

## CHEMISTRY TEAM

S.No.	Name	Designation	School	Tel. No.
1.	Dr. Naresh Pal Dhaka	Principal	Dr. Rajendra Prasad Govt. Sarvodaya Vidyalaya President Estate, New Delhi	23013529 (O) 9811501775 (M)
2.	Mrs. Reeta Kathuria	Lecturer	SKV, Vivek Vihar	9891707760
3.	Mrs. Kiran Bhutani	Lecturer	RPVV, Surajmal Vihar	9811406541
4.	Dr. Mrs. Amita Puri	Lecturer	RPVV, Lajpat Nagar	9891551186
5.	Sh. Sunil Dahiya	Lecturer	RPVV, Sec.-11, Rohini	9868876784
6.	Sh. Hans Raj Modi	Lecturer	RPVV, Gandhi Nagar	9810877320

# Chapter - 1

## THE SOLID STATE

### VSA type questions (1 Mark)

1. Mention two factors responsible for widely different properties of solids.
2. What is meant by long range order in solids?
3. What are amorphous solids?
4. Why are amorphous solids isotropic in nature?
5. Why glass is regarded as an amorphous solid?
6. Define the term 'Crystal lattice.'
7. Name the crystal system for which all four types of unit cells are possible.
8. What is the total number of atoms per unit cell in a fcc crystal structure?(Ans : 4)
9. What difference in behaviour between the glass and sodium chloride would you expect to observe, if you break off a piece of either cube?
10. Define the term voids.
11. Name two closest packed arrangements of identical spheres.
12. ★ If the formula of a compound is  $A_2B$ , which site would be occupied by A ions?
13. What is the coordination number for
  - (a) an octahedral void
  - (b) a tetrahedral void
14. ★ How many octahedral voids are there in 1 mole of a compound having cubic closed packed structure? (Ans : 1 mole)
15. What does the term 'Coordination number' indicate?
16. Arrange simple cubic, bcc and fcc lattice in increasing order of the fraction of the occupied space.
17. How much space is empty in a hexagonal closed packed solid?
18. An element crystallizes separately both in *hcp* and *ccp* structure. Will the two structures have the same density? Justify your answer.
19. ★ Write dimension & bond angles of match-box type of unit cells.
20. ★ Calculate the number of atoms in a cubic unit cell having one atom on each corner and two atoms on each body diagonal. (Ans : 9)
21. ★ In  $NaCl$  crystal,  $Cl^-$  ions form the cubic close packing. What sites are occupied by  $Na^+$

ions?

22. In corundum oxide ions form  $hcp$  and  $Al^{3+}$  occupy two third of octahedral voids. Determine the formula of corundum. (Ans :  $Al_2O_3$ )
23. What are stoichiometric defects?
24. Define the term 'dislocation' in relation to crystals.
25. Why is Frenkel defect not found in pure alkali metal halides?
26. Define F-centres.
27. Which point defect is observed in a crystal when a vacancy is created by an atom or ion missing from a lattice site?
28. Why are the solids containing F-Centres Paramagnetic?
29. Name the crystal defect produced when  $NaCl$  crystal is doped with  $MgCl_2$ .
30. What type of stoichiometric defect is shown by (i)  $ZnS$  and (ii)  $CsCl$ ?
31. Define the term point defects.
32. Define the term 'doping.'
33. Although pure silicon is an insulator then how does it behaves as a semiconductor on heating.
34. Name the crystal defect which lowers the density of an ionic crystal.
35. What makes the crystal of  $KCl$  appear sometimes violet?
36. Which point defect in crystal does not alter the density of the relevant solid?
37. In a  $p$ -type semiconductor the current is said to move through holes. Explain.
38. Mention the effect of increasing temperature on the conductivity of semiconductors.
39.  $Fe_3O_4$  Ferrimagnetic at room temperature but becomes paramagnetic when heated at 850 K?

### SA (I) Type Questions (2 Marks)

1. List four main characteristic properties of the solids.
2. (a) What is meant by the term crystallinity of a solid?  
(b) Why is quartz regarded as a crystalline solid while glass is an amorphous solid?
3. List four distinctions between crystalline and amorphous solids.
4. Give reasons for  
(a) Ionic solids are hard and brittle.  
(b) Copper is malleable and ductile.

5. Account for the following :-
  - (a) Glass objects from ancient civilizations are found to become milky in appearance.
  - (b) Window glass panes of old buildings are thicker at the bottom than at the top.
6. Why graphite is soft lubricant and good conductor of electricity?
7. Explain the term "Unit Cell". Name the parameters that characterize a unit cell.
8. Explain :-
  - (a) The basis of similarities and differences between metallic and ionic crystals.
  - (b) Sodium chloride is hard but sodium metal is soft.
9. ★ What do you understand by stacking sequences :-
  - (a) ABAB . . . . .
  - (b) ABCABC . . . . .
 What kind of lattices do these sequences lead to?
10. Calculate the percentage of efficiency of packing in body centered cubic structure. (Ans : 68%)
11. Explain packing efficiency of solids by giving suitable example.
12. How can you calculate the density of a crystal whose length of the edge of the unit cell is known?
13. Explain how much portion of an atom located at (a) corner (b) body centre (c) face-centre and (d) edge centre of a cubic unit cell in part of its neighbouring unit cells.
14. ★ In a fcc arrangement of A and B atoms, A are present at the corners of the unit cell and B are present at the face centres. If one atom of A is missing from its positions at the corners, what is the formula of the compound? (Ans :  $A_7B_{24}$ )
15. A compound made up of elements 'A' and 'B' crystallizes in a cubic closed structure. Atom A are present on the corners as well as face centres, whereas atoms B are present on the edge-centers as well as body centre. What is the formula of the compound? (Ans :  $A_4B_4$  or AB)
16. Why are  $Cu-Be$  alloys sometimes used in electric switches whose circuits are closed and opened frequently, instead of copper metal, which is better electric conductor than  $Cu-Be$  alloy?
 

(Hint :  $Cu$  and  $Be$  form interstitial solid solution which is harder than copper and has higher melting point)
17. Explain the term 'crystal defects'. Name the two types of crystal defects.
18. Explain how vacancies are introduced in a solid when a cation of higher valence is added to it.
19. What is meant by non-stoichiometric defect? Ionic solids which have anionic vacancies due to metal excess defect develop colour. Explain with the help of suitable

example.

20. Explain the terms :-
  - (a) Intrinsic semiconductors
  - (b) Extrinsic semiconductor
21. Pure silicon is an insulator. Silicon doped with phosphorus is a semiconductor. Silicon doped with gallium is also a semiconductor. What is the difference between the two types?
22. (a) What is the origin of magnetic moments associated with electrons in atoms?  
(b) Distinguish between paramagnetism and diamagnetism.
23. Calculate the efficiency (Percentage of volume occupied and unoccupied) of packing in case of a metal crystal for simple cubic.

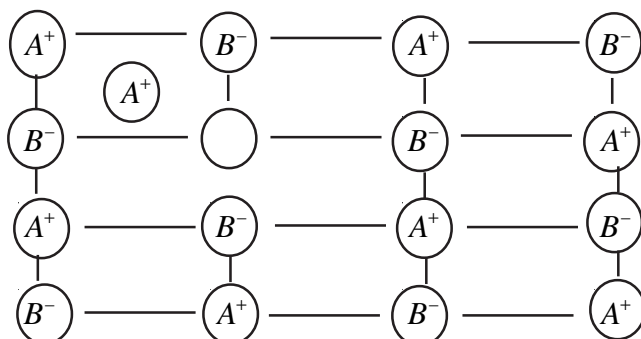
### **SA (II) Type Questions (3 Marks)**

1. Write the relationship between atomic radius ( $r$ ) and edge length ( $a$ ) of cubic unit cell for
  - (a) Simple cubic unit cell
  - (b) Body centred cubic unit cell
  - (c) Face centred cubic unit cell
2. Write and explain three differences between consequences of schottky and Frenkel defects under the heads :-
  - (a) Effect on density
  - (b) Effect on electrical conductivity
  - (c) Effect on stability of the crystal.
3. Account for the following :-
  - (a) Zinc oxide on heating turns yellow.
  - (b) Schottky defect decreases the density of a crystal.
  - (c) Non-stoichiometric sodium chloride is yellow in colour.
4. What is a semiconductor? Describe the two main types of semiconductors on the basis of their conductance mechanism.
5. Explain the following :-
  - (a) Ferromagnetism and Ferrimagnetism

(b) Antiferromagnetism

(c) 13-15 compounds

6. ★ Examine the defective crystal given below and answer the following of questions



(a) Name the defect present in ionic solids.

(b) Out of  $AgCl$  and  $NaCl$ , which is most likely to show this type of defect and why?

(c) Why this defect is also known as dislocation defect?

### Numerical Problems :-

1. Sodium crystallises in a bcc unit cell. What is the approximate number of unit cells in 4.6 g of sodium? Given that the atomic mass of sodium is  $23 \text{ g mol}^{-1}$ . (Ans :  $6 \times 10^{22}$ )
2. ★ In a crystalline solid anions 'C' are arranged in cubic close packing, cations 'A' occupy 50% of tetrahedral voids and cations 'B' occupy 50% of octahedral voids. What is the formula of the solid? (Ans :  $A_2BC_2$ )
3. ★ Magnetite, a magnetic oxide of iron used on recording tapes, crystallizes with iron atoms occupying  $\frac{1}{8}$  of the tetrahedral holes and  $\frac{1}{2}$  of the octahedral holes in a closed packed array of oxides ions. What is the formula of magnetite? (Ans :  $Fe_3O_4$ )
4. A metal crystallises into two cubic phases fcc and bcc, whose edge lengths are  $3.5\text{\AA}$  and  $3.0\text{\AA}$  respectively. Calculate the ratio of the densities of fcc and bcc lattices. (Ans : 1.26)
5. An element of atomic mass  $98.5 \text{ g mol}^{-1}$  occurs in fcc structure. If its unit edge length is 500 pm and its density is  $5.22 \text{ g cm}^{-3}$ . Calculate the value of Avogadro constant. (Ans :  $6.03 \times 10^{23} \text{ mol}^{-1}$ )
6. An element crystallises in a structure having a fcc unit cell of an edge 200 pm. Calculate the density if 200 g of this element contain  $24 \times 10^{23}$  atoms. (Ans :  $41.6 \text{ g cm}^{-3}$ )
7. A fcc unit cell containing element (molar mass  $60.4 \text{ g mol}^{-1}$ ) has cell edge  $4 \times 10^{-8} \text{ cm}$ .

Calculate the density of unit cell.

(Ans :  $6.23 \text{ g/cm}^3$ )

8. ★ A metal crystallises in fcc lattice with edge length 0.556 nm. Calculate the density of metal if there are :-

(a) 0.1% Frenkel defect (b) 0.1% Schottky defect

(Ans : (a)  $1.5458 \text{ g/cm}^3$  (b)  $1.5443 \text{ g/cm}^3$ )

9. Analysis shows that a metal oxide has the empirical formula  $M_{0.96}O$ . Calculate the percentage of  $M^{2+}$  and  $M^{3+}$  ions in this crystal. (Ans :  $M^{2+} = 91.7\%$ ,  $M^{3+} = 8.3\%$ )

10.  $AgCl$  is doped with  $10^{-2} \text{ mol\%}$  of  $CdCl_2$ , find the concentration of cation vacancies.

(Ans :  $6.02 \times 10^{19}$ )

11. A metallic element has a body central cubic lattice. Edge length of unit cell is  $2.88 \times 10^{-8}$  cm. The density of the metal is  $7.20 \text{ gcm}^{-3}$ .

Calculate :-

(a) The volume of unit cell.

(b) Mass of unit cell

(c) Number of atoms in 100 g of metal.

(Ans : (a)  $2.39 \times 10^{-23} \text{ cm}^3$  (b)  $1.72 \times 10^{-22} \text{ g}$ , (c)  $1.162 \times 10^{24}$  atoms)

12. Iron has a bcc unit cell with a cell edge of 286.65 pm. The density of iron is  $7.87 \text{ gcm}^{-3}$ . Use the information to calculate Avogadro's number. (Atomic mass of  $Fe = 56 \text{ g mol}^{-1}$ )

(Ans :  $6.04 \times 10^{23} \text{ mol}^{-1}$ )

13.  $KF$  has  $NaCl$  structure. Its density is  $2.48 \text{ g/cm}^3$ . Calculate edge length of crystal lattice. (Given  $K = 39 \text{ g mol}^{-1}$ ,  $F = 19 \text{ g mol}^{-1}$  and  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ )

(Ans : 538 pm)

14. Molybdenum has atomic mass  $96 \text{ g mol}^{-1}$  with density  $10.3 \text{ g/cm}^3$ . The edge length of unit cell is 314 pm. Determine lattice structure whether simple cubic, bcc or fcc. (Given  $N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$ )

(Ans :  $z = 2$ , bcc type)

## Chapter - 2

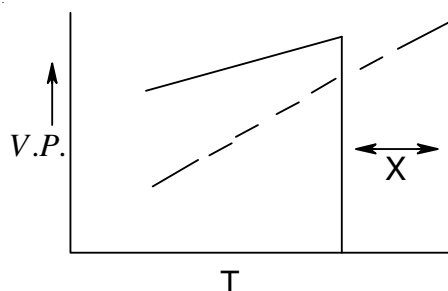
# SOLUTIONS

### VSA type questions (1 Mark)

1. Give an example of 'liquid in solid' type solution.
2. Give two examples of gaseous solutions.
3. Which type of solid solution will result by mixing two solid components with large difference in the sizes of their molecules?
4. Define mole fraction of a component in a solution.
5. What is meant by semimolar and decimolar solutions?
6. What will be the mole fraction of water in  $C_2H_5OH$  solution containing equal number of moles of water and  $C_2H_5OH$  ? (Ans : 0.5)
7. Which method is adopted for expressing the concentration of a solution, when the number of components in solution are more than two?
8. What type of solution an alloy belongs to?
9. Which of the following is a dimensionless quantity : molarity, molality or mole fraction?
10. A solution of glucose in water is labelled as 10%  $w/w$ . What does it mean?
11. How is the concentration of a solute present in trace amount in a solution expressed?
12. ★ Which aqueous solution has higher concentration 1 molar or 1 molal solution of the same solute? Give reason.
13. ★  $N_2$  and  $O_2$  gases have  $K_H$  values 76.48 Kbar and 34.86 kbar respectively at 293 K temperature. Which of these will have more solubility in water?
14. ★ Under what condition molality and molarity are identical. Explain with suitable reason.
15. State the formula relating to pressure of a gas with its mole fraction in a liquid solution.
16. Gases tend to be less soluble in liquids as the temperature is raised. Why?
17. State the conditions which must be satisfied of an ideal solution is to be formed.
18. A mixture of chlorobenzene and bromobenzene form nearly ideal solution but a mixture of chloroform and acetone does not. Why?
19. What type of a azeotrope is formed on mixing nitric acid with water?
20. What is the effect of the addition of non-volatile solute on the vapour pressure of liquid solvent?
21. Volatile hydrocarbons are not used in breaks of automobiles as lubricant, but non-

volatile hydrocarbon are used as lubricants. Why?

22. ★ Addition of  $HgI_2$  to  $KI$  (aq.) shows an increase in vapour pressure. Why?
23. What will happen to the boiling point of the solution on mixing two miscible liquids showing negative deviation from Raoult's law.
24. When 50 mL of ethanol and 50 mL of water are mixed, predict whether the volume of the solution is equal to, greater than or less than 100 mL. Justify.
25. Liquid 'Y' has higher vapour pressure than 'X'. Which of them will have higher boiling point?
26. Which type of deviation is shown by the solution formed by mixing cyclohexane and ethanol?
27. ★ The phase diagram for pure solvent and the solution containing non-volatile solute are recorded below. The quantity indicated by 'X' in the figure is .



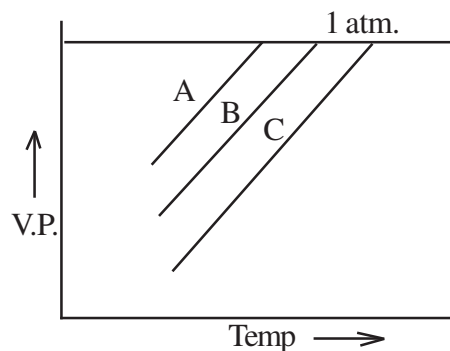
28. A and B liquids on mixing produce a warm solution. Which type of deviation from Raoult's law is there?
29. Define cryoscopic constant.
30. Mention the unit of ebullioscopic constant.
31. If  $k_f$  for water is  $1.86 \text{ k kg mol}^{-1}$ . What is the freezing point of 0.1 molal solution?
32. Name the component that separate first when salt solution is frozen.
33. Define osmotic pressure.
34. What is reverse osmosis? Give one large scale use of it.
35. What is the value of Van't Hoff factor ( $i$ ) for  $Na_2SO_4 \cdot 10H_2O$ ? **(Ans :  $i = 3$ )**
36. Define colligative properties.
37. Which colligative property should be measured for (i) thermally unstable compound (ii) compound having very low solubility at room temperature.
38. What is the value of Van't Hoff factor ( $i$ ) ,if some molecule undergoes dimerisation.

( $i = 0.5$ )

### SA (I) Type Questions (2 Marks)

1. Explain the following :-
  - (a) Solubility of a solid in a liquid involves dynamic equilibrium.
  - (b) Ionic compounds are soluble in water but are insoluble in non-polar solvents.
2. Give an example of solution :-
  - (a) Showing positive deviation
  - (b) Showing negative deviation
  - (c) Forming azeotropes with maximum boiling
  - (d) Forming azeotropes with minimum boiling
3. Some non-ideal solutions show positive deviations while some other negative deviations. Why?
4. Draw vapour pressure  $v_s$  composition diagram for an ideal solution.
5. Define azeotropes. Mention their important characteristics.
6. Draw the total vapour pressure  $v_s$  mole fraction diagram for a binary solution exhibiting non-ideal behaviour with negative deviation.
7. What are ideal solutions? Give two examples.
8. Describe the following by giving a suitable example in each case :-
  - (i) minimum boiling azeotropes
  - (ii) maximum boiling azeotropes
9. Show that the relative lowering of vapour pressure of a solvent is a colligative property.
10. Benzene and toluene form a nearly ideal solution. At a certain temperature, calculate the vapour pressure of solution containing equal moles of the two substances.  
[Given  $P^\circ_{\text{Benzene}} = 150 \text{ mm of Hg}$ ,  $P^\circ_{\text{Toluene}} = 55 \text{ mm of Hg}$ ]
11. What is meant by abnormal molecular mass? Illustrate it with suitable examples.
12. ★ When 1 mole of  $\text{NaCl}$  is added to 1 litre water the boiling point increases. When 1 mole of  $\text{CH}_3\text{OH}$  is added to 1 litre water, the boiling point decreases. Suggest reason.
13. Can we separate water completely from  $\text{HNO}_3$  solution. Justify your answer.
14. ★ 1 gram each of two solutes 'A' and 'B' (molar mass of A > molar mass of B) are dissolved separately in 100 grams each of the same solvent. Which solute will show greater elevation in boiling point. Why?
15. ★  $\text{FeCl}_3$  on reduction with  $\text{K}_4[\text{Fe}(\text{CN})_6]$  in aqueous solution gives blue colour. These are separated by semi-permeable membrane. Will there be the appearance of a blue colour on either side due to osmosis. (Ans : No blue colour)

16. ★ The vapour pressure curves for the same non-volatile solute in the same solvent are shown. The curves are parallel to each other and do not intersect. What is the correct order of the concentrations of the solutions.



**SA (II) Type Question (3 Marks)**

- Define molarity and molality. Write two points of difference between molarity and molality of a solution.
- State and explain Henry's law.
  - If  $O_2$  is bubbled through water at 393 K, how many millimoles of  $O_2$  gas would be dissolved in 1L of water? Assume that  $O_2$  exerts a pressure of 0.95 bar.  
(Given  $K_H$  for  $H_2O = 46.82$  bar at 393 K)
- Explain the following :-
  - Aquatic species are more comfortable in cold water rather than warm water.
  - To avoid bends scuba divers use air diluted with helium.
  - Cold drink bottles are sealed under high pressure.
- Why should a solution of a non-volatile solute boil at a higher temperature? Explain with the help of a diagram. Derive the relationship between molar mass and elevation in boiling point.
- Account for the following :-
  - $CaCl_2$  is used to clear snow from roads on hill stations.
  - Ethylene glycol is used as antifreeze solution in radiators of vehicles in cold countries.
  - The freezing point depression of 0.1 M  $NaCl$  is nearly twice that of 0.1 M glucose solution.
- Why do colligative properties of an electrolyte solution of a given concentration are found to be larger than those of a non electrolyte solution of the same concentration.
- Give reasons for the following :-
  - RBC swell up and finally burst when placed in 0.1%  $NaCl$  solution.
  - When fruits and vegetables that have been dried are placed in water, they slowly

swell and return to original form.

(c) A person suffering from high blood pressure is advised to take less amount of table salt.

8. ★ Glycerine, Glycol and methanol sell at the same price per kg. Which would be cheaper for preparing an antifreeze solution for the radiator of an automobile?

(Ans :  $CH_3OH$ )

9. ★ Determine the correct order of the property mentioned against them :-

(a) 10 g glucose ( $\pi_1$ ), 10 g urea ( $\pi_2$ ), 10 g sucrose ( $\pi_3$ ) (Osmotic pressure)

(b) 0.1 M  $NaCl$ , 0.1 M urea, 0.1 M  $MgCl_2$  (Elevation in b.p.)

(c) 0.1 M  $CaCl_2$ , 0.1 M sucrose, 0.1 M  $NaCl$  (Depression in  $f.p.$ )

### Long Answer Type Questions (5 Marks)

1. (a) Explain the terms (i) volume % (ii) molality

(b) A solution of 25% water, 25% ethanol and 50% acetic acid by mass. Calculate the mole fraction of each component.

(Ans :  $X_{H_2O} = 0.503$ ,  $X_{C_2H_5OH} = 0.196$  and  $X_{CH_3COOH} = 0.301$ )

(c) Find the molarity and molality of a 15% solution  $\frac{w}{W}$  of  $H_2SO_4$ .

(Density of  $H_2SO_4 = 1.02 \text{ g cm}^{-3}$ )

(Ans : 1.8 m, 1.56 M)

2. (a) State and derive Raoult's law for a solution containing (i) a volatile solutes (ii) a non-volatile solutes.

(b) Benzene and toluene form nearly ideal solution. At a certain temperature, the vapour pressure of pure benzene is 150 mm  $Hg$  and of pure toluene is 50mm of  $Hg$ . Calculate the vapour pressure of the solution containing equal weights of benzene and toluene.

3. (a) Describe a method of determining molar mass of a non-volatile solute from vapour pressure lowering.

(b) How much urea (mol. mass 60  $\text{g mol}^{-1}$ ) must be dissolved in 50 g of water so that the vapour pressure at the room temperature reduced by 25%? Also calculate the molality of the solution obtained. (Ans : 55.55 g and 18.5 m)

4. (a) Why is the freezing point depression considered as a colligative property?

(b) The cryoscopic constant of water is 1.86  $Km^{-1}$ . Comment on this statement.

(c) Calculate the amount of ice that will separate out on cooling solution containing 50 g of ethylene glycol in 200 g  $H_2O$  to  $-9.3^\circ C$ . ( $K_f$  for water =  $1.86 K kg mol^{-1}$ )

(Ans : 38.71 g)

5. (a) Explain how molecular mass of a solute can be determined by osmotic pressure.  
(b) What is the molar concentration of particles in human blood if the osmotic pressure is 7.2 atm at normal body temperature of  $37^\circ C$ ? (Ans : 0.283M)

### Numerical Problems :-

1. Calculate the mass percentage of benzene ( $C_6H_6$ ) and carbon tetrachloride ( $CCl_4$ ), if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.

(Ans : ( $C_6H_6$ )=15.3%,  $CCl_4$  = 84.7%)

2. Calculate the molarity of a solution prepared by mixing 2.5 L of 0.5 M urea solution and 500 mL of 2 M urea solution. (Ans : 0.75 M)

3. The mole fraction of  $CH_3OH$  in an aqueous solution is 0.02 and density  $0.994 g cm^{-3}$ . Determine the molality and molarity. (Ans : 1.13 m, 1.08 M)

4. 200 mL of calcium chloride solution contains  $3.011 \times 10^{22} Cl^-$  ions. Calculate the molarity of the solution. Assume that calcium chloride is completely ionised.

(Ans : 0.125 M)

5.  $6 \times 10^{-3} g$  oxygen is dissolved per kg of sea water. Calculate the ppm of oxygen in sea water. (Ans : 6 ppm)

6. The solubility of oxygen in water is  $1.35 \times 10^{-3} mol L^{-1}$  at  $20^\circ C$  and 1 atm pressure. Calculate the concentration of oxygen at  $20^\circ C$  and 0.2 atm. pressure.

(Ans :  $1.7 \times 10^{-3} mol L^{-1}$ )

7. Two liquids X and Y on mixing form an ideal solution. The vapour pressure of the solution containing 3 mole of X and 1 mol of Y is 550 mm Hg. But when 4 mole of X and 1 mole of Y are mixed, the vapour pressure of solution thus formed is 560 mm Hg. What will be the vapour pressure of pure X and pure Y at this temperature?

(Ans : X = 600 mm Hg, Y = 400 mm of Hg)

8. An aqueous solution containing 3.12 g of Barium Chloride in 250 g of water is found to be boil at  $100.0832^\circ C$ . Calculate the degree of dissociation of Barium Chloride. (Given : Molar Mass  $BaCl_2 = 208 g mol^{-1}$ ,  $K_b$  for water = 0.52 K/m). (Ans : 83.3%)

9. The degree of dissociation of  $Ca(NO_3)_2$  in a dilute aqueous solution, containing 7.0 g

of salt per 100 g of water at  $100^{\circ}\text{C}$  is 70%. If the vapour pressure of water at  $100^{\circ}\text{C}$  is 760 mm, calculate the vapour pressure of the solution. (Ans : 745.3mm of Hg )

10. 2g of  $\text{C}_6\text{H}_5\text{COOH}$  dissolved in 25g of benzene shows depression in freezing point equal to 1.62K. Molar depression constant for benzene is  $4.9\text{K kg mol}^{-1}$ . What is the percentage association of acid if it forms a dimer in solution? (Ans : 99.2%)
11. Calculate the amount of  $\text{NaCl}$  which must be added to one kg of water so that the freezing point is depressed by 3K. Given  $K_f = 1.86\text{ K kg mol}^{-1}$ , Atomic mass : Na = 23, Cl = 35.5. (Ans : 47.2 g NaCl )
12. Three particles of a solute, A associate in benzene to form species  $\text{A}_3$ . Calculate the freezing point of 0.25 molal solution. The degree of association of solute A is found to be 80%. The freezing point of benzene is  $5.5^{\circ}\text{C}$  and its  $K_f$  value is  $5.13\text{ Km}^{-1}$ .  
(Ans :  $4.9^{\circ}\text{C}$ )
13. A 5% solution of sucrose  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$  is isotonic with 0.877% solution of urea. Calculate the molecular mass of urea. (Ans :  $59.99\text{ g mol}^{-1}$ )
14. Osmotic pressure of a 0.0103 molar solution of an electrolyte was found to be 0.7 atm at  $27^{\circ}\text{C}$ . Calculate Van't Hoff factor. (Ans :  $i = 3$ )
15. ★ The maximum allowable level of nitrates in drinking water as set by U.S. is 45 mg nitrate ions/ $\text{dm}^3$ . Express this level in ppm? (Ans : 45 ppm)
16. 75.2 g of Phenol ( $\text{C}_6\text{H}_5\text{OH}$ ) is dissolved in solvent of  $K_f = 14$ , if the depression in freezing point is 7 K, then find the % of Phenol that dimerises. (Ans : 75%)
17. ★ An aqueous solution of glucose boils at  $100.01^{\circ}\text{C}$ . The molal elevation constant for water is  $0.5\text{ K kg mol}^{-1}$ . What is the number of glucose molecule in the solution containing 100 g of water. (Ans :  $1.2 \times 10^{21}$  molecules)
18. A bottle of commercial  $\text{H}_2\text{SO}_4$  [density = 1.787 g/mL] is labelled as 86% by mass.  
(a) What is the molality of the acid?  
(b) What volume of the acid has to be used to make 1 litre 0.2 M  $\text{H}_2\text{SO}_4$ ?  
(c) What is the molality of the acid? (Ans : 15.7 M, 12.74mL, 62.86 m)

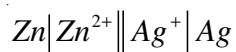
## Chapter - 3

# ELECTROCHEMISTRY

### VSA Type Qyestiuous (1 Mark)

1. Define electrochemistry.
2. List two main advantages of electrochemistry.
3. What is a galvanic cell?
4. Draw a cell diagram for Daniell cell.
5. Mention the purpose of salt-bridge placed between two half cells of a galvanic cell.
6. Condition for Daniell cell in which there is no flow of electrons or current or we can conclude that there is no chemical reaction.  $(E_{ext.} = 1.1V)$
7. What is meant by standard electrode potential?
8. Give the redox reaction involved in Daniell cell.
9. How is electrode potential different from a cell potential?
10. What is the significance of standard hydrogen electrode(SHE)?
11. Can you store zinc sulphate solutions in a copper container?
12. How does an electrochemical series help us in predicting whether a redox reactions is feasible in a given direction or not?
13. Write Nernst equation for the electrode reaction  $M^{n+}(aq) + ne^{-} \rightarrow M(s)$
14. As per electrochemical series and on the basis of  $E^{\circ}$  values :-
  - (a) Gas which have highest tendency to reduce.
  - (b) Weakest oxidising ion.
15. List the two factors that influence the value of cell potential of a galvanic cell.
16. How is equilibrium constant of a reaction related to standard cell potential?
17. Why is equilibrium constant (K) related to only  $E^{\circ}_{cell}$  and not  $E_{cell}$ ?
18. Define cell constant.
19. What is the SI unit of cell constant?
20. Define specific conductance.
21. How does specific conductance vary with temperature?
22. What is the SI unit of (i) Conductance (ii) Conductivity?
23. What is a concentration cell?

24. State one difference between a primary battery and secondary battery.
25. ★ Galvanized iron does not corrode even if the coating of zinc is broken. Explain why?
26. Define the term 'Faraday Constant.' What is its numerical value?
27. Write the name of a chemical substance which is used to prevent the corrosion.
28. What is the use of platinum foil in the hydrogen electrode?
29. ★ What is the direction of flow of electrons in the following cell?



30. Rusting of iron becomes quicker in saline water. Explain.
31. ★ Two metals A and B have reduction potential values of  $-0.25\text{ V}$  and  $0.80\text{ V}$  respectively. Which of these will liberate hydrogen gas from dilute  $\text{H}_2\text{SO}_4$ ?
32. Express the relation between conductivity and molar conductivity.
33. Name the cell which was used in Apollo space programme.
34. ★ How many Faraday's are required to reduce 2 gm. mole of  $\text{Cu}^{2+}$  to  $\text{Cu}$  metal.

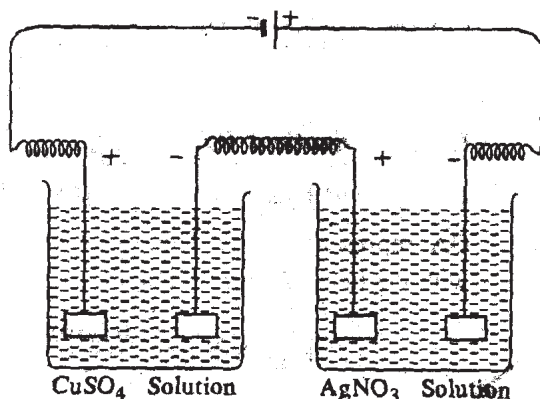
(Ans : 4 F)

### SA (I) Type Questions (2 Marks)

1. List four factors which affect the conductivity of ionic solutions.
2. A conventional method of representing a Daniell cell is  

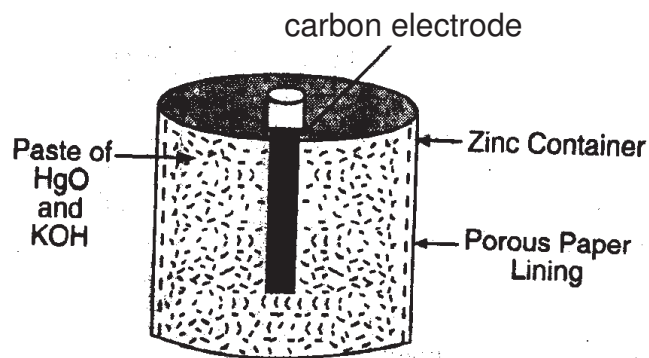
$$\text{Zn}(s)|\text{Zn}^{2+}(1M)||\text{Cu}^{2+}(1M)|\text{Cu}(s).$$
  - (a) Draw a diagram of the cell and mark anode and cathode as current is drawn from the cell.
  - (b) Write the reactions taking place at the cathode and the anode during operation of Daniell cell.
3. Mention two differences between electrochemical cell and electrolytic cell.
4. Describe the construction and working of standard hydrogen electrode.
5. List four differences between metallic conductance and electrolytic conductance.
6. How does molar conductivity vary with concentration for  
  - (a) Weak electrolytes
  - (b) for strong electrolytes? Give reasons for these variations.
7. Suggest a method to determine the  $\Lambda_m^0$  value of water.
8. Write the cell reaction which occur in the lead storage battery (a) when the battery is in use (b) when the battery is on charging.
9. Why absolute value of electrode Potential cannot be determined?

10. ★ Account for the fact that when chlorine is passed through a fluoride solution, no reaction takes place. (Given  $E^\circ_{F_2/2F^-} = 2.87V$ ,  $E^\circ_{Cl_2/2Cl^-} = -1.36V$ )
11. ★ Copper does not dissolve in  $HCl$  (aq) but dissolves in  $HNO_3$  (aq) producing  $Cu^{2+}$  ions. Explain the difference in behaviour.  
(Given  $E^\circ_{Cu^{2+}/Cu} = +0.34V$ ,  $E^\circ_{Cl_2/2Cl^-} = +1.36V$  and  $NO_3^- + 4H^+ + 3e^- \rightarrow NO_{(g)} + 2H_2O$ ,  $E^\circ_{NO_3^-/NO} = +0.97V$ ).
12. Explain the following observations :
- The product of electrolysis of molten  $NaCl$  are sodium metal and chlorine gas.
  - The product of electrolysis of aqueous sodium chloride solutions are  $NaOH$ ,  $Cl_2$  and  $H_2$ .
13. Represents a concentration cell using copper sulphate solutions of two concentrations  $C_1$  and  $C_2$ . How can emf of such a cell be calculated.
14. What are full cells? Describe the principle and overall reaction involved in the working of hydrogen-oxygen fuel cell.
15. Explain the meaning of the terms :-
- Ionic mobility
  - Overvoltage
16. What is electrochemical series? List its two characteristics.
17. ★ The figure shows two electrolytic cells connected in series.



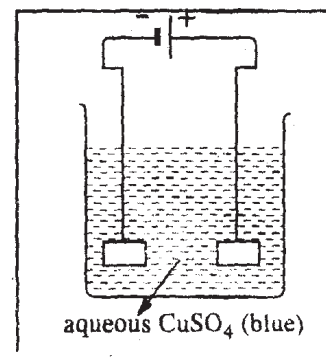
- How much electricity is required for the reduction of 1 mole of  $Ag^+$  ions to  $Ag$ ?
- If three Faradays of electricity is passed through these cells what is the ratio of cations [ $Ag^+$  and  $Cu^{2+}$ ] deposited on cathodes? (**Ans** : (a) 1F, (b) 2:1)

18. ★



- (a) Which substance act as anode and which as cathode?  
(b) Which electrolyte is used in the cell?  
(c) What is the cell potential of the cell?
19. ★ Two platinum electrodes are dipped in an aqueous solution of copper sulphate blue in colour. A current is passed through it.

- (a) What will happen on the two electrodes?  
(b) What will happen to the colour of this solution?



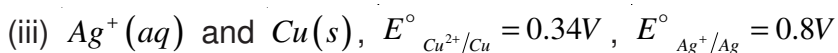
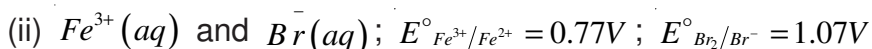
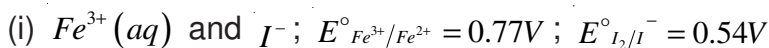
20. Account for the following observations :
- (i) In a dry cell, the build up of ammonia gas around the carbon cathode should disrupt the electric current, but in practice this does not happen.  
(ii) Ordinary dry cells are not rechargeable.
21. Some standard reduction potentials are as given below :-

Half-Cell	$E^\circ$ value
$F_2(g)/F^-$	+ 2.9 V
$Ag^+/Ag$	+ 0.8 V
$Cu^+/Cu$	+ 0.5 V
$Fe^{2+}/Fe$	- 0.4 V
$Na^+/Na$	- 2.7 V
$K^+/K$	- 2.9 V

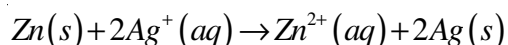
- (a) Arrange oxidising agents in order of increasing strength.
- (b) Which of these oxidising agents will oxidise  $Cu$  to  $Cu^+$  under standard conditions?

### SA (II) Type Questions (3 Marks)

1. ★ Using the standard electrode potential, product the reaction, if any that occurs between the following :-



2. State the relationship amongst cell constant of a cell, resistance of this solution in the cell and conductivity of the solution. How is molar conductivity of a solute related to conductivity of its solution?
3. Describe the composition of anode and cathode in a mercury cell. Write the electrode reactions for this cell. Why it provides constant voltage throughout its life?
4. Give reasons for :
- (i) For a weak electrolyte, its molar conductivity in dilute solution increases sharply as its concentration in solution is decreased.
- (ii) Molar conductivity of a strong electrolyte like  $KCl$  decrease slightly while increasing concentration?
- (iii) It is not easy to determine  $\Lambda^\circ_m$  of a weak electrolyte by extrapolation of  $\sqrt{c}$  vs  $\Lambda_m$  curve?
5. List two disadvantages of corrosion. Describe the following methods of prevention of corrosion.
- (a) Electrochemical method
- (b) Covering the surface by other metal.
6. Formulate the galvanic cell in which the following reaction takes place :-



State :-

- (a) Which one of its electrodes is negatively charged?
- (b) The reaction taking place at each of its electrode.
- (c) The direction of current within this cell.

7. ★ The standard reduction potentials are as given below :-

Half Cell	$E^\circ$ Value
$Zn(OH)_2/Zn$	- 1.245 V
$Mg(OH)_2/Mg$	- 2.690 V
$Fe(OH)_2/Fe$	- 0.877 V
$Fe(OH)_3/Fe$	- 2.30 V

Under standard conditions :

- Which is the strongest reducing agent?
- Which reducing agent could reduce  $Zn(OH)_2$  to  $Zn$ ?
- Which reducing agent could reduce  $Fe(OH)_2$  to  $Fe$ ?

### Long answer type Questions (5 Marks Questions)

1. (a) Explain with examples the terms weak and strong electrolytes.

(b) Calculate the emf of the cell  $Mg|Mg^{2+}(0.001M)||Cu^{2+}(0.0001M)|Cu$

Given  $E^\circ_{Cu^{2+}/Cu} = 0.34V$ ,  $E^\circ_{Mg^{2+}/Mg} = -2.375V$ .

(Ans : 2.651 V)

2. (a) Explain Kohlrausch's law of independent migration of ions. Mention two applications of this law.

(b) The conductivity of 0.001M  $CH_3COOH$  is  $4.95 \times 10^{-5} Scm^{-1}$ . Calculate its dissociation constant. Given for acetic acid  $\Lambda^\circ$  is  $390.5S cm^2 mol^{-1}$ .

(Ans :  $1.85 \times 10^{-5}$ )

3. (a) Define molar conductivity. How does it vary with temperature?

(b) Resistance of a solution (A) is 50 ohm and that of solution (B) is 100 ohm, both solutions being taken in the same conductivity cell, if equal volumes of solutions (A) and (B) are mixed, what will be the resistance of the mixture, using the same cell? Assume that there is no increase in the degree of dissociation of (A) and (B) on mixing.

(Ans : 66.66 ohm)

[Hint :

$$\text{For (i) } k_1 = \frac{1}{50} y, k_2 = \frac{1}{100} y : \text{ Specific conductance of mixture} = \frac{k_1 + k_2}{2}$$

$$\frac{k_1 + k_2}{2} = \frac{1}{R} \times y, \quad \frac{1}{2} \left[ \frac{y}{50} + \frac{y}{100} \right] = \frac{1}{R} \times y \Rightarrow R = 66.66 \text{ ohm ]}$$

4. (a) Explain Faraday's first and second law of electrolysis.
- (b) Silver is deposited on a metallic vessel of surface area  $800 \text{ cm}^2$  by passing current of 0.2 ampere. for 3 hours. Calculate the thickness of silver deposited. [Density of silver  $10.47 \text{ g cm}^{-3}$ , atomic mass of silver =  $107.924 \text{ gmol}^{-1}$ ]

(Ans :  $2.9 \times 10^{-4} \text{ cm}$ )

5. (a) Describe the construction and working of standard hydrogen electrode.
- (b) Calculate the equilibrium constant for the reaction :-

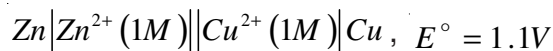
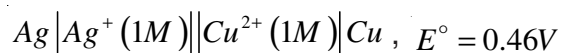


Given  $E^\circ_{Ce^{4+}/Ce^{3+}} = 1.44V$ ,  $E^\circ_{Fe^{3+}/Fe^{2+}} = 0.68V$ .

(Ans :  $7.6 \times 10^{12}$ )

### Numerical Problems :-

1. ★ The emf of the following cells are

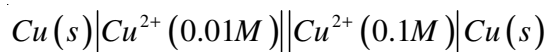


(Ans : 0.64 V)

Calculate emf of the cell



2. For concentration cell

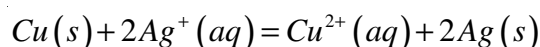


(a) Calculate the cell potential

(b) Will the cell generate emf when concentration becomes equal.

(Ans : 0.295 V, No)

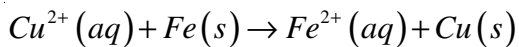
3. Calculate the equilibrium constant for the reaction at  $25^\circ C$ .



The standard cell potential for the reaction at  $25^\circ C$  is 0.46 V.

(Ans :  $4.0 \times 10^{15}$ )

4. Calculate  $\Delta G^\circ$  for the reaction

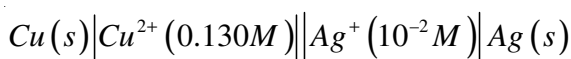


$$E^\circ_{Cu^{2+}/Cu} = +0.34V, E^\circ_{Fe^{2+}/Fe} = -0.44V$$

(Ans : -150, 540 kJ)

5. Conductivity of two electrolytic solution of 0.1M concentration of the substances A and B are  $9.2 \times 10^{-3}$  and  $4.7 \times 10^{-4} \Omega \text{ cm}^{-1}$ , which one of these offer less resistance for the flow of current and which one is a stronger electrolyte?

6. Write the Nernst equation and calculate the emf of the following cell at 298K.



$$\text{Given } E^\circ_{Cu^{2+}/Cu} = +0.34V, E^\circ_{Ag^+/Ag} = +0.80V.$$

(Ans : 0.25 V)

7. A Zinc rod is dipped in 0.1M solution of  $ZnSO_4$ . The salt is 95% dissociated at this dilution at 298K. Calculate the electrode potential  $E^\circ_{Zn^{2+}/Zn} = -0.76V$ . (Ans : -0.7902V)

8. For the electrode Pt,  $H_2(1 \text{ atm}) | H^+(aq)(XM)$ , the reduction electrode potential at  $25^\circ C$  is  $-0.34V$ . Write the electrode reaction equation and calculate the value of X. How will you deduce the  $pH$  of solution from this result?

$$(\text{Ans : } X = 1.807 \times 10^{-6}, pH = 5.743)$$

9. For what concentrations of  $Ag^+(aq)$  will the emf of the given cell be zero at  $25^\circ C$  if concentration of  $Cu^{2+}(aq)$  is 0.1M? Given  $E^\circ_{Ag^+/Ag} = 0.80V, E^\circ_{Cu^{2+}/Cu} = +0.34V$ .

(Ans :  $5.3 \times 10^{-9}$ )

10. Zinc granules are added in excess to a 500 mL of 1.0 M nickel nitrate solution at  $25^\circ C$  until the equilibrium is reached. If the standard reduction potential of  $Zn^{2+}/Zn$  and  $Ni^{2+}/Ni$  are  $-0.75V$  and  $-0.24V$  respectively, find out the concentration of  $Ni^{2+}$  in solution at equilibrium.

(Ans :  $5.88 \times 10^{-18} M$ )

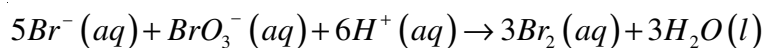
11. The molar conductivity of 0.1M  $CH_3COOH$  solution is  $4.6 \text{ S cm}^2 \text{ mol}^{-1}$ . Calculate the conductivity and resistivity of the solution. **(Ans :  $0.00046 \text{ s cm}^{-1}$ ,  $2174 \Omega \text{ cm}$ )**
12. The molar conductivities of  $NH_4^+$  ion and  $73.5 \text{ Scm}^2 \text{ mol}^{-1}$  and  $76.2 \text{ Scm}^2 \text{ mol}^{-1}$  respectively. The specific conductivity of 0.1 M  $NH_4Cl$  is  $1.288 \times 10^{-2} \text{ Scm}^{-1}$ . Calculate the dissociation constant of  $NH_4Cl$ . **(Ans :  $7.396 \times 10^{-2}$  )**
13. Molar conductivity as infinite dilution for  $NH_4Cl$ ,  $NaOH$  and  $NaCl$  solution at 298K are respectively 129.8, 218.4 and  $108.9 \text{ Scm}^2 \text{ mol}^{-1}$  and  $\Lambda_m$  for  $10^{-2}$  M solution of  $NH_4OH$  is  $9.33 \text{ Scm}^2 \text{ mol}^{-1}$ . Calculate the degree of dissociation of  $NH_4OH$ . **(Ans : 0.039)**

## Chapter - 4

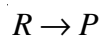
# CHEMICAL KINETICS

### VSA Type Questions (1 Mark)

1. Define 'Rate of reaction.'
2. Express the rate of reaction in terms of  $Br^- (aq)$  as reactant and  $Br_2 (aq)$  as product for the reaction :



3. For a reaction

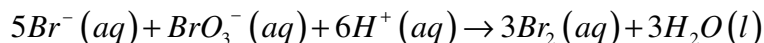


the rate of reaction is denoted by

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

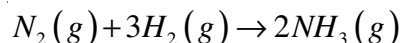
Why a positive sign (+) is placed before  $\frac{\Delta[P]}{\Delta t}$  and not before  $\frac{\Delta[R]}{\Delta t}$ ?

4. ★ for the reaction :



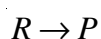
Why do we not include  $\frac{1}{3} \frac{d[H_2O]}{dt}$  for expressing the reaction rate?

5. Express the rate of reaction in terms of disappearance of hydrogen in the reaction.

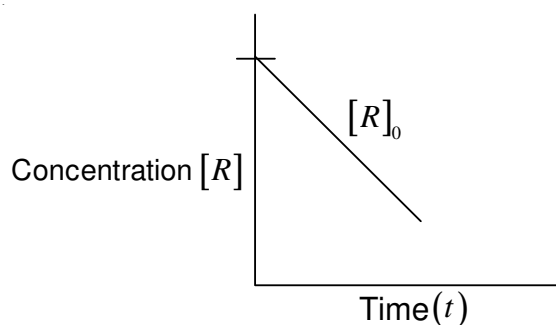


6. Why rate of reaction does not remain constant throughout?
7. State two factors by which the rate of reaction can be increased.
8. Mention the units of rate of reaction.
9. Write the unit of first order rate constant of gaseous reactions if the partial pressure of gaseous reactant is given in *atm.*.
10. A zero-order reaction :

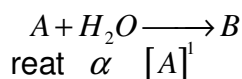
Reactant to product is represented by the graph.



What does the slope of the graph represent?



11. Mention the order of a reaction if the rate of reaction does not depend on the concentration of any of the reactants.
12. For the elementary step of a chemical reaction

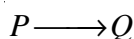


What is the (i) molecularity and (ii) order of the reaction?

13. ★ For a chemical reaction  $A \longrightarrow B$

The rate of the reaction quadruples when the concentration of A is doubled. The rate of the reaction is :  $Rate = K[A]^n$ . What is the value of n? (Ans : n = 2)

14. What is the value of the order of reaction of an artificial radioactive decay?
15. Mention one example of zero order reaction.
16. Express the relation between the half-life period of a reactant and initial concentration for a reaction of  $n^{th}$  order.
17. ★ A reaction is 50% completes in 2 hours and 75% complete in 4 hours. What is the order of reaction?
18. What is the source of activation energy in a photochemical reaction?
19. ★ Consider an endothermic reaction



With activation energies  $E_b$  and  $E_f$  respectively for the backward and forward reactions. Express the relationship between  $E_b$  and  $E_f$ .

[Hint :  $\Delta H = +ive$ ,  $\Delta H = E_f - E_b$  or  $E_b - E_f$ ]

20. Suggest an appropriate reason for the observation : “on increasing temperature of the reacting system by 10 degrees, the rate of reaction almost doubles.”
21. The rate constant of a reaction is given by the expression :

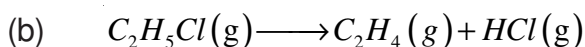
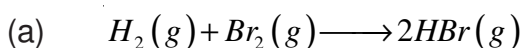
$$k = A.e^{-E_a/RT}$$

Which factor in this expression should register a decrease so that the reaction proceeds rapidly?

22. Two reactions have identical values of  $E_a$ . Does this ensure that they will have the same rate constant if run at the same temperature? Explain.
23. ★ For a chemical reaction activation energy is zero and at 300 K rate constant is  $5.9 \times 10^{-5} \text{ sec}^{-1}$ , what will be the rate constant at 400K? (Ans :  $5.9 \times 10^{-5} \text{ sec}^{-1}$ )

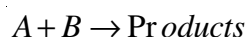
### SA (I) Type Questions (2 Marks)

1. List four factors which affect the rate of a chemical reaction. State how each of these factors changes the reaction rate.
2. Differentiate between :-
- (a) Average rate and instantaneous rate of a chemical reaction.
- (b) Rate of a reaction and rate constant of the reaction.
3. What is meant by 'rate law' for a chemical reaction? Write rate law for the following reactions :-



(Ans : (a) Rate =  $K[H_2][Br_2]$ , (b) Rate =  $K[C_2H_5Cl]$ )

4. The rate law for the reaction



is given by

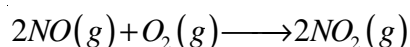
$$\text{Rate} = k[A]^n[B]^m$$

On doubling the concentration of A and reducing the concentration of B to half of its original concentration, calculate the ratio of the new rate to the earlier rate of reaction.

(Hint : New rate =  $k[2A]^n \left[ \frac{B}{2} \right]^m$ )

(Ans :  $2^{(n-m)}$ )

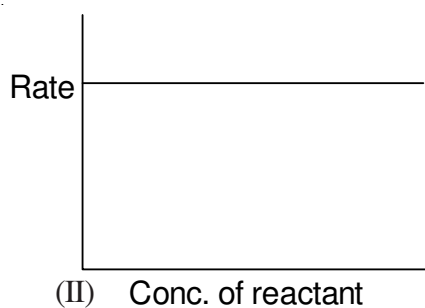
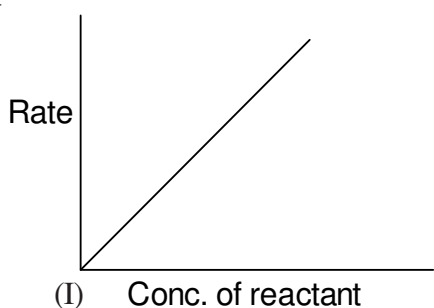
5. For the reaction in a close vessel :



$$\text{Rate} = k[NO]^2[O_2]$$

If the volume of the reaction vessel is doubled, how would it affect the rate of the reaction?  
**(Ans : Diminish to 1/8 value of initial value)**

- What is meant by 'half life of a reaction'? Show that half life for a first order reaction is independent of initial concentration.
- Explain with an example, what is a pseudo order of reaction.
- List four methods used to determine the order of reaction.
- Show that time required for 99.9% of the first order reaction is 10 times of  $t_{1/2}$  for first order chemical reaction.
- The graphs (I and II) given below are plot of rate of reaction verses concentration of the reaction. Predict the order from the graphs.



11. ★ (a) For a reaction  $A + B \rightarrow Products$ , the rate law is given by

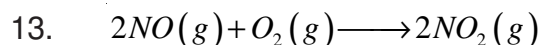
$$r = k[A]^{1/2}[B]^2$$

What is the order of reaction?

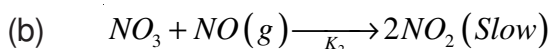
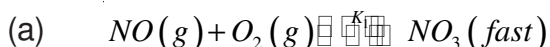
- (b) The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times how will it affect the rate of formation of Y?

**(Ans : (a)  $5/2$  (b) 9 times)**

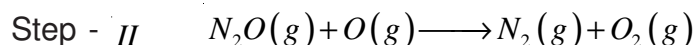
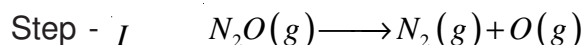
12. The slope of the line in the graph of  $\log k$  verses  $1/T$  for a reaction is  $-5841 \text{ K}$ . Calculate the energy of activation.  
**(Ans :  $1.12 \times 10^5 \text{ J mol}^{-1}$ )**



What is the predicted of rate law, if mechanism is



14. ★ Gaseous phase decomposition of  $N_2O$  is given below :



- Write a chemical reaction for overall reaction.
  - Identify the reaction intermediate.
  - What is the molecularity of each of the elementary reaction?
  - What is the molecularity of the overall reaction?
15. A highly exothermic reaction with low activation energy might become explosive as it proceeds.

### SA (II) Type Questions (3 Marks)

- A reaction is first order w.r.t. A and second order w.r.t. B.
  - Write the differential rate equation.
  - How is the rate affected on increasing the concentration of B three times?
  - How is the rate affected when the concentrations of both A and B are doubled.
- What is meant by zero order reaction? Derive an integrated rate equation for a zero order reaction.
- Write two points of difference between order and molecularity of a reaction.
  - For a reaction  $A + B \rightarrow \text{Products}$  the rate law is given by

$$r = k[A]^{1/2}[B]^2$$

Determine the order of the reaction.

4. ★ Explain the following :-
- A lump of coal burns at moderate rate in air while dust burns explosively.
  - Average rate of reaction does not give the true picture of the reaction.
  - Reactions of high molecularity less in number?
5. Draw a graph between fraction of molecules and kinetic energy of the reacting species for two different temperatures :
- Room temperature
  - Temperature  $10^\circ C$  higher than the room temperature
  - Indicate the fraction of additional molecules which react at  $(t+10)^\circ C$ .



**Calculate :-**

- (i) the order of reaction with respect to A and with respect to B.
- (ii) the rate constant at 300K.
4. (a) For first order chemical reaction half life period ( $t_{1/2}$ ) is concentration independent. Justify the statement by using integrated rate equation.
- (b) A first order reaction has a rate constant of  $0.0051 \text{ min}^{-1}$ . If we begin with 0.1M concentration to the reactant, what concentration of reactant will remain in solution after 3 hours?

**Numerical Problems :-**

1. For a chemical reaction  $A \longrightarrow B$ , it was found that concentration of B increases by  $0.20 \text{ mol L}^{-1}$  in half an hour. What is the average rate of reaction.
2. In the reaction  $R \longrightarrow P$ , the concentration of R decreases from 0.03 M to 0.02 M in 25 minutes. Calculate the average rate of reaction using unit of time both in minutes and seconds.  
(Ans :  $4 \times 10^{-4} \text{ M min}^{-1}$ ,  $6.66 \times 10^{-6} \text{ M s}^{-1}$ )
3. A first order reaction is found to have a rate constant  $k = 200 \text{ s}^{-1}$ . Find the half life period of the reaction.  
(Ans :  $3.465 \times 10^{-3} \text{ s}$ )
4. A first order reaction has a rate constant  $1.15 \times 10^{-3} \text{ s}^{-1}$ . How long will 5 g of this reactant take to reduce to 3g?  
(Ans :  $t = 444 \text{ s}$ )
5. ★ A first order reaction was started with a decimolar solution of the reactant. 8 minutes and 20 seconds later its concentration was found to be  $\frac{M}{1000}$ . Calculate the rate constant of the reaction.

[Hint :  $[R]_0 = \frac{M}{10} = 0.1M$  ;  $[R]_{500} = \frac{M}{1000} = 0.001M$  . Apply  $k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$ ]

(Ans :  $4.606 \times 10^{-3} \text{ s}^{-1}$ )

6. A certain reaction is 50% complete in 20 min at 300 K and the same reaction is again 50% complete in 5 min at 350K. Calculate the activation energy if it is a first order

reaction. ( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $\log 4 = 0.602$ )

(Ans : 24.206 kJ/mol)

7. The rate of reaction triples when the temperature changes from  $20^\circ\text{C}$  to  $50^\circ\text{C}$ . Calculate the energy of activation. ( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ ,  $\log 3 = 0.4771$ )

(Ans : 28.818 kJ  $\text{mol}^{-1}$ )

8. ★ (a) For a reaction, the energy of activation is zero. What is the value of rate constant at 300K if  $k_1 = 1.6 \times 10^{-6} \text{ Sec}^{-1}$  at 280K ( $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$ )

(Ans :  $k_2 = k_1 = 1.6 \times 10^{-6} \text{ Sec}^{-1}$ )

- (b) Rate constant ( $k$ ) of a reaction varies with temperature according to the equation

$$\log k = \log A - \frac{E_a}{2.303T}$$

Where  $E_a$  is the energy of activation. On plotting a graph between  $\log k$  versus  $\frac{1}{T}$ , a straight line with a slope  $-6670\text{K}$  is obtained. Calculate  $E_a$  for the reaction ( $R = 127.71 \text{ kJ mol}^{-1}$ )

[Hint : Slope of the line =  $E_a/2.303 R$ ]

9. ★ A hydrogenation reaction is carried out at 550 K. If the same reaction is carried out in the presence of a catalyst at the same rate. The temperature required is 400 K calculate the activation energy of the reaction if the catalyst lowers the activation barrier by 20 kJ  $\text{mol}^{-1}$ .

[Hint :  $k = AE^{-E_a/RT}$ . In the absence of catalyst,  $E_a = x \text{ kJ mol}^{-1}$ . In the presence of catalyst,  $E_a = (x - 20) \text{ kJ mol}^{-1}$ ]

(Ans :  $E_a = 100 \text{ kJ mol}^{-1}$ )

10. The rate constant for the first order decomposition of  $\text{H}_2\text{O}_2$  is given by the following equation  $\log k = 14.34 - 1.25 \times 10^4 \text{ K} / T$ .

Calculate  $E_a$  for this reaction and at what temperature will its half-period be 256 minutes.

11. Show that for a first order reaction, time required for 99% completion is twice for the

time required for the completion of 90% of reaction.

12. The experimental data for the reaction  $2A + B_2 \longrightarrow 2AB$ , are as follows. Write probable rate expression

[A] <i>mol litre<sup>-1</sup></i>	[B <sub>2</sub> ] <i>mol litre<sup>-1</sup></i>	Initial Rate <i>mol litre<sup>-1</sup> sec<sup>-1</sup></i>
0.5	0.5	$1.6 \times 10^{-4}$
0.5	1.0	$3.2 \times 10^{-4}$
1.0	1.0	$3.2 \times 10^{-4}$

(Ans :  $\frac{dx}{dt} = k[B_2]$ )

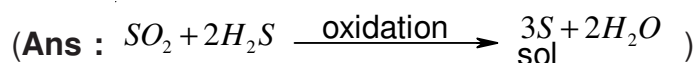
13. A reaction is 20% complete in 20 minutes. Calculate the time required for 80% completion of reaction, if reaction follow the first order kinetics. (Ans : 144 min)

## Chapter - 5

# SURFACE CHEMISTRY

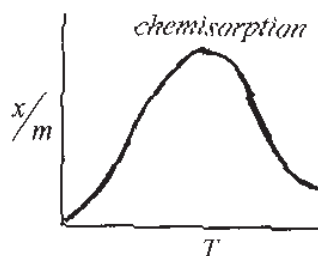
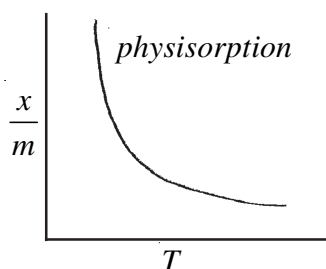
### VSA Type Qyestions (1 Mark)

1. Why does a gas mixed with another gas not form a colloidal system?
2. Under what condition it is possible to obtain ultra clean surface of the metals.
3. Why adsorbate particles are attracted and retained on the surface of adsorbent?
4. What is sorption? Give one example.
5. "Chemisorption is highly specific." Illustrate with one example.
6. "Adsorbents in finely divided form are more effective." Why?
7. Define the term 'Critical temperature' of the gas.
8. Mention one shape-selective catalyst used to convert alcohol into gasoline.
9. 'Generally high temperature is favourable for chemisorption as compared to physisorption.' Why?
10. Name the catalyst used in the following process :
  - (i) Haber process for the manufacture of  $NH_3$  gas.
  - (ii) Ostwald process for the manufacture of nitric acid.
11. Write the relationship given by Freundlich, also mention the terms involved.
13. Which group elements show maximum catalytic activity for hydrogenation reactions?  
(Hint : 7-9 group. elements)
14. How sol of sulphur can be prepared by chemical method?



15. Name the enzyme which converts milk into curd. (Ans : lacto bacilli)
16. What are the optimum temperature and  $pH$  under which enzymes are highly active.  
(Ans : Temperature 298–310K &  $pH$  –5 to 7)
17. What are the physical states of dispersed phase and dispersion medium in foam rubber.
18. Identify the micelle in the following :-
  - (i) Sulphur sol
  - (ii) Solution of  $KCl$
  - (iii) Starch sol
  - (iv)  $C_{17}H_{35}COO^-Na^+$

19. What is the composition of collodion solution?
20. Why tyndal effect is observed when colloidal solution are viewed at right angles to the passage of light?
21. Why colloidal particles show Brownian movement?  
(**Hint** : Due to unbalanced bombardment of the particles)
22. 'Colloidal particles are charged.' Why?
23. How can the ultrafiltration process of a colloidal solution be made faster?
24. State the sign of entropy changed involved when the molecules of a substance get on a solid surface.  
(**Ans** :  $\Delta S = -ive$ )
25. Define the term peptization.
26. Why is the froth-floatation method selected for the concentration of sulphide ores?  
(**Hints** : Because only particles of sulphide ores are wet by oil)
27. Why does sky appears blue to us?
28. What happens when hydrated ferric oxide (+ve sol) and arsenious sulphide (-ve sol) are mixed in almost equal proportions?
29. ★ Gelatin is generally added to ice-cream?  
(**Hint** : ice-cream is o/w emulsion and gelatin acts as emulsifier.)
30. How lake test is based upon adsorption?  
(**Hint** :  $Al(OH)_3$  has the capacity to adsorb the colour of blue litmus from the solution.)
31. ★ Draw the graphs showing relationship between extent of adsorption and temperature for both physisorption and chemisorption.



32. ★ What is saturated pressure in Freundlich's isotherm?
33. ★ Mention the two conditions for the formation of micelles.  
(**Hint** : CMC &  $T_k$ )
34. ★ 'Ultramicroscope does not provide any information about the size and shape of colloidal particles.' Why?
35. Which effect is responsible for the stability of sols?  
(**Hint** : Stirring effect due to Brownian movement.)

36. What is purple of casium? (Ans : Colloidal sol of gold)
37. Which of the following is more effective in coagulating +vely charged ferric hydroxide sol  
- (i)  $KCl$  (ii)  $CaSO_4$  (iii)  $K_3[Fe(CN_6)]$
38. Mention the cause of peptization.
39. State the purpose of impregnating the filter paper with collodion solution.
40. Mention one use of  $ZSM-5$  catalyst.

### SA (I) Type Questions (2 Marks)

41. Arrange the gases  $CO$ ,  $N_2$  and  $CH_4$  in increasing order of adsorption on the surface of charcoal in a closed vessel. Give reasons also.

(Hint :  $N_2 < CO < CH_4$  as critical temp.  $\propto$  Extent of adsorption)

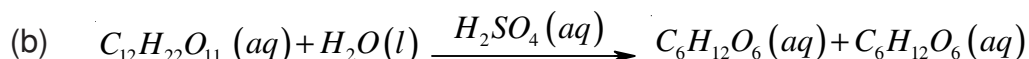
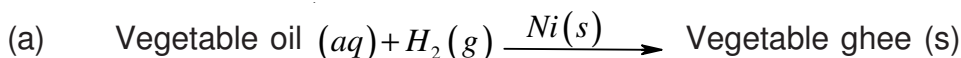
42. What happens :-

- (a) when animal charcoal is added in a solution of methylene blue dye.  
(b) when aqueous solution of raw sugar is passed over beds of animal charcoal.

43. A small amount of silica gel and a small amount of anhydrous calcium chloride are placed separately in two beakers containing water-vapour. Name the phenomenon that takes place in both the beakers.

(Hint : Silica gel-Adsorption, Anhydrous  $CaCl_2$ -Absorption, as it forms  $CaCl_2 \cdot 2H_2O$  )

44. Write the differences between adsorption and absorption.
45. How physisorption can be distinguished from Chemisorption?
46. Identify the following reactions as Homogeneous and Heterogeneous catalysis :



47. When and why Gas masks are used?
48. Write the factors upon which the catalytic reaction of shape-selective catalysis depends?  
(Hints : (a) Pore structure of the catalyst (b) Size of the reactant & product molecules. )
49. Mention two examples of emulsifying agents for o/w emulsions and w/o emulsions.
50. Suggest a mechanism of enzyme catalysed reaction along with the diagram.
51. What are the conditions for the occurrence of (a) Electrophoresis and (b) Electroosmosis.

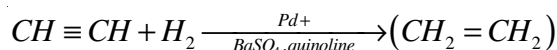
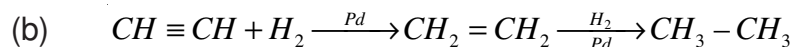
52. In what way, these are different :- (a) a sol from gel (b) a gel from emulsion.
53. State "Hardy Schulze Rule" with one example.
54. What is an emulsifying agent? What role does it play in forming an emulsion?
55. Define the terms :-  
 (a) Helmholtz electric double layer  
 (b) Zeta potential.
56. ★ A graph between  $\log\left(\frac{x}{m}\right)$  and  $\log p$  is a straight line at an angle of  $45^\circ$  with intercept on the y-axis,  $(\log k)$  equal to 0.3010. Calculate the amount of the gas absorbed per gram of the adsorbent under a pressure of 0.5 atmosphere.
- (Ans :  $\frac{1}{n} = \log 45^\circ = 1$ ,  $\log k = 0.3010$ ,  $k = 2$ ,  $p = 0.5$  atm.  $\frac{x}{m} = Kp^{\frac{1}{n}} = 2 \times (0.5)^1 = 1.0$ )
57. ★ Mention the two necessary conditions for the observation of Tyndall effect.
58. ★ "The colour of colloidal solution depends on the wavelength of light scattered by the dispersed particles." Justify the statement by giving one example.
59. ★ Account for the following :-  
 (a) Artificial rain can be caused by spraying electrified sand on the clouds.  
 (b) Electrical precipitation of smoke.
60. Write chemical equations for the preparation of sols :-  
 (a) Gold sol by reduction  
 (b)  $Fe(OH)_3$  sol by hydrolysis.
61. ★ How can the two emulsions can be distinguished :-  
 (a) oil in water type and  
 (b) water in oil type.

### SA (II) Type Questions (3 Marks Questions)

62. What is meant by activation of the adsorbent? How is it achieved?
63. Write the difference between  
 (a) Catalysts and enzymes  
 (b) Promoters and poisons (with the help of an example.)
64. Write the steps of 'Modern Adsorption Theory of Heterogenous Catalysis.'

65. Mention the two important features of solid catalysts and explain with the help of suitable examples.
66. How are the following colloids different from each in respect of dispersion medium and dispersed phase? Give one example of each type. (a) An aerosol (b) A hydrosol (c) An emulsion.
67. What happens :-
- By persistent dialysis. (**Hint** : coagulation)
  - When river water meets the sea water.
  - When alum is applied on cuts during bleeding.
68. Distinguish between multimolecular, macromolecular and associated colloids with the help of one example of each.
69. (a) How are emulsions useful in preparing photographic plates or films?  
 (b) Explain with diagram the process of electrical precipitation of smoke.
70. (a) What property of colloids is responsible for the sun to look red at the time of setting?  
 (b)  $C_2H_2$  on addition with  $H_2$  forms ethane in presence of palladium but if reaction is carried in the presence of barium sulphate and quinoline, the product is ethene and not ethane.

(**Ans** : (a) Sun is at horizon and blue part of the light is scattered away by the dust particles as light has to travel a long distance through the atmosphere.



71. (a) How does the size of the colloidal particles comparable to the size of the particles present in the true solution?  
 (b) Calculate the ratio of the volume of the colloid particles ( $V_c$ ) and volume of the solute particles in a true solution ( $V_s$ ).

(**Ans** : (a) For true solution diameter range = 1 to 10 Å for colloidal solution diameter range = 10 to 1000Å)

$$(b) \quad \frac{V_c}{V_s} = \frac{4/3 \pi r_c^3}{4/3 \pi r_s^3} = \frac{r_c^3}{r_s^3} = \frac{(10/2)^3}{(1/2)^3} = 10^3$$

## Chapter - 6

# GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENTS

### VSA Type Questions (1 Mark)

1. Name three metals which occur in native state in nature. (**Ans** : Au, Ag & Pt)
2. Define the term metallurgy.
3. What are collectors in froth flotation process? Give one example.
4. Give the names and formulae of two ores which are concentrated by froth flotation process. (**Ans** : Galena  $PbS$ ; Zinc blende  $ZnS$ , Cinabar  $HgS$ )
5. Among  $Fe$ ,  $Cu$ ,  $Al$  and  $Pb$ , which metal(s) can not be obtained by smelting. (**Ans** : Al)
6. What is the thermodynamic Criteria for the feasibility of a reaction?  
(**Ans** :  $\Delta G$  should be -ve or  $\log K = (+)$ )
7. Which is a better reducing agent at 983K, carbon or CO? And why?
8. Indicate the temperature at which carbon can be used as a reducing agent for FeO.  
(**Ans** :  $T > 1123K$ )
9. Why aluminium cannot be reduced by carbon?  
(**Hint** : Al is stronger reducing agent than carbon)
10. Name the most impure form of the iron. Mention its one use.  
(**Ans** : Cast iron, For making gutter pipes, stoves, railway sleepers etc.)
11. Name the impurities present in bauxite ore? (**Hint** :  $SiO_2$ , iron oxides and  $TiO_2$ )
12. What is the composition of copper matte?  
(**Hint** :  $Cu_2S$  and  $FeS$ .)
13. Which form of copper is called blister copper?
14. ★ What are froth stabilizers? Give two examples. (**Ans** : Gesols and aniline)
15. ★ A sample of galena is contaminated with zinc blende. Name one chemical which can be used to concentrate galena selectively by froth floatation method.
16. ★ What does a step increase in the slope of a line on Ellingham diagram indicates.  
(**Ans** : Phase transformation)
17. ★ Give one example where hydrometallurgy is used for metal extraction. (**Ans** : Extraction of Au)

18. Which form of iron is used in making anchors, chains and agricultural components?  
(Ans : Wrought iron)
19. Write the reaction involved in the extraction of copper from low grade ores and scraps.  
(Ans :  $Cu^{2+}(aq) + H_2(g) \rightarrow Cu(s) + 2H^+(aq)$ )
20. Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water. Why?
21. Zinc and not copper is used for the recovery of metallic silver from the complex  $[Ag(CN)_2]^-$ , although electrode potentials of both zinc and copper are less than that of Ag. Explain why?  
(Hint : Zinc reacts at faster rate as compared with copper further zinc is cheaper than copper)

### SA (I) Questions (2 Marks)

22. Name the process for the beneficiation of (i) An ore having impurities lighter than it. (ii) Sulphide ores.
23. What is cryolite? Mention its use in the extraction of aluminium. (Ans :  $Na_3AlF_6$ )
24. The graphite electrodes in the extraction of 'Al' by Hall-Haroult process need to be changed frequently. Why?
25. Write the chemical formulae of the following :-  
(a) Haematite (b) Magnetite (c) limonite (d) Siderite.  
(Ans : (a)  $Fe_2O_3$  (b)  $Fe_3O_4$  (c)  $Fe_2O_3 \cdot 3H_2O$  (d)  $FeCO_3$  )
26. Give equations for the industrial extraction of zinc from calamine.  
[Ans :  $ZnCO_3 \rightarrow ZnO + CO_2$  (Calcination) &  $ZnO + C \rightarrow Zn + CO$  (Reduction)]
27. Name the elements contained in anode mud during refining of copper. Why does it contain such elements?  
(Ans : Au & Ag . Since they are less electropositive than copper)
28. What is blister copper? Why is it called so?
29. Name one metal that is refined by each of the following processes :-  
(i) Mond process (ii) Van Arkel process  
(iii) Zone refining (iv) Distillation
30. What kind of elements are suitable for purification by chromatography?

31. Write the chemical reactions taking place in different zones in the blast furnace for the extraction of iron from its ore.
32. How are impurities separated from a bauxite ore to get pure alumina?
33. Why is the reduction of a metal-oxide easier if metal formed is in liquid state at the temperature of reduction?
34. Name the alloying element added to steel :-
- used in cutting tools & crushers.
  - used in making Cables, measuring tapes and aeroplane parts.

(Ans : (i) Chromium (ii) Ni)

35. ★ Free energies of formation  $\Delta G_f$  of  $MgO(s)$  and  $CO(g)$  at 1273 K and 2273 K are given below :-

$$\Delta G_f [MgO(s)] = -941 \text{ kJ mol}^{-1} \text{ at } 1273 \text{ K}$$

$$\Delta G_f [CO(g)] = -439 \text{ kJ mol}^{-1} \text{ at } 1273 \text{ K}$$

$$\Delta G_f [MgO(s)] = -314 \text{ kJ mol}^{-1} \text{ at } 2273 \text{ K}$$

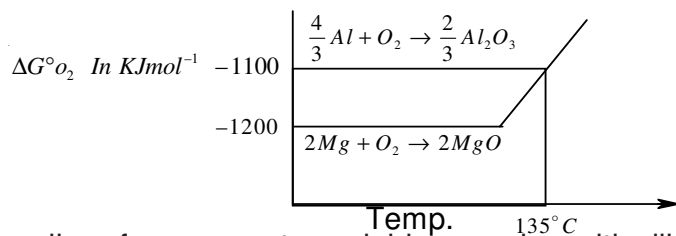
$$\Delta G_f [CO(g)] = -628 \text{ kJ mol}^{-1} \text{ at } 2273 \text{ K}$$

On the basis of above data, predict the temperature at which carbon can be used as a reducing agent for  $MgO(s)$ . (Ans : 2273 K)

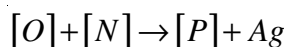
36. Write the method to produce copper matte.
37. ★ Copper can be extracted by hydrometallurgy but not zinc. Explain why?

### SA (II) Type Questions (3 Marks)

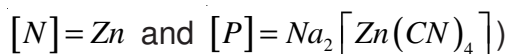
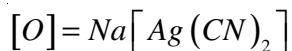
38. State the principles of refining of metals in the following methods :-
- Zone refining
  - Electrolytic refining
  - Vapour phase refining
39. How is pure copper obtained from its principle ore? Write the chemical reactions occurring during the extraction.
40. Suggest a condition under which :-
- Mg can reduce alumina ( $Al_2O_3$ )
  - Al can reduce MgO.



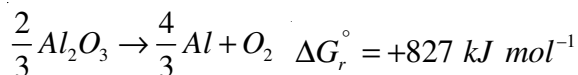
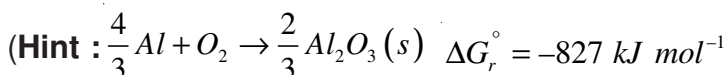
41. ★ The active silver forms a water soluble complex with dilute aqueous solution of  $NaCN$  in the presence of a gas (M). The silver metal is obtained by the addition of a metal (N). Write the structures of (O) and (P) and identify (M) and (N) in the following reaction sequence.



(Hint : Metallurgy of silver;  $[M] = O_2$ )



42. Calculate the minimum e.m.f. required to carry out the electrolysis of  $Al_2O_3$ . Given that  $\Delta G_r^\circ (Al_2O_3) = -827 \text{ kJ mol}^{-1}$ . Faraday's constant (F) =  $96500 \text{ C mol}^{-1}$ .



No. of electrons involved in this redox reaction = 4

$$\Delta G^\circ = -nE_{cell}^0 F$$

$$E_{cell}^0 = -\frac{\Delta G^\circ}{nF} = \frac{+827 \times 10^3 \text{ J mol}^{-1}}{4 \times 96500 \text{ C mol}^{-1}} = -2.14 \text{ V}$$

## Chapter - 7

# THE p-BLOCK ELEMENTS

### VSA Type Questions (1 Mark)

1. How does nitrogen occurs in earth's crust? Name and write the formula of the compound.
2. Write the formula of fluorapatite.
3. In group 15 elements, there is considerable increase in covalent radius from N to P but small increase from *As* to *Bi*. Give reason.
4. The tendency of exhibit  $-3$  oxidation state, decreases down the group in group 15 elements. Explain.
5. Maximum covalence of N is '+4' but the heavier elements of group 15 show covalence greater than '4.' Why?
6. Nitrogen exists as a diatomic molecule with a triple bond between the two atoms, whereas the heavier elements of the group do not. Assign a reason.
7. Ionization enthalpies of group 15 element are higher than that of group 14 and 16 elements in the corresponding period. Assign the reason.
8. The boiling point of  $PH_3$  is lesser than  $NH_3$ . Why?
9.  $NO_2$  dimerises to form  $N_2O_4$ . Why?
10. Draw the structure of  $N_2O_5$  molecule.
11. How does ammonia solution react with  $Ag^+(aq)$ ? Write its balanced chemical equation.
12. Mention the purpose of using dinitrogen in iron and steel industry.
13. How does  $NH_3$  acts as a complexing agent?
14. Justify the statement "Aqueous solution of  $NH_3$  is weakly basic" by giving an equation.
15. Why is the bond angle in  $PH_3$  molecule lesser than that in  $NH_3$  molecule?
16. Why is  $Bi(V)$  a stronger oxidant than  $Sb(V)$ ?
17. In the structure of  $HNO_3$  molecule, the  $N-O$  bond (121pm) is shorter than  $N-OH$  (bond 140 pm). Explain.
18. Why  $SF_4$  is easily hydrolysed, whereas  $SF_6$  is not easily hydrolysed?

19. Sulphur has a greater tendency for catenation than oxygen. Explain.
20. Bond dissociation energy of \_\_\_\_\_ is less than that of \_\_\_\_\_. Why?
21. Write the reaction of \_\_\_\_\_ with heavy water.
22. How many \_\_\_\_\_ bonds are there in cyclotrimeta-phosphoric acid?
23. In group 16, the stability of +6 oxidation state decreases and that of +4 oxidation state increases down the group. Why?
24. The electron gain enthalpy with negative sign for oxygen ( $-141\text{kJ/mol}$ ) is less than that of sulphur ( $-200\text{kJ/mol}$ ). Why?
25. Write the equation for the decomposition of hydrogen peroxide in the presence of finely divided metal and  $\text{MnO}_2$  as catalyst.
26. Name an element that occurs in nature as a decay product of thorium and uranium minerals.

27.

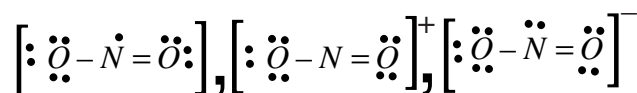
	O	S
M.P/ K	55	393
B.P/ K	90	718

Explain the large difference between the m.p and b.p of oxygen and sulphur.

28. Fluorine exhibit only  $-1$  oxidation state whereas other halogens exhibit +ve oxidation states also. Explain.
29. Arrange the following oxo acids of chlorine in increasing order of acidic strength.  
 $\text{HOCl}$ ,  $\text{HOClO}$ ,  $\text{HClO}_3$ ,  $\text{HOClO}_3$
30. The majority of known noble gas compounds are those of Xenon. Why?
31. ★ "Hypophosphorus acid is a good reducing agent." Justify with an example.
32. ★ Draw the structure of  $\text{H}_4\text{P}_2\text{O}_7$  and find out its basicity?
33. ★ Arrange the following triatomic species in the order of increasing bond angle.



[Hint :



$\text{NO}_2$  has one non bonding electron,  $\text{NO}_2^-$  has 2 non bonding  $e^-$ ,  $\text{NO}_2^+$  has no nonbonding on N atom. Bond angle of \_\_\_\_\_ is maximum but \_\_\_\_\_ is minimum. ]

34. ★ The negative value of electron gain enthalpy of fluorine is less than that of chlorine.  
 [Hint : Due to small size of F atom, there are strong inter electronic repulsions in the relatively smaller 2p orbitals of fluorine. So the incoming electron does not experience attraction.]
35. ★ Which one of the following is not oxidised by  $O_3$ . State the reason.  
 $KI, FeSO_4, K_2MnO_4, KMnO_4$   
 [Hint :  $K_2MnO_4$  since  $Mn$  is showing maximum oxidation state of +7.]
36. ★ Draw the structure of  $H_2S_2O_8$  and find out the number of  $S-S$  bond if any.

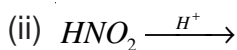
### SA (I) Type Questions (2 Marks)

- How is Nitrogen prepared in the laboratory? Write the chemical equations of the reaction. How is it purified?
- Draw the flow chart for the manufacture of ammonia on large scale. Write the condition that favour the formation of  $NH_3$  along with the equation involved in the reaction.
- Account for the following :
  - $NH_3$  is a stronger base than  $PH_3$ .
  - $XeF_2$  has a straight linear structure and not a bent angular structure.
- Name the two forms of black phosphorus. How can these forms be prepared?
- Phosphorus show marked tendency for catenation but nitrogen show little tendency for catenation. Why?
  - Write the chemical equation of the reaction that occurs between conc.  $HNO_3$  and  $S_8$ .
- Name one oxo acid used in the pickling of stainless steel. Draw its structure also.
- Draw the structures of (i)  $BrF_3$  (ii)  $XeOF_4$
- How is sulphuric acid manufactured by contact process. Mention the conditions to get maximum yield of  $SO_3$ . Write the chemical equations involved in the process.
- What happens when : (Write the chemical equations of the reactions involved)
  - Sugar is heated with conc.  $H_2SO_4$
  - Sodium Nitrate is heated with conc.  $H_2SO_4$
- Complete the following reactions :

- (i)  $(NH_4)_2Cr_2O_7 \longrightarrow$
- (ii)  $NH_4Cl(aq) + NaNO_2(aq) \longrightarrow$
11. (i)  $NH_2CONH_2 + H_2O \longrightarrow$
- (ii)  $FeCl_3(aq) + NH_4OH \longrightarrow$
12. (i)  $Ca_3P_2 + H_2O(l) \longrightarrow$
- (ii)  $I_2 + HNO_3(conc.) \longrightarrow$
13. (i)  $Ba(N_3)_2 \longrightarrow$
- (ii)  $4H_3PO_3 \xrightarrow{\Delta}$
14. (i)  $PH_4I + KOH \longrightarrow$
- (ii)  $HgCl_2 + PH_3 \longrightarrow$
15. (i)  $PCl_3 + 3H_2O \longrightarrow$
- (ii)  $S + H_2SO_4(conc) \longrightarrow$
16. (i)  $Al_2O_3(s) + NaOH(aq) + H_2O(l) \longrightarrow$
- (ii)  $HCl + O_2 \xrightarrow{CuCl_2}$
17. (i)  $Ca(OH)_2 + Cl_2 \longrightarrow$
- (ii)  $XeF_4 + H_2O \longrightarrow$
18. (i)  $Na_2SO_3 + Cl_2 + H_2O \longrightarrow$
- (ii)  $NaHCO_3 + HCl \longrightarrow$
19. (i)  $XeF_6 + H_2O \xrightarrow[\text{Hydrolysis}]{\text{Complete}}$
- (ii)  $XeF_6 + H_2O \xrightarrow[\text{Hydrolysis}]{\text{Partial}}$
20. (i) Why does chlorine water loses its yellow colour on standing?
- (ii) What happens when chlorine reacts with dilute solution of  $NaOH$ ? Write the

equation.

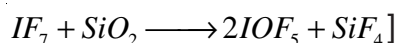
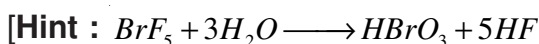
21. (i) What is the covalency of N in  $N_2O_3$ ?  
(ii) Explain why phosphorus form pentahalide whereas nitrogen and bismuth do not?
22. (i) The acidic character increases from  $H_2O$  to  $H_2Te$ . Why?  
(ii) Dioxygen is a gas while sulphur ( $S_8$ ) is a solid. Why?
23. Account for the following :-  
(i) Pentahalides of group 15 elements are more covalent than their trihalides.  
(ii)  $PCl_3$  fumes in moist air.
24. (i) Why are group 17 elements called halogens?  
(ii) "All the halogens are coloured." Why?
25. Write chemical equations to represent the oxidising and bleaching properties of chlorine gas.
26. (i) The first ionization constant of sulphuric acid is very large as compared to its second ionization constant . Why?  
(ii) "Conc. is a strong dehydrating agent." Justify the statement.
27. (i) Interhalogen compounds are more reactive than halogens. Why?  
(ii) Give one important use of .
28. "A nation's industrial strength can be judged by the quantity of sulphuric acid it produces and consumes." Justify the statement.
29. (i) Write the composition of bleaching powder.  
(ii) What happens when is heated with conc. in the presence of .  
Write the chemical equation.
30. Arrange the following in the decreasing order of their basicity. Assign the reason :
31. ★ A colourless and a pungent smelling gas which easily liquefies to a colourless liquid and freezes to a white crystalline solid gives dense white fumes with ammonia. Identify the gas and write the chemical equation for its laboratory preparation. (**Hint** : HCl)
32. ★ Why are the following reactions regarded as disproportionation reactions?  
(i)



33. ★ Suggest reason why only binary compounds of noble gases are fluorides and oxides of Krypton, Xenon and Radon.

(Hint : F and O are most electronegative elements)

34. ★ Which fluorinating agents are often used instead of  $F_2$ ? Write two chemical equations showing their use as fluorinating agents.



35. ★ (i) Hydrolysis of  $XeF_6$  is not regarded as a redox reaction. Why?

(ii) Write a chemical equation to represent the oxidising nature of  $XeF_4$ .



### SA (II) Type Questions (3 Marks Questions)

- How is  $HNO_3$  prepared on a large scale. Name the process. Write chemical equations of the reactions involved. What concentration by mass of  $HNO_3$  is obtained by this process and how can it be further concentrated to 98%?
- Write the chemical equation for the laboratory preparation of  $O_2$  gas. How can it be converted to  $O_3$ ?
  - How does  $O_3$  react with lead sulphide. Give its chemical equation.
- Assign reason for the following :
  - Noble gases have large positive value of electron gain enthalpy.
  - Helium has the lowest boiling point than any known substance.
  - $IF_7$  is known but  $ClF_7$  is not known.
- How is  $SO_2$  gas prepared in the laboratory? What happens when it is passed through acidified  $KMnO_4$  solution?
  - "The behaviour of  $SO_2$  is very similar to that of  $CO_2$ ." Give a chemical equation to justify the statement.
- Assign reason for the following statements :-

- (i)  $P_4$  is more reactive than  $N_2$ .
- (ii) All the bonds in  $PCl_5$  are not equal in length.
- (iii) Sulphur in vapour state exhibit paramagnetism.
6. How is  $Cl_2$  manufactured by Deacon's process? How does it react with hot and conc.  $NaOH$ ? Write two important uses of  $Cl_2$ .
7. (i) How is  $XeO_3$  prepared from  $XeF_6$ . Write the chemical equation for the reaction.
- (ii) Draw the structure of  $XeF_2$ ,  $XeF_4$ .
8. Account for the following :-
- (i) Among the halogens,  $F_2$  is the strongest oxidising agent.
- (ii) On addition of  $O_3$  gas to  $KI$  solution, violet vapours are formed.
- (iii) In spite of nearly the same electronegativity oxygen form hydrogen bonds while chlorine does not.
9. Assign the reason :-
- (i) Fluorine shows anomalous behaviour than other halogens.
- (ii) Bleaching action of  $SO_2$  is temporary while that of  $Cl_2$  is permanent.
- (iii) Two  $S-O$  bonds in  $SO_2$  are identical.
10. (i) Thermal stability of hydrides of group 16 elements decreases down the group. Why?
- (ii) Compare the oxidising powers of  $F_2$  and  $Cl_2$  on the basis of bond dissociation enthalpy.
- (iii) Write the chemical equation for the reaction of copper metal with conc.  $HNO_3$ .
11. ★ An unknown salt X reacts with hot conc  $H_2SO_4$  to produce a brown coloured gas which intensifies on addition of copper turnings. On adding dilute ferrous sulphate solution to an aqueous solution of X and then carefully adding conc.  $H_2SO_4$  acid along the sides of the test, a brown complex is formed at the interface between the solution and  $H_2SO_4$ . Identify X, Y and Z and write the chemical equations involved in the reaction.

[Hint : X is  $NO_3^-$  salt.]

### Long Answer type Questions (5 Marks)

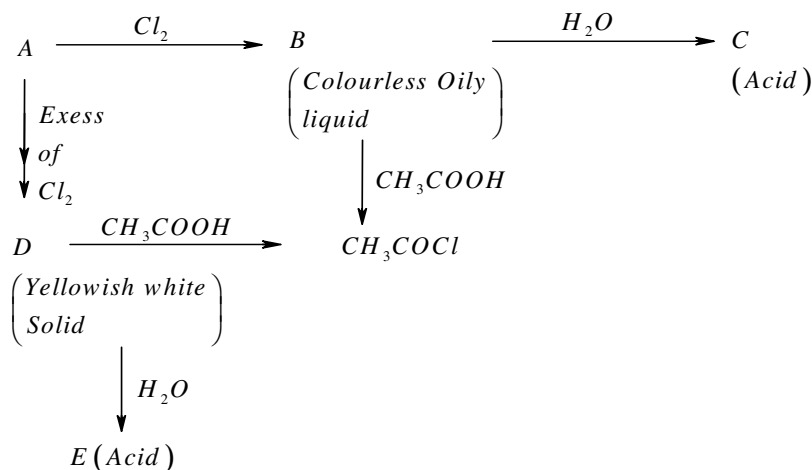
1. How is  $PH_3$  prepared in the laboratory? How is it purified? How does the solution of  $PH_3$  in water react on irradiation with light and on absorption in  $CuSO_4$ ? How can you prove that  $PH_3$  is basic in nature?

Write the chemical equations for all the reactions involved.

2. Assign a possible reason for the following :
- (i) Stability of +5 oxidation state decreases and that of +3 oxidation state increases down the group 15 elements.
  - (ii)  $H_2O$  is less acidic than  $H_2S$ .
  - (iii)  $SF_6$  is inert while  $SF_4$  is highly reactive.
  - (iv)  $H_3PO_2$  and  $H_3PO_3$  act as good reducing agents while  $H_3PO_4$  does not.
  - (v) Noble gases have comparatively large size in their respective period.
3. (i) How is  $XeF_6$  prepared from the  $XeF_4$ ? Write the chemical equation for the reaction.
- (ii) Deduce the structure of  $XeF_6$  from VSEPR theory.
- (iii) How does  $XeF_2$  reacts with  $PF_5$ ?
- (iv) Give one use each of helium and Neon.
- (v) Write the chemical equation for the hydrolysis (Complete) of  $XeF_4$ .
4. (i) Why does nitrogen show anomalous behaviours? Discuss the trend of chemical reactivity of group 15 elements with.
- (a) Oxygen (b) Halogens (c) Metals
- (ii)  $H_3PO_2$  is a dibasic acid. Why?
5. (i) Draw the structure of Ozone.
- (ii) Give one chemical reaction to show that ozone is an oxidising agent.
- (iii) Give two probable reasons for the depletion of ozone layer.
- (iv) How is  $N_2O$  gas prepared. Write the chemical equation for the reaction.
6. (i) Why oxygen show anomalous behaviour?
- (ii) Discuss the trend in chemical reactivity of group 16 elements with :-
- (a) Hydrogen (b) Oxygen (c) Halogens
- (ii) Arrange the following in the order of increasing acid strength :



7. ★ Identify A, B, C, D and E in the following sequence of reactions



Complete the reactions of the above mentioned sequence.

(Hint : A is  $P_4$ )

8. ★ A white waxy, translucent solid, M, insoluble in water but soluble in  $CS_2$ , glows in dark. M dissolves in  $NaOH$  in an inert atmosphere giving a poisonous gas (N). Also M catches fire to give dense white fumes :

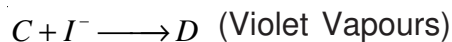
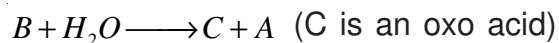
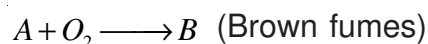
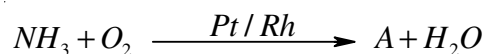
(i) Identify M, N and O and write the chemical equations of the reactions involved.

(ii) M exist in the form of discrete tetrahedral molecule. Draw its structure.

(iii) M on heating at 573 K is changed into other less reactive form, Q, which is non-poisonous, insoluble in water as well as  $CS_2$  and does not glow in dark. Identify Q and draw its structure.

(Hint : M is white phosphorus)

8. ★ Write the structure to A, B, C, D and E in the following sequence of reactions :



Complete the reactions of the above mentioned sequence and name the process.

[Hint : A is  $NO$ ]

## Chapter - 8

### THE d- and f- BLOCK ELEMENTS

#### VSA Type Question (1 Mark Questions)

1. Out of the following which one is a transition metal?
2. Write the electronic configuration of \_\_\_\_\_ ion. (Atomic number of \_\_\_\_\_)
3. Which element among transition elements exhibit the highest oxidation state?
4. Write the general electronic configuration of transition elements.
5. Gold has completely filled d orbitals \_\_\_\_\_ in its ground state. How can you say that it is a transition element? (Atomic number of gold = 79)
6. Out of the following d-block elements, identify the element which does not exhibit variable oxidation state : *Cr, Co, Zn*
7. Except *Zn, Cd* and *Hg*, the other transition metals have high melting points. Why?
8. In the *3d* series (*Sc* → *Zn*) why the enthalpy of atomization of zinc is the lowest?
9. *Cu<sup>+</sup>* ion is unstable in aqueous solution. Why?
10. Although *Co<sup>2+</sup>* ion appears to be stable, it is easily oxidised to *Co<sup>3+</sup>* ion in the presence of a strong ligand. Explain.
11. First ionization enthalpies of *5d*-series elements is higher than those of *3d*- and *4d*-series elements. Why?
12. Which of the following ions give coloured solution on dissolution in water?
13. Why *Mn<sup>2+</sup>* compounds are more stable than *Fe<sup>2+</sup>* compounds towards oxidation to their +3 state?  
(At. No. of Mn = 25, Fe = 26)
14. Ions of the same charge in a given series of transition elements show progressive decrease in their radii. Why?
15. Nickel show an oxidation state zero in its complex compound  $[Ni(Co)_4]$ . Assign a reason.
16. Calculate the magnetic moment of *Cu<sup>2+</sup>* (Z = 29) on the basis of 'Spin-only' formula.

17. The  $E^{\circ}_{Mn^{3+}/Mn^{2+}}$  value for Mn is much more than expected from the trend for the other elements in the first transition series. Why?
18. Transition metals form interstitial compounds. Explain.
19. The transition metals and their compounds are known for their catalytic activity. Give two specific reasons to justify the statement.
20. Write the chemical equation for the reaction of thiosulphate ions and alkaline potassium permanganate.
21. Mention the name and formula of the ore from which potassium dichromate is prepared.
22. Write the electronic configuration of  $Lu^{3+}$  (At. No. = 71).
23. What is the most probable oxidation state of actinoids?
24. Write the names of the catalyst used in the :-
  - (i) manufacture of sulphuric acid by contact process.
  - (ii) manufacture of polythene.
25. Mention the name of the element among lanthanides known to exhibit +4 oxidation state.
26. Name one ore of manganese and chromium.
27. Why are  $Cd^{2+}$  salts white?
28. ★ Which one is more stable  $Cu_2I_2$  or  $CuI_2$ . Why?
29. ★ How many bonds in the dichromate di anion are equivalent?  
 [Hint : 6 Cr–O bonds are equivalent]
30. ★ Arrange the following monoxides of transition metals on the basis of decreasing basic character  $TiO$ ,  $VO$ ,  $CrO$ ,  $FeO$ .  
 [Hint :  $TiO > VO > CrO > FeO$ ]

### SA (I) Type Questions (2 Marks)

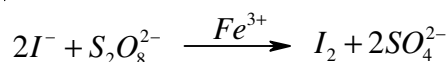
1. (i) How does the electronic configuration of transition elements differ from that of non-transition elements?  
 (ii) Explain why do the transition metals exhibit variable oxidation state?
2. On what ground you can say that vanadium (Z = 23) is a transition element but Zinc (Z = 30) is not?
3. (i) In the first transition series from Ti (Z = 22) to Cu (z = 29), a significant increase in the density is observed. Explain why?

- (ii) Zirconium (II transition series) and Hafnium (III transition series) exhibit similar radii. Why?
4. Write complete chemical equations for :
- (i) Oxidation of  $Fe^{2+}$  by  $Cr_2O_7^{2-}$  in acidic medium
- (ii) Oxidation of  $Mn^{2+}$  by  $MnO_4^-$  in neutral medium.
5. (i) Why do transition metals show high melting points?  
(ii) Out of Fe and Cu, which one would exhibit higher melting point?
6.  $Ni(II)$  compounds are found to be thermodynamically more stable than  $Pt(IV)$  compounds while  $Pt(IV)$  compounds are relatively more stable than  $Ni(IV)$  compounds. Give a possible reason.  
[At. Nos. – Ni = 28, Pt = 78]
7. (i) Out of  $Co^{2+}$  and  $Ti^{4+}$  ions which one will give coloured aqueous solution.  
(ii) How will each of them respond to magnetic field and why?
8. Mention two compounds that form the basis of Ziegler catalysts. Give its one use.
9. Give two examples of oxo metal anions of the first series of the transition metals in which the metal exhibits the oxidation state equal to its group number.
10. For the first row transition metals the enthalpy of atomisation values are :

	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
$\Delta_a H^\theta / kJ mol^{-1}$	326	473	515	397	281	416	425	430	339	126

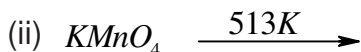
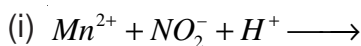
Assign reason for the following :

- (i) Transition elements have higher values of enthalpies of atomisation.  
(ii) The enthalpy of atomisation of zinc is the lowest.
11. Account for the following :-  
(i) Copper shows its inability to liberate hydrogen gas from the acids.  
(ii) Scandium ( $Z = 21$ ) does not exhibit variable oxidation states.
12. Copper ( $I$ ) compounds undergo disproportionation. Write the chemical equation for the reaction involved and give reason.
13. Iron( $III$ ) catalyses the reaction :



Write chemical equations to explain the catalytic action of Iron (III).

14. Complete the equations :



15. Draw the structure of manganate and permanganate ions and predict these magnetic character.

16. The best use of lanthanoids is for the production of alloy steels for plates and pipes. Name the alloy used and give its composition.

17. Write the compounds of first transition series used for special purposes in :

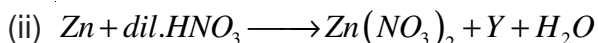
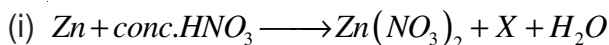
(i) Pigment industry            (ii) Dry battery cells.

18. What are coinage metals. Give two examples.

19. ★ A transition metal P liberates hydrogen gas from dilute acid but it reacts with water to liberate hydrogen only when the metal is heated and the water is in the form of steam. Identify P and write the chemical equations involved in the reaction.

(Hint : P is Fe)

20. ★ The following two reactions of  $HNO_3$  with Zn are given. (Equations are unbalanced)



Identify X and Y and write complete balanced equations.

(Hint : X is  $NO_2$  and Y is  $N_2O$ )

21. ★ Titanium shows magnetic moment of 1.73 BM in its compound. What is the oxidation number of Ti in the compound?

(Hint : O.N. of Ti = +3)

22. ★ From the following compounds (i) to (iv), find out the compound which is both paramagnetic and coloured.

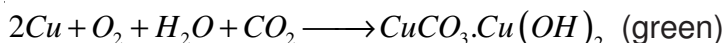


[Hint : (iii)]

23. ★ Calculate the number of electrons transferred in each case when  $KMnO_4$  acts as an oxidising agent to give (i)  $MnO_2$  (ii)  $Mn^{2+}$  (iii)  $Mn(OH)_3$  (iv)  $MnO_4^{2-}$  respectively.

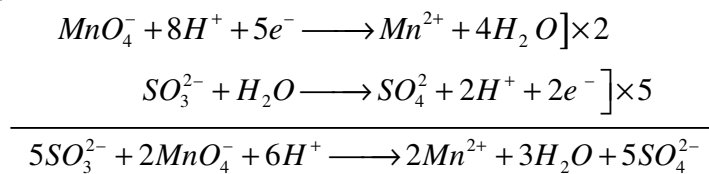
[Hint : 3, 5, 4, 1]

24. ★ Copper corrodes in moist air to produce a green layer on its surface. Explain why?  
(Hint : In moist air, a layer of basic copper carbonate is formed on the surface.)



25. ★ Calculate the number of moles of  $\text{KMnO}_4$  that will be needed to react completely with one mole of sulphite ion in an acidic medium.

[Hint : 2/5 mole



∴ 5 moles of sulphite ions oxidised by 2 moles of  $\text{KMnO}_4$ ]

### SA (II) Type Questions (3 Marks)

- What are transition metals?
  - Write any two characteristic properties of transition metals.
  - “Transition metals show paramagnetic behaviour.” Comment.
- Write the electronic configuration of  $\text{Pm}^{2+}$  ion ( $Z = 61$ ). Using Hund's rule.
  - Calculate the magnetic moment of the divalent ion  $\text{Pm}^{2+}$  in aqueous solution.
  - Arrange the following oxides in the increasing order of their acidic character :



- Account for the following :-
  - With  $3d^4$  configuration,  $\text{Cr}^{2+}$  acts as a reducing agent but  $\text{Mn}^{3+}$  acts as an oxidising agent. (At. number of Cr = 24, Mn = 25)
  - The atomic radii of transition elements decrease with atomic number in a given series.
  - The  $E^\circ$  value for  $\text{Mn}^{3+}/\text{Mn}^{2+}$  couple is much more than  $\text{Fe}^{3+}/\text{Fe}^{2+}$  couple.

$$[E^\circ_{\text{Mn}^{3+}/\text{Mn}^{2+}} = +1.57\text{V} \quad E^\circ_{\text{Fe}^{3+}/\text{Fe}^{2+}} = +0.77\text{V}]$$

- What is the general electronic configuration of 2nd transition series?
  - Deduce the number of 3d electrons in the following ions :



5. (i) What are interstitial compounds? Give an example.  
(ii) Mention four characteristics of interstitial compounds.
6. What is an alloy? Why do transition metals readily form alloys? Give an example of one best known alloy along with its important use.
7. In the following reaction,  $Mn(VI)$  changes to  $Mn(VII)$  and  $Mn(IV)$  in acidic solution.



- (i) Explain why  $Mn(VI)$  changes to  $Mn(VII)$  and  $Mn(IV)$   
(ii) What special name is given to such type of reactions?
8. What happens when?  
(i) Thiosulphate ions react with alkaline  $KMnO_4$ .  
(ii) Oxalic acid (at 333 K) reacts with acidified  $KMnO_4$ .  
(iii) Sulphurous acid reacts with acidified potassium permanganate.  
Write the chemical equations for the reactions involved.
9. (i) Write the general electronic configuration of inner transition elements.  
(ii) Which of the following atomic numbers are of inner transition series :- 70, 80?  
(iii) Mention the common oxidation state of actinoids.
10. Write chemical equations to represent the reaction of acidified potassium dichromate with :  
(i)  $Fe^{2+}$  ions      (ii)  $Sn^{2+}$  ions      (iii)  $I^-$  ions
11. Draw the structure of :  
(i) Chromate ion      (ii) Dichromate ion with proper bond angles.
12. (i) What is Actinoid contraction?  
(ii) Write the electronic configuration of Curium (At No. -96)  
(iii) "The study of actinoids is rendered more difficult than lanthanoids." Comment.
13. Name the catalysts used in :  
(i) Manufacture of Ammonia by Haber's Process  
(ii) Oxidation of ethyne to ethanal  
(iii) Photographic industry.

14. ★ Among  $TiCl_4$ ,  $VCl_3$  and  $FeCl_2$  - which one will be drawn more strongly into a magnetic field and why?

**[Hint :** Among these halids, the transition metal ion having maximum numbers of unpaired electrons will be drawn strongly into the magnetic field

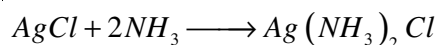
$$Ti^{4+} = 3d^0 \quad \text{no. of unpaired } e^- = 0 \quad \mu = 0$$

$$V^{3+} = 3d^2 \quad \text{no. of unpaired } e^- = 2 \quad \mu = 2.76 \text{ BM}$$

$$Fe^{2+} = 3d^6 \quad \text{no. of unpaired } e^- = 4 \quad \mu = 4.9 \text{ BM}]$$

15. ★ Account for the following :-

- (i) How are  $H_2O$  molecules bonded in  $CuSO_4 \cdot 5H_2O$  ?
- (ii) Silver chloride dissolves in excess of ammonia.
- (iii) Cuprous chloride is diamagnetic while cupric chloride is paramagnetic.



**[Hint :** (ii)  $Complex - [Diamminesilver(I) Chloride]$

### Long Questions (5 Marks)

1. Explain giving reasons the following properties of transition metals :
  - (i) Transition metals and their compounds are known for their catalytic activity.
  - (ii) Transition metals form Interstitial compounds.
  - (iii) Transition metals show paramagnetic behaviour.
  - (iv) Transition metals form coloured complexes
  - (v) The enthalpies of atomisation of transition elements are quite high.
2.
  - (i) Name the ore from which  $KMnO_4$  is prepared.
  - (ii) Write the steps involved in the preparation of  $KMnO_4$  along with the chemical equations.
  - (iii) How does  $KMnO_4$  react with :
    - (a) Hydrogen sulphide gas in acidic medium.
    - (b) Potassium iodide in acidic as well as alkaline medium.
3.
  - (i) What is Lanthanide contraction?
  - (ii) What are its probable causes?
  - (iii) Write two consequences of lanthanide contraction.
  - (iv) Mention the best single use of lanthanides.



## Chapter - 9

### CO-ORDINATION COMPOUNDS

#### VSA Type Questions (1 Mark)

- Define coordination compounds?
- Write the name of counter ion in  $Hg[Co(SCN)_4]$ .
- Calculate the oxidation state of nickel in  $[Ni(CO)_4]$  (Ans : 4)
- Calculate the coordination number of central atom in  $[Co(C_2O_4)_3]^{3-}$  (Ans : 6)
- What is the coordination number of iron in  $[Fe(EDTA)]^-$  ? (Ans : 6)
- Which complex compound is used in Chemotherapy? Write its formula also.  
(Ans : Cis-Platin,  $Pt Cl_2(NH_3)_2$  )
- Write the coordination entity used to estimate the hardness of water volumetrically.
- Give the IUPAC name of  $[Pt Cl_2(NH_2CH_3)(NH_3)_2]Cl$ .
- How many geometrical isomers are possible for the complex  $[Ni(CO)_4]$ , which is tetrahedral in nature?  
(Ans : No isomers, as the relative positions of the unidentate ligands attached to the central metal atom are same with respect to each other)
- Arrange the following in the increasing order of conductivity in solution.  
 $[Ni(NH_3)_6]Cl_2$ ;  $[Co(NH_3)_6]Cl_3$  and  $[CoCl_2(en)_2]Cl$
- Arrange the following ligands in increasing order of  $\Delta_0$  (Crystal field splitting energy) for octahedral complexes :  
 $Cl^-$ ,  $NH_3$ ,  $I^-$ ,  $CO$ ,  $en$
- Write I.U.P.A.C. name of Tollen's reagent.
- Define the term stability of a complex in solution.
- Calculate the overall complex dissociation equilibrium constant for the  $[Cu(NH_3)_4]^{2+}$  ion given that overall stability constant ( $\beta_4$ ) for this complex is  $2.1 \times 10^{13}$ .

(Ans :  $4.7 \times 10^{-14}$ )

15. What is the basis of formation of the spectro-chemical series?
16. What is a chelate ligand? give one example.
17. Write the IUPAC name of  $Li[AlH_4]$ .
18. Name one homogeneous catalyst used in hydrogenation of alkenes.
19. ★ Whether  $[Co(NH_3)_3(NO_2)_3]$  show any optical isomerism? Give reason for this.

[Ans : No, due to plane of symmetry]

20. ★  $[Ti(H_2O)_6]Cl_3$  is coloured which on heating becomes colourless. Why?

[Hint :  $H_2O$  molecule will be removed]

21. ★ What is the formula of Fisher Salt? (Ans :  $K_3[Co(NO_2)_6]$ )

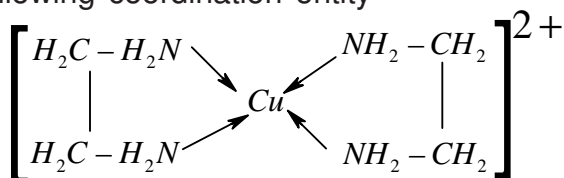
22. ★ Write the formula and the name of the coordinate isomer of  $[Co(en)_3][Cr(CN)_6]$ .

(Ans :  $[Cr(en)_3][Co(CN)_6]$  tris (ethane - 1, 2- diamminechromium (III) hexacyanocobaltate (III))

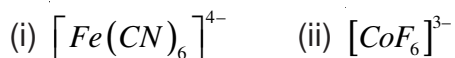
23. ★ Whether  $CuSO_4 \cdot 5H_2O$  show any isomerism?

### SA (I) Type Questions (2 Marks)

24. Write the two difference between a double salt and a coordination compound with the help of one example.
25. Mention the main postulates of Werner's Theory
26. Define (a) Homoleptic & (b) Heteroleptic complexes with the help of one example of each.
27. In the following coordination entity



- (i) Identify the ligand involved and
- (ii) Oxidation state of copper metal.
28. Are the bidentate ligands same as the ambident ligands? Justify with one example.
29. Calculate the magnetic moments of the following complexes :



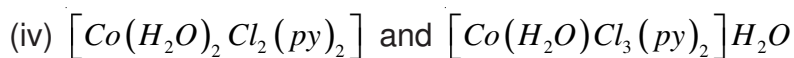
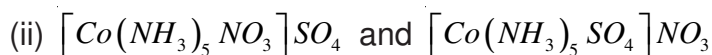
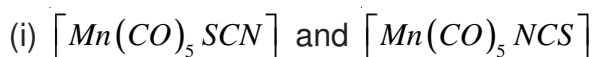
(Ans : (i) 0 BM (ii) 4.47 B.M.)

30. Explain the following :-

(i) All octahedral complexes of  $Ni^{2+}$  must be outer orbital complexes.

(ii)  $NH_4^+$  ion does not form any complex.

31. What type of structural isomerism is represented by the following pairs :



32. How complex compounds are applicable in (i) electroplating of silver, gold or other noble metals (b) in photography.

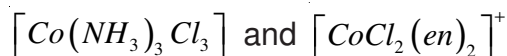
33. Mention two limitations of crystal Field Theory.

34. Explain the nature of bonding in  $Ni(CO)_4$  with the help of diagram.

35. Derive a relationship between stepwise stability constants and overall stability constant of a complex in the solution. How overall stability constant varies with dissociation equilibrium constant?

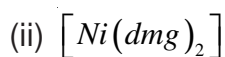
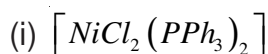
36. Explain as to how the two complexes of nickel  $[Ni(CN)_4]^{2-}$  and  $Ni(CO)_4$  have different structures but do not differ in their magnetic behaviours. (At. no. of Ni = 28)

37. Draw the structures of geometrical isomers of the coordination complexes –



(At no. of Co = 27)

38. ★ Write the IUPAC name of the complexes :



(Hint : (i) Dichloridobis (triphenylphosphine) nickel (II) (b) Dimethylglyoximatonicel (II))

39. ★ How does EDTA help as a cure for bad poisoning?

[Calcium in calcium & EDTA complex is replaced by bad in the body. The more

soluble complex lead-EDTA is eliminated in urine. ]

40. A complex is prepared by mixing  $CoCl_3$  and  $NH_3$  in the molar ratio of 1:4, 0.1 M solution of this complex was found to freeze at  $-0.372^\circ C$ . What is the formula of the complex?

$$K_f \text{ of water} = 1.86^\circ C/m$$

[Hint :  $\Delta T_f = K_f \times m = 1.86 \times 0.1 = 0.186^\circ C$

$$\Delta T_f(\text{obs}) = 0.373^\circ C$$

$\Delta T_f(\text{obs})$  is twice the Theoretical Value. This means each molecule of complex dissociates into two ions.  $[Co(NH_3)_4Cl_2]Cl$ .

41. ★ Explain using crystal Field Theory :- The  $[Mn(H_2O)_5]^{2+}$  ion contains five unpaired electrons while  $[Mn(CN)_6]^{4-}$  ion contains only one unpaired electron.

### SA (II) Type Questions (3 Marks)

42. Explain the following by giving one example in each case :
- Linkage isomerism
  - An outer orbital complex
  - A bidentate ligand.
43. Compare the following complexes with respect to their shape, magnetic behaviour and the hybrid orbitals involved.
- $[CoF_6]^{3-}$
  - $[Cr(NH_3)_6]$
  - $[Ni(Co)_4]$
- [Atomic number : Co = 27, Cr = 24, Ni = 28]
44. Draw the structure of
- Cis – dichloridotetracyanochromate (II) ion
  - Mer – triamminetrichloridocobalt (III)
  - Fac – triaquatrininitrito–N–Cobalt (III)

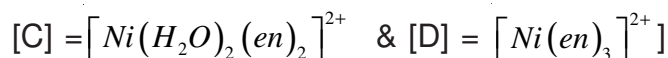
45. Name the central metal atom/ion present in (a) Chlorophyll (b) Haemoglobin (c) Vitamin  $B_{12}$ .  
(Ans : (a) Mg (b) Fe (c) Co)
46. A metal complex having composition  $Cr(NH_3)_4Cl_2Br$  has been isolated in two forms A & B. The form 'A' reacts with  $AgNO_3$  solution to give a white precipitate which is readily soluble in dilute aq. ammonia whereas 'B' gives a pale yellow precipitate soluble in concentrated ammonia solution. Write the formulae of 'A' & 'B.' Also mention the isomerism arises among 'A' & 'B'.

[Hint :  $A \rightarrow [Cr(NH_3)_4BrCl]Cl$ ,  $B \rightarrow [Cr(NH_3)_4Cl_2]Br$ , (Ionisation isomerism)]

47. Write the limitations of Valence Bond Theory.
48. Draw a sketch to show the splitting of d-orbitals in an octahedral crystal field state for a  $d^6$  ion how the actual configuration of the split d-orbitals in an octahedral crystal field is decided by the relative values of  $\Delta_0$  and pairing energy (P)?
49. ★ For the complex  $[Fe(en)_2Cl_2]Cl$  identify :
- The oxidation no. of iron.
  - The hybrid orbitals and the shape of the complex.
  - The magnetic behaviour of the complex.
  - The number of geometrical isomers.
  - Whether there is an optical isomer also and
  - Name of the complex. [At. no. of Fe = 26]
50. ★ A chloride of fourth group element of quantitative analysis gives a green coloured complex [A]. The aqueous solution of which treated with ethane -1, 2-diamine (en) gives pale - yellow solution [B] which on subsequent addition of ethane -1, 2-diamine turns to blue/ purple [C] and finally violet [D].

Identify the element and [A], [B], [C] and [D].

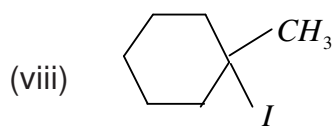
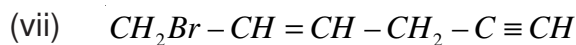
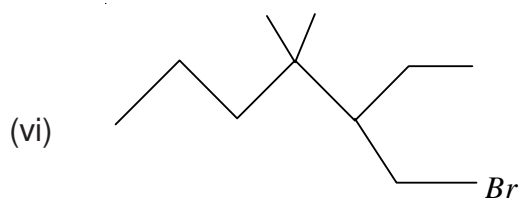
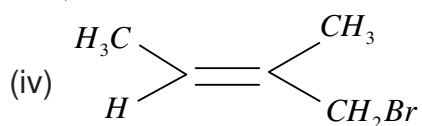
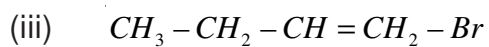
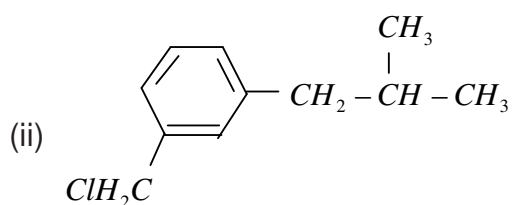
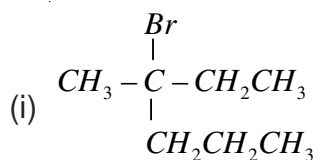
[Hint : Nickel, [A] =  $[Ni(H_2O)_6]^{2+}$ ; [B] =  $[Ni(H_2O)_4(en)]^{2+}$ ;

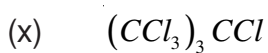


## Chapter - 10

### HALOALKANES AND HALOARENES

1. Write the IUPAC names of the following compounds :





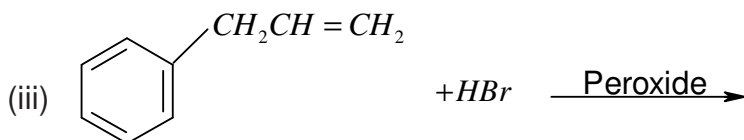
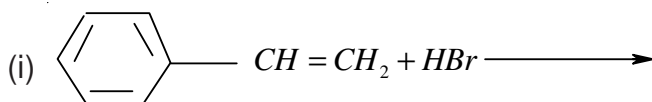
2. Write the structure of following halogen compounds :-

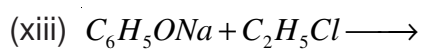
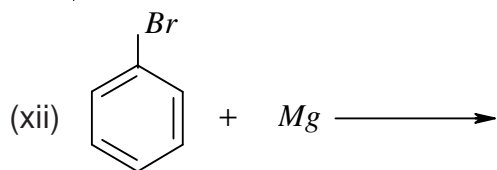
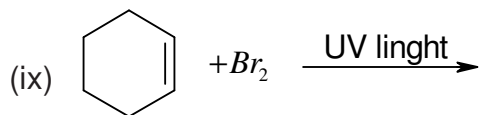
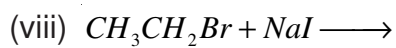
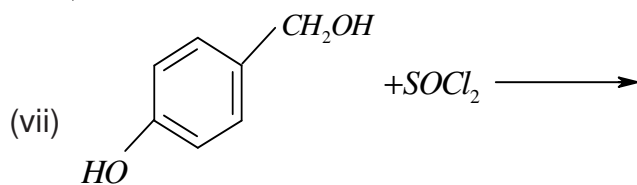
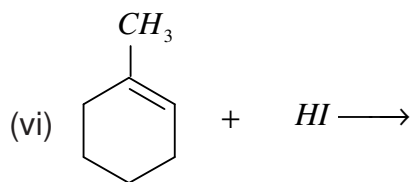
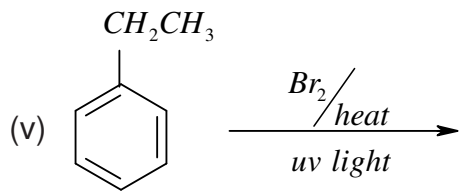
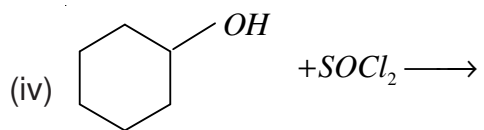
- (i) 1, 4 - Dibromobut - 2 - ene
- (ii) 4 - tert - Butyl - 3 - iodoheptane
- (iii) 1- Bromo- 4 - sec. butyl - 2- methylbenzene
- (iv) 1 -Chloro - 4 - ethylcyclohexane
- (v) 1 - Bromo - 4 - chlorobut - 2- yne
- (vi) 2 - Bromo -3, 3 - bis - (4 - Chlorophenyl) butane
- (vii) p - Bromotoluene
- (viii) 1 - Chloro - 4 - ethylcyclohexane
- (ix) Perfluorobenzene
- (x) 1 - Bromo - 4 - sec. butyl - 2 - methylbenzene

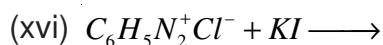
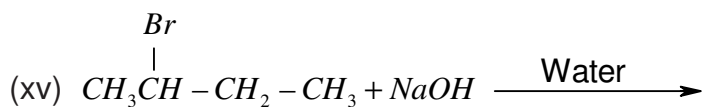
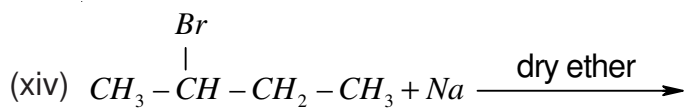
3. Arrange the following in the increasing order of property indicated :-

- (i) Bromomethane, bromoform, chloromethane, dichloromethane. (Increasing order of boiling points)
- (ii) 1 - Chloropropane, isopropyl chloride, 1 - chlorobutane (increasing order of b.pt.)
- (iii) Dichloromethane, chloroform, carbon tetrachloride. (increasing order of dipole moment)
- (iv)  $CH_3F$ ,  $CH_3Cl$ ,  $CH_3Br$ ,  $CH_3I$  (increasing reactivity towards nucleophilic substitution)
- (v) O, m, p - dichlorobenzenes (increasing order of melting points)

4. Complete the following reactions :-







5. How will you bring about the following conversions :-

(i) Propene to propan-1-ol

(ii) Ethanol to But-1-yne

(iii) 1-Bromopropane to 2 - Bromopropane

(iv) Benzene to 4 - Bromonitrobenzene

(v) Aniline to chlorobenzene

(vi) 2 - Methyl - 1 - propene to 2 - chloro -2- methylpropane

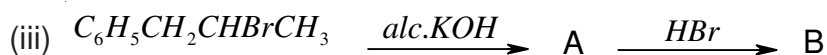
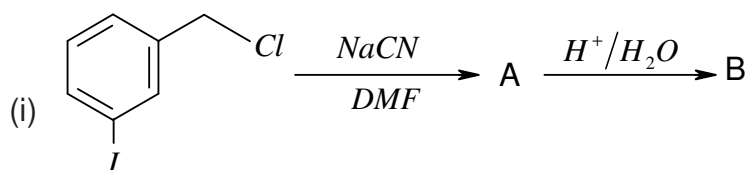
(vii) Ethyl chloride to propanoic acid

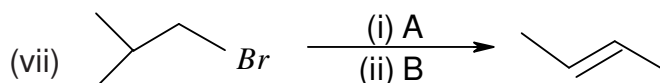
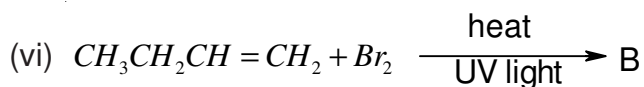
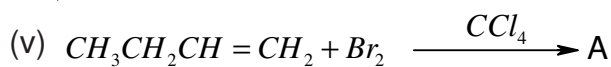
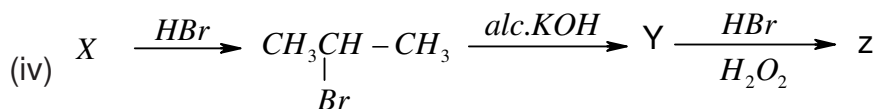
(viii) But - 1 - ene to n - butyl iodide

(ix) Ethanol to butane

(x) Tert - butylbromide to isobutylbromide

6. Identify the products formed in the following sequence :-





7. Explain the following reactions with suitable example :-

- (i) Finkelstein reaction
- (ii) Swarts reaction
- (iii) Wurtz reaction
- (iv) Wurtz Fittig reaction
- (v) Fittig reaction
- (vi) Friedel Craft's alkylation reaction
- (vii) Friedel Craft's acylation reaction
- (viii) Sandmeyer reaction

8. Explain the following terms with suitable example :-

- (i) Kharash effect (Peroxide effect)
- (ii) Saytzeff rule
- (iii) Racemic mixture
- (iv) Ambident nucleophiles
- (v) Enantiomers

9. What is the difference between :-

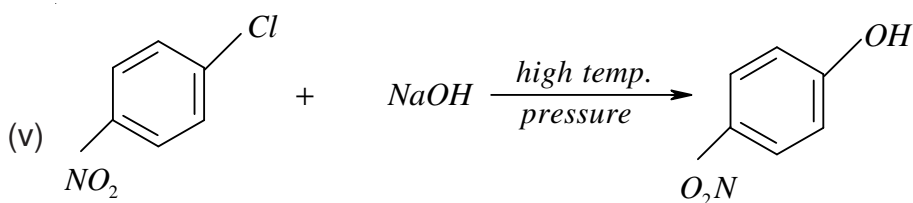
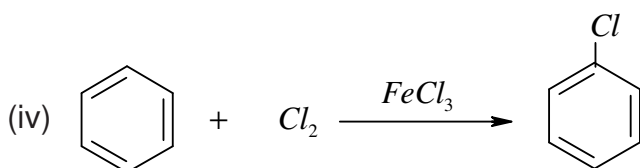
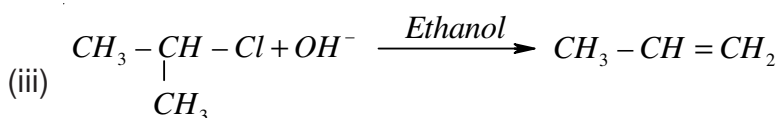
- (i) Enantiomers and diastereomers
- (ii) Retention and inversion of configuration

(iii) Electrophilic and nucleophilic substitution reactions.

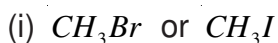
10. Give a chemical test to distinguish between the following pairs of compounds :-

- (i) Chlorobenzene and cyclohexylchloride
- (ii) Chlorobenzene and benzyl chloride
- (iii) n-Propylbromide and isopropylbromide

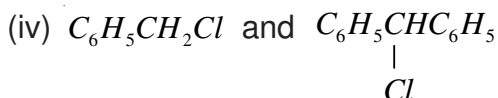
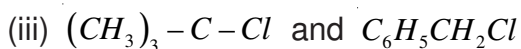
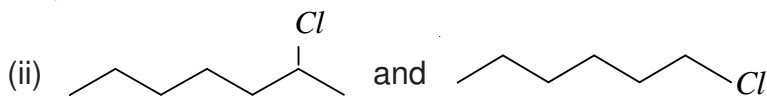
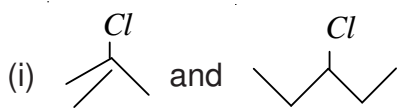
11. Give mechanism of the following reactions :-



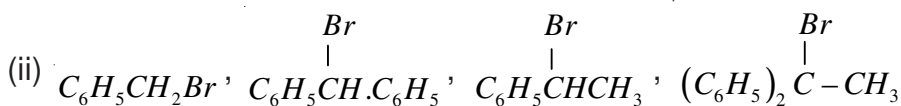
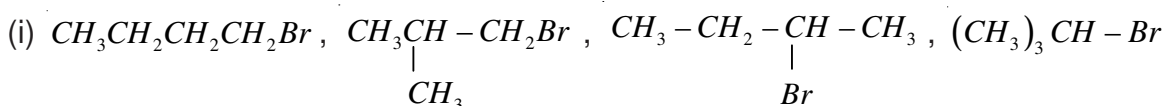
13. Which compound in each of the following pairs will react faster in  $S_N2$  reaction with  $OH^-$  and why?



14. In the following pairs which halogen compound undergoes faster  $S_N1$  reaction :-



15. Predict the order of reactivity of following compounds in  $S_N1$  and  $S_N2$  reactions :-

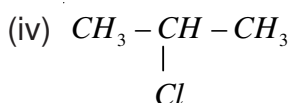
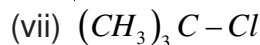
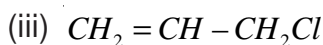
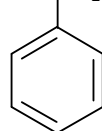
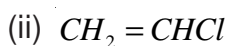
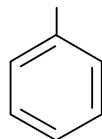
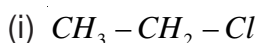


16. Give reasons for the following :-

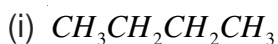
- (i) Haloalkanes have higher boiling points than the hydrocarbons of comparable molecular masses.
- (ii) Although alkyl halides are polar in nature but not soluble in water.
- (iii) t-Butyl bromide has lower boiling point than n-butyl bromide.
- (iv) Haloalkanes react with  $KCN$  to form alkyl cyanides as main product while with  $AgCN$  alkylisocyanides is the main product.
- (v) Sulphuric acid is not used in the reactions of alcohol with  $KI$ .
- (vi) Thionyl chloride is the preferred reagent for converting ethanol to chloroethane.
- (vii) Haloalkanes undergo nucleophilic substitution reaction easily but haloarenes do not undergo nucleophilic substitution under ordinary conditions.
- (viii) Alkyl halides are better solvents than aryl halides.

- (ix) Chlorobenzene on reaction with fuming sulphuric acid gives ortho and para chlorosulphonic acids.
- (x) 2, 4-Dinitro chlorobenzene is much more reactive than chlorobenzene towards hydrolysis reaction with  $NaOH$ .
- (xi) Grignard reagent should be prepared under anhydrous conditions.
- (xii) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
- (xiii) Neopentyl bromide undergoes nucleophilic substitution reactions very slowly.
- (xiv) Vinyl chloride is unreactive in nucleophilic substitution reactions.
- (xv) Benzyl chloride and alkyl chloride are easily hydrolysed with  $NaOH$ .
- (xvi) Haloalkanes undergo nucleophilic substitution reactions but haloarenes undergo electrophilic substitutions.
- (xvii) Chloroform is stored in tightly sealed coloured bottles.
- (xviii) The use of DDT is banned in many countries of the world.
- (xix) Optically active 2-iodobutane on treatment of with  $NaI$  in acetone gives a product which does not show optical activity.
- (xx) Methyl iodide is hydrolysed at faster rate than methyl chloride.

17. Write the hybrid state of different carbons in the following compounds :-



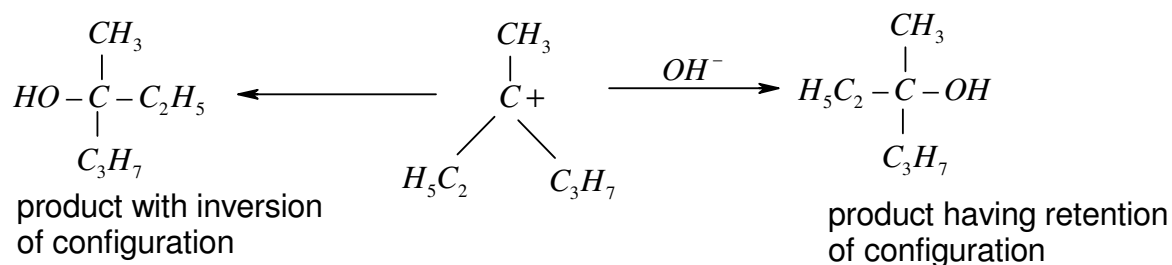
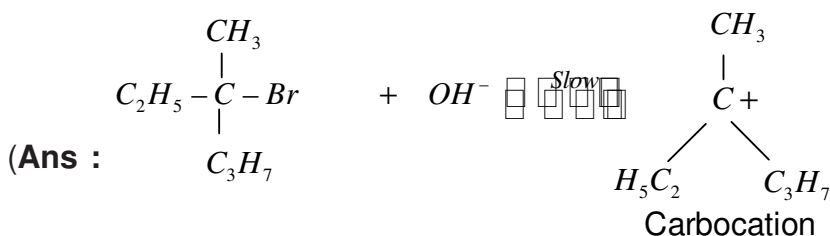
18. Write the different products formed by the monochlorination of following compounds :-



(ii)

(iii)  $(CH_3)_2CHCH(CH_3)_2$

19. Which is stronger nucleophilic  $Br^-$  or  $I^-$ ? Explain.
20. Give one use of each of following specifying the property on which the use is based:
- (i) Freon - 12
  - (ii) DDT
  - (iii) Carbon tetrachloride
  - (iv) Iodoform
21. ★ An optically active compound having molecular formula  $C_7H_{15}Br$  reacts with aqueous  $KOH$  to give  $C_7H_{15}OH$ , Which is optically inactive. Give mechanism for the reaction.

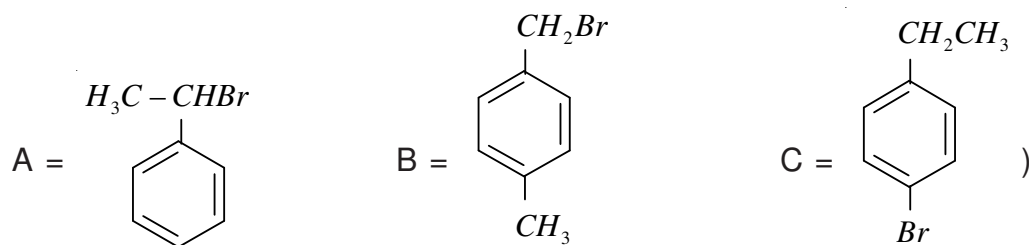


A racemic mixture is obtained which is optically inactive).

22. ★ An organic compound  $C_5H_9Br$  has three isomers A, B and C. A is optically active. Both A and B gave the white precipitate when warmed with alcoholic  $AgNO_3$  solution. Benzoic acid, Phthalic acid and p-Bromobenzoic acid were obtained on oxidation of A,

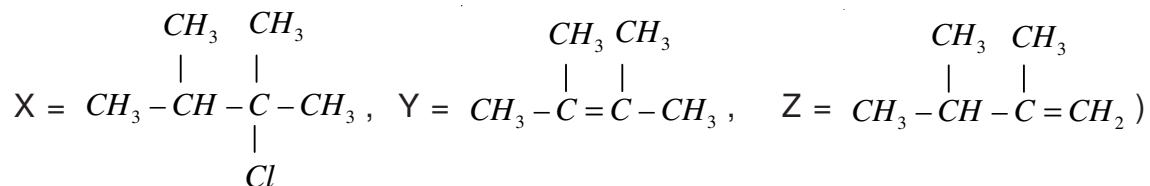
B and C respectively. Identify A, B and C.

(Ans :



23. ★ An alkyl halide X having molecular formula  $C_6H_{13}Cl$  on treatment with potassium tert. butoxide gives two isomeric alkenes Y and Z. Both alkenes on hydrogenation give 2, 3-Dimethylbutane. Identify X, Y and Z.

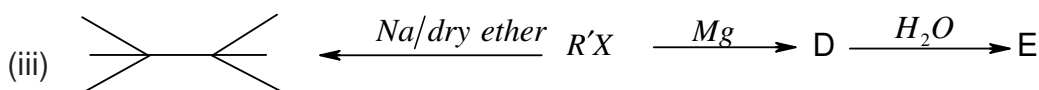
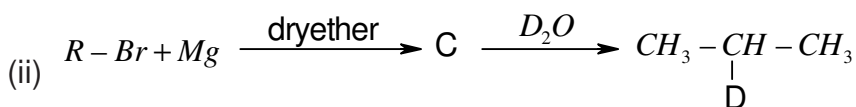
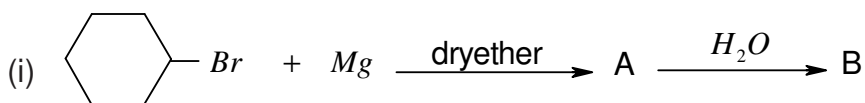
(Ans :



24. ★ An organic compound (A) having molecular formula  $C_3H_7Cl$  on reaction with alcoholic solution of  $KCN$  gives compound B. The compound B on hydrolysis with dilute  $HCl$  gives compound C and on reduction with  $H_2/Ni$  gives l-aminobutane. Identify A, B and C.

(Ans : A =  $CH_3CH_2CH_2Cl$ , B =  $CH_3CH_2CH_2CN$ , C =  $CH_3CH_2CH_2CONH_2$ )

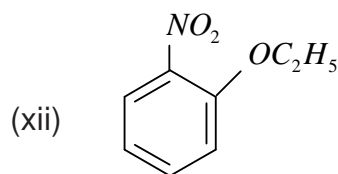
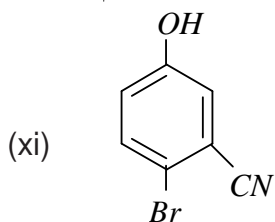
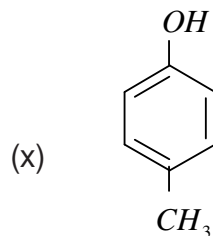
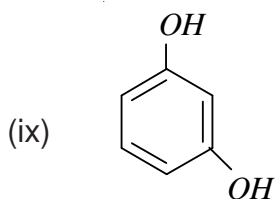
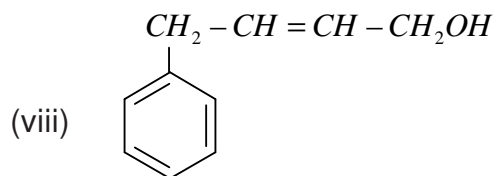
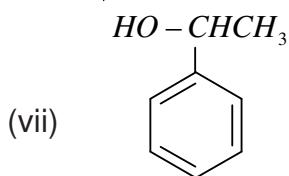
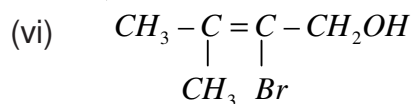
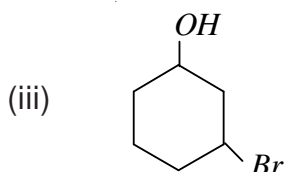
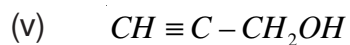
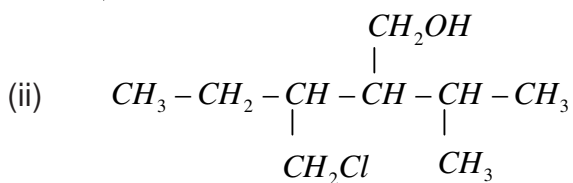
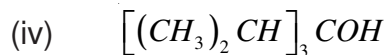
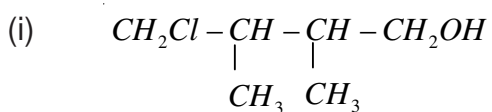
25. ★ Identify A, B, C, D, E, R and R' in the following sequence of reactions :-

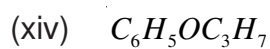
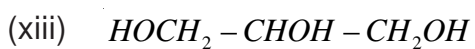


## Chapter - 11

### ALCOHOLS, PHENOLS AND ETHERS

1. Write the IUPAC names of the following compounds :-





2. Write the structures of the compounds whose IUPAC names are given below :-

(i) 2- Methylpropan - 2- ol

(ii) 1 - Phenylpropan - 2- ol

(iii) 3 - Cyclohexylpentan - 3- ol

(iv) 2, 3 - Dimethylphenol

(v) 3, 5 - Dimethoxyhexane - 1, 3, 5 - triol

(vi) Cyclohexylmethanol

(vii) 2 - Ethoxy - 3 - methylpentane

(viii) 3 - Chloromethylpentan - 2 - ol

(ix) 1 - Ethoxy - 2 - methylpropane

(x) 1 - Methoxy - 2 - chloroethane

(xi) p - Nitroanisole

(xii) 1 - Ethoxy - 4, 4 - dimethylcyclohexane.

3. Describe the following reactions with example :-

(i) Hydroboration oxidation of alkenes

(ii) Acid catalysed dehydration of alcohols

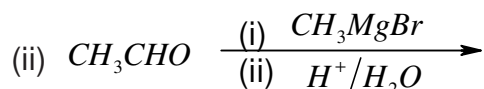
(iii) Williamson synthesis

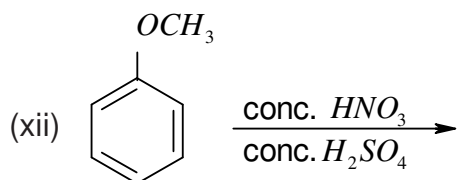
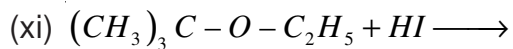
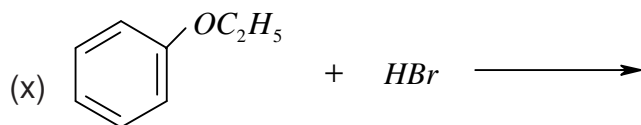
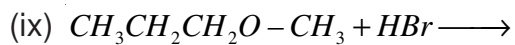
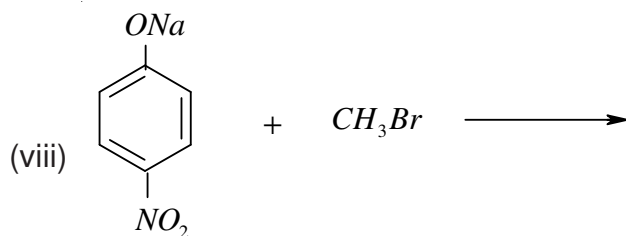
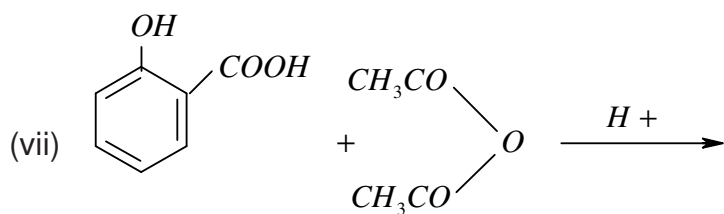
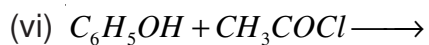
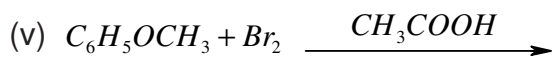
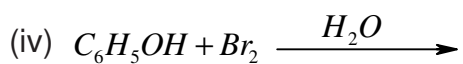
(iv) Reimer Tiemann reaction

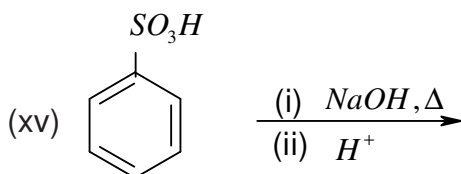
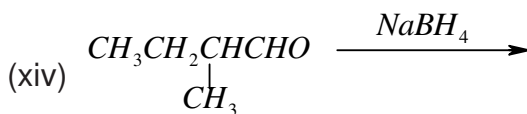
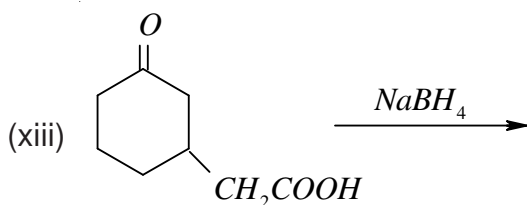
(v) Kolbe's Reaction

(vi) Friedel - crafts acylation of anisole

4. Complete the following reactions :-







5. What happens when :-

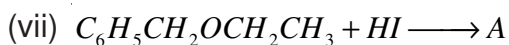
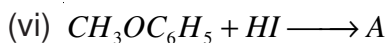
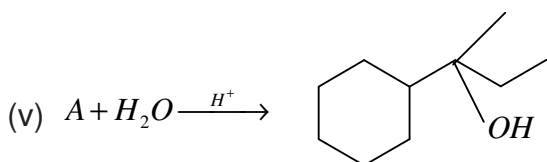
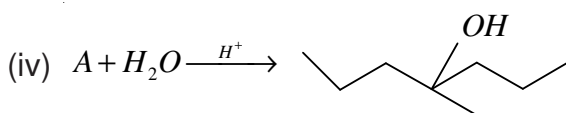
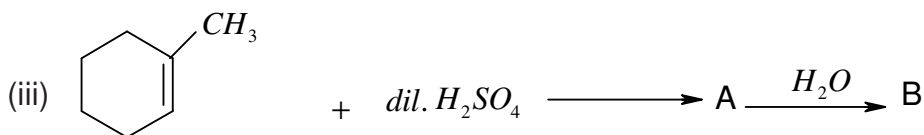
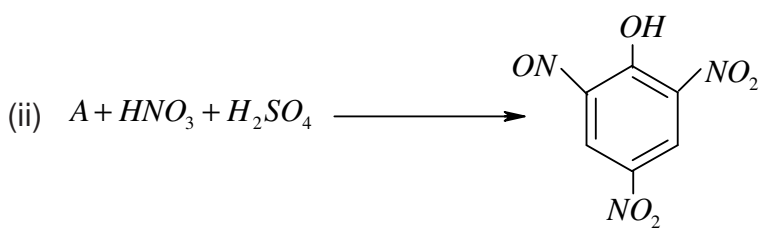
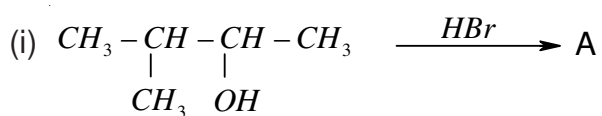
- (i) Aluminium reacts with t-butylalcohol
- (ii) Phenol is oxidised with chromic acid
- (iii) Cumene is oxidised in the presence of air and the product formed is treated with dilute acid.
- (iv) Phenol is treated with conc.  $HNO_3$ .
- (v) Phenol is treated with chloroform in presence of dilute  $NaOH$ .

6. How will you convert :-

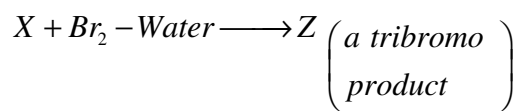
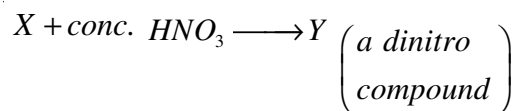
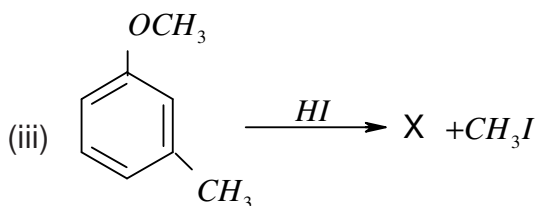
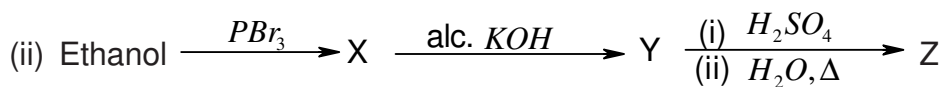
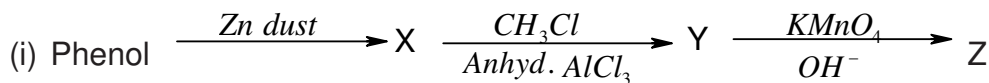
- (i) Propene to propan - 1 - ol
- (ii) Anisole to phenol
- (iii) Phenol to 2, 4, 6 - tribromoethanol
- (iv) Butane - 2- one to butan - 2- ol
- (v) Ethanal to ethanol
- (vi) Phenol to ethoxybenzene
- (vii) Phenol to salicylic acid
- (viii) 1 - Phenylethene to 1 - Phenylethanol
- (ix) Formaldehyde to cyclohexylmethanol

- (x) Butylbromide to pentan - 1 - ol
- (xi) Toluene to benzyl alcohol
- (xii) 1 - Propoxypropane to propyl iodide
- (xiii) Ethylbromide to 1 - ethoxyethane
- (xiv) Methyl bromide to 2 - methoxy - 2 - methylpropane
- (xv) Ethylbromide to ethoxybenzene
- (xvi) Ethanol to benzylethyl ether.

7. Identify the missing reactant or product (A or B) in the following equations :-

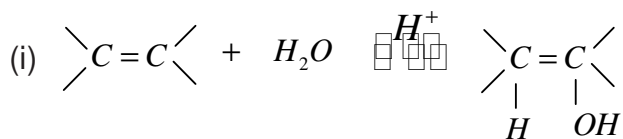


8. Identify X, Y and Z in the following sequence of reactions :-

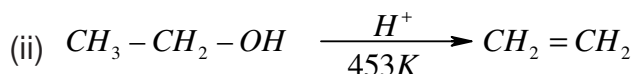


9. Describe the mechanism of alcohols reacting both as nucleophiles and electrophiles in their reactions.

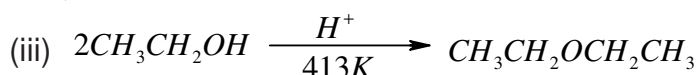
10. Write the mechanism for following reactions :-



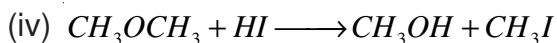
(acid catalysed hydration of alkenes)



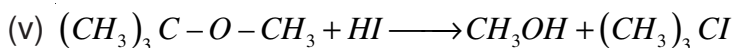
(acid catalysed dehydration of alcohols)



(acid catalysed nucleophilic substitution reaction)



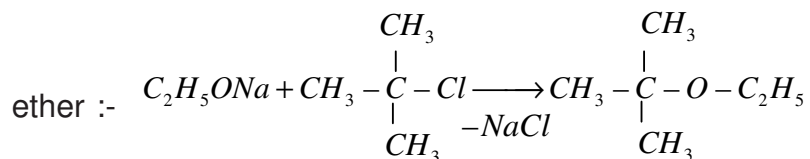
(acid catalysed cleavage of ethers)



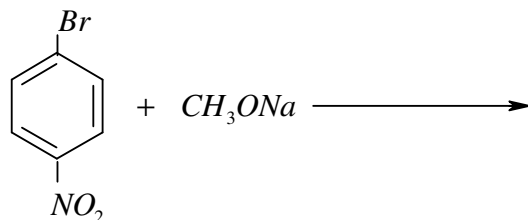
(acid catalysed cleavage of ethers)

11. Give reason for the following :-

- (i) The  $\text{C}-\text{O}-\text{C}$  bond angle in dimethylether is  $111.7^\circ$ .
- (ii) Alcohols having higher boiling points than ethers of comparable molecular mass.
- (iii) Propanol and butane have comparable molecular weights but propanol has higher boiling point than butane.
- (iv) Phenols are more acidic than alcohols.
- (v) O- nitrophenol is more acidic than O-methoxyphenol.
- (vi) Phenol is more reactive towards electrophilic substitution reaction than benzene.
- (vii) Preparation of ethers by treatment of alcohol with dilute  $\text{H}_2\text{SO}_4$  is not a suitable method for the preparation of diisopropylether or di-tert-butylether.
- (viii) The following is not an appropriate method for the preparation of t - butyl ethyl



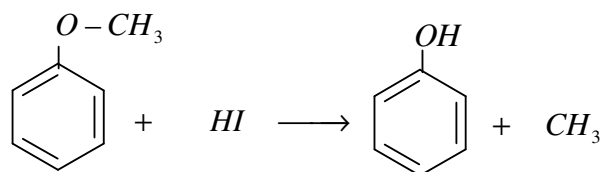
- (ix) The following is not an appropriate reaction for the preparation of 1 - methoxy - 4 - nitrobenzene :-



- (x) O-Nitrophenol is steam volatile but p-nitrophenol is not.
- (xi) Phenol has higher b.pt. than toluene .
- (xii) Phenol is less polar than ethanol.

(xiii) Diethylether is soluble in water.

(xiv) The phenylmethylether reacts with  $HI$  to form phenol and iodomethane and not iodobenzene and methanol.



(xv) Methanol is less acidic than water.

(xvi) Alcohols can act as weak base as well as weak acids.

(xvii) Phenols do not give protonation reaction readily.

(xviii) Alcohols undergo nucleophilic substitution reactions but phenols do not undergo nucleophilic substitution at  $C-1$  carbon.

(xix) Absolute ethanol can not be obtained by fractional distillation of ethanol water mixture.

(xx) Commercial ethanol is mixed with a small amount of methanol to form denatured alcohol.

(xxi) O-Nitrophenol is more acidic than phenol.

12. Arrange the following in the increasing order of property shown :-

(i) Methanol, Ethanol, Diethylether, Ethylene glycol. (Boiling points)

(ii) Phenol, O-nitrophenol, m-nitrophenol, p-nitrophenol. (Acidic strength)

(iii) Dimethylether, ethanol, phenol. (Solubility in water)

(iv) Phenol, p-methylphenol, p-nitrophenol. (Acidic strength)

(v) n-butanol, 2-methylpropan-1-ol, 2-methylpropan-2-ol. (Acidic strength)

13. Give the commercial method of preparation and two important uses of following (i) methanol (ii) ethanol.

14. Give a chemical test to distinguish between the following pair of compounds. Also write the chemical reaction involved in the test.

(i) n-Propylalcohol and isopropylalcohol

(ii) Methanol and ethanol

(iii) Cyclohexanol and phenol

(iv) Propan-2-ol and 2-methylpropan-2-ol

(v) Phenol and chlorobenzene

(vi) Phenol and anisole

(vii) Ethanol and Diethylether

(viii) Phenol and cyclohexane.

15. ★ Which of the following compounds gives fastest, reaction with \_\_\_\_\_ and why?

(i) \_\_\_\_\_ (ii) \_\_\_\_\_

(iii) \_\_\_\_\_ (iv) \_\_\_\_\_

16. ★ What is the function of \_\_\_\_\_ in Lucas test for distinction between \_\_\_\_\_ and \_\_\_\_\_ alcohols.

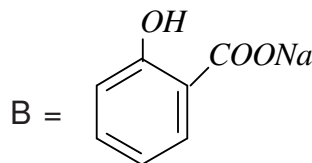
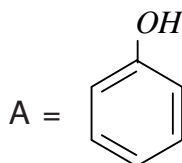
17. An alcohol A \_\_\_\_\_ on oxidation with acidified potassium dichromate gives carboxylic acid B ( $C_4H_8O_2$ ). Compound A when dehydrated with conc.  $H_2SO_4$  at 453 K gives compound C. Treatment of C with aqueous  $H_2SO_4$  gives compound D. ( $C_4$ ) which is an isomer of A compound D is resistant to oxidation but compound A can be easily oxidised. Identify A, B, C and D and write their structures.

(Ans:  $[A] = (CH_3)_2CHCH_2OH$                        $[B] = CH_3CH(CH_3)COOH$

$[C] = CH_3C(CH_3)=CH_2$                        $[D] = (CH_3)_3C-OH$ )

18. ★ An organic compound A having molecular formula  $C_6H_6O$  gives a characteristic colour with aqueous  $FeCl_3$ . When A is treated with  $NaOH$  and  $CO_2$  at 400 K under pressure compound B is obtained. Compound B on acidification gives, compound C which reacts with acetyl chloride to form D, which is a popular pain killer. Deduce the structure of A, B, C and D. What is the popular name of Drug D?

(Ans :

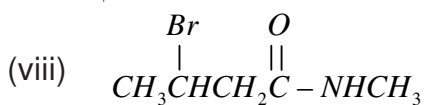
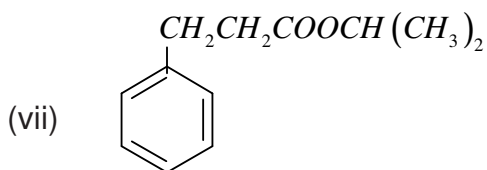
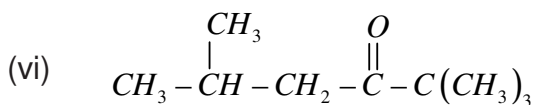
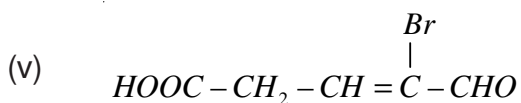
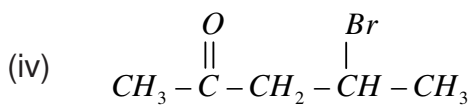
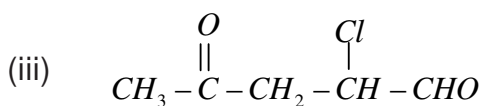
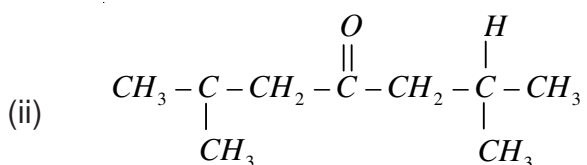
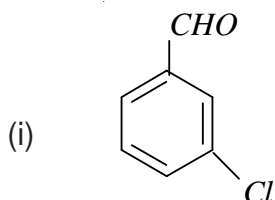


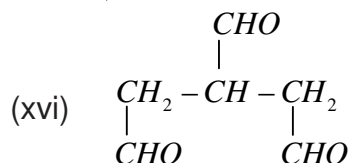
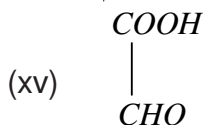
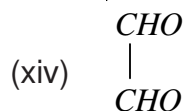
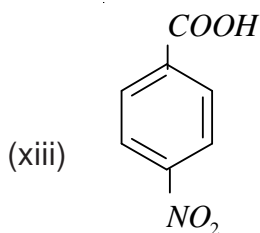
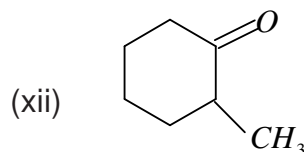
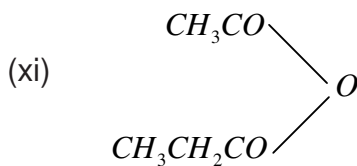
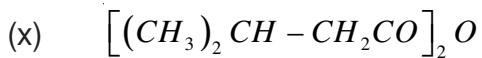
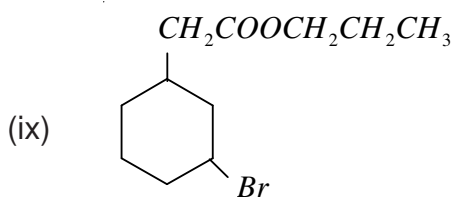


## Chapter - 12

### ALDEHYDES, KETONES AND CARBOXYLIC ACIDS

1. Indicate the electrophilic acid nucleophilic centre in acetaldehyde.
2. Write the IUPAC names of the following organic compounds :-





3. Explain the following reactions giving one example in each :-

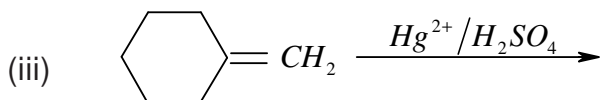
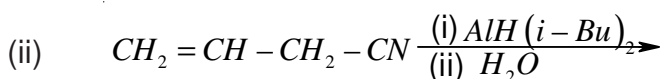
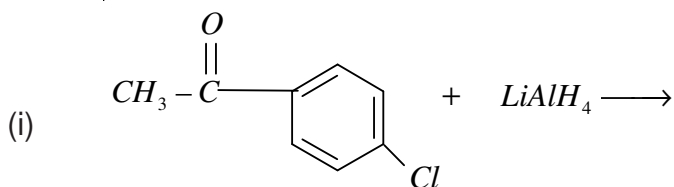
- (i) Rosenmund reduction reaction
- (ii) Stephen reaction
- (iii) Etard reaction
- (iv) Gatterman - Koch reaction
- (v) Aldol condensation
- (vi) Cross Aldol condensation
- (vii) Cannizzaro reaction
- (viii) Decarboxylation reaction
- (ix) Kolbe's reaction
- (x) Hell-Volhard-Zelinsky reaction
- (xi) Friedel Craft's acetylation

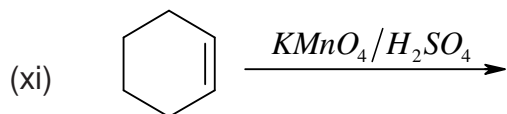
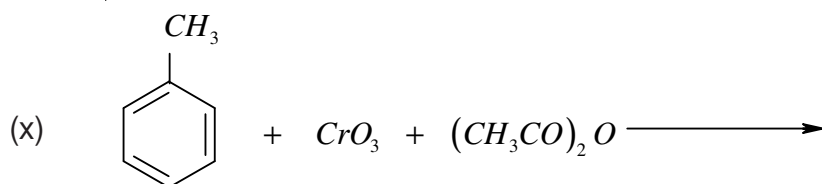
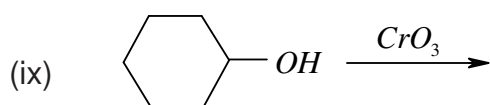
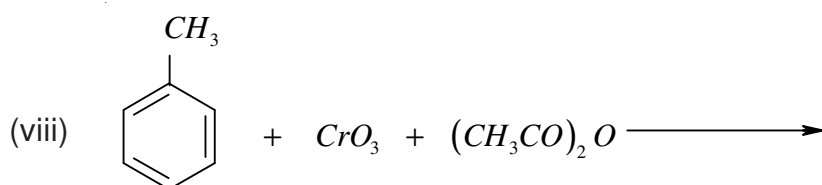
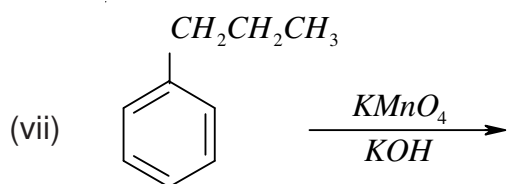
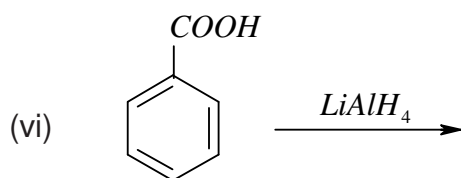
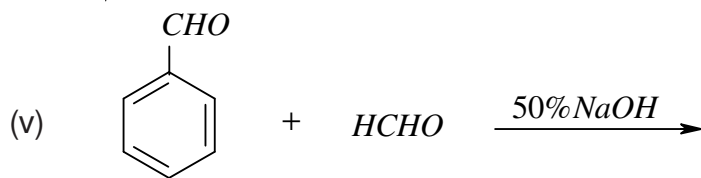
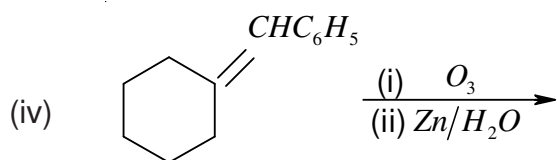
- (xii) Fischer Esterification
- (xiii) Clemmensen reduction
- (xiv) Wolff-Kishner reduction
- (xv) Haloform reaction

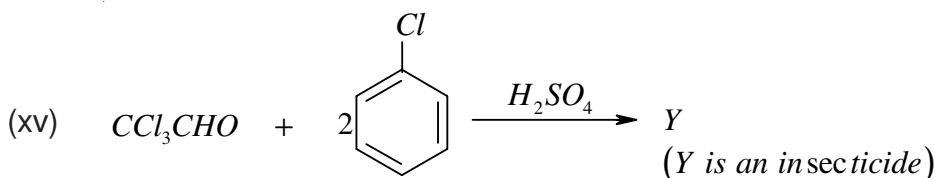
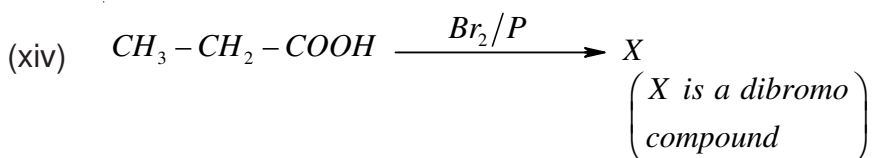
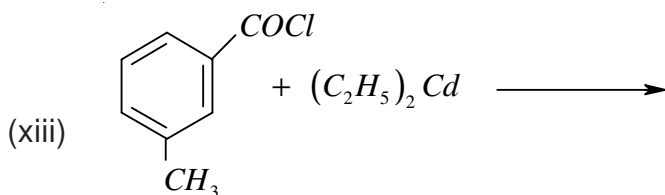
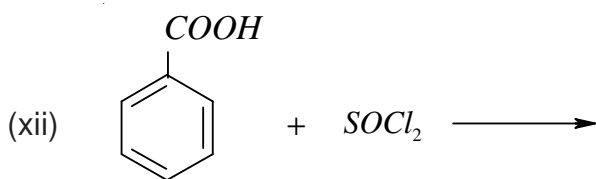
4. How will you convert :-

- (i) Isopropyl chloride to 2-methylpropionaldehyde.
- (ii) Benzene to benzaldehyde
- (iii) Benzoic acid to Acetophenone
- (iv) Propene to propanal
- (v) Butanoic acid to 2-hydroxy butanoic acid
- (vi) Benzoic acid to m-nitrobenzylalcohol
- (vii) Propanone to propene
- (viii) Propanol to Butan-2-one
- (ix) Methyl magnesium bromide to ethanoic acid
- (x) Benzoic acid to benzyl chloride
- (xi) Acetone to chloroform
- (xii) Acetylene to acetic acid
- (xiii) Formaldehyde to 1-propanol
- (xiv) Acetophenone to 2-phenyl-2-butanol.

5. Complete the following reactions :-







6. Arrange the following compounds in increasing order of their boiling points :-

(i) Propanal, Methoxyethane, n-Butane

(ii) Propan-1-ol, propan-2-one, propanal

7. Indicate the type of intermolecular interactions present in :-

(i) Acetaldehyde

(ii) Propanone

(iii) Diethylether

(iv) Propanoic acid

(v) Propane

8. How will you prepare the following derivatives of acetone

(i) Cyanohydrin

(ii) Semicarbazone

(iii) 2, 4-DNP derivative

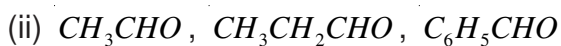
(iv) Ethyleneglycol ketal

(v) Schiff's base

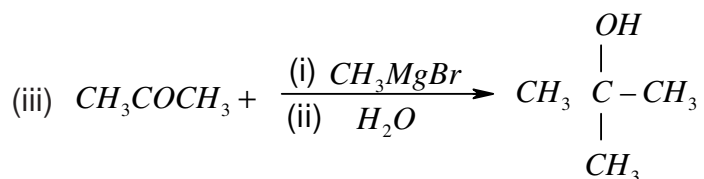
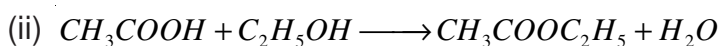
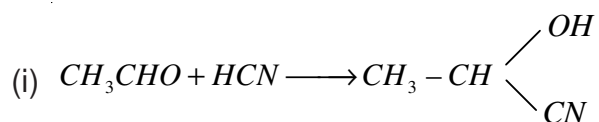
(vi) Oxime

(vii) Bisulphite addition compound

9. Arrange the following in the order of increasing reactivity towards HCN or 2, 4-DNP reagent.



10. Give the reaction mechanism for following reactions :-



11. Give the chemical tests to distinguish between following pair of compounds :-

- (i) Propanal and propanone
- (ii) Ethyl acetate and methyl acetate
- (iii) Benzaldehyde and Benzoic acid
- (iv) Benzaldehyde and acetaldehyde
- (v) Formic acid and acetic acid
- (vi) Propanal and propanol
- (vii) Ethanoic acid and ethylethanoate.

12. Give reason for the following :-

- (i) The reactivity of aromatic aldehydes and ketones is less than that of aliphatic carbonyl compounds towards nucleophilic addition reactions.
- (ii) Benzaldehyde does not give Fehling test.
- (iii) The  $\alpha-H$  atoms in ethanal are acidic in nature.
- (iv) p-Nitrobenzaldehyde is more reactive than benzaldehyde towards nucleophilic

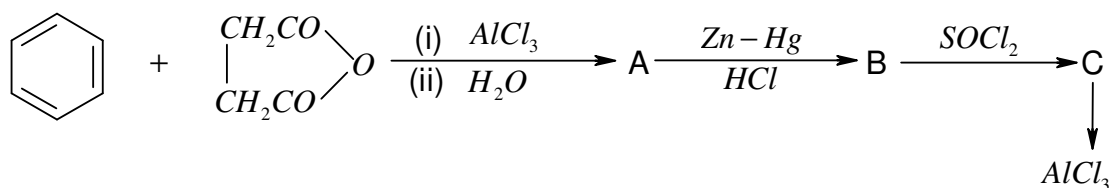
addition reactions.

- (v) Acetic acid does not give sodium bisulphite addition product.
- (vi) For the formation of ethylacetate from acetic acid and ethanol in presence of sulphuric acid, the reaction mixture is heated to remove water.
- (vii) Chloroacetic acid has lower pka value than acetic acid.
- (viii) Monochloroethanoic acid is a weaker acid than dichloroethanoic acid.
- (ix) Benzoic acid is a stronger acid than ethanoic acid.
- (x) Aldehydes are more reactive than ketones towards nucleophilic reagents.
- (xi) Benzaldehyde does not undergo aldol condensation.
- (xii) Formic acid reduces tollen's reagent.
- (xiii) Electrophilic substitution in benzoic acid takes place at m-position.
- (xiv) Carboxylic acids have higher boiling point than alcohols of comparable molecular mass.
- (xv) Carboxylic acids do not give characteristic reactions of carboxyl group.
- (xvi) Fomaldehyde gives Cannizzaro's reaction whereas acetaldehyde does not.
- (xvii) Tert. butyl benzene can not be oxidised with  $KMnO_4$ .
- (xviii) Bond length of  $C=O$  in carboxylic acids is slightly larger than  $C=O$  bond length in carbonyl compounds.
- (xix) Benzoic acid is less soluble in water than acitic acid.
- (xx) Formic acid is a stronger acid than acetic acid.

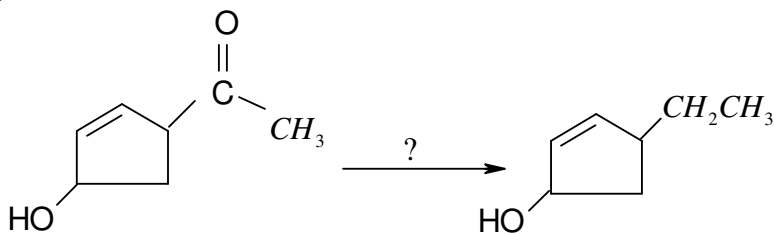
13. Name the following :-

- (i) An aldehyde used in the preparation of bakelite polymer.
- (ii) An aromatic aldehyde used in perfumery and dye industry.
- (iii) A carboxylic acid salt used as a preservative.

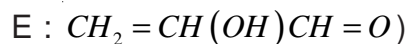
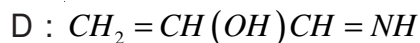
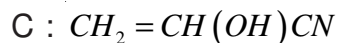
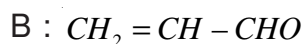
14. ★ Predict the structures of intermediates A, B, C and D in the following sequence of reactions :



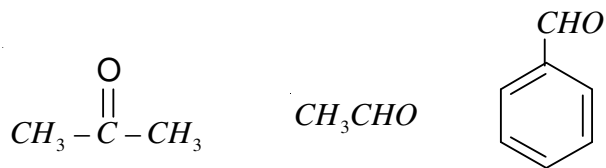
15. ★ You are given four different reagents  $Zn-Hg/HCl$ ,  $NH_2-NH_2/OH^-$ ,  $H_2/Ni$  and  $NaBH_4$ . Select one reagent for the following transformation :



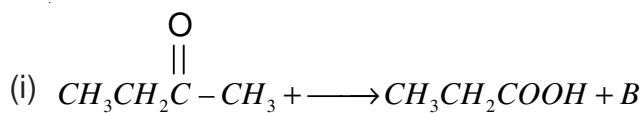
16. ★ An organic compound  $C_5H_{10}O$  gives a positive DNP test. It does not reduce Tollen's reagent but forms an addition compound with sodium hydrogensulphate. On reaction with iodine in presence of sodium precipitate B and another compound C. On oxidation it forms two acids D and E. Identify A, B, C, D and E.
17. ★ Formaldehyde and acetaldehyde on treatment with dil.  $NaOH$  form A which on heating changes to B. When B is treated with HCN form C. Reduction of C with DIBAL-H yields D which on hydrolysis yields E.

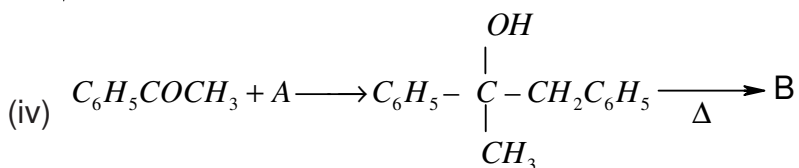
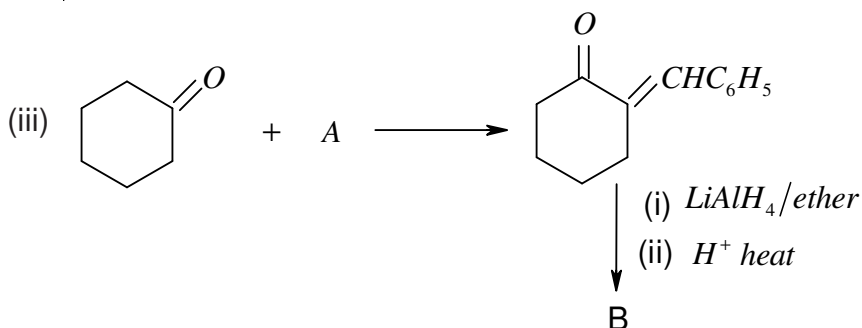
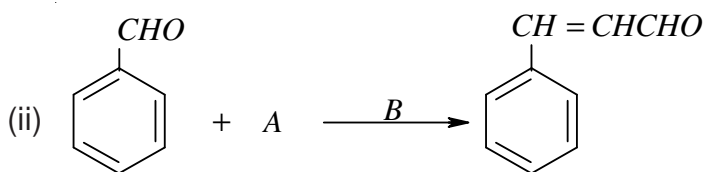


18. ★ Arrange the following in the increasing order of reactivity with  $C_6H_5MgBr$ .

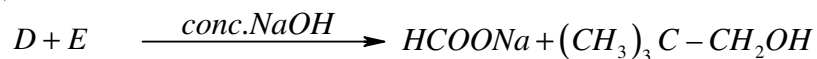
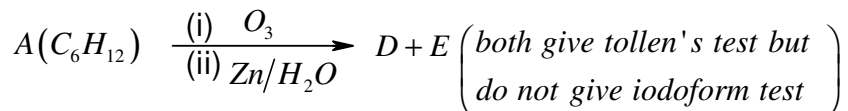
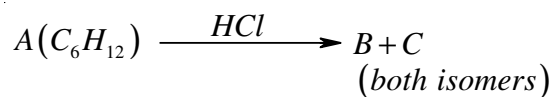


19. ★ Identify the missing reagent/products in the following reactions :-

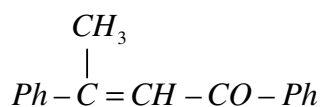




20. Identify A, B, C, D and E in the following sequences of reactions :-

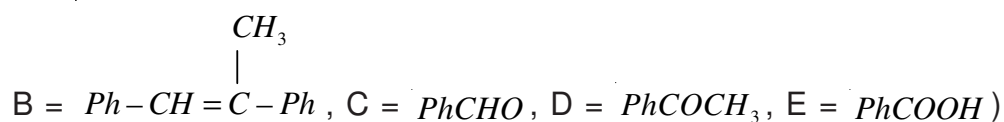
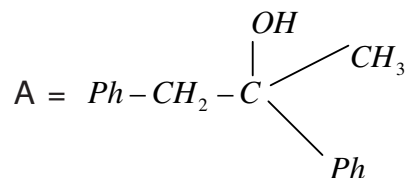


21. ★ A tertiary alcohol 'A' on acid catalyzed dehydration gave product 'B'. Ozonolysis of 'B' gives compounds 'C' and 'D'. Compound 'C' on reaction with  $\text{KOH}$  gives benzyl alcohol and compound 'E'. Compound 'D' on reaction with  $\text{KOH}$  gives  $\alpha, \beta$ -unsaturated ketone having the following structure.

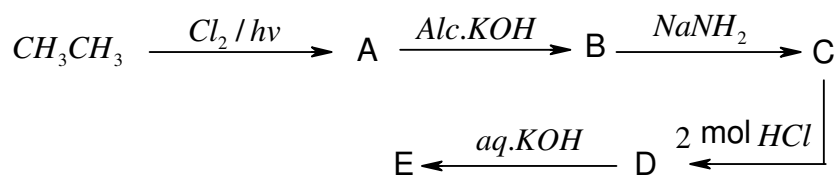


Identify A, B, C, D and E

(Ans :



22. ★ Identify A, B, C, D and E in the following :-



(Ans : A =  $\text{CH}_3\text{CH}_2\text{Cl}$

B =  $\text{CH}_2=\text{CH}_2$

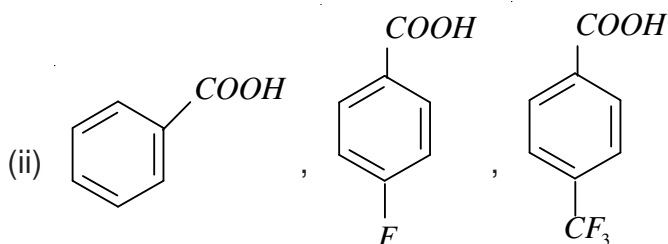
C =  $\text{CH}\equiv\text{CH}$

D =  $\text{CH}_3\text{CHCl}_2$

E =  $\text{CH}_3\text{CHO}$ )

23. ★ Arrange the following acids in the increasing order of acidic strength

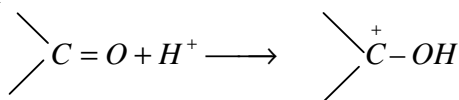
(i) Formic acid, benzoic acid, Acetic acid



(iii)  $\text{CH}_3\text{CH}_2\text{COOH}$ ,  $\text{C}_6\text{H}_5\text{COOH}$ ,  $\text{CH}_3\text{COOH}$ ,  $\text{C}_6\text{H}_5\text{CH}_2\text{COOH}$

24. ★ During the reaction of a carbonyl compound with a weak nucleophile  $H^+$  ions are added as catalyst. Why?

(Ans :



$H^+$  ions get attached to oxygen atom and make carbonyl carbon more electropositive)

25. ★ During reaction of carbonyl compound with 2, 4-DNP reagent the  $pH$  of the reaction mixture has to be maintained between 3 and 4. Why?

(Ans :  $H^+$  ions increase the electrophilicity of carbonyl carbon. When  $H^+$  ions are in excess they protonate the  $NH_2$  – group of 2, 4-DNP. After protonation  $NH_2$  group does not act as nucleophile.)

26. ★ An aromatic compound X with molecular formula  $C_9H_{10}O$  gives the following chemical tests :-

(i) Forms 2, 4 - DNP derivative

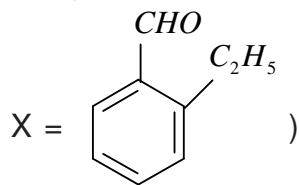
(ii) Reduces Tollen's reagent

(iii) Undergoes cannizzaro reaction and

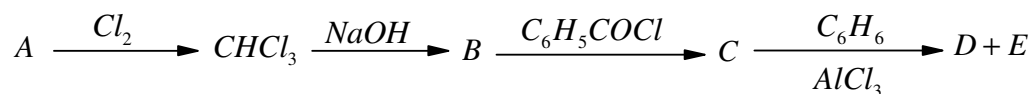
(iv) On vigorous oxidation gives 1, 2-benzenedicarboxylic acid.

Identify X and write its IUPAC name. Also write the reactions involved in the formation of above mentioned products.

(Ans :

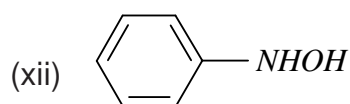
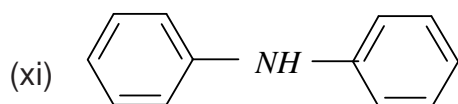
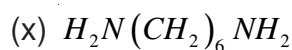
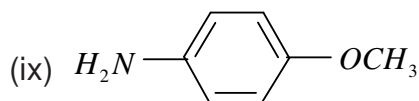
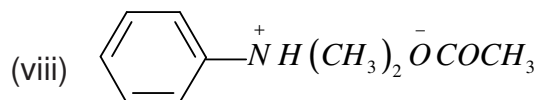
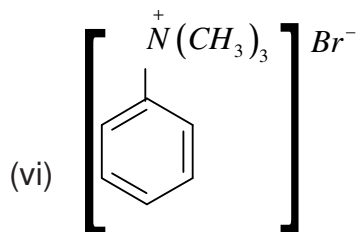
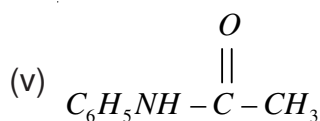
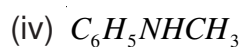
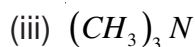
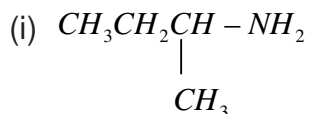


27. Identify A, B, C, D and E in the following sequence of reaction :-



## Chapter - 13 AMINES

1. Write the IUPAC names of following amines :-



2. Giving an example of each describe the following reactions :-

(i) Hoffman Bromamide reaction

(ii) Gabriel Phthalimide synthesis

(iii) Gatterman reaction

(iv) Coupling reaction

(v) Hoffman's ammonolysis

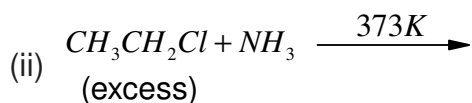
(vi) Carbylamine reaction

(vii) Acetylation of aniline

3. Describe the method for identification of primary, secondary and tertiary amines. Also write the chemical equations of the reactions involved.

4. Arrange the following in the increasing order of given property :-
- $C_6H_5NH_2$ ,  $(C_2H_5)_2NH$ ,  $(C_2H_5)_3N$  and  $NH_3$ . (Basic strength in aqueous solution)
  - $C_2H_5NH_2$ ,  $(C_2H_5)_2NH$ ,  $(C_2H_5)_3N$  and  $CH_3NH_2$ . (Basic strength in gaseous phase)
  - $NH_3$ ,  $CH_3NH_2$ ,  $C_6H_5NH_2$ . (Basic strength)
  - Aniline, p-toluidine, p-nitroaniline. (Basic strength)
  - $NH_4^+$ ,  $C_6H_5NH_3^+$ , p-Fluoro- $C_6H_5NH_3^+$ . (Acid Strength)

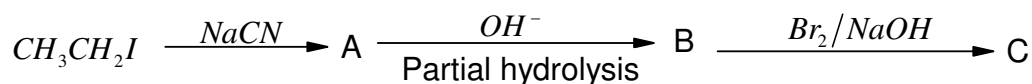
5. Identify A and B in the following reactions :-



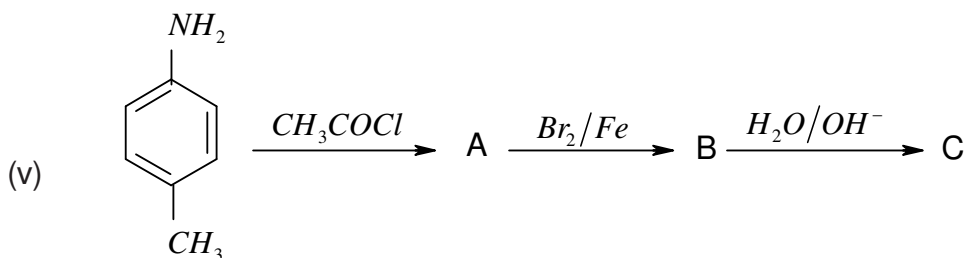
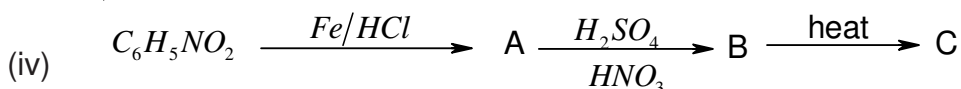
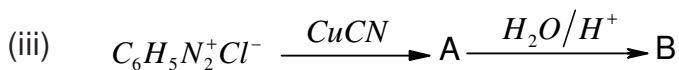
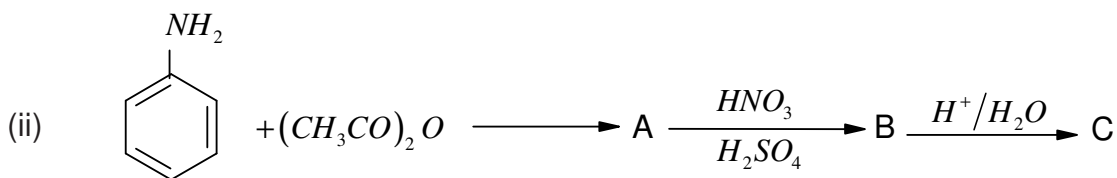
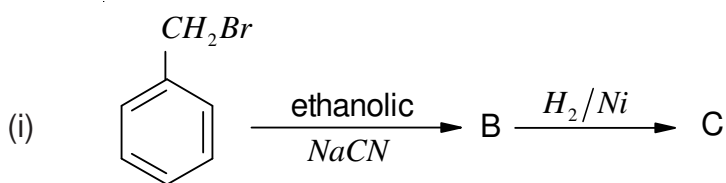
6. How will you bring about the following conversions :-

- p-Chlorobenzene to p-Chloramine
- Benzene to N, N-Dimethylaniline
- Aniline to benzene
- Acetaldehyde to ethanamine
- p-Toluidine to 2-Bromo-4-methylaniline
- Methylbromide to ethanamine
- Benzenediazonium chloride to nitrobenzene
- Ethylamine to methylamine
- Benzene to sulphanilic acid
- Hexanenitrile to 1-aminopentane

7. Write the products formed in the following sequence of reactions :-



8. Identify the missing reagent/product in the following reactions :-



9. Give one chemical test to distinguish between the following pairs of compounds :-

- (i) Methylamine and dimethylamine
- (ii) Secondary and tertiary amines
- (iii) Ethylamine and aniline
- (iv) Aniline and benzylamine
- (v) Methylamine and methanol
- (vi) Methylamine and N, N-Dimethylamine
- (vii) Ethanol and ethanamine

10. Explain why :-

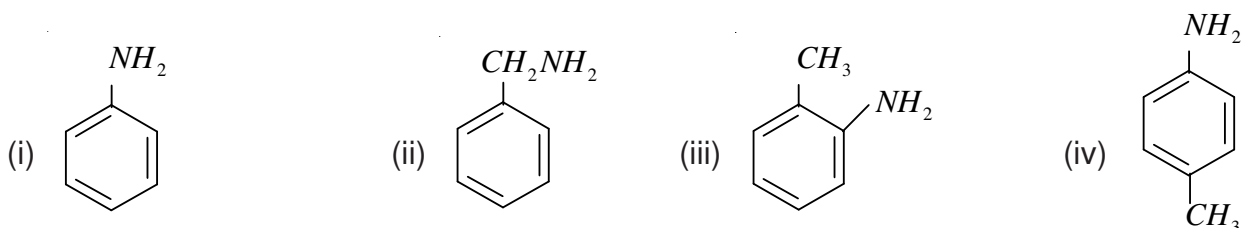
- (i) The  $C-N-C$  bond angle in trimethyl amine is  $108^\circ$ .
- (ii) The quaternary ammonium salts having four different alkyl groups are optically active.

- (iii) Alkylamines are more basic than ammonia
- (iv) Aniline can not be prepared by Gabriel Phthalimide synthesis.
- (v) Gabriel Phthalimide synthesis is preferably used for synthesising primary amines.
- (vi) Ethylamine is soluble in water but aniline is not.
- (vii) Aniline is soluble in dilute HCl.
- (viii) Amines have lower boiling points than alcohols of comparable molecular masses.
- (ix) 1° amines have higher boiling points than 2° amines which in turn are higher boiling than 3° amines.
- (x) The  $pK_b$  value of benzeneamine is 9.33 while that of ammonia is 4.75.
- (xi) Aniline does not undergo Friedel Crafts reaction.
- (xii) Aniline readily forms 2, 4, 6 - tribromoaniline on reaction with bromine water.
- (xiii) Sulphuric acid is soluble in water.
- (xiv) Methylamine in water reacts with ferric chloride to precipitate hydrated ferric oxide.
- (xv) Diazonium salt of aromatic amines are more stable than the diazonium salts of aliphatic amines.
- (xvi) Although amino group is o, p-directing in aromatic electrophilic substitution reactions, aniline on nitration gives a substantial amount of m-nitroaniline.

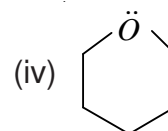
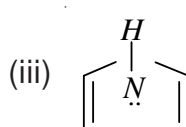
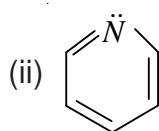
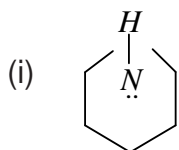
11. Which of the following compounds responds to carbylamine test?

- (i) N, N-Dimethylaniline
- (ii) 2, 4 - Dimethylaniline
- (iii) N - Methyl-2-methylaniline
- (iv) 4-Methylbenzylamine

12. Arrange the following amines in the order of increasing basic strength.



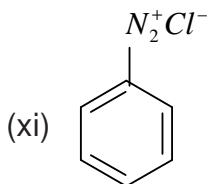
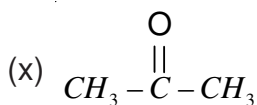
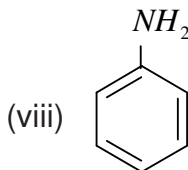
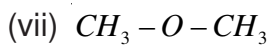
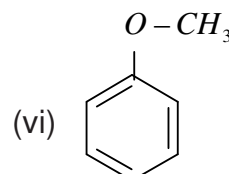
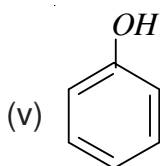
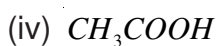
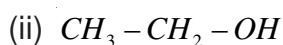
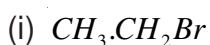
13. Arrange the following compounds in the increasing order of basicity :-



14. Why do amines act as nucleophiles? Give example of a reaction in which methylamine acts as a nucleophile.

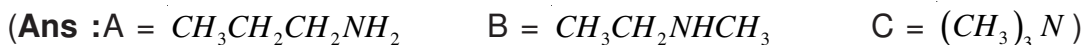
15. Why does diazonium ion act as an electrophile? Give example of a reaction where diazonium ion acts as an electrophile.

16. Identify both the electrophilic and nucleophilic centres in the following classes of compounds :-



17. ★ Three isomeric amines A, B and C have the molecular formula  $C_3H_9N$ . Compound A on reaction with benzene sulphonyl chloride forms a product which is soluble in  $NaOH$ . Compound B on reaction with benzene sulphonyl chloride forms a product which is insoluble in  $NaOH$  and compound C does not react with benzene sulphonyl chloride.

Identify A, B and C.



18. An organic compound A ( $C_2H_3N$ ) is used as a solvent of choice for many organic reactions because it is not reactive in mild acidic and basic conditions. Compound A on treatment with  $Ni/H_2$  forms B. When B is treated with nitrous acid at 273K ethanol is obtained. When B is warmed with chloroform and  $NaOH$  a foul smelling compound C formed. Identify A, B and C.



19. An organic compound A ( $C_3H_6O_2$ ) on reaction with ammonia followed by heating yields B. Compound B forms a foul smelling compound C ( $C_2H_7N$ ) on heating with chloroform and alcoholic KOH. Identify A, B and C.



## Chapter - 14

# BIOMOLECULES

### POINTS TO REMEMBER

1. Carbohydrates are optically active polyhydroxy aldehydes or ketone or molecules which provide such units on hydrolysis.
2. They are broadly classified into three groups-monosaccharides, oligosaccharides and polysaccharides.
3. Glucose the most important source of energy for mammals is obtained by the digestion of starch.
4. Monosaccharides are held together by glycosidic linkages to form disaccharides or polysaccharides.
5. Proteins are the polymers of about twenty different  $\alpha$ -amino acids which are linked by peptide bonds. Ten amino acids are called essential amino acids because they can not be synthesised in our body, Hence must be provided through diet.
6. Proteins perform various structural and dynamic functions in the organisms. Proteins which contain only  $\alpha$ -amino acids are called simple proteins.
7. The secondary or tertiary structure of proteins get disturbed on change of  $pH$  or temperature and they are not able to perform their functions. This is called denaturation of proteins.
8. Enzymes are biocatalysts which speed up the reactions in biosystems. They are very specific and selective in their action and chemically all enzymes are proteins.
9. Vitamins are accessory food factors required in the diet. They are classified as fat soluble (A, D and K) and water soluble (B and C).
10. Nucleic acid are responsible for the transfer of characters from parents to offsprings.
12. There are two types of nucleic acids : DNA and RNA. DNA contains a five carbon sugar molecule called 2-deoxy base and RNA contains ribose.
13. Both DNA and RNA contain adenine, guanine and cytosine. The fourth base is thymine in DNA and uracil in RNA. The structure of DNA is double strand while that of RNA is a single strand molecule.
14. DNA is the chemical basis of heredity and have the coded message for proteins to be synthesised.
15. There are three types of RNA i.e., m-RNA, r-RNA and t-RNA which actually carry out the protein synthesis in the molecule.
16. Human stomach do not have any enzyme capable of breaking cellulose molecules and thus we cannot digest cellulose.
17. Vitamins A and C are known to increase resistance to disease.

### VSA Type Questions (1 Marks)

1. Name polysaccharide stored in liver of animals.
2. What structural feature is required for a carbohydrate to behave as reducing sugar?
3. How many asymmetric carbon atoms are present in D-(+) glucose.
4. Name the enantiomer of D-(+) glucose?
5. Give the significance of (+) - sign in the name of D-(+) - glucose.  
[Hint : (+) sign indicates dextrorotary nature of glucose]
6. Give the significance of prefix 'D' in the name D - (+) - glucose.  
[Hint : 'D' signifies that -OH group on C - 5 is on the right hand side]
7. Glucose is an aldose sugar but it does not react with sodium hydrogen sulphate. Give reason.  
[Hint : The -CHO group reacts with - OH group at C - 5 to form a cyclic hemi-acetal]
8. Why is sucrose called invert sugar?
9. Name the building blocks of proteins.
10. Give the structure of simplest optically active  $\alpha$ -amino acid.
11. Name one  $\alpha$ -amino acid which is not optically active.
12. Write the Zwitter ion form of amino acetic acid.
13. Name the enzyme which catalyses the hydrolysis of maltose into glucose.
14. Give reason :- Amylase present in the saliva becomes inactive in the stomach.
15. How would you explain the amphoteric behaviour of amino acids.
16. What forces are responsible for the stability of  $\alpha$ -helix structure of proteins.
17. How are polypeptide different from proteins?
18. Which nucleic acid is responsible for carrying out protein synthesis in the cell?
19. The two strands in DNA are not identical but complementary? Explain.
20. When RNA is hydrolysed, there is no relationship among the qualities of different bases obtained. What does this fact suggest about the structure of RNA.
21. What type of linkage holds together the monomers of DNA and RNA.
22. Mention the number of hydrogen bonds between adenine and thymine.
23. A child diagnosed with bone deformities is diagnosed with the deficiency of which vitamin?
24. Fat soluble vitamins A, D, E and K are stored in which part of body?
25. ★ Why do proteins form an indispensable part of our body?
26. ★ What is meant by the term DNA fingerprinting?

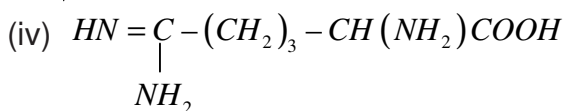
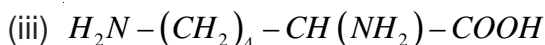
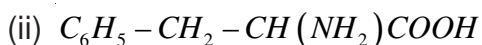
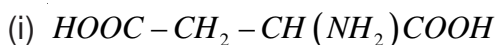
27. ★ Name the vitamin responsible for coagulation of blood.
28. ★ Except vitamin  $B_{12}$  all other vitamin of group B, should be supplied regularly in diet. Why?

**SA (I) Type Questions (2 Marks)**

- Classify carbohydrates on the basis of functional group present. Give one example of each class.
- What are the hydrolysis products of
  - Maltose
  - Cellulose
- What are the two components of starch? Out of them which is water soluble?
- Acetylation of glucose with acetic anhydride gives glucose pentacetate. Write the structure of the pentacetate.
  - Explain – Why glucose pentacetate does not react with hydroxylamine?

[Hint : The molecule glucose pentacetate has a cyclic structure in which  $-CHO$  does not react with hydroxylamine.]

- Give the names and structure of two enomers of fructose.
- Explain the term glycosidic linkage. Give the type of glycosidic linkage present in sucrose.
- Classify the following as monosaccharides or oligosaccharides.
  - Ribose
  - Maltose
  - Galactose
  - Lactose
- Classify monosaccharides on the basis of functional group. Give example of each class.
- State two main differences between globular and fibrous proteins.
- Classify the following  $\alpha$ -amino acids as neutral acidic or basic.

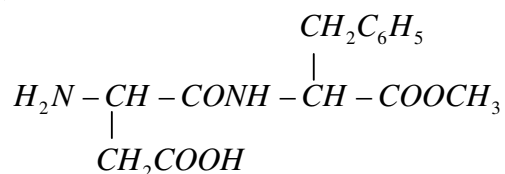


- If you have two amino acids glycine and alanine, what are the structures of two possible dipeptide that they can form?

12. Explain the significance of secondary structure of proteins. Name the common types of secondary structure of proteins and give example of each type.
13. Name four type of intermolecular forces which stabilize 2° and 3° structure of proteins.
14. Classify the following as globular or fibrous proteins.
- Keratin
  - Myosin
  - Insulin
  - Haemoglobin.
15. Explain, what happens to water present in egg on boiling.
16. Explain the following :-
- The amino acids are amphoteric in nature.
  - The melting point and solubility of aminoacids in water are generally higher than that of corresponding halo acids.
- [Hint :Amino acids behave like ionic salts due to their Zwitter ion structure whereas  $\alpha$ -haloacids can't form Zwitter ion.]**
17.
  - Name the disease caused by deficiency of vitamin D.
  - Why vitamin C cannot stored in our body?
18. Define the term hyper vitaminosis and avitaminosis.
- [Hint :Excess intake of vitamin A and D causes hyper vitaminosis while multiple deficiencies caused by lack of more than one vitamin is called avitaminosis]**
19. Explain what is meant by :-
- a peptide linkage
  - a glycosidic linkage
20. Give the sources of vitamin A and E and name the deficiency diseases resulting from lack of vitamin A and E in the diet.
21. ★ Account for the following :-
- On electrolysis in acidic solution, amino acids migrate towards cathode while in alkaline solution they migrate towards anode.
  - The monoamino monocarboxylic acids have two  $pK_a$  values.
22. ★
  - DNA is exclusively responsible for maintaining the identity of different species of organisms over million of years. Why?
  - The bare sequence found in one.

## SA (II) Type Questions (3 Marks)

- Enumerate the structural difference between DNA and RNA. Write down the structure of a nucleoside which is present only in RNA.
- ★ An optically active amino acid (A) can exist in three forms depending on the  $pH$  of the medium if the molecular formula of (A) is  $C_3H_7NO_2$ , write :-
  - The ionic structure of (A) in aqueous medium.
  - What two functional groups does this ion behave?
  - What is the specific name for such ion?
- ★ Aspartame, an artificial sweetener, has the following structure :-



- Write the zwitter ion structure of the above mentioned peptide.
  - Write the structure of two amino acids which will be formed after its hydrolysis.
- Define the following as related to proteins :-
    - Peptide linkage
    - Primary structure
    - Denaturation and renaturation.
  - Differentiate between the following :-
    - Secondary and tertiary structure of protein.
    - $\alpha$ -Helix and  $\beta$ -pleated sheet structure of proteins.
    - Fibrous and globular proteins.
  - What are enzymes?
    - Why are enzymes specific in nature?
    - Predict whether the enzyme-substrate complex will have activation energy higher or lower than the activated complex formed without enzyme?

# Chapter - 15

## POLYMERS

### POINTS TO REMEMBER

1. Polymers are defined as high molecular mass macromolecules, which consist of repeating structural units derived from the corresponding monomers.
2. In the presence of an organic peroxide initiator, the alkenes and their derivatives undergo addition polymerisation or chain growth polymerisation through a free radical mechanism. Polythene, teflon, orlon etc. are formed by addition polymerisation of an appropriate alkene or its derivative.
3. Condensation polymerisation reactions are shown by the addition of bi- or poly functional monomers containing  $-NH_2$ ,  $-OH$  and  $-COOH$  groups through the elimination of certain simple molecules as  $H_2O$ ,  $NH_3$  etc.
4. Formaldehyde reacts with phenol and melamine to form the corresponding condensation polymer products. The condensation polymerisation progresses through step by step and is called as step growth polymerisation.
5. Nylon, bakelite and dacron are some of the important examples of condensation polymers.
6. A condensation of two unsaturated monomers exhibits copolymerisation. A copolymer like Buna-S contains multiple units of 1, 3-Butadiene and styrene.
7. Natural rubber is a cis 1, 4-polyisoprene. It can be made more tough by the process of vulcanization with sulphur.
8. Synthetic rubber like Buna-N are usually obtained by copolymerisation of alkene and 1, 3-Butadiene derivatives.
9. In view of potential environmental hazards of synthetic polymeric wastes certain biodegradable polymers such as PHBV and Nylon-2-Nylon-6 are developed as alternatives.

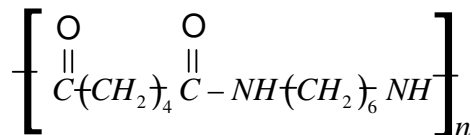
### VSA Type Questions (1 Mark)

1. Define the term Biopolymer.
2. Identify biopolymer among the following : malamine, resins, orlon.
3. Give example of natural polyamide. Which is an important constituent of diet.

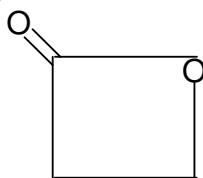
[Hint : Protein]

4. Classify polyethene and bakelite as thermoplastic, thermosetting plastic.
5. Among fibres, elastomers and thermosetting polymers which one has strongest inter molecular forces of attraction?

6. Name the element used for vulcanisation.
7. Give the monomers of bakelite.
8. Identify the monomer in the following polymeric structure.



9. Nylon-2- Nylon-6 is a biodegradable polymer obtained from glycine  $\text{H}_2\text{N} - \text{CH}_2 - \text{COOH}$  and amino caproic acid  $\text{H}_2\text{N}(\text{CH}_2)_5\text{COOH}$  . Write the structure of this polymer.
10. Give two uses of teflon.
11. Name the polymer used for making insulation material for coating copper wire.  
[Hint : PVC]
12. Write the name and structure of monomers of the polymer which is used as synthetic wool.
13. What is the difference in Buna-N and Buna-S?
14. Name the polymer used for making radio television cabinets and feeding bottles of children.
15. What do the 6 and 66 represent in the names nylon-6 and nylon-66?
16. Give the full form of PHBV.
17. Which of the following sets has all members capable of repeatedly softening on heating and hardening on cooling.
  - (i) Glyptal, Melamine, PAN.
  - (ii) PVC, PMMA, Polystyrene.
  - (iii) Polypropylene, urea formaldehyde resin, teflon.
18. ★ Why benzoyl peroxide is used as an initiator for chain growth polymerisation?
19. ★ Write the structure of polymer produced by the treatment of the following monomer with a catalytic amount of hydroxide ion.

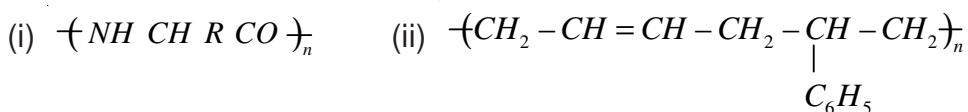


20. ★ During the free radical polymerisation reactions purest sample of monomers are taken

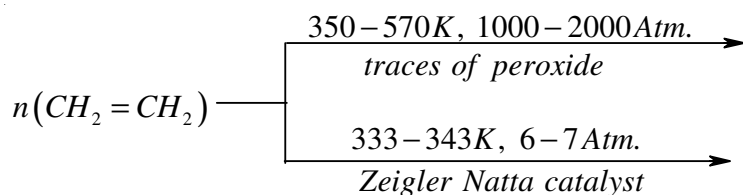
why?

### SA (I) Type Questions (2 Marks)

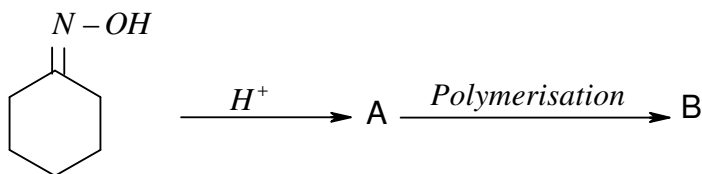
1. Give the structure of monomer of the polymer neoprene. What is the advantage of neoprene over the natural rubber?
2. Classify the following as homopolymer or copolymer. Also classify them as addition or condensation polymers.



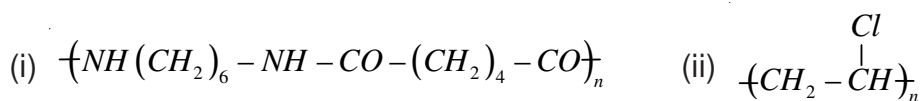
3. Give the mechanism of polymerisation of ethene to polyethene in presence of benzoyl peroxide.
4. Complete the following reaction :-



5. (i) What is the difference between step growth polymer and chain growth polymers?  
(ii) Classify the following as chain growth or step growth Polymers : Terylene and Poly Vinyl chloride.
6. Identify the products A and B in the :



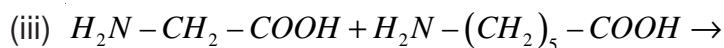
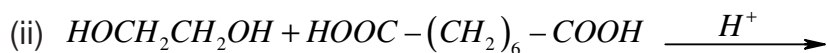
7. (i) Which synthetic rubber is resistant to action of petrol and organic solvents?  
(ii) Name the two monomers which are used in its preparation.
8. Mention the type of intermolecular forces present in nylon 66. What properties do they impart to nylon?
9. Identify linear polymer and branched chain polymer from :- LDP and HDP
10. Identify the polymers whose structure are given and mention one of their important use



11. Arrange the following polymers in the order of increasing intermolecular forces :
- (i) Nylon - 6,6, Buna-S, Polythene.  
(ii) Nylon - 6, Neoprene, PVC.
12. Write the expanded form and give the structures of monomers for the following polymers. (i) PAN (ii) PTFE
13. Novolac is the linear polymer which on heating with formaldehyde forms cross-linked bakelite. Write the structures of monomers and the polymer novolac.
14. Write the structure of following polymers and also give their one use :
- (i) Polystyrene (ii) Melamine formaldehyde resin.
15. Identify the polymer used in the manufacture of paints and lacquers. Write the structure of the polymer and its monomers.
16. How does alkalization change the character of natural rubber?
17. A regular copolymer of ethylene and Vinyl chloride contains alternate monomer of each type :-
- (i) Give the structure of the copolymer formed.  
(ii) What is the weight percentage of ethylene in this polymer?
18. Write the structure of the monomer used in the synthesis of :-
- (i) Nylon - 6 (ii) Nylon - 6,6
19. Linking in benzene ring through  $-CH_2-$  group in bakelite is always at -ortho- and para-position. Explain.
20. Give reason for the following :-
- (i) Tyre made up of natural rubber tend to crack and wither rapidly in areas around major cities where high levels of ozone and other industrial pollution are found.  
(ii) Nylon is more easily damaged by acids or alkali as compared to chain growth polymer such as orlon and polythene.
- [Hint :**(i) Ozone attack double bond of polymeric rubber  
(ii) Acid hydrolysis the amide linkage of nylon.]
21. ★ The monomer of natural rubber gives two moles of  $CH_2O$  and one mole of  $CH_3COCHO$  on ozonolysis.
- (i) Write the structure of monomer.  
(ii) Write all cis configuration of polymeric chain.

### SA (II) Type Questions (3 Marks)

- Differentiate between the following pairs :-
  - Branched chain polymers and Cross linked polymers.
  - Thermoplastic and thermosetting polymers.
  - Chain growth and step growth polymerisation.
- Write the chemical reaction involved in the preparation of following polymers.
  - Buna-N
  - Glytal
  - Polystyrene
- List two uses each of the following polymer :-
  - Nylon - 2 - Nylon - 6.
  - Urea formaldehyde resin
  - Glyptal
- What is meant by biodegradable polymers?
  - A biodegradable polymer is used in speciality packaging, orthopaedic devices and in controlled release of drugs. Identify the polymer and give its structure.
- Polyethene finds widespread use to make carry bags and also for manufacturing buckets and pipes.
  - Name the different types of polythene used for above mentioned application.
  - What is the structural difference between these two types?
  - Write the method of preparation of high density polythene.
- ★ Give the mechanism of polymerisation of styrene in presence of tert-butyl peroxide.
- ★
  - Can a copolymer be formed in both addition and condensation polymerisation? Explain with two examples.
  - Mention the main advantage of copolymer over homopolymer.
- ★ Draw the structures of step growth polymers you would expect to obtain from the following reactions :



## Chapter - 16

# CHEMISTRY IN EVERYDAY LIFE

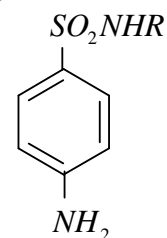
### POINTS TO REMEMBER

1. A drug is a chemical agent which effects human metabolism and provides cure from ailment. If taken in doses higher than recommended, these any have poisonous effect.
2. Use of chemicals for therapeutic effect is called chemotherapy.
3. Drugs usually interact with biological macromolecules such as carbohydrates, proteins, lipids and nucleic acids. These are called target molecules.
4. Drugs are designed to interact with specific targets so that these have the least chance of affecting other targets. This minimises the side effects and localises the action of the drug.
5. Drugs like analgesics, antibiotics, antiseptics, disinfectants, antacids and tranquilizers have specific pharmacological functions.
6. Antifertility drugs are used to control population. These contain a mixture of synthetic estrogen and progesterone derivatives.
7. Chemicals are added to food for there preservation, enhancing their appeal and adding nature value by them.
8. Artificial sweetening agents like aspartame, saccharin etc. are of great value of diabetic persons and people who need to control their calories.
9. These days detergents are much in vogue and get preference over soaps because they work even in hard water.
10. Synthetic detergents are classified into three main categories namely anionic, cationic and non-ionic.
11. Detergents with straight chain of hydrocarbons are preferred over branched chain as the latter are non-biodegradable and consequently causes environmental pollution.
12. The unbranched hydrocarbon side chains of the detergent molecule are more prone to attack by bacteria, so the detergents are more easily bio-degradable and pollution is prevented.

### VSA Type Questions (1 Marks)

1. Write formula and IUPAC name of Aspirin.
2. Give two types of the drugs classified on the basis of pharmacological effect.
3. What is the role of Bithionol in toilet soaps?

4. What is the significance of classifying drugs on the basis of structure?



5. Name the type of drugs having following structural formula :-

6. Why the receptor embedded in cell membranes show selectivity for one chemical messenger over the other?

7. With reference to which classification has the statement 'rantidine is an antacid' been given?

8. Name the medicine used for the treatment of syphilis.

9. Give the composition of tincture of iodine.

10. How does aspirin act as analgesic?

11. Name the antiseptic agents present in dettol.

[Hint :Chloroxylenol and Terpineol]

12. What precaution will be taken before administering penicillin to a patient?

13. Explain why aspirin finds use in prevention of heart attacks?

14. Mention one use of drug meprobamate.

15. Name the derivative of sucrose which taste like sugar and can be safely used by weight conscious people.

16. Which of the following is used as a preservative to protect processed food?

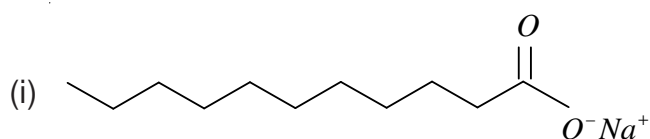
17. ★ How is acidity cured with cimetidine?

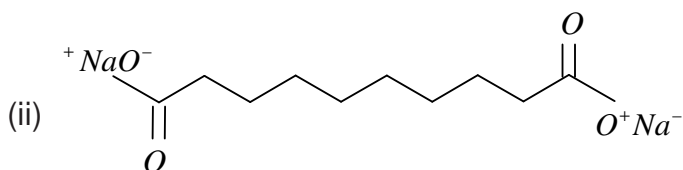
[Hint :Cimetidine prevents the interaction of histamine with the receptors present in stomach wall.]

18. ★ While antacids and antiallergic drugs interfere with the function of histamines, why do these not interfere with the function of each other?

[Hint :Antacids and antiallergic drugs bind to the different receptor sites. Therefore they do not interfere with the function of each other.]

19. ★ Which of the following two compounds can be used as a surface agent :-





### SA (I) Type Questions (2 Marks)

- Mention two types of drugs having different pharmacological effect and the mode of action.
- Can soap be used at  $pH$  7 or below? Explain.
- Explain the following terms as used in medicinal chemistry :  
(i) Target molecules      (ii) Enzyme inhibitors.
- Give one important use of each of following :-  
(i) Equanil      (ii) Morphine
- Explain the term lead molecules. Write two different sources of lead molecules.

**[Hint :** A knowledge of the physiological function of the drug target in the body helps us to choose a compound which can interact with the target and hence is expected to be therapeutically active. These compounds are called lead molecules and drugs are designed from these compounds.

Lead compounds can be obtained from natural sources such as plants, tree, bushes, venoms and metabolites of microorganisms lead molecule have also been isolated from fish, coral, sponger and marine organism.]

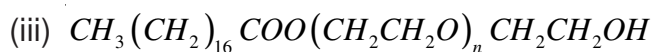
- (i) What are antibiotics?  
(ii) Where in India penicillin is manufactured?
- Which of the following drug is used for :-  
(i) treating allergic conditions.  
(ii) to get relief from pain.  
Cromphenisamine, Ciprofloracin, Hesoin, Chloramphenicol.
- Give two reasons why the drug should not be taken without consulting a doctor?
- State the main difference between bacteriostatic and bacteriocidal antibiotics. Give one example of each.
- What are antifertility drugs? Give the names of constituents of an oral contraceptive.
- What do you mean by monobiodegradable detergents? How can we make biodegradable detergents?
- ★ If water contains dissolved calcium hydrogencarbonate, which out of soap and detergent

will you prefer to use? Why?

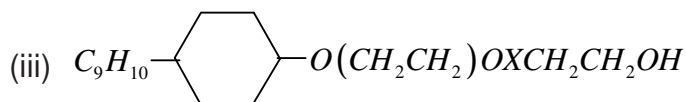
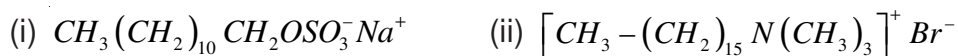
13. ★ Sulpha drugs work like antibiotics but they are not antibiotics. Explain with the help of example.
14. ★ What are barbiturates? What is the action of barbiturates on human body?
15. ★ Write the structures of soaps obtained by the hydrolysis of following fats :-
  - (i)  $(C_{15}H_{31}COO)_3C_3H_5$  - Glycerol palmitate
  - (ii)  $(C_{17}H_{33}COO)_3C_3H_5$  - Glycerol oleate.

### SA (II) Type Questions (3 Marks)

1.
  - (i) Why are artificial sweetening agents harmless when taken?
  - (ii) Name one such artificial sweetening agent.
  - (iii) Why is the use of aspartame as an artificial sweetener limited to cold foods?
2. Pick out the odd one amongst the following on the basis of their medicinal properties. Give suitable reason.
  - (i) Luminal, Seconal, terfenadine, equanil
  - (ii) Chloroxylenol, phenol, chloramphenicol, bithional.
  - (iii) Sucralose, aspartame, alitame, sodium benzoate.
3. Give the main function of following in the body of human beings?
  - (i) Enzymes
  - (ii) Receptor proteins
  - (iii) Neurotransmitter
4. Give the function of following drugs.
  - (i) Pheneizine (Nardin)
  - (ii) Aspirin
  - (iii) Mifepristone
5. Give the pharmacological function of the following type of drugs :
  - (i) Analgesics
  - (ii) Tranquilizers
  - (iii) Antifertility drugs
6. Give the name of medicine used in the treatments of following diseases :
  - (i) Tuberculosis
  - (ii) Joint Pain (in Arthritis)
  - (iii) Hypertension
7. Give the class of drugs to which these substances belong :
  - (i) Bithional
  - (ii) Amoxycillin
  - (iii) Salvarsan
8. How are antiseptics different from disinfectants? How does an antibiotic differ from these two? Give one example of each of them.
9. Explain the following terms with suitable examples :
  - (i) Cationic detergents
  - (ii) Anionic detergents
  - (iii) Nonionic detergents
10. ★ Label hydrophilic and hydrophobic part in the following compounds :-



11. ★ Classify the following structures as cationic detergents, anionic detergents or nonionic detergents :



Where ( $X = 5-10$ )

12. Explain the term hyperacidity discuss two types of medicines use to check hyperacidity and their mode of action.
13. ★ How do enzyme inhibitors work? Distinguish between competitive and noncompetitive enzyme inhibitors.

**MODEL TEST PAPER – I (SOLVED)**  
**(FOR SR. SEC. SCHOOL EXAMINATION - 2010)**  
**CHEMISTRY (THEORY)**

**Time Allowed : 3 hours**

**Maximum Marks : 70**

**General Instructions**

- (i) All questions are compulsory.
- (ii) Question number 1 to 8 are very short answer questions, carrying 1 mark each. Answer these in one word or about one sentence each.
- (iii) Question number 9 to 18 are short answer questions, carrying 2 marks each. Answer these in about 30 words each.
- (iv) Question number 19 to 27 are short answer questions carrying 3 marks each. Answer these in about 40 words each.
- (v) Question number 28 to 30 are long answer questions, carrying 5 marks each. Answer these in about 70 words each.
- (vi) Use log table, if necessary.
- (vii) Use of calculator is not permitted.

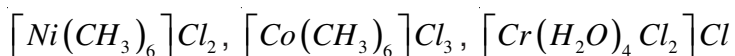
Q. 1 Zinc Oxide is white but turns yellow on heating. Why?

Q. 2 Why does a dry cell become dead after a long time even if it has not been used?

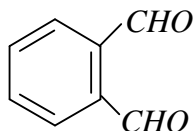
Q. 3 Define 'Peptization'.

Q. 4 Can molten alumina be electrolysed alone? Give reason.

Q. 5 Arrange them in the increasing order of electrical conductivity



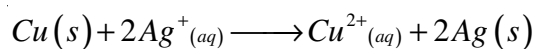
Q. 6 Write IUPAC names of :



Q. 7 Name the vitamin responsible for coagulation of blood.

Q. 8 Give the two uses of teflon polymer.

Q. 9 Calculate the equilibrium constant for the reaction at  $25^\circ C$  :-

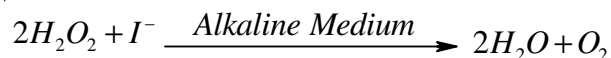


Given  $E^\circ_{Cu^{2+}/Cu} = +0.34V$ ,  $E^\circ_{Ag^+/Ag} = 0.80V$

Q. 10 How does molar conductivity vary on dilution for

- weak electrolyte and
- strong electrolyte. Explain graphically.

Q. 11 Write the mechanism of the reaction :-



Rate equation for this reaction is

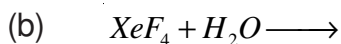
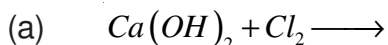
$$\text{Rate} = K[H_2O_2][I^-]$$

Q. 12 The  $\Delta_f G^\circ$  values for the formation of  $Cr_2O_3$  and  $Al_2O_3$  are  $-540$  and  $-827 \text{ kJ mol}^{-1}$  of  $O_2$  respectively. Is the reduction of  $Cr_2O_3$  possible with  $Al$ . Justify your answer.

Q. 13 Draw the structure of  $SF_6$  and  $XeF_6$ .

**OR**

Complete the following reactions.



Q. 14 Explain the following with suitable reason

- Why O-nitro phenol is more acidic than O-methoxy phenol?
- Why reactivity of carbonyl compounds to enhance towards weak nucleophile in acidic medium.

Q. 15 Explain using crystal field theory – The  $[Mn(H_2O)_5]^{2+}$  ion contains five unpaired electrons while  $[Mn(CN)_6]^{4-}$  ion contains only one unpaired electrons?

Q. 16 Describe with an example :-

- Cannizaro reaction
- Hoffman's bromamide reaction

Q. 17 A biodegradable polymer is used in speciality packaging, orthopaedic devices and in controlled release of drugs. Identify the polymer and give its structure.

- Q. 18 With reference to which classification has the statement 'Rantidine is an antacids' been given.
- Q. 19 Chromium metal crystallizes with a body centred cubic lattice. The length of the unit cell edge is found to be 287 pm. Calculate the atomic radius. What would be the density of chromium in  $g/cm^3$ ? (Atomic mass of Cr = 54,  $N_A = 6.023 \times 10^{23}$ )
- Q. 20 A certain reaction is 50% complete in 20 minutes at 300 K and the same reaction is 50% complete in 5 minutes at 350 K. Calculate the activation energy if the reaction follow first order kinetics.
- Q. 21 Explain :-
- What happens when freshly precipitated ferric hydroxide is treated with dilute solution of  $FeCl_3$ .
  - Electric current is passed through a colloidal sol.
  - A beam of light is passed through colloidal sol.
- Q. 22 Account for the following observation :-
- Nitrogen does not form pentachloride like phosphorus.
  - Thermal stability of water is much higher than that of  $H_2S$ .
  - Electron gain enthalpy of fluorine is less than that of chlorine.
- Q. 23 (i) Name the state of hybridisation of orbitals in  $XeF_2$  molecules.  
(ii) Arrange the following in decreasing order of oxidising power.  
 $HClO_4, HClO_3, HClO_2, HClO$   
(iii) Why is helium used in diving apparatus?
- Q. 24 Write the mechanism of the following reactions :-
- $CH_3 - CH_2 - CH_2 - CH_2 - Br + KCN \longrightarrow NC - CH_2 - CH_2 - CH_2 - CH_3$
  - $CH_3 - COOH + CH_3CH_2OH \xrightarrow{H_2SO_4} CH_3 - \overset{\overset{O}{\parallel}}{C} - OC_2H_5$
- Q. 25 (i) Write the chemical equation for the preparation of 2-ethoxy-3-methylpentane starting from ethanol and 3-methyl pentan-2-ol. Name the reaction involved.  
(ii) Arrange the following sets of compounds in order of their increasing boiling points.  
Pentan-1-ol, n-butane, pentanal, ethony ethane
- Q. 26 How will you carry out the following conversions :-
- Ethanamine to methenamine

- (ii) Benzene to m-bromophenol
- (iii) Methanol to ethanoic acid.

Q. 27 Aspartame, an artificial Sweetner, has the following structure :

- (i) Write the Zwitter ion structure of the above mentioned peptide.
- (ii) Write the structure of two amino acids which will be formed after its hydrolysis.

**OR**

Enumerate the difference between DNA and RNA. Write the structure of a nucleoside which is present only in RNA.

Q. 28 (i) State and derive Raoult's law for a solution containing.

- (a) Volatile solute
- (b) non volatile solute

- (ii) Benzene and toluene form nearly ideal solution. At a certain temperature the vapour pressure of pure benzene and pure toluene are 150 mm of Hg and 50 mm of Hg. Calculate the vapour pressure of the solution containing equal weights of benzene and toluene.

**OR**

- (i) What is meant by abnormal molecular mass? Illustrate it with suitable example.
- (ii) 19.5g of  $CH_2FCOOH$  is dissolved in 500 g of water. The depression in the freezing point of water observed is  $1.0^\circ C$ . Calculate the van't Hoff factor and dissociation constant of fluoroacetic acid.

Q. 29 (i) Explain

- (a) Out of  $Cr^{2+}$  and  $Mn^{2+}$  which one is stronger reducing agent? (Atomic No. of Cr = 24, Mn = 25.)

- (b)  $Cu^{2+}$  is more stable than  $Cu^+$  in aqueous solution.

(ii) Compare the chemistry of the lanthanoids with that of actinoids with reference to

- (a) Electronic configuration
- (b) Oxidation state
- (c) Chemical reactivity

**OR**

What is pyrolusite [ $MnO_2$ ]. Describe the preparation of  $KMnO_4$  from it? Write chemical equation to represent the reaction of acidified  $KMnO_4$  solution with :-

- (i)  $H_2S$       (ii)  $FeSO_4$       (iii)  $KI$

Q. 30 (i) Give simple chemical tests to distinguish between :-

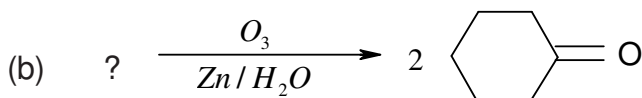
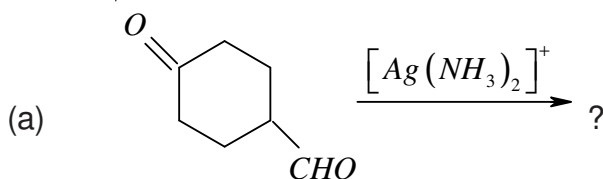
- (a) Acetophenone and Benzophenone  
(b) Ethanol and Ethanoic Acid

(ii) Give plausible explanation for :-

- (a) There are two  $-NH_2$  groups in semicarbazide. However, only one is involved in the formation of semicarbazone.  
(b) Although amino group is o- and p-directing in aromatic electrophilic substitution reactions, aniline on nitration give a substantial amount of m-nitroaniline.  
(c) Grignard reagent should be prepared under anhydrous conditions?

**OR**

(i) Complete the following :-

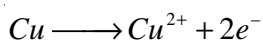


(ii) An organic compound [A] with molecular formula  $C_8H_8O$  forms an orange-red precipitate with 2, 4 - DNP reagent and given no precipitate on heating with Iodine in the presence of NaOH. It reduce tollens as well as Fehling reagent. It does not decolourise bromine water or Bayers reagent on drastic oxidation with  $KMnO_4$  acidified it gives a carboxylic Acid [B] having molecular formula  $C_7H_6O_2$ . Identify compound A and B and write the reaction involved.

## MARKING SCHEME

1. Free electrons occupy spaces created by loss of  $O_2$  from  $ZnO$  when heated. (1)
2. Acidic  $NH_4Cl$  corrode with zinc container. (1)
3. The process of conversion of a freshly prepared precipitate into colloidal solution by adding suitable electrolyte. (1)
4. No, because of its poor conductivity. (1)
5.  $[Cr(H_2O)_4Cl_2]Cl < [Ni(NH_3)_6]Cl_2 < [Co(NH_3)_6]Cl_3$  (1)
6. Benzene-1, 2-dicarbaldehyde. (1)
7. Vitamin K. (1)
8. Making oil seal, gasket and non-stick surface coated utensil. [Any two] ( $\frac{1}{2} \times 2 = 1$ )

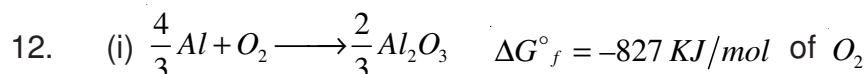
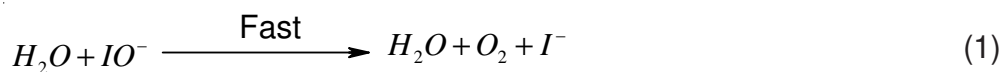
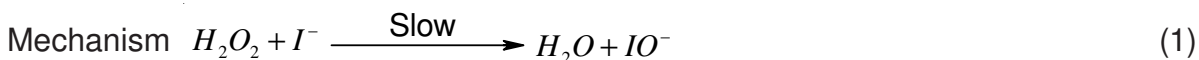
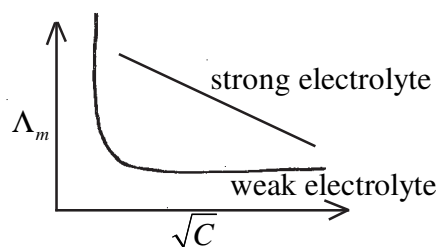
9.  $E^\circ_{cell} = E^\circ_{Ag^+/Ag} - E^\circ_{Cu^{2+}/Cu} = 0.80 - 0.34V = 0.46V$  (1/2)

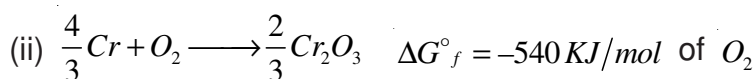


$$0.0591 \log K = nE^\circ \Rightarrow \log K = \frac{nE^\circ}{0.0591} = \frac{2 \times 0.46}{0.0591}$$

$$\log K = 15.5668 \quad K = \text{Anti } 15.5668 = 3.686 \times 10^{15} \quad (1)$$

10. (1 × 2 = 2)

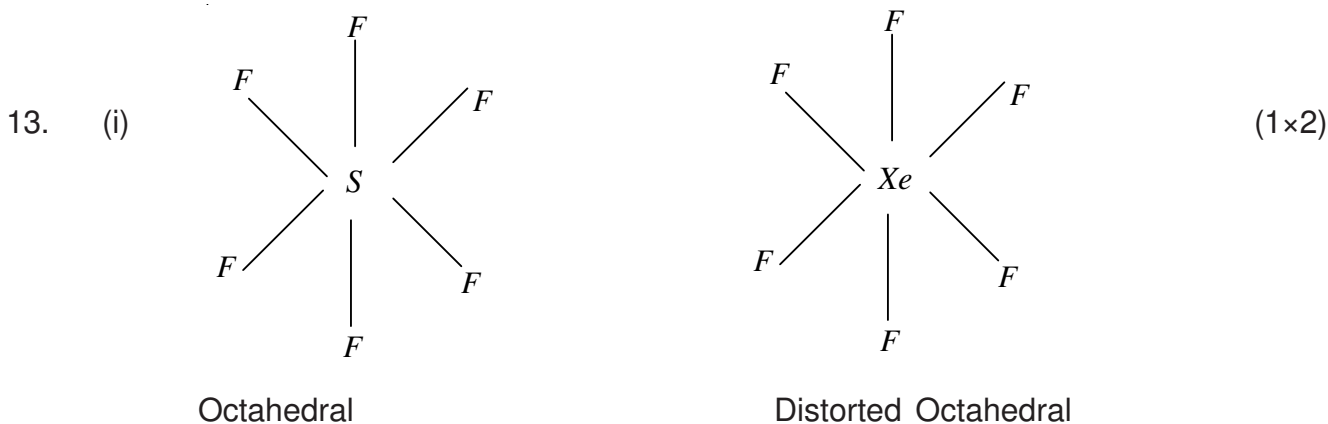




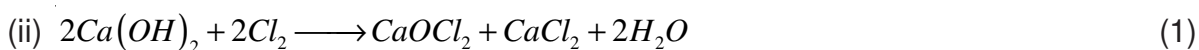
Subtract (ii) from (i) (1)



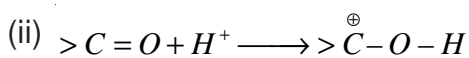
Yes, reaction will be feasible.



**OR**

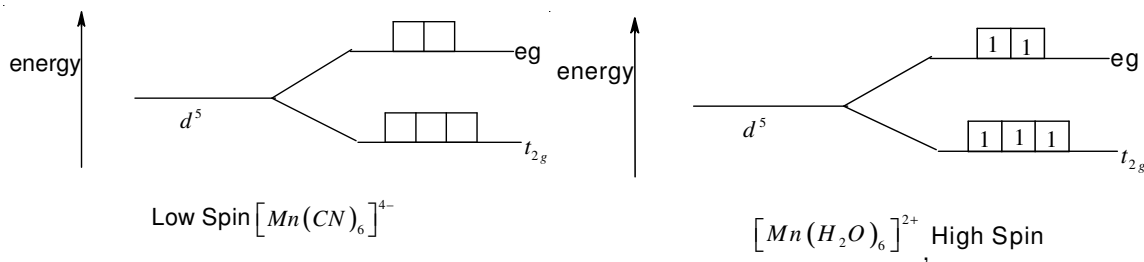


14. (i)  $-NO_2$  is electron withdrawing group. The phenoxide while  $-OCH_3$  is electron donor group destabilize the phenoxide. (1)



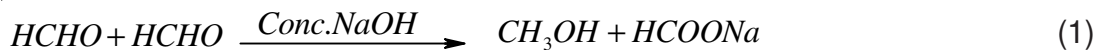
$H^+$  get attached to O of the carbonyl group and make carbonyl more electropositive. (1)

15.  $H_2O$  is a weak field ligand so can not cause the pairing of electrons in 3d orbitals while  $CN^-$  is a strong field ligand and cause the pairing of electrons in 3d orbital. (1×2)

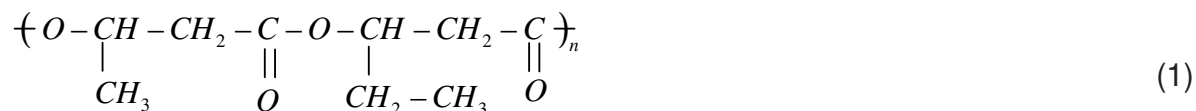


16. (i) Cannizzaro Reaction :- Aldehydes which do not have any  $\alpha-H$  atom in presence of

alkali are rely oxidized and reduced.



17. Poly- $\beta$ -hydroxybutyrate - Co- p - hydroxy valerate (PHBV) (1)



18. It states the classification according to pharmacological effect of the drug because any drug which will be used to contract the effect of excess acid in the stomach will be called antacid. (1+1)

19. For B.C.C.

$$r = \frac{\sqrt{3}}{4}a = 0.433a = 0.433 \times 287 \text{ pm} = 124.27 \text{ pm} \quad (1)$$

$$d = \frac{Z \times M}{N_A \times a^3 \times 10^{-30}} = \frac{2 \times 51.99}{(287)^3 \times 6.02 \times 10^{23} \times 10^{-30}} = 7.32 \text{ g/cm}^3 \quad (1+1)$$

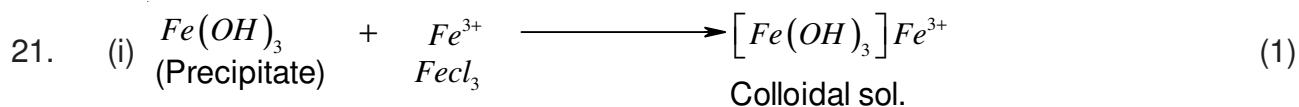
$$20. \quad k = \frac{0.693}{t_{\frac{1}{2}}} \Rightarrow k_1 = \frac{0.693}{20 \text{ min}} = 0.03465 \text{ min}^{-1} \quad (1)$$

$$k_2 = \frac{0.693}{5 \text{ min}} = 0.1386 \text{ min}^{-1}$$

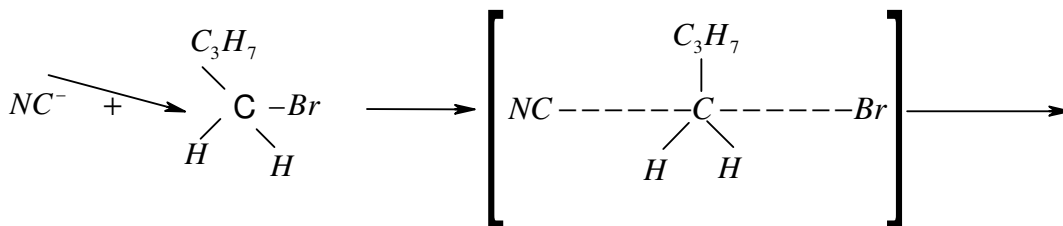
$$\log \frac{k_1}{k_2} = \frac{E_a}{2.303R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right) = \quad (1/2)$$

$$\log \left[ \frac{0.1386}{0.03465} \right] = \frac{E_a}{2.308 \times 8.314 \text{ Jkmol}^{-1}} \times \left[ \frac{1}{300K} - \frac{1}{350K} \right] \quad (1)$$

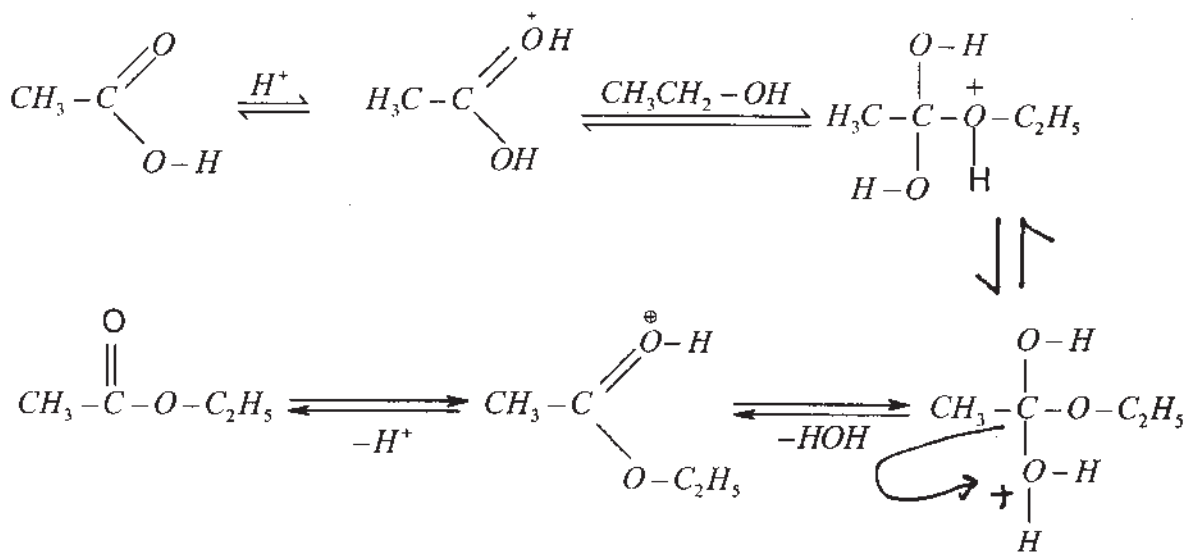
$$E_a = 24205.8 \text{ Jmol}^{-1} = 24.2 \text{ kJmol}^{-1} \quad (1/2)$$



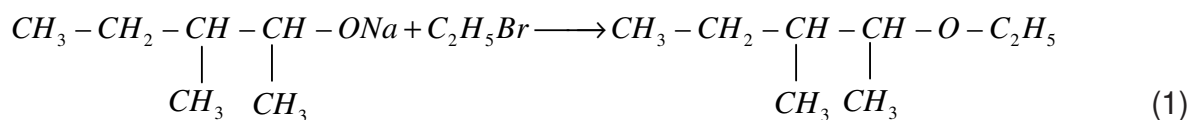
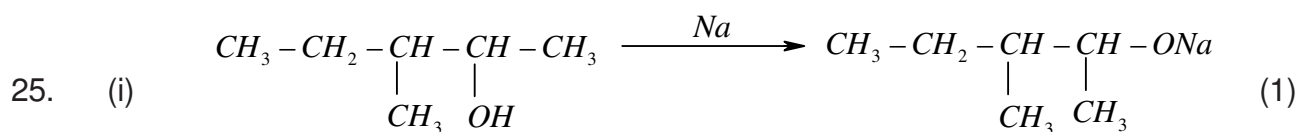
- (ii) electrophoresis. (1)
- (iii) Tyndall effect. (1)
22. (i) Because of absence of vacant d-orbital in nitrogen. (1)
- (ii) Intermolecular H-bond in water. (1)
- (iii) Because of small atomic size of F atom and large electron crowding so incoming electron experience lesser attraction towards nucleus. (1)
23. (i)  $sp^3d^1$  (1)
- (ii) Decreasing order  $HClO_4 < HClO_3 < HClO_2 < HClO$  (1)
- (iii) Helium does not dissolve in blood. (1)
24. (i)



(ii)



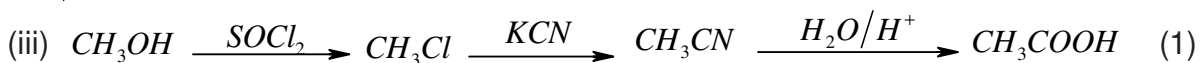
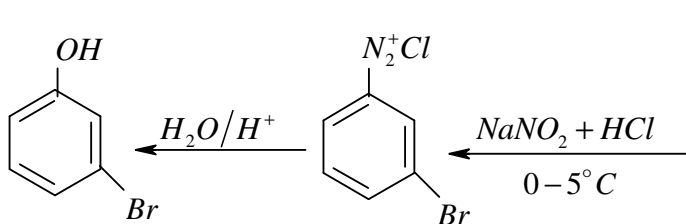
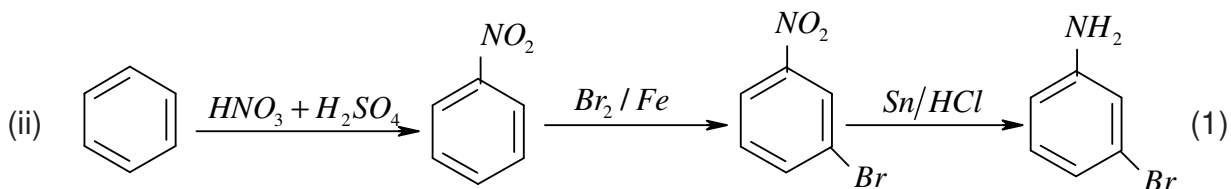
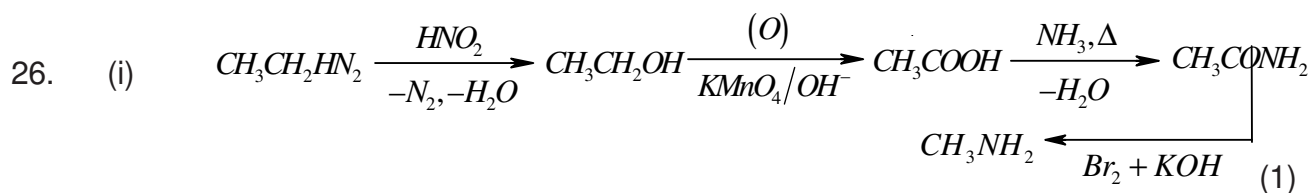
(1½)

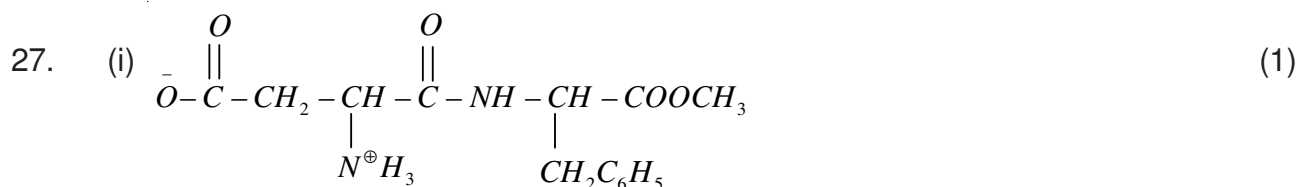


Williamson Synthesis

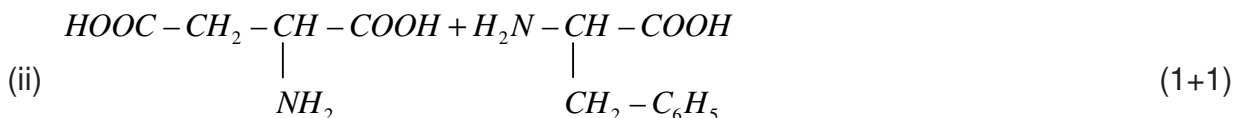
(ii) Increasing order of b.pt (1)

n-butane < ethoxy ethane < pentanal < Pentan-1-ol





Zwitter ion



OR

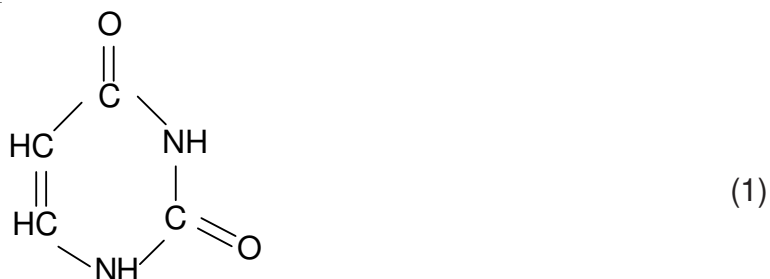
**D.N.A.**

- (i) Sugar is Deoxy Ribose  
 (ii) Base unit - Adenine, Guanine, Cytosine and Thymine

**R.N.A.**

- Sugar unit is ribose  
 Base unit are Adenine, Guanine, Cytosine and Uracil. (1+1)

Structure of Uracil :-



28. (i) Definition of Raoult's law

Volatile solute :

$$P_{\text{solution}} = P_A + P_B = P_A^{\circ}x_A + P_B^{\circ}x_B, \quad x_B = 1 - x_A$$

$$P_{\text{solution}} = P_A^{\circ}(1-x_B) + P_B^{\circ}x_B$$

Non-Volatile solute :  $P_B = 0$

$$P_{\text{solution}} = P_A = P_A^{\circ}x_A \quad x_A = 1 - x_B$$

$$P_A = P_A^{\circ}(1 - x_B) = P_A^{\circ} - P_A^{\circ}x_B \quad (1+1)$$

$$\frac{P_A^{\circ} - P_A}{P_A^{\circ}} = x_B$$

$$(ii) \quad P^{\circ}_{Benzene} = 150mm. \quad P^{\circ}_{Toluene} = 50mm.$$

$$W^{\circ}_{Benzene} = xg \quad W^{\circ}_{Toluene} = xg$$

$$M^{\circ}_{Benzene} = 78mol^{-1} \quad M^{\circ}_{Toluene} = 92mol^{-1}$$

$$x_B = \frac{\frac{x}{78}}{\frac{x}{92} + \frac{x}{78}} \quad \text{and} \quad x_T = 1 - x_B$$

$$P_{solution} = P_B + P_T$$

$$P_B = P^{\circ}_B x_B$$

OR

- (i) Abnormal molar mass – Molar mass of substance calculated from Colligative if comes different then the formula molar mass. i.e. molar mass of  $CH_3COOH$  is  $60gmol^{-1}$  but due to association it comes  $120gmol^{-1}$ . (1+1)

$$(ii) \quad \Delta T_f = i \times k_f \times m \quad i = \frac{\Delta T_f}{k_f \times m}$$

$$\text{Molality} = \frac{19.5}{78 \times 0.5} = 0.15mol \text{ kg}^{-1} \quad (1)$$

$$i = \frac{1.0k}{1.86 \times 0.5} = \underline{1.07530}$$

$$\alpha = \frac{i-1}{n-1} = \frac{1.0753-1}{2-1} = \underline{0.0753}$$



$$\begin{array}{ccc} 0.5 & 0 & 0 \end{array}$$

$$\begin{array}{ccc} 0.5(1-\alpha) & 0.5\alpha & 0.5\alpha \end{array} \quad (1)$$

$$K_a = \frac{C\alpha^2}{1-\alpha} = \frac{0.5 \times (0.0753)^2}{1-0.0753} = \underline{\underline{3.07 \times 10^{-3}}}$$

29. (i)  $Cr^{2+}$  is reducing as its configuration changes from  $d^4$  to  $d^3$  having a half-filled  $t_{2g}$  level. (1)

(ii) It is due to much more negative hydration energy of  $Cu^{2+}(aq)$  than  $Cu^+(aq)$  (1)

(iii)

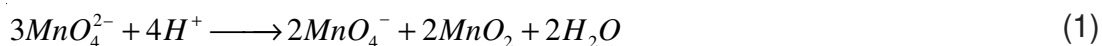
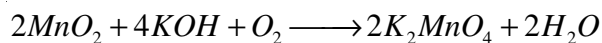
	Lanthanoid	Actinoids
(a)	Electronic Configuration - [Xe] $4f^{1-14} 5d^{0-1} 6s^2$	[Rn] $5f^{1-14} 6d^{0-1} 5s^2$
(b)	Oxidation state - +3 stable also +2 and +4	+3 stable also +4, +5, +6
(c)	Chemical reactivity - do not form oxocations	Highly reactive in finely divided form. form oxocations.

OR

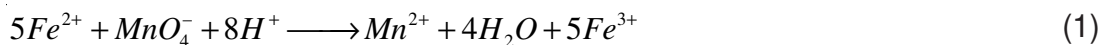
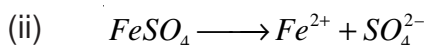
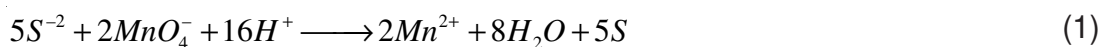
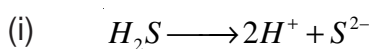
(1x3=3)

Pyrolusite ( $MnO_2$ ) is an ore used for the preparation of  $KMnO_4$  (1)

Preparation of  $KMnO_4$  :-



Chemical equation



(iii)

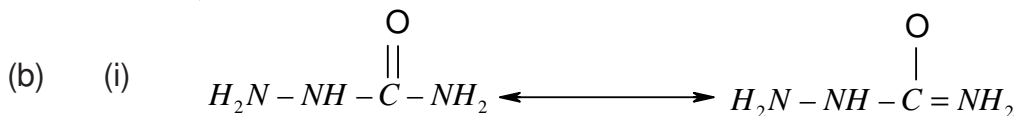
(1)

30. (a) (i)

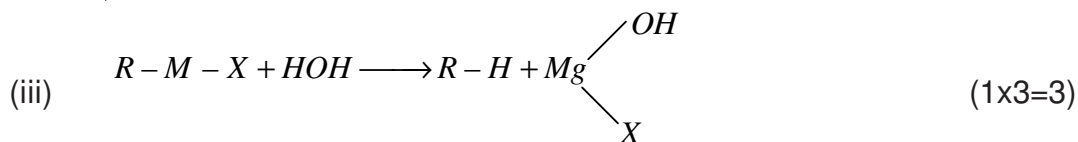
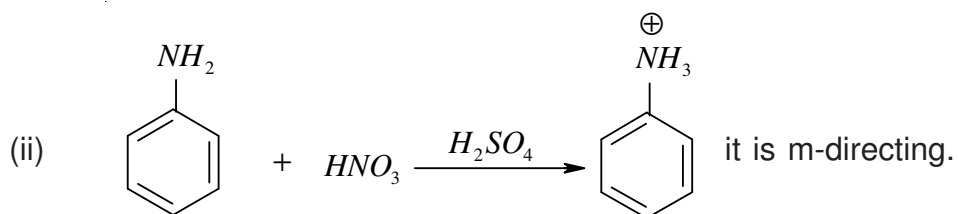
Acetophenone	Benzophenone
test : Yellow ppt of	No ppt.

Test	Ethanol	Ethanoic Acid
Add $Na_2HCO_3$ test	no reaction	effervescence of $CO_2$

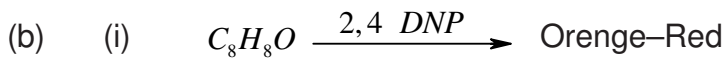
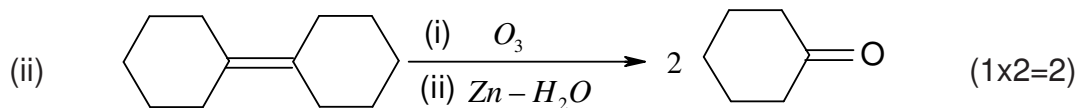
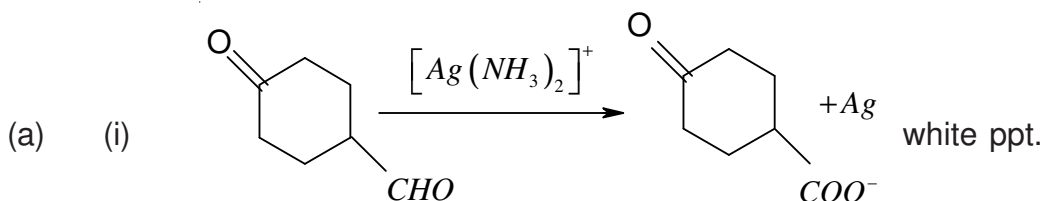
(1x2=2)



Due to resonance.



OR



Means there is  $\overset{\overset{[A]}{O}}{\parallel} - C = O$  carboxyl group.

- (ii) No colouration. There is no group.
- (iii) reduces Tollen reagent. There is – CHO group.
- (iv) reduces Fehling solution. There is aliphatic –CHO group.
- (v) It does not decolorise water/ Bayer reagent. There is no unsaturation  
mean or bond.

So A is

(1x3=3)

**MODEL TEST PAPER – II (UNSOLVED)**  
**(FOR Sr. SEC. SCHOOL EXAMINATION - 2010)**  
**CHEMISTRY (Theory)**

**Time Allowed : 3 hours**

**Maximum Marks : 70**

**General Instructions :-**

1. All questions are compulsory.
2. Question No. 1 to 8 are very short-answer questions, carrying 1 mark each. Answer these in one word or about one sentence each.
3. Question No. 9 to 18 are short-answer questions, carrying 2 marks each. Answer these in about 30 words each.
4. Question No. 19 to 27 are short-answer questions, carrying 3 marks each. Answer these in about 40 words each.
5. Question No. 28 to 30 are long-answer questions, carrying 5 marks each. Answer these in about 70 words each.
6. Use log table, if necessary use of calculator is not permitted.

1. A group 14 element is to be converted into n-type semiconductor by doping it with a suitable impurity. To which group should this impurity belong? Give one example.
2. Name a zeolite catalyst which directly converts alcohol into gasoline.
3. Write an equation for the preparation of  $\text{XeOF}_4$  from  $\text{XeF}_6$ .
4. Write one structural difference between DNA and RNA.
5. Write the name of the monomer of Nylon - 6.
6. Mention one example of cationic detergent.
7. Which compound in the following pair will react faster in  $\text{S}_{\text{N}}2$  reaction with  $\text{OH}^-$ ?  
(i)  $(\text{CH}_3)_3\text{C Cl}$  or (ii)  $\text{CH}_3\text{Cl}$
8. How is formalin related to formaldehyde?
9. Draw a labelled diagram which represent the working of hydrogen- oxygen fuel cell. Write the anode and cathode reactions taking place in the above cell.

**OR**

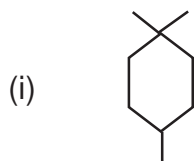
Rusting to iron is an electrochemical phenomenon. Justify by giving anode, cathode and overall reactions.

10. The rate constant of a first order reaction for the decomposition of ethyl iodide by the reaction:  
$$\text{C}_2\text{H}_5\text{I}(\text{g}) \longrightarrow \text{C}_2\text{H}_4(\text{g}) + \text{HI}(\text{g})$$

at 600K is  $1.60 \times 10^{-5} \text{ s}^{-1}$ . Its energy of activation is  $2.9 \text{ kJ mol}^{-1}$ . Calculate the rate constant for the reaction at 700K.

( $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$ )

11. Write balanced chemical equations for the production of sulphuric acid from  $\text{SO}_2(\text{g})$  by contact process. List the two most favourable conditions for getting the maximum yield of  $\text{SO}_3(\text{g})$ .
12. (i) Why is  $\text{Cr}^{2+}$  reducing and  $\text{Mn}^{3+}$  oxidising while both have  $d^4$  configuration?  
(At. No. of Cr = 24, At. No. of Mn = 25)
- (ii) Using the 'spin-only' formula calculate the magnetic moment of  $\text{Ni}^{2+}$  ion in aqueous solution. (At. no. of Ni = 28)
13. Define biodegradable polymer. Give an example of a biodegradable  
(i) Polyester and (ii) Polyamide.
14. (i) How are broad spectrum antibiotics different from narrow spectrum antibiotics?  
(ii) Under what conditions phenol can be used as:-  
(i) an antiseptic and (ii) a disinfectant
15. Describe the following reactions giving necessary conditions involved :-  
(i) Reimer Tiemann reaction. (ii) Williamson synthesis
16. Write the IUPAC names of the following compounds :-



(ii)

17. An aromatic compound 'A' on heating with  $\text{Br}_2$  and  $\text{KOH}$  forms a compound 'B' of molecular formula  $\text{C}_6\text{H}_7\text{N}$ . Draw the structures of the compounds A and B and write the reactions involved.
18. Account for the following:-  
(i)  $\text{pK}_b$  of aniline is more than that of methylamine.  
(ii) Diazonium salts of aromatic amines are known while those of aliphatic amines are not known.
19. (i) Silver crystallize in fcc lattice. If the edge length of the cell is  $4.07 \times 10^{-8} \text{ cm}$  and density is  $10.5 \text{ g cm}^{-3}$ , calculate the atomic mass of silver.