Chapter - 1

THE SOLID STATE

QUESTIONS

VSA QUESTIONS (1 - MARK QUESTIONS)

1. What are anistropic substances.

2. Why are amorphous solids isotropic in nature?

3. Why glass is regarded as an amorphous solid?

4. Define the term 'crystal lattice.'

8. Define the term voids.

9. What type of stochiometric defect is shown by (i) ZnS and (ii) CsCl?

 [**Hint. :** (i) Frenkel defect (ii) Schottky defect]

*10. If the formula of a compound is A_2B, which sites would be occupied by A ions?

 [**Hint. :** Number of A ions is double to B ions, so ions will occupy tetrahedral voids]

11. What is the coordination number for

 (a) an octahedral void

 (b) a tetrahedral void.

 [**Hint. :** (a) 6; (b) 4]

*12. How many octahedral voids are there in 1 mole of a compound having cubic closed packed structure? [**Ans. :** 1 mole]

13. Arrange simple cubic, bcc and fcc lattice in decreasing order of the fraction of the unoccupied space.

 [**Hint. :** fcc < bcc < sc]

14. How much space is empty in a hexagonal closed packed solid?

15. An element crystallises separately both in hcp and ccp structure. Will the two structures have the same density? Justify your answer.

[**Hint :** Both crystal structures have same density because the percentage of occupied space is same.]

16. In NaCl crystal, Cl^- ions form the cubic close packing. What sites are occupied by Na^+ ions.

17. In Corundum, O^{2-} ions from hcp and Al^{3+} occupy two third of octahedral voids. Determine the formula of corundum.   [**Ans. :** Al_2O_3]

18. Why is Frenkel defect not found in pure alkali metal halides?

19. Which point defect is observed in a crystal when a vacancy is created by an atom missing from a lattice site.

20. Define the term 'doping'.

21. Why does conductivity of silicon increase with the rise in temperature.

22. Name the crystal defect which lowers the density of an ionic crystal.

[**Ans. :** Schottky defect]

23. What makes the crystal of KCl sometimes appear violet?

[**Hint :** F-Centre]

24. Which point defect in ionic crystal does not alter the density of the relevant solid?

25. Name one solid in which both Frenkel and Schottky defects occur.

26. Which type of defects are known as thermodynamic defects?

[**Ans. :** Stoichiometric defects]

27. In a p-type semiconductor the current is said to move through holes. Explain.

28. Solid A is very hard, electrical insulator in solid as well as in molten state and melts at extremely high temperature. What type of solid is it?

[**Hint :** Covalent solid]

SA (I) TYPE QUESTIONS (2 - MARK QUESTIONS)

1. List four distinctions between crystalline and amorphous solids with one example of each.

2. Give suitable reason for the following–

    (a)   Ionic solids are hard and brittle.

    (b)   Copper is malleable and ductile.

3. Define F–centre. Mention its one consequence.

4. What is packing efficiency. Calculate the packing efficiency in body-centered cubic crystal.

5. Explain :

    (a)   List two differences between metallic and ionic crystals.

    (b)   Sodium chloride is hard but sodium metal is soft.

6. 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.

7. Why is graphite soft lubricant and good conductor of electricity?

8. What do you understand by the following types of stacking sequences :

    (a)   AB AB ....   (b)   A B CABC ....

    What kind of lattices do these sequences lead to?

9. Derive the formula for the density of a crystal whose length of the edge of the unit cell is known?

$$\left[\text{*Hint : d} = \frac{zm}{a^3 \times n_A} \right]$$

10. Explain how much portion of an atom is located at (a) corner (b) body centre (c) face-centre and (d) edge centre of a cubic unit cell.

*11. 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 position at the corner, what is the formula of the compound?

[**Ans. :** A_7B_{24}]

*12. A compound made up of elements 'A' and 'B' crystallises in a cubic close packed structure. Atoms A are present on the corners as well as face centres, whereas atoms B are present on the edge-centres as well as body centre. What is the formula of the compound? [**Ans.** AB]

13. Explain the terms :

    (a) Intrinsic semiconductor

    (b) Extrinsic semiconductor.

14. Explain how vacancies are introduced in a solid NaCl crystal when divalent cations are added to it.

15. 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.

16. Define the term **'point defects'** Mention the main difference between stoichiometric and non-stoichiometric point defects.

THE SOLID STATE (2 - MARK QUESTIONS)

17. A compound M_pX_q has cubic close packing (ccp) arrangement of X. Its unit cell structure is show below :
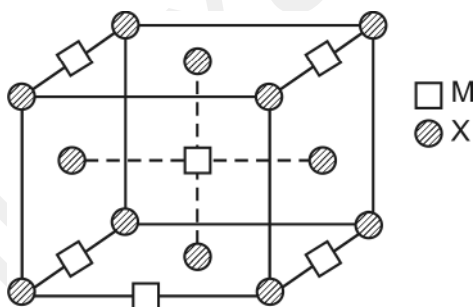
   Determine the empirical formula of the compound. [**Ans :** MX_2]

18. The concentration of cation vacancies in NaCl crystal doped with $CdCl_2$ is found to be 6.02×10^{16} mol^{-1}. What is the concentration of $CdCl_2$ added to it? [**Ans :** 10^{-5} mol% $CdCl_2$]

19. Iron changes its crystal structure from body contred to cubic close backed structure when heated to 916°C. Calculate the ratio of the density of the BCC crystal to that of CCP crystal. Assume that the metallic radius of the atom does not change. [**Ans :** 1]

SA (II) TYPE QUESTIONS (3 - MARK QUESTIONS)

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

    $$\left[\textbf{*Hint:} \ \text{(a)} \ a = 2r \quad \text{(b)} \ a = \frac{4}{\sqrt{3}}r \ \text{(c)} \ a = 2\sqrt{2}\,r \right]$$

2. Define a semiconductor? Describe the two main types of semiconductors when it is doped with

    (a) group 13 element,   (b) group 15 element.

3. Explain the following terms with one example each :

    (a) Ferrimagnetism   (b) Antiferromagnetism

    (c) 13-15 compounds

*4. Examine the defective crystal lattice given below and answer the following questions :
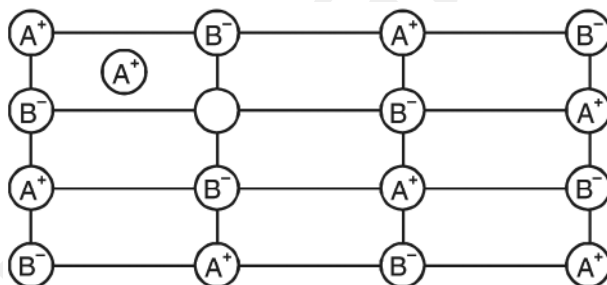
    (a) Name the crystal defect present in ionic solid.

    (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?

5. Tungsten crystallizes in body centred cubic unit cell. If the edge of the unit cell is 316. 5pm, calculate the radius of tungsten atom?

6. Iron has a body centred cubic unit cell with a cell dimension of 286.65 pm. The density of iron is 7.874 g cm^{-3}. Use this information to calculate Arogadro number.

    (At. Mass of Fe = 55.845u).

NUMERICALS

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 g mol^{-1}. **[Ans. : 6.022×10^{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 octanedral voids. What is the formula of the solid? **[Ans. : A_2BC_2]**

*3. Magnetite, a magnetic oxide of iron used on recording tapes, crystallises 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 crystalises into two cubic lattices fcc and bcc, whose edge length are 3.5Å and 3.0Å respectively. Calculate the ratio of the densities of fcc and bcc lattices.

5. An element of atomic mass 98.5 g mol^{-1} occurs in fcc structure. If its unit cell edge length is 500 pm and its density is 5.22 g cm^{-3}. Calculate the value of Avogadro constant. **[Ans. : 6.03×10^{23} mol^{-1}]**

6. An element crystallises in a cubic close packed structure having a fcc unit cell of an edge 200 pm. Calculate the density if 200 g of this element contain 24×10^{23} atoms. **[Ans. : 41.6 g cm^{-3}]**

7. Analysis shows that a metal oxide has a 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%]

8. AgCl is doped with 10^{-2} mol% of $CdCl_2$, find the concentration of cation vacancies. **[Ans. : 10^{-4} mol]**

9. A metallic element has a body centered cubic lattice. Edge length of unit cell is 2.88×10^{-8} cm. The density of the metal is 7.20 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) 2.39×10^{-23} cm^3 (b) 1.72×10^{-22} g, (c) 1.162×10^{24} atoms]

10. Molybednum has atomic mass 96 g mol^{-1} with density 10.3 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 × 10^{23} mol^{-1})   [**Ans. :** Z = 2, bcc type]

*13. The density of copper metal is 8.95 g cm^{-3}. If the radius of copper atom is 127 pm, is the copper unit cell a simple cubic, a body-centred cubic or a face centred cubic structure?

(Given at. mass of Cu = 63.54 g mol^{-1} and N_A = 6.02 × 10^{23} mol^{-1}]

[**Ans. :** Z = 4, fcc type]

[**Hint :** d = $\dfrac{ZM}{a^3 \times N_A}$ calculate Z/a^3 by putting the values given in the question.

Calculate packing efficiency by $\dfrac{z \times \dfrac{4}{3}\pi r^3 \times 100}{a^3}$ using value of

Z/a^3,which is 74%. This shows that Z = 4

14. The well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral there are 4 Ca^{2+} ions and 8F$^-$ ions and that Ca^{2+} ions are arranged in a fcc lattice. The F$^-$ ions fill all the tetrahedral holes in the fcc lattice of Ca^{2+} ions. The edge of the unit cell is 5.46 × 10^{-8} cm in length. The density of the solid is 3.18 g cm^{-3}. Use this information to calculate Avogadro's number (Molar mass of CaF_2 = 78.08 g mol^{-1}]

[**Ans. :** 6.02 × 10^{23} mol^{-1}]

Chapter - 2

SOLUTIONS

VSA QUESTIONS (1 - MARK QUESTIONS)

1. Give an example of 'liquid in solid' type solution.

2. Which type of solid solution will result by mixing two solid components with large difference in the sizes of their molecules?

3. What is meant by semimolar and decimolar solutions? $\left[\textbf{Ans.:}\ \frac{M}{2},\ \frac{M}{10}\right]$

4. 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]

5. Which of the following is a dimensionless quantity : molarity, molality or mole fraction? [**Ans. :** mole fraction]

6. 10 g glucose is dissolved in 400 g. of solution. Calculate percentage concentration of the solution. [**Ans. :** 2.5% w/w]

7. Gases tend to be less soluble in liquids as the temperature is raised. Why?

8. State the conditions which must be satisfied if an ideal solution is to be formed.

9. A mixture of chlorobenzene and bromobenzene forms nearly ideal solution but a mixture of chloroform and acetone does not. Why?

10. How is the concentration of a solute present in trace amount in a solution expressed?

*12. N_2 and O_2 gases have K_H values 76.48 kbar and 34.86 kbar respectively at 293 K temperature. Which one of these will have more solubility in water?

LearnGuide.in

*13. Under what condition molality and molarity of a solution are identical. Explain with suitable reason.

*14. Addition of H_gI_2 to KI (aq.) shows decrease in vapour pressure. Why?

15. What will happen to the boiling point of the solution formed on mixing two miscible liquids showing negative deviation from Raoult's law?

16. Liquid 'Y' has higher vapour pressure than liquid 'X', which of them will have higher boiling point?

17. 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.

18. Which type of deviation is shown by the solution formed by mixing cyclohexane and ethanol?

19. A and B liquids on mixing produce a warm solution. Which type of deviation from Raoult's law is there?

20. Define cryoscopic constant (molal freezing point depression constant.)

21. Mention the unit of ebullioscopic constant (molal boiling point elevation constant.)

22. If k_f for water is 1.86 K kg mol^{-1}, what is the freezing point of 0.1 molal solution of a substance which undergoes no dissociation or association of solute?

[**Hint :** $\Delta T_f = iK_f \cdot m$]

24. What is reverse osmosis? Give one large scale use of it.

*25. What is the maximum value of van't Hoff factor (i) for $Na_2SO_4 \cdot 10H_2O$?

[**Ans. :** i = 3]

26. What is the value of van't Hoff factor (i) if solute molecules undergo dimerisation. [**Ans. :** i = 0.5]

27. Under what condition is van't Hoff factor less than one?

[**Ans. :** Association]

*28. The Phase Diagram for pure solvent and the solution containing nonvolatile solute are recorded below. The quantity indicated by 'X' in the figure is known as : [**Ans. :** ΔTb]
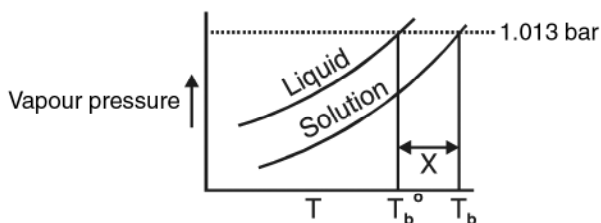
*29. AgNO$_3$ on reaction with NaCl in aqueous solution gives white precipitate. If the two solutions are separated by a semi-permeable membrane, will there be appearance of a white ppt. in the side 'X' due to osmosis?

0.1 M AgNO$_3$ X	S P M	0.01 M NaCl Y

[**Ans. :** No ppt, because only solvent particles moves through SPM]

SA (I) - TYPE QUESTIONS (2 - MARK QUESTIONS)

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 nonpolar solvents.

2. Give two examples each of a solution :

   (a) showing positive deviation from Raoult's Law.

   (b) showing negative deviation from Raoult's Law.

3. Draw vapour pressure vs composition (in terms of mole fraction) diagram for an ideal solution.

4. Define azeotropes with one example of each type.

5. Draw the total vapour pressure vs. mol fraction diagram for a binary solution exhibiting non-ideal behaviour with negative deviation.

6. The vapour pressure curve for three solutions having 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. [**Hint. :** A < B < C]

3

1 bar
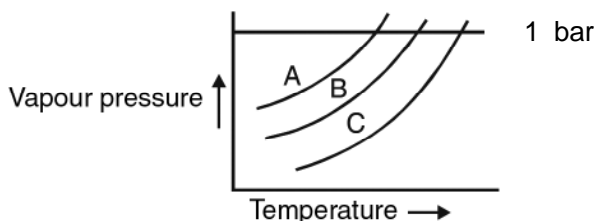
7. Show that the relative lowering of vapour pressure of a solvent is a colligative property.

8. 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 : $P°_{Benzene}$ = 150 mm of Hg, $P°_{Toluene}$ = 55 mm of Hg]

9. What is meant by abnormal molecular mass? Illustrate it with suitable examples.

*10. When 1 mole of NaCl is added to 1 litre water, the boiling point increases? When 1 mole of CH_3OH is added to 1 litre water, the boiling point decreases? Suggest reasons.

11. Can we separate water completely from HNO_3 solution by vapourisation? Justify your answer.

*12. 1 gram each of two solutes 'A' and 'B' (molar mass of A > molar mass of B) are dissolved separately in 100 g each of the same solvent. Which solute will show greater elevation in boiling point and Why?

Solution

2 - MARK QUESTIONS

13. Examine the following illustrations and answer the following questions
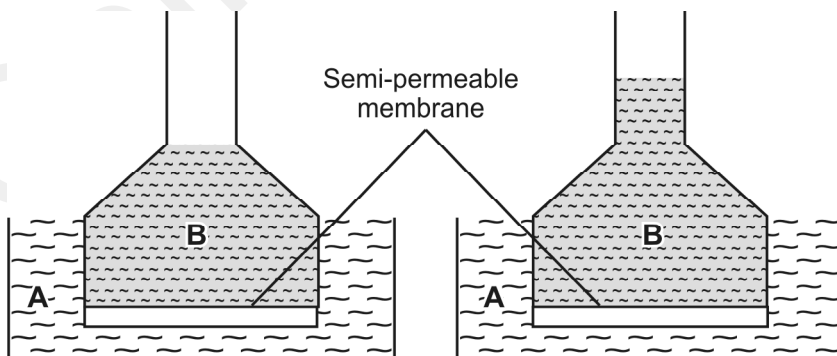
(a)   Identify the liquid A and liquid B (pure water or sugar solution)

(b)   Name the phenomenon involved in this experiment so that the level of liquid in this the funnel has risen after some time.

14.   How relative lowering in vapour pressure is related with depression in freezing point and elevation in boiling point?

SA (II) TYPE QUESTIONS (3 - MARK QUESTIONS)

1.   (a)   State Henry's Law.

(b)   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 O_2 = 46.82 bar at 393K).

2.   Given reason for the following :–

(a)   Aquatic species are more comfortable in cold waters than in warm waters.

(b)   To avoid bends scuba divers use air diluted with helium.

(c)   Cold drinks bottles are sealed under high pressure of CO_2.

3.   Why should a solution of a non-volatile and non-eletrolyte solute boil at a higher temperature? Explain with the help of a diagram. Derive the relationship between molar mass and elevation in boiling point.

4.   Account for the following :–

(a) $CaCl_2$ is used to clear snow from roads in hill stations.

(b)   Ethylene glycol is used as antifreeze solution in radiators of vehicles in cold countries.

(c)   The freezing point depression of 0.01 m NaCl is nearly twice that of 0.01 m glucose solution.

5.   Why do colligative properties of solution of a given concentration are found to give abnormal molecular weight of solute. Explain with the help of suitable examples.

6.   Give reasons for the following :–

(a)   RBC swell up and finally burst when placed in 0.1% NaCl solution.

(b)   When fruits and vegetables that have been dried are placed in water, they slowly swell and return to original form.

LearnGuide.in

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

*7. Glycerine, ethylene glycol and methanol are sold at the same price per kg. Which would be cheaper for preparing an antifreeze solution for the radiator of an automobile? **[Ans. :** Methanol]

*8. Determine the correct order of the property mentioned against them :

(a) 10% glucose (p_1), 10% urea (p_2), 10% sucrose (p_3) **[Osmotic pressure]**

(b) 0.1 m NaCl, 0.1 m urea, 0.1 m $MgCl_2$ **[Elevation in b.pt.]**

(c) 0.1 m $CaCl_2$, 0.1 m sucrose, 0.1 m NaCl **[Depression in f.pt.]**

9. For a dilute solution containing 2.5 g of a non-volatile non-electrolyte solute in 100 g of water, the elevation in boiling point at 1 atm pressure is 2°C. Assuming concentration of solute is much lower than the concentration of solvent, determine the vapour pressure (mm of Hg) of the solution.

[**Given :** K_b for water = 0.76 kg mol^{-1}] [**Ans.:** 724 mm of Hg]

[**Hind :** $\Delta T_b = K_b \cdot m \Rightarrow 0.76 \times \dfrac{2.5}{M_B} \times \dfrac{1000}{100} = 2k$

$M_b = 9.5$ g mol^{-1}

$\dfrac{p°_A - p_A}{p°_A} = \dfrac{25}{95} \times \dfrac{18}{100}$

$\dfrac{760 - p_A}{760} = \dfrac{25}{95} \times \dfrac{18}{100} \Rightarrow p_A = 724$ mm of Hg]

10. 15.0 g of an unknown molecular substance was dissolved in 450 g of water. The resulting solution was fund to freeze at –0.34°C. What is the molar mass of this substance. (K_f for water = 1.86 K kg mol^{-1}).

LONG ANSWER TYPE QUESTIONS (5 MARKS)

1. (a) What are ideal solutions? Write two examples.

(b) Calculate the osmoic pressure in pascals exerted by a solution prepared by dissolving 1.0g of polymer of molar mass 185000 in 450 mL of water at 37°C.

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

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

[**Ans. :** 55.55 g and 18.5 m]

3.   (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 $-9.3°C$. (K_f for water = 1.86 K kg mol^{-1})   [**Ans. :** 38.71g]

4.   (a)   Define osmotic pressure.

    (b)   Why osmotic pressure is preferred over other colligative properties for the determination of molecular masses of macromolecules?

    (c)   What is the molar concentration of particles in human blood if the osmotic pressure is 7.2 atm at normal body temperature of 37°C?

[**Ans. :** 0.283 M]

NUMERICAL PROBLEMS

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

[**Ans. :** C_6H_6 = 15.3%, CCl_4 = 84.7%]

2.   Calculate the molarity of a solution prepared by mixing 500 mL of 2.5 M urea solution and 500 mL of 2M urea solution.   [**Ans. :** 2.25 m]

    [**Hint :** $M = \dfrac{M_1 V_1 + M_2 V_2}{V_1 + V_2}$

3.   The mole fraction of CH_3OH in an aqueous solution is 0.02 and density of solution 0.994 g cm^{-3}. Determine the molality and molarity.

[**Ans. :** 1.13m, 1.08m]

4.   200 mL of calcium chloride solution contains 3.011 × 10^{22} Cl^{-} ions. Calculate the molarity of the solution. Assume that calcium chloride is completely ionized.   [**Ans. :** 0.125 M]

LearnGuide.in

5. 6×10^{-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 1.35×10^{-3} mol L^{-1} at 20°C and 1 atm pressure. Calculate the concentration of oxygen at 20°C and 0.2 atm pressure. [**Ans. :** 2.7×10^{-4} mol L^{-1}]

7. Two liquids X and Y on mixing form an ideal solution. The vapour pressure of the solution containing 2 mol of X and 1 mol of Y is 550 mm Hg. But when 4 mol 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 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°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°C is 70%. If the vapour pressure of water at 100°C is 760 mm of Hg, calculate the vapour pressure of the solution. [**Ans. :** 745.3 mm of Hg]

10. 2g of C$_6$H$_5$COOH dissolved in 25g of benzene shows depression in freezing point equal to 1.62K. Molar freezing point depression constant for benzene is 4.9 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 NaCl which must added to one kg of water so that the freezing point is depressed by 3K. Given K$_f$ = 1.86 K kg mol^{-1}, Atomic mass : Na = 23, Cl = 35.5). [**Ans. :** 0.81 mol NaCl]

12. Three molecules of a solute (A) associate in benzene to form species A$_3$. Calculate the freezing point of 0.25 molal solution. The degree of association of solute A is found to be 0.8. The freezing point of benzene is 5.5°C and its K$_f$ value is 5.13 K/m. [**Ans. :** 4.9°C]

13. A 5% solution of sucrose (C$_{12}$H$_{22}$O$_{11}$) is isotonic with 0.877% solution of urea. NH$_2$CONH$_2$) Calculate the molecular mass of urea.[**Ans. :** 59.99 g mol^{-1}]

14. Osmotic pressure of a 0.0103 molar solution of an electrolyte was found to be 0.75 atm at 27°C. Calculate Van't Hoff factor. [**Ans. :** i = 3]

LearnGuide.in

8

*15. The maximum allowable level of nitrates in drinking water is 45 mg nitrate ions/dm^3. Express this level in ppm? [**Ans. :** 45 ppm]

16. 75.2 g of Phenol (C_6H_5OH) is dissolved in 1 kg solvent of $K_f = 14$ Km^{-1}, if the depression in freezing point is 7K, then find the % of phenol that dimerises. [**Ans. :** 75%]

*17. An aqueous solution of glucose boils at 100.01°C. The molal boiling point elevation constant for water is 0.5 K kg mol^{-1}. What is the number of glucose molecule in the solution containing 100 g of water.

[**Ans. :** 1.2 × 10^{21} molecules]

18. A bottle of commercial H_2SO_4 [density = 1.787 g/mL] is labelled as 86% by mass.

    (a) What is the molarity of the acid?

    (b) What volume of the acid has to be used to make 1 litre 0.2 M H_2SO_4?

    (c) What is the molality of the acid?

[**Ans. :** 15.7 M, 12.74 mL, 62.86 m]

19. A solution containing 30g of non-volatile solute exactly in 90g of water has a vapour pressure of 2.8 kPa at 298 K. Furhter, 18 g of water is then added to the solution and the new vapour pressure becomes 2.9 kPa at 298 K. Calculate :

    (i) molar mass of the solute

    (ii) Vapour pressure of water at 298 K. [**Ans. :** 34 g mol^{-1}, 3.4 kPa]

20. The vapour pressure of pure liquids A and B are 450 and 750 mm Hg respectively, at 350K. Find out the composition of the liquid mixture if total vapour pressure is 600 mm Hg. Also find the composition of the vapour phase. [**Ans. :** $X_A = 0.4$, $X_B = 0.6$, $Y_A = 0.3$, $Y_B = 0.7$]

21. An aqueous solution of 2% non-volatile solute exerts a pressure of 1.004 bar at the normal boiling point of the solvent. What is the molar mass of the solute? [**Ans. :** 41.35 g mol^{-1}]

LearnGuide.in

Chapter - 3

Electro Chemistry

QUESTION CARRING 1 MARK

1. What is the effect of temperature on molar conductivity?
Ans. Molar conductivity of an electrolyte increases with increase in temperature.

2. Why is it not possible to measure single electrode potential?
Ans. (It is not possible to measure single electrode potential because the half cell containing single electrode cannot exist independently, as charge cannot flow on its own in a single electrode.)

3. Name the factor on which emf of a cell depends:-
Ans. Emf of a cell depends on following factor-

    a. Nature of reactants.

    b. Concentration of solution in two half cells.
    c. Temperature

    d. Pressure of gas.

4. What are the units of molar conductivity?
(cm^2 ohm^{-1} mol^{-1} or Scm^{2}mol$^{-1)}$

5. Write Nernst equation –
For the general cell reaction
aA+bB→cC+dD

Ans. **Ecell = E^{0}cell-RTln$\dfrac{[C]^c[[D]^d}{[A]^a[B]^b}$**

    nF
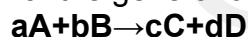
6. What is the EMF of the cell when the cell reaction attains equilibrium?
Ans. Zero

7. What is the electrolyte used in a dry cell?
Ans. A paste of NH_4Cl, MnO_2 and C

8. How is cell constant calculated from conductance values?
Ans. Cell constant= specific conductance/ observed conductance.

9. What flows in the internal circuit of a galvanic cell.
Ans. Ions

10. Define electrochemical series.
Ans. The arrangement of various electrodes in the decreasing or increasing order of their standard reduction potentials is called electrochemical series.

QUESTIONS CARRYING TWO MARKS

1. How can you increase the reduction potential of an electrode.?
   For the reaction

   $M^{n+}(aq) + ne^- \rightarrow M(s)$

   Ans. Nernst equation is:
   $$E^0_{M^{n+}/M} = E_{M^{n+}/M} - \frac{2.303RT}{nF}\log\frac{1}{[Mn^+]}$$

$E_{M^{n+}/M}$ can be increased by

a. increase in concentration of M^{n+} ions in solution
b. by increasing the temperature.

2. Calculate emf of the following cell at 298K

LearnGuide.in

Zn/Zn^{2+} (10^{-4} M) || Cu^{2+} (10^{-2}M)/Cu
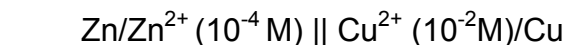
Given E^0 Zn^{2+}/Zn=-0.76V

E^{0}Cu^{2+}/Cu=+0.34V

Ans.   Cell reaction is as follows.

Zn(s) + Cu^{2+}(aq)→ Zn^{2+}(aq) + Cu(s)
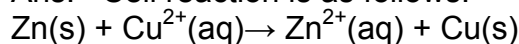
N=2

T=298K

Ecell=(E^{0}Cu^{2+}/Cu-E0Zn^{2+}/Zn)-0.0591V log$\frac{[Zn^{2+}(aq)]}{[Cu^{+}(aq)]}$

= 0.34V-(-0.76)-0.02955Vlog$\frac{10^{-4}}{10^{-2}}$

= 1.10V-0.02955V log 10-2

= 1.10V+2 X 0.02955V

= 1.10V + 0.0591 V

= 1.1591V

Q 3. Electrolysis of KBr(aq) gives Br$_2$ at anode but KF(aq) does not give F$^{2.}$ Give reason.

Ans. Oxidation takes place at anode. Now higher the oxidation Potential, easier to oxidize. Oxidation potential of Br$^-$, H2O,F$^-$ are in the following order.

Br->H$_2$O>F-
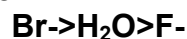
Therefore in aq. Solution of KBr. Br$^-$ ions are oxidized to Br$_2$ in preference to H$_2$O. On the other hand, in aq. Solution of KF, H$_2$O is oxidized in preference to F$^-$. Thus in this case oxidation of H$_2$O at anode gives O$_2$ and no F$_2$ is produced.

3. What happens when a piece of copper is added to (a) an aq solution of FeSO$_4$(b) an Aq solution of FeCl$_3$?
a. Nothing will happen when the piece of copper is added to FeSo4 because reduction potential E0 Cu2/Cu(0.34) is more than the reduction potential E0(Fe2+/Fe) (0.44V).
b. Copper will dissolve in an aq solution of FeCl$_3$ because reduction potential E^{0}Fe^{3+}/Fe^{2+}(0.77V) is more than the reduction potential of E^{0}Cu$_2$/Cu(0.34)

Cu(s)+ 2FeCl$_3$ (aq) → Cu$_2$(aq) + 2 FeCl$_2$(aq)
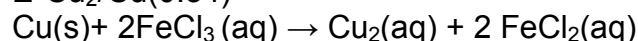
4. Define corrosion. Write chemical formula of rust.
Corrosion is a process of determination of metal as a result of its reaction with air and water, surrounding it. It is due to formulation of sulphides, oxides, carbonates, hydroxides, etc.
Formula of rust- Fe$_2$O.XH$_2$O
5. Write short notes on reduction and oxidation potentials.
6. How are standard electrode potentials measured?
7. What is cell constant? How it is determined?
8. what is conductivity water

9. Why it is necessary to platinize the electrodes of a conductivity cell before it is used for conductance measurement?
10. Why mercury cell gives the constant voltage.
11. What is fuel cell, write reaction involved in H_2-O_2 fuel cel.

QUESTION CARRYING THREE MARKS

1. Write any three differences between potential difference and e.m.f.

E.M.F	POTENTIAL DIFFERENCE
1.It is difference between electrode potential of two electrodes when no current is flowing through circuit.	1.it is difference of potential between electrode in a closed circuit.
2. it is the maximum voltage obtained From a cell.	2.it is less than maximum voltage Obtained from a cell.
3. it is responsible for steady flow of Current.	3.it is not responsible for steady Flow of current.

2. Why an electrochemical cell stops working after sometime?
   The reduction potential of an electrode depends upon the concentration of solution with which it is in contact.

   As the cell works, the concentration of reactants decrease. Then according to Le chatelier's principle it will shift the equilibrium in backward direction. On the other hand if the concentration is more on the reactant side then it will shift the equilibrium in forward direction. When cell works concentration in anodic compartment in cathodic compartment decrease and hence E^0 cathode will decrease. Now EMF of cell is
   $E^0_{cell}= E^0_{cathode} - E^0_{anode}$

   A decrease in $E^0_{cathode}$ **and a corresponding increase in** E^0 anode wil mean that EMF of the cell will decrease and will ultimately become zero i.e., cell stops working after some time.

3. for the standard cell
   $Cu(s)/Cu^+(aq)|| Ag^+(aq)/Ag(s)$
   E^0_{cell} $^{2+/}Cu = +0.34$ V
   E^0_{cell} $^{2+}$ =+0.34 V
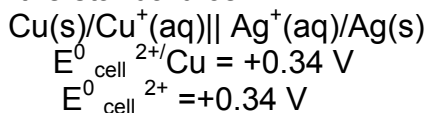
   E^0 Ag^+/Ag =+0.80 V
   i.   identify the cathode and the anode as the current is drawn from the cell.
   ii.   Write the reaction taking place at the electrodes.
   iii.   Calculate the standard cell potential.

   Ans. 1.From the cell representation

4

Ag/Ag⁺ electrode is cathode and Cu/Cu⁺ electrode is anode .
1. At anode :
Cu(s)→
Cu²⁺ (aq)+2e⁻→Ag(s)
E⁰ cell = E⁰ cathode − E⁰ anode
= E⁰ Ag+/Ag − E⁰ Cu2+ /Cu
= +.80 V − (+0.34V)
= +0.80V-0.34V
= 0.46V
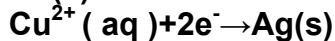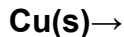
2. Can we store copper sulphate in (i)Zinc vessel (ii) Silver vessel? Give reasons**.**
Given E^0 Cu^{2+}/Cu = +0.34V, $E^0 Zn^{2+}/Zn$= -0.76V) , $E0 Ag^+/Ag$ = +0.80V

Ans. A metal having lower reduction potential can displace a metal having higher   reduction potential from solution of its salt.of $Cu^{2+}(E^0 Cu^{2+}/C$

I. Since standard reduction potential of $Zn^{2+}(E^0 Zn^{2+}/Zn$ = -0.76V) is less than the standard reduction potentialof Cu^{2+} ($E^0 Cu^{2+}/Cu$=+0.34V), Zn can displace copper from copper sulphate solution. Thus, $CuSo_4$ solution can be stored in silver vessel.

3. How many grams of chlorine can be produced by the electrolysis of matters NaCl with a current of 1.02 A for 15 min?
$2NaCl(l) →2Na^+(l)+2Cl^-(l)$
$2 Cl^- →Cl_2(g) + 2e^-$
2 mole   1mol
 Q= nf
Q= 2 x 96500 C/mol= 1.93 x 10⁵C
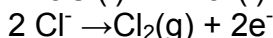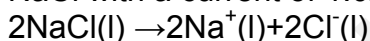
Quantity of electricity used = IT
= 1.02 A X (15 X 60)sec
= 900C
Molar mass of Cl2 = 2 X 35.5 = 71 gmol⁻¹ X 10⁵ C of charge produce chlorine = 71g
1.93 X 10⁵ C of charge produce chlorine = 71gm
900 C of charge produce chlorine 71 X 900
1.93 X 10⁵
= 0.331 gm
4. What is understood by a normal hydrogen electrode? Give its significance.
5. Define electrode potential. Why absolute value of reduction potential of electrode cannot be determined?
6. Write the equation showing the effect of concentration on the electrode potential.

7. Derive the relationship between Gibb's free energy change and the cell potential.
8. How Nernst equation can be applied in the calculation of equilibrium constant of any cell reaction.?
9. The cell reaction as written is spontaneous if the overall EMF of the cell is positive. Comment on this statement.

QUESTIONS CARRYING 5 MARKS

1. Explain the term electrolysis. Discuss briefly the electrolysis of (i) molten NaCl (ii) aqueous sodium chloride solution (iii) molten lead bromide (iv) water.
2. state and explain Faraday's laws of electrolysis. What is Electrochemical equivalent?
3. What do you understand by 'electrolytic conduction'? what are the factors on which electrolyte conduction depends.? What is the effect of temperature on electrolytic conduction?
4. How is electrolytic conductance measured experimentally?
5. Describe normal hydrogen electrode and its applications.

VERY IMPORTANT QUESTIONS

<u>1 Mark questions</u>:-
1. Why in a concentrated solution, a strong electrolyte shows deviations from Debye-Huckle- Onsagar equation?
Ans:- Because interionic forces of attractions are large.

2. What is the use of Platinum foil in the hydrogen electrode?
A: It is used for inflow and outflow of electrons.
3. Corrosion of motor cars is of greater problem in winter when salts are spread on roads to melt ice and snow. Why?

4. Is it safe to stir $AgNO_3$ solution with copper spoon? ($E^0_{Ag+/Ag}$ = 0.80 Volt; $E^0_{Cu+/Cu}$ = 0.34 Volt)
Ans: No it is not safe because reacts with $AgNO_3$ Solution (Emf will be positive.)
5. Why is it necessary to use salt bridge in A galvanic cell?
Ans: To complete inner circuit and to maintain electrical neutrality of the solution.

<u>2 mark questions</u>:-

1. Why is Li best reducing agent where as Fluorine is best oxidizing agent ?

2. Equilibrium constant is related to Eθ cell but not to Ecell. Explain.

3. Why sodium metal is not obtained at cathode when aq NaCl is electrolysed with Pt electrodes but obtained when molten NaCl is electrolysed ? 2

4. Zn rod weighing 25 g was kept in 100 mL of 1M copper sulphate solution. After certain time interval, the molarity of Cu^{2+} was found to be 0.8 M. What is the molarity of SO_4^{-2} in the resulting solution and what should be the mass of Zn rod after

cleaning and drying ?

5. Which will have greater molar conductivity and why? Sol A. 1mol KCl dissolved in 200cc of the solution or Sol B. 1 mol KCl dissolved in 500cc of the solution.

3/ 5 mark questions:-

1. What do you mean by (i) negative standard electrode potential and
(ii) positive standard electrode potential ?

2. Which cell is generally used in hearing aids?Name the material of the anode, cathode and the electrolyte. Write the reactions involved.

3. Iron does not rust even if Zinc coating is broken in agalvanised iron pipe but rusting occurs much faster if tin coating over iron is broken.Explain.

4. ' Corrosion is an electrochemical phenomenan', explain.

5. Calculate the pH of following cell: Pt, H_2/ H_2SO_4, if its electrode potential is0.03V.

6 . A cell contains two hydrogen electrodes. The negative electrode is in contact witha solution of 10^{-5} M H+ ions. The emf of the cell is 0.118 V at 298 K. Calculate theconcentration of the H+ ions at the positive electrode.

7. Crude copper containing Fe and Ag as contaminations was subjected to electro refining by using a current of 175 A for 6.434 min. The mass of anode was found to decrease by 22.260 g, while that of cathode was increased by 22.011 g. Estimate the % of copper, iron and silver in crude copper.

8 Zinc electrode is constituted at 298 K by placing Zn rod in 0.1 M aq solution of zinc sulphate which is 95 % dissociated at this concentration. What will be the electrode potential of the electrode given that EθZn2+/Zn= - 0.76 V. 3

9. At what pH will hydrogen electrode at 298 K show an electrode potential of -0.118 V, when Hydrogen gas is bubbled at 1 atm pressure ? 3

10 Electrolysis of the solution of MnSO4 in aq sulphuric acid is a method for the preparation of MnO2 as per the chemical reaction
Mn2+ + 2H2O → MnO2 + 2H+ + H2
Passing a current of 27 A for 24 Hrs gives 1 kg of MnO2. What is the current efficiency ? What are the reactions occurring at anode and cathode ?

Electrochemistry

Q 1.What do you mean by kohlrauch's law: from the following molar conductivities at infinite dilution

$\Delta m\infty$ Ba(OH)$_2$ =457.6 Ω^{-1} cm^2 mol^{-1}

$\Delta m\infty$ Ba Cl$_2$ = 240.6 Ω^{-1} cm^2 mol^{-1}

$\Delta m\infty$ NH$_4$Cl= 129.8 Ω^{-1} cm^2 mol^{-1}

Calculate $\Delta m\infty$ for NH$_4$OH

Ans. 238.3 Ω^{-1}cm^2 mol^{-1}

Q2. Calculate the equilibrium constant for the reaction

Zn + Cd^{2+} $\longleftrightarrow$ Zn^{2+} +Cd

If E^0 Cd^{++}/Cd =-.403 v
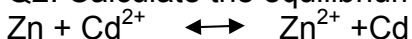
E^0 Zn^{++}/Zn= -0.763 v

Antilog 12.1827

Ans.1.52*10^{12}

Q3. Predict the products of electrolyzing of the following

(a) a dil. Solution of h^{2}So^4 with Pt. electrode

(b). An aqueous solution of AgNO3 with silver electrode

Chapter - 4

CHEMICAL KINETICS

1 MARKS QUESTION

1. The gas phase decomposition of acetaldehyde

$$CH_3CHO \rightarrow CH_4 + CO$$
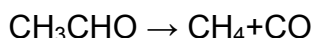
Follows the rate law.

What are the units of its rate constant.

Ans. $Atm^{-1/2}sec^{-1}$

2. State the order with respect to each reactant and overall reaction.

$$H_2O + 3I^- + 2H^+ \rightarrow 2H_2O + I_3^-$$
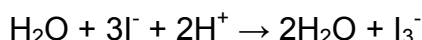
Rate = $k[H_2O_2]^1[I^-]^1$

Ans. Order of reaction = 1+1= 2

3. Give one example of pseudo first order reaction.

Ans. Hydrolysis of an ester
    $CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH + C_2H_5OH$
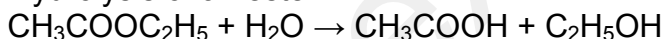
4. The conversion of molecules X to Y follows the second order of kinetics. If concentration of X is increased 3 times, how will it affect the rate of formation of Y.

Ans. Rate = $k[A]^2$
         = $k[3A]^2$
         = $k[9a]^2$

The rate of formation will become nine times.

5. The rate law for a reaction is
    Rate = $K[A][B]^{3/2}$
Can the reaction be an elementary process? Explain.

Ans. No, an elementary process would have a rate law with orders equal to its molecularities and therefore must be in integral form.

6. What do you understand by 'rate of reaction'?
7. Name the factors on which the rate of a particular reaction depends.
8. Why rate of reaction does not remain constant throughout?
9. Define specific reaction rate or rate constant.

10. What is half-life period of a reaction?

2 MARKS QUESTION

1. The rate of a particular reaction quadruples when the temperature changes from 293K to 313K. Calculate activation energy.

Ans. $K_2/K_1 = 4$,

T1= 293K T2 = 313K

Log $[K2/K1]$ = Ea[T2-T1]/19.15

Thus on calculating and substituting values we get…..

Ea = 52.86 KJ mol^{-1}

2. If the decomposition of nitrogen oxide as
$2N_2O_5 \longrightarrow 4NO_2 + O_2$
follows a first order kinetics.
(i)   Calculate the rate constant for a 0.05 M solution if the instantaneous rate is 1.5×10^{-6} mol/l/s?
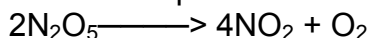
Ans. Rate = K $[N_2O_5]$

K= $\dfrac{\text{Rate}}{[N_2O_5]}$

K= $\dfrac{1.5 \times 10^{-6}}{0.05}$

K= 3.0×10^{-5}
ii) What concentration of N_2O_6 would give a rate of 2.45×10^{-5} mol L^{-1}s^{-1}
Rate = 2.45×10^{-5} mol L^{-1}s^{-1}
$[N_2O_5]$ = $\dfrac{\text{Rate}}{K}$ = $\dfrac{2.45 \times 10^{-5}}{3.0 \times 10^{-5}}$
   = 0.82 M
3) Write the difference between order and molecularity of reaction.

Ans.

ORDER	MOLECULARITY
It is the sum of the powers of concentration terms in the rate law expression.	It is the number of reacting speci--es undergoing simultaneously Collision in a reaction.
It is determined experimentally	it is a theoretical concept
Order of reaction need not be a whole number	It is whole no. only
Order of reaction can be zero.	It can't be zero or fractional

LearnGuide.in

2

4) Define Threshold energy and activation energy. How they are related?
Ans. Threshold Energy: It is the minimum amount of energy which the reactant molecules must possess for the effective collision in forming the products.

Activation Energy: It is the excess energy required by the reactants to undergo chemical reaction.

Activation energy = Threshold energy – Average kinetic energy of molecules.

5(a). Draw a schematic graph showing how the rate of a first order reaction changes in concentration of reactants.
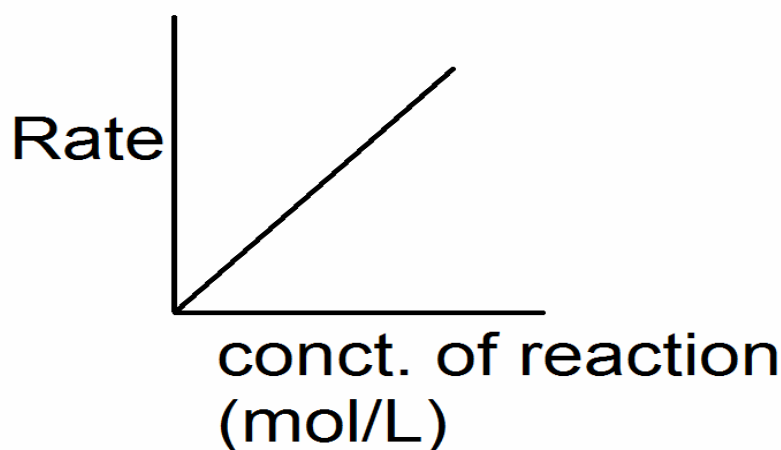
Variation of rate of first of first order reaction with concentration.

(b). rate of reaction is given by the equation
Rate = k [A] 2[B]
What are the units of rate constant for this reaction?
Ans. Rate = k [A] 2[B]

$$K = \frac{mol\ L^{-1}s^{-1}}{(mol\ L^{-1})^2(mol^{-1})}$$
$$K= mol^{-2}L^2s^{-1}$$

6. List the factors affecting the rate of reaction.
7. Explain with suitable example, how the molecularity of a reaction is different from the order of a reaction.

LearnGuide.in

3

8. Define the term 'rate constant' of 'specific reaction rate'.

9. What are Pseudo unimolecular reactions? Explain with the help of a suitable example.

10. What is half life period? Derive and expression for half-life period in case of a first order reaction.

3 marks question

Q1. The rate constant for first order reaction is 60/s. How much time will it take to reduce the concentration of the reaction to 1/10 of its initial value.

Ans:-

$$t = \frac{2.303}{K} \log \frac{[R_0]}{[R]}$$

$$t = \frac{2.303}{1} \log \frac{[R0]}{[R]}$$
$$\frac{}{10}$$

$$t = \frac{2.303}{60} \log 10$$

$$t = \frac{2.303}{60} = 3.38 \times 10^{-2} s^{-1}$$

2. The rate of most of reaction double when their temperature is raised from 298k to 308k. Calculate the activation energy of such a reaction.

Ans:-

$$\text{Log} \frac{K_2}{K_1} = \frac{E_a}{2.303 \ R} \quad \frac{1}{T_1} - \frac{1}{T_2}$$

$$E_a = \frac{2.303 \times 8.314 \times 298 \times 308 \times 0.3010}{1000}$$

$$E_a = 52.89 KJ/mol$$

3. A first order reaction takes 69.3 min for 50% completion. Set up on equation for determining the time needed for 80% completion.

Ans. $K = \frac{0.693}{T^{1/2}}$

= 0.693/69.3min

= $10^{-2} min^{-1}$

$T = \frac{2.303 \log}{K} \frac{[R_0]}{[R]}$

T= $2.303/10^{-2} \log 5$

T= 160.9min

4. Following reaction takes place in one step
$$2NO + O_2 \rightarrow 2NO_2$$

LearnGuide.in
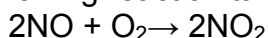
How will the rate of the reaction of the above reaction change if the volume of reaction vessel is diminished to 1/3 of its original volume? Will there be any change in the order of reaction with reduced volume?

Ans. $2NO + O_2 \rightarrow 2NO_2$

$dx/dt = k*[NO]_2[O_2]1$

[Since it is one step]

If the volume of reaction vessel is diminished to 1/3, conc. Of both NO and O2 will become 3 time, the rate of reaction increased 27 times.
In the order of reaction with the reduced volume.

5. The decomposition of NH_3 on platinum surface is a zero order reaction. What are the rate of production of N_2 and H_2.
   If k= 2.5×10^{-4}

Ans. $2NH_3 \rightarrow N_2 + 3H_2$

$$\frac{-1}{2}\frac{d[NH_3]}{dt} = \frac{d[NH_2]}{dt} + \frac{1}{3}\frac{d[H_2]}{dt}$$

$$\frac{-d[NH_3]}{dt} = rate = k \times [NH_3]^0$$

$= 2.5 \times 10^{-4}$ molL^{-1}sec^{-1}

$$\frac{d[N_2]}{dt} = -\frac{1}{2}\frac{d[NH_3]}{dt}$$

$= 1/2 \times 2.5 \times 10^{-4}$ molL^{-1}sec^{-1}

$d[H_2] = -\frac{3}{2}\frac{d[NH_3]}{dt} = 3/2 \times 2.5 \times 10^{-4}$

$= 3.75 \times 10^{-44}$molL^{-1}sec^{-1}

Rate $= -\frac{d[NH3]}{dt} = k \times [NH3]^0$

$= 2.5 \times 10^{-4}$ molL^{-1}sec^{-1}

Rate of production of N_2 = 2.5×10^{-4} molL^{-1}sec^{-1}

6. How is the rapid change in concentration of reactants/products monitored for fast reactions.
7. What are photochemical reactions? Give two examples,
8. What is the effect of temperature on the rate of reaction? Explain giving reasons.
9. Comment on free energy change of 'photochemical reactions'.
10. State the role of activated complex in a reaction and state its relation with activation energy.

QUESTIONS CARRYING 5 MARKS

LearnGuide.in

1. What do you understand by the rate of a reaction? How it is expressed? How it is the rate of reaction determined?
2. What do you understand by order of a reaction? How does rate law differ from law of mass action? Give two example of each of the reactions of (i) zero order (ii) first order (iii) second order
3. Derive the equation for the rate constant for a first order reaction. What would be the units of the first order rate constant if the concentration is expressed in mole per litre and time in seconds.
4. Explain why the rate of reaction increases with increase in temperature.
5. Briefly explain the effect of temperature on the rate constant of a reaction.

IMPORTANT QUESTIONS

1. The half-life period of two samples are 0.1 and 0.4 seconds. Their initial Concentrations are 200 and 50 mol L $^{-1}$ respectively. What is the order of reaction?

2. What is the ratio of $t_{3/4} : t_{1/2}$ for a first order reaction ?

3. Higher molecularity reactions (viz. molecularity, 4 and above) are very rare. Why?

4. Consider the reaction 2A + B _____> Products

When concentration of B alone was doubled, half life time does not change. When conc. of A alone is doubled, the rate increases by two times. What is the unit of K and what is the order of the reaction?

5. For the reaction, the energy of activation is 75KJ / mol. When the energy of activation of a catalyst is lowered to 20KJ / mol. What is the effect of catalyst on the rate of reaction at 20^0C.

6. The gas phase decomposition of CH_3OCH_3 follows first order of kinetics
$CH_3OCH_3 \rightarrow CH_4 (g) + H_2 (g) + CO (g)$
The reaction is carried out at a constant volume of the container at 500^0 C and has $t_{1/2}$ =14.5min.
Initially only dimethyl ether is present at a pressure of 0.40 atm. What is the total pressure of the system after 12 min? Assume ideal behavior.
Q 7. See the graph and answer the following question

LearnGuide.in

1). What is the order of r^n

2) what is the value of a and b

Graph: y-axis labeled Log [R], x-axis labeled t. Line with intercept "? (a)" and Slope= ?(b)
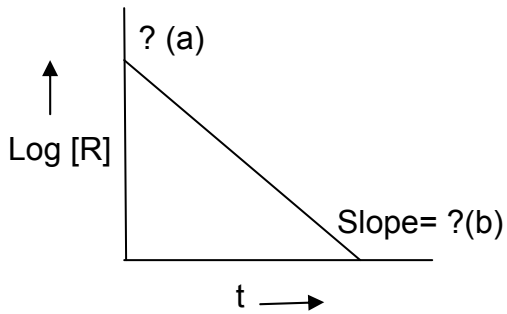
q 8. 1) what is the order of r^n
2) what is the value of slope and intercept

Graph: y-axis labeled [R], x-axis labeled t. Line with intercept "?" and Slope= ?

q 9.1). what is the value of slope
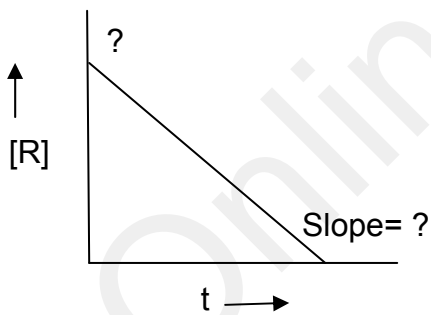
Graph: y-axis labeled [R], x-axis labeled t. Line with intercept "log A" and Slope= ?
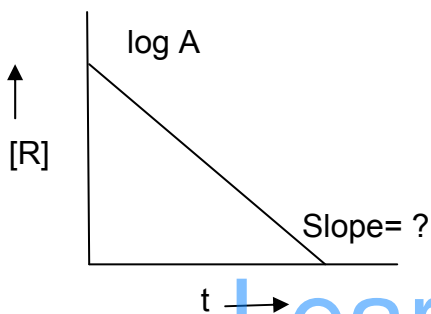
Chapter - 5

SURFACE CHEMISTRY

VSA QUESTIONS (1 - MARK QUESTIONS)

1. Why does a gas mixed with another gas not form a colloidal system?

2. Why are adsorbate particles attracted and retained on the surface of adsorbent?

3. Explain the terms sorption and desorption.

4. "Chemisorption is highly specific." Illustrate with an example.

5. "Adsorbents in finely divided form are more effective." Why?

6. Name two compounds used as adsorbent for controlling humidity.

   [**Ans. :** Silica gel, Alumina gel]

7. Mention one shape selective catalyst used to convert alcohol directly into gasoline.

8. 'Generally high temperature is favourable for chemisorption.' Why?

9. Name the catalyst used in the following process :

   (a) Haber's process for the manufacture of NH_3 gas.

   (b) Ostwald process for the manufacture of nitric acid.

10. Explain the relationship given by Freundlich in adsorption isotherm.

11. Which group elements show maximum catalytic activity for hydrogenation reactions?

    [**Hint :** 7–9 group elements]

12. Why gas masks are used by miners in coal mines while working?

13. Write the chemical reaction involved in the preparation of sulphur sol.

14. Name the enzyme which converts milk into curd.   [**Ans. :** lactobacilli]

15. What are the optimum temperature and pH at which enzymes are highly active. [**Ans. :** Temperature 298–310K and pH 5 to 7]

16. What are the physical states of dispersed phase and dispersion medium in foam rubber.

18. What is the composition of colloidion solution?

19. Why do colloidal particles show Brownian movement?

    [**Hint :** Due to unbalanced bombardment of the particles by the molecules of the dispersion medium]

21. State the sign of entropy change involved when the molecules of a substances get adsorbed on a solid surface. [**Ans. :** $\Delta S = -ve$]

22. Why does sky appear blue to us?

23. What happens when hydrated ferric oxide and arsenious sulphide sols are mixed in almost equal proportions?

24. Gelatin is generally added to ice-cream. Why?

    [**Hint :** Ice-cream is water in oil type emulsion and gelatin acts as emulsifier].

25. How is lake test for aluminium ion based upon adsorption?

    [**Hint :** $Al_2O_3.xH_2O$ has the capacity to adsorb the colour of blue litmus from the solution]

26. What is saturation pressure in Freundlich's isotherm?

27. Mention the two conditions for the formation of micelles.

    [**Hint. :** CMC and T_k]

28. How is Brownian movement responsible for the stability of sols?

    [**Hint :** Stirring effect due to Brownian movement does not allow the particles to settle down.]

29. Which of the following is more effective in coagulating positively charged hydrated ferric oxide sol : (i) KCl (ii) $CaSO_4$ (iii) K_3 [Fe(CN)$_6$].

30. State the purpose of impregnating the filter paper with colloidion solution.

31. Mention one use of ZSM–5 catalyst.

SA (I) TYPE QUESTIONS (2 - MARK QUESTIONS)

35. Explain the effect of temperature on the extent of physical and chemical adsorption.

36. Define the term peptization and mention its cause.

37. What will be the charge on colloidal solutions in the following cases.

(I)   (II)
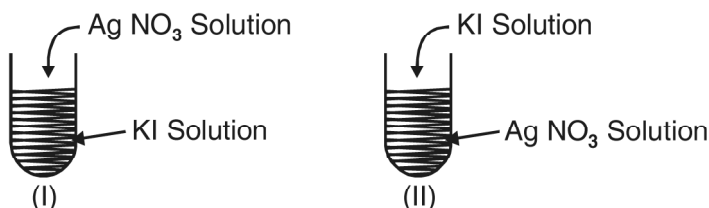
Give reasons for the origin of charge.

38. Write the factors upon which the catalytic reaction of shape-selective catalyst depends?

    [**Hint :** (a) Pore structure of the catalyst; (b) Size and shape of the reactant and product molecules.]

39. Mention two examples of emulsifying agents for o/w emulsions and w/o emulsions.

40. Suggest a mechanism of enzyme catalysed reaction.

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

    [**Hint :** Silica gel – Adsorption, Anhydrous $CaCl_2$–Absorption, as it forms $CaCl_2 \cdot 2H_2O$)

42. Write the differences between adsorption and absorption?

43. How can physisorption be distinguished from chemisorption?

44. Classify the following reactions as homogeneous and heterogeneous catalysis :

    (a) Vegetable oil (l) + H_2 (g) $\xrightarrow{\text{Ni(s)}}$ Vegetable ghee (s)

    (b) $C_{12}H_{22}O_{11}$ (aq) + H_2O (l) $\xrightarrow{H_2SO_4 \text{ (aq)}}$ $C_6H_{12}O_6$ (aq) + $C_6H_{12}O_6$ (aq)
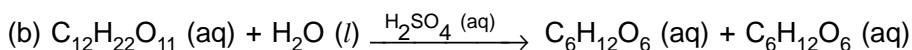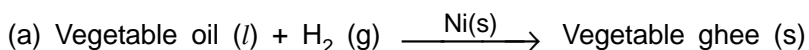
45. In what way these are different : (a) a sol and a gel (b) a gel and an emulsion.

46. State "Hardy Schulze Rule" with one example.

47. What is an emulsifying agent? What role does it play in forming an emulsion?

48. Define the terms :

   (a) Helmholtz electrical double layer.

   (b) Zeta potential.

49. A graph between $\dfrac{x}{m}$ and log p is a straight line at an angle of 45° with intercept on the y-axis i.e. (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.

$$\left[\begin{array}{l} \textbf{Hint :}\ \text{Refer to NCERT Text Book page 125, Fig. 5.2} \\[4pt] \dfrac{1}{n} = \tan 45° = 1,\ \log k = 0.3010, k = 2,\ p = 0.5\ \text{atm.} \\[6pt] \qquad\qquad \dfrac{x}{m} = kp^{\frac{1}{n}} = 2 \times (0.5)^{1} = 1.0 \end{array}\right]$$

50. Mention the two necessary conditions for the observation of Tyndall Effect.

51. Account for the following :

   (a) Artificial rain can be caused by spraying electrified sand on the clouds.

   (b) Electrical precipitation of smoke.

52. Write chemical equations for the preparation of sols :

   (a) Gold sol by reduction.

   (b) hydrated ferric oxide sol by hydrolysis.

53. How can the two emulsions can be distinguished :

   (a) oil in water type (O/W) and

   (b) water in oil type (W/O)

SA (II) TYPE QUESTIONS (3 - MARK QUESTIONS)

54. Write the difference between

    (a) catalysts and enzymes

    (b) promoters and poisons

55. Write the steps of 'Modern Adsorption Theory of Heterogenous Catalysis.'

56. Mention the two important features of solid catalysts and explain with the help of suitable examples.

57. How are the following colloids different from each other in respect of dispersion medium and dispersed phase? Give one example of each type.

    (a) An aerosol   (b) A hydrosol   (c) An emulsion.

58. What happens :

    (a) by persistent dialysis of a sol.

    (b) when river water meets the sea water.

    (c) when alum is applied on cuts during bleeding.

59. Distinguish between multimolecular, macromolecular and associated colloids with the help of one example of each.

60. (a) Which 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 catalyst but if reaction is carried in the presence of barium sulphate and quinoline, the product is ethene and not ethane. Why?

[**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.

(b) $$CH = CH + H_2 \xrightarrow{\text{Pd}} CH_2 = CH_2 \xrightarrow[\text{Pd}]{H_2} CH_3 - CH_3$$

$$CH \equiv CH + H_2 \xrightarrow[\text{BaSO}_4, \text{ quinoline}]{\text{Pd}} (CH_2 = CH_2)$$
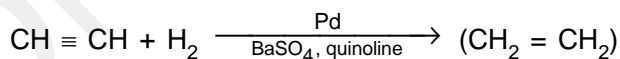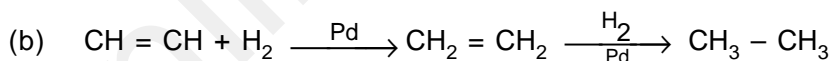
($BaSO_4$ in presence of quinoline act as poison. The catalyst in this case is not effective in further reduction].

LearnGuide.in   5

Chapter - 6

GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENTS

VSA QUESTIONS (1 - MARK QUESTIONS)

1. Name three metals which occur in native state in nature.

   [**Ans. :** Au, Ag and Pt]

2. What are collectors in froth flotation process? Give one example.

   [**Ex. :** Pine oil]

*3. Give the names and formulae of three ores which are concentrated by froth floatation process.

   [**Ans. :** Galena (PbS), zinc blend (zns) cinnabar (HgS)]

4. Among Fe, Cu, Al and Pb, which metal (s) can not be obtained by smelting.

   [**Ans. :** Al]

5. What is the thermodynamic criteria for the feasibility of a reaction?

   [**Ans. :** ΔG should be –ve or log K = + ve]

8. Why can't aluminium be reduced by carbon?

   [**Hint :** Al is stronger reducing agent than carbon]

9. Name the most important form of iron. Mention its one use.

   [**Ans. :** Cast iron is used for making gutter pipes, castings, railway sleepers, toys etc.]

10. Name the impurities present in bauxite ore.

    [**Ans. :** SiO_2, Fe_2O_3 and TiO_2]

11. What is the composition of copper matte?

    [**Hint :** Cu_2S and FeS]

12. Which from of copper is called blister copper?

13. What are froth stabilizers? Give two examples.

    [**Ex. :** Cresol and aniline].

14. A sample of galena is contaminated with zinc blend. Name one chemical which can be used to concentrate galena selectively by froth floatation method. [**Ans. :** NaCN]

15. What are the constituents of German silver?

    [**Ans. :** Cu = 25-30%, Zn = 25-30%, Ni = 40-50%]

16. Why is froth floatation process selected for concentration of the sulphide ore?

    [**Ans. :** Sulphide ore particles are wetted by oil (Pine oil) and gangue particles by water]

17. Write the reaction involved in the extraction of copper from low grade ores.

    [**Ans. :** First step is leaching of ore with acid or bacteria then Cu^{2+} (aq) + H_2 (g) $\rightarrow$ Cu(s) + $2H^+$ (g)]

18. Although aluminium is above hydrogen in the electrochemical series, it is stable in air and water. Why?

19. Which method of purification is represented by the following reaction

    Ti(s) + $2I_2$, (g) $\xrightarrow{523K}$ Ti I_4(g) $\xrightarrow{1700K}$ Ti(s) + $2I_2$(g)

20. Zinc is used but not copper 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].

21. Write the composition of motlen mixture which is electrolysed to extract aluminium.

SA (I) QUESTIONS (2 - MARK QUESTIONS)

*22. What is hydrometallurgy? Give one example where it is used for metal extraction.

[**Ans. :** Leaching followed by reduction is called hydrometallurgy. It is used in extraction and copper

*23. Name the process for the benefaction/concentration of (i) an ore having lighter impurities (ii) sulphide ore.

24. Mention the role of cryolite in the extraction of aluminium.

25. Mention the role of following :

   (a) SiO_2 in the metallurgy of Cu.

   (b) $CaCO_3$ in the metallurgy of Fe.

   (c) CO in the metallergy of iron

   (d) I_2 in the purification of zirconium.

26. Extraction of copper directly from sulphide ore is less favourable than from its oxide through reduction. Explain.

   [**Ans. :** $2Cu\ S(s) + C(s) \rightarrow CS_2\ (l) + 2Cu(s)$

   $CuO(s) + C(s) \rightarrow CO\ (g) + Cu(s)$

   ΔG value is more –ve in second case as compared with first case]

27. The graphite electrodes in the extraction of 'alluminium' by Hall-Heroult process need to be changed frequently. Why?

28. Write the chemical formulae of the following ores (a) Haematite (b) Magnetite (c) Limonite (d) Siderite.

   [**Ans. :** (a) Fe_2O_3 (b) Fe_3O_4 (c) $Fe_2O_3.2H_2O$ (d) $FeCO_3$]

29. Give equations for the industrial extraction of zinc from calamine.

   [**Ans. :** $ZnCO_3 \rightarrow ZnO + CO_2$ (Calcination) $ZnO + C \rightarrow Zn + CO$ (Reduction)]

30. Name the elements present in anode mud during refining of copper. Why does it contain such elements?

   [**Ans. :** Au and Ag. They are not oxidised at anode. They are less electropositive than copper.]

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 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?

   [**Hint :** Entropy is more positive when the metal is in liquid state as compared with solid state, so ΔG becomes more −ve]

34. What is pyrometallurgy? Explain with one example.

   [**Ans. :** A process of reducing a metal oxide by heating with either coke or some other reducing agent *e.g.*, Al, Mg etc.

   $$ZnO + C \xrightarrow{\quad 975\ k \quad} Zn + CO]$$
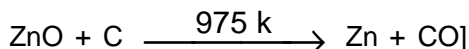
35. Write the method to produce Copper matte from copper pyrites.

*38. Copper can be extracted by hydrometallurgy but not zinc. Explain why?

   [**Hint :** $E^{\varnothing}_{Zn^{2+}/Zn}$ is − ve, $E^{\varnothing}_{Cu^{2+}/Cu}$ is +ve]

*39. Gibbs energies of formation $\Delta_f G$ of MgO(s) and CO(g) at 1273K and 2273 K are given below:

   $\Delta_f G$ [MgO(s)] = −941 kJ mol^{-1} at 1273 K.

   $\Delta_f G$ [CO(g)] = −439 kJ mol^{-1} at 1273 K.

   $\Delta_f G$ [MgO(s)] = −314 kJ mol^{-1} at 2273 K.

   $\Delta_f G$ [CO(g)] = −628 kJ mol^{-1} at 2273 K.

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

   [**Ans. :** For the reaction, MgO(s) + C(s) $\rightarrow$ Mg(s) + CO(g)

   At 1273K, $\Delta_r G = \Delta_f G[CO(g)] - \Delta_f G[MgO(s)]$ = −439 − (−941) KJ mol^{-1} = 502 kJ mol^{-1}

   At 2273 K, $\Delta_r G$ = −628 − (−314) kJ mol^{-1} = −314 kJ mol^{-1}

   The temperature is 2273 K]

SA (II) TYPE QUESTIONS (3 - MARK QUESTIONS)

*40. State the principles of refining of metal by the following methods.

(a) Zone refining (b) Electrolytic refining (c) Vapour phase refining.

41. How is pure copper obtained from its principle ore? Write the chemical reactions occurring during the extraction.

42. Name the method of refining of the following metals –

(a) Hg   (b) Sn   (c) Cu   (d) Ge   (e) Ni   (f) Zr

[**Ans. :** (a) Distillation, (b) Liquation; (c) Electrolytic refining
(d) Zone refining; (e) Mond Process (f) Van Arkel Processl]

*44. The native silver forms a water soluble compound (B) with dilute aqueous solution of NaCN in the presence of a gas (A). The silver metal is obtained by the addition of a metal (C) to (B) and complex (D) is formed as a byproduct. Write the structures of (C) and (D) and identify (A) and (B) in the following sequence –

$Ag + NaCN + [A] + H_2O \rightarrow [B] + OH^- + Na^+$.

$[C] + [B] \rightarrow [D] + Ag$.

[**Ans. :** $[A] = O_2$
$[B] = Na[Ag(CN)_2]$
$[C] = Zn$
$[D] = Na_2[Zn(CN)_4]$].

45. In the cynamide extraction process of silver pon argentite ore, name the oxidising and reducing agents. Write the chemical equations of the reactions involved.

Chapter - 7

Anomalous behaviour of first member of p-Block Elements
VSA QUESTIONS (1 - MARK QUESTIONS)

1. In group 15 elements, there is considerable increase in covalent radius from N to P but small increase from As to Bi. Why?

   [**Hint :** Due to completely filled d- and / or f-orbitals in As, Sb and Bi.

2. The tendency to exhibit – 3 oxidation state, decreases down the group in group 15 elements. Explain.

   [**Hint :** Due to increase in size and decrease in electronegativity down the groups].

3. Maximum covalence of Nitrogen is '4' but the heavier elements of group 15 show covalence greater than '4'. Why?

4. Nitrogen exists as a diatomic molecule with a triple bond between the two atoms, whereas the heavier elements of the group do not exist as E_2 at room temperature. Assign a reason.

   [**Hint :** p_π – p_π multiple bonds are formed by N due to its small size.]

5. The ionization enthalpies of group 15 elements are higher than those of corresponding members of group 14 and 16 elements. Assign the reason.

6. The boiling point of PH_3 is lesser than NH_3. Why?

7. NO_2 dimerises to form N_2O_4. Why?

   [**Hint :** Due to presence of odd electron on N]

8. Draw the structure of N_2O_5 molecule.

9. How does ammonia solution react with Ag^+ (aq)? Write the balanced chemical equation.

10. Why does NH_3 forms intermolecular hydrogen bonds whereas PH_3 does not?

    [**Hint :** Due to strong electronegativity, small size of Nitrogen atom and presence of lone pair of electrons on N atom]

11. Write disproportionation reaction of H_3PO_3?

12. How does NH_3 acts as a complexing agent?

    [**Hint :** Metal hydroxides are dissolved in excess of NH_4OH. Ammonia acts as a Lewis base].

13. Why HF is the weakest acid and HI is the strongest.

    Hint : Ka : (HF) = 7×10^{-4} (HI) = 7×10^{11}

11

LearnGuide.in

Intermolecular H–bonds in H–F and high bond dissociation enthalpy of H–F makes it weakest and weak bond in H–I makes it strogest.

14. Explain why halogens are strong oxidising agents.

    [**Hint :** Ready acceptance of electron due to more negative eletron gain enthalpy.]

15. Why is Bi(V) a stronger oxidant than Sb(V)?

    [**Hint :** +3 oxidation state is more stable than +5 oxidation state in Bi].

16. Why SF_4 is easily hydrolysed, whereas SF_6 is resistant to hydrolysis?

    [**Hint :** Water molecule can not attack 'S' atom due to steric hinderance and 'S' atom is also coordinately saturated in SF_6 molecule.]

17. Bond dissociation enthalpy of F_2 is less than that of Cl_2. Why?

18. Write the reaction of PCl_5 with heavy water.

    [**Hint :** $PCl_5 + D_2O \rightarrow POCl_3 + 2DCl$]

19. How many P – O – P bonds are there in cyclotrimetaphosphoric acid?

    [**Hint :** 3 bonds]

20. In group 16, the stability of +6 oxidation state decreases and that of +4 oxidation state increases down the group. Why?

    [**Hint :** due to inert pair effect]

21. Why we can not prepare HBr by heating KBr with sulphuric acid.

    [**Hint :** As HBr readily reduces H_2SO_4 forming Br_2]

24. Fluorine exhibit only –1 oxidation state whereas other halogens exhibit +ve oxidation states also. Explain.

25. Arrange the following oxoacids of chlorine in increasing order of acidic strength.

    HOCl, HOClO, HOClO$_3$, HOClO$_3$

*26. The majority of known noble gas compounds are those of Xenon. Why?

*27. "Hypophosphorus acid is a good reducing agent." Justify with an example.

    [**Hint :** $4AgNO_3 + H_3PO_2 + 2H_2O \rightarrow 4Ag + HNO_3 + H_3PO_4$.

*28. Draw the structure of $H_4P_2O_7$ and find out its basicity?

    [**Hint :** Tetrabasic]

LearnGuide.in

*29. Arrange the following triatomic species in the order of increasing bond angle.

NO_2, NO_2^+, NO_2^-

[**Hint :** $\left[\overset{\cdot\cdot}{\underset{\cdot\cdot}{:O}} - \overset{\cdot}{N} = \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} : \right]$, $\left[\overset{\cdot\cdot}{\underset{\cdot\cdot}{:O}} - N = \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} \right]^+$, $\left[\overset{\cdot\cdot}{\underset{\cdot\cdot}{:O}} - \overset{\cdot\cdot}{N} = \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} \right]^-$
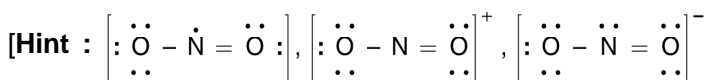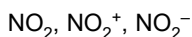
NO_2 has one non-bonding electron, NO_2^- has two non-bonding electrons, NO_2^+ has no non-bonding electron on N atom. Bond angle of NO_2 is maximum that of NO_2^- minimum].

30. With what neutral molecule ClO^- is isoelectronic?

31. Draw the structure of $H_2S_2O_8$ and find the number of S–S bond if any.

32. What is cause of bleaching action of chlorine water? Explain it with chemical equation?

[**Hint :** Formation of nascent oxygen]

*33. Electron gain enthalpy of fluorine is more negative than that of chlorine.

[**Hint. :** Due to small size of F atom, there are strong interelectronic repulsions in the relatively smaller 2p orbitals of fluorine. So the incoming electron does experience less attraction than in Cl]

*34. Which one of the following is not oxidised by O_3. State the reason.
    KI, $FeSO_4$, K_2MnO_4, $KMnO_4$
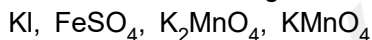
[**Hint. :** $KMnO_4$ since Mn is showing maximum oxidation state of +7.]

SA (I) TYPE QUESTIONS (2 - MARK QUESTIONS)

2. Why is red phosphorus denser and less chemically reactive than white phosphorus?

3. Give chemical reaction in support of the statement that all the bonds in PCl_5 molecule are not equivalent.

[**Hint :** $PCl_5 + H_2O \rightarrow POCl_3 + 2HCl$
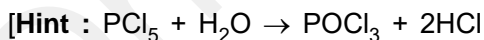
4. Account for the following :

   (a) XeF_2 has linear structure and not a bent structure.

   (b) Phosphorus show marked tendency for Catenation.

5. Draw the structures of BrF_3, $XeOF_4$, XeO_3 using VSEPR theory.

6. Write the conditions that favour the formation of ammonia gas along with the reactions involved in Haber's Process.
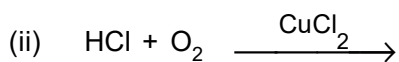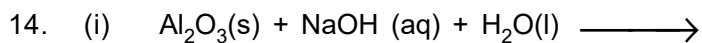
LearnGuide.in

7. Write the chemical equations of the following reactions

    (a)   Glucose in heated with conc. H_2SO_4.

    (b)   Sodium nitrate is heated with conc. H_2SO_4.

Complete the following reactions :

8.   (i) $(NH_4)_2 Cr_2O_7 \xrightarrow{\text{heat}}$

    (ii) $N_4H\ Cl\ (aq) + NaNO_2\ (aq) \longrightarrow$

9.   (i) $NH_2CONH_2 + H_2O \longrightarrow$

    (ii) $FeCl_3\ (aq) + NH_4OH \longrightarrow$

10.   (i) $Ca_3 P_2 + H_2 O\ (l) \longrightarrow$

    (ii) $I_2 + HNO_3\ (conc.) \longrightarrow$

11.   (i) $Ba(N_3)_2 \xrightarrow{\text{heat}}$

    (ii) $4H_3PO_3 \xrightarrow{\text{heat}}$

12.   (i) $PH_4I + KOH \longrightarrow$

    (ii) $HgCl_2 + PH_3 \longrightarrow$

13.   (i) $PCl_3 + 3H_2O \longrightarrow$

    (ii) $S + H_2SO_4\ (conc.) \longrightarrow$

14.   (i) $Al_2O_3(s) + NaOH\ (aq) + H_2O(l) \longrightarrow$

      (ii) $HCl + O_2 \xrightarrow{\ CuCl_2\ }$

15.   (i) $Ca(OH)_2 + Cl_2 \longrightarrow$

      (ii) $XeF_4 + H_2O \longrightarrow$

16.   (i) $Na_2SO_3 + Cl_2 + H_2O \longrightarrow$

      (ii) $NaHCO_3 + HCl \longrightarrow$

17.   (i) $XeF_6 + H_2O \xrightarrow[\text{hydrolysis}]{\text{Complete}}$

      (ii) $XeF_6 + H_2O \xrightarrow[\text{hydrolysis}]{\text{Partial}}$

18.   (i) $NO_3^- + Fe^{2+} + H^+ \longrightarrow$

      (ii) $Zn + HNO_3\ (dil) \longrightarrow$

19.   (i) $Zn + HNO_3\ (conc) \longrightarrow$

      (ii) $P_4 + HNO_3\ (conc) \longrightarrow$

20.   (i) $NH_3 + O_2 \xrightarrow{\ Pt/Rh\ }$

      (ii) $P_4 + NaOH + H_2O \longrightarrow$

21.   (i) $P_4 + SOCl_2 \longrightarrow$

      (ii) $P_4 + SO_2Cl_2 \longrightarrow$

LearnGuide.in

22. (i) PbS + O_3 $\longrightarrow$

(ii) KI + H_2O + O_3 $\longrightarrow$

23. (i) MnO_4^- + SO_2 + H_2O $\longrightarrow$

(ii) Zn + HNO_3 $\longrightarrow$
   (dil)

24. (i) NH_3 (Excess) + Cl_2 $\longrightarrow$

(ii) NH_3 + Cl_2 (Excess) $\longrightarrow$

25. (i) Cl_2 + NaOH (cold and dil) $\longrightarrow$

(ii) Cl_2 + NaOH (hot & conc) $\longrightarrow$

26. (i) Fe + HCl $\longrightarrow$

(ii) Cl_2 + F_2 (Excess) $\longrightarrow$

27. (i) U + ClF_3 $\longrightarrow$

(ii) $FeSO_4$ + H_2SO_4 + Cl_2 $\longrightarrow$

28. (i) What is the covalency of N in N_2O_5?

(ii) Explain why phosphorus forms pentachloride whereas nitrogen and bismuth do not?

29. (i) The acidic character of hydrides of group 15 increases from H_2O to H_2Te. Why?

(ii) Dioxygen is a gas while sulphur (S_8) is a solid. Why?

30. (i) Interhalogen compounds are more reactive than halogens except F_2. Why?

(ii) Give one important use of ClF_3.

31. (i) Write the composition of bleaching powder.

(ii) What happens when NaCl is heated with conc. H_2SO_4 in the presence of MnO_2. Write the chemical equation.

32. Arrange the following in the decreasing order of their basicity. Assign the reason :

PH_3, NH_3, SbH_3, AsH_3, BiH_3.

*33. A colourless and a pungent smelling gas which easily liquifies 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]

*34. Complete following disproportionation reactions.

(a) P_4 + NaOH + H_2O $\longrightarrow$

(b) HNO_2 $\xrightarrow{H^+}$

35. Arrange the following trichlorides in decreasing order of bond angle NCl_3 PCl_3, $AsCl_3$, $SbCl_3$

36. Suggest reason why only known binary compounds of noble gases are fluorides and oxides of Krypton, Xenon.

[**Hint :** F and O are most electronegative elements. Kr and Xe both have low Ionisation enthalpies.]

37. Which fluorinating agent are oftenly used instead of F_2? Write two chemical equations showing their use as fluorinating agents.

[**Hint :** BrF_5 + $3H_2O$ $\rightarrow$ $HBrO_3$ + 5HF

$2IF_7$ + SiO_2 $\rightarrow$ $2IOF_5$ + SiF_4]

38. (a) Hydrolysis of XeF_6 is not regarded as a redox reaction. Why?

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

[**Hint :** (b) XeF_4 + $2H_2$ $\rightarrow$ Xe + 4HF)]

39. Write Chemical equation :

(a) XeF_2 is hydrolysed

(b) PtF_6 and Xenon are mixed together.

LearnGuide.in

SA (II) TYPE QUESTIONS (3 - MARK QUESTIONS)

1. (i)   How is HNO_3 prepared commercially?

    (ii) Write chemical equations of the reactions involved.

    (iii) What concentration by mass of HNO_3 is obtained?

2. (i)   How does O_3 react with lead sulphide? Write chemical equation.

    (ii) What happens when SO_2 is passed in acidified $KMnO_4$ solution?

    (iii) SO_2 behaves with lime water similar to CO_2.

3. Assign reason for the following :

    (i)   Sulphur in vapour state exhibits paramagnetism.

    (ii) F_2 is strongest oxidising agent among halogens.

    (iii) In spite of having same electronegativity, oxygen forms hydrogen bond while chlorine does not.

4. Give appropriate reason for each of the following :

    (i)   Metal fluorides are more ionic than metal chlorides.

    (ii) Perchloric acid is stronger than sulphuric acid.

    (iii) Addition of chlorine to KI solution gives it a brown colour but excess of Cl_2 makes it colourless.

    [Hint :
    (i)   According to Fajan's Rule, bigger ions more are polarised than the smaller ion by a particular cation.

    (ii) ClO_4^- is more resonance stabilised than SO_4^{2-} since dispersal of negative charnge is more effective in ClO_4^- as compared with SO_4^{2-}

    (iii) $2KI + Cl_2 \rightarrow 2KCl + I_2$

    Excess $5Cl_2 + I_2 + 6H_2O \rightarrow 2HIO_3 + 10\ HCl$ (Colourless).

5. Explain why :

    (i)   No chemical compound of helium is known.

    (ii) Bond dissociation energy of fluorine is less than that of chlorine.

    (iii) Two S–O bonds in SO_2 are identical.

6. Out of the following hydrides of group 16 elements, which will have :

    (i) H_2S (ii) H_2O (iii) H_2Te

LearnGuide.in

(a)   lowest boiling point

(b)   highest bond angle

(c)   highest electropositive hydrogen.

7.   (i)   How is XeO_3 prepared from XeF_6? Write the chemical equation for the reaction.

(ii)   Draw the structure of XeF_4.

8.   (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, electron gain ethalpy of hologens and hydration enthalpy of halide ions.

(iii)   Write the chemical equation for the reaction of copper metal with conc. HNO_3.

*9.   An unknown salt X reacts with hot conc. H_2SO_4 to produce a brown coloured gas which intensifies on addition on copper turnings. On adding dilute ferrous sulphate solution to an aqueous solution of X and then carefully adding conc. H_2SO_4 along the sides of the test tube, a brown complex Y is formed at the interface between the solution and H_2SO_4. Identify X and Y and write the chemical equation involved in the reaction.
[**Hint :** X is NO_3^- salt].

10.   Assign reason to the following :

(i)   Noble gases have large positive values of electron gain enthalpy.

(ii)   Helium is used by scuba divers.

11.   Arrange the following in the order of the property indicated for each set–

(a) F_2, Cl_2, Br_2, I_2 (Increasing bond dissociation energy).

(b)   HF, HCl, HBr, HI (decreasing acid strength).

(c) NH_3, PH_3, ASH_3, SbH_3, BiH_3 (decreasing base strength).

[Hint :

(a) F_2 has exceptionally low bond dissociation enthalpy. Lone pairs in F_2 molecule are much closer to each other than in Cl_2 molecule. Larger electron–electron repulsions among the lone pairs in F_2 molecule make its bond dissociation enthalpy exceptionally low.

(b)   Depends upon H–X bond dissociation enthalpy as the size of atom increases, bond dissociation enthalpy of H–X decreases.

LearnGuide.in

(c) Electron availability on the central atom 'E' in EH_3 decreases down the group.

*12. A transluscent while waxy solid (A) on heating in an inert atmosphere is converted to its allotropic form (B), Allotrope (A) on reaction with very dilute aqueous NaOH liberates a highly poisonous gas (C) having a rotten fish smell, with excess of chlorine forms D which hydrolyses to form compound (E). Identify the compounds (A) to (E).

A : White phosphorus, B : Red phosphorus, C : PH_3, D : PCl_3, E : H_3PO_4

13. Write balanced equation for the following reactions :

(a) Zn is treated with dilute HNO_3.

(b) NaCl is heated with H_2SO_4 in the presence of MnO_2.

(c) Iodine is treated with conc. HNO_3.

14. X_2 is a greenish yellow gas with pungent offensive smell used in purification of water. It partially dissolves in H_2O to give a solution which turns blue litmus red. When X_2 is passed through NaBr Solution, Br_2 is obtained.

(a) Identify X_2, name the group to which it belongs.

(b) What are the products obtained when X_2 reacts with H_2O? Write chemical equation.

(c) What happens when X_2 reacts with hot and conc. NaOH? Give equation.

16. Assign the appropriate reason for the following:

(a) Nitrogen exists as diatomic molecule and phorphorous as P_4, Why?

(b) Why does $R_3P = 0$ exist but $R_3N = 0$ does not ? (R = an alkyl group).

(c) Explain why fluorine forms only one oxoacid, HOF.

[Hint :

(a) Due to its small size and high electronegativity N forms $p\pi - p\pi$ multiple bond (N $\equiv$ N). whereas P does not form $p_\pi - p_\pi$ bonds but forms P – P single bond.

(b) Due to the absence of d-orbitals, N cannot expand its covalence beyond four.

In $R_3N = 0$, N should have a covalence of 5 so the compound $R_3N = 0$ does not exist since maximum covalence shown by N cannot exceed 4.

LearnGuide.in

(c) F does not form oxoacids in which the oxidation state of F would be +3, +5, +7, it forms one oxoacid, because of unavailability of d orbitals in its valence shell.

LONG ANSWER TYPE QUESTIONS (5 - MARK QUESTIONS)

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 :

    (a) Stability of +5 oxidation state decreases and that of +3 oxidation state increases down the group 15 elements.

    (b) H_2O is less acidic than H_2S.

    (c) SF_6 is inert while SF_4 is highly reactive towards hydrolysis.

    (d) H_3PO_2 and H_3PO_3 act as good reducing agents while H_3PO_4 does not.

    (e) Noble gases have comparatively large size in their respective periods.

3. (a) How is XeF_6 prepared from the XeF_4? Write the chemical equation for the reaction.

    (b) Deduce the structure of XeF_6 using VSEPR theory.

    (c) How does XeF_2 reacts with PF_5?

    (d) Give one use each of helium and neon.

    (e) Write the chemical equation for the hydrolysis of XeF_4.

4. (a) Why does nitrogen show anomalous behaviour? Discuss the trend of chemical reactivity of group 15 elements with.

    (a) oxygen   (b) halogens   (c) metals

    (b) H_3PO_3 is a dibasic acid. Why?

5. (a) Arrange the following in the order of their increasing acid strength.

    (a) Cl_2O_7, SO_2, P_4O_{10}

    (b) How is N_2O gas prepared? And draw its structure.

    (c) Give one chemical reaction to show O_3 is an oxidising agent.

LearnGuide.in

*6. Identify A, B, C, D and E in the following sequence of reactions
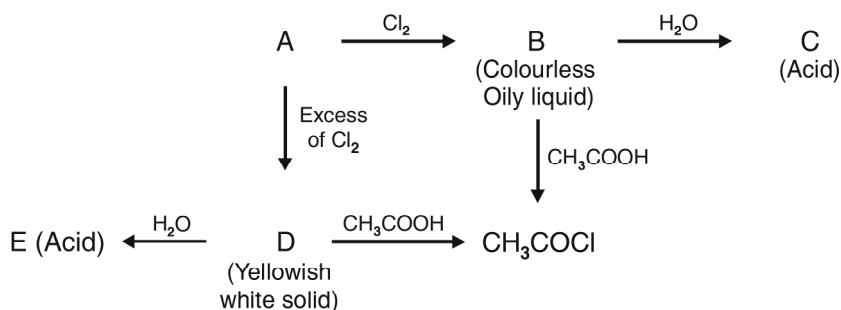
Complete the reactions of the above mentioned sequence.

[**Hint :** A is P_4].

*7. 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 of Q :

(a) Identify M, N and Q and write the chemical equations of the reactions involved.

(b) M exists in the form of discrete tetrahedral molecules. Draw its structure.

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

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

$$NH_3 + O_2 \xrightarrow{\text{Pt/Rh}} A + H_2O$$

$$A + O_2 \longrightarrow B \text{ (brown fumes)}$$

$$B + H_2O \longrightarrow C + A \text{ (C is an oxoacid)}$$

$$C + I^- \longrightarrow D \text{ (Violet vapours)}$$
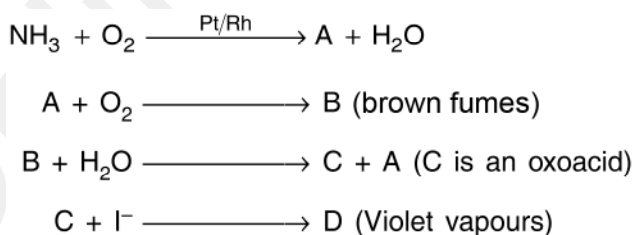
Complete reactions of the above mentioned sequence and name the process by which 'C' is obtained.

[**Hint. :** A is NO and Ostwald process for the manufacture of HNO_3].

LearnGuide.in

9. Give reason for each of the following :

   (a) NH_3 is more basic than PH_3.

   (b) Ammonia is a good complexing agent.

   (c) Bleaching by SO_2 is temporary.

   (d) PCl_5 is ionic in solid state.

   (e) Sulphur in vapour state exhibits paramagnetism.

10. Knowing the electrons gain enthalpy value for $O \rightarrow O-$ and $O^- \rightarrow O^{2-}$ as -141 and 720 kJ mol^{-1} respectively, how can you account for the formation of large number of oxides having O^{2-} species and not O^-?

    [**Hint :** Latlice enthalpy of formation of oxides having O^{2-} more than compensates the second $\Delta_{eg}H$ of oxygen.

Chapter - 8

d – AND f – BLOCK ELEMENTS

VERY SHORT ANSWER TYPE QUESTIONS

(1 - MARK QUESTIONS)

1. Write the electronic configuration of Cr^{3+} ion (atomic number of Cr = 24)?

3. Explain $CuSO_4 . 5H_2O$ is blue while $ZnSO_4$ and $CuSO_4$ are colourless?

4. Why is the third ionisation energy of Manganese (Z = 25) is unexpectedly high?

   [**Hint :** The third electron is to be removed from stable configuration Mn^{2+} ($3d^5$). It requires higher energy.]

5. Which element among 3d– transition elements, exhibit the highest oxidation state?

   [**Hint :** Mn (+7)]

6. Silver (Ag) has completely filled d-orbitals ($4d^{10}$) in its ground state. How can you say that it is a transition element.

7. In 3d series (Sc $\longrightarrow$ Zn), the enthalpy of atomisation of Zn is low. Why?

   [**Hint :** Poor interatomic bonding in zinc.]

8. Out of the following elements, identify the element which does not exhibit variable oxidation state?

   Cr, Co, Zn.

9. The +3 oxidation state of lanthanum (Z = 57), gadolinium (Z = 64) and lutetium (Z = 71) are especially stable. Why?

10. Mention one consequence of Lanthanoid Contraction?

11. The first ionization enthalpies of 5d– series elements is higher than those of 3d and 4d series elements why?

    [**Hint :** Increasing value of effective nuclear charge due to lanthanoid contraction.]

12. Why Mn^{2+} compounds are more stable than Fe^{2+} compounds towards oxidation to their +3 state?

14. Calculate the magnetic moment of Cu^{2+} (Z = 29) on the basis of "spin-only" formula.

   [**Hint :** $\mu = \sqrt{n(n+2)}$ B.M.]

15. What is the shape of chromate ions?

   [**Hint :** Tetrahedral]

16. Why does vanadium pentoxide act a catalyst?

   [**Hint :** In V_2O_5, Vanadium shows variable oxidation sates.]

17. What are interstitial compounds?

18. The transition metals and their compounds are known for their catalytic activity. Give two specific reasons to justify the statement.

19. Write the chemical equation for the reaction of thiosulphate ions and alkaline potassium permanganate.

   [**Hint :** $8MnO_4^- + 3S_2O_3^{2-} + H_2O \longrightarrow 8MnO_2 + 2OH^- + 6SO_4^{2-}$].

20. Mention the name and formula of the ore from which potassium dichromate is prepared.

   [**Hint :** $FeCr_2O_4$ (Chromite)].

21. Write the electronic configuration of Lu^{3+} (At. No. = 71).

22. What is the most common oxidation state of actinoids?

23. Write the names of the catalyst used in the :

   (a) Manufacture of sulphuric acid by contact process.

   (b) Manufacture of polythene.

24. Mention the name of the element among lanthanoids known to exhibit +4 oxidation state.

25. Name one ore each of manganese and chromium.

26. Why is Cd^{2+} ion white?

*27. Draw the structure of dichromate anion.

*28. Arrange the following monoxides of transition metals on the basis of decreasing basic character TiO, VO, CrO, FeO.[Hint : TiO > VO > CrO > FeO]

SHORT ANSWER TYPE QUESTIONS
(2 - MARK QUESTIONS)

1. Write the chemical equation, when the yellow colour of aqueous solution of Na_2CrO_4 changes to orange on passing CO_2 gas?

2. The stability of Cu^{2+} (aq) is more than that of Cu+ (aq). Why?

3. Indicate the steps in the preparation of

   (a) $K_2Cr_2O_7$ from Chromite ore.

   (b) $KMnO_4$ from Pyrolusite ore.

4. Give reason for : –

   (a) In permanganate ions, all bonds formed between manganese and oxygen are covalent.

   (b) Permanganate titrations in presence of hydrochloric acid are unsatisfactory.

5. Write complete chemical equations for

   (a) oxidation of Fe^{2+} by $Cr_2O_7^{2-}$ in acidic medium

   (b) oxidation of Mn^{2+} by MnO_4^- in neutral or faintly alkaline medium.

6. (a) Why do transition metals show high melting points?

   (b) Out of Fe and Cu, which one would exhibit higher melting point?

   [**Hint.** (i) Strong interatomic bonding arising from the participation of *ns* and unpaired ($n - 1$) *d*-electrons.

   (ii) Fe has higher melting point due to presence of more unpaired electrons 3*d*-orbitals.

7. Describe giving reason which one of the following pairs has the property indicated :
   (a) Cr^{2+} or Fe^{2+} (stronger reducing agent).
   (b) Co^{2+} or Ni^{2+} (lower magnetic moments).

8. Of the ions Co^{2+}, Sc^{3+}, Cr^{3+} which one will give colourless aqueous solution and how will each of them respond to magnetic field and why?

   [**Hint :** Co^{2+} ($3d^7$); Cr^{3+} ($3d^4$); Sc^{3+} ($3d°$)]

9. Complete the following equations :

   (a) $MnO_2 + KOH + O_2 \longrightarrow$ (b) $Na_2Cr_2O_7 + KCl \longrightarrow$

10. Transition metals show low oxidation states with carbon monoxide.

[Hind : CO is a π acceptor ligand capable of forming a π bond by accepting π electrons from the filled d-orbitals of transition metal and CO also form σ bond by donating σ electrons to transition metal orbital.

11. For the first row transition metals the enthalpy of atomisation value 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	26

Assign reason for the following :

(a) Transition elements have higher values of enthalpies of atomisation.

(b) The enthalpy of atomisation of zinc is the lowest in 3d - series.

12. Account for the following :

(a) Copper shows its inability to liberate hydrogen gas from the dilute acids.

(b) Scandium (Z = 21) does not exhibit variable oxidation states.

13. Copper (I) compounds undergo disproportionation. Write the chemical equation for the reaction involved and give reason.

14. Iron (III) catalyses the reaction :

$$2I^- + S_2O_8^{2-} \xrightarrow{\ Fe^{3+}\ } I_2 + 2SO_4^{2-}$$
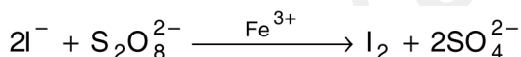
15. Complete the equations :

(a) $MnO_4^- + NO_2^- + H^+ \longrightarrow$

(b) $KMnO_4 \xrightarrow{\ 513\ k\ }$

16. The following two reactions of MNO_3 with Zn are given.

(a) $Zn + conc.\ HNO_3 \longrightarrow Zn(NO_3)_2 + X + H_2O$

(b) $Zn + dil.HNO_3 \longrightarrow Zn(NO_3)_2 + Y + H_2O$
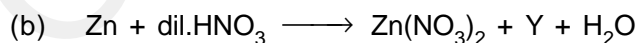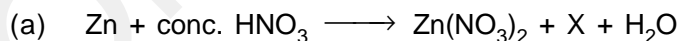
Identify X and Y and write balanced equations.

[**Hint :** X is NO_2 and Y is N_2O].

17. 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].

18. Account for the following :

(a) Transition metals and majority of their compounds act as good catalysts.

(b) From element to element, actionoid contraction is greater than lanthanoid contraction

19. 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].]

20. Calculate the number of moles of KM_nO_4 that is needed to react completely with one mole of sulphite ion in acidic medium.

[**Hint :** 2/5 moles].

SHORT ANSWER TYPE QUESTIONS (3 - MARK QUESTIONS)

1. Account for the following :
   (a) $La(OH)_3$ is more basic than $Lu(OH)_3$
   (b) Zn^{2+} salts are white.

   (c) Cu(I) compounds are unstable in aqueous solution and undergo disproportination.

2. Describe the oxidising action of potassium dichromate with following. Write ionic equations for its reaction with.
   (a) Iodide ion   (b) Iron (II)   (c) H_2S.

3. (a) Deduce the number of 3d electrons in the following ions : Fe^{3+}, Cu^{2+} and Sc^{3+}.
   (b) Why do transition metals form alloys.
   (c) Write any two characteristics of interstitial compounds.

*4. In the following reaction, Mn(VI) changes to Mn(VII) and Mn(IV) in acidic solution.

$$3Mn^{VI}O_4^{2-} + 4H+ \longrightarrow 2Mn^{VII}O_4^- + Mn^{IV}O_2 + 2H_2O$$

(a) Explain why Mn(VI) changes to Mn(VII) and Mn(IV).

(b) What special name is given to such type of reactions?

5. What happens when

    (a) thiosulphate ions react with alkaline $KMnO_4$.

    (b) ferrous oxalate reacts with acidified $KMnO_4$.

    (c) sulphurous acid reacts with acidified $KMnO_4$

    Write the chemical equations for the reactions involved.

7. Name the catalysts used in the

    (a) manufacture of ammonia by Haber's Process

    (b) oxidation of ethyne to ethanol

    (c) photographic industry.

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

[**Hint :** Among these halides the transition metal ion having maximum number of unpaired electrons will be drawn strongly into the magnetic field.

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

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

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

9. Complete the following equations

    (a) $MnO_4^{2-} + H^+ \longrightarrow$ .... + ...+ ....

    (b) $KMnO_4 \xrightarrow{\text{Heat}}$

    (c) $H^+ + MnO_4^- + Fe^{2+} + C_2O_4^{2-} \longrightarrow$

10. How do you account for the following?

    (a) With the same d-orbital configuration (d^4), Cr^{2+} is a reducing agent while Mn^{3+} is an oxidiising agent.

    (b) The actinoids exhibit a larger number of oxidation states than the corresponding members in the lanthanoid series.

    (c) Most of transition metal ions exhibit characteristic colours in aqueous solutions.

LONG ANSWER TYPE QUESTIONS (5 - MARK QUESTIONS)

1. A green compound 'A' on fusion with NaOH in presence of air forms yellow compound 'B' which on acidification with dilute acid, gives orange solution of compound 'C'. The orange solution when reacted with equimolar ammonuim salt gives compound 'D' which when heated liberates nitrogen gas and compound 'A'. Identify compounds A to D and write the chemical equation of the reactions involved.

   [**Hint :** 'A' = CrO_3; 'B' = Na_2CrO_4; 'C' = $Na_2Cr_2O_7$ 'D' = $(NH_4)_2 Cr_2O_7$

2. Assign reasons for the following :

   (a) There is no regular trends in E° values of M^{2+}/M systems in 3d series.

   (b) There is gradual decrease in the ionic radii of M^{2+} ion in 3d series.

   (c) Majority of transition metals form complexes.

   (d) Ce^{3+} can be easily oxidised to Ce^{4+}

   (e) Tantalum and palladium metals are used to electroplate coinage metals.

3. Account for the following :

   (a) Actinoids display a variety of oxidation states.

   (b) Yb^{2+} behaves as a good reductant.

   (c) Cerium (iv) is a good analytical reagent.

   (d) Transition metal fluorides are ionic in nature while chlorides and bromides are covalent in nature.

   (e) Hydrochloric acid attacks all the actinoids.

*4. Explain by giving suitable reason :

   (a) Co(II) is stable in aqueous solution but in the presence of complexing agent it is readily oxidised.

   (b) Eu^{2+}, Yb^{2+} are good reductants whereas Tb^{4+} is an oxidant.

   (c) AgCl dissolves in ammonia solution

   (d) Out of Cr^{2+} or Fe^{2+}, which one is a stronger reducing agent?

   (e) The highest oxidation state is exhibited in oxoanions of a transition metal.

5. When a white crystalline compound A is heated with $K_2Cr_2O_7$ and conc. H_2SO_4, a reddish brown gas B is evolved, which gives a yellow coloured solution C when passed through NaOH. On adding CH_3COOH and $(CH_3COO)_2$ Pb to solution C, a yellow coloured ppt. D is obtained. Also on heating A with NaOH and passing the evolved gas through K_2HgI_4 solution, a reddish brown precipitate E is formed.

Identify A, B, C, D and E and write the chemical equations for the reactions involved.

[Hint : (A) NH_4Cl,   (B) CrO_2Cl_2 (g),   (C) Na_2CrO_4

(D) $PbCrO_4$, (E) $NH_2\begin{cases} HgO \\ HgI \end{cases}$]
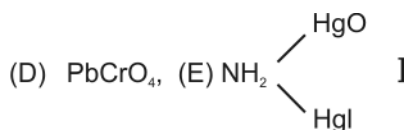
*6. (a) Describe the preparation of potassium dichromate ($K_2Cr_2O_7$). Write the chemical equations of the reactions involved.

(b) "The chromates and dichromates are interconvertible by the change in pH of medium." Why? Give chemical equations in favour of your answer.

7. Explain giving reasons :

(a) Transition metals are less reactive than the alkali metals and alkaline earth metals.

(b) $E^{\varnothing}_{Cu^{2+}/Cu}$ has positive value

(c) Elements in the middle of transition series have higher melting points.

(d) The decrease in atomic size of transition elements in a series is very small.

8. (a) Compare the chemistry of the actinoids with that of lanthanoids with reference to—

(i) electronic configuration

(ii) oxidation states

(iii) chemical reactivity.

(b) How would you account for the following :

  (i) of the d^4 species, Cr^{2+} is strongly reducing while Mn^{3+} is strongly oxidising.

  (ii) the lowest oxide of a transition metal is basic whereas highest is amphoteric or acidic.

9. (a) What is meant by disproportionation of an oxidation state. Give one example.

  (b) Explain why europium (II) is more stable than Ce(II)?

  [**Hint :** (a) When particular state becomes less stable relative to other oxidation states, one lower and one higher, it is said to undergo disproportionation, for example,

$$\overset{VI}{3MnO_4^{2-}} + 4\overset{+}{H} \longrightarrow \overset{VII}{2MnO_4^-} + \overset{IV}{MnO_2} + 2H_2O$$
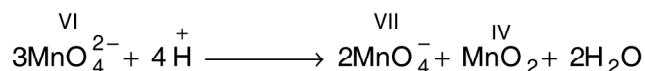
  (b) Eu (II)= [Xe] $4f^7$ $5d^0$ (4f subshell is half filled)

  Ce (II)= [Xe] $4f^1$ $5d^0$ (5d Subshell is empty and 4f subshell has only one electron which can be easily lost.)]

10. (a) For M^{2+}/M and M^{3+}/M^{2+} systems, the E^θ values for some metals are as follows :

  $Cr^{2+}/Cr = -0.9V$ and $Cr^{3+}/Cr^{2+} = -0.4V$

  $Mn^{2+}/Mn = -1.2$ V and $Mn^{3+}/Mn^{2+} = +1.5V$

  $Fe^{2+}/Fe = -0.4V$ and $Fe^{3+}/Fe^{2+} = +0.8V$

  Use this data to comment upon :

  (i) the stability of Fe^{3+} in acid solution as compared to that of Cr^{3+} and Mn^{3+}

  (ii) the ease with which iron can be oxidised as compared to a similar process for either chromium or manganese.

  (b) How is the variability in oxidation states of transition metals different from that of the non-transition metals? Illustrate with examples.

Chapter - 9

CO-ORDINATION COMPOUNDS

QUESTIONS

VSA QUESTIONS (1 - MARK QUESTIONS)

1. Define the term coordination compound?

2. Write the names of counter ions in

   (i) Hg [Co (SCN)$_4$] and (ii) [Pt(NH$_3$)$_4$] Cl$_2$.

3. Write the oxidation state of nickel in [Ni(CO)$_4$]

*4. What is the coordination number of central atom in [Co(C$_2$O$_4$)$_3$]$^{3-}$?

[**Ans. :** 6]

5. What is the coordination number of iron in [Fe (EDTA)]$^-$?   [**Ans. :** 6]

6. Write the name of a complex compound used in chemotherapy.

[**Ans. :** Cis–Platin. [Pt(NH$_3$)$_2$ Cl$_2$]

7. Name the compound used to estimate the hardness of water volumetrically.

8. Give the IUPAC name of [Pt Cl$_2$ (NH$_2$CH$_3$) (NH$_3$)$_2$] Cl.

*9. How many geometrical isomers are possible for the tetrahedral complex [Ni(CO)$_4$].

   [**Ans. :** No isomer, as the relative positions of the unidentate ligands attached to the central metal atom are same with respect to each other].

10. 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

11. Arrange the following ligands in increasing order of Δ_o (Crystal field splitting energy) for octahedral complexes with a particular metal ion.

    Cl^-, NH$_3$, I$^-$, CO, en.

12. Write I.U.P.A.C. name of Tollens' reagent.

13. Which is more stable? $K_3[Fe(CN)_6]$ or $K_4[Fe(CN)_6]$

14. Calculate the overall dissociation equilibrium constant for the $[Cu(NH_3)_4]^{2+}$ ion. Given that overall stability constant (β_4) for this complex is 2.1×10^{13}.

[**Ans. :** 4.7×10^{-14}]

*15. What is a chelate ligand? Give one example.

16. Write the I.U.P.A.C. name of $Li[AlH_4]$.

17. Name one homogeneous catalyst used in hydrogenation of alkenes.

*18. Name the types of isomerism shown by coordination entity : $[CrCl_2(Ox)_2]^{3-}$

*19. $[Ti(H_2O)_6]Cl_3$ is coloured but on heating becomes colourless. Why?

*20. Write the IUPAC name of ionization isomer of $[Co(NH_3)_5(SO_4)]$ Br

*21. 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, diammine) chromium (III) hexacyanocobaltate (III)]

SA(I) TYPE QUESTIONS (2 - MARK QUESTIONS)

*22. Write two differences between a double salt and a coordination compound with the help of an example of each.

23. Mention the main postulates of Werner's Theory.

24. Define (a) Homoleptic and (b) Heteroleptic complexes with the help of one example of each.

25. In the following coordination entity : $[Cu(en)_2]^{2+}$

   (a) Identify the ligand involved and

   (b) Oxidation state of copper metal.

27. Calculate the magnetic moments of the following complexes :

   (i) $[Fe(CN)_6]^{4-}$ (ii) $[CoF_6]^{3-}$

28. Explain the following :

   (a) $[Fe(CN)_6]^{3-}$ is an inner orbital complex whereas $[FeF_6]^{3-}$ is an outer orbital complex.

   (b) NH_3 acts as complexing agent but NH_4^+ does not.

LearnGuide.in

29. What type of structural isomerism is represented by the following complexes:

   (a) $[Mn(CO)_5(SCN)]$ and $[Mn(CO)_5(NCS)]$

   (b) $[Co(NH_3)_5(NO_3)]$ SO_4
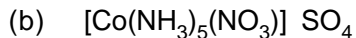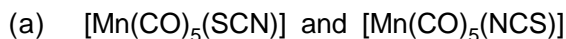
30. How are complex compounds applicable in (a) electroplating of silver, gold or other noble metals (b) in photography.

31. Explain on the basis of Valance Bond Theory that diamagnetic $[Ni(CN)_4]^{2-}$ has square planar structure and paramagnetic $[NiCl_4]^{2-}$ ion has tetrahedal geometry.

23. 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).

34. Draw the structures of geometrical isomers of the coordination complexes– $[Co(NH_3)_3Cl_3]$ and $[CoCl_2(en)_2]^+$

35. Write the IUPAC name of the complexes :

   (a) $[NiCl_2 (PPh_3)_2]$ (b) $[Co(NH_3)_4 Cl(NO_2)]$ Cl

   (c) $K[Cr(H_2O)_2 (C_2O_4)_2]$
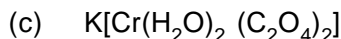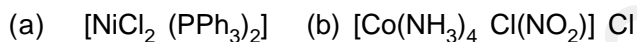
   [**Hint. :**   (a) Dichloridobis(triphenylphosphine)nickel (II);

36. Using IUPAC norms write the formulae for the following :

   (a) Terabromidocuprate (II)

   (b) Pentaamminenitrito–O– Cobalt (III)

*37. How does EDTA help as a cure for lead poisoning?

   [**Ans. :** Calcium in Ca–EDTA complex is replaced by lead in the body. The more soluble complex lead-EDTA is eliminated in urine].

37. 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°C. What is the formula of the complex?

   K_f of water = 1.86°C/m

   [**Hint :** $\Delta T_f = i\, K_f \times m = i \times 1.86 \times 0.1$

   $\Delta T_f(obs) = 0.373°C$

   This means each molecule of complex dissociates into two ions. Hence the formula is i = 2

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

SA (II) TYPE QUESTIONS (3 - MARK QUESTIONS)

39. Account for the following —

   (i) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral.

   (ii) $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Ni(NH_3)_6]^{2+}$ weakly paramagnetic.

   (iii) $[Co(NH_3)_6]^{3+}$ is an inner orbital complex whereas $[Ni(MH_3)_6]^{2+}$ is in outer orbital complex.

40. Compare the following complexes with respect to their shape, magnetic behaviours and the hybrid orbitals involved.

   (a) $[CoF_6]^{3-}$

   (b) $[Cr(NH_3)_6]^{3+}$

   (c) $[Fe(CN)_6]^{4-}$

   [Atomic Number : Co = 27, Cr = 24, Fe = 26]

41. Draw the structure of

   (a)   cis-dichloridotetracyanochromate (II) ion

   (b)   mer-triamminetrichloridocobalt (III)

   (c)   fac-triaquatrinitrito–N–cobalt (III)

42. Name the central metal atom/ion present in (a) Chlorophyll (b) Haemoglobin (c) Vitamin B-12.   [**Ans. :** (a) Mg (b) Fe; (c) Co.]

43. A metal complex having composition $Cr(NH_3)_4 Cl_2Br$ has been isolated in two forms 'A' and 'B'. The form 'A' reacts with $AgNO_3$ solution to give white precipitate which is readily soluble in dilute aqueous ammonia, whereas 'B' gives a pale yellow precipitate which is soluble in concentrated ammonia solution. Write the formula of 'A' and 'B'. Also mention the isomerism which arises among 'A' and 'B'.

   [**Hint :** A = $[Cr(NH_3)_4 BrCl]$ Cl; B = $[Cr(NH_3)_4Cl_2]$ Br are ionisation isomers].

44. Write the limitations of Valence Bond Theory.

45. Draw a sketch to show the splitting of d-orbitals in an octahedral crystal field state for a d^4 ion. How the actual electronic configuration of the split

4

d-orbitals in an octahedral crystal field is decided by the relative values of Δ_0 and pairing energy (P)?

*46. For the complex $[Fe(en)_2Cl_2]Cl$ identify

   (a)   the oxidation number of iron.

   (b)   the hybrid orbitals and the shape of the complex.

   (c)   the magnetic behaviour of the complex.

   (d)   the number of geometrical isomers.

   (e)   whether there is an optical isomer also?

   (f)   name of the complex. [At. no. of Fe = 26]

48. A chloride of fourth group cation in qualitative analysis gives a green coloured complex [A] in aqueous solution which when 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 to violet [D]. Identify [A], [B], [C] and [D] complexes,

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

   [C] = $[Ni(H_2O)_2 (en)_2]^{2+}$;   [D] = $[Ni(en)_3]^{2+}$.

Chapter - 10

HALOALKANES AND HALOARENES

1. Write the IUPAC names of the following compounds.

(i)

$$CH_3—\overset{\overset{\displaystyle Br}{|}}{C}—CH_2CH_3$$
$$\underset{CH_2CH_2CH_3}{|}$$

(ii)

$$\underset{CH_3}{\overset{CH_3}{\diagdown}}C=C\overset{\diagup CH_3}{\diagdown CH_2Br}$$

(iii)

CH_2Cl attached to benzene ring

(iv)

$$CH_3(CH_2)_2—C(CH_3)_2 \ \overset{\overset{\displaystyle CH_2Br}{|}}{C}HCH_2CH_3$$

(v) $CH_2Br – CH = CH – CH_2 – C \equiv CH$

(vi)

H_3C and Br on cyclohexane ring

(vii)

$$CH_3—\overset{\overset{\displaystyle OH}{|}}{C}H—\overset{|}{C}H—\overset{\overset{\displaystyle OH}{|}}{C}H—CH_3$$
$$\underset{\underset{\displaystyle H_3C}{|}}{H\overset{|}{C}—CH_3}$$

(ix) $(CCl_3)_3 \ CCl$
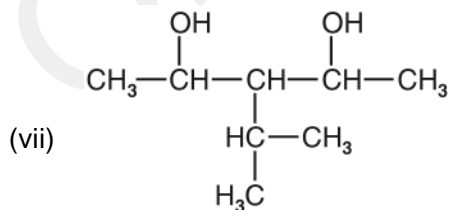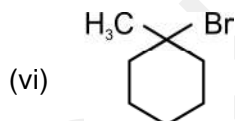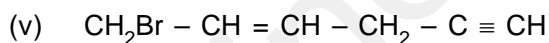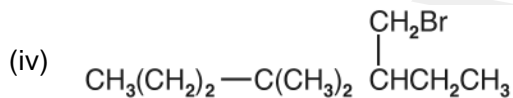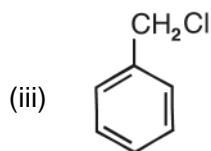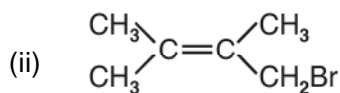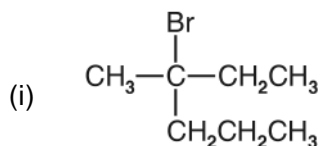
2. Write the structure of following halogen compounds

   (i) 2-chloro-3-methylpentane

   (ii) 2-(2-chlorophenyl)-1-iodooctane

   (iii) 1-bromo-4-sec-butyl-2–methylebenzene.

   (iv) p-bromotoluene.

   (v) chlorophenylmethane

3. Arrange the following in the increasing order of properly indicated :

   (i) bromomethane, chloromethane, dichloromethane. (Increasing order of boiling points).

   (ii) 1-chloropropane, isopropyl chloride, 1-chlorobutane (Increasing order of boiling point)

   (iii) dichloromethane, chloroform, carbon terachloride. (Increasing order of dipole moment.

   (iv) CH_3F, CH_3Cl, CH_3Br, CH_3I (Increasing reactivity towards nucleophilic substitution and increasing order of dipole moment)

   (v) *o,m.p*-dichlorobenzenes (Increasing order of melting points).

4. Complete the following reactions :

   (i) $-CH = CH_2 + HBr \longrightarrow$

   (ii) $CH_3 - CH_2 - Cl + Ag\ NO_2 \longrightarrow$

   (iii) $+ HBr \xrightarrow{\text{peroxide}}$

   (iv) $\xrightarrow{\text{NaOH (aq)}}$

2

(v)

$$\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3 \xrightarrow[\text{uv light}]{\text{Br}_2/\text{heat}}$$

(vi)

$$+ \text{ HI} \longrightarrow$$

(vii)

$$+ \text{ SOCl}_2 \longrightarrow$$

(viii) $\quad \text{CH}_3\text{CH}_2\text{Br} + \text{NaI} \xrightarrow{\text{acetone}}$

(ix)

$$+ \quad \text{Br}_2 \xrightarrow{UV \text{ light}}$$

(x) $\quad (\text{CH}_3)_3\,\text{CBr} + \text{KOH} \xrightarrow[\text{heat}]{\text{ethanol}}$

(xi) $\quad \text{CH}_3\text{CH}_2\text{Br} + \text{KCN} \xrightarrow{aq.\ \text{EtOH}}$

(xii)

$$+ \quad \text{Mg} \xrightarrow[\text{Ether}]{\text{dry}}$$

(xiii) $\quad \text{C}_6\text{H}_5\text{ONa} + \text{C}_2\text{H}_5\text{Cl} \longrightarrow$

(xiv) $\quad \overset{\overset{\displaystyle \text{Br}}{|}}{\text{CH}_3-\text{CH}}-\text{CH}_2-\text{CH}_3 + \text{Na} \xrightarrow{\text{dry ether}}$

(xv) $\quad \overset{\overset{\displaystyle \text{Br}}{|}}{\text{CH}_3\text{CH}}-\text{CH}_2-\text{CH}_3 + \text{NaOH (aq)} \longrightarrow$

(xvi) $\quad \text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- + \text{KI} \longrightarrow$
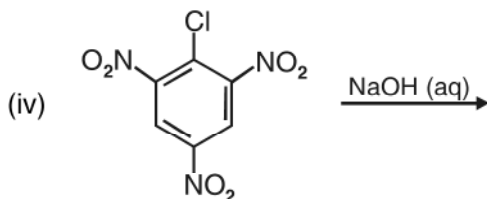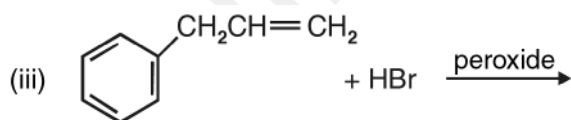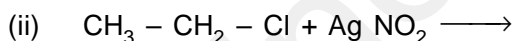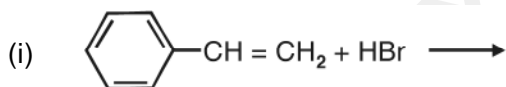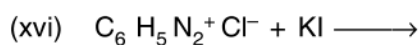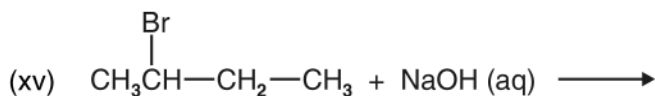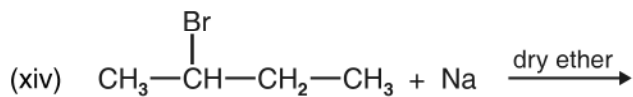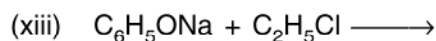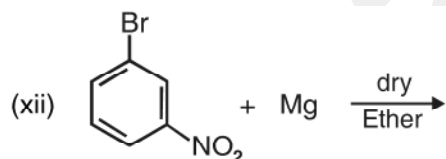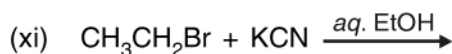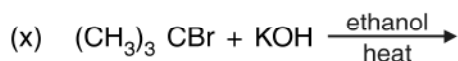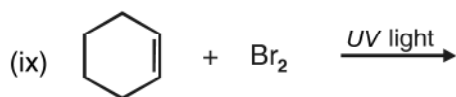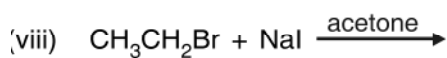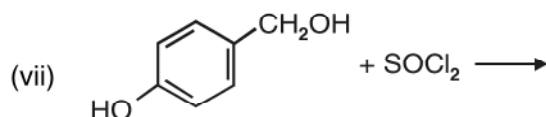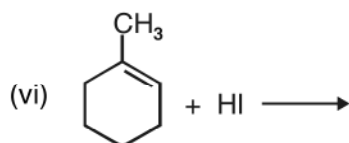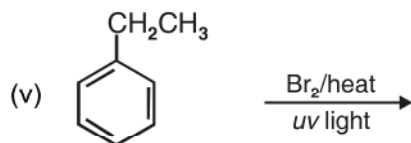
5.   How will you bring about the following conversions?

   (i)   benzene to 3-bromonitrobenzene

   (ii)   ethanol to but-1-yne

   (iii)   1-bromopropane to 2-bromopropane

   (iv)   benzene to 4-bromo-1-nitrobenzene

   (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)   benzene to phenylchloromethane.

   (x)   tert-butyl bromide to isobutyl bromide.

6.   Identify the products formed in the following sequence :

   (i)

   (ii)

   (iii) $C_6H_5CH_2CHBrCH_3 \xrightarrow{\text{alc. KOH}} A \xrightarrow{\text{HBr}} B$

   (iv) $CH_3\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{\text{alc. KOH}} X \xrightarrow[\text{H}_2\text{O}_2]{\text{HBr}} Y$

   (v) $CH_3CH_2CH = CH_2 + Br_2 \xrightarrow{\text{CCl}_4} A$

   (vi) $CH_3CH_2CH = CH_2 + Br_2 \xrightarrow[\text{UV light}]{\text{heat}} B$

   (vii)

4

(viii) $CH_3Br \xrightarrow{KCN} A \xrightarrow{H_3O^+} \xrightarrow[ether]{Li\,Al\,H_4}$
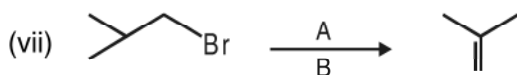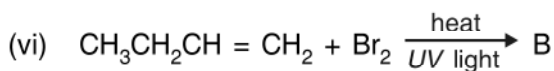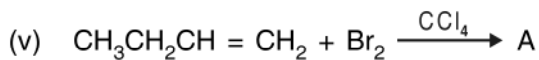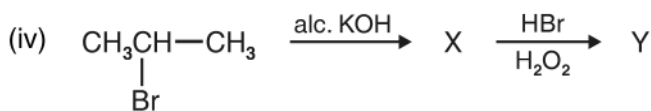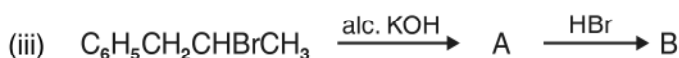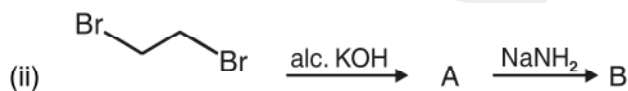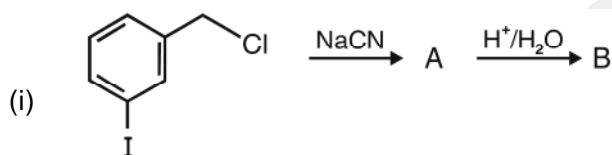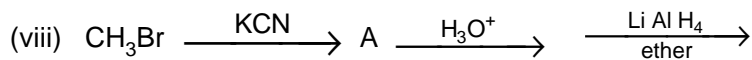
7. Explain the following reactions with suitable example :

    (i)   Finkelstein reaction.

    (ii) Swarts reaction.

    (iii) Wurtz reaction.

    (iv) Wurtz-Fitting reaction

    (v)   Friedel-Craft's alkylation reaction.

    (vi) Friedel-Craft's acylation reaction

    (vii) Sandmeyer reaction.

8. Write the major products and name the rule responsible for the formation of the product.

    (i) CH_3—CH_2—$\underset{\underset{Br}{|}}{CH}$—$CH_3$ $\xrightarrow{\frac{KOH}{EtOH}}$

    (ii) CH_3—CH_2—$CH = CH_2$ + HBr $\xrightarrow{\substack{organic \\ peroxide}}$
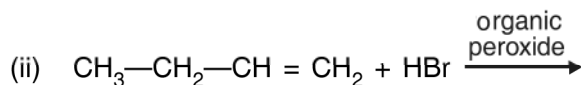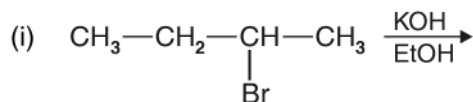
9. Write the difference between

    (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) vinyl chloride and ethyl chloride.

    (iii) n-propyl bromide and isopropyl bromide.

11. Give mechanism of the following reactions :

    (i) $(CH_3)_3C - Cl + \bar{O}H \longrightarrow (CH_3)_3\,C - OH$

    (ii) $CH_3 - Cl + OH^- \longrightarrow CH_3 - OH$

LearnGuide.in

(iii) $CH_3-\underset{\underset{\displaystyle CH_3}{|}}{CH}-Cl + OH^- \xrightarrow{\text{ethanol}} CH_3-CH=CH_2$

(iv) $+ Cl_2 \xrightarrow[\text{dark}]{\text{FeCl}_3}$

(v) $+$ NaOH $\xrightarrow[\text{pressure}]{\text{high temp.}}$
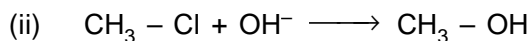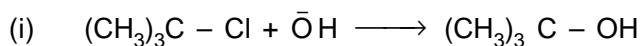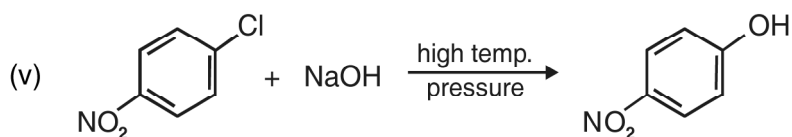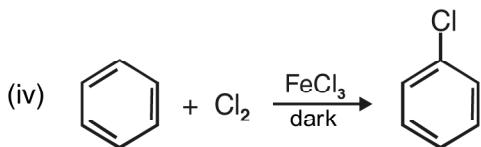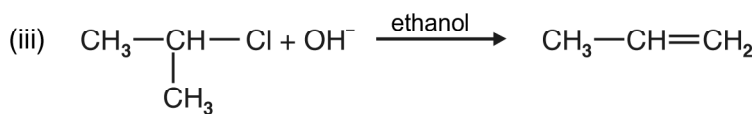
12. Which compound in each of the following pairs will react faster in S_N2 reaction with OH^- and why?

(i) CH_3Br or CH_3I

(ii) $(CH_3)_3$ CCl or CH_3Cl
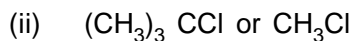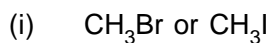
13. In the following pairs which halogen compound undergoes faster SN1 reaction?

(i) and

(ii) and

(iii) $(CH_3)_3C - Cl$ and $C_6H_5CH_2Cl$

(iv) $C_6H_5CH_2Cl$ and $C_6H_5C(Cl)C_6H_5$

(v) $CH_2 = CH - Cl$ and $CH_2 = CH - CH_2Cl$
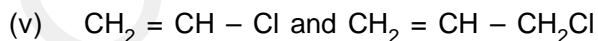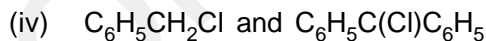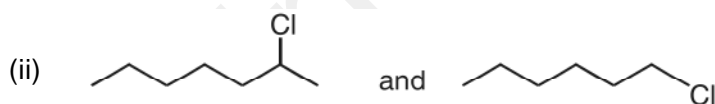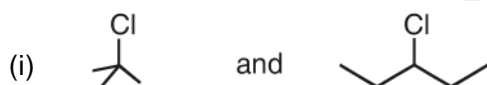
14. Give reasons for the following :

(i) The bond length of C–Cl bond is larger in haloalkanes than that in haloarenes.

(ii) Although alkyl halides are polar in nature but are not soluble in water.

(iii) tert-butyl bromide has lower boiling point than n-Butyl bromide.

(iv) haloalkanes react with KCN to form alkyl cyanide as main product while with AgCN alkyl isocyanide is the main product.

(v) sulphuric acid is not used in the reaction 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) chlorobenzene on reaction with fuming sulphuric acid gives ortho and para chlorosulphonic acids.

(ix) 2, 4-dinitro chlorobenzene is much more reactive than chlorobenzene towards hydrolysis reaction with NaOH.

(x) Grignard reagent should be prepared under anhydrous conditions.

(xi) the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.

(xii) neopentyl bromide undergoes nucleophilic substitution reactions very slowly

(xiii) vinyl chloride is unreactive in nucleophilic substitution reaction.

(xiv) An optically inactive product is obtained after the hydrolysis of optically active 2- bromobutane.

[**Hint :** The hydrolysis reaction occurs by S_N1 pathway. The carbocation is formed first which gives a mixture of ($\pm$) butan-2-ol in the second step].
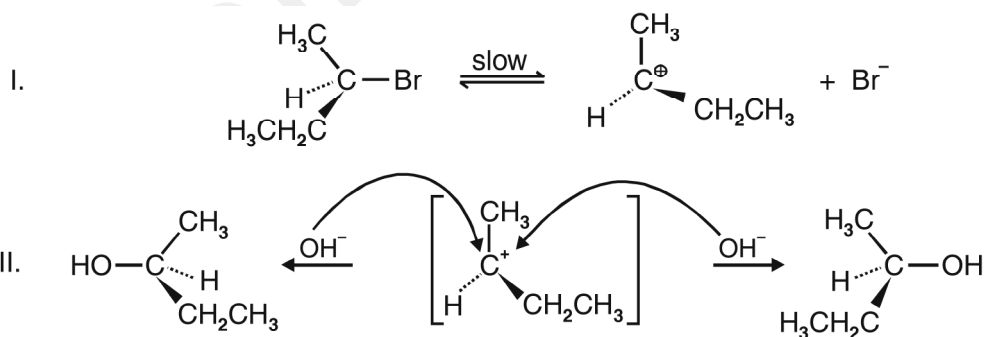
(xv) methyl iodide is hydrolysed at faster rate than methyl chloride.

15. Write the different products and their number formed by the monochlorination of following compounds :

(i) $CH_3CH_2CH_2CH_3$

(ii) $(CH_3)_2CHCH_2CH_3$

(iii) $(CH_3)_2CHCH(CH_3)_2$
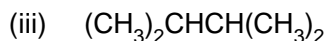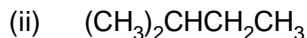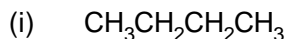
[**Hint :** (i) Two, (ii) four, (iii) three

16. (a) When 3-methylbutan-2-ol is treated with HBr, the following reaction takes places :

$$CH_3-\underset{\underset{CH_3}{|}}{CH}-\underset{\underset{OH}{|}}{CH}-CH_3 \xrightarrow{\ HBr\ } CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{Br}{|}}{C}}-CH_2-CH_3$$

Give the mechanism for this reaction.

(b) In the following reaction :

$$H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH=CH_2 \xrightarrow{\ H_2O/H^+\ }$$
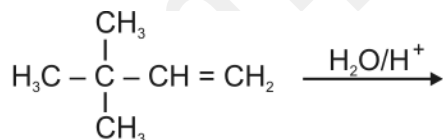
major and minor products are :

(i) $CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\underset{\underset{OH}{|}}{CH}-CH_3$

(ii) $\underset{\underset{OH}{|}}{CH_2}-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-CH_3$

(iii) $CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-\underset{\underset{CH_3}{|}}{CH}-CH_3$

(iv) $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2\,OH$
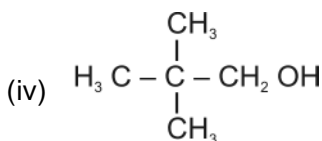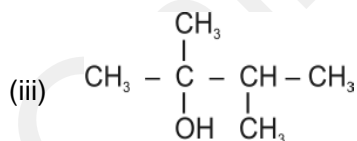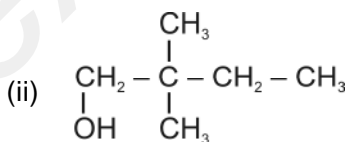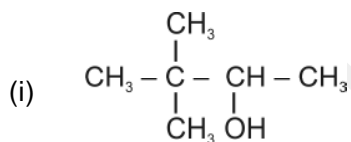
Ans. Major (iii) minor (i)

17. Give one use of each of following :

(i) Freon-12   (ii) DDT

(iii) Carbon tetrachloride   (iv) Iodoform

8

18. 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.

[**Ans.** : (i)

$$C_2H_5-\underset{\underset{C_3H_7}{|}}{\overset{\overset{CH_3}{|}}{C}}-Br \xrightarrow{-Br^-} \underset{H_5C_2 \quad C_3H_7}{\overset{\overset{CH_3}{|}}{C+}} \qquad (Slow)$$

Carbocation

(ii) $HO-\underset{\underset{C_3H_7}{|}}{\overset{\overset{CH_3}{|}}{C}}-C_2H_5 \xleftarrow{OH^-} \underset{H_5C_2 \quad C_3H_7}{\overset{\overset{CH_3}{|}}{C+}} \xrightarrow{OH^-} H_5C_2-\underset{\underset{C_3H_7}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$

product with inversion   product having retention
of configuration   of configuration
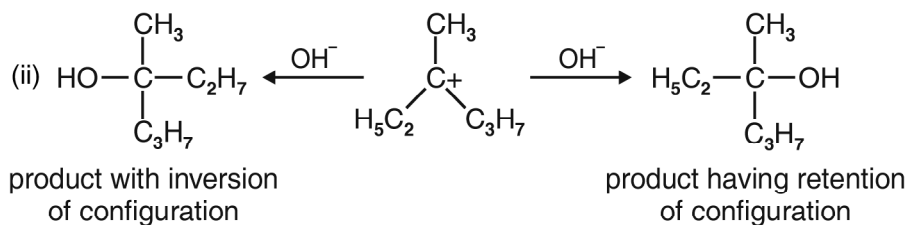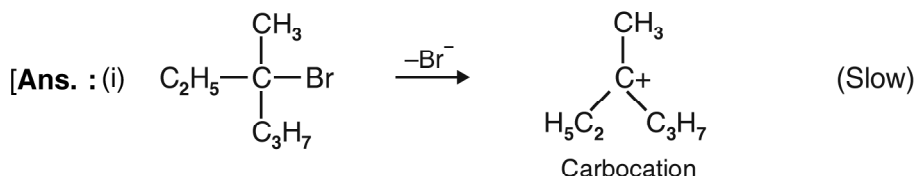
A racemic mixture is obtained which is optically inactive.]

19. An organic compound C_8H_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 in alkaline medium. Benzoic acid, terephthalic and p-bromobenzoic acid were obtained on oxidation of A, B and C respectively. Identify A, B and C.

[**Ans.** : (A) $H_3C-CHBr$ ⬡   (B) CH_2Br ⬡ CH_3 (C) CH_2CH_2 ⬡ Br
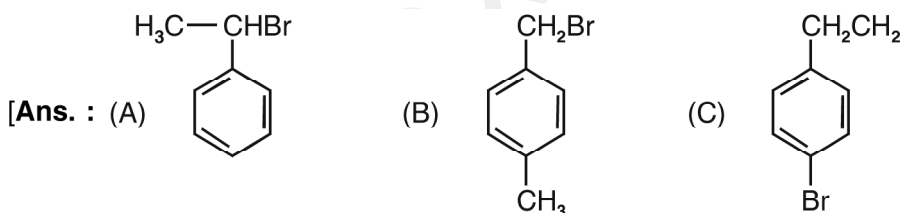
*20. An alkyl halide X having molecular formula $C_6H_{13}Cl$ on treatment with potassium tert-butoxide gives two isomeric alkenes Y and Z but alkene y is symetrical. Both alkenes on hydrogenation give 2, 3-dimethylbutane. Identify X, Y and Z.

[**Ans.**

(X) $CH_3-\underset{\underset{Cl}{|}}{\overset{\overset{CH_3}{|}}{CH}}-\overset{\overset{CH_3}{|}}{C}-CH_3$, (Y) $CH_3-\overset{\overset{CH_3}{|}}{C}=\overset{\overset{CH_3}{|}}{C}-CH_3$, (Z) $CH_3-\overset{\overset{CH_3}{|}}{CH}-\overset{\overset{CH_3}{|}}{C}=CH_2$

9
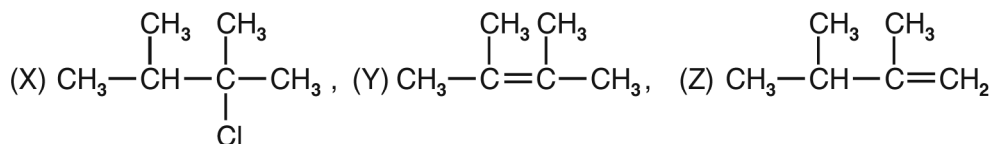
*21. An organic compound (A) having molecular formula C_3H_7Cl on reaction with alcoholic solution of KCN gives compound B. The compound B on hydrolysis with dilute HCl gives compound C. C on reduction with H_2/ Ni gives 1-aminobutane. Identify A, B and C.

[**Ans. :** (A) $CH_3CH_2CH_2Cl$, (B) $CH_3CH_2CH_2CN$, (C) $CH_3CH_2CH_2CONH_2$

*22. Identify A, B, C, D, E, R and R´ in the following sequence of reactions :

(a) Br + Mg $\xrightarrow{\text{dry ether}}$ A $\xrightarrow{H_2O}$ B

(b) R — Br + Mg $\xrightarrow{\text{dry ether}}$ C $\xrightarrow{D_2O}$ CH$_3$—CH—CH$_3$
$\underset{\underset{D}{|}}{}$

(c) $\xleftarrow{\text{Na/dry ether}}$ R´X $\xrightarrow{Mg}$ D $\xrightarrow{H_2O}$ E
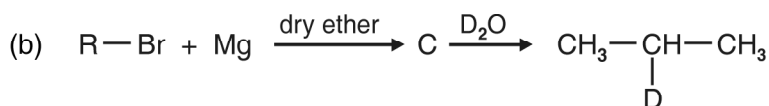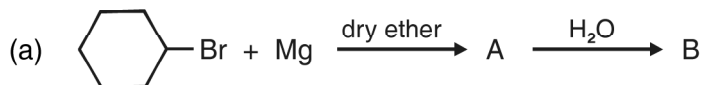
23. Which nomenclature is not occording to IUPAC system.

(i) Br – CH$_2$ CH = CH$_2$; 1–bromoprop-2-ene

(ii) CH$_3$–CH$_2$ – $\underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}}$ – CH$_2$– $\underset{\underset{Br}{|}}{CH}$ – CH$_3$ 4–bromo-2, 4-dimethylhexane

(iii) CH$_3$ – $\underset{\underset{CH_3}{|}}{CH}$ – $\underset{\underset{\text{⬡}}{|}}{CH}$ – CH$_2$CH$_3$, 2–methyl–3–phenylpentane

(iv) CH$_3$ – $\underset{\underset{O}{||}}{C}$ – CH$_2$ CH$_2$–CH$_2$COON, 5–oxohexanoic acid

LearnGuide.in

Chapter - 11

ALCOHOLS, PHENOLS AND ETHERS

1. Write IUPAC names of the following compounds :

(i)
$$CH_3-CH_2-\underset{\underset{CH_2Cl}{|}}{CH}-\underset{\underset{}{|}\, CH_2OH}{CH}-\underset{\underset{CH_3}{|}}{CH}-CH_3$$

(ii)

(iii) $CH \equiv C-CH_2OH$

(iv)

(v)

(vi)

1

(vii)

(viii)

(ix) $C_6H_5OC_3H_7$

(x) $CH_3CH_2OCH_2CH_2CH_2Cl$
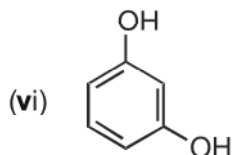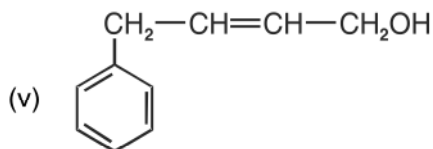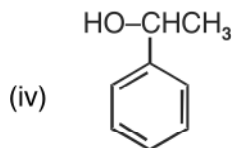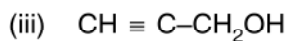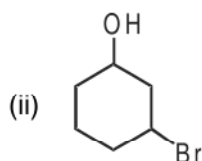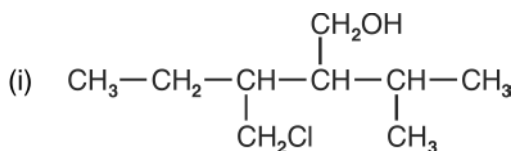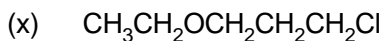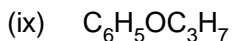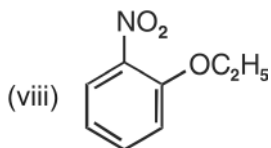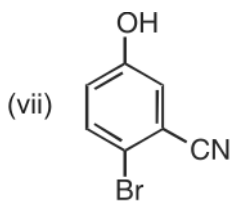
2. Write the structures of the compounds whose names are given below :

   (i) 3, 5-dimethoxyhexane-1, 3, 5-triol

   (ii) cyclohexylmethanol

   (iii) 2-ethoxy-3-methylpentane

   (iv) 3-chloromethylpentan-2-ol

   (v) p-nitroanisole

3. Describe the following reactions with example :

   (i) Hydroboration oxidation of alkenes

   (ii) Acid catalysed dehydration of alcohols at 443K.

   (iii) Williamson synthesis

   (iv) Reimer-Tiemann reaction.

   (v) Kolbe's reaction

   (vi) Friedel-Crafts acylation of Anisole.

4. Complete the following reactions :

   (i) $CH_3CH_2CH_2CHO \xrightarrow{\text{Pd/H}_2}$

   (ii) $CH_3CHO \xrightarrow[\text{(ii) H}^+/\text{H}_2\text{O}]{\text{(i) CH}_3\text{MgBr}}$

(iii) $CH_3CH_2OH \xrightarrow{\text{Cu/573K}}$

(iv) $C_6H_5OH + Br_2 \xrightarrow{H_2O}$

(v)   2-hydroxybenzoic acid (salicylic acid, benzene ring with OH and COOH) $+$ acetic anhydride $\begin{matrix} CH_3CO \\ CH_3CO \end{matrix}\!\!>\!O$ $\xrightarrow{H+}$

(vi)   (benzene ring with ONa and NO₂, i.e. sodium 4-nitrophenoxide) $+ CH_3Br \longrightarrow$

(vii) $CH_3CH_2CH_2O - CH_3 + HBr \longrightarrow$

(viii)   (benzene ring with OC_2H_5, phenetole) $+ HBr \longrightarrow$

(ix) $(CH_3)_3C - O - C_2H_5 + HI \longrightarrow$

(x)   (benzene ring with OCH_3, anisole) $\xrightarrow[\text{conc. } H_2SO_4]{\text{conc. } HNO_3}$

(xi)   (cyclohexanone ring bearing a CH_2COOH substituent) $\xrightarrow{NaBH_4}$

3

(xiii) $CH_3CH_2\underset{\underset{CH_3}{|}}{CH}CHO \xrightarrow{NaBH_4}$

(xiv)

benzene ring with SO_3H $\xrightarrow[\text{(ii) } H^+]{\text{(i) NaOH, }\Delta}$

5. What happens when :

   (i) aluminium reacts with tert-butyl alcohol

   (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-l-ol.

   (ii) anisole to phenol

   (iii) butan-2-one to butan-2-ol

   (iv) ethanal to ethanol

   (v) phenol to ethoxybenzene

   (vi) 1-phenylethene to 1-phenylethanol

   (vii) formaldehyde to cyclohexylmethanol

   (viii) butyl bromide to pentan-1-ol.

   (ix) toluene to benzyl alcohol

   (x) 1-propoxypropane to propyl iodide

   (xi) ethyl bromide to 1-ethoxyethane

   (xii) methyl bromide to 2-methoxy-2-methylpropane

   (xiii) ethyl bromide to ethoxybenzene

   (xiv) ethanol to benzyl ethyl ether.

7. Identify the missing reactant or product A to D in the following equations:

(i) $(A) + HNO_3 + H_2SO_4 \longrightarrow$

(ii)

$+ \text{ dil. } H_2SO_4 \longrightarrow (B)$

(iii) $(C) + H_2O \xrightarrow{H^+} CH_3(CH_2)_2\, C(CH_3)\, (OH)\, (CH_2)_2CH_3$

(vi) $CH_3OC_6H_5 + HI \longrightarrow (D)$
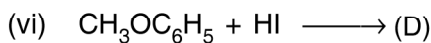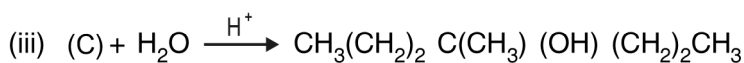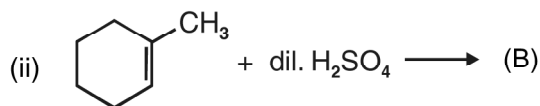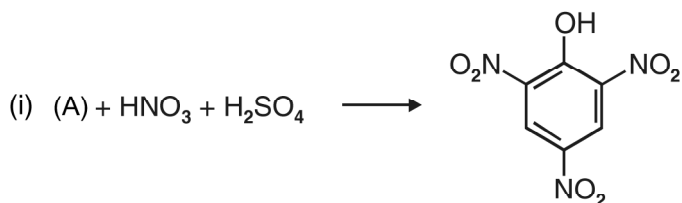
8. Identify X, Y and Z in the following sequence of reactions :

(i) Phenol $\xrightarrow{\text{Zn dust}}$ X $\xrightarrow[\text{Anhyd. } AlCl_3]{CH_3Cl}$ Y $\xrightarrow[OH^-]{KMnO_4}$ Z

(ii) Ethanol $\xrightarrow{PBr_3}$ X $\xrightarrow{\text{alc. KOH}}$ Y $\xrightarrow{\text{dil.}H_2SO_4}$ Z

(iii)

$\xrightarrow{HI}$ X + CH_3I

   X + conc. $HNO_3 \longrightarrow$ Y (a dinitro compound)

   X + Br_2(aq) $\longrightarrow$ Z (a tribromo product)
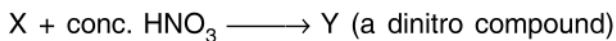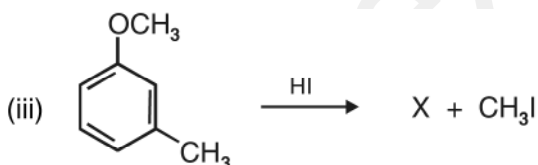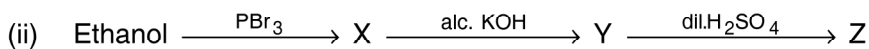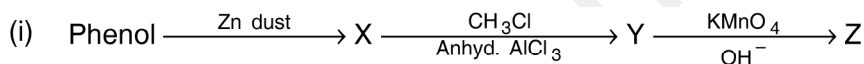
10. Write the mechanism for following reactions :

(i) $+ H_2O \xrightleftharpoons{H^+}$
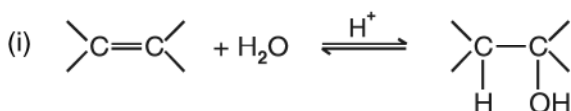
(acid catalysed hydration of alkenes)

(ii)　$CH_3 - CH_2 - OH \xrightarrow[443 \text{ K}]{H^+} CH_2 = CH_2$
(acid catalysed dehydration of alcohols)

(iii)　$2CH_3CH_2OH \xrightarrow[413 \text{ K}]{H^+} CH_3CH_2OCH_2CH_3$
(acid catalysed nucleophilic substitution reaction)

(iv)　$CH_3OCH_3 + HI \longrightarrow CH_3OH + CH_3I$

(v)　$(CH_3)_3C - O - CH_3 + HI \longrightarrow CH_3OH + (CH_3)_3 Cl$

11.　Give reason for the following :

(i)　The C–O–C bond angle in dimethyl ether is (111.7°)

(ii)　Alcohols have higher boiling points than ethers of comparable molecular masses.

(iii)　Phenols are more acidic than alcohols.

(iv)　Nitrophenol is more acidic than o-methoxyphenol.

(v)　Phenol is more reactive towards electrophilic substitution reaction than benzene.

(vii)　The following is not an appropriate method for the preparation of t-butyl ether :

$$C_2H_5ONa + CH_3-\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}-Cl \xrightarrow[-NaCl]{} CH_3-\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}-O-C_2H_5$$

(a)　What would be the major product of this reaction?

(b)　Write suitable reaction for the preparation of t–butyl ethyl ether.

(viii)　The following is not an appropriate method for the preparation of 1-methoxy-4-nitrobenzene;
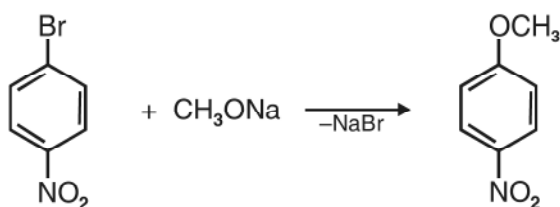
(x)   Write the suitable reaction for the preparation of 1–methoxy–4–nitrobenzene

(ix)   o-nitrophenol is steam volatile but p-nitrophenol is not.

(x)   phenol is less polar than ethanol.

(xi)   The phenyl methyl ether reacts with HI fo form phenol and iodomethane and not iodobenzene and methanol.
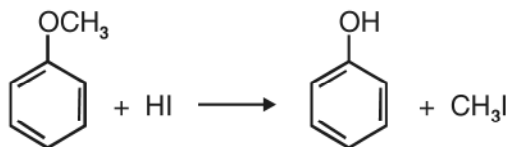
(xii)   methanol is less acidic than water.

(xiii)   alcohols can act as weak base as well as weak acids.

(xiv)   phenols do not give protonation reaction readily.

(xvi)   absolute ethanol can not be obtained by factional distillation of ethanol and water mixture.

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

(i)   methanol, ethanol, diethylether, ethyleneglycol. (Boiling points)

(ii)   phenol, o-nitrophenol, m-nitrophenol, p-nitrophenol. (Acid strength)

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

(iv)   n-butanol, 2-methylpropan-1-ol, 2-methylpropan-2-ol. (Acid strength)

13.   Give a chemical test to distinguish between the following pair of compounds.

(i)   n-propyl alcohol and isopropylalcohol

(ii)   methanol and ethanol

(iii)   cyclohexanol and phenol.

(iv)   propan-2-ol and 2-methylpropan-2-ol.

(v)   phenol and anisole

(vi)   ethanol and diethyl ether

*14.   Which of the following compounds gives fastest reaction with HBr and why?

(i) $(CH_3)_3COH$

(ii) $CH_3CH_2CH_2OH$

OH
|
(iii) CH_3—CH—CH_3

CH_3
|
(iv) CH_3—CH—CH_2OH
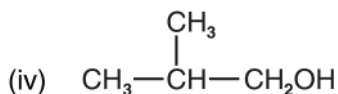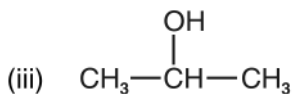
*15. What is the function of $ZnCl_2$ (anhyd) in Lucas test for distinction between 1°, 2° and 3° alcohols.

16. An alcohol A ($C_4H_{10}O$) on oxidation with acidified potassium dichromate gives carboxylic acid B ($C_4H_8O_2$). Compound A when dehydrated with conc. H_2SO_4 at 443 K gives compound C. Treatment of C with aqueous H_2SO_4 gives compound D ($C_4H_{10}O$) 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] : $(CH_3)_2C = CH_2$ [D] : $(CH_3)_3C – OH$

*17. 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 common name of Drug D?
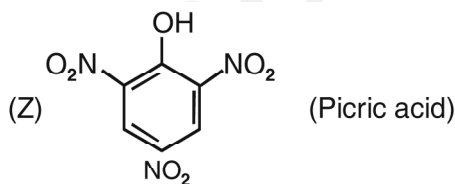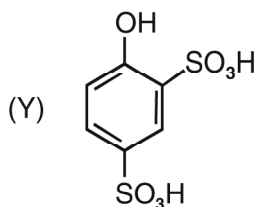
[**Ans. :**

(A)

(B)

(C)

(D)
Aspirin
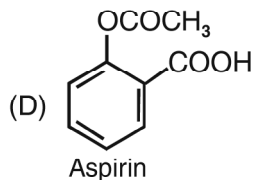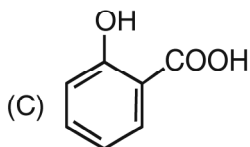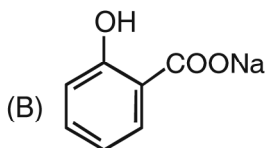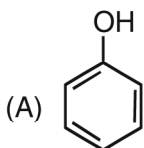
19. An ether A ($C_5H_{12}O$) when heated with excess of hot concentrated HI produced two alkyl halides which on hydrolysis from compounds B and C. Oxidation of B gives an acid D whereas oxidation of C gave a ketone E. Deduce the structures of A, B, C, D and E.
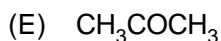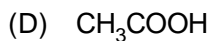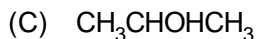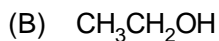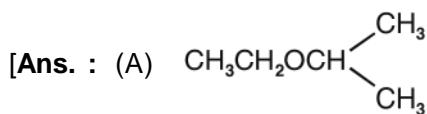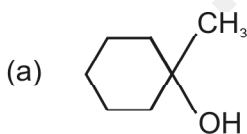
20. Phenol, C_6H_5OH when it first reacts with concentrated sulphuric acid, forms Y.Y is reacted with concentrated nitric acid to form Z. Identify Y and Z and explain why phenol is not converted commercially to Z by reacting it with conc. HNO_3.
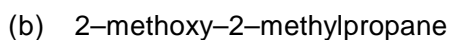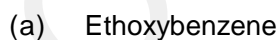
21. Synthesise the following alcohols from suitable alkenes.

(a) [structure: cyclohexane ring with CH_3 and OH on same carbon]

(b) [structure: branched chain with OH]

22. How are the following ethers prepared by williumson synthesis?

(a)   Ethoxybenzene   (b)   2–methoxy–2–methylpropane
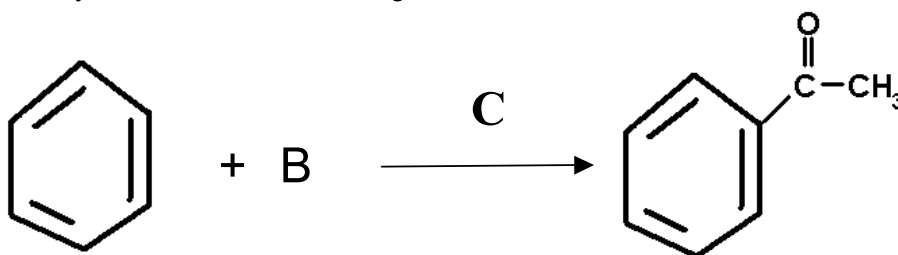
LearnGuide.in

UNIT-12
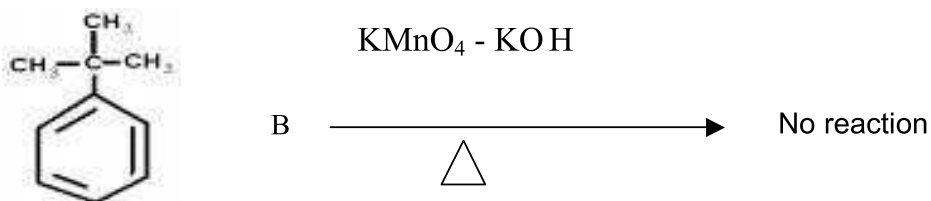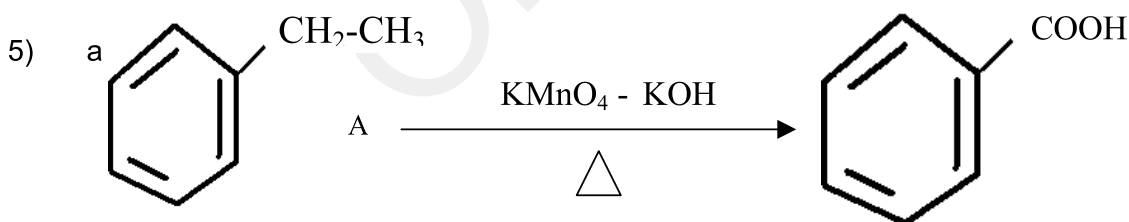## ALDEHYDES KETONES AND CARBOXYLIC ACIDS

1-Mark Questions

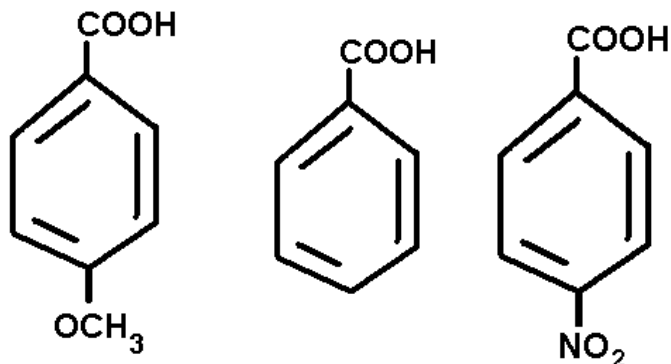1) Identify X.
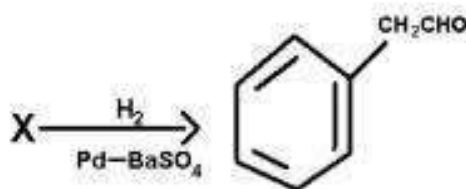
2) Identify B and C in the following reaction.

3) Arrange the following compounds in the increasing order of their boiling points.
$CH_3CH_2CH_2CH_3$, $CH_3OCH_2CH_3$, CH_3CH_2CHO, CH_3COCH_3, $CH_3CH_2CH_2OH$

4) Propanal is more reactive than propanone. Give the reason.
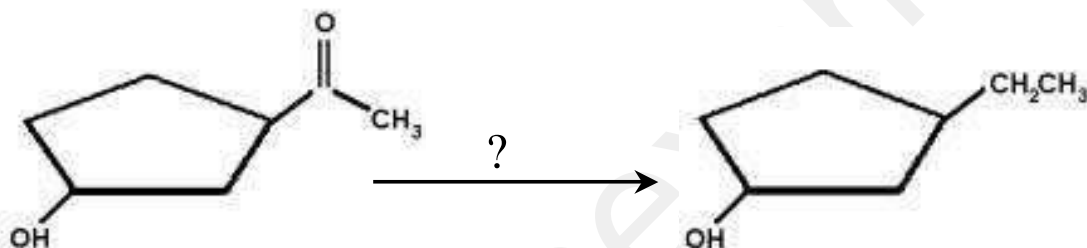
5)

Observe the reactions and state why the compound A is oxidized where as compound B is not oxidized by alkaline $KMnO_4$?

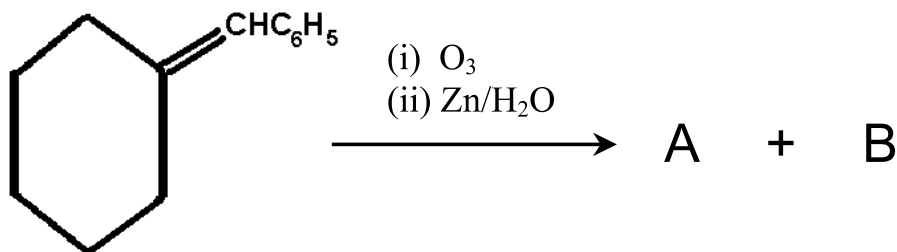6)   Which one among the following is the strongest acid?

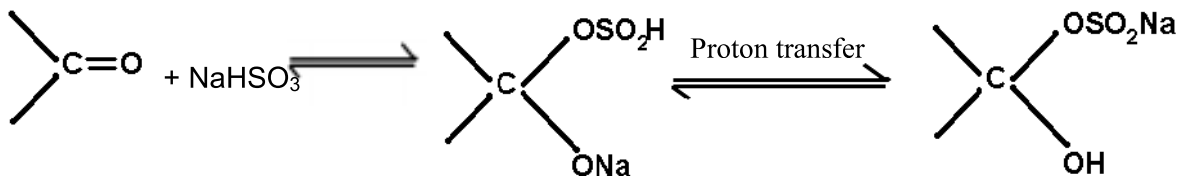7)   Identify the reagent used in the following conversion.

8)   Fluorine is more electronegative than Chlorine even then P-Fluorobenzoic acid is weaker acid than P-Chlorobenzoic acid. State the plausible reason for this.

9)   Identify A and B in the following reaction:

(i) O₃
(ii) Zn/H₂O

A + B

LearnGuide.in

2- Mark Questions

10) For the reaction:

The position of equilibrium lies largely to the right hand side for most Aldehydes and to the left for most ketones. Find out the reason.

11) Identify the following named reactions and write the reagents used:

$CH_3CHO \longrightarrow CH_3-CH_3 + H_2O$
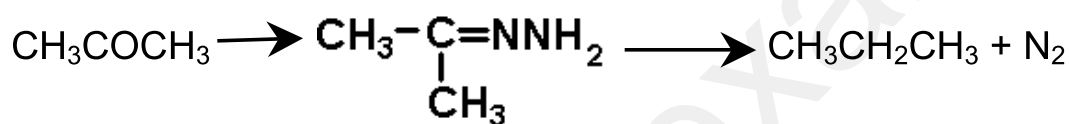
12) Aldol condensation of a ketone in presence of dilute alkali gives 4-Hydroxy -4-methylpentan-2-one.Write the structure of ketone and its IUPAC name.

13) Which among the following compounds give Cannizzaro reaction and state the reason?

, CH_3CHO, CH_3COCH_3.

LearnGuide.in
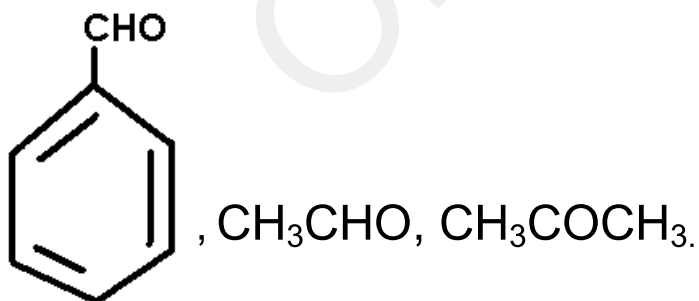
14) Predict the products of the following reactions:

$+ HO\text{-}NH_2 \xrightarrow{H^+}$

$R\text{-}CH=CH\text{-}CHO + NH_2\text{-}C\text{-}NH\text{-}NH_2 \xrightarrow{H^+}$
(with C=O below the central carbon)

15) The decreasing order of acidity of a few carboxylic acids is given below:
$C_6H_5COOH > C_6H_5CH_2COOH > CH_3COOH > CH_3CH_2COOH$.
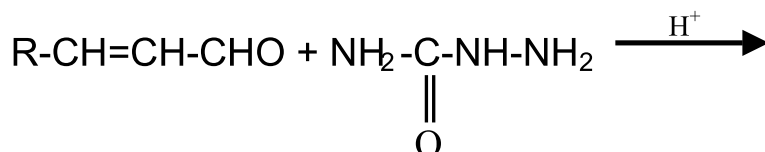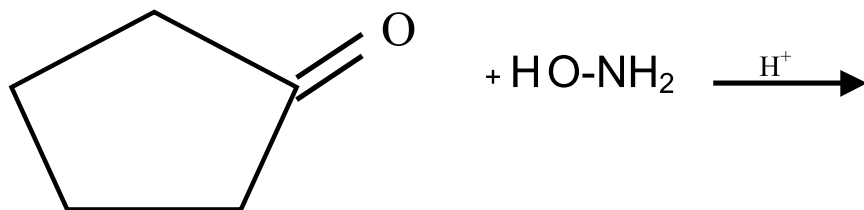Explain plausible reason for the order of acidity followed.

16) An organic compound A, Molecular Formula $C_9H_{10}O$ forms 2,4 DNP derivative, reduces Tollens reagent and undergoes Cannizaros reaction. On vigorous oxidation it gives 1,2-benzene dicarboxylic acids. Identify A.
(Hint: An aldehyde which do not contain α hydrogen atom.)

17) Do the following conversion using suitable reagents not more than two steps:

a. Ethanol to 3-Hydroxy butanal.
b. Bromobenzene to 1-phenyl ethanol.

18) Compound A $C_4H_8Cl_2$ is hydrolysed to a compound B C_4H_8O which form an oxime with NH_2OH and give negative Tollens test. What are the structures of A and B. Write balanced chemical equations for the reactions involved.
(Hint: A is a gemdihallide and B is a ketone)

19) Write the structure of the product and name the reaction.

$\xrightarrow{I_2 \mid NaOH}$

?

LearnGuide.in

4
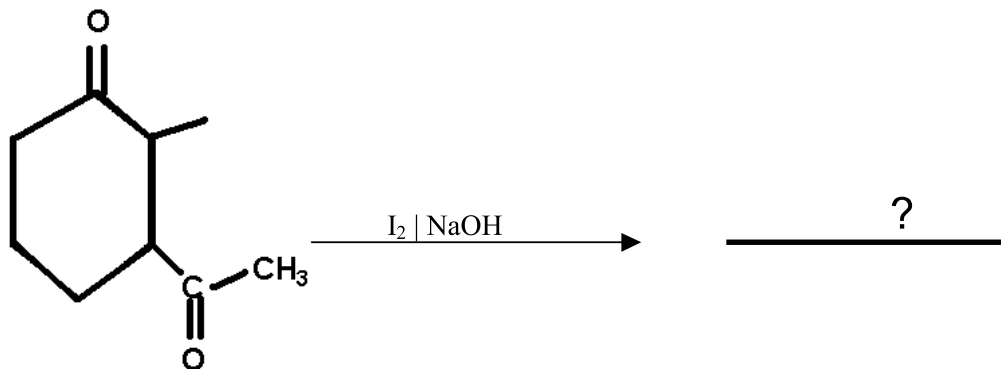
20) Give reasons for the following:

atom.)

(Hint: In strong acidic medium N of reagent gets protonated to get an electrophile which cannot react.)

21) Both C=C and C=O give addition reactions. How do the addition reactions differ in both the cases and explain why?

Hint: C=C Formed between two similar atoms having same electronegativity.

C=O Formed between two different atoms with different electronegativities.

22) Benzaldehyde gives positive test with Tollens reagent but not with Fehlings solution. State the reason.
Hint:+R effect increases electron density on carbonyl group and C-H become strong.
$Ag(NH_3)_2^+$ is a stronger oxidizing agent than Cu^{2+} + tartarate + base.

23) Write the structures of the products in the following reactions:
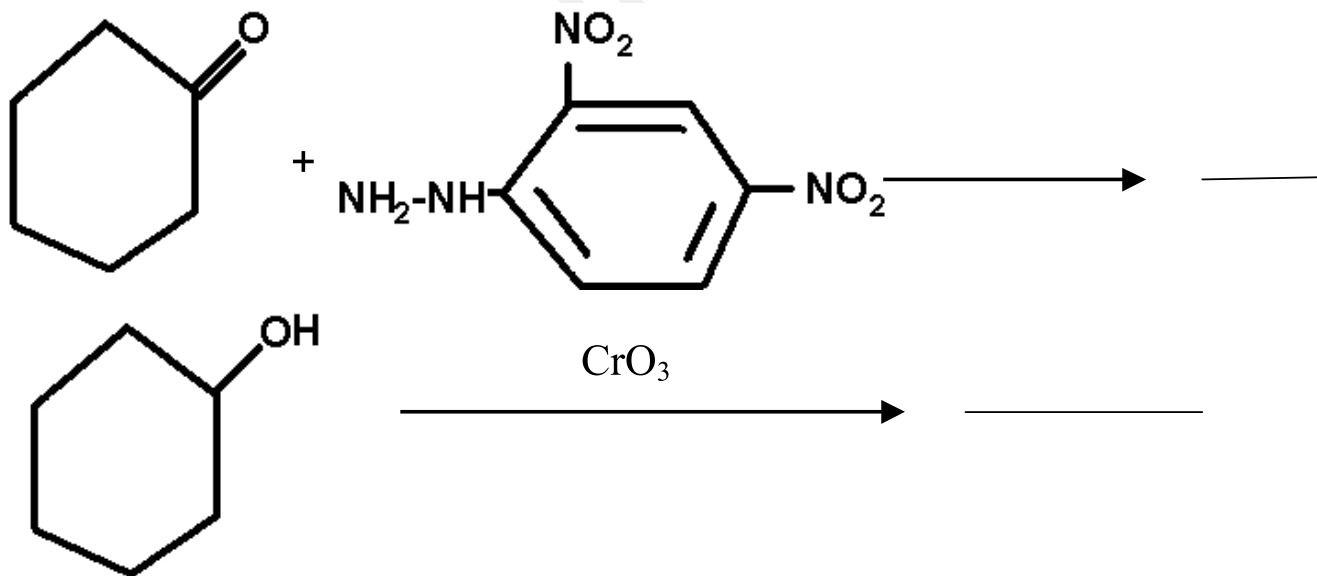
3-Mark Questions

24)
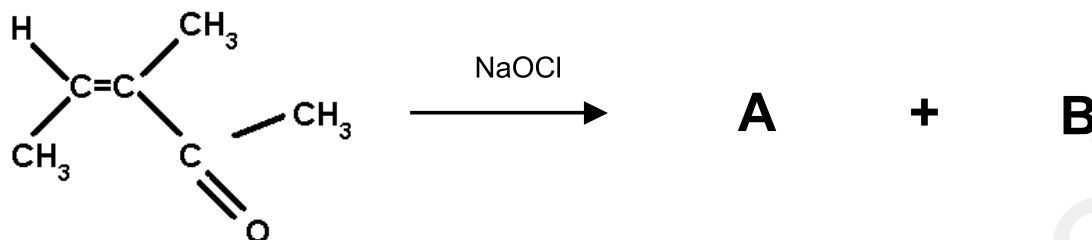
a. Write the structures of A and B.
b. Identify any two important features of this reaction.
(Hint: - Structural characteristics of compounds giving haloform reaction.)

25)
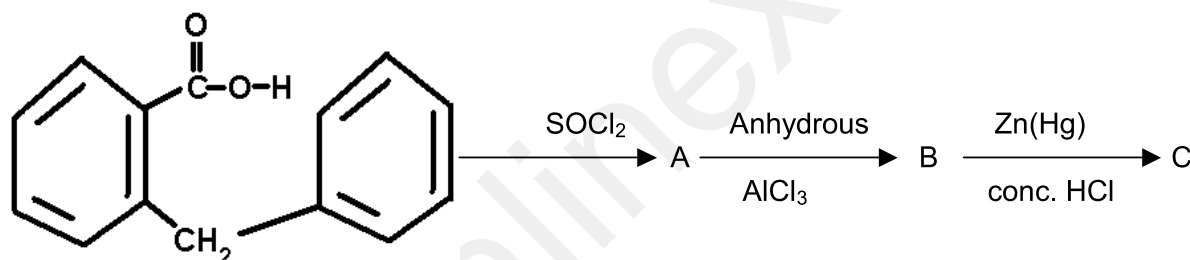
Write the structures of A, B and C.

26) Compound X, containing Chlorine on treatment with strong ammonia gives a solid Y which is free from Chlorine. Y on analysis gives C=49.31%, H=9.59% and N=19.18% and reacts with Br_2 and caustic soda to give a basic compound Z. Z reacts with HNO_2 to give ethanol. Suggest structures for X, Y and Z.

Hint:
Calculate the empirical formula of the compound. Y reacts with Br_2 and alkali indicates that it is amide.

27) Complete the following equation and write the structures of A, B, C, D, E and F.

$$A \xrightarrow{P/Br_2} CH_3CH_2CH_2Br \xrightarrow{Alc.KOH} B \xrightarrow{Br_2|CCl_4} C \xrightarrow[\text{(ii) NaNH}_2]{\text{(i) Alc.KOH}} D \xrightarrow[\text{dil. H}_2SO_4]{\text{Hg2+}} E \xrightarrow{NH_2OH \mid H^+} F$$
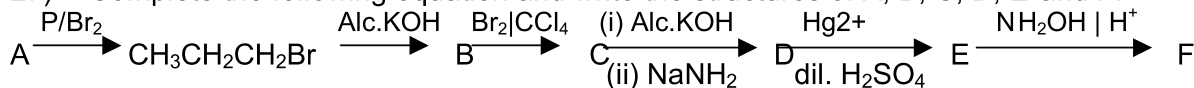
28)   A compound X (C_2H_4O) on oxidation gives Y ($C_2H_4O_2$). X undergoes haloform reaction. On treatment with HCN, X forms a product Z which on hydrolysis gives 2-hydroxy propanoic acid.
      a. Write down the structures of X and Y.
      b. Name the product when X reacts with dil. NaOH.
      c. Write down the equations for the reactions involved.

Hint: - X is an aldehyde since it has general formula $C_nH_{2n}O$ and has only two carbon atoms.

5- Mark Questions

29)   An alkene (A with molecular formula C7H14) on ozonolysis yields an aldehyde. The aldehyde is easily oxidized to an acid (B). When B is treated with Bromine in presence of Phosphorous it yields a compound (C) which on hydrolysis gives a hydroxy acid (D). This acid can also be obtained from acetone by the reaction with hydrogen cyanide followed by hydrolysis. Identify A, B, C and D and write the chemical equations for the reactions involved.

30)   Five isomeric para-di- substituted aromatic compounds, A to E with molecular formula $C_8H_8O_2$ were given for identification. Based on the following observations give the structures of the compounds:

Both A and B form silver mirror with Tollens reagent, also B gives a positive test with
   $FeCl_3$.
C gives positive Iodoform test.
D is readily extracted in aqueous $NaHCO_3$ solution.
E on acid hydrolysis gives 1,4-dihydroxy benzene.

Hint: A and B contain CHO groups since they've shown positive Tollens test. B has phenolic group as it reacts with $FeCl_3$ solution. C should have $–CH_3CO$ group. D should have –COOH group. E should be p-hydroxy phenyl vinyl ether.

LearnGuide.in

Chapter - 13

AMINES

1. Write IUPAC names of the following :

   (i) $CH_3CH_2CH-NH_2$
                 |
               CH_3

   (ii) $CH_3NHCH(CH_3)_2$

   (iii) $(CH_3)_3$ N

   (iv) $C_6H_5NHCH_3$

   (v) $C_6H_5NH-\overset{\displaystyle O}{\overset{\|}{C}}-CH_3$

   (vi) $\left[\begin{array}{c} \overset{+}{N}(CH_3)_3 \\ C_6H_5 \end{array} \right] Br^-$

   (vii) $H_2N-C_6H_4-OCH_3$

   (viii) $H_2N\ (CH_2)_6NH_2$

   (ix) $C_6H_5-NH-C_6H_5$

   (x) C_6H_5-NHOH
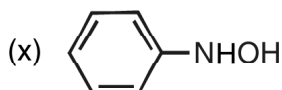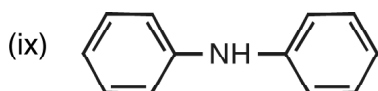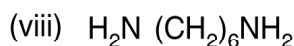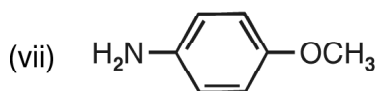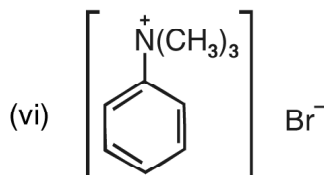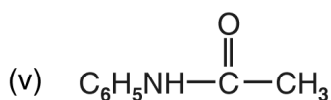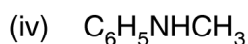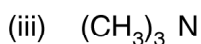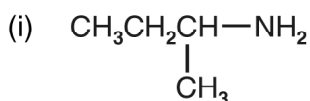
2. Giving an example of each, describe the following reactions :

   (i)   Hoffman bromamide reaction

   (ii)   Gabriel phthanlimide synthesis

   (iii) Gatterman reaction

   (iv) Coupling reaction

   (vi) Carbylamine reaction

   (vii) Acetylation of aniline.

LearnGuide.in

1

3. Describe the Hinsberg's test 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 indicated.

   (i) $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$ and NH_3, (Basic strength in aqueous solution).

   (ii) $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$ and CH_3NH_2. (Basic strength in gaseous phase).

   (iii) Aniline, p-toluidine, p-nitroaniline. (Basic strength).

   (iv) C_2H_5OH, $(CH_3)_2 HN$, $C_2H_5NH_2$ (Boiling point)

5. Identify A and B in the following reactions :

   (i) $CH_3CH_2Cl + NH_3$ (Excess) $\xrightarrow[\text{OH}^-]{\text{373K}}$ A

   (ii) $CH_3CH_2Cl + NH_3 \xrightarrow[\text{OH}^-]{\text{373K}}$

   (excess)
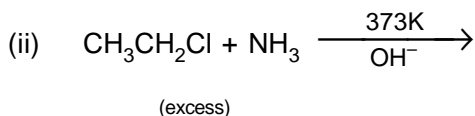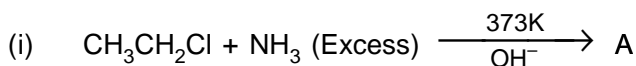
6. How will you bring about the following conversions?

   (i) benzene to Aniline

   (ii) aniline to benzene

   (iii) ethanoic acid to ethanamine

   (iv) p-toluidine to 2-bromo-4-methylaniline.

   (v) methylbromide to ethanamine

   (vi) benzenediazonium chloride to nitrobenzene

   (vii) ethylamine to methylamine

   (ix) benzene to sulphanilic acid

   (x) hexanenitrile to 1-aminopentane.

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

   $CH_3CH_2I \xrightarrow{\text{NaCN}} A \xrightarrow[\text{Partial hydrolysis}]{\text{OH}^-} B \xrightarrow{\text{Br}_2/\text{NaOH}} C$

2
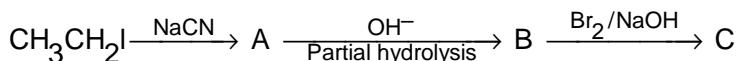
8. Identify the missing reagent/product in the following reactions :

(i)

$\text{C}_6\text{H}_5\text{CH}_2\text{Br} \xrightarrow[\text{NaCN}]{\text{ethanolic}} \text{B} \xrightarrow{\text{H}_2/\text{Ni}} \text{C}$

(ii)

$\text{aniline} + (\text{CH}_3\text{CO})_2\text{O} \longrightarrow \text{A} \xrightarrow[\text{H}_2\text{SO}_3]{\text{HNO}_3} \text{B} \xrightarrow{\text{H}^+/ \text{H}_2\text{O}} \text{C}$

(iii) $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow{\text{CuCN}} \text{A} \xrightarrow{\text{H}_2\text{O}/\text{H}^+} \text{B}$

(iv) $\text{C}_6\text{H}_5\text{NO}_2 \xrightarrow{\text{Fe/HCl}} \text{A} \xrightarrow{\text{H}_2\text{SO}_4} \text{B} \xrightarrow{\text{heat}} \text{C}$

(v)

$\xrightarrow{\text{CH}_3\text{COCl}} \text{A} \xrightarrow{\text{Br}_2/\text{Fe}} \text{B} \xrightarrow{\text{H}_2\text{O}/ \text{OH}^-} \text{C}$
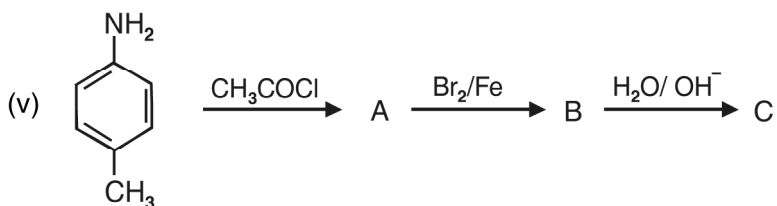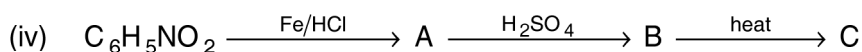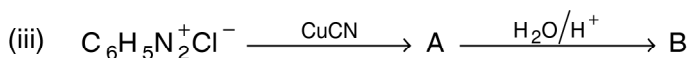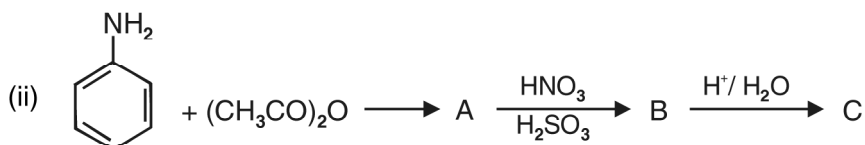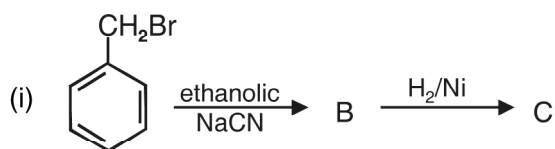
9. Give one chemical test to distinguish between the following pairs of compounds :

(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°

    (ii)   the quaternary ammonium salts having four different alkyl groups are optically active

    (iii)   alkylamines are more basic than ammonia

    (iv)   aniline cannot be prepared by Gabriel phthalimide synthesis

    (v)   Garbriel phthalimide synthesis is preferably used for synthesising primary amines.

    (vi)   ethylamine is soluble in water but aniline is not

    (vii)   amines are soluble in dilute HCl.

    (viii)   amines have lower boiling point 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)   sulphanilic 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. Why do amines act as nucleophiles? Give example of a reaction in which methylamine acts as a nucleophile.

*12. 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

LearnGuide.in

4

does not react with benzene sulphonyl chloride. Identify A, B and C.

[**Ans. :** (A) $CH_3CH_2CH_2NH_2$ (B) $CH_3CH_2NHCH_3$ (C) $(CH_3)_3N$]

13. 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.

[**Ans. :** (A) CH_3CN (B) $CH_3CH_2NH_2$ (C) CH_3CH_2NC

14. An organic compound [A] $C_3H_6O_2$ on reaction with ammonia followed by heating yield B. Compound B on reaction with Br_2 and alc. NaOH gives compound C (C_2H_7N). Compound C forms a foul smelling compound D on reaction with chloroform and NaOH. Identify A, B, C, D and the write the equations of reactions involved.

[**Hint :**   (A) CH_3CH_2COOH (B) $CH_2CH_2CONH_2$

              (C) $CH_3CH_2NH_2$ (D) CH_3CH_2NC.]

Chapter - 14

BIOMOLECULES

QUESTIONS

VSA TYPE QUESTIONS (1 - MARK QUESTIONS)

1. Name polysaccharide which is stored in the liver of animals.

2. What structural feature is required for a carbohydrate to behave as reducing sugar?

   [**Hint :** The carbonyl group of any one monosaccharide present in carbohydrate should be free]

3. How many asymmetric carbon atoms are present in D (+) glucose?

4. Name the enantiomer of D-glucose.

   [**Hint :** L-glucose]

5. Give the significance of (+)-sign in the name D-(+)-glucose.

   [**Hint :** (+) sign indicates dextrorotatory 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 sulphite. Give reason.

   [**Hint :** The –CHO group reacts with –OH group at C–5 to form a cyclic hemiacetal].

8. Why is sucrose called invert sugar?

   [**Hint :** When sucrose is hydrolysed by water, the optical rotation of solution changes from positive to negative.]

9. Name the building blocks of proteins.

10. Give the structure of simplest optically active amino acid.

11. Name the amino acid which is not optically active.

12. Write the Zwitter ionic form of aminoacetic 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.

    [**Hint :** HCl present in stomach decreases the pH]

15. How would you explain the amphoteric behavior of amino acids.

    [**Hint :** Amino acids are amphoteric due to the presence of both acidic and basic functional groups.]

16. Which forces are responsible for the stability of α – helical structure of proteins.

17. How are polypeptides 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.

    [**Hint :** H-bonding is present between specific pairs of bases present in stands.]

20. When RNA is hydrolysed, there is no relationship among the quantities of different bases obtained. What does this fact suggest about the structure of RNA.

    [**Hint :** RNA is single stranded].

21. What type of linkage holds together the monomers of DNA and RNA.

    [**Hint :**Phosphodiester linkage]

22. Mention the number of hydrogen bonds between adenine and thymine.

23. A child diagnosed with bone deformities, is likely to have the deficiency of which vitamin?

24. What is meant by the term DNA fingerprinting?

25. List two important functions of proteins in human body.

26. Name the vitamin responsible for coagulation of blood.

27. Except vitamin B_{12}, all other vitamins of group B, should be supplied regularly in diet. Why?

28. How is glucose prepared commercially?

29. What is the structural difference between glucose and fructose?

30. What is the difference between an oligosaccharide and a polysaccharide.

31. Give the Haworth projection of D-glucopyranose.

SA (I) TYPE QUESTIONS (2 - MARK QUESTIONS)

1. What are anomers. Give the structures of two anomers of glucose.

2. Write the hydrolysed products of
    (i)   maltose   (ii) cellulose.

3. Name the two components of starch? Which one is water soluble?

4. (i)   Acetylation of glucose with acetic anhydride gives glucose pentaacetate. Write the structure of the pentaacetate.
    (ii) Explain why glucose pentaacetate does not react with hydroxylamine?

    [**Hint :** The molecule of glucose pentaacetate has a cyclic structure in which –CHO is involved in ring formation with OH group at C–5]

5. What are vitamins? How are they classified?

6. (i)   Why is sucrose called a reducing sugar?
    (ii) Give the type of glycosidic linkage present in sucrose.

7. Classify the following as monosaccharides or oligosaccharides.
    (i)   Ribose   (ii) Maltose
    (iii) Galactose   (iv) Lactose

8. Write the products of oxidation of glucose with
    (a)   Bromine water   (b)   Nitric acid

9. State two main differences between globular and fibrous proteins.

10. Classify the following α-amino acids as neutral, acidic or basic.
    (i) $HOOC – CH_2 – CH (NH_2) COOH$
    (ii) $C_6H_5 – CH_2 – CH(NH_2) COOH$
    (iii) $H_2N – (CH_2)_4 – CH(NH_2) – COOH$
    (iv) $HN = C – (CH_2)_3 – CH(NH_2)COOH$
          $\quad\quad\quad |$
          $\quad\quad NH_2$

11. You have two amino acids, *i*,e. glycine and alanine. What are the structures of two possible dipeptides that they can form?

12. What are essential and non essential amino acids? Give one example of each type.

13. Name four type of intermolecular forces which stabilize 2° and 3° structure of proteins.

    [**Hint :** Hydrogen bonds, disulphide linkages, vander Waals and electrostatic forces of attraction.]

14. Classify the following as globular or fibrous proteins.
    (i)   Keratin   (ii) Myosin
    (iii) Insulin   (iv) Haemoglobin.

15. What do you understand by

    (a)   denaturation of protein   (b) specificity of an enzyme.

16. On electrolysis in acidic solution amino acids migrate towards cathode while in alkaline solution they migrate towards anode.

    [**Hint :** In acidic solution, COO^- group of zwitter ion formed from α-amino acid is protonated and NH_3^+ groups is left unchanged while in basic solution deprotonation converts NH_3^+ to NH_2 and COO^- is left unchanged.]

17. (i)   Name the disease caused by deficiency of vitamin D.

    (ii) Why cannot vitamin C be stored in our body?

18. Define the terms hypervitaminosis and avitaminosis.

    [**Hint :** Excess intake of vitamin A and D causes hypervitaminosis while multiple deficiencies caused by lack of more than one vitamins are called avitaminosis]

19. Explain what is meant by :
    (i)   a peptide linkage   (ii) a glycosidic linkage?

    [**Hint :** (i) Peptide linkage refers to the –CONH– linkage formed by reaction between –COOH group of one amino acid with –NH_2 group of the other amino acid.
    (ii) Glycosidic linkage refers to –C–O–C– linkage between two sugars formed by loss of H_2O.]

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. What are the main functions of DNA and RNA in human body.

SA(II) TYPE QUESTIONS (3 - MARK QUESTIONS)

1. How are carbohydrate classified?
2. (i)   Name four bases present in DNA.
   (ii) Which of them is not present in RNA.
   (iii) Give the structure of a nucleotide of DNA.

3. Differentiate between the following :
   (i)   secondary and tertiary structure of protein.
   (ii) α-Helix and β-pleated sheet structure of protein.
   (iii) fibrous and globular proteins.

LearnGuide.in   4

UNIT -16
CHEMISTRY IN EVERYDAY LIFE

1 Mark Question

1)   Which among the following is a semi synthetic modification of penicillin
         Erythromycin, ampicillin, tetracycline, ofloxacin.

2)   Substances produced wholly or partly by chemical synthesis, which in low   concentrations
         inhibits the growth or destroys microorganisms by intervening in their metabolic processes.
         Identify the substance.

3)   Drugs are classified as
                 Aspirin   –   analgesic
                 Chlordiazepoxide   –   tranquilizer
                 Penicillin   –   antibiotic
         Mention on what basis the above classification is done?

4)
$$\left[CH_3(CH_2)_{15} \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{N}} - CH_3 \right]^+ \quad Br^-$$
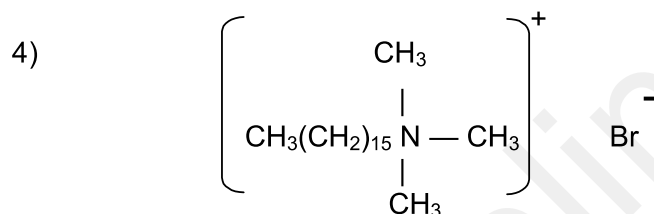
                 Identify the type of detergent given in the above structure.

5)   Which of the following drug combinations is not correct and state why?

                 Chloramphenicol   –   broad spectrum antibiotic.
                 Equanil   –   sedative.
                 Phenacetin   –   antipyretic.
                 Bithional   –   tranquilizer.

LearnGuide.in

2 Mark Questions

6)   Analysis of water in a place shows that the water contains Magnesium Chloride.   The people in that place are advised to use detergents for washing clothes.   Why?

7)   Pick out the odd one from the following and mention why?

         Erythromycin, penicillin, tetracycline, chloramphenicol

8)   Antiallergics and antacids are antihistamines. Can antiallergics be used to reduce the acidity of the stomach? Give plausible reason for your answer.

9)   Following drugs are used as analgesics. One among them is different from   others. Identify it and state the reason.

   Morphine, Heroin, Aspirin, Codeine.

10)
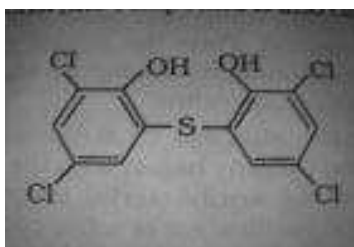
         i.   Identify the compound.
         ii.   What is its use?

11)   Birth control pills essentially contain a mixture of synthetic estrogen and progesterone. What are estrogen and progesterone? Why are they used in birth control pills?

12)   Sodium and Potassium soaps are only used for cleaning purposes. Why?

13)   Detergents containing unbranched chains are more preferable than those containing branched chains. State the reason.

14)   Low level of noradrenalin is the cause of depression. Suggest drugs to cure this problem?
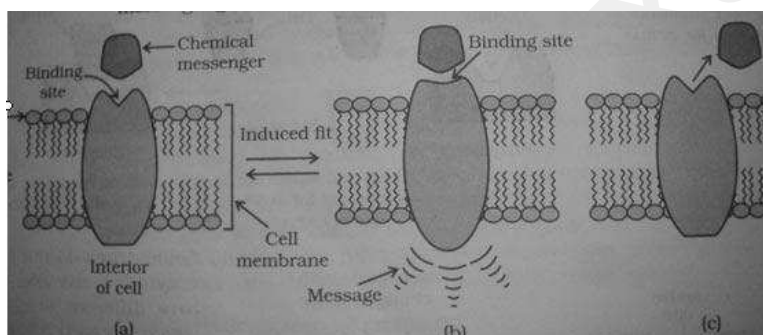
3 Mark Questions

15) Observe the diagram and answer the questions given below:
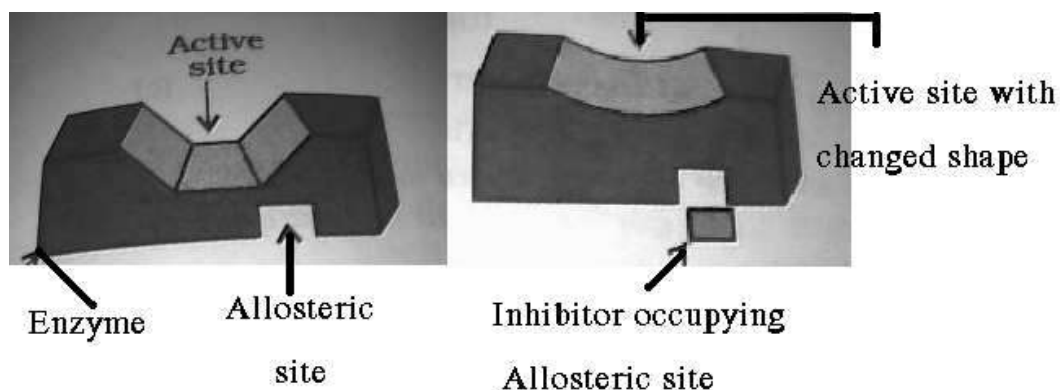
i. Name the drug target.
ii. What is meant by allosteric site?
iii. Mention the role of inhibitors.

16) Observe and identify the steps a, b, c from the diagram given below:

17) Sodium hydrogen carbonate and ranitidine are used as antacids. Which one is a better choice? Why?

18) Identify the following substances:

i. It is about 550 times as sweet as cane sugar and excreted from body in urine unchanged.

ii. It is 100 times as sweet as cane sugar and its use is limited to cold food and soft drinks as it is unstable at cooking temperature.

iii. It is a trichloro derivative of Sucrose and it is stable at room temperature.