Sample Question Paper- Chemistry

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

General Instruction:

1. Question 1 is of 20 marks having four sub parts, all of which are compulsory.
2. Question numbers 2 to 8 carry 2 marks each, with two questions having internal choice.
3. Question numbers 9 to 15 carry 3 marks each, with two questions having internal choice.
4. Question numbers 16 to 18 carry 5 marks each, with an internal choice.
5. All working, including rough work, should be done on the same sheet as, and adjacent to the rest of the answer.
6. The intended marks for questions or parts of questions are given in brackets [].
7. Balanced equations must be given wherever possible and diagrams where they are helpful.
8. When solving numerical problems, all essential working must be shown.
9. In working our 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}
   1 l atm = 1 dm^3 atm = 101.3 J. 1 Faraday = 96500 Coulombs.
   Avogadro's number = 6.023×10^{23} mol^{-1}.

Question 1: (a) Fill in the blanks by choosing the appropriate word/ words from those given in the brackets: **[4]**

(increases, decreases, efficient, same as , 68, non- efficient, greater than, 74, less than, sp^3d^3, sp^3d^2, octahedral, distorted octahedral, remains same)

(i) Both ccp and hcp are _____ close packing and occupy about_____ % of the available space.
(ii) The molar conductance of a solution _____ with dilution while its specific conductance_____ with dilution..
(iii) The geometry of XeF_6 molecule is _____ and the hybridization of Xe atom in the molecule is _____.
(iv) The acidic strength of phenol is_____ ethyl alcohol but _____ nitro phenol.

(b) Complete the following statements by selecting the correct alternative from the choices given: **[4]**

(i) The molal freezing point constant of water is 1.86 K kg mol^{-1}. Therefore, the freezing point of 0.1m NaCl solution in water is expected to be:
(a) -1.86°C
(b) -0.372°C
(c) -0.186°C
(d) +0.372°C

(ii) Which among the following reacts fastest by S_N2 reaction?

(a) $(CH_3)_3C-Br$

(b) $(CH_3)_2CHBr$

(c) CH_3-CH_2-Br

(d) CH_3-Br

(iii) When acetaldehyde is treated with Grignard reagent followed by hydrolysis, the product formed is:

(a) Primary alcohol
(b) Secondary alcohol
(c) Carboxylic acid
(d) Tertiary alcohol

(iv) Which of the following ores can be concentrated by forth floatation process?

(a) Haematite
(b) Calamine
(c) Zinc blende
(d) Bauxite

(c) Match the laws given in Column I with expressions given in Column II. [4]

Column I	Column II
A. Disaccharie	1. Adsorption
B. Arrhenius equation	2. Condensation polymer
C. Dacron	3. Activation energy
D. Freundlich isotherm	4. Surcose

(d) Answer the following questions: [4×2]

(i) Calculate the mass of compound (molar mass = 256 $gmol^{-1}$) to be dissolved in 75g of benzene to lower its freezing point by 0.48K(Kf = 5.12 $Kkgmol^{-1}$)

(ii) Write the IUPAC name of the complex, $[Cr(NH_3)_4Cl_2]^+$. Which type of isomerism will be exhibited by it?

(iii) Why do the transition elements have higher enthalpies of atomization? In 3d series (Sc to Zn), which element has the lowest enthalpy of atomization and why?

(iv) Write balanced chemical equations for carbylamines reaction and diazotization reaction.

Solution 1:

(a) (i) efficient, 74.
(ii) increase, decreases.
(iii) distorted octahedral, sp^3d^3.
(iv) Greater than, less than.

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

(c) $A \to 4, B \to 3, C \to 2, D \to 1.$

(d) (i) Given that, $K_f = 5.12 Kkgmol^{-1}$

Mass of benzene, $W_1 = 75g$

Depression in freezing point, $\Delta T_f = 0.48K$

Molar mass of compound, $M_2 = 256gmol^{-1}$

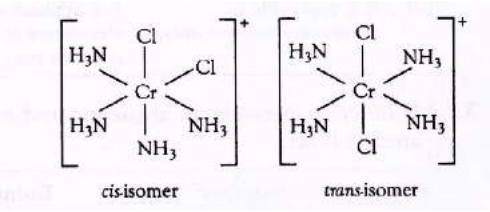
If W2 is the mass of compound,
Then,

$$\Delta T_f = \frac{K_f \times W_2 \times 1000}{W_1 \times M_2}$$

$$\Rightarrow 0.48 = \frac{5.12 \times W_2 \times 1000}{75 \times 256}$$

$$\Rightarrow W_2 = \frac{0.48 \times 75 \times 256}{5.12 \times 1000} = 1.8g$$

(ii) IUPAC name of complex, $[Cr(NH_3)_4Cl_2]^+$ is tetraamminedichloroidochromium (III) ion. It shows geometrical isomerism as follows:

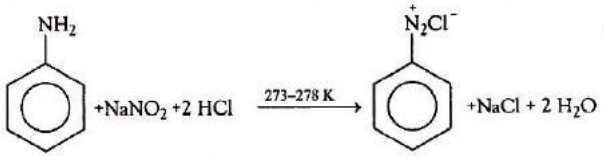


(iii) Energy required to convert metallic crystal into individual atom is known as enthalpy of atomization. The transition metals have high enthalpy of atomization. It can be explained on the basis of strong inter atomic interaction due to unpaired electrons. Greater the number of unpaired electrons, stronger is the resultant bonding. In 3d series Zn ha the least enthalpy of atomization because it has stable ground state configuration due to its completely filled d – orbital. Thus, zinc has least tendency to form metallic bonds in the series.

(iv) Carbylamine Reaction: Aliphatic or aromatic amines on heating with chlorofoam and alcoholic KOH forms isocyanides or carbylamines which are foul smelling substances.

$$\underset{\text{Amine}}{R-NH_2}+\underset{\text{Chloroform}}{CHCl_2}+3KOH \xrightarrow{\Delta} \underset{\text{Alkyl or aryl isocyanide}}{R-NC}+3KCL+3H_2O$$

Diazotisation Reaction: Diazonium salts can be prepared by diazotization. In this reaction, ice-cold solution of $HNO_3(NaNO_2+HCl+NaNO_2+H_2SO_4)$ is added to ice-cold solution of primary aromatic amine dissolved in acid to form diazonium salt.



Question 2: Account for the following: **[2]**

Identify the reaction order from each of the following rate constant:

(i) k= $2.3\times10^{-5}Lmol^{-1}s^{-1}$

(ii) k= $3\times10^{-4}s^{-1}$

OR

Write two differences between 'order of reaction' and 'molecularity of reaction'.

Solution 2:

(i) Unit of rate constant for second order reaction is $Lmol^{-1}sec^{-1}$.

(ii) Unit of rate constant for first order reaction is sec^{-1}.

OR

Differences between molecularity and order of a reaction are as follows:

Molecularity	Order
(i) The number of reacting species which must collide simultaneously in order to carry out a chemical reaction is called molecularity of a reaction.	The sum of powers of the concentration of the reactants in the rate law expression is called the order of that chemical reaction.
(2) It is a theoretical concept.	It is determined experimentally.
(3) It is always a whole number value.	It may be zero, whole number or fractional values, even negative.
(4) It is applicable to elementary reaction only.	It is applicable to elementary as well as complex reactions.

Question 3: **[2]**

(i) Differentiate between an antiseptic and a disinfectant.

(ii) Name a biodegradable detergent.

Solution 3:

(i) Differences between an antiseptic and a disinfectant are as follows:

Antiseptic	Disinfectant
(i) These are chemicals which prevent either the growth of micro-organisms or kill them but are not harmful to living tissues.	These are the chemicals which kills the micro-organisms and are applied to in animate objects like floors, drainage system, instruments etc.
(ii) They are safe to be applied to living tissues.	They are not safe to be applied to living tissues.

(ii) **Biodegradable detergent :** These are those detergents which can be degraded or decomposed and have straight chains of hydrocarbons in the molecule, e.g. sodium lauryl sulphate, sodium dodecyl benzene sulphate.

Question 4: **[2]**

What will be the major product obtained when 2- bromobutane reacts with alcoholic potassium hydroxide? State the type of reaction involved in it.

Solution 4:

The type of reaction involved in above case is β -elimination.

Question 5: Write the names of the monomers of the following polymers:

(a) Nylon-6

(b) Buna- N **[2]**

Solution 5:

(a) Monomer of nylon-6 is caprolactam.

(b) Monomer of buna-N is 1, 3-butadiene and acrylonitrile.

Question 6: Explain the atmospheric behavior of amino acids. **[2]**

Solution 6: Amino acids contain both an acidic carboxyl group and a basic amino group. In aqueous solution, they neutralize each other involving transfer of a proton from the carboxylic group to the amino group, giving rise to a dipolar ion known as 'Zwitter ion'. It is neutral but contains both positive and negative charges.

In Zwitter ionic form, amino acids shows amphoteric behavior as they can react with both acids and bases.

Question 7: How is phenol converted to benzoic acid? Explain with the help of balanced chemical equations.

OR

Write the mechanism of acid dehydration of ethanol to yield ethene.

Solution 7:

OR

The mechanism of dehydration of ethanol involves the following steps:

Step I: Formation of protonated alcohol:

Step II: Formation of carbocation

It is the slowest step and hence, the rate determining step of the reaction.

Step III: Formation of ethene by the elimination of a proton

The acid used in step I is released in step III. To drive the equilibrium to the right hand side, ethene is removed as it is formed.

Question 8: A substance decomposes by following first order kinetics. If 50% of the compound is decomposed in 120 minutes, how long will it take for 90% of the compound to decompose? **[2]**

Solution 8:

For a first order reaction to complete 50% in 120 min,

Let, $[x]_0 = 100\text{M}, [x]_{120} = 100 - 50 = 50\text{M}$ and $t = 120\,\text{min}$

$$k = \frac{2.303}{t}\log\frac{x_0}{x} = \frac{2.303}{120}\log\frac{100}{50} = 0.019\log 2$$

$$= 5.78\times10^{-3}\,\text{min}^{-1}$$

Time taken to complete 90% reaction =?

$[x]_0 = 100\text{M}, [x]_{90} = 100 - 90 = 10\text{M}$

$k = 5.78\times10^{-3}\,\text{min} - 1$

$$t = \frac{2.303}{k}\log\frac{x_0}{x} = \frac{2.303}{5.78\times10^{-3}}\log\frac{100}{10}$$

$$= 0.3984\times10^{-3}\times\log 10$$

$$= 398.4\,\text{min}$$

Question 9: **[3]**

Calculate the amount of CaCl2 (mole mass = 111 $gmol^{-1}$) which must be added to 500g of water to lower its freezing point by 2K, assuming CaCl2 is completely dissociated. (K_f for water = 1.86 Kkg mol^{-1}).

OR

A solution containing 0.5g of KCl dissolves in 100 g of water and freezes at -0.24°C. Calculate the degree of dissociation of the salt. K_f for water = 1.86 Kkg mol^{-1}).

Solution 9: It is given that K_f for water = 1.86 Kkg mol^{-1}, $\Delta T_f = 2K$

Amount of water taken (W_1) = 500g

Amount of $Cacl_2$ (W_2) = ?

Molar mass of $CaCl_2$ (M_2) is completely dissociated,

$$CaCl_2 \rightarrow Ca^{2+} + 2Cl^-$$

Thus, Number of particles after dissociating = 3

Van't Hoff factor, i = 3

$$\Delta T_f = \frac{i \times K_f \times W_2 \times 1000}{W_1 \times M_2}$$

$$\Rightarrow W_2 = \frac{\Delta T_f \times W_1 \times M_2}{i \times 3K_f \times 1000}$$

$$= \frac{2 \times 500 \times 111}{3 \times 1.86 \times 1000} = 19.89g$$

OR

Given, K_f for water = 1.86°C

Amount of KCL taken (W_2) = 0.5g

Amount of water taken (W_1) = 100g

$$\Delta T_f = 0 - (-0.24) = 0.24^oC$$

Observed molecular mass of

$$KCl(M_2) = \frac{1000 \times K_f \times W_2}{\Delta T_f \times W_1}$$

$$= \frac{1000 \times 1.86 \times 0.5}{0.24 \times 100} = 38.75 g mol^{-1}$$

Normal molecular mass of KCl = 39 +35.5

=74.5 g mol^{-1}

$$\text{Van't Hoff factor} = \frac{\text{Normal molecular mass}}{\text{Observed molecular mas}}$$

$$i = \frac{74.5}{38.75} = 1.92$$

$$KCl \rightleftharpoons K^+ + Cl^{-1}$$

Initial moles	1 mol	0	0
Moles after dissociation	$1-\alpha$	α	α

Total number of moles after dissociation

$$= 1 - \alpha + \alpha + \alpha = 1 + \alpha$$

$$i = 1 + \alpha$$

$$1.92 = 1 + \alpha$$

So, degree of dissociation, $\alpha = 1.92 - 1 = 0.92, \text{i.e.} 92\%$ dissociated.

Question 10: An element with density 10gcm-1 forms a cubic unit cell with edge length of 3×10^{-8}cm . What is the nature of the cubic unit cell if the atomic mass of the element is 81 g mol^{-1}?**[3]**

Solution 10: Given, cell edge length (a) = 3×10^{-8}cm
Density 9d0 = $10gcm^{-3}$
Molar mass (M) = 81 g mol^{-1}
We know that,

$$\text{density, (d)} = \frac{Z.M}{a^3.N_A}$$

Thus,

$$10gcm^{-3} = \frac{Z\times81gmol^{-1}}{(3\times10^{-8}cm)^3\times6.023\times10^{23}}$$

$$z = \frac{10gcm^{-3}\times(3\times10^{-8}cm)^3\times6.023\times10^{23}mol^{-1}}{81gmol^{-1}}$$

$$Z = 2$$

Hence, the nature of cubic unit cell is bcc.

Question 11: **[3]**
Give reasons for the following observations:
(a)Physisorption decrease with an increase in temperature.
(b) Addition of alum purifies water.
(c) Brownian movement stabilizes colloidal solutions.

Solution 11:
(a) Physisorption is an exothermic process.

$$\underset{\text{(Adsorbent)}}{\text{Solid}} + \underset{\text{(Adsorbate)}}{\text{Gas}} \rightleftharpoons \text{Gas adsorbed on solid+heat} \uparrow$$

As temperature increase, the equilibrium shifts towards the backward direction to neutralize the effect of the change. So, physisorption decrease with increase in temperature.

(b) We add alum to purify water as alum coagulates the colloidal impurities present in water. These impurities get settle down and removed by decantation or filtration.

(c) Brownian movement arises due to the unbalanced bombardment of the particles by the molecules of the dispersion medium. This movement has a string effect which does not permit the particles to settle. Thus, responsible for the stability of sols.

Question 12: **[3]**

(a)What type of isomers are $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5\ SO_4]$ Br? Give a chemical test to distinguish between the two isomers.

(b) Write the structures of optical isomers of the complex ion $[Co(en)_2Cl_2]^+$.

Solution 12:

(a) $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5\ SO_4]$ Br show ionization isomerism.

Chemical test to distinguish between two isomers. We dissolve both the compounds in water in different test tubes. To the both test tubes.

Test I:

Add BaCl2 solution, one compound gives white precipitate indicating the presence of SO_4^{2-} ions.

The other compound does not give white precipitate, indicating the absence of SO_4^{2-} ions.

$$[Co(NH_3)_5Br]SO_4 + BaCl(aq) \rightarrow [Co(NH_3)_5Br] + \underset{\text{White ppt.}}{BaSO_4)(s)\downarrow}$$

Test II:

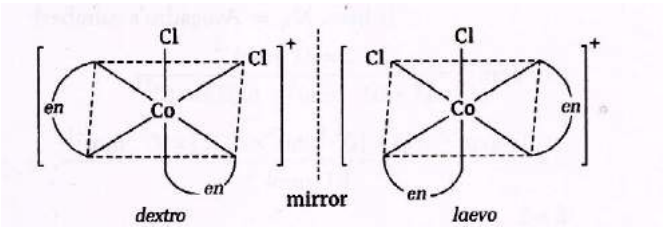
Add $AgNO_3$ solution to both the compounds in separate test tubes.

Only $[Co(NH_3)_5\ SO_4]$ Br compound gives yellow precipitate, not $[Co(NH_3)_5Br]\ SO_4$, due to the absence of Br^- as counter ion.

$$[Co(NH_3)_5SO_4]Br + AgNO_3(aq) \rightarrow [Co(NH_3)_5SO_4]NO_3 + \underset{\text{Yellow ppt.}}{AgBr(s)\downarrow}$$

The above two test prove that the given two compounds are a pair of ionization isomers.

(b) The structure of optical isomers of the complex ion $[Co(en)_2Cl_2]^+$ are shown below:



Question 13: **[3]**

(i) Transition metals exhibit variable oxidation states.

(ii) Zr(Z=40) and Hf (Z = 72) have almost identical radii.

(iii) Transition metals and their compounds act as a catalyst

OR

Complete the following chemical equations:

(i) $K_2Cr_2O_7 + H_2SO_4 + FeSO_4 \rightarrow$

(ii) $K_2Cr_2O_7 + H_2SO_4 + H_2S \rightarrow$

(iii) $KMnO_4 + H_2SO_4 + H_2C_2O_4 \rightarrow$

Solution 13:
(i) Transition metal exhibit variable oxidation states. This is because of the fact that the difference in the energy (n-1) d –electron and ns-electron is low which implies that electrons from both energy levels can take part in bonding.

(ii) In lanthanoid due to poor shielding effect of 4 f- electrons the attraction between the elctrons and the nucleus increases and hence atomic radius decrease. This is called lanthanoid contraction. Because of this reason Zr and Hf have alomost identical radii.

(iii) many transition metals and their compounds are used as catalyst. Their catalytic activity is due to their ability to adopt multiple oxidation states and to form complexes.

OR

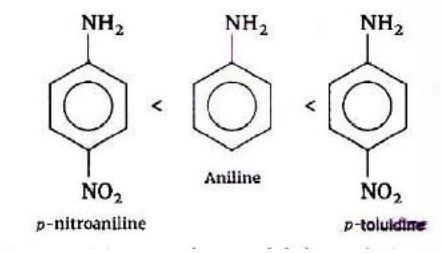
(i) $K_2Cr_2O_7 + 7H_2SO_4 + 6FeSO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 3Fe_2(SO_4)_3 + 7H_2O$

(ii) $K_2Cr_2O_7 + 4H_2SO_4 + 3H_2S \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3S$

(iii) $2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$

Question 14: **[3]**
Arrange the following as directed:
(a) Increasing order of basic strength: Aniline, p- nitroaniline and p- toluidine.
(b) Decreasing order of basic strength in gas phase: $C_2H_5NH_2, (C_2H_5)_2NH, (C_2H_5)_3N$ and NH_3
(C) Increasing order of solubility in water: $C_6H_5NH_2, (C_2H_5)_2NH, C_2H_5NH_2$

Solution 14: (a) Increasing order of basic strength is as follows:



(b) Decreasing order of basic strength in gas phase is as follows:

$(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2 > NH_3$

(b) Increasing order of solubility in water is as follows:

$C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH$

Question 15: How is silver extracted from its ore? Explain the process with relevant equations.**[3]**

Solution 15: The extraction of silver involves leaching the metal ore, i.e. argentite (Ag_2S) with dilute solution of NaCN or KCN which is an oxidation reaction, i.e. the reaction occur in presence of air. The metal is latter recovered by the displacement method using more electropositive zinc metal.

$$2Ag(s) + 8CN^-(aq) + 2H_2O(aq) + O_2(g) \rightarrow 4[Ag(CN)_2]^-(aq) + 4OH^-(aq) + 2$$

$$2[Ag(CN)_2]^-(aq) + Zn(aq) \rightarrow 2Ag(s)\downarrow + [Zn(CN)_4]^{2-}(aq)$$

Question 16: **[5]**

(i) Resistance of a conductivity cell filled with 0.1mol L^{-1} KCl solution is 100Ω, If the resisitance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520 Ω, calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 mol L^{-1} KCl solution is $1.29\times10^{-2}\Omega^{-1}cm^{-1}$

(ii) Define the following terms:
(a) Limiting molar conductivity.
(b) Fuel cell.

OR

(i) Calcuate emf of the following cell at 298K:

$$Mg(s)\,|\,Mg^{2+}(0.1M)\,||\,Cu^{2+}(0.01M)\,|\,Cu(s)$$

[Given: $E^o_{cell} = +2.71V, 1Farday = 96500Cmol^{-1}$]

(ii) State faraday's first law of electrolysis. Calculate the charge required in terms of Faraday for the reduction of 1 mole of Cu^{2+} to Cu.

Solution 16:

(i) For electrolyte having 0.01 molL^{-1} KCl solution,
Molarity = 0.1molL-1
Resistance = 100Ω
Conductivity = $1.29\times10^{-2}\Omega^{-1}cm^{-1}$
Cell constant (G) = Resistance (R) × conductivity(κ)

$$= 100\Omega\times1.29\times10^{-2}\Omega^{-1}cm^{-1}$$

$$= 1.29cm^{-1}$$

For electrolyte having 0.01 mol L^{-1} KCl solution,
Molarity = 0.02molL^{-1}
Resistance = 520Ω
Conductivity = ?
Conductivity of 0.02molL^{-1} KCl solution,

$$\kappa = \frac{\text{Cell constant}}{\text{Resistance}} = \frac{1.29}{520}\frac{(\text{cm}^{-1})}{(\Omega)}$$

$$= 2.481\times10^{-3}\text{cm}^{-1}\Omega^{-1}$$

Molar conductivity,

$$\Lambda_m = \frac{\kappa\times1000}{\text{Molarity}}$$

$$= \frac{2.481\times10^{-3}\times1000}{0.02}$$

$$= 1.24\Omega^{-1}\text{cm}^2\text{mol}^{-1}$$

(ii) (a) Limiting Molar Conductivity: When the concentration of electrolyte in solution approaches zero, the molar conductivity reaches a limiting value, known as limiting molar conductivity. It is denoted as Λ_m^o.

(b) Fuel Cell: It is a type of galvanic cell, in which reactants are continuously feed to the electrodes, which reacts to produce electricity and product thus formed are continuously removed. They are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol etc. directly into highly efficient electrical energy.

The electrode reactions are given below:

At Cathode:

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

At anode:

$$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$

OR

(i) For the given cell, the half-cell reactions will be given as below

At anode: $Mg \rightarrow Mg^{2+} + 2e^-$

At cathode: $Mg^{2+} + 2e^- \rightarrow Cu$

Therefore, the overall cell reaction will be

$$Mg + Cu^{2+} \rightarrow Mg^{2+} + Cu$$

The Nerst equation is

$$E_{cell} = E^o_{cell} - \frac{0.0591}{n}\log\left[\frac{Mg^{2+}}{Cu^{2+}}\right]$$

In this case, n = 2

Thus,

$$E_{cell} = \left[2.71 - \frac{0.0591}{n} \log \left[\frac{0.1}{0.01} \right] \right]$$

$$= \left[2.71 - 0.0295 \log 10 \right]$$

$$= 2.71 - 0.0295$$

$$\Rightarrow E_{cell} = 2.68V$$

(ii) **Faraday's First law:** It states that the amount of chemical reaction occurring at any electrode by passing current is directly proportional to the quantity of electricity passed through the electrolyte (in solution or in the molten state).

Thus, wg of the substance gets deposited on passing Q coulomb of electricity

$w \alpha Q$ or $w = ZQ$

$w = Z \times it$ as $Q = it$

Where, Q= quantity of electricity, i = current (in A), t= time (in s),

Z = constant of proportionality called electrochemical equivalent.

Charged required for the reduction of 1 mole of

$Cu^{2+} = 2F$

$= 2 \times 96500C$.

$= 193000C$

Question 17: **[5]**

(i) **Account for the following/ Explain why:**

(a) Interhalogens are more reactive than halogens.

(b) N_2 is less reactive at room temperature.

(c) Reducing character increase from NH_3 to BiH_3.

(ii) Draw structures of the following:

(a) $H_4P_2O_7$

(b) XeF_4

OR

(i) **Account for the following/ Explain why:**

(a) PCl_5 exists but NCl_5 does not.

(b) Fluorine is a stronger oxidizing agent than chlorine.

(c) Bond enthalpy of F_2 is less than that of Cl_2.

(ii) Complete and balance the following reactions:

(a) $FeSO_4 + H_2SO_4 + Cl_2 \rightarrow$ _____ + _____

(b) $P_4 + HNO_3 \rightarrow$ _____ + _____ + _____

Solution 17:

(i) (a) Interhalogens are more reactive than halogens except fluorine because 'X-X' bond in interhalogens compounds is weaker than "X-X' bond in halogens (except F-F bond).

(b) N_2 is less reactive at room temperature because of high bond enthalpy of a triple bond ($N \equiv N$). Due to this ($N \equiv N$)bond, nitrogen is inert and unreactive at room temperature.

(c) Reducing character increase from NH_3 to BiH_3. Due to decrease in the thermal stability of hydrides down the group. As a result, tendency to liberate hydrogen increases. Hence, their reducing character increases from NH_3 to BiH_3.

(ii) (a) Structure of $H_4P_2O_7$ is as follows:

(b) Structure of XeF_4 is as follows:

OR

(i) (a) N does not form pentahalides due to the absence of d-orbital in its valence shell, however P from pentahalide due to the presence of d- orbital.

(b) Due to low bond dissociation enthalpy, high electronegativity and large negative electron gain enthalpy, of Fluorine have a strong tendency to accept electrons and thus get reduced as compared to chlorine. That's why it acts as good oxidizing agent.

(c) The bond enthalpy of F_2 is lower than the Cl_2. It is due to the relatively large interelectronic repulsions between the lone pairs in the relatively smaller 2p-orbitals of fluorine atoms in F_2 molecule where they are much closer to each other than in case of Cl_2 due to larger size of Cl-atom.

(ii) (a) $2FeSO_4 + H_2SO_4 + Cl_2 \rightarrow Fe_2(SO_4)_3 + 2HCl$

(b) $P_4 + 20HNO_3 \rightarrow 4H3PO4 + 20NO_2 + 4H_2O$

Question 18: **[5]**

(i) Write the product(s) of the following reactions:

(a) $CH_3COCH_3 + H_2NOH \rightarrow$

(b) $2C_6H_5CHO + \text{conc.NaOH} \rightarrow$

(c) $CH_3COOH \xrightarrow{Cl2/P}$

(ii) Give one chemical test each to distinguish between the following pairs of compounds:

(a) Benzaldehyde and Benzoic acid

(b) Propanal and Propanone

OR

(i) Write the chemical equations to illustrate the following name reactions:

(a) Wolff- Kishner reduction
(b) Aldol condensation
(c) Cannizzaro reaction

(ii) Account for the following:
(a) CH_3CHO is more reactive with HCN than CH_3COCH_3.
(b) Carboxylic acids are stronger acids than phenol.

Solution 18:
(i) (a)
(b)

(ii) (a) Benzaldehyde and benzonic acid $NaHCO_3$ test is used to distinguish between the two molecule benzoic acid being an acid reacts with $NaHCO_3$ solution to produce brisk effervescence due to evolution of CO_2 while benzaldehyde does not give this test.

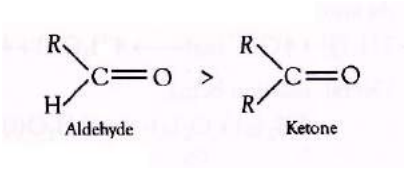
(b) Propanal and propanone: Propanone responds to iodoform test whereas propanal (CH_3CH_2CHO) due to the absence of CH_3CO- group does not.

OR

(i) Aldol Condensation: Aldehydes and ketones containing at least one α - H atom undergo a reaction in the presence of dilute alkali as catalyst to form β - hydroxyl aldehydes (aldol.) or β - hydroxy ketones.
β -hydroxy aldehydes are called aldols while β - hydroxyl ketones are collectively called Ketols and the reaction is called aldol condensation. The name aldol (or ketol) us derived from the names of the two functional groups, aldehyde(or ketone).

(c) Cannizzaro Reaction: Aldehydes which do not have α - H atom undergo self-oxidation and reduction (disproportionation) on treatment with conc. alkali. In this reaction, one molecule of aldehyde is reduced to alcohol while another molecule is oxidized to salt of carboxylic acid.

(ii) (a) CH_3CHO is more reactive with HCN than CH_3COCH_3 because aldehydes are more reactive towards nucleophilic addition reactions than ketones. It can be explained by the following facts:
Inductive Effect:
Since, an alkyl group has electron donating (+I) inductive effect. Hence, grater the number of alkyl groups attached to carbonyl group, greater the electron density on carbonyl carbon. Thus, it lowers the attack of nuleophile and hence, reactivity decreases. Hence,



Steric effect'
As a number of alkyl group attached to carbonyl carbon increase, the attack of nuleophile on carbonyl group becomes more and more difficult due to steric hindrance. Therefore, due to the presence of two bulky (or R) groups, the attack of nucleophile is hindered and hence, ketones are less reactive than aldehydes.

(b) Phenoxide ion has non- equivalent resonance structures in which the negative charfe is less effectively delocalized over less elelctronegative carbon atom and one oxygen atom.
While in carboxylate ion, the negative charge is delocalized over two electronegative oxygen atoms. Thus, carboxylate ion is much more resonance stablised than phenoxide ion. Since, more stable the conjugate base of an acid, stronger is the acid.