

(iii) $Ni^{2+}(28) = 4s^0 3d^8$, Cl^- is a weak ligand and it does not cause pairing of electrons.



Due to the presence of 2 unpaired electrons, it is paramagnetic in nature.

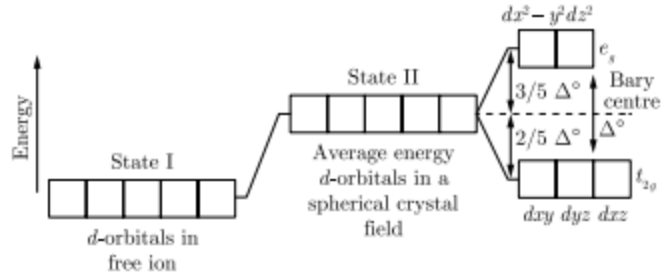
or

Explain bonding in coordination compounds with the help of crystal field theory.

Ans :

The main points of crystal field theory are:

1. Metal ligand bonds are ionic having electrostatic interaction similar to ions in a crystal, therefore named as crystal field theory (CFT).
2. Ligand is treated as a point of negative charge. The arrangement of the ligands around the central ion is such that the repulsion between them are minimum.
3. In free transition metal ion all the five d-orbitals have equal energies i.e. they are degenerate. Due to ligand the degeneracy is split, because those orbitals which have lobes along the axes towards ligands feel greater repulsion. The splitting of the degenerate levels due to the presence of ligand is called Crystal field splitting.
Example : Splitting of d-orbitals in an Octahedral Crystal field.



The energy separation is denoted by Δ_0. The energy of two e_g. orbitals will increase by $(3/5)\ \Delta_0$ and that of the three t_{2g} will decease by $(2/5)\ \Delta_0$.

□□□□□□□