

# C.B.S.E. CLASS – XII BOARD - 2014

## CHEMISTRY

### SET- 1

Time allowed 3 hours

Maximum Marks: 70

#### General Instructions:

- (i) All questions are compulsory.
- (ii) Marks for each question are indicated against it.
- (iii) Question numbers **1** to **8** are very short-answer questions, carrying **1** mark each. Answer these in one word or about one sentence each.
- (iv) Question numbers **9** to **18** are short-answer questions, carrying **2** marks each. Answer these in about **30** words each.
- (v) Question numbers **19** to **27** are short-answer questions, carrying **3** marks each. Answer these in about **40** words each.
- (vi) Question numbers **28** to **30** are long-answer questions, carrying **5** mark each. Answer these about **70** words each.
- (vii) Use Log Tables, if necessary. Use of calculators is **not** allowed.

1. Give one example each of 'oil in water' and 'water in oil' emulsion. [1]

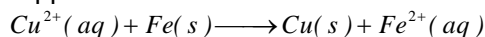
Sol. Type of emulsions and their examples

- (a) Oil in water – Milk  
(b) Water in oil – Butter

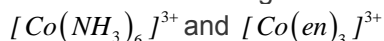
2. Which reducing agent is employed to get copper from the leached low-grade copper ore? [1]

Sol. Leaching of copper from low-grade copper ore:

Scrap iron is used as reducing agent to obtain copper metal from the solution containing copper.



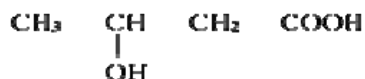
3. Which of the following is a more stable complex and why? [1]



Sol. Comparison of stability in  $[\text{Co}(\text{NH}_3)_6]^{3+}$  and  $[\text{Co}(\text{en})_3]^{3+}$

$\text{NH}_3$  is unidentate ligand and  $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$  ( $\text{en}$ ) is a bidentate ligand. Chelating ligands form more stable complexes compared to non-chelating ligands. Thus  $[\text{Co}(\text{en})_3]^{3+}$  is more stable.

4. Write the IUPAC name of the compound. [1]



Sol. IUPAC name: 3-Hydroxybutanoic acid (or, 3-Hydroxybutan-1-oic acid)

5. Which of the following isomers is more volatile:  $o$ -nitrophenol or  $p$ -nitrophenol? [1]

Sol. Volatility of  $o$ -nitrophenol and  $p$ -nitrophenol:

$o$ -nitrophenol is more volatile owing to the presence of intramolecular H-bonding. Intermolecular H-bonding in  $p$ -nitrophenol increases its boiling point.

6. What are isotonic solutions? [1]

Sol. Isotonic solutions:

Two or more solutions having same osmotic pressure are called isotonic solutions. For example, 0.5 M NaCl, 0.5 M KCl and 1 M glucose solutions are isotonic.

7. Arrange the following compounds in increasing order of solubility in water: [1]  
 $\text{C}_6\text{H}_5\text{NH}_2$ ,  $(\text{C}_2\text{H}_5)_2\text{NH}$ ,  $\text{C}_2\text{H}_5\text{NH}_2$

Sol. Solubility of amines is based on the tendency to form H-bonding which is more in  $1^\circ$  amine than in  $2^\circ$  and  $3^\circ$  amines, and aniline is aromatic, further low solubility.  
∴ Increasing order of solubility  $\text{C}_6\text{H}_5\text{NH}_2 < (\text{C}_2\text{H}_5)_2\text{NH} < \text{C}_2\text{H}_5\text{NH}_2$

8. Which of the two components of starch is water soluble? [1]

Sol. Water soluble component of starch

Amylose is the water soluble content of starch between Amylose and Amylopectin.

9. An element with density  $11.2 \text{ g cm}^{-3}$  forms a f.c.c. lattice with edge length of  $4 \times 10^{-8} \text{ cm}$ . Calculate the atomic mass of the element. [2]  
(Given:  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ )

Sol. To compute atomic mass of the element

Given,

$$d = 11.2 \text{ g cm}^{-3} \quad N_a = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$a = 4 \times 10^{-8} \text{ cm} \quad \text{For fcc, number of atoms present per unit cell (Z)} = 4$$

$$\text{Formula, } d = \frac{Z \times M}{N_A \times a^3}$$

$$11.2 \text{ g cm}^{-3} = \frac{4 \times M}{6.022 \times 10^{23} \text{ mol}^{-1} \times (4 \times 10^{-8} \text{ cm})^3}$$

$$\therefore M = \frac{11.2 \times 6.022 \times 10^{23} \times 64 \times 10^{-24}}{4} \text{ g mol}^{-1}$$

$$= 107.91 \text{ g mol}^{-1}$$

$\therefore$  Atomic mass of the element is  $107.91 \text{ g mol}^{-1}$ .

10. Examine the given defective crystal:

[2]



Answer the following questions :

(i) What type of stoichiometric defect is shown by the crystal?

(ii) How is the density of the crystal affected by this defect?

(iii) What type of ionic substances show such defect?

Sol. (i) Type of stoichiometric defect

As equal number of cations and anions are missing, the type of defect is – Schottky

(ii) Effect on density – Density decreases as ions are missing from crystal lattice.

(iii) Type of ionic substances showing Schottky defect – ionic substance in which the size of cation and anion are comparable, i.e., almost similar sizes. For example, *KCl*

11. Calculate the mass of a compound (molar mass =  $256 \text{ g mol}^{-1}$ ) to be dissolved in  $75 \text{ g}$  of benzene to lower its freezing point by  $0.48 \text{ K}$  ( $K_f = 5.12 \text{ K kg mol}^{-1}$ ). [2]

Sol. To calculate the mass of solute ( $W_A$ ) using colligative property lowering of freezing point

$$\text{Given, } M_A = 256 \text{ g mol}^{-1} \quad W_B = 75 \text{ g} \quad K_f = 5.12 \text{ K kg mol}^{-1}$$

$$\Delta T_f = 0.48 \text{ K}$$

$$\Delta T_f = m \cdot K_f \quad \left( m = \frac{n_A}{W_B (\text{in Kg})} = \frac{W_A}{M_A \times W_B (\text{in Kg})} \right)$$

$$= \frac{W_A}{M_A \times W_B (\text{in Kg})} \times K_f$$

$$W_A = \frac{\Delta T_f \times M_A \times W_B (\text{in Kg})}{K_f} = \frac{(0.48 \text{ K})(256 \text{ g mol}^{-1})(0.075 \text{ kg})}{(5.12 \text{ K kg mol}^{-1})} = 1.8 \text{ g}$$

12. Define an ideal solution and write one of its characteristics. [2]

Sol. Ideal solution:

The solution which obey Raoult's law at all concentrations and temperatures is called ideal solution. Interaction between A-A, B-B and A-B are same. For example, solution of  $C_2H_5Br$  and  $C_2H_5I$  behaves as ideal solutions.

For ideal solutions,

$$P = P_A + P_B$$

$$P_A = P_A^0 X_A$$

$$P_B = P_B^0 X_B$$

$$\therefore P = P_A^0 X_A + P_B^0 X_B$$

Where P=Total pressure

$P_A, P_B, P_A^0, P_B^0$  and  $X_A, X_B$  are partial pressure, pressure of pure component and mole fraction of component A and B respectively.

Characteristics: In ideal solution  $\Delta H_{mix} = 0$  and  $\Delta V_{mix} = 0$

13. Write two differences between 'order of reaction' and 'molecularity of reaction'. [2]

Sol. Two differences in Molecularity and order of reaction

S.No.	<u>Molecularity</u>	<u>Order of reaction</u>
1.	It is theoretical concept. It is the number of reacting species taking part in an elementary reaction.	It is determined experimentally. It is equal to the sum of all the exponent of all the reactants present in the rate law expression.
2.	It cannot be zero or fractional.	It may be equal to zero or can have fractional value

14. Outline the principles behind the refining of metals by the following methods: [2]  
(i) Zone refining method  
(ii) Chromatographic method

Sol. Principles behind the techniques used in metallurgy

(i) Zone refining method

This method is employed when impurities are more soluble in the melt than in solid form of the metal. The method is used to obtain very pure forms of germanium (Ge), silicon (Si), gallium (Ga), etc.

(ii) Chromatographic method – These methods are used when the impurities are not very different in chemical properties from the element to be purified. The components of the mixture show different mobility on the stationary phase, i.e., the components are adsorbed differently on the adsorbent. Various chromatographic methods based on different mobile and stationary phases are Gas chromatography, Liquid chromatography, Paper chromatography etc.

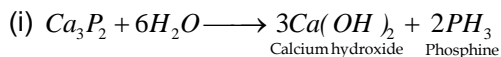
15. Complete the following chemical equations : [2]  
(i)  $Ca_3P_2 + H_2O \rightarrow$   
(ii)  $Cu + H_2SO_4(\text{conc.}) \rightarrow$

OR

Arrange the following in the order of the property indicated against each set :

- (i) HF, HCl, HBr, HI – increasing bond-dissociation enthalpy.  
(ii)  $H_2O, H_2S, H_2Se, H_2Te$  – increasing acidic character.

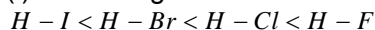
Sol. Completion of Chemical Equations



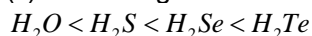
OR

Arranging as per the indicated property

(i) Increasing order of bond dissociation energy



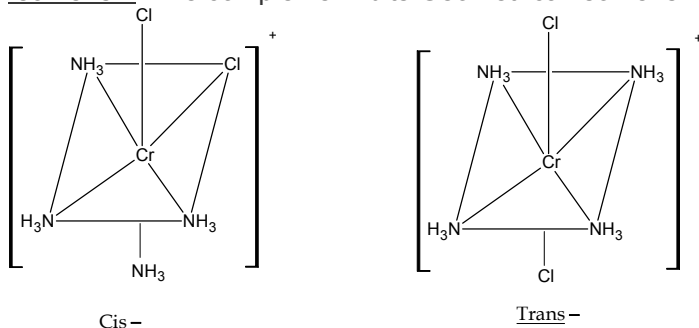
(ii) Increasing acidic character



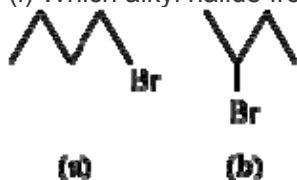
16. Write the IUPAC name of the complex  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$ . What type of isomerism does it exhibit? [2]

Sol. IUPAC name of the  $[\text{Cr}(\text{NH}_3)_4\text{Cl}_2]^+$  - Tetraamminedichloridochromium (III) ion

Isomerism: The complex exhibits Geometrical Isomerism



17. (i) Which alkyl halide from the following pair is chiral and undergoes faster  $\text{S}_{\text{N}}2$  reaction? [2]



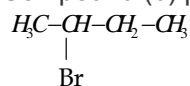
(ii) Out of  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$ , which reaction occurs with

(a) Inversion of configuration

(b) Racemisation

Sol. (i) Chiral centre and faster  $\text{S}_{\text{N}}2$  reaction

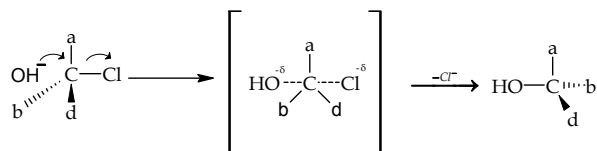
Compound (b) possesses chiral centre.



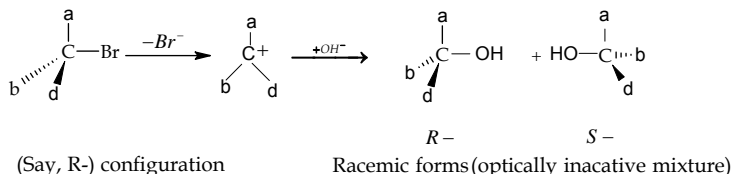
And compound (a) undergoes faster  $\text{S}_{\text{N}}2$  reaction as  $\text{S}_{\text{N}}2$  mechanism is more favourable in  $1^\circ$  alkyl halides.

(ii) Impact of  $\text{S}_{\text{N}}1$  and  $\text{S}_{\text{N}}2$

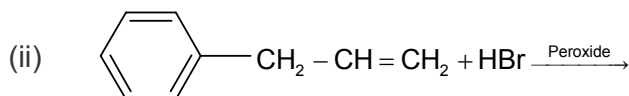
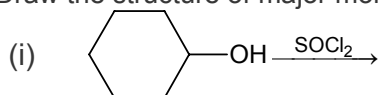
(a) Inversion of configuration results in  $\text{S}_{\text{N}}2$  as there is formation of intermediate transition state in which there is simultaneous attack and migration of leaving group.



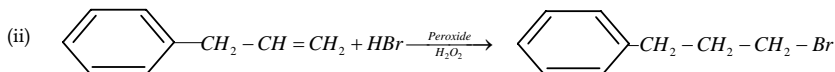
(b) Racemisation in  $S_N1$  reaction is due to attack of nucleophile on both sides of the planar carbocation.



18. Draw the structure of major monohalo product in each of the following reactions: [2]



Sol. Major monohalo product



As per anti-Markonikov rule

19. (a) In reference to Freundlich adsorption isotherm, write the expression for adsorption of gases on solids in the form of an equation.  
 (b) Write an important characteristic of lyophilic sols.  
 (c) Based on the type of particles of dispersed phase, give one example each of associated colloid and multimolecular colloid. [3]

Sol. (a) Expression in Freundlich adsorption isotherm

$$\frac{x}{m} = kp^{1/n} \text{ (where } n > 1 \text{)}$$

Where  $x$  = mass of the adsorbate (gas adsorbed)

$m$  = mass of the adsorbent (solid)

$p$  = pressure of the gas

$n$  and  $k$  are constants depend on the nature of the adsorbate and adsorbent

(b) Characteristics of lyophilic sols

Reversible in nature. If dispersed phase is separated from dispersion medium, remixing reconstitutes sol

(c) Examples

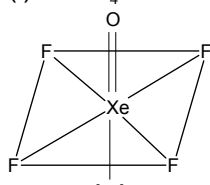
Associated colloid- soap/detergent solution (micelle formation)

Multimolecular colloid – Gold sol/sulphur sol

20. (a) Draw the structures of the following molecules: [3]  
 (i)  $\text{XeOF}_4$   
 (ii)  $\text{H}_2\text{SO}_4$   
 (b) Write the structural difference between white phosphorus and red phosphorus.

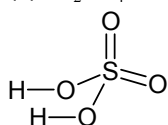
Sol. (a) Structures

(i)  $\text{XeOF}_4$



Square Pyramidal

(ii)  $\text{H}_2\text{SO}_4$

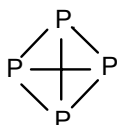


Tetrahedral

(b) Structural difference between white and red phosphorous

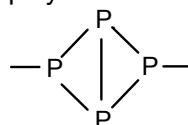
White phosphorus

$\text{P}_4$  molecules are held by weak vander Waal's forces.



Red phosphorus

$\text{P}_4$  molecules are held by covalent bonds in polymeric structure.



21. Account for the following: [3]  
 (i)  $\text{PCl}_5$  is more covalent than  $\text{PCl}_3$ .  
 (ii) Iron on reaction with HCl forms  $\text{FeCl}_2$  and not  $\text{FeCl}_3$ .  
 (iii) The two O-O bond lengths in the ozone molecule are equal.

Sol. (i) More covalent character in  $\text{PCl}_5$  than  $\text{PCl}_3$

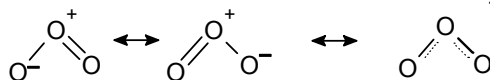
As per Fajan's rule, higher the oxidation state of the central atom, more is its polarising power, hence more is the covalent character of the bond formed. Oxidation state of P in  $\text{PCl}_5$  is +5 and +3 in  $\text{PCl}_3$ . Thus,  $\text{PCl}_5$  is more covalent in nature than  $\text{PCl}_3$ .

(ii)  $\text{FeCl}_2$  is produced, not  $\text{FeCl}_3$  in reaction of iron with HCl (sacrificial oxidation)

Hydrogen gas produced reacts with the available oxygen thus  $\text{Fe}^{2+}$  does not get the chance to oxidize to  $\text{Fe}^{3+}$ .

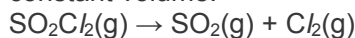
(iii) O-O bond lengths are equal in ozone

Ozone molecule is resonance hybrid of the molecule in which there is single bond with one terminal oxygen and double bond with other terminal oxygen of the central oxygen atom.



So neither single nor double bond is pure. Thus both O-O lengths are equal.

22. The following data were obtained during the first-order thermal decomposition of  $\text{SO}_2\text{Cl}_2$  at a constant volume: [3]



Experiment	Time/s <sup>-1</sup>	Total pressure/atm
1	0	0.4
2	100	0.7

Calculate the rate constant.

(Given:  $\log 4 = 0.6021$ ,  $\log 2 = 0.3010$ )

- Sol. Calculation of  $k$  for first order reaction:

$$k = \frac{2.303}{t} \log \frac{P_0}{2P_0 - P_t}$$

$$t = 100 \text{ s}$$

$$P_0 = 0.4 \text{ atm}$$

$$P_t = 0.7 \text{ atm}$$

$$\therefore k = \frac{2.303}{100} \log \frac{0.4}{2 \times 0.4 - 0.7}$$

$$= \frac{2.303}{100} \log \frac{0.4}{0.1}$$

$$= \frac{2.303}{100} \log 4 = \frac{2.303}{100} \times 0.6020 = 1.38 \times 10^{-2} \text{ s}^{-1}$$

23. (i) Give two examples of macromolecules that are chosen as drug targets. [3]  
 (ii) What are antiseptics? Give an example.  
 (iii) Why is the use of aspartame limited to cold foods and soft drinks?

- Sol. (i) Macromolecules used as drug targets

Proteins, carbohydrates, lipids and nucleic acids are called drug targets as drug interacts with these macromolecules.

- (ii) Antiseptics

These are the chemical substances which prevent the growth of microorganisms and are capable of killing them without harming the human tissues. These are applied on wounds, ulcers, cuts and diseased skin surfaces. For example, savlon, 0.2% solution of phenol.

- (iii) Use of aspartame is limited to cold foods and soft drinks

Aspartame decomposes on heating. Thus as an artificial sweetener, it is limited to foods and soft drinks at low temperatures.

24. (i) Deficiency of which vitamin causes night-blindness? [3]  
 (ii) Name the base that is found in nucleotide of RNA only.  
 (iii) Glucose on reaction with HI gives n-hexane. What does it suggest about the structure of glucose?

- Sol. (i) Cause of night blindness – Deficiency of vitamin A

- (ii) Base found in nucleotide of RNA only – Uracil

- (iii) Reaction of glucose with HI suggests

- (a) Glucose is straight six membered carbon chain  
 (b) Open structure of glucose



25. After the ban on plastic bags, students of a school decided to make people aware of the harmful effects of plastic bags on the environment and Yamuna River. To make the awareness more impactful, they organized a rally by partnering with other schools and distributed paper bags to vegetable vendors, shopkeepers and departmental stores. All the students pledged not to use polythene bags in the future to save the Yamuna River.

After reading the above passage, answer the following questions:

- What values are shown by the students?
- What are bio-degradable polymers? Give one example.
- Is polythene a condensation or an addition polymer?

[3]

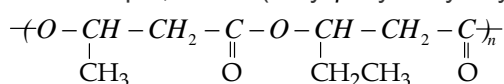
Sol. (i) Values shown by the students

- Awareness about the environment
- How can they contribute towards the cleaner pollution free environment?
- Rally organization with other school students imbibe the quality of cooperation, and they also understand the value of team work.

(ii) Biodegradable polymers

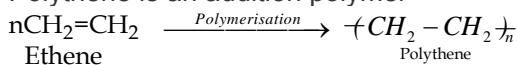
Polymers that are decomposed over a period of time by itself or by the action of microorganisms are called biodegradable polymers. Their use and disposal do not cause environment hazard.

For example, PHBV (Poly  $\beta$ -hydroxybutyrate-co- $\beta$ -hydroxy valerate)



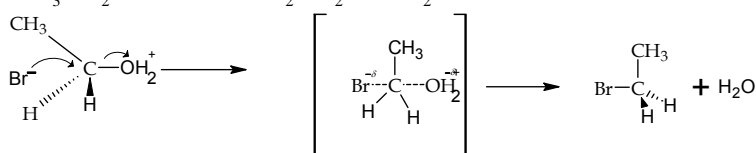
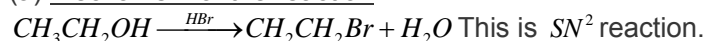
(iii) Polythene

Polythene is an addition polymer

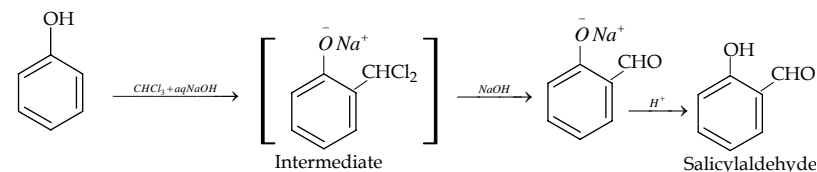


26. (a) Write the mechanism of the following reaction: [3]  
 (b) Write the equation involved in Reimer-Tiemann reaction.

Sol. (a) Mechanism of the reaction



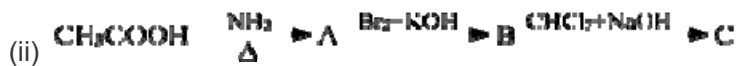
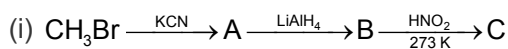
(b) Reimer-Tiemann Reaction



Reaction of phenol with chloroform in the presence of sodium hydroxide introduces  $-\text{CHO}$  group at o-position of benzene ring.

27. Give the structures of A, B and C in the following reactions :

[3]

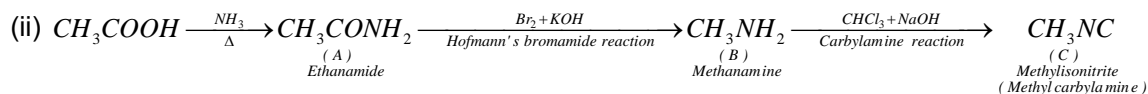
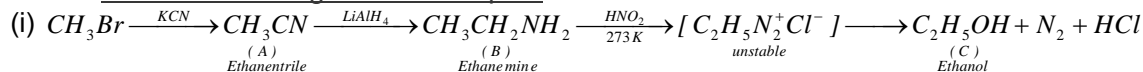


OR

How will you convert the following?

- Nitrobenzene into aniline
  - Ethanoic acid into methanamine
  - Aniline into N-phenylethanamide
- (Write the chemical equations involved.)

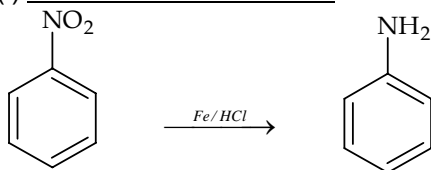
Sol. Structures in the given reaction path



OR

Conversions

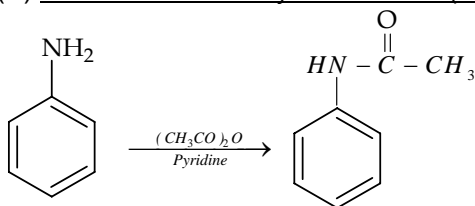
(i) Nitrobenzene into Aniline



(ii) Ethanoic acid into methanamine



(iii) Aniline into N-Phenylethanamide (Acetanilide)



28. (a) Define the following terms :

[5]

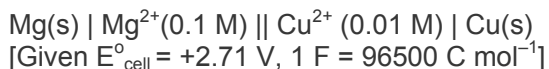
- Limiting molar conductivity
- Fuel cell

(b) Resistance of a conductivity cell filled with  $0.1 \text{ mol L}^{-1}$  KCl solution is  $100 \Omega$ . If the resistance of the same cell when filled with  $0.02 \text{ mol L}^{-1}$  KCl solution is  $520 \Omega$ , calculate the conductivity and molar conductivity of  $0.02 \text{ mol L}^{-1}$  KCl solution. The conductivity of  $0.1 \text{ mol L}^{-1}$  KCl solution is  $1.29 \times 10^{-2} \Omega^{-1} \text{ cm}^{-1}$ .

OR

(a) State Faraday's first law of electrolysis. How much charge in terms of Faraday is required for the reduction of  $1 \text{ mol}$  of  $\text{Cu}^{2+}$  to  $\text{Cu}$ .

(b) Calculate emf of the following cell at  $298 \text{ K}$ :



Sol. (a) (i) Limiting Molar conductivity ( $\wedge_m^\infty$ )

The molar conductivity at infinite dilution, i.e., when  $C \rightarrow 0$  is known as limiting molar conductivity.

$$\lim_{C \rightarrow 0} \wedge_m = \wedge_m^\infty$$

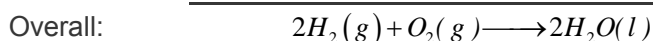
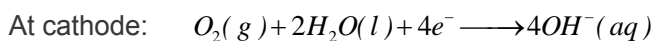
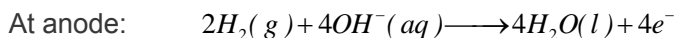
On the plot molar conductivity against  $\sqrt{C}$ , we can obtain  $\wedge_m^\infty$  by extrapolating the graph to  $\sqrt{C} = 0$ .

(ii) Fuel Cell

A fuel cell is a galvanic cell in which one of the reactants is a traditional fuel such as CH<sub>4</sub> or H<sub>2</sub>. Reactants are continuously supplied from an external reservoir.

Hydrogen-oxygen fuel cell is used as a source of electric power in space vehicles. The fuel (gaseous H<sub>2</sub>) and the oxidizing agent (gaseous O<sub>2</sub>) flow into separate cell compartments where

H<sub>2</sub> is oxidized at anode and O<sub>2</sub> is reduced at the cathode.



(b) Calculation of conductivity and molar conductivity

Given  $R_1 = 100\Omega$   $C_1$  (Concentration of KCl solution) = 0.1 mol L<sup>-1</sup>  $K_1 = 1.29 \times 10^{-2} \Omega^{-1} cm^{-1}$

$R_2 = 520\Omega$   $C_2$  (Concentration of KCl solution) = 0.02 mol L<sup>-1</sup>

Cell constant (G) = conductivity  $\times$  resistance

$$= 1.29 \times 10^{-2} \Omega^{-1} cm^{-1} \times 100\Omega = 1.29 cm^{-1}$$

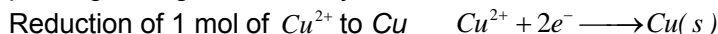
$$\therefore K_2 = \frac{\text{Cell constant}}{\text{Resistance}} = \frac{1.29 cm^{-1}}{520\Omega} = 2.48 \times 10^{-3} \Omega^{-1} cm^{-1}$$

$$\begin{aligned} \text{Molar conductivity} (\wedge_m) &= \frac{K_2 \times 1000}{C_2} \\ &= \frac{2.48 \times 10^{-3} \times 1000 S cm^{-1}}{0.02 mol cm^{-3}} \\ &= 1.24 \times 10^2 \text{ or } 124 S cm^2 mol^{-1} \end{aligned}$$

OR

(a) Faraday's first law of electrolysis

The amount of chemical change produced is proportional to the quantity of electric charge passing through an electrolysis cell.



One mole of electrons carry 1 F charge since 2 moles of e<sup>-</sup>s are required for reduction of 1 mol of Cu<sup>2+</sup>, so charge required = 2F

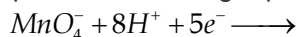
(b) EMF of the cell

$$\begin{aligned}
 E_{\text{cell}} &= E_{\text{cell}}^0 - \frac{0.059}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]} \\
 &= 2.71 - \frac{0.059}{2} \log \frac{0.1}{0.01} \\
 &= 2.71 - 0.0295 \log 10 \\
 &= 2.71 - 0.0295 = 2.6805 \text{ V}
 \end{aligned}$$

29. (a) How do you prepare: [5]
- (i)  $K_2MnO_4$  from  $MnO_2$ ?
- (ii)  $Na_2Cr_2O_7$  from  $Na_2CrO_4$ ?
- (b) Account for the following:
- (i)  $Mn^{2+}$  is more stable than  $Fe^{2+}$  towards oxidation to +3 state.
- (ii) The enthalpy of atomisation is lowest for Zn in 3d series of the transition elements.
- (iii) Actinoid elements show wide range of oxidation states.

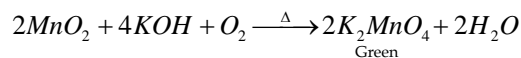
OR

- (i) Name the elements of 3d transition series that show maximum number of oxidation states. Why does this happen?
- (ii) Which transition metal of 3d series has positive  $E^\circ (M^{2+}/M)$  value and why?
- (iii) Out of  $Cr^{3+}$  and  $Mn^{3+}$ , which is a stronger oxidising agent and why?
- (iv) Name a member of the lanthanoid series that is well-known to exhibit +2 oxidation state.
- (v) Complete the following equation



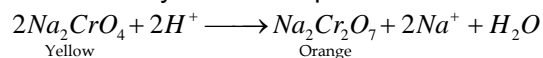
- Sol. (a) (i) Preparation of  $K_2MnO_4$  from  $MnO_2$  (pyrolusite)

The ore is fused with  $KOH$  in the presence of atmospheric oxygen or an oxidizing agent ( $KNO_3$  or  $KClO_3$ ) to give potassium permanganate.

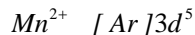


- (ii) Sodium dichromate from sod. chromate

Acidification of yellow solution of  $Na_2CrO_4$  with  $H_2SO_4$  gives orange solution of  $Na_2Cr_2O_7$  from where the crystals are separated out.



- (b) (i)  $Mn^{2+}$  is stable than  $Fe^{2+}$  towards oxidation to +3 state



$Mn^{2+}$  is already in half filled stable  $d^5$  configuration and by losing one electron  $Fe^{2+}$  can attain stable  $d^5$  configuration. Thus  $Mn^{2+}$  shows stability while  $Fe^{2+}$  can be easily oxidized to  $Fe^{3+}$  state.

- (ii) Zinc has lowest enthalpy of atomization in 3d series

Enthalpy of atomization  $\propto$  extent of metallic bonding

Unpaired electrons account for stronger metallic bond. Zn lacks unpaired electrons as it has configuration  $[Ar]3d^{10}4s^2$  thus metallic bonding is the weakest. So, Zn has the lowest enthalpy of atomization.

- (iii) Wide range of oxidation states in actinoids

The energy of 5f, 6d and 7s are comparable in actinoids which is the main reason for finding wide range of oxidation states in actinoids.

OR

(i) Max number of oxidation states in 3d transition series

Manganese shows maximum number of oxidation states in 3d transition series as its electronic configuration is  $[Ar]3d^5 4s^2$ . All the five d-orbital electrons are unpaired. Thus Mn shows oxidation states from +2 to +7.

(ii) Positive  $E^0_{(M^{2+}/M)}$  value in 3d series

Cu has positive  $E^0_{(Cu^{2+}/Cu)}$  value (+0.34 V),  $E^0_{(M^{2+}/M)}$  of any metal depends on

- Enthalpy of atomization ( $\Delta_a H$ )
- Enthalpy of ionization ( $\Delta_i H$ ) and
- Enthalpy of hydration ( $\Delta_{hyd} H$ )

Copper has high value of  $\Delta_a H$  and low value of  $\Delta_{hyd} H$ .

Ans.  $\Delta_i H$  required is not compensated by the energy released. Therefore,  $E^0_{(Cu^{2+}/Cu)}$  is positive.

(iii) Stronger oxidizing agent -  $Cr^{3+}$  or  $Mn^{3+}$

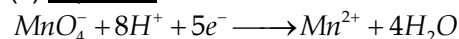
$E^0_{(Cr^{3+}/Cr^{2+})} = -0.4V$  and  $E^0_{(Mn^{3+}/Mn^{2+})} = +1.5V$

$E^0$  negative shows the stability of  $Cr^{3+}$  state and high positive value of  $E^0$  in case of manganese shows that  $Mn^{3+}$  is easily converted to  $Mn^{2+}$ . Thus  $Mn^{3+}$  is stronger oxidizing agent than  $Cr^{3+}$ .

(iv) Examples of element in lanthanoid series with +2 oxidation state

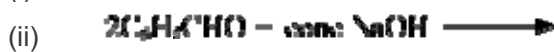
Europium shows +2 oxidation state owing to half filled configuration  $Eu^{2+}(f^7)$ .

(v) Equation



30. (a) Write the products of the following reactions:

[5]



(b) Give simple chemical tests to distinguish between the following pairs of compounds:

- Benzaldehyde and Benzoic acid
- Propanal and Propanone

OR

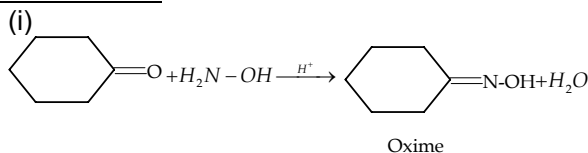
(a) Account for the following:

- $CH_3CHO$  is more reactive than  $CH_3COCH_3$  towards reaction with HCN.
- Carboxylic acid is a stronger acid than phenol.

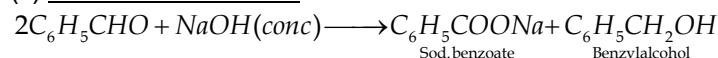
(b) Write the chemical equations to illustrate the following name reactions:

- Wolff-Kishner reduction
- Aldol condensation
- Cannizzaro reaction

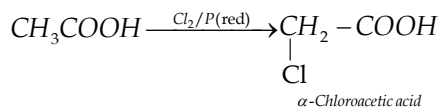
Sol. (a) Oxime formation



(ii) Cannizzaro's reaction



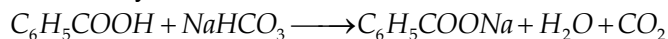
(iii) HVZ reaction



(b) Chemical test to distinguish compounds

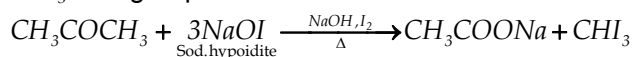
(i) Benzaldehyde and Benzoic acid

Benzoic acid reacts with  $\text{NaHCO}_3$  to produce effervescences of carbon dioxide where as benzaldehyde does not.



(ii) Propanal and Propanone

Iodoform test is used to distinguish these compounds. Propanone responds to test as it has  $\text{CH}_3\text{CO}$  - group.

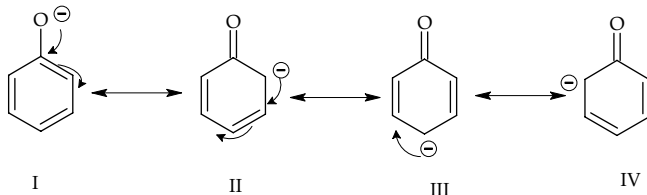
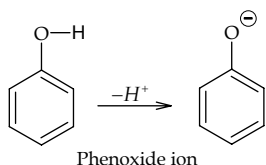
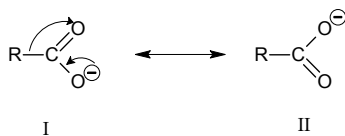
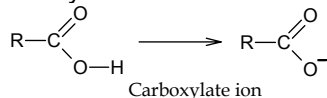


OR

(a) (i) Reactivity towards HCN of acetaldehyde and acetone

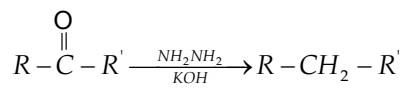
The reactivity of the compound depends on the steric hindrance due to the groups present around the carbonyl group. More the steric hindrance, less will be the reactivity of the compound. The carbonyl carbon is more electrophilic in  $\text{CH}_3\text{CHO}$  than in  $\text{CH}_3\text{COCH}_3$ .  
∴ Reactivity of  $\text{CH}_3\text{CHO} >$  reactivity of  $\text{CH}_3\text{COCH}_3$ .

(ii) Carboxylic acid is a stronger acid than phenol because its conjugate base i.e., carboxylate ion is more stable than the conjugate base of phenol i.e., phenoxide ion.



The reason for greater stability of carboxylate ion is that it involves equivalent resonance in which negative charge is present on oxygen atom all the time. In phenoxide ion, in three structures out of total four resonating structures, negative charge is present on carbon which makes it less stable.

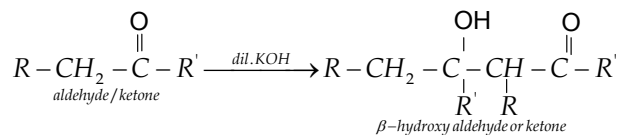
(b) (i) Wolff – Kishner reduction



$R = \text{any alkyl group}$

$R' = -\text{H or any alkyl group}$

(ii) Aldol condensation



(iii) Cannizzaro reaction

