U-LIKE

SAMPLE QUESTION PAPER 1

CHEMISTRY (*Theory*)

(*With Solutions*)

CLASS XII

(Delhi 2012 Question Paper Modified According to the Latest CBSE Sample Question Paper)

Time Allowed : 3 Hours | *Max. 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 and carry* 1 *mark each.*
(*iv*) *Question numbers* 9 *to* 18 *are short-answer questions and carry* 2 *marks each.*
(*v*) *Question numbers* 19 *to* 27 *are also short-answer questions and carry* 3 *marks each.*
(*vi*) *Question numbers* 28 *to* 30 *are long-answer questions and carry* 5 *marks each.*
(*vii*) *Use log tables, if necessary. Use of calculators is not allowed.*

Q.1. What is meant by 'doping' in a semiconductor ? 1

Ans. The addition of appropriate amount of a suitable impurity to increase the conductivity of a semiconductor.

Q.2. What is the role of graphite in the electrometallurgy of aluminium ? 1

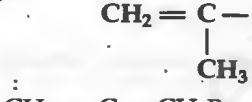
Ans. In the metallurgy of aluminium, graphite is used as anode. Al_2O_3 is reduced to Al and oxygen liberated at anode reacts with carbon of anode producing CO_2.

$$2Al_2O_3 + 3C \longrightarrow 4Al + 3CO_2$$

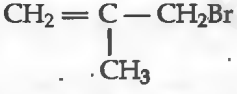
Q.3. Which one of PCl_4^+ and PCl_4^- is not likely to exist and why ? 1

Ans. PCl_5 is ionic in nature in solid state because it exists as $[PCl_4]^+$ $[PCl_6]^-$. Therefore PCl_4^- is not likely to exist.

Q.4. Give the IUPAC name of the following compound : 1



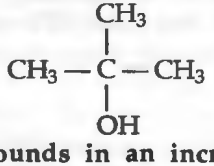
Ans.



3-Bromo-2-methyl-prop-1-ene

Q.5. Draw the structural formula of 2-methylpropan-2-ol molecule. 1

Ans. Structural formula of 2-methylpropan-2-ol is



Q.6. Arrange the following compounds in an increasing order of their reactivity in nucleophilic addition reactions : ethanal, propanal, propanone, butanone. 1

Ans. butanone < propanone < propanal < ethanal.

Q.7. Arrange the following in the decreasing order of their basic strength in aqueous solutions : 1

CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$ and NH_3

Ans. Decreasing order of the basic strength is as

$$(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$$

Q.8. Define the term, 'homopolymerisation' giving an example. 1

Ans. The polymers formed from addition of one type of monomers are called homopolymers and this phenomenon is called homopolymerisation.

$$\underset{\text{Ethene}}{nCH_2 = CH_2} \xrightarrow{\text{Polymerisation}} \underset{\substack{\text{Polythene} \\ \text{Homopolymer}}}{(CH_2 - CH_2)_n}$$

Q.9. A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18 °C. Determine the van't Hoff factor for trichloroacetic acid (K_b for water = 0.512 K kg mol^{-1}). 2

Ans. Apply the relation

$$\Delta T_b = K_f \times m$$
$$\Delta T_b = 0.512 \times 1$$
$$= 0.512$$

$$\text{van't Hoff factor } (i) = \frac{\text{Observed elevation in boiling point}}{\text{Calculated elevation in boiling point}} = \frac{0.18}{0.512} = 0.3516$$

Or

Define the following terms :

(*i*) Mole fraction

(*ii*) Isotonic solutions

(*iii*) van't Hoff factor

(*iv*) Ideal solution.

Ans. *(i)* **Mole fraction** – It is the fraction of number of moles of a component to the total number of moles of all the components. If n_1 and n_2 is the number of moles of components 1 and 2, then

$$\text{Mole fraction of component 1, } x_1 = \frac{n_1}{n_1 + n_2}$$

$$\text{Mole fraction of component 2, } x_2 = \frac{n_2}{n_1 + n_2}$$

(ii) **Isotonic solutions** – Those solutions which have the same osmotic pressure and have equal molar concentration, are called isotonic solutions.

(iii) **van't Hoff factor** – It is the ratio of experimental value of the colligative property to the calculated value of calculated property.

(iv) **Ideal solution** – Those solutions which obey Raoult's law at all temperature and concentration are called ideal solutions.

Intermolecular attraction between the solute and solvent molecules are of the same magnitude as between solute-solute and solvent-solvent molecules.

Q.10. What do you understand by the 'order of a reaction' ? Identify the reaction order from each of the following units of reaction rate constant :

(*i*) L^{-1} mol s^{-1}

(*ii*) L mol^{-1} s^{-1} 2

Ans. Order of the reaction – Order of a reaction is the sum of the powers to which concentration terms should be raised to express the observed rate of reaction.

If the rate law for a reaction is

$$\text{Rate} = k[A]^p[B]^q[C]^r$$

Then order of the reaction = $p + q + r$

Unit of the reaction rate = $(\text{mol } L^{-1})^{1-n}\ s^{-1}$

(i) L^{-1} mol s^{-1}. Here $n = 0$. Therefore it is a zero order reaction.

(ii) L mol^{-1} s^{-1}. Here $n = 2$. Therefore it is a second order reaction.

Q.11. Name the two groups into which phenomenon of catalysis can be divided. Give an example of each group with the chemical equation involved. 2

Ans. Catalysis is of two types :

(*i*) **Homogeneous catalysis** – A catalytic reaction in which the reacting substance and the catalyst are in the same phase is called homogeneous catalysis. For example :

$$CH_3COOCH_3\ (l) + H_2O\ (l) \xrightarrow{HCl\ (l)} CH_3COOH\ (aq) + CH_3OH\ (aq)$$

(*ii*) **Heterogeneous catalysis** – A catalytic reaction in which the reacting substance and the catalyst are in different phases is called heterogeneous catalysis. These catalysts are usually solids. This type of catalysis is also called surface catalysis. For example :

$$2SO_2\ (g) + O_2\ (g) \xrightarrow{V_2O_5\ (s)} 2SO_3\ (g)$$

Q.12. What is meant by coagulation of a colloidal solution ? Describe briefly any three methods by which coagulation of lyophobic sols can be carried out. 2

Ans. The process of setting of colloidal particles is called coagulation or precipitation of the sol.

It can be achieved by the following methods :

(*i*) **By mixing two oppositely charged sols.** Oppositely charged sols when mixed in almost equal proportions, neutralise their charges and get partially or completely precipitated. Mixing of hydrated ferric oxide (+ve sol) and arsenious sulphide (–ve sol) bring them in precipitated form.

(*ii*) **By boiling.** When a sol is boiled, the adsorbed layer is disturbed due to increased collisions with the molecules of dispersion medium. This reduces the charge on colloidal particles which settle down as precipitate.

(*iii*) **By persistent dialysis.** On prolonged dialysis traces of the electrolytes are removed almost completely and the colloids coagulate.

Q.13. Describe the principle involved in each of the following processes :

(*i*) **Mond process for refining of Nickel.**

(*ii*) **Column chromatography for purification of rare elements.** 2

Ans. (*i*) **Mond's process** – This method is based on the fact that certain metals are converted to their volatile compounds while the impurities are not affected during compound formation. The compound formed gives the pure metal on heating. Nickel is refined as under :

$$Ni + 4CO \xrightarrow{330\text{–}350\ K} \underset{\text{Volatile}}{Ni(CO)_4} \xrightarrow{450\text{–}470\ K} \underset{\text{Pure}}{Ni} + 4CO$$

(*ii*) **Column chromatography** – This method is based on the principle that different components of a mixture are differently adsorbed on an adsorbent. The mixture is put in a liquid or gaseous medium which is moved through the adsorbent at different levels on the column. Later the adsorbed components are removed (eluted) by using suitable solvents (eluents).

Q.14. Explain the following giving an appropriate reason in each case :

(*i*) **O_2 and F_2 both stabilise higher oxidation states of metals but O_2 exceeds F_2 in doing so.**

(*ii*) **Structures of Xenon fluorides cannot be explained by Valence Bond approach.** 2

Ans. (*i*) O_2 and F_2 both stabilise higher oxidation states of metals but O_2 exceeds F_2 in doing so due to ability of oxygen to form multiple bonds to metals.

(*ii*) According to valence bond approach, covalent bonds are formed by the overlapping of half-filled atomic orbitals. But xenon has fully filled electronic configuration. Hence the structure of xenon fluorides cannot be explained by VBT.

Q.15. Complete the following chemical equations :

(*i*) $Cr_2O_7^{2-} + H^+ + I^- \longrightarrow$

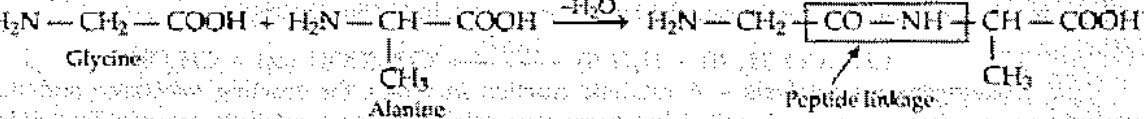
(*ii*) $MnO_4^- + NO_2^- + H^+ \longrightarrow$ 2

Ans. (*i*) $Cr_2O_7^{2-} + 14H^+ + 6I^- \longrightarrow 2Cr^{3+} + 3I_2 + 7H_2O$

(*ii*) $2MnO_4^- + 5NO_2^- + 6H^+ \longrightarrow 2Mn^{2+} + 5NO_3^- + 3H_2O$

Q.16. What is meant by (*i*) peptide linkage (*ii*) biocatalysts ? 2

Ans. (*i*) **Peptide linkage** – Peptide linkage is an amide formed between – COOH group and – NH_2 group. For example, when carboxyl group of glycine combines, with alanine, we get a dipeptide, glycylalanine.



(*ii*) **Biocatalysts** – Biocatalysts or enzymes are complex nitrogenous organic compounds. They catalyse one particular reaction.

$$C_2H_5OH + O_2 \xrightarrow{\text{Mycoderma aceti}} CH_3COOH + H_2O$$

$$C_{12}H_{22}O_{11} + H_2O \xrightarrow{\text{Invertase}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$C_6H_{12}O_6 \xrightarrow{\text{Zymase}} 2C_2H_5OH + CO_2$$

Q.17. Write any two reactions of glucose which cannot be explained by the open chain structure of glucose molecule. 2

Ans. (*i*) Glucose on heating with methyl alcohol in presence of dry HCl gas forms two isomeric methyl glucoside (α and β). This test is not expected from the open chain structure of glucose.

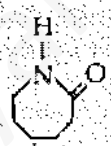
(*ii*) Glucose does not give 2,4-DNP test, Schiff's test and it does not give hydrogensulphite addition product, despite having the aldehydic group. This observation is explained by ring structure of glucose.

Q.18. Draw the structure of the monomer for each of the following polymers :

(*i*) **Nylon 6**

(*ii*) **Polypropene** 2

Ans. (*i*) Monomer of Nylon 6



Caprolactum

(*ii*) Monomer of polypropene

$$\underset{\text{Propene}}{CH_3 - CH = CH_2}$$

Q.19. Tungsten crystallises in body centred cubic unit cell. If the edge of the unit cell is 316.5 pm, what is the radius of tungsten atom ? 3

Ans. For bcc structure, $r = \frac{\sqrt{3}}{4}a$

Given a = 316.5 pm

Substituting the value of a in the equation above, we have

$$r = \frac{\sqrt{3}}{4} \times 316.5$$

$$= 137.04 \text{ pm.}$$

Or

Iron has a body centred cubic unit cell with a cell dimension of 286.65 pm. The density of iron is 7.874 g cm^{-3}. Use this information to calculate Avogadro's number. (At. mass of Fe = 55.845 u)

Ans. Apply the following relation

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

As it has bcc structure, Z = 2

Substituting the values in the above relation, we have

$$N_A = \frac{2 \times 55.845}{(286.65)^3 \times 10^{-30} \times 7.874} = 6.02 \times 10^{23}$$

Q.20. Rohan's father was trading in foodgrains. What he would do to purchase 1000 bags of wheat before the rainy season and sell off these bags after the rainy season. He was doing so for many years. He had become rich and was living a luxurious life.

(a) Can you tell what was the secret behind his exceptional earning ?

(b) Can you comment on his involvement in such a business ?

[Value Based Question] 3

Ans. (a) The coating on the foodgrains like wheat or rice is cellulose which is a kind of semi-permeable membrane. During rainy season, there is a lot of moisture (water vapours) in the air. Water enters the grains through the semipermeable membrane, thus increasing the mass of the grain by 5% or even more. He will thus earn extra money on the increased mass of wheat, in addition to the normal margin in the sale of wheat.

(b) Such a practice is devoid of value because it involves dishonest means. He should reduce the selling price of wheat in such a case because the buyer will obtain less wheat after he dries it in the sun before sending it to the grinding mill.

Q.21. For the reaction

$$2NO\ (g) + Cl_2\ (g) \longrightarrow 2NOCl\ (g)$$

the following data were collected. All the measurements were taken at 263 K :

Experiment No.	*Initial* [NO] (M)	*Initial* [Cl_2] (M)	*Initial rate of disappearance of* Cl_2 (M/min)
1	0.15	0.15	0.60
2	0.15	0.30	1.20
3	0.30	0.15	2.40
4	0.25	0.25	?

(a) Write the expression for rate law.

(b) Calculate the value of rate constant and specify its units.

(c) What is the initial rate of disappearance of Cl_2 in exp. 4 ? 3

Ans. (a) Let the rate law = $k[NO]^x\ [Cl_2]^y$

From Expt. 1, $0.60 = k[0.15]^x\ [0.15]^y$ ...1

From Expt. 2, $1.20 = k[0.15]^x\ [0.30]^y$ ...2

From Expt. 3, $2.40 = k[0.30]^x\ [0.15]^y$ ...3

Dividing eq. 2 by eq. 1

$$2 = \frac{k[0.15]^x[0.30]^y}{k[0.15]^x[0.15]^y} \quad \text{or} \quad 2 = 2^y \quad \text{or} \quad y = 1$$

Dividing eq. 3 by eq. 1

$$4 = \frac{k[0.30]^x[0.15]^y}{k[0.15]^x[0.15]^y} \quad \text{or} \quad 4 = 2^x \quad \text{or} \quad x = 2$$

Thus rate law = $k[NO]^2[Cl_2]$

(b) From eq. 1

$$0.60 = k[0.15]^2\ [0.15]^1$$

or $$k = \frac{0.60}{0.15 \times 0.15 \times 0.15} = 177.77 \text{ mol}^{-2} \text{ L}^2 \text{ min}^{-1}$$

Units of $k = (\text{mol L}^{-1})^{1-n} \text{ min}^{-1}$

n(overall order of the reaction) = 3

$\therefore$ $k = \text{mol}^{-2} \text{ L}^2 \text{ min}^{-1}$

(c) $\text{Rate} = k[NO]^2 [Cl_2]$

$= 177.77 \times (0.25)^2 \times 0.25$

$= 2.77 \text{ mol L}^{-1} \text{ min}^{-1}$

Q.22. How would you account for the following ?

(*i*) Many of the transition elements are known to form interstitial compounds.

(*ii*) The metallic radii of the third (5*d*) series of transition metals are virtually the same as those of the corresponding group members of the second (4*d*) series.

(*iii*) Lanthanoids form primarily +3 ions, while the actinoids usually have higher oxidation states in their compounds, +4 or even +6 being typical. 3

Ans. (*i*) Transition metals form interstitial compounds. This is because of the availability of enough space inside the crystal lattice of metals to accommodate small atoms like H, C or N. Such compounds have higher melting points than those of pure metals.

(*ii*) Metallic radii of third series of transition elements are virtually the same as those of corresponding members of second series. This is the consequence of lanthanide contraction. This causes the radii of the members of the third transition series to be very similar to those of the corresponding members of the second series. For example, Zr (160 pm) and Hf (159 pm) have almost identical radii.

(*iii*) Energies of 5*f*, 6*d* and 7*s* are comparable. So all these electrons can take part in bond formation. How many electrons are actually participating depends upon the other reactant and the reaction conditions. Therefore, actinoids have +4 and +6 oxidation states besides +3 oxidation state in there compounds.

Q.23. Give the formula of each of the following coordination entities :

(*i*) Co^{3+} ion is bound to one Cl^-, one NH_3 molecule and two bidentate ethylene diammine (en) molecules.

(*ii*) Ni^{2+} ion is bound to two water molecules and two oxalate ions.

Write the name and magnetic behaviour of each of the above coordination entities. (At. Nos. Co = 27, Ni = 28) 3

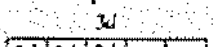
Ans. (*i*) $Co^{3+} + 1Cl^- + 1NH_3 + 2$ Ethylene diammine

$[CoClNH_3(H_2NCH_2CH_2NH_2)_2]^{2+}$

Name : Amminechloridobis(ethane-1, 2-diammine)cobalt (III) ion.

The electronic configuration of Co^{3+} is

In the presence of the ligands NH_3 and en, pairing of electrons will take place.



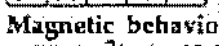
d^2sp^3 hybridisation will take place giving rise to octahedral shape.

Magnetic behaviour – As there are no unpaired electrons, the complex will be diamagnetic.

(*ii*) $Ni^{2+} + 2H_2O + 2$ oxalate

$[Ni(H_2O)_2(ox)_2]^{2-}$

Name : Diaquadioxalatonickelate(II)

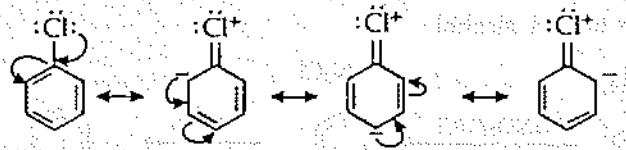


We cannot get two *d*-orbitals even if pairing takes place. Therefore, sp^3d^2 hybridisation takes place giving octahedral shape.

Magnetic behaviour – As there are two unpaired electrons, the complex is paramagnetic.

Q.24. Although chlorine is an electron withdrawing group, yet it is ortho-, para-directing in electrophilic aromatic substitution reactions. Explain why it is so ? 3

Ans. Although chlorine is an electron withdrawing group and exerts – I inductive effect but it also exerts + M effect due to the presence of lone pair of electrons. Also mesomeric effect is stronger than inductive effect.



I II III IV

As a result of resonance, there is delocalisation of electrons. The ortho and para positions on the benzene ring are comparatively negative. Hence, further substitution takes place at *o*- and *p*-positions.

Q.25. Draw the structure and name the product formed if the following alcohols are oxidized. Assume that an excess of oxidizing agent is used.

(*i*) $CH_3CH_2CH_2CH_2OH$

(*ii*) 2-butenol

(*iii*) 2-methyl-1-propanol 3

Ans. (*i*) $CH_3CH_2CH_2CH_2OH$

$$CH_3CH_2CH_2CH_2OH \xrightarrow{[O]} CH_3CH_2CH_2CHO \xrightarrow{[O]} \underset{\text{Butanoic acid}}{CH_3 - CH_2 - CH_2 - COOH}$$

(*ii*) 2-butenol

$$\underset{\text{2-butenol}}{CH_3 - CH = CH - CH_2OH} \xrightarrow{PCC} \underset{\text{2-butenal}}{CH_3 - CH = CH - CHO}$$

(*iii*) 2-methyl-1-propanol

$$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2OH \xrightarrow{[O]} CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CHO \xrightarrow{[O]} \underset{\text{3-methylpropanoic acid}}{CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - COOH}$$

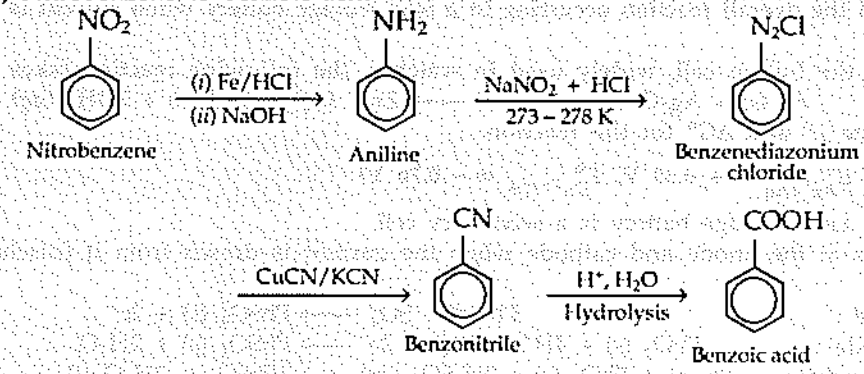
Q.26. Write chemical equations for the following conversions :

(*i*) Nitrobenzene to benzoic acid.

(*ii*) Benzyl chloride to 2-phenylethanamine.

(*iii*) Aniline to benzyl alcohol. 3

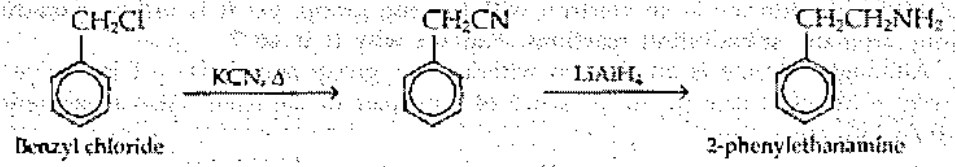
Ans. (*i*) Nitrobenzene to benzoic acid



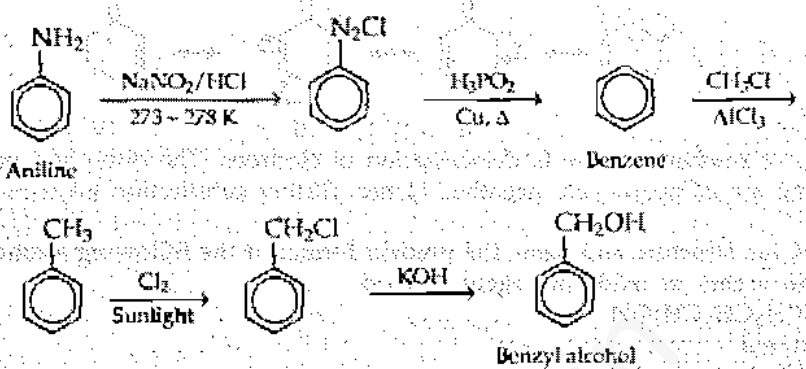
Nitrobenzene Aniline Benzenediazonium chloride

Benzonitrile Benzoic acid

(*ii*) Benzyl chloride to 2-phenylethanamine



(*iii*) Aniline to benzyl alcohol



Q.27. What are the following substances ? Give one example of each one of them.

(*i*) Tranquilizers

(*ii*) Food preservatives

(*iii*) Synthetic detergents. 3

Ans. (*i*) **Tranquilizers** – Tranquilizers are a class of chemical compounds used for treatment of stress and mild or even severe mental diseases. They relieve anxiety, stress, irritability or excitement by inducing a sense of well being. They form an essential component of sleeping pills. Some examples of tranquilizers are meprobamate and equanil.

(*ii*) **Food preservatives** – Substances that prevent spoilage of food due to microbial growth are called food preservatives. Commonly used preservatives include table salt, sugar and sodium benzoate.

(*iii*) **Synthetic detergents** – Synthetic detergents are cleansing agents which have all the properties of soaps but which actually do not contain any soap. These can be used both in soft and hard water.

Cationic detergents such as ceatyltrimethyl ammonium bromide. Anionic detergents such as sodium laurylsulphate. Non-ionic detergents such as polyethylene glycol stearate.

Q.28. (*a*) **What type of a battery is the lead storage battery ? Write the anode and the cathode reactions and the overall reaction occurring in a lead storage battery when current is drawn from it.**

(*b*) **In the button cell, widely used in watches, the following reaction takes place**

$$Zn\ (s) + Ag_2O\ (s) + H_2O\ (l) \longrightarrow Zn^{2+}\ (aq) + 2Ag\ (s) + 2OH^-\ (aq)$$

Determine E° and ΔG° for the reaction.

(Given : $E^\circ_{Ag^+/Ag} = +0.80$ V, $E^\circ_{Zn^{2+}/Zn} = -0.76$ V) 2, 3

Ans. (*a*) Lead storage battery is a secondary cell.

Reactions at the anode and cathode when the current is drawn from it (discharge) are as follows :

At anode : $Pb\ (s) + SO_4^{2-} \longrightarrow PbSO_4\ (s) + 2e^-$

At cathode : $PbO_2\ (s) + 4H^+ + SO_4^{2-} + 2e^- \longrightarrow PbSO_4\ (s) + 2H_2O$

Overall reaction : $Pb\ (s) + PbO_2\ (s) + 2H_2SO_4\ (aq) \longrightarrow 2PbSO_4 + 2H_2O\ (l)$

(*b*) $Zn\ (s) + Ag_2O\ (s) + H_2O\ (l) \longrightarrow Zn^{2+}\ (aq) + 2Ag\ (s) + 2OH^-\ (aq)$

Given : $E^\circ_{Ag^+/Ag} = +0.80$ V, $E^\circ_{Zn^{2+}/Zn} = -0.76$ V

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= 0.80 - (-0.76) = 1.56$ V

$\Delta G^\circ = -nFE^\circ$

$= -2 \times 96500 \times 1.56$

$= -301080$ J mol^{-1}

$= -301.08$ kJ mol^{-1}

Or

(*a*) Define molar conductivity of a solution and explain how molar conductivity changes with change in concentration of solution for a weak and a strong electrolyte.

(*b*) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is 0.146×10^{-3} S cm^{-1} ?

Ans. (*a*) Molar conductivity is the conductivity of all ions produced by ionisation of 1 g mol of an electrolyte when present in V mL of solution. It is denoted by μ.

$$\mu = \kappa \times V$$

where V = volume in mL containing 1 g mol of the electrolyte

$$\mu = \kappa \times \frac{1000}{C}$$

where C = concentration of the solution in g mol/L.

Variation of molar conductivity with concentration for strong electrolytes – Molar conductivity increases slowly with dilution. It approaches a limiting value when the concentration approaches zero. This value is called molar conductivity at infinite dilution Λ°_m. Variation of conductivity with concentration may be given by

$\Lambda_m = \Lambda^\circ_m - AC^{1/2}$ where A is a constant and C is concentration.

Variation of molar conductivity with concentration for weak electrolytes – Variation of Λ_m with concentration is very large to the extent that we cannot obtain molar conductance at infinite dilution Λ°_m by extrapolation of Λ_m *vs* $C^{1/2}$ plots.

(*b*) Conductivity $\kappa = 0.146 \times 10^{-3}$ S cm^{-1}

Resistance $R = 1500$ ohm

$$\text{Cell constant} = \frac{\text{Conductivity}\,(\kappa)}{\text{Conductance}\,(G)}$$

$$= \text{Conductivity}\ (\kappa) \times \text{Resistance}\ (R)$$

$$= 0.146 \times 10^{-3} \times 1500$$

$$= 0.219\ \text{cm}^{-1}$$

Q.29. (*a*) Complete the following chemical reaction equations :

(*i*) $P_4 + SO_2Cl_2 \longrightarrow$

(*ii*) $XeF_6 + H_2O \longrightarrow$

(*b*) Predict the shape and the asked angle (90° or more or less) in each of the following cases :

(*i*) SO_3^{2-} and the angle O — S — O

(*ii*) ClF_3 and the angle F — Cl — F

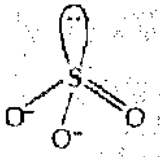
(*iii*) XeF_2 and the angle F — Xe — F **2, 3**

Ans. (*a*) (*i*) $P_4 + 10SO_2Cl_2 \longrightarrow 4PCl_5 + 10SO_2$

(*ii*) $XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$

(b) (i) SO_3^{2-}

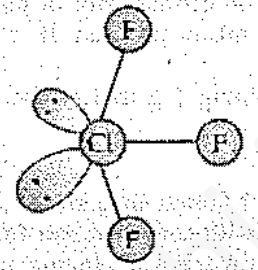
sp^3 hybridisation is involved. It has a pyramidal shape.



The angle O — S — O is more than 90°.

(ii) ClF_3

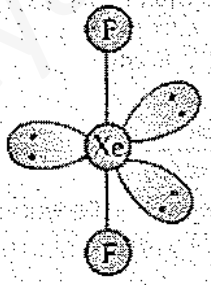
There are three bond pairs and two lone pairs. According to VSEPR theory, they will occupy the corners of a trigonal bipyramid. Two lone pairs will occupy the equitorial position to minimise lone pair and lone pair-bond pair repulsions, which are greater than the bond pair-bond pair repulsions. The shape of ClF_3 is that of a bent T.



ClF_3

The bond angle F — Cl — F is less than 90°.

(iii) XeF_2



It has a linear and square planar structure. The angle F — Xe — F will be more than 90°.

Or

(a) Complete the following chemical equations :

(i) $NaOH + Cl_2 \longrightarrow$ (Hot and conc.)

(ii) $XeF_4 + O_2F_2 \longrightarrow$

(b) Draw the structures of the following molecules :

(i) H_3PO_2

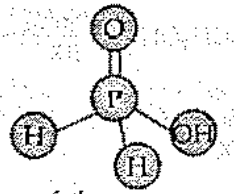
(ii) $H_2S_2O_7$

(iii) $XeOF_4$

Ans. (a) (i) $6NaOH + 3Cl_2 \longrightarrow NaClO_3 + 5NaCl + 3H_2O$

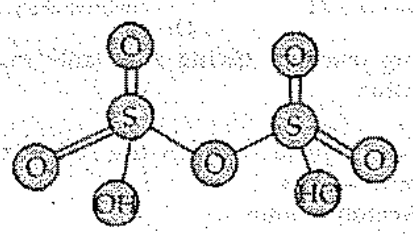
(ii) $XeF_4 + O_2F_2 \longrightarrow XeF_6 + O_2$

(b) (i) H_3PO_2



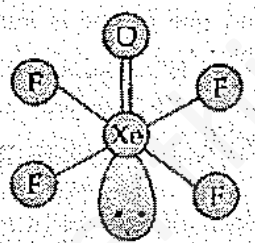
It is a powerful reducing agent because of the presence of two P — H bonds. Oxidation state of P is +1 (monobasic acid).

(ii) $H_2S_2O_7$



It is known as oleum.

(iii) $XeOF_4$



It has a square pyramidal shape.

Q.30. (a) Illustrate the following name reactions giving suitable example in each case :

(i) Clemmensen reduction

(ii) Hell-Volhard-Zelinsky reaction

(b) How are the following conversions carried out ?

(i) Ethylcyanide to ethanoic acid.

(ii) Butan-1-ol to butanoic acid

(iii) Benzoic acid to *m*-bromobenzoic acid. **2, 3**

Ans. (a) (i) Clemmensen reduction : This reduction involves reduction with **Zn — Hg** and conc. HCl.

$$\underset{\text{Propanone}}{CH_3-\overset{CH_3}{\overset{|}{C}}=O} + 2[H] \xrightarrow[HCl]{Zn/Hg} \underset{\text{Propane}}{CH_3CH_2CH_3} + H_2O$$

(ii) Hell-Volhard-Zelinsky reaction

$$\underset{\text{Propionic acid}}{CH_3CH_2COOH} \xrightarrow[-HBr]{Br_2,\ P} \underset{\alpha\text{-Bromopropionic acid}}{CH_3CHBrCOOH} \xrightarrow[-HBr]{Br_2,\ P} \underset{\alpha\text{-}\alpha\text{-Dibromopropionic acid}}{CH_3CBr_2COOH}$$

(b) (i) Ethylcyanide to ethanoic acid

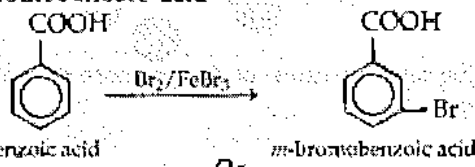
$$\underset{\text{Ethylcyanide}}{CH_3CH_2CN} \xrightarrow{H^+,\ H_2O} CH_3CH_2CONH_2 \xrightarrow{Br_2/KOH} CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH \xrightarrow[[O]]{KMnO_4} CH_3CHO \xrightarrow[[O]]{KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

(*ii*) **Butan-1-ol to butanoic acid**

$$CH_3CH_2CH_2CH_2OH \xrightarrow[[O]]{KMnO_4} CH_3CH_2CH_2COOH$$

Butan-1-ol — Butanoic acid

(*iii*) **Benzoic acid to *m*-bromobenzoic acid**



Benzoic acid — *m*-bromobenzoic acid

Or

(*a*) **Illustrate the following reactions giving a suitable example for each :**

(*i*) **Cross aldol condensation**

(*ii*) **Decarboxylation**

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

(*i*) **Pentan-2-one and Pentan-3-one**

(*ii*) **Benzaldehyde and Acetophenone**

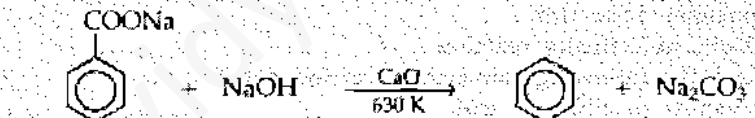
(*iii*) **Phenol and Benzoic acid.**

Ans. (*a*) (*i*) **Cross aldol condensation** – Aldol condensation between two aldehydes or two ketones or between one aldehyde and one ketone is known as cross aldol condensation.

$$CH_3CHO + HCHO \xrightarrow{\text{Dil. NaOH}} \underset{\text{3-Hydroxypropanal}}{HOCH_2CH_2CHO} \xrightarrow[\Delta]{H^+/H_2O} \underset{\text{Acrolein}}{CH_2 = CH - CHO}$$

$$CH_3COCH_3 + HCHO \xrightarrow{\text{Dil. NaOH}} \underset{\text{4-Hydroxybutan-2-one}}{CH_3COCH_2CH_2OH} \xrightarrow[\Delta]{H^+/H_2O} \underset{\text{Methyl vinyl ketone}}{CH_3COCH = CH_2}$$

(*ii*) **Decarboxylation** – The process of removal of a molecule of CO_2 from a carboxylic acid is called decarboxylation. It is carried out by heating a carboxylic acid or its salt with sodalime at 600 °C.



Sodium benzoate — Benzene

$$CH_3CH_2COONa + NaOH \xrightarrow[630\ K]{CaO} \underset{\text{Ethane}}{CH_3CH_3} + Na_2CO_3$$

(*b*) (*i*) **Pentan-2-one and pentan-3-one** – The two compounds can be distinguished by iodoform test.

$$\underset{\text{Pentan-2-one}}{CH_3COCH_2CH_2CH_3} + 3NaOI \longrightarrow CH_3CH_2CH_2COONa + 2NaOH + \underset{\text{(yellow ppt.)}}{CHI_3}$$

$$\underset{\text{Pentan-3-one}}{CH_3CH_2COCH_2CH_3} + 3NaOI \longrightarrow \text{No formation of yellow ppt.}$$

(*ii*) **Benzaldehyde and acetophenone** – The two compounds can be distinguished by performing iodoform test. Acetophenone will give the yellow ppt. of iodoform while benzaldehyde will not give any ppt.

$$C_6H_5COCH_3 + 3NaOH \longrightarrow C_6H_5COONa + 2NaOH + CHI_3$$

(*iii*) **Phenol and benzoic acid** – Add neutral ferric chloride. Phenol will form a violet colour while benzoic acid will not.