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राज्य शैक्षणिक संशोधन व प्रशिक्षण परिषद, महाराष्ट्र  
७०८ सदाशिव पेठ, कृमठेकर मार्ग, पणे ४११०३०.

### प्रश्नपेढी (Question Bank) 2023

इयत्ता:- बारावी

माध्यम:- इंग्रजी

विषय:- रसायनशास्त्र (Chemistry)

सूचना-

1. सदर प्रश्नपेढी ही १००% अभ्यासक्रमावर तयार करण्यात आली आहे.
2. सदर प्रश्नपेढीतील प्रश्न हे अधिकच्या सरावासाठी असून प्रश्नसंचातील प्रश्न बोर्डाच्या प्रश्नपत्रिकेत येतीलच असे नाही, याची नोंद घ्यावी.

## Subject -CHEMISTRY (55)

### INDEX

<b>Sr. No.</b>	<b>Name of Chapter</b>	<b>Page no.</b>
1.	Solid State	3
2.	Solutions	6
3.	Ionic Equilibria	9
4.	Chemical Thermodynamics	12
5.	Electrochemistry	16
6.	Chemical Kinetics	19
7.	Elements of Groups 16, 17 and 18	22
8.	Transition and Inner transition elements	25
9.	Coordination compounds	28
10.	Halogen Derivatives	31
11.	Alcohols, Phenols and Ethers	34
12.	Aldehydes, Ketones and Carboxylic acids	37
13.	Amines	40
14.	Biomolecules	43
15.	Introduction to Polymer Chemistry	46
16.	Green Chemistry and Nanochemistry	49



### Very short answer questions (1 Mark)

1. Write the effect on density of a substance in the Frenkel defect?
2. Write an example of a diamagnetic substance.
3. Give one property common to both hcp and ccp crystal lattices.
4. Write the relationship between the radius of the atom and edge length of the fcc unit cell.
5. Draw diagram of bcc unit cell.
6. Find the number of tetrahedral voids formed if the number of atoms in a crystal is  $N/2$ .
7. Write the percentage of empty space in the bcc lattice.
8. If the total volume of a simple cubic unit cell is  $6.817 \times 10^{-23} \text{ cm}^3$ , what is the volume occupied by particles in the unit cell? **(Ans:  $3.57 \times 10^{-23} \text{ cm}^3$ )**
9. Calculate the number of octahedral voids formed in 0.5 mol of a compound forming hcp structure **(Ans:  $3.011 \times 10^{23}$ )**
10. Write the number of atoms in the fcc unit cell.

### Short answer questions (Type- I) (2 Marks)

1. Explain the terms: a) Isomorphism b) Polymorphism with examples
2. Classify the following solids as molecular, ionic, covalent and metallic solids. Pb,  $\text{MgF}_2$ ,  $\text{SO}_2$  and quartz
3. Explain vacancy defect with diagram.
4. Calculate the number of unit cells in 0.3 g of a species having density of  $8.5 \text{ g/cm}^3$  and unit cell edge length  $3.25 \times 10^{-8} \text{ cm}$ . **(Ans:  $1.028 \times 10^{21}$ )**
5. A compound crystallizes in bcc structure. What is the unit cell edge length if the diameter of its atom is 120 pm? **(Ans: 138.6 pm)**
6. Distinguish between crystalline solids and amorphous solids.
7. When gold crystallizes, it forms fcc unit cells. The unit cell edge length is 408 pm. Calculate the density of gold. Molar mass of gold is 197 g/mol. **(Ans:  $19.27 \text{ g/cm}^3$ )**
8. Explain the terms: a) Substitutional impurity defect b) Interstitial impurity defect.

### Short answer questions (Type- II) (3 Marks)

1. Calculate the packing efficiency for bcc lattice.
2. In case of hcp structure, how are spheres in the first, second and third layers arranged?
3. A substance crystallizes in fcc structure. The unit cell edge length is 367.8pm. Calculate the molar mass of the substance if its density is  $21.5 \text{ g/cm}^3$ .  
(Ans:161.1 g/mol)
4. The unit cell of Na is bcc and its density is  $0.97 \text{ g/cm}^3$ . What is the radius of a sodium atom if the molar mass of Na is 23 g/mol?  
(Ans: $1.86 \times 10^{-8} \text{ cm}$ )
5. Write classification of non-stoichiometric point defects. Explain with a diagram the metal deficiency defect.
6. Explain with one example each, the diamagnetic, paramagnetic and ferromagnetic substances.
7. Write the relationship between 'a' and 'r' for sc, bcc and fcc unit cells.
8. Define: a. Diamagnetic solids b. Paramagnetic solids c. Ferromagnetic solid

### Long answer questions (4 marks)

1. What are non stoichiometric point defects? Explain with a diagram the formation of F-centers.
2. Write the classification of stoichiometric point defects. What is a substitutional impurity defect? Explain solid solutions of metals and vacancy through aliovalent cations.
3. Derive the relationship between density of substance, its molar mass and the unit cell edge length. Explain how you will calculate the number of particles, and number of unit cells in  $x \text{ g}$  of metal.
4. Define Bravais lattices. Niobium forms bcc structure. The density of niobium is  $8.55 \text{ g/cm}^3$  and the edge length of the unit cell is 330.6 pm. How many atoms and unit cells are present in 0.5 g of niobium?  
(Ans: no.of atoms-  $3.237 \times 10^{21}$  and no.of unit cell-  $1.618 \times 10^{21}$ )
5. Define: a. Conductors b. Insulators c. Semiconductors d. Doping

## Chapter-2

### Solutions

Marks 4 with option 6

#### Multiple choice questions (1 Mark)

- Sugar dissolves in water because
  - sugar is nonpolar
  - water is polar
  - it forms hydrogen bonding with water**
  - sugar and water are both polar
- The solubility of a gas in water
  - decreases with increase in temperature**
  - increases with increase in temperature
  - decreases with decrease in temperature
  - is not affected by temperature
- The units of Henry's law constant are
  - $\text{bar dm}^3 \text{ mol}^{-1}$
  - $\text{mol L}^{-1} \text{ bar}^{-1}$**
  - $\text{L mol}^{-1} \text{ bar}^{-1}$
  - $\text{bar L}^{-1} \text{ mol}^{-1}$
- The colligative properties of solutions
  - depend on nature of solute particles
  - do not depend on number of solute particles
  - do not depend on dissociation of solute in solvent
  - depend on number of solute particles**
- Which of the following solutions /solvent has maximum vapor pressure ?
  - 1M copper sulphate solution
  - pure solvent water**
  - 0.5M copper sulphate solution
  - 2M copper sulphate solution
- According to Raoult's law, relative lowering of vapor pressure of solution containing dissolved non-volatile solute
  - is equal to mole fraction of solvent
  - is equal to mole fraction of solute**
  - does not depend on mole fraction of solute
  - is equal to molality of solution
- Freezing point depression constant of a solvent is
  - inversely proportional to molality of solution
  - directly proportional to molarity of solution
  - directly proportional to molality of solution
  - expressed in  $\text{K kg mol}^{-1}$**
- Which of the following statements is applicable for 0.1M urea solution and 0.1M sucrose solution?
  - osmotic pressure of urea solution is greater than that of sucrose solution
  - osmotic pressure of sucrose solution is greater than that of the urea solution
  - sucrose solution is not isotonic with urea solution
  - both the solutions have the same osmotic pressure**
- The Henry's law constant of a gas is  $6.7 \times 10^{-4} \text{ mol}/(\text{L bar})$ . Its solubility when the partial pressure of the gas at 298 K is 0.65 bar is..
  - $4.355 \times 10^{-4} \text{ mol/L}$**
  - $4.355 \times 10^{-2} \text{ mol/L}$
  - $2.225 \times 10^{-6} \text{ mol/L}$
  - $2.225 \times 10^{-2} \text{ mol/L}$

### Very short answer questions (1 Mark)

1. What are hypertonic solutions?
2. What is cryoscopic constant?
3. Write the effect of dissolution of a nonvolatile solute on the freezing point of solvent.
4. Write the expression for relative lowering of vapor pressure.
5. State Raoult's law.
6. State Henry's law.
7. What type of solutions exhibit positive deviations from Raoult's law?
8. What is the enthalpy change and volume change on mixing of two components forming an ideal solution?
9. The vapor pressures of pure liquids A and B are 0.600 bar and 0.933 bar respectively, at a certain temperature. What is the mole fraction of solute when the total vapor pressure of their mixture is 0.8 bar?

**(Ans:0.6004)**

10. The vapor pressure of a pure liquid is 0.043 bar at a certain temperature. When a nonvolatile solute is dissolved into it, the vapor pressure of the solution is found to be 0.041 bar. What is the relative lowering of vapor pressure? **(Ans:0.0465)**

### Short answer questions (Type- I) (2 Marks)

1. For a very dilute solution, the osmotic pressure is given by  $\pi = n_2RT/V$  where V is the volume in L containing  $n_2$  moles of nonvolatile solute. Establish the equation for molar mass of solute.
2. Distinguish between ideal and non-ideal solutions.
3. Write two points to explain why vapor pressure of solvent is lowered by dissolving nonvolatile solute into it.
4. In what way  $K_f$  and  $K_b$  are similar and in what way they are different?
5. Calculate total moles after dissociation in 0.1M KCl solution and 0.05M aluminum sulphate solution. Which of the two solutions will have higher freezing point depression.

**(Ans: KCl=0.2mol,  $Al_2(SO_4)_3$ = 0.25 mol. Aluminium sulfate solution has higher freezing point depression)**

6. When 50 g of a nonvolatile solute is dissolved in a certain quantity of solvent, the elevation of boiling point is 2.0 K. What will be the elevation of boiling point when 30 g of solute is dissolved in the same amount of the same solvent? **(Ans:1.2 K)**
7. The Henry's law constant of methyl bromide ( $CH_3Br$ ), is  $0.159 \text{ mol L}^{-1} \text{ bar}^{-1}$  at  $25^\circ\text{C}$ . What is the solubility of methyl bromide in water at  $25^\circ\text{C}$  and at pressure of 130 mmHg? **(Ans: 0.02755M)**
8. Explain the relationship between van't Hoff factor and degree of dissociation.

### Short answer questions (Type- II) (3 Marks)

1. Derive the expression for molar mass of solute in terms of boiling point elevation of solvent.
2. Explain the phenomenon of osmosis with a suitable diagram.
3. Explain with the help of vapor pressure-temperature curves for solution and solvent, why boiling point of solvent is elevated when a nonvolatile solute is dissolved into it.
4. A solution containing 3 g of solute A ( $M=60$  g/mol) in 1L solution is isotonic with a solution containing 8.55 g of solute B in 500 mL solution. What is the molar mass of B? **(Ans:342 g/mol)**
5. The vapor pressure of a pure solvent(water) at a certain temperature is 0.0227 bar. What is the vapor pressure of a solution containing 6 g of solute ( $M=60$  g/mol) in 50 g of solvent? **(Ans:0.02188 bar)**
6. Explain the relationship between van't Hoff factor and degree of dissociation.

### Long answer questions (4 Marks)

1. What are non-ideal solutions? Explain with reasons and diagrams the positive and negative deviations from Raoult's law shown by non-ideal solutions.
2. Explain with vapor pressure-temperature curves that the freezing point of a solvent is lowered by dissolving a nonvolatile solute into it. Give a reason for such lowering of freezing of solvent.
3. Define following terms a) Reverse Osmosis b) Semi permeable membrane c) Osmotic pressure d) Isotonic solution.



## Chapter-03

### Ionic Equilibria

Marks 4 - with option 06

#### Multiple choice questions (1 Mark)

i) What is the percentage dissociation of 0.1 M Solution of acetic acid?

$$[k_a(\text{CH}_3\text{COOH}) = 10^{-5}]$$

- a) 0.01%                      **b) 1%**                      c) 10%                      d) 100%

ii) For a reaction  $\text{HCl}_{(\text{aq})} + \text{H}_2\text{O}_{(\text{l})} \rightleftharpoons \text{H}_3\text{O}^+_{(\text{aq})} + \text{Cl}^-_{(\text{aq})}$

Which of the following is a conjugate acid-base pair?

- a)  $\text{H}_2\text{O}$  and  $\text{Cl}^-$                       b)  $\text{H}_3\text{O}^{(+)}$  and  $\text{Cl}^-$   
c)  **$\text{H}_3\text{O}^{(+)}$  and  $\text{H}_2\text{O}$**                       d)  $\text{HCl}$  and  $\text{H}_3\text{O}^{(+)}$

iii) In biochemical system, pH of blood in our body is maintained due to following buffer

- a)  $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl}$                       **b)  $\text{HCO}_3^- + \text{H}_2\text{CO}_3$**   
c)  $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}$                       d) citric acid +  $\text{Mg}(\text{OH})_2$

iv) If 'IP' is the ionic product and ' $k_{\text{sp}}$ ' is the solubility product, precipitation of the compound will occur under the condition when.

- a)  $\text{IP} = k_{\text{sp}}$                       **b)  $\text{IP} > k_{\text{sp}}$**   
c)  $\text{IP} < k_{\text{sp}}$                       d)  $\text{IP} \ll k_{\text{sp}}$

v)  $\text{NH}_4\text{F}$  is a salt of weak acid HF ( $k_a = 7.2 \times 10^{-4}$ ) and weak base  $\text{NH}_4\text{OH}$

( $K_b = 1.8 \times 10^{-5}$ ), the solution of  $\text{NH}_4\text{F}$  will be

- a) slightly acidic**                      b) slightly basic  
c) strongly basic                      d) neutral

vi) The theory which explain amphoteric nature of water is

- a) Arrhenius theory                      b) Lewis theory  
c) Ostwald theory                      **d) Bronsted - Lowry theory**

vii) The  $\text{p}K_b$  of weak base BOH [ $K_b(\text{BOH}) = 1 \times 10^{-5}$ ] will be

- a) -5                      **b) 5**                      c) 1                      d)  $10^{-5}$

### Very short answer questions (1 Mark)

- i) Write the name of buffer which is used to maintain pH of 8 to 10 for precipitation of cations of III A group in qualitative analysis
- ii) Write the solubility product of sparingly soluble salt  $\text{Bi}_2\text{S}_3$
- iii) What is the  $\text{p}^{\text{OH}}$  if the hydrogen ion concentration in solution is  $1 \times 10^{-3} \text{ mol dm}^{-3}$  (Ans:11)
- iv) Write the relationship between molar Solubility (S) and solubility product ( $k_{\text{sp}}$ ) for  $\text{PbI}_2$
- v) Write any one example of salt derived from weak acid and weak base.
- vi) Write the formula to calculate  $\text{p}^{\text{H}}$  of buffer solution.
- vii) Indicate the one conjugate acid-base pair in the following reaction.



- viii) Calculate the  $\text{P}^{\text{OH}}$  of  $10^{-8} \text{ M}$  of HCl (Ans:7.0414)

### Short answer questions (Type- I) (2 Marks)

- 1) Calculate the  $\text{p}^{\text{H}}$  and  $\text{p}^{\text{OH}}$  of 0.0001M HCl Solution      Ans: ( $\text{p}^{\text{H}}= 4$  and  $\text{p}^{\text{OH}} = 10$ )
- 2) The solubility product of  $\text{BaCl}_2$  is  $4.0 \times 10^{-8}$  what will be its molar solubility in  $\text{mol dm}^{-3}$  ?      Ans: ( $\text{S} = 1 \times 10^{-2} \text{ mol dm}^{-3}$ )
- 3) Classify the following species into Lewis acids and Lewis bases
  - i)  $\text{Cl}(\text{c})$
  - ii)  $\text{NH}_4^+$
  - iii)  $\text{BCl}_3$
  - iv)  $\text{NH}_3$
- 4) Define the following terms i)  $\text{pH}$       ii)  $\text{pOH}$
- 5) Define molar solubility. Write its unit.
- 6) Write a solubility product of the following sparingly soluble salts.
  - i)  $\text{BaSO}_4$
  - ii)  $\text{AgCl}$
- 7) Explain Ostwald's dilution law for weak acids.
- 8) Explain Ostwald's dilution law for weak bases.
- 9) Write any four applications of buffer solution

### Short answer questions (Type- II) (3 Marks)

- 1) Define buffer solution. Explain its types.
- 2) Write one application for each of the following buffers.
  - i) citrate buffer
  - ii)  $\text{HCO}_3^- + \text{H}_2\text{CO}_3$
  - iii)  $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl}$
- 3) Derive the equation which implies that the degree of dissociation of weak acid is inversely proportional to the square root of its concentration.
- 4) A buffer solution contains  $0.3 \text{ mol dm}^{-3} \text{ NH}_4\text{OH}$  ( $K_b = 1.8 \times 10^{-5}$ ) and  $0.4 \text{ mol dm}^{-3}$  of  $\text{NH}_4\text{Cl}$ .  
Calculate pOH of the solution. **(Ans: 4.8696)**
- 6) The solubility of AgBr in water is  $1.20 \times 10^{-5} \text{ mol dm}^{-3}$ . Calculate the solubility product of AgBr. **(Ans:  $K_{sp} = 1.44 \times 10^{-10}$ )**

### Long answer questions (4 Marks)

- 1) Derive the equation  $p^H + p^{OH} = 14$   
Distinguish between strong electrolyte and weak electrolyte
- 2) If 'S' is solubility in mol dm and  $k_{sp}$  is the solubility product. Then write the relation between them for the  $\text{CaF}_2$  and  $\text{BaSO}_4$   
Calculate the concentration of  $\text{H}_3\text{O}^+$  ion in Soft drink whose  $P^H$  is 3.5 **(Ans:  $3.162 \times 10^{-4} \text{ mol/dm}^3$ )**
- 3) Explain the amphoteric nature of water.  
Define a) Solubility product      b) Hydrolysis of salt



### Very short answer questions (1 Mark)

- 1) Write the expression to calculate maximum work done when 1 mole of an ideal gas expands isothermally and reversibly from  $V_1$  to  $V_2$ .
- 2) Write the mathematical relation between  $\Delta H$  and  $\Delta U$  during formation of one mole of  $\text{CO}_2$  under standard conditions.
- 3) Standard enthalpy of formation of water is  $-286 \text{ kJ mol}^{-1}$ . Calculate the enthalpy change for formation of 0.018 kg of water. **(Ans: -286kJ)**
- 4) Write the expression of the first law of thermodynamics for an isothermal process.
- 5) What is the sign convention when work is done on the system by the surrounding?
- 6) Write the expression showing relation between enthalpy change and internal energy change for gaseous phase reaction
- 7) Calculate enthalpy of formation of HCl if Bond enthalpies of  $\text{H}_2$ ,  $\text{Cl}_2$  and HCl are  $434 \text{ kJ mol}^{-1}$ ,  $242 \text{ kJ mol}^{-1}$  and  $431 \text{ kJ mol}^{-1}$  respectively. **(Ans: -93kJ/mol)**
- 8) Write the condition of  $\Delta G$  for Spontaneous reaction.

### Short answer questions (Type- I) (2 Marks)

- 1) Define the terms: (i) Standard enthalpy of combustion (ii) Enthalpy of sublimation.
- 2) State and explain Hess's law of constant heat summation.
- 3) Write the features of reversible processes.
- 4) Derive an expression for pressure- volume work.
- 5) The enthalpy change of the following reaction



The bond enthalpies are

Bond	C-H	Cl-Cl	H-Cl
$\Delta H^\circ/\text{kJ mol}^{-1}$	414	243	431

**(Ans: 330 kJ mol<sup>-1</sup>)**

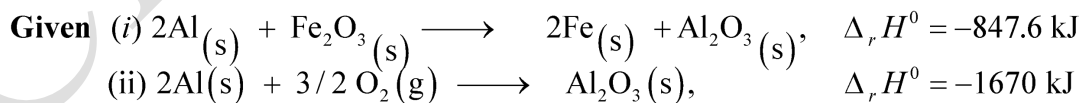
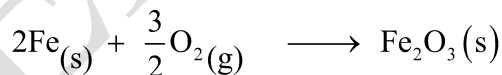
- 6) Calculate the standard enthalpy of combustion of  $\text{CH}_4(\text{g})$  if  $\Delta_f H^\circ(\text{CH}_4) = -74.8 \text{ kJ mol}^{-1}$ ,  $\Delta_f H^\circ(\text{CO}_2) = -393.5 \text{ kJ mol}^{-1}$  and  $\Delta_f H^\circ(\text{H}_2\text{O}) = -285.8 \text{ kJ mol}^{-1}$  **(Ans: -890.3 kJ mol<sup>-1</sup>)**
- 7) Define: a) Extensive property b) Intensive property with examples.
- 8) Write relationship between  $\Delta G$  and  $\Delta S_{total}$

### Short answer questions (Type- II) (3 Marks)

- a. Define an isolated system.  
b. Three moles of an ideal gas are expanded isothermally from  $15 \text{ dm}^3$  to  $20 \text{ dm}^3$  at constant external pressure of 1.2 bar, calculate the amount of work in Joules. **(Ans: -600J)**
- Define enthalpy of fusion. Derive an expression for the maximum work.
- Derive the expression  $\Delta H = \Delta U + P\Delta V$ . Write the relationship between  $Q$  and  $\Delta U$  for an isochoric process.
- Define standard enthalpy of formation. Derive the relationship between standard enthalpy of reaction  $aA + bB \rightarrow cC + dD$  and enthalpies of formation of reactants and products.
- 0.022 kg of  $\text{CO}_2$  is compressed isothermally and reversibly at 298 K from initial pressure of 100 kPa when the work obtained is 1200 J, calculate the final pressure. **(Ans=263.4kPa)**
- Define the following terms:-
  - Enthalpy of vaporization
  - Standard enthalpy of combustion.Why is work done in vacuum zero

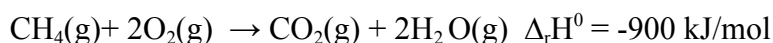
### Long answer questions (4 Marks)

- Define the following terms:-
  - Enthalpy of atomization
  - Extensive propertiesWrite mathematical statement of first law of thermodynamics for following processes
  - Isothermal process
  - adiabatic process.
- Define the following terms:
  - Bond Enthalpy
  - Enthalpy of ionization.Calculate the standard enthalpy of the reaction. **(Ans = -822.4kJ)**



- The amount of heat evolved when 12 g of CO reacts with  $\text{NO}_2$ ? The reaction is  $4\text{CO}(g) + 2\text{NO}_2(g) \rightarrow 4\text{CO}_2(g) + \text{N}_2(g)$   $\Delta_r H^\circ = -1200 \text{ kJ}$  **(Ans:128.5 kJ of heat is evolved)**  
Write an application of Hess's law.

Does the following reaction represent a thermochemical equation?



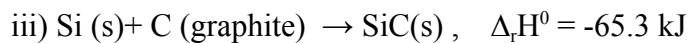
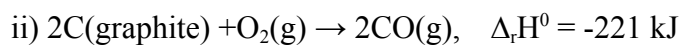
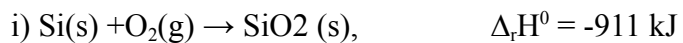
4) Classify the following into intensive and extensive properties. Pressure, volume, mass, temperature.

Define state function and write two examples of it.

5) Write sign conventions of W and Q

Calculate the standard enthalpy of the reaction (**Ans: 624.7 kJ**)

$\text{SiO}_2(\text{s}) + 3\text{C}(\text{graphite}) \rightarrow \text{SiC}(\text{s}) + 2\text{CO}(\text{g})$  from the following reactions







### Very short answer questions (1 Mark)

- i) Write SI unit of conductivity.
- ii) What is cell voltage?
- iii) Write a mathematical expression for Standard Cell Potential.
- iv) Write the formula to calculate molar conductivity of the given solution.
- v) Write the chemical composition present in the salt bridge.
- vi) Write the potential produced through the NICAD storage cell.
- vii) Write an equation that shows the relationship between molar conductivity and degree of dissociation of weak electrolyte.
- viii) Write Arrhenius equation.

### Short answer questions (Type- I) (2 Marks)

- 1) Draw a neat and labeled diagram of Standard Hydrogen Electrode.
- 2) What are the functions of a salt bridge in a galvanic cell?
- 3) Derive relation between equilibrium constant of reaction(K) and standard cell potential( $E^0_{\text{cell}}$ )
- 4) Write applications of Kohlrausch's Law.
- 5) What is the cell constant? Write its SI unit.
- 6) Mention difficulties in setting Standard Hydrogen Electrode.
- 7) What is the mass of copper metal produced at cathode during the passage of 2.03A current through the  $\text{CuSO}_4$  solution for 1 hour. Molar mass of Cu =  $63.5 \text{ g mol}^{-1}$  (Ans: 2.405 g)
- 8) Mercury battery provides more constant voltage than any other dry cell; Explain.
- 9) Represent the galvanic cell from following overall cell reaction  
$$\text{Cd (s)} + \text{Cu}^{2+}(\text{aq}) \rightarrow \text{Cd}^{2+}(\text{aq}) + \text{Cu (s)}$$
Define: Anode
- 10) How many moles of electrons are required for reduction of 2 moles of  $\text{Zn}^{2+}$  to Zn ? (Ans: 4 moles)
- 11) Calculate standard cell potential of following galvanic cell:  
 $\text{Zn}/\text{Zn}^{2+}(1 \text{ M}) // \text{Pb}^{2+}(1 \text{ M})/\text{Pb}$ . If  $E^0_{\text{pb}} = 0.126\text{V}$  and  $E^0_{\text{Zn}} = -0.763\text{V}$  (Ans: 0.889V)
- 12) Draw a neat and labeled diagram of Lead accumulator.
- 13) Draw a neat and labeled diagram of Leclanche cell(Dry Cell)

### Short answer questions (Type- II) (3 Marks)

- 1) State Kohlrausch law of independent migration of ions. Derive the relationship between Gibbs energy of cell reaction and cell potential.
- 2) Write the main difference between electrolytic conductivity and molar conductivity with respect to concentration. Also write one application of electrochemical series.
- 3) Write three important steps required to determine molar conductivity.
- 4) Draw a neat and well labeled diagram of Standard Hydrogen Electrode. Write one application.
- 5) Define reference electrode. Write two applications of electrochemical series.
- 6) Calculate the voltage of the cell  $\text{Sn(s)} / \text{Sn}^{2+}(0.02 \text{ M}) // \text{Ag}^{+}(0.01 \text{ M}) / \text{Ag(s)}$  at  $25^{\circ}\text{C}$ .  
Given:  $E^{\circ}_{\text{Sn}} = -0.136\text{V}$ ,  $E^{\circ}_{\text{Ag}} = 0.800\text{V}$  (Ans: **0.8679V**)
- 7) Draw a well labeled diagram of a conductivity cell. Write net cell reaction involved in electrolysis of aqueous NaCl.
- 8) Write a mathematical formula for mole ratio. How long will it take to produce 2.415g of Ag metal from its salt solution by passing a current of 3A? Molar mass of Ag=  $107.9 \text{ gmol}^{-1}$  (Ans: **720 s or 12 min.**)

### Long answer questions (4 Marks)

- 1) Why is the Nickel Cadmium cell referred to as a secondary cell? Write working of NICAD storage cells. Write its applications.
- 2) Write relation between electrolytic conductivity and molar conductivity.  
Calculate molar conductivity at zero concentration for  $\text{CaCl}_2$  and NaCl.  
Given: molar ionic conductivities of  $\text{Ca}^{2+}$ ,  $\text{Cl}^-$ ,  $\text{Na}^+$  ions are respectively, 104, 76.4,  $50.1 \text{ } \Omega^{-1}\text{cm}^2\text{mol}^{-1}$   
(Ans:  **$256.8\Omega^{-1}\text{cm}^2\text{mol}^{-1}$  and  $126.5\Omega^{-1}\text{cm}^2\text{mol}^{-1}$** )
- 3) Calculate  $E^{\circ}_{\text{cell}}$  of the following galvanic cell:  
 $\text{Mg(s)} / \text{Mg}^{2+}(1 \text{ M}) // \text{Ag}^{+}(1 \text{ M}) / \text{Ag(s)}$  if  $E^{\circ}_{\text{Mg}} = -2.37\text{V}$  and  $E^{\circ}_{\text{Ag}} = 0.8\text{V}$ . Write cell reactions involved in the above cell. Also mention if cell reaction is spontaneous or not. (Ans: **3.17 V**)
- 4) Explain construction, working in terms of cell reactions and the results of electrolysis of fused NaCl.
- 5) Explain Construction of Standard Hydrogen electrode (SHE), write its applications and difficulties in setting.

**Chapter-6**  
**Chemical Kinetics**

**Marks-4 with option- 6**

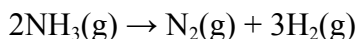
**Multiple choice questions (1 Mark)**

- i) A First order reaction is 50% complete in 69.3 minutes. Time required for 90% completion for the same reaction is  
a) 100      b) 125 mins      c) 230 mins      **d) 230.3 mins**
- ii) Time required for 100% completion of a zero order reaction is \_\_\_\_  
a) **a/k**      b) a/2k      c) a.k      d) 2k/a
- iii) Rate constant of a reaction is  $3.6 \times 10^{-3} \text{ S}^{-1}$ . The order of reaction is \_\_\_\_  
a) **First**      b) Second      c) Third      d) Zero
- iv) The rate law relates to the rate of a chemical reaction in terms of \_\_\_\_  
a) Concentration of catalyst      b) Temperature      c) Potential energy      **d) mol/L of reactants**
- v) For first order reaction the rate constant for decomposition of  $\text{N}_2\text{O}_5$  is  $6 \times 10^{-4} \text{ s}^{-1}$ . The half-life period for decomposition in seconds is \_\_\_\_  
a) 1.155      b) 11.55      c) 115.5      **d) 1155**
- vi) Order of reaction for which unit of rate constant is  $\text{mol dm}^{-3}\text{s}^{-1}$  is \_\_\_\_  
a) **0**      b) 1      c) 2      d) 3
- vii) The rate of catalyzed reaction is larger than the uncatalyzed reaction as \_\_\_\_  
a)  $E_a$  (catalyzed)  $> E_a$  (uncatalyzed)      **b)  $E_a$  (catalyzed)  $< E_a$  (uncatalyzed)**  
c)  $E_a$  (catalyzed)  $= E_a$  (uncatalyzed)      d)  $E_a$  (catalyzed)  $\gg E_a$  (uncatalyzed)
- viii) Which of the following is a unimolecular reaction?  
a)  $2\text{HI} \rightarrow \text{H}_2 + \text{I}_2$   
**b)  $\text{N}_2\text{O}_5 \rightarrow \text{N}_2\text{O}_4 + \frac{1}{2} \text{O}_2$**   
c)  $\text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl}$   
d)  $\text{PCl}_3 + \text{Cl}_2 \rightarrow \text{PCl}_5$
- ix) Effect of catalyst in a chemical reaction is to change the  
**a) Activation energy**      b) Equilibrium concentration      c) Final products      d) Heat of a reaction

### Very short answer questions (1 Mark)

i) Write the unit of rate constant for the first order reaction.

ii) Write order of the following reaction:



iii) Write molecularity of following reaction:



iv) Rate constant for the reaction  $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$  is  $4.98 \times 10^{-4} \text{ s}^{-1}$ . Find the order of reaction?

**(Ans: First order)**

v) Write a mathematical expression for integrated rate law for zero order reaction.

vi) Write the equation for half life and rate constant of the first order reaction.

vii) Give one example of zero order reaction.

viii) For the reaction  $2\text{NO}(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$ . The rate law is  $\text{rate} = k[\text{NO}]^2[\text{H}_2]$ .

What is the overall order of reaction?

ix) Write a unit of rate constant of zero order reaction.

x) Write only the equation of integrated rate law for the first order reaction in solutions.

### Short answer questions (Type- I) (2 Marks)

1) What is half-life of first order reaction if time required to decrease concentration of reactants from 0.8M to 0.2M is 12 hrs. **(Ans: 6 hrs)**

2) Distinguish between order of reaction and molecularity.

3) For the reaction  $2\text{NOBr} \rightarrow 2\text{NO}_2 + \text{Br}_2$ , the rate law is  $\text{rate} = k[\text{NOBr}]^2$ . If the rate of a reaction is  $6.5 \times 10^{-6} \text{ molL}^{-1}\text{s}^{-1}$ , when the concentration of NOBr is  $2 \times 10^{-3} \text{ molL}^{-1}$ . What would be the rate constant of the reaction? **(Ans:  $1.625 \text{ Lmol}^{-1}\text{s}^{-1}$ )**

4) Explain pseudo first order reaction with a suitable example.

5) Define order of reaction with suitable examples.

6) Explain with the help of a potential energy diagram that the catalyst increases the rate of the reaction.

7) Explain the integrated rate law for zero order reactions.

### Short answer questions (Type- II) (3 Marks)

- 1) Derive an integrated rate law expression for first order reaction:  $A \rightarrow B + C$
- 2) Define molecularity. The rate constant of the first order reaction is  $1.386\text{min}^{-1}$ . Calculate the time required for 80% reactant to decompose? (Ans: **1.162 min. OR 69.7 s**)
- 3) A reaction occurs in the following steps:
  - a)  $\text{NO}_2(\text{g}) + \text{F}_2 \rightarrow \text{NO}_2\text{F}(\text{g}) + \text{F}(\text{g})$  (slow)
  - b)  $\text{F}(\text{g}) + \text{NO}_2(\text{g}) \rightarrow \text{NO}_2\text{F}$  (Fast)
  - i) Write the equation of overall reaction
  - ii) Write the rate law
  - iii) Identify reaction intermediate
- 4) Define the half-life of a reaction. Write units of rate constants for:
  - a) First order reaction
  - b) Zero order reaction
- 5) Write an expression for the instantaneous rate of reaction:  $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$ .  
What is the order of reaction?
- 6) Why is molecularity applicable for only elementary reactions whereas order of reaction is applicable for elementary and complex reactions? Explain with suitable examples.
- 7) For a zero order reaction molecularity can never be equal to zero. Explain.
- 8) For the reaction  $2\text{A} + \text{B} \rightarrow \text{C}$ , rate of disappearance of A  $0.076\text{ mol s}^{-1}$ .
  - a) What is the rate of formation of C?
  - b) What is the rate of consumption of B?
  - c) What is the rate of the overall reaction?(Ans: **a.  $0.038\text{ mol s}^{-1}$  b.  $0.038\text{ mol s}^{-1}$  c.  $0.038\text{ mol s}^{-1}$** )

### Long answer questions (4 Marks)

- 1) In a first order reaction  $A \rightarrow B$ , 60% of a given sample of a compound decomposes in 45 mins. What is the half-life of a reaction? Also write the rate law equation for the above first order reaction.  
(Ans:  **$t_{1/2} = 34.02\text{min}$** )
- 2) Derive an expression for the relation between half-life and rate constant for first order reaction. The half-life period for first order reaction is 1.7 hrs. How long will it take for 20% of the reactant to disappear?  
(Ans:  **$t = 0.5475\text{ hrs. or } 32.86\text{ min}$** )
- 3) Write one example of the reaction where order and molecularity are the same. Mention any two factors that influence the rate of chemical reaction. If for the reaction  $A \rightarrow \text{products}$ , a straight line graph passing

through origin is obtained between the rate of reaction against concentration of A, what would be the order of reaction? Why

## Chapter- 07

### Elements of Group 16, 17, 18

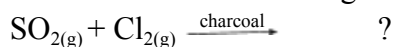
Marks 6 with option 8

#### Multiple Choice Questions (1 Mark)

- i) In chlorous acid, the oxidation state of chlorine is.....  
(a) +2            (b) +3            (c) +4            (d) +7
- ii) Acidic strength of halogen acids increases in the order of....  
(a)  $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$             (b)  $\text{HCl} > \text{HF} > \text{HBr} > \text{HI}$   
(c)  $\text{HBr} > \text{HCl} > \text{HF} > \text{HI}$             (d)  **$\text{HI} > \text{HBr} > \text{HCl} > \text{HF}$**
- iii) Sulfur dioxide reacts with sodium hydroxide solution to form \_\_\_\_\_  
(a) **Sodium Sulfite**            (b) Sodium Sulfate  
(c) Sodium hydrogen sulfite            (d) Sodium hydrogen sulfate
- iv) The gas is evolved, when sulfuric acid reacts with copper metal \_\_\_\_\_  
(a) **Sulfur dioxide**            (b) Sulfur trioxide  
(c) Nitrogen dioxide            (d) Nitrogen trioxide
- v) When hot and concentrate alkali NaOH reacts with chlorine to form \_\_\_\_\_  
(a) Only Chlorate            (b) Only Hypochlorite  
(c) **Chloride and Chlorate**            (d) Chloride and Hypochlorite
- vi) When  $\text{SO}_2$  is passed through an aqueous solution of  $\text{I}_2$  solution becomes \_\_\_\_\_  
(a) ruby red            (b) **colorless**            (c) violet            (d) yellowish green
- vii)  $\text{O}_2$  molecule is \_\_\_\_\_  
(a) ferromagnetic            (b) diamagnetic  
(c) **paramagnetic**            (d) ferrimagnetic
- viii) The number of covalent bonds are present in sulfuric acid?  
(a) 2            (b) 4            (c) 6            (d) **8**
- ix) In Interhalogen compounds, which halogen is never the central atom?  
(a) I            (b) **F**            (c) Br            (d) Cl

### Very Short Answer Questions ( 1 Mark)

i) Complete and write the following chemical reaction.



ii) Write the name of a solution formed by passing sulfur dioxide in water.

iii) Write chemical formula of galena

iv) Why does oxygen cannot exhibit higher oxidation state?

v) The number of lone pairs of electron are present in  $\text{ClF}_5$

vi) Write the order of ionic character of halide with monovalent metal (M)

vii) Write chemical composition of cryolite.

### Short Answer Questions (Type- I ) (2 Marks)

Q.1 Draw structure and name the shape of bromine trifluoride.

Q.2 Write four uses of chlorine.

Q.3 Write a balanced chemical reaction of sulfuric acid with (a) carbon (b) sulfur.

Q.4 Draw resonance hybrid structure of  $\text{SO}_2$  in two canonical forms.

Q.5 What is the action of chlorine on (a) cold and dilute sulfuric acid (b) hot and concentrated sulfuric acid.

Q.6 Elements of group 16 have lower ionization enthalpy values compared to those of group 15 elements.

Explain why?

Q.7 Write uses of dioxygen.

Q.8 a. Define: Dry bleach

b. Write the name of an element, which is a radioactive decay product of thorium and uranium.

Q.9 Write uses of Neon and Helium.

Q.10 Draw the structure and write shape of Chlorine pentafluoride.

Q.11 Write structure of ozone and sulfur dioxide

### Short Answer Questions (Type-II) (3 Marks)

Q.1 What is oxidation state of sulfur in following

(a) Sulfurous acid (b) Sulfuric acid (c) Peroxy monosulfuric acid.

Q.2 Explain why fluorine shows only +1 oxidation state while other halogens show higher positive

oxidation state?

Write chemical reaction of action of  $\text{Cl}_2$  in excess  $\text{NH}_3$

Q.3 Distinguish between rhombic sulfur and monoclinic sulfur with respect to following points:

Colour, shape, melting point, density, solubility in  $\text{CS}_2$ , structure.

Q.4 Explain the trend in the following atomic properties of group 16 elements:

(a) atomic radii (b) electronegativity (c) electron gain enthalpy

Q.5 What are chalcogens? Discuss industrial method of preparation of sulfur dioxide from zinc sulfide and iron pyrites.

Q.6 Write three physical properties and three uses of sulfuric acid.

Q.7 Explain the anomalous behavior of Oxygen with respect to

i) Atomicity ii) Magnetic property iii) Oxidation state

Q.8 Define: Interhalogen compounds. Write general characteristics of interhalogen compounds.

Q.9 Write preparation of Potassium dichromate by using Chromite ore.

### Long Answer Questions ( 4 Marks)

Q.1 Write chemical reactions in the manufacture of sulfuric acid by contact process.

Q.2 What happens when chlorine reacts with following.

(a) Al (b) Na (c)  $\text{S}_8$  (d)  $\text{P}_4$

Q.3 Draw structure of chloric acid and chlorous acid. Discuss four points of anomalous behavior of fluorine.

Q.4 Write the structures of following oxoacids of sulfur

i) Pyrosulphuric acid ii) Peroxy mono sulphuric acid  
iii) Peroxydisulfuric acid iv) Thiosulphuric acid.

Q.5 Write the structures of following oxoacids of chlorine

i) Chloric acid ii) Hypochlorous acid iii) Chlorous acid iv) Perchloric acid.

Q.6 Draw the structures of i)  $\text{XeF}_2$  ii)  $\text{XeF}_4$  iii)  $\text{XeF}_6$  iv)  $\text{XeOF}_4$





(c) chromium and manganese

(d) cobalt and nickel

### Very Short Answer Questions (1 Mark)

- i) Write a formula to calculate magnetic moment.
- ii) Write the general electronic configuration of 3d series.
- iii) Write the name of the radioactive element of Lanthanoid.
- iv) What is lanthanide contraction?
- v) Write chemical formula of ore of zinc.
- vi) Write the name of alloy formed from copper and tin.
- vii) Which alloy is used in the Fischer-Tropsch process in the synthesis of gasoline?
- viii) Write the name of catalyst used in the hydrogenation of ethene to ethane.
- ix) Write the general electronic configuration of lanthanoids.

### Short Answer Questions (Type- I ) (2 Marks)

- Q.1) Salt of  $\text{Sc}^{3+}$  and  $\text{Ti}^{4+}$  are colorless. Explain why?
- Q.2) Write observed electronic configuration of Europium ( $Z=63$ ) and Gadolinium ( $Z=64$ ).
- Q.3) Distinguish between lanthanides and actinides.
- Q.4) Manganese in the +2 oxidation state is more stable than +3 oxidation state whereas iron is stable at +3 oxidation state than +2 oxidation state. Explain why?
- Q.5) Explain terms cast iron and wrought iron with their uses?
- Q.6) What are the causes of lanthanide contraction?
- Q.7) Calculate the spin only magnetic moment of divalent cation of a transition metal with atomic number 26.
- Q.8) Write similarities between Lanthanoids and actinoids.
- Q.9) Define: a) Ore b) Mineral
- Q.10) Define: Gangue. Write chemical composition of Haematite.

### Short Answer Questions (Type-II) (3 Marks)

- Q.1) Give similarities and differences in the elements of 3d, 4d and 5d series.
- Q.2) Discuss the position of d-block elements, lanthanoids and actinoids in the periodic table.

- Q.3) Calculate magnetic moment of thorium ( $Z=90$ ). Is this element diamagnetic or paramagnetic?
- Q.4) What are interstitial compounds? write any four properties of it.
- Q.5) What are ferrous and non-ferrous alloys? Write any two uses of alloy.
- Q.6) What are rare earth elements? Write any two properties and uses of actinides.
- Q.7) Define: a) Pyrometallurgy b) Hydrometallurgy c) Electrometallurgy

**Long Answer Questions ( 4 Marks)**

- Q.1) Ground state electronic configurations of gadolinium and lawrencium are different than expected. Explain why?
- Q.2) Explain the trends in: (a) Atomic radii (b) Oxidation state of 3d elements.  
Which factors relate to the color of transition metal?
- Q.3) Define transuranium and d-block elements. Write two applications of lanthanides and actinides.
- Q.4) Write the chemical composition of the following minerals.  
i) Haematite ii) Chalcopyrite iii) Calamine iv) Chalcocite



### Very Short Answer Questions ( 1 Mark)

1. Draw structure of Ethylenediaminetetraacetate ion.
2. Write coordination number of Fe in  $[Fe(CN)_6]^{3-}$
3. Write the chemical composition of carnallite.
4. Write oxidation number of iron in  $[Fe(CO)_5]$
5. Calculate effective atomic number of iron in  $[Fe(CN)_6]^{4-}$  complex ion
6. Write the type of isomerism exhibited by  $[Co(NH_3)_5(NO)]^{2+}$  and  $[Co(NH_3)_5ONO]^{2+}$  pair of complex ion.
7. Write the IUPAC name of  $[Fe(CN)_6]^{4-}$  ion.

### Short Answer Questions (Type- I ) (2 Marks)

- 1) Explain homoleptic and heteroleptic complexes.
- 2) Write four postulates of Werner's theory
- 3) Write one example each of bidentate and ambidentate ligands.
- 4) Distinguish between double salt and coordination complex.
- 5) Define the following terms: (i) Coordination isomer (ii) Hydrated isomers
- 6) Write two applications of coordination compound.

### Short Answer Questions (Type-II) (3 Marks)

- 1) Write classification of ligands with one example of each type.
- 2) Define following terms (i) Coordination isomer (ii) Hydrated isomers.

Draw structure of cis isomer of  $[Co(NH_3)_4Cl_2]^+$

- 3) Write a formula to calculate EAN with significance of terms involved in it. Calculate EAN of  $[Fe(CN)_6]^{3-}$ .
4. Write the IUPAC name of  $[Ni(CN)_4]^{2-}$ .

Draw the geometrical isomers of following complexes  $[Pt(NH_3)(H_2O)Cl_2]$  and  $[Co(NH_3)_4Cl_2]^+$

5. Define ligand. Explain the magnetic properties of  $[Ni(CN)_4]^{2-}$ .

6. Define (i) Anionic complex (ii) coordination number. Draw optical isomers

Of  $[Co(en)_3]^{3+}$

### Long Answer Questions (4 Marks)

- 1) Write oxidation state and coordination number of Co in  $[Co(NH_3)_4Cl_2]^+$  ion. Calculate EAN of iron in  $[Fe(CN)_6]^{4-}$ . Write the IUPAC name of  $[Zn(NH_3)_4]^{2+}$ .
- 2) Explain, why  $[Co(NH_3)_6]^{3+}$  ion is low spin? Calculate number of unpaired electrons and write the geometry of  $[Co(NH_3)_6]^{3+}$ .
- 3) Answer the following with respect to  $[CoF_6]^{3-}$  ion
  - i) Type of hybridization
  - ii) Number of unpaired electrons
  - iii) Geometry of complex ion
  - iv) Magnetic property.

**Chapter- 10**  
**Halogen Derivatives** **Marks 5 with option 7**

**Multiple choice questions (1 Mark)**

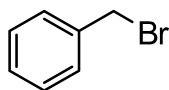
- i) The type of monohalogen derivative in which a halogen atom is bonded to  $sp^3$  hybridized carbon atom next to carbon-carbon double bond is .....
- a) alkyl halide **b) allylic halide**  
c) vinylic halide d) benzylic halide
- ii) Aromatic electrophilic substitution with iodine can be carried out using.....
- a)  $HNO_3$**  b) HCl  
c) HI d)  $H_3PO_4$
- iii) For the isomeric dihalobenzenes , melting point of .....
- a) ortho isomer is higher b) meta isomer is higher  
**c) para isomer is higher** d) all isomers is nearly same
- iv) Optical activity of a molecule is NOT associated with ....
- a) plane polarized light b) 3-D structure of a molecule  
c) achiral molecule **d) superimposable mirror images**
- v) Propane nitrile can be prepared by heating .....
- a) ethyl bromide with alcoholic KCN** b) propyl bromide with alcoholic KCN  
c) ethyl bromide with alcoholic AgCN d) propyl bromide with alcoholic AgCN
- vi) The following will react faster by  $S_N1$  mechanism
- a) 1-chloropropane b) 2-chloropropane  
**c) 2-chloro-2-methylpropane** d) chloroethane
- vii) Major product of the following reaction is .....
- $CH_3-CH_2-Mg-Br + NH_3 \longrightarrow ?$
- a)  $CH_3-CH_2-Mg-NH_2$  **b)  $CH_3-CH_3$**

c) Mg-Br -NH<sub>2</sub>

d) CH<sub>3</sub>-CH<sub>2</sub>-Br

### Very Short Answer Questions ( 1 Mark)

i) Write IUPAC name of the following.



ii) Write the major product of the following reaction.



iii) Write the correct decreasing order of boiling point for bromomethane, chloroform, dibromomethane and bromoform .

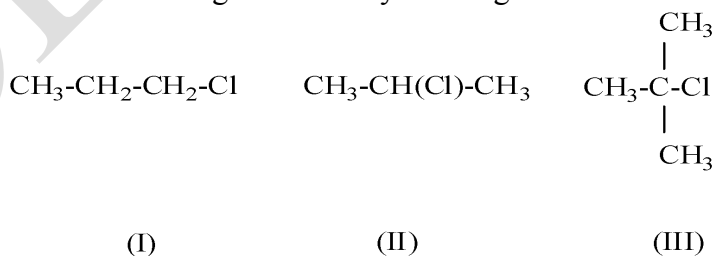
iv) Write IUPAC name of the product 'B' in the following reaction sequence.



v) Nucleophilic substitution reaction of 2,4-dinitrochlorobenzene is faster than p- nitro chlorobenzene. Give a reason.

vi) Write the name of reagent used to convert alkyl halide to ester.

vii) Write the correct order of increasing ease of dehydrohalogenation.



### Short Answer Questions (Type- I ) (2 Marks)

i) Define Optical activity. Draw the structure of DDT.



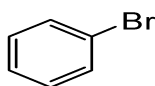
- ii) Explain reactions of haloarenes with sodium metal.
- iii) What is the action of chlorine on chlorobenzene? Write two uses of chloroform .
- iv) Explain optical activity of 2-chlorobutane.
- v) Distinguish between  $S_N1$  and  $S_N2$  mechanisms .
- vi) Explain primary benzylic halide shows higher reactivity by  $S_N1$  mechanism than other primary alkyl halide.
- vii) Explain Wurtz reaction by taking examples of two different alkyl halides.

### Short Answer Questions (Type-II) (3 Marks)

- i) Explain the factors affecting  $S_N1$  and  $S_N2$  mechanisms.
- ii) Explain alkaline hydrolysis of aqueous tert. butyl bromide.
- iii) How are the following conversions carried out?
  - a) propene to 1-iodopropane    b) propene to 2-nitropropane    c) benzene to biphenyl
- iv) What is Grignard reagent? How is it prepared? Why are they prepared under anhydrous condition?
- v) Write chemical equations indicating the action of following on bromobenzene.
  - a)  $\text{CH}_3\text{COCl}$  / anhy.  $\text{AlCl}_3$     b) fuming  $\text{H}_2\text{SO}_4$     c) conc.  $\text{HNO}_3$  / conc.  $\text{H}_2\text{SO}_4$
- vi) An organic compound A with molecular formula  $\text{C}_4\text{H}_{10}\text{O}$  on treatment with phosphorus pentachloride gives alkyl chloride. Alkyl chloride on treatment with Mg in presence of dry ether gives a highly reactive compound B. Compound B reacts with water to give hydrocarbon C. Alkyl chloride on treatment with Na in dry ether as a solvent gives alkane, 2,2,3,3-tetramethylbutane. Identify 'A', 'B', 'C' .

### Long Answer Questions ( 4 Marks)

- i) Write the chemical reactions for preparation of ethyl chloride from alcohols using following reagents.
  - a) Halogen acid    b) Phosphorus halide    c) Thionyl chloride
 Which among the above method is preferred for preparation of ethyl chloride and why?
- ii) What is dehydrohalogenation? State the rule for formation of preferred products of dehydrohalogenation. Predict all the alkenes that would be formed by dehydrohalogenation of the following alkyl halide.
  - a) 2-chloro-2-methylbutane    b) 3-bromo-2,2,3-trimethylpentane
- iii) Observe the following compounds and answer the questions given below.



(I)



(II)



c)  $\text{Br}_2 / \text{H}_2\text{O}$

d)  $\text{KBr aq.}$

### Very Short Answer Questions ( 1 Mark)

- i) Why do phenols give deep coloration with neutral ferric chloride?
- ii) Write the name of valuable byproduct formed in preparation of phenol by using cumene.
- iii) Write IUPAC name of crotonyl alcohol.
- iv) Write the structure of the major product of hydroboration-oxidation of propene.
- v) Write the reaction for the preparation of aspirin from salicylic acid.
- vi) Write the name of major product when anisole reacts  $\text{HI}$  at  $398 \text{ K}$ .
- vii) What is the action of atmospheric oxygen on ethers?
- viii) Draw intramolecular hydrogen bonding structure in o-nitrophenol.

### Short Answer Questions (Type- I ) ( 2 Marks)

- i) What is the action of following reagents on pent-3-enal, write a complete chemical equation.  
a)  $\text{H}_2 / \text{Ni}$                       b)  $\text{LiAlH}_4 / \text{H}_3\text{O}^+$
- ii) Write the reactions involved in preparation of phenol from aniline.
- iii) Write Kolbe's reaction.
- iv) Write the name of reagents used to convert phenol into  
a) picric acid                      b) p-benzoquinone
- v) Write the structure of 'A' and 'B' in the following reaction sequence.  
$$\text{CH}_3\text{COOH} + \text{C}_2\text{H}_5\text{OH} \xrightarrow[-\text{H}_2\text{O}]{\text{H}^+} \text{A} \xrightarrow[\Delta]{\text{H}_2/\text{Ni}} \text{B}$$
- vi) Write chemical equations, when acetyl chloride reacts with following reagents  
a) ethanol                      b) phenol

### Short Answer Questions (Type-II) ( 3 Marks)

- i) What is the action of following reagents on phenol at low temperature.

- a) dil.  $\text{HNO}_3$       b) conc.  $\text{H}_2\text{SO}_4$       c)  $\text{Br}_2/\text{CS}_2$
- ii) Explain with reactions, the action of Lucas reagent on primary, secondary and tertiary alcohols.
- iii) How will you bring about the following conversions?
- a) isopropyl alcohol to acetone  
b) 2-methyl propan-2-ol to 2-methylpropene  
c) acetone to 2-methylpropan-2-ol
- iv) Compound 'A' with molecular formula  $\text{C}_6\text{H}_5\text{Cl}$  is fused with  $\text{NaOH}$  at high temperature under pressure to give compound 'B'. Compound 'B' on treatment with dil.  $\text{HCl}$  gives compound C having characteristic carbolic odor. Write the chemical equations in support of this. Name the process and give uses of compound C.
- v) Write the preparation of ethanol from methyl magnesium iodide. Write the reaction between ethanol and acetic anhydride.
- vi) Write the reactions for preparation of carbolic acid from aniline. What is the action of conc.  $\text{H}_2\text{SO}_4$  on carbolic acid at 373 K.

### Long Answer Questions ( 4 Marks)

- i) Write chemical reactions to convert phenol into salicylaldehyde. Write the name of the reaction.  
What happens if  $\text{CCl}_4$  is used instead of  $\text{CHCl}_3$  in the above reaction.
- ii) An organic compound gives hydrogen on reaction with sodium metal. It forms an aldehyde with molecular formula  $\text{C}_2\text{H}_4\text{O}$  on oxidation with pyridinium chlorochromate. Give the chemical equations in support of these observations.  
Explain the fact that in alkyl aryl ethers, alkoxy group is ring activating and ortho/para directing towards electrophilic aromatic substitution.
- iii) How will you prepare diethyl ether by dehydration of alcohols? What are the limitations to prepare ether by this method? What is the action of following on diethyl ether?
- a) dil.  $\text{H}_2\text{SO}_4$       b)  $\text{PCl}_5$



vii) The following compounds will give a positive Fehling's test.

- a. Propanone
- b) Pentan-3-one
- c) Butanone
- d) Butan-2-ol**

### Very short answer type of questions (1 mark )

- 1. Write IUPAC name of Phthalaldehyde?
- 2. Write the structure of cyclic ketal.
- 3. Write the name of the product when ketones react with ethane-1,2 -diol in presence of dry HCl .
- 4. Write another name for the disproportionation reaction?
- 5. Write the number of products when a mixture of ethanal and propanal is reacted with dilute alkali?
- 6. Write structure of the product formed when carboxylic acid is heated with dehydrating agent like  $P_2O_5$
- 7. Write the formula of a reducing agent, which can't reduce  $-COOH$  group of carboxylic acid.

### Short answer questions (Type-I) ( 2 Marks)

- i) Write Classification of aliphatic ketones with suitable example
- ii) What is the action of Grignard reagent on benzonitrile?
- iii) Carboxylic acids have higher boiling points than those of ethers .Give reason.
- iv) Explain Cannizzaro reaction with suitable examples.
- v) What is the action of following reagents on propanal?    a.Sodium Bisulphite    b.Hydrazine
- vi) Write the chemical reactions for the preparation of acid amide from the following.
  - a. Carboxylic acid
  - b. Acid chloride

### Short answer questions (Type-II ) (3 marks )

- i) What is the action of following reagents on ethanoic acid?
  - a)  $SOCl_2$  / heat    b) soda lime / heat    c)  $P_2O_5$  / heat
- ii) Explain aldol condensation reaction of ethanal in detail.
- iii) Write reactions for the following conversions.
  - a. Benzene to Benzaldehyde

b. Propanone to Propane

c. 4-Nitrobenzoic acid to Nitrobenzene

iv) Explain haloform reaction with suitable example.

Write chemical reaction to distinguish acetaldehyde from acetone

v) Write IUPAC name of mesityl oxide. What is the action of following reagents on acetaldehyde?

a. hydroxylamine      b. acidified potassium dichromate

vi) Write chemical reactions to convert  $-\text{COOH}$  group of acetic acid into following

a.  $\text{CH}_4$    b.  $\text{C}_2\text{H}_5\text{OH}$    c.  $\text{CH}_3\text{COCl}$

### Long answer questions. (4 marks)

i) Draw structure of salicylaldehyde.

Write reaction for preparation of acetophenone from benzoyl chloride.

Explain the acidic nature of carboxylic acids.

ii) Write reactions for the action of following reagents on p-chlorobenzaldehyde.

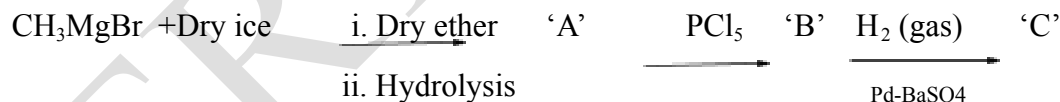
a) Ethane-1,2-diol in presence of dry HCl.

b) Tollen's reagent.

c) Phenyl hydrazine.

Write reagent for conversion of alkyl nitrile into aldehyde.

iii) What are aliphatic aldehydes? Complete the following sequence of reactions and write structures for A, B, C.



**Chapter -13**  
**Amines** **Marks 3 with option 4**

**Multiple Choice Questions (1 Mark )**

- i) The following amine is the product of Gabriel phthalimide synthesis
- a) secondary aliphatic amine                      **b) primary aliphatic amine**  
c) primary aromatic amine                      d) tertiary aliphatic amine
- ii) Mendius' reaction is used to convert .....
- a) amide into amine                      b) alkyl halide into amine  
c) nitroalkane into amine                      **d) alkyl cyanide into amine**
- iii) The strongest base amongst the following is
- a) Methanamine                      **b) N-Methylmethanamine**  
c) N-Methylaniline                      d) N, N-Dimethylmethanamine
- iv) The reaction in which diazonium salt is used
- a) Sandmeyer reaction**                      b) Mendius reaction  
c) Hofmann rearrangement reaction                      d) Carbylamine reaction
- v) The type of isopropylamine is a .....
- a) primary amine**                      b) secondary amine  
c) tertiary amine                      d) quaternary ammonium salt
- vi) Aniline on reaction with bromine water produces .....
- a) 1,4-Dibromobenzene                      b) 1,2,4-Tribromobenzene  
c) 2,4-Dibromoaniline                      **d) 2,4,6-Tribromoaniline**
- vii) Tertiary amines have lowest boiling points because .....
- a) they possess polar N-C bonds  
b) they possess intermolecular dipole-dipole attraction forces



- c) they possess intermolecular H-bonding
- d) they do not possess intermolecular H-bonding

### Very short answer type of questions (1 mark )

1. Write the name of process of breaking the C-X bond of R-X by ammonia in preparation of amines.
2. Arrange the following compounds in increasing order of their boiling points.  
Ethyl alcohol, Ethyl amine, Ethanoic acid, Ethane
3. Write the number of moles of ethanoyl chloride required for complete acylation of N,N-Dimethylaniline.
4. Write the name of the gas evolved when a primary amine is reacted with nitrous acid.
5. Write the structure of Hinsberg's reagent.
6. Write the order of reactivity of alkyl halides with ammonia.
7. Write the structure of Methylphenylamine

### Short answer questions (Type-I) (2 Marks)

- i. What is the action of fluoroboric acid on arene diazonium salt and the product is heated.
- ii. Write the reactions to bring about the following conversions.  
a. Aniline to Sulfanilic acid                      b. Methyl chloride to Ethanamine
- iii. Explain carbylamine reaction.
- iv. Write IUPAC names of p-toluidine and Trimethylamine
- v. What is the action of nitrous acid on the following compounds?  
a. Isopropylamine                                      b. Aniline
- vi. Write the reactions to bring about the following conversions.  
a. Nitroalkane to Alkylamine                      b. Alkyl cyanide to Alkylamine

### Short answer questions (Type-II ) (3 marks )

- i. Distinguish between methanamine ,dimethanamine and triethanamine using Hinsberg's reagent.

ii. Write IUPAC name of  $\text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2$  .

Write reactions to bring about the following conversions.

- a) Acetamide to Ethylamine
- b) Benzene diazonium chloride to phenol.

iii. Explain Hoffmann's exhaustive alkylation with suitable reactions.

iv. Explain nitration of aniline. Write reactions for the preparation of p-nitroaniline?

v. Explain Hofmann degradation reaction with an example

### Long answer questions (4 marks)

i. Write reactions for preparation of ethanamine using Gabriel phthalimide synthesis. Why aniline cannot be prepared by Gabriel phthalimide synthesis?

ii. Explain the basicity of amine with suitable examples. Write the factors influencing basicity of amines.

iii. Explain the following reactions with suitable examples.

- a) Gatterman reaction
- b) Sandmeyer reaction.
- c) Hofmann elimination reaction.
- d) Hoffmann Carbylamine test.

iv. Write the chemical reaction of ethylamine with

- i) moist  $\text{Ag}_2\text{O}$
- ii) Methyl iodide
- iii) Hinsberg reagent
- iv) Ethanoyl chloride

v. Write the chemical reaction of Benzenediazonium chloride with following reagents

- i) phosphinic acid (hypophosphorous acid,  $\text{H}_3\text{PO}_2$ )
- ii) Ethanol
- iii) Copper powder & HCl
- iv)  $\text{CuCN/KCN}$

**Chapter- 14**  
**Biomolecules** **Marks-3 with option 4**

**Multiple Choice Questions (1-Mark)**

- i) Glucose on oxidation with dilute nitric acid gives-----  
a) **saccharic acid**                      b) oxalic acid                      c) gluconic acid                      d) malonic acid
- ii) The glycosidic linkage in maltose is formed between-----  
a) C-1 of  $\alpha$ -D glucose and C-2 of  $\alpha$ -D glucose    **b) C-1 of  $\alpha$ -D glucose and C-4 of  $\alpha$ -D glucose**  
c) C-1 of  $\alpha$ -D glucose and C-2 of  $\alpha$ -D fructose    d) C-1 of  $\alpha$ -D glucose and C-4 of  $\alpha$ -D fructose
- iii) The optically inactive  $\alpha$ - amino acid among the following is-----  
a) alanine                                      b) insulin                                      c) leucine                                      **d) glycine**
- iv) The sugar component of nucleotide unit in RNA is-----  
a)  $\alpha$ - deoxy-D-ribose                      **b) D-ribose**                                      c) L-ribose                                      d) 2-deoxy-L-ribose
- v) The chemical nature of peptide bond in proteins is -----  
a) primary amide                              **b) secondary amide**                              c) tertiary amide                              d) an ionic bond
- vi) In which of the following structure of DNA carries genetic information of the organism  
**a) the primary structure of DNA**    b) the double helix structure of DNA  
c) complementary base pairing              d) sugar-phosphate backbone
- vii) In the process of denaturation, there is NO change in the structure following protein  
**a) primary**                                      b) secondary                                      c) tertiary                                      d) quaternary

**Very Short Answer Questions (1-Mark)**

- i) Write the name of polysaccharide used for commercial preparation of glucose.  
ii) Draw the structure of  $\alpha$ -D glucopyranose.

- iii) Write the structure of Zwitter ion of alanine.
- iv) Write the glycosidic linkage in sucrose.
- v) Write the name of the base present in DNA but not found in RNA.
- vi) Write the number of chiral carbon atoms present in fructose.
- vii) write the name of Sugar present in DNA.
- viii) Complete the following reaction.



### Short Answer Questions (Type-I) (2-Marks)

- i) Explain preparation of glucose from sucrose
- ii) Write chemical reaction for following conversions
  - a) glucose into glucoxime
  - b) glucose into gluconic acid
- iii) Define peptide bond. Write types of proteins depending upon molecular shape.
- iv) Define the following terms.
  - a) nucleotide
  - b) nucleoside
- v) Explain denaturation of proteins
- vi) Define enzymes. Write industrial application of enzyme catalysis.
- vii) Draw structure of following.
  - a) 2-Deoxy-D-ribose
  - b) Cytosine
- viii) Explain globular and fibrous proteins with example.
- ix) Classify the following carbohydrates into monosaccharide, disaccharide, oligosaccharide and polysaccharide
  - glucose, cellulose, maltose, stachyose

### Short Answer Questions (Type-II) (3-Marks)

- i) What is the action of following reagents on glucose?
  - a) acetic anhydride
  - b) hydrogen cyanide
  - c) hydrogen iodide.
- ii) Define carbohydrates. Draw the Haworth projection structures of the following.
  - a)  $\alpha$ -D-(-) fructofuranose
  - b) maltose
- iii) Explain D and L configuration in sugars. Write a chemical reaction to convert glucose into glucose cyanohydrin.
- iv) Define  $\alpha$ - amino acids. Draw the structures of a) Zwitterion of alanine b) Haworth formula of sucrose.
- v) Explain the primary structure of proteins. Write a commercial method for preparation of glucose.
- vi) Write the structure of following
  - a.  $\alpha$ -D-(+) Glucose by Fischer projection formula.

b.  $\alpha$ -D-(+) Glucopyranose.

c.  $\alpha$ -D-(-) fructofuranose

### Long Answer Questions (4-Marks)

- i) Define carbohydrates. Give the classification of carbohydrates with example.
- ii) What is monosaccharide? How is glucose prepared on a commercial scale? Draw the structure of pyran.
- iii) Write the glycosidic linkages present in Maltose, lactose, cellulose and amylose.

## Chapter- 15

### Introduction to polymer chemistry      Marks-3 with option 4

#### Multiple Choice Questions (1-Mark)

- i) Semisynthetic polymer among the following is -----  
a) linen                      b) silk                      c) nylon                      **d) cellulose nitrate**
- ii) Addition polymer among the following is -----  
a) terylene                      **b) polythene**                      c) nylon 6,6                      d) nylon 6.
- iii) Homopolymer among the following is -----  
a) Buna-S                      **b) Nylon 6,6**                      c) PHBV                      d) Dacron
- iv) Which of the following is a biodegradable polymer?  
a) nylon6                      b) nylon 6, 6                      **c) nylon2-nylon6**                      d) viscose rayon
- v) Chemical combination of Ziegler-Natta catalyst is-----  
a) trimethyl aluminium titanium tetrachloride  
**b) triethyl aluminium titanium tetrachloride**  
c) triethyl aluminium titanium trichloride  
d) triethyl aluminium titanium dichloride
- vi) Dacron is a copolymer of ethylene glycol and-----  
a) adipic acid                      b) hexamethylenediamine                      c) phthalic acid                      **d) terephthalic acid**
- vii) Nylon 6, 6 is a condensation polymer of hexamethylenediamine and-----  
a) picric acid                      **b) adipic acid**                      c) terephthalic acid                      d) ε caprolactam

#### Very Short Answer Questions (1-Mark)

- i) Write the number of carbon atoms present in the monomer used for preparation of nylon 6 polymer.

- ii) Write the name of the catalyst used for preparation of high density polythene polymer.
- iii) Write the name of the monomer used for preparation of polyacrylonitrile.
- iv) Write the name of a polymer formed by condensation polymerization of monomers ethylene glycol and terephthalic acid.
- v) Write name of the monomer of natural rubber.
- vi) Write the name of biodegradable polymer formed by two amino acids namely glycine and  $\epsilon$ -amino caproic acid.
- vii) Write the name of the functional group present in terylene polymer.
- viii) Write the name of the polymer obtained by polymerization of 2-chloro-1, 3-butadiene.

### Short Answer Questions (Type-I) (2-Marks)

- i) Define elastomer. Write the name of the raw material used for preparation of nylon 6 polymer.
- ii) Write chemical reactions for the preparation of following polymers a) Teflon b) polyacrylonitrile
- iii) Define vulcanization .Write the structure of the monomer used in natural rubber.
- iv) Explain the term copolymers with examples.
- v) Write preparation of low density polythene.Mention two uses of LDP.
- vi) Write chemical reactions for preparation of the following. a) Buna-S b) Neoprene.
- vii) Explain thermoplastic and thermosetting polymers.
- viii) Explain homopolymers with examples.
- ix) Write the name of one example of each polymer in which following repeating units.  
 $(-\text{CF}_2-\text{CF}_2-)$  ,  $-\text{[NH}-(\text{CH}_2)_5\text{-CO-]}$  ,  $(-\text{CH}_2-\text{CH})-\text{CN}$  ,  $(-\text{CH}_2-\text{CH}_2-)$

### Short Answer Questions (Type-II) (3-Marks)

- i) Explain classification of polymers on the basis of structures.
- ii) Explain copolymers. Write the name and formulae of the monomers used for preparation of Dacron.
- iii) Write chemical reactions for the preparation of high density polythene.Write its two uses and two properties.
- iv) Write the preparation of nylon 6, 6. Mention two properties and two uses of nylon 6,6 polymer.
- v) Explain classification of polymers on the basis of origin.
- vi) Define fibres.Explain vulcanization of rubber.
- vii) Explain free radical mechanisms in detail for the preparation of addition polymers.

### Long Answer Questions (4-Marks)

- i) Define rubber. Write the chemical reactions for the preparation of following polymers.  
a) teflon b) polyisoprene c) polyacrylonitrile d) SBR
- ii) Explain the reactions involved in the preparation of viscose rayon.

### Chapter-16

### Green Chemistry and Nanochemistry Marks 3 with option 4

#### Multiple choice questions (1 Mark)

- i) Bottom ash of thermal power stations can be used as raw material for cement and brick industry. This example illustrates which of the following principle of green chemistry
- |                                  |   |
|----------------------------------|---|
| a) Atom economy.                 | b) Designing safer chemicals.                 |
| c) Design for energy efficiency. | <b>d) Prevention of waste or by products.</b> |
- ii) Less hazardous chemical synthesis point of view instead of harmful DDT Now a days ----- is used as insecticides
- |                  |               |
|------------------|---------------|
| a) Benzene       | <b>b) BHC</b> |
| c) Chlorobenzene | d) Ethanol    |
- iii) The concept that aims to maximize efficiency and minimize hazardous effect on human health and environment was coined by Paul T. Anastas
- |                     |                           |
|---------------------|---------------------------|
| a) Green revolution | b) Blue revolution        |
| c) Nano chemistry   | <b>d) Green Chemistry</b> |
- iv) Nanorods are the example of -----
- |                                    |   |
|------------------------------------|---|
| a) One dimensional nanostructure   | <b>b) Two Dimensional nanostructure</b> |
| c) Three dimensional nanostructure | d) Zero dimensional nanostructure       |
- v) Which nanoparticles act as highly effective bacterial disinfectants, removing E.Coli from water?
- |                       |                                |
|-----------------------|--------------------------------|
| a) Gold nanoparticles | <b>b) Silver nanoparticles</b> |
|-----------------------|--------------------------------|



- c) TiO<sub>2</sub> nanoparticles  
d) ZnO nanoparticles
- vi) Catalyst used for hydrogenation of oil is-----  
a) V<sub>2</sub>O<sub>5</sub>  
b) Fe  
c) **Raney Ni**  
d) MnO<sub>2</sub>
- vii) In green technology developed by Drath and Frost, adipic acid is enzymatically synthesized from  
a) Sucrose  
b) lactose  
c) maltose  
d) **glucose**

### Very short answer Questions (1 Mark)

- i) Name the catalyst used to manufacture of H<sub>2</sub>SO<sub>4</sub> by contact process  
ii) Name the plant which is an example of self-cleaning  
iii) Write the name of a metal nanomaterial, which is used as a bacterial disinfectant.  
iv) Name the  $\gamma$ -isomer of Benzene hexachloride  
v) Which principle of green chemistry has its perspective towards to carrying out reactions at room temperature and pressure  
vi) Write any example of nanoparticles which are used in photo catalysis.  
vii) Write the name of the technique used to determine the geometry of nanomaterial.  
viii) Write the name of the nanostructured material that is used to increase the life of a car tyre.  
ix) Write the name of a nanomaterial synthesis process based on inorganic Polymerization.

### Short Answer Questions (Type-I) (2-Marks)

- 1) Define: Atom economy. Write the formula to calculate % atom economy  
2) Define      i) Green chemistry      ii) Nanochemistry  
3) Write one example of safer solvent and hazardous solvent  
4) How does nanochemistry play an important role in water purification?

### Short Answer Questions (Type-II) (3-Marks)

- 1) Explain prevention of waste or by-products which is one of the principles of green chemistry.  
2) Write any three advantages of nanoparticles and nanotechnology.

- 3) Write one example of nanomaterial used in following
  - i) water purification
  - ii) tyre of car
  - iii) ancient glass painting
- 4) Explain the role of green chemistry.
- 5) Explain any three characteristic features of nanoparticles.
- 6) State Disadvantages of nanoparticles and nanotechnology.
- 7) Define : a) Green chemistry b) Atom economy c) Sustainable development
- 8) Write three principles of green chemistry with examples.

### Long Answer Questions (4-Marks)

- 1) i) Explain the term sustainable development  
ii) How is nanotechnology useful for the energy sector?
- 2) i) Write a short note on catalytic activity of nanoparticles.  
ii) Complete and write the following table

S/N	Nanomaterial dimension	Nanomaterial type
a)	One dimension <100 nm	-----
b)	Two dimension <100 nm	-----

- 3) i) Explain use of safer solvent by giving suitable examples.  
ii) Define a) Nanomaterial  
b) Nanotechnology