CLASS XII
QUESTION BANK
(SESSION 2026-27)

Chapter 1. SOLUTIONS

MULTIPLE CHOICE QUESTIONS (1 MARK)	
1	K_H value for Ar(g), CO_2(g), HCHO (g) and CH_4(g) are 40.39, 1.67, 1.83 × 10^{-5} and 0.413 respectively. Arrange these gases in the order of their increasing solubility. a) HCHO < CH_4 < CO_2 < Ar b) HCHO < CO_2 < CH_4 < Ar c) Ar < CO_2 < CH_4 < HCHO d) Ar < CH_4 < CO_2 < HCHO
2	When a non-volatile solid is added to pure water it will: a) boil above 100^{o}C and freeze above 0^{o}C b) boil below 100^{o}C and freeze above 0^{o}C c) boil above 100^{o}C and freeze below 0^{o}C d) boil below 100^{o}C and freeze below 0^{o}C
3	Water- HCl mixture I. shows positive deviations II. forms minimum boiling azeotrope III. shows negative deviations IV. forms maximum boiling azeotrope a) I and II b) II and III c) I and IV d) III and IV
4	An azeotropic solution of two liquids has boiling point lower than either of them when solute solvent interactions are: a) Equal to solute solute and solvent solvent interactions b) Stronger than solute solute and solvent solvent interactions c)Weaker than solute solute and solvent solvent interactions d)None of the above
5	Molarity of a solution at 60^{o}C is -------- than molarity at 30^{o}C a) More b) less c) same d) no effect of temperature
6	For isotonic solutions which of the following is not equal a) concentration b) temperature c) osmotic pressure d) vapour pressure
7	For non-electrolyte solute value of Van't Hoff factor is a)0 b) 1 c) >1 d) <1
8	In reverse osmosis: a) a pressure greater than osmotic pressure is applied on pure water side b) a pressure lesser than osmotic pressure is applied on pure water side c)a pressure greater than osmotic pressure is applied on salt water side d)a pressure lesser than osmotic pressure is applied on salt water side
9	Which of the following salt will have same value of Van't Hoff's factor (i) as that of $K_4[Fe(CN)_6]$

(a) $Al_2(SO_4)_3$ (b) NaCl (c) $Al(NO_3)_3$ (d) Na_2SO_4

10	Pure benzene has vapour pressure three times that of pure toluene. They form nearly ideal solution. What would be the ratio of their mole fractions in the vapour phase of a solution having equal mole fractions of benzene and toluene. a)1 b) 2/3 c) 3 d) 1/3
ASSERTION REASON TYPE QUESTIONS (1 MARK)	
	Note: In the following questions (1-5) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices. (a) Assertion and reason both are correct statements and reason is the correct explanation for assertion. (b) Assertion and reason both are correct statements but the reason is not a correct explanation for assertion. (c) Assertion is a correct statement but the reason is the wrong statement. (d) Assertion is a wrong statement but the reason is a correct statement.
1	**Assertion:** When methyl alcohol is added to water, the boiling point of water decreases. **Reason:** When a volatile solute is added to a volatile solvent elevation in boiling point is observed.
2	**Assertion**: Cooking time in pressure cooker is reduced **Reason**: Boiling point inside the pressure cooker is raised
3	**Assertion**: Vapour pressure of a liquid is constant at a constant temperature **Reason:** At equilibrium rate of evaporation becomes equal to the rate of condensation.
4	**Assertion**: The components of azeotropic mixture can be separated by distillation **Reason**: At a particular composition azeotropic mixture boil at the same temperature.
5	**Assertion**: The shrinking of cells is called hemolysis. **Reason**: Hemolysis occurs when cell comes in contact with solution of lower osmotic pressure than that of cell

VERY SHORT ANSWER QUESTIONS 1 mark Type:

Q1 Give an example of a solid solution in which solute is a liquid

Q 2 Suggest the most important type of intermolecular attractive interaction between methanol and acetone

Q 3 X and Y liquids on mixing produces cold solution. What type of deviation is shown by them?

Q 4 Aquatic species are more comfortable in cold waters rather than in warm waters. Give reason.

Q 5 If is **α** the degree of dissociation of Na_2SO_4, calculate Van't Hoff factor to determine the molecular mass.

Q 6 Give an example of a substance that can be used as a SPM.

Q 7. What happens when blood cells are placed in a solution containing more than 0.9% (mass/volume) sodium chloride?

Q 8 People taking lot of salt experience puffiness or swelling of the body. Why ?

Q 9 What are hypotonic solutions?

Q 10 How can the direction of osmosis be reversed?

VERY SHORT ANSWER QUESTIONS (2 MARKS)

1	a) Common salt and Calcium chloride are used to clear snow on the roads, both are of almost same cost but sodium chloride is preferred. Why? b) How the freezing point changes when mercuric iodide is added to the aqueous solution of potassium iodide?
2	a) Write the expression for degree of dissociation of a weak electrolyte AxBy in terms of Van't Hoff factor. b) Name a substance that can be used in radiators of vehicles in places where the temperature is less than zero.
3	a) How the osmotic pressure of 5 % aqueous solution of glucose (π_1) is related to that of 5 % aqueous solution of urea (π_2)? b) Why do salt water fish die when they are suddenly transferred to a fresh water aquarium?
4	a) Two 500 ml beakers were taken. One filled with 400ml water marked 'X' and another with 400ml of 2M NaCl solution marked 'Y'. At the same temperature both were placed in closed containers of same material and same capacity, in which container the vapour pressure is less. b) Out of 1M sucrose and 1M urea solution which has more osmotic pressure?
5	a) Sia's father is suffering from high blood pressure but he is advised to consume less quantity of common salt. Why? b) Two solutions A and B are separated by semi-permeable membrane. If the liquid flows from A to B then which solution is more concentrated?
6	a) Why the colligative property of an electrolyte solution is always greater than

	that of a non-electrolyte solution? b) Mohit wants to put an egg with outer shell removed in a bottle but he is unable to do so as mouth of bottle is slightly smaller. Suggest one method to help him putting the peeled egg in the bottle
7	a) Out of 1M and 2M sugar solutions which one has a lower boiling point? b) While performing practical it is directed that the bottle of liquid ammonia is to be cooled before opening the seal but Suman forgot to cool it before opening. What consequence she faced?
8	a) What is the effect of temperature on the process when shrunk and dried vegetables are placed in water? b) The boiling point of 0.2 mol kg^{-1} solution of X in water is greater than equimolal solution of Y in water. Which one is undergoing dissociation in water?
9	a) What is the unit of Ebullioscopic constant? b) Which type of deviation is shown by Carbon tetrachloride and chloroform mixture?
10	a) What is the significance of Henry's Law constant K_H? b) How the colligative properties change if the solute undergo dissociation in solution?
SHORT ANSWER TYPE QUESTIONS (3 MARKS)	
1	a) If the elevation in boiling point of a solution for which i = 1 in a solvent (K_f =x K kg mol^{-1} and K_b=y K kg mol^{-1}) is z K,then calculate the depression in freezing point of the same concentration. b) Give two examples of materials used for making semi permeable membrane for carrying out reverse osmosis.
2	a) What is the degree of dissociation for 0.1M $Ba(NO_3)_2$ if i(Van't Hoff factor) is 2.74 b) Arrange the following solutions in increasing order of Van't Hoff factor. 0.1M $CaCl_2$, 0.1M KCl, 0.1M $C_{12}H_{22}O_{11}$, 0.1 M $Al_2(SO_4)_3$
3	a) Molal elevation constant for benzene is 2.52 K/m. A solution of some organic substance in benzene boils at 0.126°C higher than benzene. What is the molality of the solution?

	b) What are the values of Van't Hoff factor for NaCl and K_2SO_4, respectively?
4	a) State Henry's law. b) Which cold drink you prefer one chilled or other one at room temperature and why? c)At the same temperature hydrogen is more soluble in water than Helium. Which of them will have higher value of K_H and why?
5	a) Account for the reason, marine life like fish prefers to stay at lower level and stay away from the upper layer of water. b) Why freezing/melting point of a substance used as a criterion for testing the purity of a substance? c) Account for the reason for preservation of fruits against bacterial action by adding sugar.
LONG ANSWER TYPE QUESTIONS (5 MARKS)	
1	a) If boiling point of an aqueous solution containing a non-volatile solute is 100.15^{o}C. What is its freezing point? Given latent heat of fusion and vapourisation of water are 80cal/g and 540 cal/g respectively. b) Electrolyte A gives 4 ions and B is a non-electrolyte. If 0.1 molar solution of solute B produces an osmotic pressure 'p', then 0.02 molar solution of A will produce how much osmotic pressure?
2	a) 0.6 mL of acetic acid CH_3COOH, having density 1.06 g/mL, is dissolved in 1 litre of water. The depression in freezing point observed for this strength of acid was 0.0205°C. Calculate the van't Hoff factor and the dissociation constant of acid. K_f= 1.86 K kg /mol. b) How does Raoult's law become a special case of Henry's law?

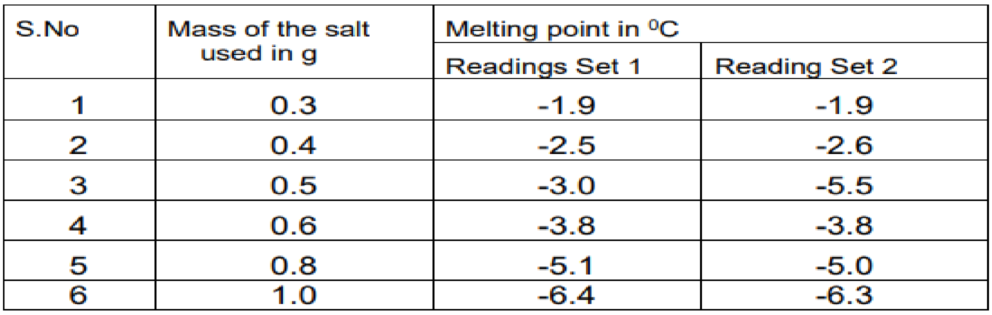
CASE BASED QUESTIONS (4 MARKS)

Read the passage given below and answer the following case-based questions:

Q1.	Boiling point or freezing point of liquid solution would be affected by the dissolved solids in the liquid phase. A soluble solid in solution has the effect of raising its boiling point and depressing its freezing point. The addition of non-volatile substances to a solvent decreases the vapor pressure and the added solute particles affect the formation of pure solvent crystals. According to many researches the decrease in freezing point directly correlated to the concentration of solutes dissolved in the solvent. This phenomenon is expressed as freezing point depression and it is useful for several applications such as freeze concentration of liquid food and to find the molar mass of an unknown solute in the solution. Freeze concentration is a high-quality liquid food concentration method where water is removed by forming ice crystals. This is done by cooling the liquid food below the freezing point of the solution. The freezing point depression is referred as a colligative property and it is proportional to the molar concentration of the solution (m), along with vapor pressure relative lowering, boiling point elevation, and osmotic pressure. These are physical characteristics of solutions that depend only on the identity of the solvent and the concentration of the solute. The characters are not depending on the solute's identity. (Jayawardena, J. A. E. C., Vanniarachchi, M. P. G., & Wansapala, M. A. J. (2017). Freezing point depression of different Sucrose solutions and coconut water.)
A	What is the relation between vapour pressure of solid and liquid states at freezing point?
B	Why freezing point of 0.1m solution of acetic acid in benzene is less than freezing point of 0.01m solution?
C	Out of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression? KCl , $C_6H_{12}O_6$, $Al_2(SO_4)_3$, K_2SO_4
	OR
C	If K_f for water is 1.86 °C/m, explain why 1m NaCl in water does not have a freezing point equal to a) -1.86 °C b) -3.72°C

Q2

1. Henna is investigating the melting point of different salt solutions. She makes a salt solution using 10 mL of water with a known mass of NaCl salt. She puts the salt solution into a freezer and leaves it to freeze. She takes the frozen salt solution out of the freezer and measures the temperature when the frozen salt solution melts. She repeats each experiment.



S.No	Mass of the salt used in g	Melting point in ^{0}C	
		Readings Set 1	Reading Set 2
1	0.3	-1.9	-1.9
2	0.4	-2.5	-2.6
3	0.5	-3.0	-5.5
4	0.6	-3.8	-3.8
5	0.8	-5.1	-5.0
6	1.0	-6.4	-6.3

Assuming the melting point of pure water as 0^{o}C, answer the following questions:

(a) One temperature in the second set of results does not fit in the pattern. Which temperature is that? Justify your answer. 1

(b) Why did Henna collect two sets of results? 1

(c) In place of NaCl, if Henna had used glucose, what would have been the melting point of the solution with 0.6 g glucose in it? 2

OR

(c) What is the predicted melting point if 1.2 g of salt is added to 10 mL of water? Justify your answer.

Q3

Aarav Sharma is very fond of a special drink made by his grandmother using different fruits available in their hometown. It has an outstanding taste and also provides great health benefits of natural fruits. He thought of utilizing his grandmother recipe to create a new product in the beverage market that provide health benefits and also contain fizziness of various soft drinks available in the market. Based on your understanding of solutions chapter, help Aarav Sharma to accomplish his idea by answering following:

(a) How he can add fizz to the special drink made by his grandmother? 1

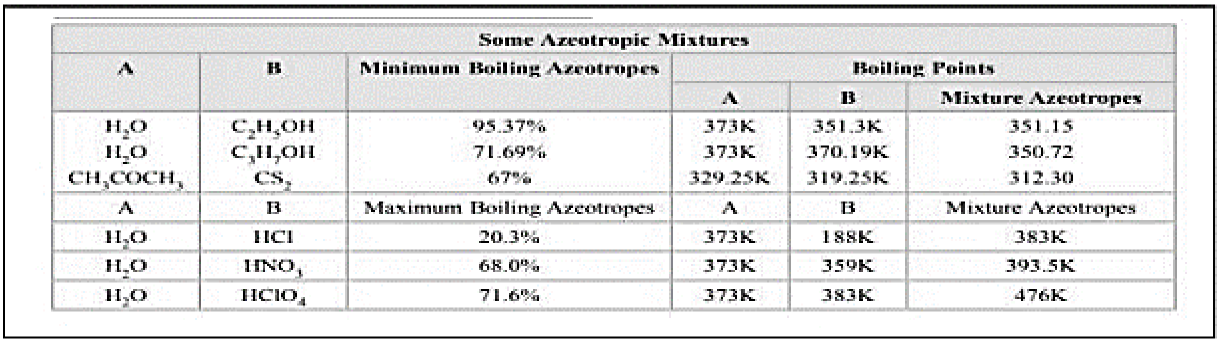
(b) What is the law stated in the chapter that can help Aarav to make his drink fizzy? 1

(c) What precautions he should take while bottling so that his product does not lose fizz during storage and handling across long distances? 2

OR

(c)The mole fraction of helium in a saturated solution at 20°C is 1.2×10^{-6}. Find the pressure of helium above the solution. Given Henry's constant at 20°C is 144.97 kbar.

Q4 Observe the table in which azeotropic mixtures are given along with their boiling points of pure Components and azeotropes and answer the questions that follow.



Some Azeotropic Mixtures

A	B	Minimum Boiling Azeotropes	Boiling Points A	Boiling Points B	Boiling Points Mixture Azeotropes
H_2O	C_2H_5OH	95.37%	373K	351.3K	351.15
H_2O	C_3H_7OH	71.69%	373K	370.19K	350.72
CH_3COCH_3	CS_2	67%	329.25K	319.25K	312.30
A	B	Maximum Boiling Azeotropes	A	B	Mixture Azeotropes
H_2O	HCl	20.3%	373K	188K	383K
H_2O	HNO_3	68.0%	373K	359K	393.5K
H_2O	$HClO_4$	71.6%	373K	383K	476K

(a) What type of deviation is shown by minimum boiling azeotropes? 1

OR

(a) Why does H_2O and HCl mixture form maximum boiling azeotropes? 1

(b) What are azeotropes?

(c) Give one example of ideal solution. What type of liquids form ideal solutions? 2

Q5 Boiling point or freezing point of liquid solution would be affected by the dissolved solids in the liquid phase. A soluble solid in solution has the effect of raising its boiling point and depressing its freezing point. The addition of non-volatile substances to a solvent decreases the vapor pressure and the added solute particles affect the formation of pure solvent crystals According to many researches the decrease in freezing point directly correlated to the concentration of solutes dissolved in the solvent. This phenomenon is expressed as freezing point depression and it is useful for several applications such as freeze concentration of liquid food and to find the molar mass of an unknown solute in the solution.

Freeze concentration is a high-quality liquid food concentration method where water is removed by forming ice crystals, this is done by cooling the liquid food below the freezing point of the solution. The freezing point depression is referred as a colligative property and it is proportional to the molar concentration of the solution (m), along with vapour pressure lowering boiling point elevation, and osmotic pressure. These are physical characteristics of solutions that depend only on the identity of the solvent and the concentration of the solute. The characters are not depending on the solute's identity.

(Source: Jayawardena, J. A. E. C., Vanniarachchi, M. P. G., & Wansapala, M. A. J. (2017). Freezing point depression of different Sucrose solutions and coconut water)

a. Four samples $BaCl_2$, NaCl, $ZnCl_2$ and $AICI_3$ of 0.5 M are being boiled Which of the among will show highest elevation in boiling point?

b. How does sprinkling of salt help in clearing the snow-covered roads in hilly areas?

c. The freezing point of nitrobenzene is 278.8 K. When 2.8 g of an unknown substance is dissolved in 100 g of nitrobenzene, the freezing point of solution is found 276.8 K. If the freezing point depression of nitrobenzene is 8.0 K kg mol^{-1}, what is the molar mass of unknown substance? [K_f=8 KKgmol^{-1}for nitrobenzene]

OR

C.A solution prepared by dissolving 2g of oil of wintergreen (methyl salicylate) in 100.0 g of benzene has a boiling point of 80. 31° C. Determine the molar mass of this compound. (B.P. of benzene - 80.10°C and K_b for benzene 2.52^0 C kg mol^{-1})

2. ELECTROCHEMISTRY

Q1. The positive value of the standard electrode potential of Cu^{2+}/Cu indicates that

(a) this redox couple is a stronger reducing agent than the H^+ /H_2 couple.
(b) this redox couple is a stronger oxidising agent than H^+ /H_2.
(c) Cu can displace H_2 from acid.
(d) Cu can displace H_2 from acid

Q2. On increasing temperature,
(a) ionic conductance increases and electronic conductance decreases.
(b) ionic conductance decreases and electronic conductance increases.
(c) both ionic and electronic conductance increase.
(d) both ionic and electronic conductance decrease.

Q3. The electrolyte used in the mercury cell is
(a) paste of NH_4Cl and $ZnCl_2$ (b) paste of HgO and carbon
(c) paste of KOH and ZnO (d) paste of PbO and H_2SO_4

Q4. A device that converts energy of combustion of fuels like hydrogen and methane directly into electrical energy is known as:
(a)=dynamo (b) Ni-Cd cell (c) fuel cell (d)= electrolytic cell

Q5. Which one of the following is always true about the spontaneous cell reaction in a= galvanic cell?
(a)=$E°_{cell} > 0$, $\Delta G° < 0$, $Q > K_C$ (b) $E°_{cell} < 0$, $\Delta G° < 0$, $Q < K_C$
(c)=$E°_{cell} > 0$, $\Delta G° > 0$, $Q > K_C$ (d) $E°_{cell} > 0$, $\Delta G° < 0$, $Q < K_C$

Q6. Charge carried by 1 mole of electrons is
(a) 6.023×10^{23} coulomb (b) 9.65×10^{4} coulomb
(c)=1.6×10^{-19} coulomb (d) 6.28×10^{19} coulomb=

Q7. To calculate the standard emf of the cell, which of the following options is correct if=E ° is reduction potential values?
(a) emf = $E°_{cathode} - E°_{anode}$ (b) emf = $E°_{anode} - E°_{cathode}$
(c) emf = $E°_{anode} + E°_{cathode}$ (d) None of these

ASSERTION REASON TYPE QUESTIONS(1MARKS)

Given below are two statements labelled as Assertion (A) and Reason (R)
Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

Q1. Assertion (A) : E_{cell} should have a positive value for the cell to function.
Reason(R) : $E_{cathode} < E_{anode}$

Q2. Assertion (A) : Copper sulphate cannot be stored in zinc vessel.
Reason (R) : Zinc is less reactive than copper.

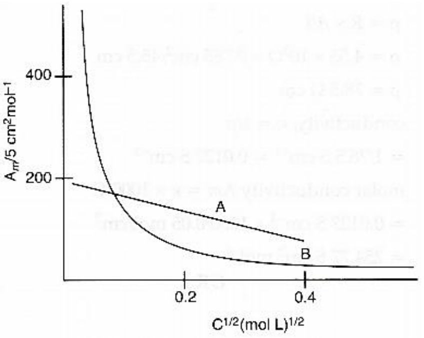
Q3. Assertion (A) : Current stops flowing when $E_{cell} = 0$.
Reason (R) : Equilibrium of the cell reaction is attained.

Q4. Assertion (A) : Conductivity of all electrolytes decreases on dilution.
Reason (R) : On dilution number of ions per unit volume decreases.

Q5. Assertion (A) : Conductivity decreases for weak electrolyte and increases for strong electrolyte with decrease in concentration.
Reason (R) : On dilution, the number of ions per unit volume that carry the current decreases.

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

Q1. In the plot of molar conductivity (Λ_m) vs square root of concentration ($C^{1/2}$), following curves are obtained for two electrolytes A and B.



Answer the following:

(i) Predict the nature of electrolytes A and B.

(ii) What happens on extrapolation of Λ_m to concentration approaching zero for electrolytes A and B?

(ii) For electrolyte A, the plot becomes linear near high dilution and thus can be extrapolated to zero concentration to get the molar conductivity at infinite dilution.
For weak electrolyte B, Λ_m increases steeply on dilution and extrapolation to zero concentration is not possible. Hence, molar conductivity at infinite dilution cannot be determined.

Q2. Calculate $\Delta_r G^\circ$ and $\log K_c$ for the following reaction at 298 K :

$$2\text{Cr}(s) + 3\text{Fe}^{2+}(aq) \longrightarrow 2\text{Cr}^{3+}(aq) + 3\text{Fe}(s)$$

Given: $E^0_{\text{cell}} = 0.30$ V

Q3. Three iron sheets have been coated separately with three metals A, B and C whose standard electrode potentials are given below. Identify in which rusting will takes place faster when coating is damaged.

Metal	A	B	C	Iron
E^0	-0.46 V	-0.66 V	-0.20 V	-0.44 V

Q4. Can you store copper sulphate solutions in a zinc pot?

Q5. Suggest a way to determine the Λ_m^0 value of water.

Q6. Why on dilution the Λm of CH_3COOH increases drastically while that of CH_3COONa increases gradually?

Q7. (a) What is the role of $ZnCl_2$ in a dry cell?
(b) Unlike dry cell, the mercury cell has a constant cell potential throughout its useful life. why?

Q8. **(a)** Value of standard electrode potential for the oxidation of Cl^- ions is more positive than that of water, even then in the electrolysis of aqueous sodium chloride, why is Cl^- oxidised at anode instead of water?
(b) How will the pH of brine (aq. NaCl solution) be affected when it is electrolysed?

Q9. **(a)** Which type of a metal can be used in cathodic protection of iron against rusting?
(**b**) Write the name of the electrolyte used in fuel cell

Q10. Depict the galvanic cell in which the reaction $Zn(s) + 2Ag^+ (aq) \rightarrow Zn^{2+} (aq) + 2Ag(s)$ takes place. **Further show: (i)** Which of the electrode is negatively charged? **(ii)** The carriers of the current in the cell.

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

Q1. **(a)** Calculate the cell emf and ΔG° for the cell reaction at 25°C for the cell :
$\mathrm{Zn}_{(s)}|\mathrm{Zn}^{2+}(0.0004\mathrm{M}) \parallel \mathrm{Cd}^{2+}(0.2\mathrm{M})|\mathrm{Cd}_{(s)}$ E° values at 25°C: $\mathrm{Zn}^{2+}/\mathrm{Zn} = -0.763$ V
$\mathrm{Cd}^{2+}/\mathrm{Cd} = -0.403$ V; $F = 96500\mathrm{Cmol}^{-1}$; $R = 8.314\ \mathrm{J\ K^{-1}\ mol^{-1}}$.
(b) If E° for copper electrode is 0.34 V, how will you calculate its emf value when the solution in contact with it is 0.1M in copperions? How does emf for copper electrode change when concentration of Cu^{2+} ions in the solution is decreased?

Q2. The molar conductivity of sodium acette, sodium chloride and hydrochloric acid are 83,127 and 426 mho $\mathrm{cm^2 mol^{-1}}$ at 250°C respectively. Calculate the molar conductivity of acetic acid solution.

Q3. A strip of nickel metal is placed in a 1 molar solution of $\mathrm{Ni(NO_3)_2}$ and a strip of silver metal is placed in a 1 molar solution of $\mathrm{AgNO_3}$. An electrochemical cell is created when the two solutions are connected by a salt bridge and the two strips are connected by wires to a voltmeter.
(i) Write the balanced equation for the overall reaction occurring in the cell and calculate the cell potential.
(ii) Calculate the cell potential, E, at 25°C for the cell if the initial concentration of $\mathrm{Ni(NO_3)_2}$ is 0.100 molar and the initial concentration of $\mathrm{AgNO_3}$ is 1.00 molar.
$\left[E^0_{\mathrm{Ni^{2+}/Ni}} = -0.25\ \mathrm{V}; E^0_{\mathrm{Ag^+/Ag}} = 0.80\ \mathrm{V}, \log 10^{-1} = -1\right]$
Ans. Cell reaction: $Ni + 2Ag^+ \rightarrow Ni^{2+} + 2Ag$, $E^\circ_{Cell} = E^\circ_{cathode} - E^\circ_{anode}$, $E^\circ_{Cell} = 1.05V$

Q4. The electrochemical cell given alongside converts the chemical energy released during the redox reaction to electrical energy: $\mathrm{Zn}(s) + \mathrm{Cu}^{2+}(aq) \longrightarrow \mathrm{Zn}^{2+}(aq) + \mathrm{Cu}(s)$
It gives an electrical potential of 1.1 V when concentration Zn^{2+} and Cu^{2+} ions is unity. State the direction of flow of current and also specify whether zinc and copper are deposited or dissolved at their respective electrodes when:

(i) an external opposite potential of less than 1.1 V is applied.
(ii) an external potential of 1.1 V is applied.
(iii) an external potential of greater than 1.1 V is applied.

Q5. Explain redox potential. Reduction potentials of some ions are given below. Arrange them in decreasing order of oxidizing power.

Ion	$\mathrm{ClO_4^-}$	$\mathrm{IO_4^-}$	$\mathrm{BrO_4^-}$
Reduction potential $E^\ominus/V$	$E^0 = 1.19$ V	$E^0 = 1.65$ V	$E^0 = 1.74$ V

LONG ANSWER TYPE QUESTIONS (5 MARKS)

Q1. (i) State two advantages of H_2—O_2 fuel cell over ordinary cell.
(ii) Silver is electrodeposited on a metallic vessel of total surface area 500 cm^2 by passing a current of 0.5 amp for two hours. Calculate the thickness of silver deposited. [Given: Density of silver = 10.5 g cm^{-3}, Atomic mass of silver = 108 amu, F = 96,500 C mol^{-1}]

Ans. (i) pollution free, 75% efficiency, continuous source of energy.
(ii) m=ZIt = 4.029g, V=m/d = 0.3837 cm^3, thickness of Ag deposited is x, V= A. x = 7.67×10^{-4}cm

Q2. (i) Define limiting molar conductivity and fuel cell.
(ii) Resistance of a conductivity cell filled with 0.1 mol L^{-1} KCl solution is 100 ohm. If the resistance of the same cell when filled with 0.02 mol L^{-1} KCl solution is 520 ohm, calculate the conductivity and molar conductivity of 0.02 mol L^{-1} KCl solution. The conductivity of 0.1 molL^{-1} KCl solution is 1.29×10^{-2} ohm^{-1} cm^{-1}.

Ans (i) Limiting Molar conductivity -limiting value of molar conductivity when concentration approaches to zero. Fuel cell - device which converts energy produced during the combustion of fuels directly into electrical energy.
(ii) cell constant = conductivity x resistance = 1.29 cm^{-1}, Conductivity, k = Cell constant/Resistance = 0.00248 ohm^{-1} cm^{-1}, $\Lambda_m =$ k X 1000/M = 124 ohm^{-1} cm^2 mol^{-1}

CASE BASED QUESTIONS

Read the passage carefully and answer the questions.

Redox reactions play an important role in chemistry. Whenever a redox reaction takes place directly in a single beaker, chemical energy in the form of heat is produced. By suitable means, it is possible to bring about the redox reactions indirectly so as to convert the chemical energy into electrical energy. A device used to convert the chemical energy produced in a redox reaction into electrical energy is called an electrochemical cell. If a redox reaction is allowed to take place in such a way that oxidation half reaction takes place in one beaker and the reduction half reaction in another beaker, the electrons given out by the former will be taken by the latter and the current will flow. The two portions of the cell are called half cells. The values of standard redox potential (E^0) of two half cell reactions decides in which way the reaction will proceed. A redox reaction is feasible when the substance having higher reduction potential gets reduced and the one having lower reduction potential gets oxidised. For example, In Daniel cell, zinc goes into solution and copper gets deposited.

1.Formulate the galvanic cell for: $\mathrm{Zn}(s)+2\mathrm{Ag}^{+}(aq) \longrightarrow \mathrm{Zn}^{2+}(aq)+2\mathrm{Ag}(s)$

Ans. The cell is represented as: $\mathrm{Zn}(s)|\mathrm{Zn}^{2+}(aq) \parallel \mathrm{Ag}^{+}(aq)|\mathrm{Ag}(s)$

2. Is it safe to stir $\mathrm{AgNO_3}$ solution with a copper spoon? Why or why not?

Given: $E^0_{\mathrm{Ag^+/Ag}}=0.80$ volt and $E^0_{\mathrm{Cu^{2+}/Cu}}=0.34$ volt

Ans. No, because copper is more reactive than Ag and can displace Ag from $\mathrm{AgNO_3}$ solution.

3. Two half-cell reactions of an electrochemical cell are given below:

$$\mathrm{MnO_4^-}(aq)+8\mathrm{H}^{+}(aq)+5e^{-} \longrightarrow \mathrm{Mn}^{2+}(aq)+4\mathrm{H_2O}(l), \quad E^0=+1.51\ \mathrm{V}$$
$$\mathrm{Sn}^{2+}(aq) \longrightarrow \mathrm{Sn}^{4+}(aq)+2e^{-}, \quad E^0=+0.15\ \mathrm{V}$$

Construct the redox reaction from the two half-cell reactions and predict if this reaction favours formation of reactants or products shown in the equation.

Ans.

$$2\mathrm{MnO_4^-}(aq)+16\mathrm{H}^{+}(aq)+5\mathrm{Sn}^{2+}(aq) \longrightarrow 2\mathrm{Mn}^{2+}(aq)+5\mathrm{Sn}^{4+}(aq)+8\mathrm{H_2O}(l)$$
$$E^o_{\text{Cell}}=E^\circ_{\text{Cathode}}-E^\circ_{\text{Anode}}=1.51\ \mathrm{V}-0.15\ \mathrm{V}=0.36\ \mathrm{V},\ \text{product forms}$$

OR

(i) State the factors affecting cell potential of: $\mathrm{Mg}(s)|\mathrm{Mg}^{2+}(aq) \parallel \mathrm{Ag}^{+}(aq)|\mathrm{Ag}(s)$

(ii) Can E^0_{cell} or $\Delta_r G^0$ for cell reaction ever be equal to zero?

Ans.(i) concentration of Mg^{2+} and Ag^{+}ions in the solution and temperature.

(iii) No, E°_{cell} or $\Delta_r G^0$ for cell reaction can never be zero. $\Delta G^\circ = -nFE^\circ$

3. CHEMICAL KINETICS

MULTIPLE CHOICE QUESTIONS:

1. For a given rate, the unit of rate and the rate constant are the same.
   (A) zero order reaction (B) first order reaction
   (C) second order reaction (D) third order reaction
2. If concentration of reactant 'A' is increased 10 times and the rate of reaction becomes 100 times. What is the order with respect to 'A'?
   (A) 1 (B) 2 (C) 3 (D) 4
3. Which of the following is not a direct factor affecting the rate of a reaction?
   (A) Temperature (B) Presence of catalyst
   (C) Order of reaction (D) Molecularity
4. In the elementary reaction $2A + B \rightarrow A_2B$, if the concentration of A is doubled and that of B is halved, then the rate of the reaction will
   (A) increase 2 times (B) increase 4 times
   (C) decrease 2 times (D) remain the same
5. A first order reaction has a half-life length of 10 minutes. In 100 minutes, what proportion of the response will be completed?
   (A) 25% (B) 50% (C) 99.9% (D) 75%
6. What is the order of reaction decomposition of Ammonia on platinum surface is
   (A) Zero order reaction (B) First order reaction
   (C) Second order reaction (D) Fractional order reaction
7. In the rate equation, when the concentration of reactants is unity then the rate is equal to:
   (A) Specific rate constant (B) Average rate constant
   (C) Instantaneous rate constant (D) None of the above
8. The rate constant of zero order reactions has the unit
   (A) s^{-1} (B) mol $L^{-1}s^{-1}$
   (C) L^2 mol^{-2} s^{-1} (D) L $mol^{-1}s^{-1}$
9. Radioactive disintegration is an example of
   (A) first order reaction (B) zero order reaction
   (C) second order reaction (D) third order reaction
10. A catalyst alters, which of the following in a chemical reaction?
    (A) Entropy (B) Enthalpy
    (C) Internal energy (D) Activation energy

ASSERTION – REASON BASED QUESTIONS

Read the Assertion and Reason statements and choose the appropriate option from below:

A) Both A and R are true and R is the correct explanation of A
B) Both A and R are true and R is not the correct explanation of A
C) A is true but R is false
D) A is false but R is true

1. Assertion: Increasing the pressure of reactants can increase the rate of a reaction.
   Reason: Higher pressure can increase the frequency of collisions between reactant molecules
2. Assertion: The presence of a catalyst increases the activation energy of a reaction.
   Reason: Catalysts provide an alternative reaction pathway with a lower activation energy.
3. Assertion: Hydrolysis of methyl ethanoate is a pseudo-first-order reaction.

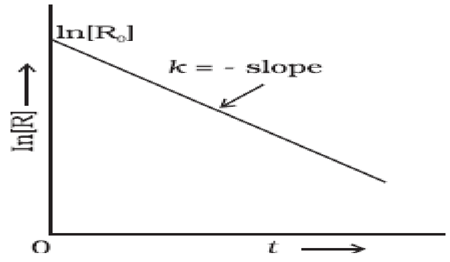
Reason: Water is present in large excess and therefore its concentration remained constant throughout the reaction.

4. Assertion: Average rate and instantaneous rate of a reaction have the same unit.
Reason: Average rate becomes an instantaneous rate when the time interval is too small.

5. Assertion: All collision of reactant molecules lead to product formation.
Reason: Only those collisions in which molecules have correct orientation and sufficient kinetics energy lead to compound formation.

VERY SHORT ANSWER QUESTIONS (1 MARK)

1. In some cases, it is found that a large number of colliding molecules have energy more than threshold value, yet the reaction is slow. Why?
2. For a reaction R→P, half-life ($t_{½}$) is observed to be independent of the initial concentration of reactants. What is the order of reaction?
3. Why does the rate of a reaction not remain constant throughout the reaction process?
4. What is elementary reaction?
5. Express the rate of the following in terms of ammonia.
$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
6. Mention the factors that affect the rate of a chemical reaction.
7. In a reaction, 2A → Products, the concentration of A decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the rate during this interval?
8. A graph is drawn between ln[R] and *t* for a reaction. What is order of reaction?



9. Time required to decompose SO_2Cl_2 to half of its initial amount is 60 minutes. If the decomposition is a first order reaction, calculate the rate constant of the reaction.
10. How catalyst increase the rate of reaction?

SHORT ANSWER QUESTIONS TYPE-1 (2 MARKS)

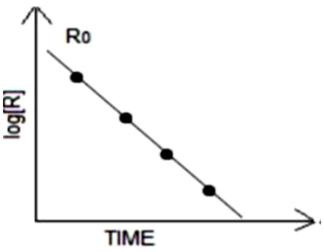
1. What is the effect of temperature on the rate constant of a reaction?
2. Define each of the following:
(i) Specific rate of a reaction. (ii) Energy of activation of a reaction.
3. Bring out the difference between order and molecularity of reaction.
4. The rate of the chemical reaction doubles for an increase of 10 K in absolute temperature from 298 K. Calculate Ea.
5. The rate for the decomposition of NH_3 on platinum surface is zero order. What are the rate of production of N_2 and H_2 if $K=2.5\times10^{-4}$mol litre^{-1}s^{-1}.

SHORT ANSWER QUESTIONS TYPE-2 (3 MARKS)

1. For the reaction A + B →products, the following initial rates were obtained at various given initial concentrations. Determine the overall order of a reaction

S.No.	[A] mol / L	[B] mol / L	Initial rate M/s
1.	0.1	0.1	0.05
2.	0.2	0.1	0.10
3.	0.1	0.2	0.05

2. Observe the graph in diagram and answer the following questions.



(i) If slope is equal to -2.0 x10^{-6} sec^{-1}, what will be the value of rate constant?
(ii) How does the half-life of zero order reaction relate to its rate constant?

3. (a) Consider a certain reaction A → Products with k = 2.0 × 10^{-2} s^{-1}. Calculate the concentration of a remaining after 100 s if the initial concentration of A is 1.0 mol l^{-1}
(b) The half-life for radioactive decay of C -14 is 5730 years. An archaeological artefact containing wood had only 80% of the C -14 found in a living tree. Estimate the age of the sample.

4. If a zero-order reaction starts with the concentration of 10 mol/L, it's half-life is 2 minutes, what will be the half-life of the same reaction, if it is started with 20 mol/L?

5. (i) What will be the effect of temperature on rate constant?
(ii) State a condition under which a biomolecular reaction is kinetically first order reaction.
(iii) For a zero-order reaction, will the molecularity be equal to zero? Explain.

LONG ANSWER QUESTIONS (5 MARKS)

1. (a) (i) For the reaction 2X →X_2, the rate of reaction becomes three times, when concentration of X is increased 27 times. What is the order of the reaction?
(ii) Write the rate equation for the reaction
2A + B →2C, if the order of the reaction is zero.
(iii) Oxygen is available in plenty in air, yet fuels do not burn by themselves at room Temperature. Explain.
(b) Rate constant for first order reaction has been found to be 2·54 ×10^{-3} s^{-1}. Calculate its three- fourth life. [log 2 = 0·3010].

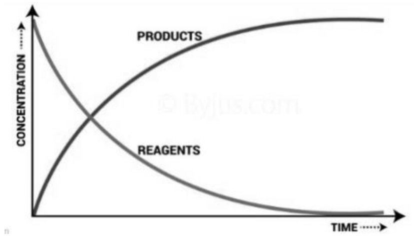
2. (a) (i) A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of the reaction?
(ii) A first order reaction is 50% completed in 1.26 × 10^{14} s. How much time would it take for 100% completion?
(iii) The activation energy of a reaction is zero. Will the rate constant depend upon temperature? Explain.
(b) A reaction is first order in A and second order in B. Write the differential rate equation and calculate how the rate is affected when
(i) concentration of B is tripled, (ii) concentration of both A and B is doubled.

CASE BASED QUESTIONS / INTEGRATED BASED QUESTIONS (4 MARKS)

1. **Read the passage carefully and answer the questions that follow**

Rate of the Reaction

Speed of any event is measured by the change that occurs in any interval of time. The speed of a reaction (reaction rate) is expressed as the change in concentration of a reactant or product over a certain amount of time. Sometimes it is more convenient to express rates as numbers of molecules formed or consumed in unit time.



We could also look at the rate of appearance of a product. As a product appears, its concentration increases. The rate of appearance is a positive quantity. We can also say the rate of appearance of a product is equal to the rate of disappearance of a reactant.

Answer the following questions:

(a) Write the rate of the chemical reaction with respect to the variables for the given equation.

$$2A+3B\rightarrow C+2D$$

(b) In a reaction, 2A → Products, the concentration of A decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the rate during this interval?

(c) In the reaction $H_2O_{2(aq)} \rightarrow H_2O_{(l)} + \frac{1}{2} O_{2(g)}$, the initial concentration of H_2O_2 is 0.2546 M, and the initial rate of reaction is 9.32×10^{-4} M s^{-1}. What will be $[H_2O_2]$ at t = 35 s?

OR

(c) How is the rate of disappearance of ozone related to the rate of appearance of oxygen in the following equation?

$$2O_{3\ (g)} \rightarrow 3O_{2\ (g)}$$

If the rate of appearance of O_2 is 60.0×10^{-5} M/s at a particular instant, what is the value of the rate of disappearance of O_3 at this same time?

2. **Read the passage carefully and answer the questions that follow**

Order of the Reaction

The rate law for a chemical reaction relates the reaction rate with the concentrations or partial pressures of the reactants. For a general reaction, aA + bB→ C with no intermediate steps in its reaction mechanism, meaning that it is an elementary reaction. The rate law is given by $r = k [A]^x [B]^y$ where [A] and [B] express the concentrations of A and B in moles per litre. Exponents x and y vary for each reaction and are determined experimentally. The value of k varies with conditions that affect reaction rate, such as temperature, pressure, surface area, etc. The sum of these exponents is known as overall reaction order. A zero order reaction has constant rate that is independent of the concentration of the reactants. A first order reaction depends on the concentration of only reactant. A reaction is said to be of second order when the overall order is two. Once we have determined the order of the reaction, we can go back and plug one set of our initial values and solve for k.

Answer the following questions:

(a) Calculate the overall order of the reaction which has the following rate expression:

Rate= $k[A]^{1/2}[B]^{3/2}$

(b) What is the effect of temperature on rate of the reaction?

(c) What is meant by the rate of reaction?

(d) A first order reaction takes 77.78 minutes for 50% completion. Calculate the time required for 30% completion of the reaction. (log 10= 1, log 7=0.8450)

OR

A first order reaction has a rate constant 1×10^{-3} s^{-1}. How long will 5 gm of this reactant take to reduce to 3 gm? (log 3= 0.4771, log 5=0.6990)

3. **Read the passage carefully and answer the questions that follow**

Radio Activity

There are nuclear reactions constantly occurring in our bodies, but these are very few of them compared to the chemical reactions, and they do not affect our bodies much. All of the physical processes that take place to keep a human body running are chemical processes. Nuclear reactions can lead to chemical damage, which the body may notice and try to fix. The nuclear reaction occurring in our bodies is radioactive decay. This is the change of a less stable nucleus to a more stable nucleus. Every atom has either a stable nucleus or an unstable nucleus, depending on how big it is and on the ratio of protons to neutrons. The ratio of neutrons to protons in a stable nucleus is thus around 1:1 for small nuclei ($Z<20$). Nuclei with too many neutrons, too few neutrons, or that are simply too big are unstable. They eventually transform to a stable form through radioactive decay. Wherever there are atoms with unstable nuclei (radioactive atoms), there are nuclear reactions occurring naturally. The interesting thing is that there are small amounts of radioactive atoms everywhere: in your chair, in the ground, in the food you eat, and yes, in your body. The most common natural radioactive isotopes in humans are carbon-14 and potassium-40. Chemically, these isotopes behave exactly like stable carbon and potassium. For this reason, the body uses carbon-14 and potassium-40 just like it does normal carbon and potassium; building them into the different parts of the cells, without knowing that they are radioactive. In time, carbon-14 atoms decay to stable nitrogen atoms and potassium-40 atoms decay to stable calcium atoms. Half-life of C-14 is 6000 years Chemicals in the body that relied on having a carbon14 atom or potassium-40 atom in a certain spot will suddenly have a nitrogen or calcium atom. Such a change damages the chemical. Normally, such changes are so rare, that the body can repair the damage or filter away the damaged chemicals.

Answer the following questions:

(a) Why is Carbon -14 radioactive while Carbon -12 not?

(Atomic number of Carbon: 6)

(b) Which are the two most common radioactive decays happening in human body?

(c) Suppose an organism has 20 g of Carbon -14 at its time of death. Approximately how much Carbon -14 remains after 10,320 years? (Given antilog 0.517 = 3.289)

OR

(c) Approximately how old is a fossil with 12 g of Carbon -14 if it initially possessed 32 g of Carbon -14? (Given log 2.667 = 0.4260)

4. **Read the passage carefully and answer the questions that follow**

Temperature Dependence of Rate of a Reaction

Temperature influences the rate of a reaction. As the temperature increases, the rate of a reaction increases. For example, the time taken to melt a metal will be much higher at a lower temperature but it will decrease as soon as we increase the temperature. It has been found that the rate constant is nearly *doubled* for a chemical reaction with a rise in temperature by 10°. The dependence of the rate of a chemical reaction on temperature can be explained by Arrhenius equation.

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

According to the Arrhenius equation, a reaction can only take place when a molecule of one substance collides with the molecule of another to form an unstable intermediate. This intermediate exists for a very short time and then breaks up to form product. The energy required to form this intermediate is known as activation energy (E_a). The fraction of molecules with kinetic energy equal to or greater than E_a at a given temperature may lead to the product. As the temperature rises, the proportion of molecules with energies equal to or greater than activation energy ($\geq E_a$) increases. As a result, the reaction rate would increase.

Answer the following questions:

(a) How does the half life period of a first order reaction vary with temperature?

OR

For an endothermic reaction, the activation energy of forward reaction will be equal to or less than or more than activation energy of backward reaction.

(b)The slope of Arrhenius Plot (ln k vs 1/T) of first order reaction is $-5\times10^3 K$. Calculate the value of E_a of the reaction. [Given R = 8.314$JK^{-1}mol^{-1}$]

(c) The rate constant of a reaction is $6\times10^{-3}\ s^{-1}$ at 50° and $9\times10^{-3}\ s^{-1}$ at 100° C. Calculate the energy of activation of the reaction.

5. Read the passage carefully and answer the questions that follow:

The Arrhenius equation, developed by Swedish chemist Svante Arrhenius, is a fundamental equation in chemical kinetics that relates the rate constant (k) of a reaction to temperature (T) and the activation energy (Ea). The equation is given by:

$$k = A\ e^{-Ea/RT}$$

Here, A is the pre-exponential factor or frequency factor, Ea is the activation energy, R is the ideal gas constant, and T is the absolute temperature.

The Arrhenius equation helps explain the temperature dependence of reaction rates. As temperature increases, the exponential term $e^{-Ea/RT}$ becomes smaller, leading to a higher rate constant and consequently, a faster reaction. Conversely, lower temperatures result in a decrease in the rate constant and a slower reaction.

In summary, the Arrhenius equation provides valuable insights into the relationship between temperature and reaction rates, aiding in the understanding and prediction of chemical reactions under different temperature conditions.

a) Calculate the activation energy for a reaction if the rate constant is known at two different temperatures.

b) Define activation energy?

c) Calculate the activation energy of a reaction if the slope of its ln k vs 1/T plot is -3166 K.

OR

c) The activation energy for the reaction 2 HI(g) → H_2 + I_2 (g) is 209.5 kJ mol^{-1} at 581K. Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy?

4. THE d- AND f-BLOCK ELEMENTS

	MULTIPLE CHOICE QUESTIONS (1 MARKS)
1.	In which of the following pairs, both the ions are coloured in aqueous solutions? [Atomic no of Sc = 21, Ti = 22, Ni = 28, Co = 27, Cu = 29] (a) Sc^{3+}, Ti^{+3} (b) Sc^{3+}, Co^{2+} (c) Ni^{2+}, Cu^{+} (d) Ni^{2+}, Ti^{3+}
2.	Which of the following is most stable in aqueous solution? (a) Mn^{3+} (b) Cr^{3+} (c) V^{3+} (d) Ti^{3+}
3.	$KMnO_4$ is not acidified by HCl instead of H_2SO_4 because: (a) H_2SO_4 is stronger acid than HCl (b) HCl is oxidised to Cl_2 by $KMnO_4$ (c) H_2SO_4 is dibasic acid (d) rate of reaction is faster in presence of H_2SO_4
4.	Manav poured some potassium chromate solution in test tube for qualitative analysis. The yellow colour of potassium chromate soon turned orange in colour. Manav realised that this happened because the test tube was not clean and contained a few drops of some liquid. Which of the following were the liquid drops most likely to be. (a) Drops of water (b) methyl orange solution (c) NaOH solution (d) HCl solution
5.	Generally, transition elements form coloured salts due to the presence of unpaired electrons. Which of the following compounds will be coloured in solid state? (a) Ag_2SO_4 (b) CuF_2 (c) ZnF_2 (d) Cu_2Cl_2
6.	When $KMnO_4$. solution is added to oxalic acid solution, the decolourisation is slow in the beginning but becomes instantaneous after some time because (a) CO_2 is formed as the product. (b) Reaction is exothermic. (c) MnO_4^- catalyses the reaction. (d) Mn^{2+} acts as auto catalyst.
7.	Which of the following are d-block elements but not regarded as transition elements? (a) Cu, Ag, Au (b) Zn, Cd, Hg (c) Fe, Co, Ni (d) Ru, Rh, Pd

8. Transition elements form alloys easily because they have
(a) Same atomic number (b) Same electronic configuration
(c) Nearly same atomic size (d) None of the above.

9. Which of the following ion has magnetic moment value of 5.9?
(a) Mn^{2+} (b) Fe^{2+} (c) Ni^{2+} (d) Cu^{2+}

10. Which of the following lanthanoids show +2 oxidation state besides the characteristic oxidation state +3 of lanthanoids?
(a) Ce (b) Eu (c) Tb (d) Dy.

ASSERTION REASON TYPE QUESTIONS(1MARKS)

In the Following questions a statement of Assertion(A) is followed by a statement of Reason(R). Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

11. **Assertion(A):** Magnetic moment values of actinides are lesser than the theoretically predicted values.
Reason(R): Actinide elements are strongly paramagnetic.

12. **Assertion(A):** $KMnO_4$ act as an oxidising agent in acidic, basic or neutral medium.
Reason(R): $KMnO_4$ oxidises ferrous sulphate to ferric sulphate.

13. **Assertion(A):** Of the $3d^4$species Cr^{2+} is strongly reducing and Mn^{3+} is strongly oxidising**.**
Reason(R): Cr^{+3} state is stable due to half-filled t_2g set, Mn^{+2} is stable due to half- filled d orbitals

14. **Assertion(A):** In the series Sc to Zn the enthalpy of atomisation of Zinc is the lowest.
Reason(R): Zinc has greater number of unpaired electrons

15. **Assertion(A):** Magnetic moment of Mn^{2+} is less than that of Cr^{2+}.
Reason(R): Magnetic moment depends on the number of unpaired electrons.

VERY SHORT ANSWER TYPE QUESTIONS (1 MARK)

16. Which element has highest melting point in 3d series?
17. Out of Cu_2Cl_2 and $CuCl_2$ which is more stable in aqueous solution.
18. Which element of the first transition series don't exhibit variable oxidation states?
19. Name an oxo anion having oxidation number of metal (3d series) equal to its group number.
20. Name two elements of 3d series which show anomalous electronic configuration.
21. Identify the Transition metal of 3d series that acts as a strong reducing agent in +2 oxidation state in aqueous solution.
22. Name a member of lanthanoid series which is well-known to show +4 oxidation state.
23. Among the elements of 3d series which element is soft?
24. Arrange the following in increasing order of acidic character: CrO_3,CrO, Cr_2O_3
25. Complete the following equation :

$$3MnO_4^{2-} + 4H^+ \longrightarrow$$

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

26. Name an important alloy which contains some of the lanthanoid metals. Mention its uses.
27. Among Elements of 3d transition series: Write the element
(a) Which is not regarded as transition element.

	(b) Which shows maximum number of oxidation states. (c) Which forms stable divalent(M^{2+}) ion (d) Which shows only +3 state?
28.	What is Lanthanoid contraction? Give its cause. What are its Consequences?
29.	When pyrolusite ore MnO_2 is fused of with KOH in presence of air, a green coloured compound (A) is obtained which undergoes disproportionation reaction in acidic medium to give purple coloured compound (B). (i) Write the formulae of (A) & (B). (ii) What happens when compound (B) is heated.
30.	When chromite ore $FeCr_2O_4$ is fused with NaOH or (Na_2CO_3) in presence of air, a yellow coloured compound (A) obtained which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KCl forms an orange coloured crystalline compound (C). (a) Write the formulae of (A), (B) & (C). (b) Write one use of compound (C).
	SHORT ANSWER TYPE QUESTIONS (3 MARKS)
31.	Explain giving a suitable reason for each of the following (a) Metal –metal bonding is more frequent for the 4d & 5d series of transition metals than that for the 3d series. (b) Cu^+ salts are colourless while Cu^{2+} salts are Coloured (c) Mn^{2+} exhibits maximum Para magnetism
32.	Account for the following (a) Although Zr belongs to 4d and Hf belongs to 5d transition series but it is quite difficult to separate them. (b) There is in general increase in density of element from titanium to copper. (c) Most of the transition metals and their compounds act as good catalysts.
33.	Explain the following observations. (a) Mn Shows the highest oxidation state of +7 among 3d series elements. (b) Mn Shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4. (c) MnO is basic while Mn_2O_7 is acidic in nature.
34.	Account for the following (a) Cu^+ ion is not stable in aqueous solutions. (b) The d^1 configuration is very unstable in ions. (c) E^o value for the Mn^{2+}/Mn much more than expected.
35.	Assign reasons for the following. (a) Scandium is a transition element but Zinc is not. (b) Silver atom has completely filled d orbital ($4d^{10}$) in its ground state, yet it is transition element. (c) In the series Sc (Z = 21) to Zn (Z = 30), the enthalpy of atomisation of zinc is the lowest.
	LONG ANSWER TYPE QUESTIONS (5 MARKS)
36.	Give Reasons for the following (i) Ce^{4+} in aqueous solution is a good oxidising agent. (ii) Actinoids contraction is greater from element to element than lanthanoid contraction. (iii) The actinoids exhibit a larger number of oxidation states than the corresponding lanthanoids. (iv) La^{3+} and Lu^{3+}do not show any colour in solutions. (v) Chemistry of all the lanthanoids are quite similar.
37.	Complete & balance the following reactions: - a) $Cr_2O_7^{2-}+ Fe^{2+}+ H^+\rightarrow$

b) $MnO_4^- + H^+ + C_2O_4^{2-}$

c) $KMnO_4 \xrightarrow{Heat,\Delta}$

d) $MnO_4^- + H_2O + I^-$

e) $Cr_2O_7^{2-} + OH^- \rightarrow$

CASE BASED QUESTIONS

The Following questions are case based questions carries 4 (1+1+2) marks. Read the given passage carefully and answer the questions that follow:

38. The transition metals react with a number of non-metals like oxygen, nitrogen, Sulphur and halogens to form binary compounds. The first series transition metal oxides are generally formed from the reaction of metals with oxygen at high temperatures. These oxides dissolve in acids and bases to form oxo metallic salts. Potassium dichromate and potassium permanganate are common examples. Potassium dichromate is prepared from the chromite ore by fusion with alkali in presence of air and acidifying the extract. Pyrolusite ore (MnO_2) is used for the preparation of potassium permanganate. Both the dichromate and the permanganate ions are strong oxidising agents.

(a) What happens when Manganate ions (MnO_4^{2-}) undergoes disproportionation reaction in acidic medium? (1)

(b) Explain why the colour of $KMnO_4$ disappears when oxalic acid is added to its solution in acidic medium. (1)

(c) When an orange solution containing $Cr_2O_7^{2-}$ ion is treated with an alkali, a yellow solution is formed and when H^+ ions are added to a yellow solution, an orange solution is obtained. Explain why does this happen? (2)

OR

A solution of $KMnO_4$ on reduction yields either colourless solution or a brown precipitate or a green solution depending on the pH of the solution. What different stages of the reduction do these represent and how are they carried out?

39. The d-block, which lies between s and p-blocks contains, elements of groups 3-12, in which d- orbitals are progressively filled in each of four long periods of periodic table. These elements are also called transition elements or metals.

The elements constituting the f-block are those in which 4 f and 5 f-orbitals are progressively filled. They are place in a separate panel at the bottom of the periodic table. The elements of f-block are also called inner-transition

(a) Transition metal are very good catalyst. Why? (1)

(b) Transition metals form a large number of interstitial compounds. Give reason. (1)

(c) Why the paramagnetic characteristic in 3d- transition series increases up to Cr and then decreases?

OR

Out of $La(OH)_3$ and $Lu(OH)_3$, which is more basic and why? (2)

40. In the periodic table, the elements are classified into mainly four blocks, i.e. s, p, d and f. The d-block elements are called transition elements. The s-block contains the elements of the group 3-12. They possess properties that are transitional between the s and p-block elements. Zn, Cd, Hg do not exhibit characteristic properties of transition elements. All the elements belong to this section are metals. There are four rows of the transition elements involving filling of 3d, 4d, 5d and 6d orbitals.

(a) Why does the transition element scandium not exhibit variable oxidation state? (1)

(b) Why chromium is a typical hard metal while mercury is a liquid? (1)

(c) Fe^{3+}/Fe^{2+} redox couple has less positive electrode potential than Mn^{3+}/Mn^{2+} couple.Why? (2)

OR

Copper (I) is diamagnetic, whereas copper (II) is paramagnetic.

41. Within the 3d-series, manganese exhibits oxidation states in aqueous solution from +2 to +7, ranging from Mn^{2+} (aq) to MnO^-_4 (aq). Likewise, iron forms both Fe^{2+} (aq) and Fe^{3+}(aq) as well as the FeO_4^{2-} ion. Cr and Mn form oxo anions CrO_4^{2-}, MnO_4^-, owing to their willingness to form multiple bonds. The highest oxidation states of the 3d-metals may depend upon complex formation (e.g., the stabilization of $Co^{3}+$ by ammonia) or upon the pH (thus MnO_4^{2-}(aq) is prone to disproportionation in acidic solution). Within the 3d-series, there is considerable variation in relative stability of oxidation states,
sometimes on moving from one metal to a neighbour; thus, for iron, Fe^{3+} is more stable than Fe^{2+},especially in alkaline conditions, while the reverse is true for cobalt. The ability of transition metals to exhibit a wide range of oxidation states is marked with metals such as vanadium, where the standard potentials can be rather small, making a switch between states relatively easy.

(a) Highest fluoride of Mn is MnF_4 whereas the highest oxide is Mn_2O_7 (1)
(b) Which is more stable Fe^{2+} or $Fe^{3}+$? (1)
(c). The higher oxidation states are usually exhibited by the members in the middle of a series of transition elements? (2)

OR

Electrode potential of copper E^0 Cu^{+2} / Cu is positive, whereas E_0 Mn^{+2} / Mn is more negative than expected Why ?

42. Potassium permanganate, ($KMnO_4$) is prepared by fusion of pyrolusite, MnO_2 with KOH in the presence of an oxidising agent like KNO_3. This produces the dark green potassium manganate, K_2MnO_4 which disproportionates in a neutral or acidic solution to give purple permanganate ion. Potassium permanganate is an important oxidising agent in acidic, alkaline as well as neutral medium.

(a) What is the state of hybridisation of Mn in MnO_4^-? (1)
(b) Write an application of potassium permanganate. (1)
(c) How do the oxides of transition elements in lower oxidation states differ from those in higher oxidation state in the nature of metal-oxygen bonding and why? (2)

OR

Draw the structure of permanganate ion. Is it paramagnetic or diamagnetic?

5. COORDINATION COMPOUNDS

Multiple Choice Questions

1	**Write the no. of ions produced from the complex $K_4[Fe(CN)_6]$ in solution**	
	(A) 2	(B) 5
	(C) 4	(D) 1
2	**The denticity of $EDTA^{4-}$ ligand is**	
	(A) 6	(B) 3
	(C) 4	(D) 2
3	**Of the following complexes, which one will show linkage isomerism?**	
	(A) $[Cr(NH_3)_6][Co(en)_3]$	(B) $[Cr(NH_3)_6]Cl_3$
	(C) $[Cr(en)_3]Cl_3$	(D) $[Cr(NH_3)_5NO_2]Cl_2$
4	**The crystal field splitting energy for octahedral and tetrahedral complexes is related as**	
	(A) $\Delta_t = 2/9\ \Delta_o$	(B) $\Delta_o = 2/9\ \Delta_t$
	(C) $\Delta_t = 4/9\ \Delta_o$	(D) $\Delta_o = 4/9\ \Delta_t$
5	**The type of isomerism shown by the complex $[CoCl_2(en)_2]$ is**	
	(A) Geometrical isomerism	(B) Ionization isomerism
	(C) Coordination isomerism	(D) Linkage isomerism
6	**The coordination number and oxidation state of Cr in $K_3[Cr(C_2O_4)_3]$ are respectively**	
	(A) 3 and +3	(B) 3 and 0
	(C) 6 and +3	(D) 4 and +2
7	**The geometry and magnetic behaviour of the complex $[Ni(CO)_4]$ are**	
	(A) Square planar and paramagnetic	(B) Tetrahedral and diamagnetc
	(C) Square planar and diamagnetic	(D) Tetrahedral and paramagnetic
8	**Which of the following complex has minimum magnitude of crystal field splitting?**	
	(A) $[Co(NH_3)_6]^{3+}$	(B) $[Cr(H_2O)_6]^{3+}$
	(C) $[Cr(CN)_6]^{3-}$	(D) $[CoCl_6]^{3-}$
9	**The core atom of which of the following biologically significant coordination molecules is cobalt?**	
	(A) Vitamin B12	(B) Haemoglobin
	(C) Chlorophyll	(D) Carboxypeptidase-A
10	**How many isomers are possible for the complex $[Co(NH_3)_4Cl_2]Cl$?**	
	(A) 4	(B) 2
	(C) 1	(D) 3

Assertion and Reason Based Questions

Given below are two statements labelled as Assertion (A) and Reason (R)
Select the most appropriate answer from the options given below:
(A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true

11	**Assertion**: $CuSO_4$ solution mixed with aqueous ammonia in 1:4 molar ratio gives the test of Cu^{2+} ion. **Reason**: Cu^{2+} ion forms a complex with ammonia.
12	**Assertion**: Linkage isomerism arises in coordination compounds containing ambidentate ligand. **Reason**: Ambidentate ligand has two donor atoms.
13	**Assertion**: The spin-only magnetic moment of $[MnBr_4]^{2-}$ is 5.9 BM **Reason**: The shape of the complex is square planar.
14	**Assertion**: Low spin tetrahedral complexes are not formed. **Reason:** Orbital splitting energies for tetrahedral complexes are sufficiently large for forcing pairing.
15	**Assertion**: The complex $[Ti(H_2O)_6]^{3+}$ is colourless. **Reason:** Crystal field splitting occurs in presence of ligands.

Very Short Answer Questions (1 Mark)

16	Write the IUPAC name of $[Cr(H_2O)_2(C_2O_4)_2]^-$.
17	Which of the following is more stable complex and why? $[Co(NH_3)_6]^{3+}$ and $[Co(en)_3]^{3+}$
18	Write down the formula of : Tetraammineaquachloridocobalt(III) chloride.
19	When a coordination compound $CrCl_3.6H_2O$ is mixed with $AgNO_3$, 2 moles of AgCl are precipitated per mole of the compound. Write the structural formula of the complex.
20	Define denticity of a ligand.
21	Indicate the types of isomerism exhibited by the following complex: $[Co(en)_3]Cl_3$ (en = ethylene diamine)
22	What type of isomerism is shown by the complex $[Cr(H_2O)_6]Cl_3$?
23	Out of the following two coordination entities which is chiral (optically active)? (a) cis-$[CrCl_2(ox)_2]^{3-}$ (b) trans-$[CrCl_2(ox)_2]^{3-}$
24	Find the primary and secondary valences of cobalt in $[Co(NH_3)_6]Cl_3$.
25	Give two examples of ligands which form coordination compounds useful in analytical chemistry.

Short Answer Questions TYPE-1 (2 Marks)

26	Draw the structures of optical isomers of each of the following complex ions: $[Cr(C_2O_4)_3]^{3-}$, $[PtCl_2(en)_2]^{2+}$
27	Give a chemical test to distinguish the following pair. $[Co(NH_3)_5Cl]SO_4$ and $[Co(NH_3)_5(SO_4)]Cl$.
28	$[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain.(At. no. Fe = 26)
29	What is meant by the chelate effect? Give an example.
30	$CuSO_4.5H_2O$ is blue in colour while $CuSO_4$ is colourless. Why?

Short Answer Questions TYPE-2 (3Marks)

31	(i)Draw the geometrical isomers of $[Fe(NH_3)_2(CN)_4]^-$. (ii) Why is geometrical isomerism not possible in tetrahedral complexes having two different types of unidentate ligands coordinated with the central metal ion ?
32	Discuss briefly giving an example in each case the role of coordination compounds in : (i) biological systems, (ii) medicinal chemistry (iii) extraction/metallurgy of metals.
33	For the complex $[Fe(en)_2Cl_2]Cl$,(en = ethylene diamine), identify (i) the oxidation number of iron, (ii) the hybrid orbitals and the shape of the complex, (iii) the magnetic behaviour of the complex, (iv) the number of geometrical isomers, (v) whether there is an optical isomer also, and (vi) name of the complex. (At. no. of Fe = 26)
34	Write the state of hybridization, the shape and the magnetic behaviour of the following complex entities : (i) $[Cr(NH_3)_4Cl_2]Cl$ (ii) $[Co(en)_3]Cl_3$ (iii) $K_2[Ni(CN)_4]$
35	Explain why $[Fe(H_2O)_6]^{3+}$ has magnetic moment value of 5.92 BM whereas $[Fe(CN)_6]^{3-}$ has a value of only 1.74 BM.

Long Answer Questions (5 Marks)

36	(i) Define the following. (a) Heteroleptic complexes (b) Spectrochemical series (c) Coordination polyhedron (ii)Give reason. (a)The pi complexes are known for transition elements only. (*b*) CO is a stronger ligand than NH_3 for many metals.
37	(i)Using crystal field theory, write electronic configuration of the central metal atom/ion and determine the magnetic moment value in the following. (a)$[CoF_6]^{3-}$ (b)$[Fe(CN)_6]^{4-}$ (c)$[Fe(H_2O)_6]^{2+}$ (ii) A solution of $[Ni(H_20)_6]^{2+}$ is green but a solution of $[Ni(CN)_4]^{2-}$is colourless. Explain.

Case-Based Questions

Read the passage carefully and answer the questions that follow.

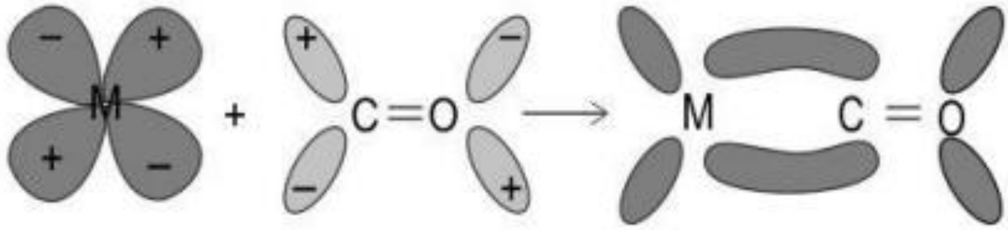
38	Alfred Werner, a Swiss chemist was the first to formulate his idea about the structure of coordination compounds. He proposed the concept of primary and secondary valences for a metal ion. The primary valences are normally ionisable and satisfied by negative ions. The secondary valences are non-ionisable and it is equal to coordination number and is fixed for a metal. The groups bound by the secondary linkages to metal have spatial arrangements corresponding to different coordination numbers. Octahedral, tetrahedral and square planar geometrical shapes are more common in coordination compounds of transition metals. Double salts and coordination complexes are formed by the combination of two or more stable compounds in stoichiometric ratio. Double salts are dissociated into simple ions completely when dissolved in water whereas complexes do not dissociate completely into its ions. Werner was the first to discover optical activity in certain coordination compounds. (i)What is the oxidation number of cobalt in coordination entity $[Co(H_2O)(CN)(en)_2]^{2+}$? (ii) What is the coordination number of chromium in $K[Cr(H_2O)_2(C_2O_4)_2]$? (iii) Arrange the following complexes in increasing order of conductivity of their solution. Give reason. $[Co(NH_3)_3Cl_3]$, $[Co(NH_3)_4Cl_2]Cl$, $[Co(NH_3)_6]Cl_3$, $[Co(NH_3)_5Cl]Cl_2$ **OR** (iii)a) How many ions are produced from the complex $[Co(NH_3)_6]Cl_3$ in solution? b) When 1 mol $CrCl_3.6H_2O$ is treated with excess of $AgNO_3$, 3mol of AgCl are obtained. Write the formula of the complex.

39 Valence bond theory considers the bonding between metal ion and ligands as purely covalent. On the other hand, crystal field theory considers the metal-ligand bond to be ionic arising from electrostatic interaction between the metal ion and the ligands. In coordination compounds, the interaction between the ligand and the metal ion causes the five d-orbitals to split-up. This is called crystal field splitting and the energy difference between the two sets of energy levels is called crystal field splitting energy. The crystal field splitting (Δ_o) depends upon the nature of the ligand and the charge of the metal ion.The electronic configuration of the metal ion in the complexes depends on the relative values of Δ_o and P (pairing energy)
If $\Delta o < P$, then complex will be high spin.
If $\Delta o > P$, then complex will be low spin.
(i)Calculate the magnetic moment of the metal ion in the complex $K_4[(Fe(CN)_6]$.
(ii)On the basis of crystal field theory, write the electronic configuration of d^4 in terms of t_{2g} and e_g in an octahedral field when $\Delta_O > P$.
(iii)Explain the violet colour of $[Ti\ (H_2O)_6]^{3+}$ complex on the basis of the crystal field theory. (Atomic number of Ti = 22)

OR

(iii)State the magnetic property of each of the following complexes.
  a) Hexaaminechromium (III) ion (At no of Chromium = 24)
  b) Tetraamminezinc(II) ion (At number of Zinc =30)

40 In metal carbonyls, there is synergic bonding interaction between metal and carbon monoxide. This leads to increase in strength of metal ligand bond and decrease in bond order of CO in carbonyl complex. Donation of electrons from a filled d-orbital of metal into the vacant antibonding π* bonding orbital of CO decreases the bond order three to two and half or slightly more thus increasing the bond length between C– O.



(i)What type of bond is exists in metal carbonyls?

(ii)How is Δ_0 value affected by the interaction of CO ligands and metal ion in metal carbonyl?
(iii)Describe the bonding between metal and CO ligand in creating a synergic effect.

OR

(iii)Give an example of a homoleptic metal carbonyl complex and also mention the oxidation state of the metal in it.

41	The coordination compounds are of great importance. These compounds are widely present in the mineral, plant and animal worlds and are known to play many important functions in the area of analytical chemistry; metallurgy, biological system, industry and medicine. Formation of coordination compound is largely used in analytical chemistry for the qualitative detection and quantitative estimation of metal ions. (i)Which ligand's complex is used for determination of hardness of water? (ii)Which complex is used in the treatment of cancer? (iii)a) Haemoglobin present in Blood is a complex of which metal? b) Name the complex of magnesium metal which is present in green plants. **OR** (iii)Describe how gold is extracted using complex formation.
42	Compounds that have the same chemical formula but different structural arrangements are called isomers. **Ionization Isomerism**-This type of isomerism is due to the exchange of groups between the complex ion and the ions outside it. Coordination isomerism - This isomerism occurs in compounds containing complex anionic and cationic parts and can be thought of as occurring by interchange of some ligands from the cationic part to the anionic part. Linkage isomerism -This isomerism occurs with ambidentate ligands that are capable of coordinating in more than one way. Hydrate isomerism - This isomerism results from the replacement of a coordinated group by a solvent molecule (Solvate Isomerism). (i)What type of isomerism is exhibited by $[Co(ONO)(NH_3)_5]Cl$ and $[Co(NO_2)(NH_3)_5]Cl$? (ii)What type of isomerism is exhibited by $[CrCl_2(H_2O)_4]Cl.2H_2O$, $[CrCl(H_2O)_5]Cl_2.H_2O$,$[Cr(H_2O)_6]Cl_3$? **(iii)What is coordination isomerism? Give one example.** OR **What is an ambidentate ligand? Explain with an example.**

6. HALOALKANES AND HALOARENES

1. Which of the following is an example of vicinal dihalide?

(a) Dichloromethane (b) 1,2-dichloroethane (c) Ethylidene chloride (d) Allyl chloride

2. Based on the position of –Br in the compound in $CH_3CH=CHC(Br)(CH_3)_2$ can be classified as ___________ halide.
(a) Allyl (b) Aryl (c) Vinyl (d) Secondary

3. Chlorobenzene is formed by the reaction of chlorine with benzene in the presence of $AlCl_3$. Which of the following species attacks the benzene ring in this reaction?
(a) Cl^- (b) Cl^+ (c) $AlCl_3$ (d) $[AlCl_4]^-$

4. Ethylidene chloride is a/an _____________.
(a) vicinal dihalide (b) geminal dihalide (c) allylic halide (d) vinylic halide

5. A primary alkyl halide would prefer to undergo ____________.
(a) S_N1 reaction (b) S_N2 reaction (c) α–Elimination (d) Racemisation

6. Which of the following alkyl halides will undergo S_N1 reaction most readily?
(a) $(CH_3)_3C—F$ (b) $(CH_3)_3C—Cl$ (c) $(CH_3)_3C—Br$ (d) $(CH_3)_3C—I$

7. What should be the correct IUPAC name for Diethyl bromomethane?
(a) 1-Bromo-1,1-diethylmethane (b) 3-Bromopentane
(c) 1-Bromo-1-ethylpropane (d) 1-Bromopentane

ASSERTION REASON TYPE QUESTIONS(1MARK)
For following questions select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

11. **Assertion:** Hydrogen halides (HX) are preferred over thionyl chloride for the preparation of alkyl halides from alcohols.
Reason: Gaseous side products are formed in the case of thionyl chloride.
12. **Assertion:** Tertiary alkyl halides are least reactive towards S_N1 reaction.
Reason: In S_N1 reaction, the rate of reaction depends only on the concentration of alkyl halide.
13. **Assertion:** Haloalkanes are sparingly soluble in water.
Reason: Haloalkanes do not form hydrogen bonds with water.
14. **Assertion:** Propene reacts with HBr to form 2-bromo propene.
Reason: As intermediate formed carbocation is secondary which is more stable than primary.
15. **Assertion:** S_N2 mechanism leads to the inversion of configuration.
Reason: As in this mechanism optical activity is lost.

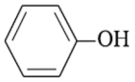
VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)
16. What happens when an excess of bromine attacks on $CH_2=CH—CH_2—C\equiv CH$?

17. Aryl chlorides and bromides can be easily prepared by electrophilic substitution of arenes with chlorine and bromine respectively in the presence of Lewis acid catalysts. But why does the preparation of aryl iodides require the presence of an oxidizing agent?

18. Out of o-and p-dibromo benzene which one has a higher melting point and why?

19. Which of the following compounds (a) and (b) will not react with a mixture of NaBr and H_2SO_4. Explain why?

(a) $CH_3CH_2CH_2OH$ (b)



20. Which of the products will be the major product in the reaction given below? Explain.

$$CH_3CH = CH_2 + HI \longrightarrow \underset{(A)}{CH_3CH_2CH_2I} + \underset{(B)}{CH_3CHICH_3}$$

21. Draw resonance structures of haloarene and find out whether the functional group present in the molecule is ortho, para directing, or meta directing.

22. Write the structures and names of the compounds formed when compound 'A' with the molecular formula, C_7H_8 is treated with Cl_2 in the presence of $FeCl_3$.

23. Identify the products A and B formed in the following reaction:

$$CH_3—CH_2—CH{=}CH—CH_3 + HCl \longrightarrow A + B$$

24. Write down the structure and IUPAC name for neo-pentyl bromide.

25. Which of the following haloalkanes reacts with aqueous KOH most easily? Explain giving reason.
(i) 1-Bromobutane(ii) 2-Bromobutane(iii) 2-Bromo-2-methylpropane(iv) 2-Chlorobutane

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

26. Compound 'A' with molecular formula C_4H_9Br is treated with aq. KOH solution. The rate of this reaction depends upon the concentration of compound 'A' only. When another optically active isomer 'B' of this compound was treated with aq. In KOH solution, the rate of reaction was found to be dependent on the concentration of the compound and KOH both.
(i) Write down the structural formula of both compounds 'A' and 'B'.
(ii) Out of these two compounds, which one will be converted to the product with an inverted configuration?

27. Why can aryl halides not be prepared by reaction of phenol with HCl in the presence of $ZnCl_2$?

28. Why is it necessary to avoid even traces of moisture during the use of a Grignard reagent?

29. Aryl halides are extremely less reactive towards nucleophilic substitution. Predict and explain the order of reactivity of the following compounds towards nucleophilic substitution:

30. Cyanide ion acts as an ambient nucleophile. From which end it acts as a stronger nucleophile in the aqueous medium? Give a reason for your answer.

LONG ANSWER TYPE QUESTIONS (5 MARKS)

31. Some alkyl halides undergo substitution whereas some undergo elimination reaction on treatment with bases. Discuss the structural features of alkyl halides with the help of examples that are responsible for this difference.

32. What happens when
(i) n-butyl chloride is treated with alcoholic KOH,
(ii) bromobenzene is treated with Mg in the presence of dry ether,
(iii) chlorobenzene is subjected to hydrolysis,
(iv) ethyl chloride is treated with aqueous KOH,
(v) methyl bromide is treated with sodium in the presence of dry ether

33. Case-based question (4 Marks)

Case 1

The substitution reaction of alkyl halides occurs in S_N1 and S_N2 mechanism, whatever mechanism alkyl halide follow for substitution reaction to occur, the polarity of the carbon halogen bond is responsible for the substitution reaction. The rate of S_N1 reactions is governed by the stability of carbocation whereas for S_N2 reactions steric factor is a deciding factor. If the starting material is a chiral compound, we may end up with an inverted product or racemic mixture depending upon the type of mechanism followed by alkyl halide.

1. Among 1-bromopropane and 2-methyl-2-bromo propane, which will follow S_N1 mechanism? 1

2. Among following in which inversion of configuration will occur on reaction with aq alkali

1-bromo propane, and 2-methyl-2-bromo butane
1

3. What is the role of polar protic solvent in S_N1 reaction? (2)

OR

How will a protic solvent system affect the S_N2 reaction? (2)

Case 2

Chlorofluorocarbons (CFCs) described as 'miracle chemicals' have no natural resources. They were first manufactured in the 1930s and industries soon found variety of applications for them due to their chemical non-reactivity and heat absorbing properties. CFCs have been used as refrigerants in air conditioners and refrigerators, in aerosol spray cans, in manufacturing foams and as cleansing agents in the manufacture of electronics. These chemicals have been given the tradename 'Freons' and the term since became a household name.

1.What is 'Freon – 12'? (1)
2. Draw its molecular structure (1)
3. State any two harmful effects of CFCs on the environment. (2)

OR

3. State any two ways to reduce the harmful effect of CFCs. (2)

Case 3

Alkyl Halides can be readily prepared from Alkenes by addition reactions with Hydrogen Halides. When the alkene is symmetrical about the double bond, only one product is obtained. But if the alkene is unsymmetrical the addition of Hydrogen Bromide results in formation of two products. The addition of HBr to an unsymmetrical alkene in presence of an organic peroxide also results in the formation of two products. The only difference is in the quantities of isomeric bromides obtained in each case since the mechanism is different.

1.What is the major product obtained when Propene reacts with HBr? What rule governs the formation of this product? (1)

2. What mechanism is adopted in presence of Benzoyl Peroxide. (1)

3. Why does only HBr show these anomalies unlike HI or HCl. (2)

OR

3. Write the mechanism of the addition reaction of Propene with HBr in presence or in absence of organic peroxides. (2)

Case 4

Alkyl Halides have higher melting and boiling points than Alkanes of comparable molecular mass. The other trends observed are as follows;

i.For a given Alkyl Halide the melting point and boiling point increases with increase in molecular mass. So, the order is $RCl<RBr<RI$.

ii. For a given halogen the boiling point rises with increasing Carbon number.

iii. The boiling point also varies as per the nature of the Carbon i.e primary> secondary> tertiary.

1.Arrange CH_3I, CH_3F, CH_3Br and CH_3Cl in decreasing order of melting points. (1)

2. Which has a lower boiling point – Chloropropane or 2-Chloropropane. Why? (2)

OR

2. Arrange the following in increasing order of boiling points. (2)

$(CH_3)_3CBr$, $CH_3CH(Br)CH_2CH_3$, $CH_3(CH_2)_3Br$, $(CH_3)_3CCl$

3. Among the isomeric Chlorotoluene, which isomer has the highest melting point?

Case 5:

Chloroform is a colourless, volatile liquid with sweetish sickly odour and burning taste. It is denser than water. It is soluble in organic solvents but insoluble in water. It itself acts as a good solvent. Chloroform causes temporary unconsciousness when its vapours are inhaled. For this reason, it was used as an anaesthetic until recently. It is also used as a preservative for anatomical specimen and as a laboratory reagent.

1.What is the IUPAC name of Chloroform? (1)

2. How is Chloroform commercially prepared? (1)

3. Why should Chloroform be stored in dark bottles which are completely filled? Give chemical equation in support of your answer. (2)

OR

3. Write a short note on any two-name reactions where Chloroform is used as a reagent. (2)

7. Alcohols, Phenols and Ethers

MULTIPLE CHOICE QUESTIONS (1 MARKS)

1. What is the correct order of reactivity of alcohols in the following reaction?

$$R{-}OH + HCl \xrightarrow{ZnCl_2} R{-}Cl + H_2O$$

a) 1° > 2° > 3° b) 1° < 2° > 3° c) 3° > 2° > 1° d) 3° > 1° > 2°

2. CH_3CH_2OH can be converted into CH_3CHO by ______________.

a) catalytic hydrogenation c) treatment with $LiAlH_4$

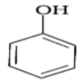
b) treatment with pyridinium chlorochromate d) treatment with $KMnO_4$

3. The process of converting alkyl halides into alcohols involves

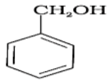
a) addition reaction c) substitution reaction

b) dehydrohalogenation reaction d) rearrangement reaction

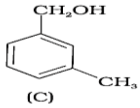
4. Which of the following compounds is/are Benzylic alcohols?



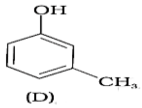
(A)



(B)



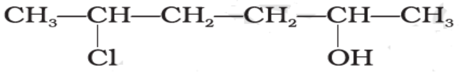
(C)



(D)

a) A, B, C, D b) A,D c) B, C d) A

5. Give IUPAC name of the compound

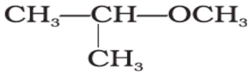


$$CH_3{-}\underset{Cl}{CH}{-}CH_2{-}CH_2{-}\underset{OH}{CH}{-}CH_3$$

a) 2-Chloro-5-hydroxyhexane c) 5-Chlorohexan-2-ol

b) 2-Hydroxy-5-chlorohexane d) 2-Chlorohexan-5-ol

6. IUPAC name of the following compound



$$CH_3{-}\underset{CH_3}{CH}{-}OCH_3$$

a) 1-methoxy-1-methylethane c) 2-methoxypropane

b) 2-methoxy-2-methylethane d) isopropylmethyl ether

7. Phenol is less acidic than

a) Ethanol b) o-nitrophenol c) o-methylphenol d) o-methoxyphenol

8. Arrange the following compounds in increasing order of boiling point.
Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol

a) Propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol c) Pentan-1-ol, butan-2-ol, butan-1-ol, propan-1-ol

b) Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol d) Pentan-1-ol, butan-1-ol, butan-2-ol, propan-1-ol

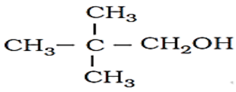
9. Which of the following reagents can be used to oxidise primary alcohols to aldehydes?

(i) CrO_3 in anhydrous medium. (iii) Pyridinium chlorochromate

(ii) $KMnO_4$in acidic medium (iv) Heat in the presence of Cu at 573K.

a) (i), (ii) b) (i), (iii), (iv) c) (ii), (iii), (iv) d) (iii), (iv)

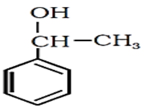
10. Which one is secondary alcohol

(i) 

$$CH_3{-}\overset{CH_3}{\underset{CH_3}{C}}{-}CH_2OH$$

(ii) $H_2C{=}CH{-}CH_2OH$

(iii) $CH_3{-}CH_2{-}CH_2{-}OH$

(iv) 

(a)(i) b) (ii) c) (iii) d) (iv)

ASSERTION REASON TYPE QUESTIONS(1MARKS)

The following questions are statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

1. Assertion: p-nitrophenol is more acidic than phenol.
Reason: Nitro group helps in the stabilisation of the phenoxide ion by dispersal of negative charge due to resonance.

2. Assertion: Ethanol is a weaker acid than phenol.
Reason: Ethanol reacts with Na and phenol reacts with Na and NaOH

3. Assertion: o-Nitrophenol is more soluble in water than the m-and p-isomers.
Reason: m- and p- Nitrophenols exist as associated molecules because of inter molecular hydrogen bonding.

4. Assertion: Phenols give o- and p-nitrophenol on nitration with conc. HNO_3 and Sulphuric acid mixture.
Reason: —OH group in phenol is o–, p– directing.

5. Assertion: Bromination of phenol does not require the presence of Lewis acid.
Reason: -OH group attached to benzene ring has highly activating effect

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

1. Out of o-nitrophenol and p-nitrophenol, which is more volatile? Explain

Answer: - o-nitrophenol, due to intramolecular hydrogen bonding, is more volatile in nature. In para-nitrophenol, there is intermolecular hydrogen bonding.

2. Nitration is an example of aromatic electrophilic substitution and its rate depends upon the group already present in the benzene ring. Out of benzene and phenol, which one is more easily nitrated and why?

Answer: -Phenol will be easily nitrated since the —OH group attached to the benzene ring activates it towards electrophilic substitution due to +R effect.

3. In Kolbe's reaction, instead of phenol, phenoxide ion is treated with carbon dioxide. Why?

Answer: -Phenoxide ion is more activating than phenol towards electrophilic substitution reaction. Hence, it undergoes electrophilic substitution with carbon dioxide, a weak electrophile.

4. Arrange the following sets of compounds in order of their increasing boiling points:

(a) Pentan-1-ol, butan-1-ol, butan-2-ol, ethanol, propan-1-ol, methanol.

(b) Pentan-1-ol, n-butane, pentanal, ethoxyethane.

Answer: - (a) Methanol, ethanol, propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol.
(b) n-Butane, ethoxyethane, pentanal and pentan-1-ol.

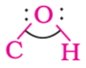
5. The carbon– oxygen bond length (136 pm) in phenol is slightly less than that in methanol (142 pm). Explain.

Answer: - This is due to

(i) partial double bond character of C-O bond because of resonance in phenol and

(ii) *sp*^{2} hybridised state of carbon of phenol to which oxygen is attached.

6. Give reasons: -

a. The bond angle  in alcohols is slightly less than the tetrahedral angle (109°-28').

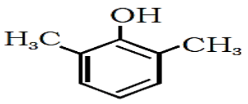
b. In methoxymethane  bond angle is slightly greater than the tetrahedral angle

Answer: -a) It is due to the repulsion between the unshared electron pairs of oxygen.

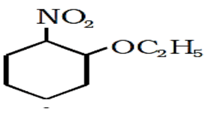
b) It is due to more repulsive interaction between the two bulky methyl groups.

7. Give the IUPAC names of the following compounds:-

(i)



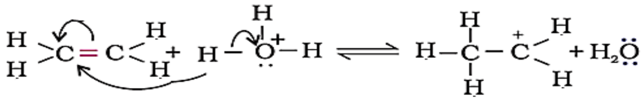
(ii)



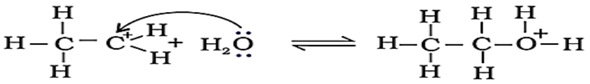
Answer: -(i) 2,6-Dimethylphenol (ii) 1-Ethoxy-2-nitrocyclohexane

8. Explain the mechanism of the acid catalysed hydration of ethene.

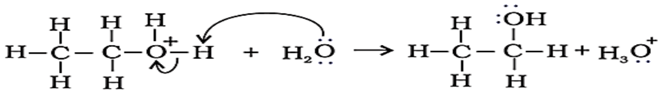
Answer: -Step 1: Protonation of ethene to form carbocation by electrophilic attack of H_3O^+ or H^+.



Step 2: Nucleophilic attack of water on carbocation.

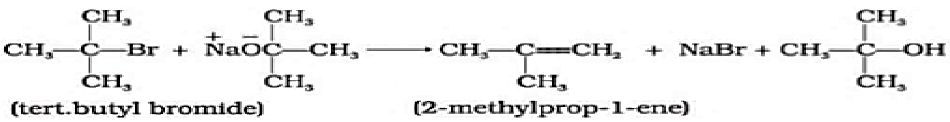


Step 3: Deprotonation to form an alcohol.



9. Ethers can be prepared by Williamson synthesis in which an alkyl halide is reacted with sodium alkoxide. Di-tert-butyl ether can't be prepared by this method. Explain.

Answer: -In tert-butyl halides, elimination is favoured over substitution, so alkene is the major product formed and ether is not formed.

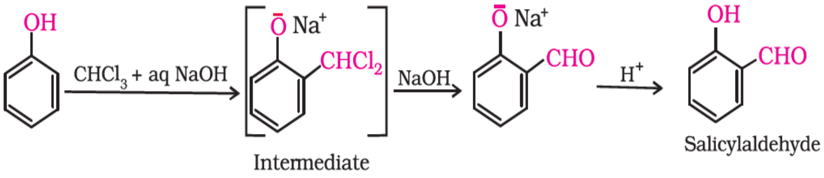


$$CH_3-C(CH_3)_2-Br + Na\overset{+}{}\overset{-}{O}C(CH_3)_2-CH_3 \longrightarrow CH_3-C(CH_3)=CH_2 + NaBr + CH_3-C(CH_3)_2-OH$$

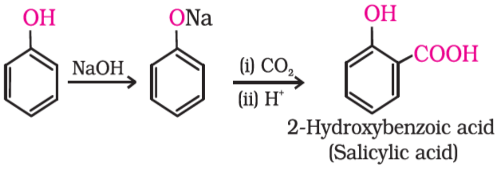
10. Write the equations involved in the following reactions:

a) Reimer - Tiemann reaction b) Kolbe's reaction

Answer:-a)



Answer:-b)



SHORT ANSWER TYPE QUESTIONS (3 MARKS)

1. Give reasons for the following:

a) Phenol is more acidic than ethanol.

b) Boiling point of ethanol is higher in comparison to methoxymethane.

c) $(CH_3)_3C-O-CH_3$ on reaction with HI gives $CH_3OH$and $(CH_3)_3C-I$ as the main products and not $(CH_3)_3C-OH$ and CH_3I.

Answer: -

a) It is because after the removal of H^+ion the phenoxide ion formed is more stable than ethoxide ion.

b) It is because ethanol molecules are more associated due to presence of intermolecular H-bonding, whereas methoxymethane does not have intermolecular H – bonding in it.

c) This reaction follows S_N1 mechanism and the $(CH_3)_3C^+$(Tert. carbocation) formed is more stable which reacts with Iodide to form tert. butyl iodide.

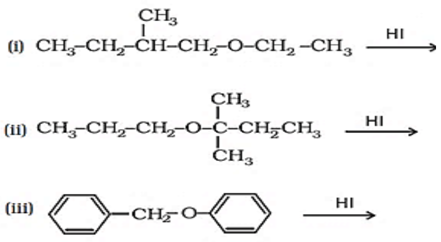
2. Give one chemical test each to distinguish between the following pairs of compounds: (i) Phenol and Benzoic acid (ii) Propan-1-ol and Propan-2-ol (iii) Methanol and ethanol.

Answer: -(i) Add $NaHCO_3$to each. Phenol will not react, whereas benzoic acid will give brisk effervescence due to CO_2.

(ii) Add I_2 and NaOH to each one. Propan-2-ol will give yellow ppt. of iodoform (iodoform test), whereas propan-1-ol will not give yellow ppt.

(iii) Add I_2 and NaOH to each one. Ethanol will give yellow ppt. of iodoform (iodoform test), whereas methanol will not give yellow ppt.

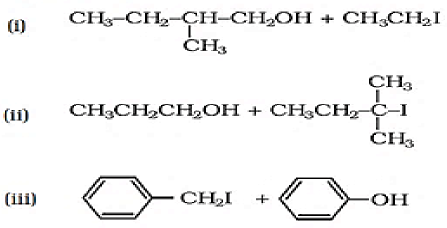
3. Give the major products that are formed by heating each of the following ethers with HI.



(i) $CH_3-CH_2-\underset{}{\overset{CH_3}{\overset{|}{C}}}H-CH_2-O-CH_2-CH_3 \xrightarrow{HI}$

(ii) $CH_3-CH_2-CH_2-O-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_2CH_3 \xrightarrow{HI}$

Answer:-



(i) $CH_3-CH_2-\underset{CH_3}{\underset{|}{C}}H-CH_2OH + CH_3CH_2I$

(ii) $CH_3CH_2CH_2OH + CH_3CH_2-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-I$

4. Give the structures and IUPAC names of the products expected from the following reactions:

(a) Catalytic reduction of butanal.

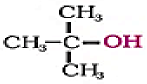
(b) Hydration of propene in the presence of dilute sulphuric acid.

(c) Reaction of propanone with methyl magnesium bromide followed by hydrolysis.

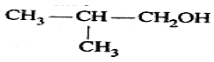
Answer: -

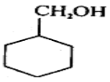
(a) $CH_3-CH_2-CH_2-CH_2-OH$
Butan-1-ol

(b) 
$CH_3-CH(OH)-CH_3$
Propan-2-ol

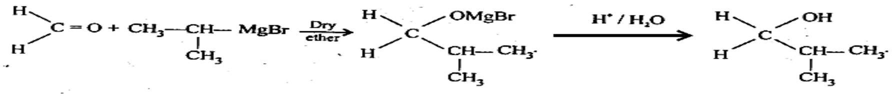
(c) 
$CH_3-C(CH_3)_2-OH$
2-Methylpropan-2-ol

5. Show how are the following alcohols prepared by the reaction of a suitable Grignard reagent on methanal?

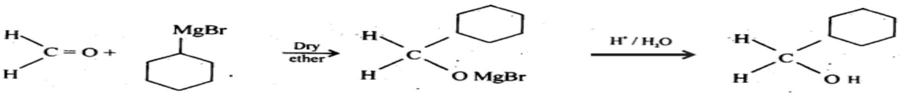
(i) 
$CH_3-CH(CH_3)-CH_2OH$

(ii) 

Answer: -(i)



(ii)



LONG ANSWER TYPE QUESTIONS (5 MARKS)

(1) Give reasons for the following: -

(a) Alcohols are more soluble in water than the hydrocarbon of comparable molecular masses.

(b) Lower alcohols are soluble in water higher alcohols are not.

(c) Ortho nitro phenol is more acidic than Ortho-methoxyphenol.

(d) 2,4,6-trinitrophenol gives sodium bicarbonate test.

(e) Alcohol reacts with sodium metal whereas ether do not.

Answer: -(a)Alcohols have hydrogen bonding whereas hydrocarbons have weak van der Waal's force of attraction.

(b) Due to steric hindrance higher alcohols are incapable of forming hydrogen bonding with water and so are insoluble in water.

(c) Ortho nitrophenol is more acidic due to electron withdrawing effect of nitro group which facilitates release of proton

(d) 2,4,6-trinitrophenol is stronger acid due to presence of three nitro group showing electron withdrawing effect.

(e) Alcohol reacts with sodium metal due to presence of active hydrogen in it.

(2) Account for the following: -

(a) Phenol doesn't react with $NaHCO_3$ whereas carboxylic acid reacts.

(b) Phenol is more easily nitrated than benzene.

(c) Sodium metal can be used for drying Di ethyl ether but not ethyl alcohol.

(d) Ether acts as Lewis base.

(e) Ortho nitro phenol is more volatile than para nitro phenol

Answer: -(a) Phenol is less acidic than carbonic acid whereas carboxylic acid is more acidic than carbonic acid.

(b) Phenol has activating group -OH which shows +R effect and so increases electron density at ortho and para position. so, phenol gets easily nitrated

(c) Sodium metal does not react with ether whereas it reacts with alcohol.

(d) Ether has two lone pair of electrons on oxygen and also two alkyl groups showing +I effect which helps in donation of electrons.

(e) Ortho nitro phenol has intramolecular hydrogen bonding and so molecules are less associated with each other whereas para nitro phenol has intermolecular hydrogen bonding.

CASE BASED QUESTIONS

Read the passage given below and answer the following questions:

Both alcohols and phenols are acidic in nature, but phenols are more acidic than alcohols. Acidic strength of alcohols mainly depends upon the inductive effect. Acidic strength of phenols depends upon a combination of both inductive effect and resonance effects of the substituent and its position on the benzene ring. Electron withdrawing groups increases the acidic strength of phenols whereas electron donating groups decreases the acidic strength of phenols. Phenol is a weaker acid than carboxylic acid.

1. Arrange the following compounds in increasing order of their acid strength: 1 mark
   Propan-1-ol, 2,4,6-trinitrophenol, 3-nitrophenol, 3,5-dinitrophenol, phenol, 4-methylphenol

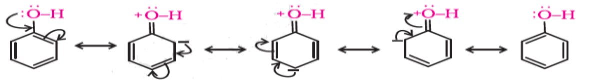
Answer: - Propan-1-ol, 4-methylphenol, phenol, 3-nitrophenol, 3,5-dinitrophenol, 2,4, 6-trinitrophenol

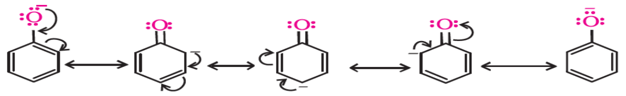
2. Alcohols act as Bronsted bases also. Explain 1 mark

Answer: -It is due to the presence of unshared electron pairs on oxygen, which makes them proton acceptors.

3. Draw the resonating structures of phenol and phenoxide ions 2 mark

Answer:-





OR

Explain why phenoxide ion is more stable than phenol.

Answer: -Resonance structures of phenol have charge separation due to which the phenol molecule is less stable than phenoxide ion which has charge delocalization.

MULTIPLE CHOICE QUESTIONS (ONE CORRECT ANSWER)

1. Phenol reacts with Br$_2$ in CS$_2$ at low temperature to give
   (a) o-Bromophenol
   (b) o-and p-bromophenols
   (c) p-Bromophenol
   (d) 2, 4, 6Tribromophenol

2. The correct order of boiling points of alcohol of the same molecular mass :
   (a) $1^\circ > 2^\circ > 3^\circ$
   (b) $3^\circ > 2^\circ > 1^\circ$
   (c) $2^\circ > 1^\circ > 3^\circ$
   (d) $2^\circ > 3^\circ > 1^\circ$

3. When Phenol is distilled with zinc dust, it gives
   (a) Benzene
   (b) Toluene
   (c) Benzaldehyde
   (d) Benzoic acid

4. Which of the following cannot be made by using Williamson Synthesis:
   (a) Methoxybenzene
   (b) Benzyl p-nitrophenyl ether
   (c) tert. butyl methyl ether
   (d) Ditert. butyl ether

5. Dehydration of alcohol to ethers is catalysed by
   (a) conc. H_2SO_4 at 413 K
   (b) Hot NaOH
   (c) Hot HBr
   (d) Hot HNO_3

ASSERTION-REASON TYPE QUESTION

Each question consists of two statements, namely, Assertion (A) and Reason (R).For selecting the correct answer, use the following code:

(a) Both Assertion (A) and Reason (R) are the true and Reason (R) is a correct explanation of Assertion (A).
(b) Both Assertion (A) and Reason (R) are the true but Reason (R) is not a correct explanation of Assertion (A).
(c) Assertion (A) is true and Reason (R) is false.
(d) Assertion (A) is false and Reason (R) is true.

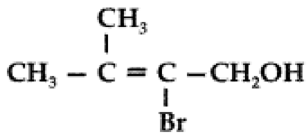
1. Assertion (A): Phenol is more acidic than ethanol.
   Reason (R): Phenoxide ion is stabilized by resonance but ethoxide ion is not.
2. Assertion (A): Phenol gives o-and p- nitrophenol on nitration with conc. HNO_3 and H_2SO_4 mixture.
   Reason (R): -OH group in phenol is O- and P-directing.
3. Assertion (A): Alcohols have higher boiling point than ethers.
   Reason (R): They can form intermolecular hydrogen bonding.

4. Assertion (A): O – nitrophenol is less volatile than P-nitrophenol.
   Reason (R): Intramolecular hydrogen bonding is present in O-nitrophenol while intermolecular hydrogen bonding is present in O-nitrophenol.
5. Assertion (A): Lucas test can be used to distinguish between 1-propanol and 2-propanol.
   Reason (R): Lucas test is based upon the difference in reactivity of primary, secondary and tertiary alcohols with conc. HCl and anhydrous $ZnCl_2$.

NOMENCLATURE TYPE QUESTIONS

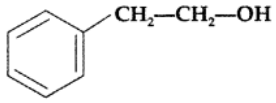
1. Write the IUPAC name of the following compounds.

(a)

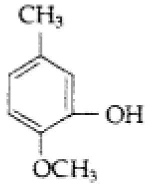


$CH_3-\overset{CH_3}{\overset{|}{C}}=\underset{\underset{Br}{|}}{C}-CH_2OH$

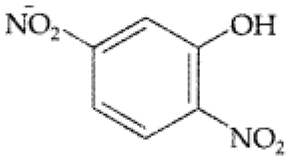
(b)



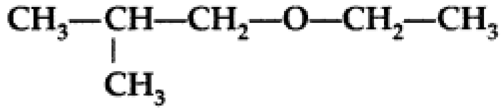
(c)



(d)



(e)



$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-O-CH_2-CH_3$

2. Write the structure of the following compound whose IUPAC name are as follows:

   (a) 2-methylpropan- 2-ol molecule.
   (b) Hex-l-en-3-ol
   (c) Butane-1,3-diol
   (d) 1-phenylpropan-2-ol
   (e) 2-Methoxypropane

COMPETENCY BASED QUESTIONS

REASONING TYPE QUESTIONS

1. Ortho nitrophenol has lower boiling point than p-nitrophenol. Why?
2. Ortho-nitrophenol is more acidic than ortho-methoxyphenol. Why?
3. Of the two hydroxy organic compounds ROH and R'OH, the first one is basic and other is acidic in behaviour. How is R different from R'?
4. Which of the following isomers is more volatile : o-nitrophenol or p-nitrophenol?
5. Out of CH_3OH and C_6H_5OH which one is more acidic and why?
6. Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses?
7. The boiling point of ethanol is higher than that of methoxymethane?
8. The C—O—H bond angle in alcohols is slightly less than the tetrahedral angle (190°28′)?
9. $(CH_3)_3C—O—CH_3$ on reaction with HI gives $(CH_3)_3C—I$ and $CH_3—OH$ as the main products and not $(CH_3)_3C—OH$ and $CH_3—I$?
10. $(CH_3)_3C—Br$ on reaction with sodium methoxide (Na+ _OCH_3) gives alkene as the main product and not an ether.

CHEMICAL TEST TYPE QUESTIONS

1. Give one chemical test to distinguish between: Propan-1-ol and Propan-2-ol
2. Give one chemical test to distinguish Phenol and Acetic acid.
3. Give one chemical test to distinguish Methanol and ethanol.
4. Give one chemical test each to distinguish between the following pair: (i)Phenol and Propan-1-ol (ii)Ethanol and dimethyl ether (iii) propan-1-ol and 2-methyl propan-2-ol

5. Give one chemical test to distinguish (i) Ethanol and propan-1-ol (ii) Propan-2-ol and pentan-3-ol
6. Give one chemical test to distinguish

(i) β – naphthol and ethanol
(ii) diethyl ether and n-butane
(iii) Diethyl ether and but-1-ene

NAME REACTION TYPE QUESTIONS

1. Write the following name reaction:

a) Kolbe's reaction
b) Reimer-Tiemann reaction
c) Williamson synthesis
d) Hydroboration
e) Esterification

MECHANISM TYPE QUESTIONS

1. Write the mechanism of acid catalysed hydration of alkenes.
2. Write the mechanism of acid catalysed dehydration of ethanol to yield ethene at 443K.
3. Write the mechanism of dehydration of Alcohol to form Ether at 413 K.

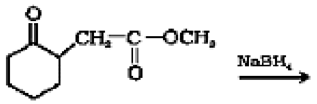
CONVERSION TYPE QUESTIONS

1. How are the following conversions carried out? (i) Propane to Propan-2-ol (ii) Phenol to acetophenone (iii) Propene to propan-1-ol
2. How will you bring about the following conversions? (i) Ethyl chloride to Ethanal (ii) Phenol to salicylic acid (ii) Benzyl chloride to Benzyl alcohol
3. Write the chemical reactions for the following conversions. (i) Phenol to anisole (ii) Ethyl magnesium chloride to Propan-1-ol (iii) Cumene to phenol (iv) Phenol to picric acid

COMPLETE THE REACTIONS TYPE QUESTIONS

1. Predict the products of the following reactions :

   a) $CH_3 - CH_2 - CH_2 - CH_2 - OH + SOCl_2 \rightarrow$
   b) $CH_3 - CH_2 - CH_2 - O - CH_3 + HBr \rightarrow$
   c) $C_6H_5 - CH_2 - O - C_6H_5 + HI \xrightarrow{heat}$
   d) $CH_3 - CH = CH_2 \xrightarrow{H_2O/H^+}$



ARRANGE IN CORRECT ORDER TYPE QUESTIONS

1. Arrange each set of compounds in the decreasing order of property indicated

   a) Methanol, ethanol, diethyl ether, ethylene glycol. (Boiling point)
   b) Phenol, O- nitrophenol, p- methoxyphenol, p- nitrophenol. (K_a value)
   c) Dimethyl ether, ethanol, phenol. (Solubility in water)
   d) 2-methylpropan-1-ol, n-Butanol, 2-methylpropan-2-ol (acidic nature)
   e) Ethanol, n-butane, water, propane. (Boiling point)
   f) Isobutane, n-butane, n- butanol, n-butyl chloride (boiling point)
   g) Water, ethanol, phenol (acidity character)
   h) Ethanol, isopropanol, tertiary butyl alcohol (reactivity towards Lucas reagent)
   i) Methanol, ethyl alcohol, ethylene glycol, glycerol. (Solubility in water)
   j) Phenol, o- nitrophenol, p-nitrophenol, m-nitrophenol (boiling point order)

WORD PROBLEM TYPE QUESTIONS

1. An organic compound A with molecular formula $C_8H_{16}O_2$ was hydrolysed with sulphuric acid to give a carboxylic acid B and alcohol C. Oxidation of C with chromic acid produced B. C on dehydration gives but-1-ene. Write reactions involved.
2. When an aromatic organic compound with molecular formula C_6H_6O is treated with bromine water, white precipitate of compound Y is obtained. Give the structure and the name of X and Y and write the chemical reaction involved.
3. An organic compound ‘A’ having molecular formula C_3H_6 on treatment with aq. H_2SO_4 give ‘B’ which on treatment with Lucas reagent gives ‘C’. The compound ‘C’ on treatment with ethanolic KOH gives back ‘A’. Identify A, B, C.
4. An organic compound A (C_6H_6O) gives a characteristic colour with aq.$FeCl_3$ solution. (A) On reacting with CO_2 and NaOH at 400 K under pressure gives (B) which on acidification gives a compound (C). The compound (C) reacts with acetyl chloride to give (D) which is a popular pain killer. Deduce the structure of A, B, C& D.
5. An organic compound (X) when dissolved in ether and treated with magnesium metal forms a compound Y. The compound, Y, on treatment with acetaldehyde and the product on acid hydrolysis gives isopropyl alcohol. Identify the compound X. What is the general name of the compounds of the type Y.

8. Aldehydes, Ketones & Carboxylic Acids

MULTIPLE CHOICE QUESTIONS (1 MARKS)

1.) Which aldehyde will give Cannizzaro's reaction?
(a) $CH_3CH_2CH_2CHO$ (b) CH_3CH_2CHCHO
(c) $(CH_3)_3CCHO$ (d) $(CH_3)_2CH_2CH_2CHO$

2.) Carboxylic acids are more acidic than phenol and alcohol because of
(a) Formation of dimers (b) Resonance stabilization of their conjugate base
(c) Highly acidic hydrogen (d) Intermolecular hydrogen bonding

3.) Aldehydes and ketones undergo _________ reactions.
a) electrophilic addition b) electrophilic substitution
c) nucleophilic addition d) nucleophilic substitution

4.) What is the correct order of reactivity of the following towards nucleophilic addition?
a) Methanal > Ethanal > Acetone b) Acetone > Ethanal > Methanal
c) Methanal > Acetone > Ethanal d) Ethanal > Methanal > Acetone

5.) Identify the reagent for the conversion of but-2-ene to ethanal.
a) O_3/H_2O-Zn dust b) H_2O, H_2SO_4, $HgSO_4$
c) PCC d) DIBAL-H

6.) Which of the reactions below can result in ketones?
a) Oxidation of primary alcohols
b) Oxidation of secondary alcohols
c) Dehydrogenation of tertiary alcohols
d) Dehydrogenation of primary alcohols

7.) Which of the following orders of relative strengths of acids is correct?
(a) $ClCH_2COOH > FCH_2COOH > BrCH_2COOH$
(b) $ClCH_2COOH > BrCH_2COOH > FCH_2COOH$
(c) $BrCH_2COOH > ClCH_2COOH > FCH_2COOH$
(d) $FCH_2COOH > ClCH_2COOH > BrCH_2COOH$

8.) The reagent which does not react with both Propanone and Benzaldehyde:
(a) Grignard reagent (b) Tollen's reagent
(c) Zn-Hg amalgam (d)Fehling solution

9.) Which of the following compound will not give $NaHCO_3$ test?
(a)Carbolic acid (b)Formic acid (c) Acetic acid (d) Benzoic acid

10.) In Clemmensen Reduction carbonyl compound is treated with __
(a) Zinc amalgam + HCl (b) Sodium amalgam + HCl
(c) Zinc amalgam + nitric acid (d) Sodium amalgam + HNO_3

ASSERTION REASON TYPE QUESTIONS(1MARKS)

Note : In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

c) Assertion is correct statement but reason is wrong statement.

d) Assertion is wrong statement but reason is correct statement.

11.) Assertion: Methanal, ethanal and propanone are miscible with water in all proportions.

Reason: The lower members of aldehydes and ketones form hydrogen bond with water.

12.) Assertion: Aldehydes are generally more reactive than ketones in nucleophilic addition reactions.

Reason: Sterically, the presence of two relatively large substituents in ketones hinder the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent.

13.) Assertion: Sodium hydrogen sulphite adds to aldehydes and ketones to form the addition product.

Reason: Reaction of aldehydes with Sodium hydrogen sulphite is useful for separation and purification of aldehydes.

14.) Assertion: Pk_a of acetic acid is lower than that of phenol

Reason: Phenoxide ion is more resonance stabilized than acetate ion.

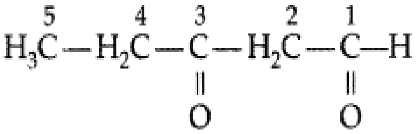
15.) Assertion : α-hydrogen atoms of carbonyl compounds are acidic in nature.

Reason: The strong electron donating effect of the carbonyl group and resonance destabilisation of the conjugate base makes the alpha hydrogen acidic.

VERY SHORT ANSWER TYPE QUESTIONS (1 MARKS)

16) Write the structure of 3-oxopentanal.

Ans:



$$\overset{5}{H_3C}-\overset{4}{H_2C}-\overset{3}{C}(=O)-\overset{2}{H_2C}-\overset{1}{C}(=O)-H$$

3-oxopentanal

17) Give a chemical test to distinguish between Benzoic acid and Phenol.

Ans: Benzoic acid forms a brisk effervescence with $NaHCO_3$ solution but phenol does not respond to this test.

18) Formaldehyde does not undergo aldol condensation reaction. Why?

Ans: Formaldehyde does not contain α-hydrogen atom.

19) Aldehydes and Ketones have lower boiling points than corresponding alcohols. Why?

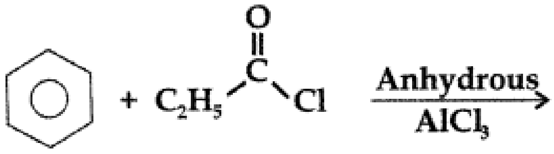
Ans: Aldehydes and ketones have weak intermolecular interactions dipole – dipole interactions whereas alcohols have intermolecular hydrogen bonding.

20) Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions:

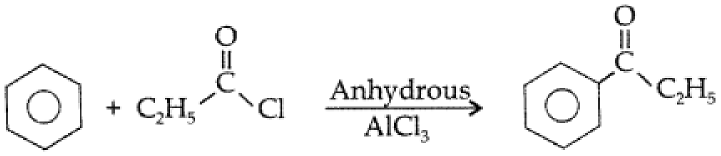
(i)Ethanal, Propanal, Propanone, Butanone.
(ii)Benzaldehyde, *p*-Tolualdehyde, *p*-Nitrobenzaldehyde, Acetophenone.

Ans: (i)Butanone<Propanone<Propanal<Ethanal
(ii)Acetophenone < p-Tolualdehyde < Benzaldehyde < p-nitro benzaldehyde

21) Write the structure of the product formed in the following reaction.



Ans:



22) Carboxylic acids do not give characteristic reactions of carbonyl group. Why?

Ans: The carboxylic carbon is less electrophilic due to resonance than the carbonyl carbon.

23) Write the reagents required in the following reactions.

$$(i)\ CH_2=CH-CH_2OH \xrightarrow{?} CH_2=CH-CHO$$
$$(ii)\ CH_3-COOH \xrightarrow{?} CH_3-CONH_2$$

Ans:

$$(i)\ CH_2=CH-CH_2OH \xrightarrow{PCC} CH_2=CH-CHO$$
$$(ii)\ CH_3-COOH \xrightarrow[\Delta]{NH_3} CH_3-CONH_2$$

24) Why does benzoic acid not undergo Friedel-Craft reaction?

Ans: – COOH group in C_6H_5COOH is an electron withdrawing group which deactivates the benzene ring. Hence electrophilic substitution becomes difficult.

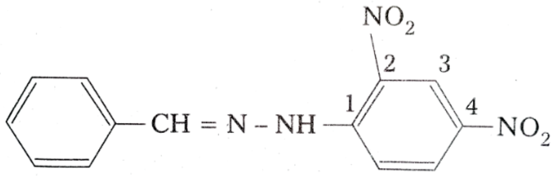
25) Why Pka of F-CH_2COOH is lower than that of Cl–CH_2COOH?

Ans: Stronger –I effect of fluorine makes F-CH_2COOH to be stronger acid than Cl–CH_2COOH and has less Pka.

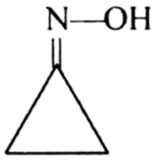
SHORT ANSWER TYPE QUESTIONS (2 MARKS)

26) Draw structures of the following derivatives:
(i) The 2,4-dinitrophenylhydrazone of benzaldehyde
(ii) Cyclopropanone oxime

Ans: (i)



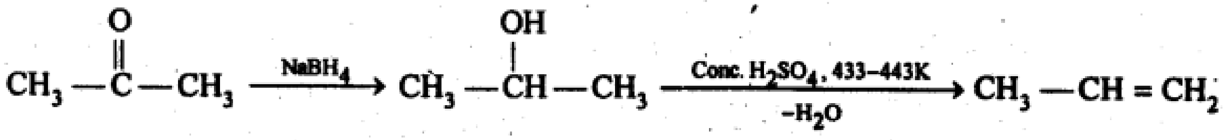
(ii)



27) **How will you convert**
(i) Propanone to Propene (ii) Benzoic acid to Benzaldehyde

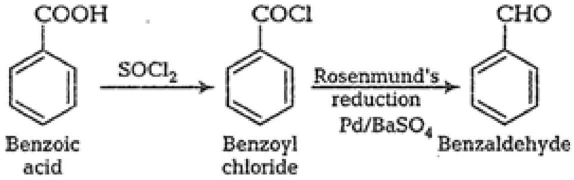
Ans:

(i) Propanone to propene:



$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{NaBH_4} CH_3-\overset{OH}{\overset{|}{C}H}-CH_3 \xrightarrow[-H_2O]{Conc.\ H_2SO_4,\ 433-443K} CH_3-CH=CH_2$$

(ii)

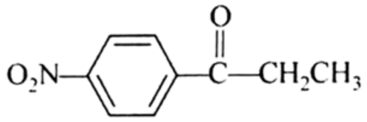


28) Give the structure of the following compounds.

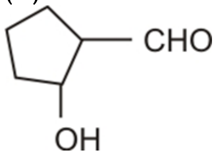
(i) 4-Nitropropiophenone

(ii) 2-Hydroxycyclopentanecarbaldehyde

Ans: (i)



(ii)



29) Explain each of the following.

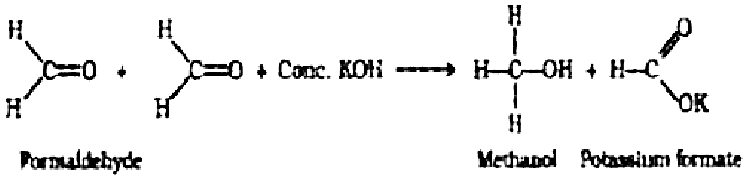
(i) Cyanohydrin (ii) Acetal

Ans: **(i)** Cyanohydrin: gem-Hydroxynitriles, i.e., compounds possessing hydroxyl and cyano groups on the same carbon atom are called cyanohydrins. These are produced by addition of HCN to aldehydes or ketones in a weakly basic medium**.**

(ii) gem – Di alkoxy compounds in which the two alkoxy groups are present on the terminal carbon atom are called acetals. These are produced by the action of an aldehyde with two equivalents of a monohydric alcohol in presence of dry HCl gas.

30) What happens when Formaldehyde is treated with conc.KOH?

Ans: It undergoes disproportionation to form Methanol and Potassium formate. This is called Cannizzaro reaction**.**



SHORT ANSWER TYPE QUESTIONS (3MARKS)

31. Give plausible explanation for each of the following:

(i) Cyclohexanone forms cyanohydrin in good yield but 2,2,6-trimethylcyclohexanone does not.

(ii) There are two – NH_2 groups in semicarbazide. However, only one is involved in the formation of semicarbazones.

(iii)During the preparation of esters from a carboxylic acid and an alcohol in the presence of an acid catalyst**,** the water or the ester should be removed as soon as it is formed.

Ans

(i) In 2,2,6-trimethylcyclohexanone due to the presence of three methyl groups nearer to the C = O, the nucleophilic attack by the CN^- ion does not occur due to steric hinderance. Since there is no such steric hindrance in cyclohexanone, therefore, nucleophilic attack by the CN– ion occurs readily and hence cyclohexanone cyanohydrin is obtained in good yield.

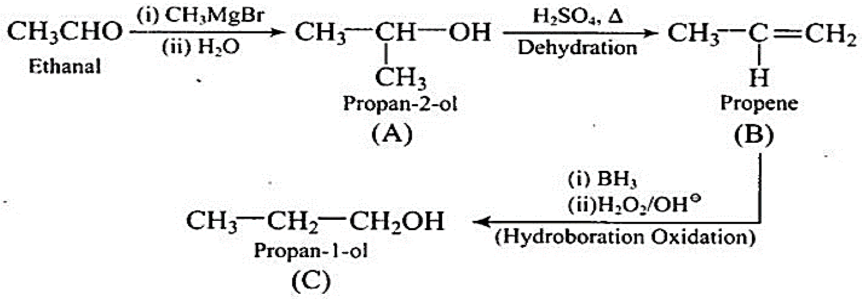
(ii) Although semicarbazide has two – NH_2 groups but one of them (i.e. which is directly attached to C = O) is involved in resonance as shown above. As a result, electron density on N of this -NH_2 group decreases and hence it does not act as a nucleophile. In contrast, the other -NH_2 group (i.e. attached to NH) is not involved in resonance and hence lone pair of electrons present on N atom of this -NH_2 group is available for nucleophilic attack on the C = O group of aldehydes and ketones.

(iii) The formation of esters from a carboxylic acid and an alcohol in presence of an acid catalyst is a reversible reaction. Thus, to shift the equilibrium in the forward direction, the water or the ester formed should be removed as fast as it is formed.

32. Identify the compounds A, B and C in the following reaction.

$$CH_3CHO \xrightarrow[\text{(ii) } H_2O]{\text{(i) } CH_3MgBr} (A) \xrightarrow{H_2SO_4,\ \Delta} (B) \xrightarrow{\text{Hydroboration oxidation}} (C)$$

Ans:



33. Give simple chemical tests to distinguish between the following pairs of compounds.

(i) Propanal and Propanone (ii) Acetophenone and Benzophenone

(iii)Phenol and Benzoic acid

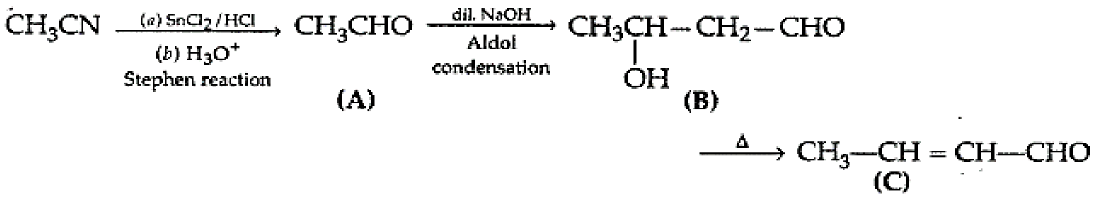
Ans: (i) Tollen's test- Propanal on warming with ammoniacal silver nitrate solution produces bright silver mirror. Propanone does not give this test.

(ii)Iodoform test-Acetophenone gives yellow ppt of iodoform on treating with I_2 and NaOH. Benzophenone does not give this test.

(iii)$NaHCO_3$ test- Benzoic acid gives brisk effervescence when treated with $NaHCO_3$, Phenol does not give this test.

34. Write structures of compounds A, B and C in the following reactions:

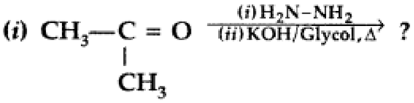
$$CH_3CN \xrightarrow[(b)\ H_3O^+]{(a)\ SnCl_2/HCl} A \xrightarrow{\text{dil. NaOH}} B \xrightarrow{\Delta} C$$



Ans:

A-Ethanal, B- 3-hydroxybutanal, C-But-2-enal

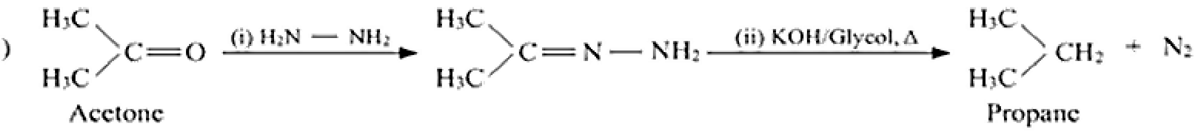
35. Predict the products of the following reactions.



$$(i)\ CH_3-\underset{CH_3}{\underset{|}{C}}=O \xrightarrow[(ii)\ KOH/Glycol,\Delta]{(i)\ H_2N-NH_2} ? \qquad (ii)\ C_6H_5-CO-CH_3 \xrightarrow{NaOH/I_2} ? + ?$$

$$(iii)\ CH_3COONa \xrightarrow[\Delta]{NaOH/CaO} ?$$

Ans:

(i) 

(ii) $C_6H_5-CO-CH_3 \xrightarrow[\Delta]{NaOH/I_2} CHI_3\downarrow + C_6H_5COONa$

Acetophenone Iodoform (Yellow)

(iii) $CH_3-COONa \xrightarrow[\Delta]{NaOH/CaO} CH_4 + Na_2CO_3$

Sodium acetate Methane

Long Answer Type Questions (5 marks each):

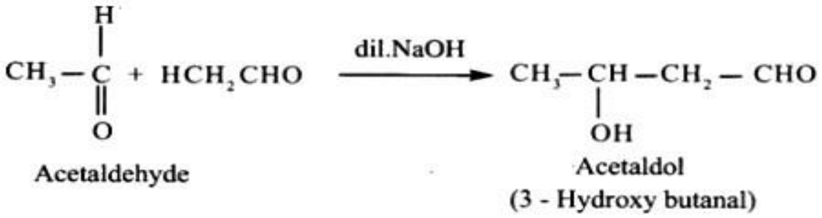
36. Describe the following :

(i) Aldol Condensation (ii)Cannizzaro Reaction

(iii)Clemmensen Reduction (iv)Rosenmund Reduction

(v) Hell Volhard Zelinsky Reaction.

Ans: (i) Aldol Condensation-Aldehydes having α-hydrogen react with a dilute base to give β-hydroxy aldehydes called aldols.

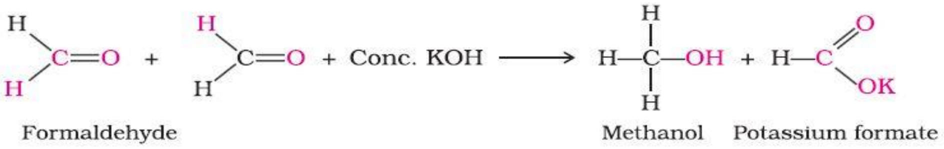


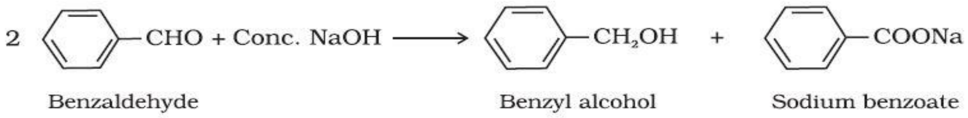
$$CH_3-\overset{H}{\underset{O}{C}} + HCH_2CHO \xrightarrow{dil.NaOH} CH_3-\underset{OH}{CH}-CH_2-CHO$$

Acetaldehyde Acetaldol (3 - Hydroxy butanal)

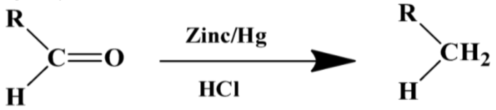
(ii)Cannizzaro reaction:

Aldehydes which do not contain hydrogen when treated with a concentrated solution of an alkali undergo self oxidation-reduction. As a result, one molecule of aldehyde is reduced to corresponding alcohol while the other molecule is oxidized to the corresponding acid.

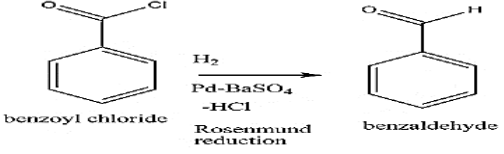




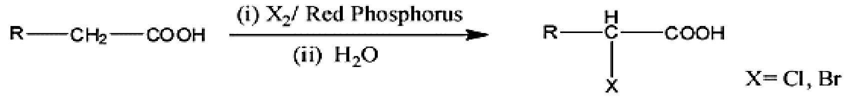
(iii)Clemmensen Reduction: Aldehydes or ketones are reduced to alkanes using hydrochloric acid and zinc amalgam.



(iv)Rosenmund Reduction: Acyl chloride is hydrogenated in the presence of catalyst – palladium on barium sulphate to produce aldehydes.



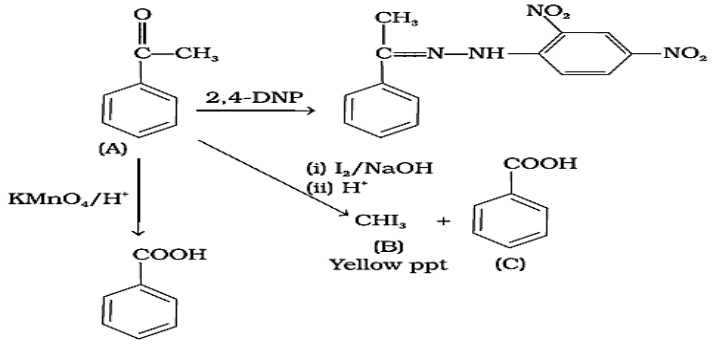
(v)Hell Volhard Zelinsky Reaction: It involves the halogenation of a carboxylic acid having alpha hydrogen when treated with Red P and Cl_2 or Br_2.



Alpha halo carboxylic acid

37. An aromatic compound 'A' (Molecular formula C_8H_8O) gives positive 2,4-DNP test. It gives a yellow precipitate of compound 'B' on treatment with iodine and sodium hydroxide solution. Compound 'A' does not give Tollen's or Fehling's test. On drastic oxidation with potassium permanganate, it forms a carboxylic acid 'C' (Molecular formula $C_7H_6O_2$), which is also formed along with the yellow compound in the above reaction. Identify A, B and C and write all the reactions involved.

Ans: A-Acetophenone B-Iodoform C- Benzoic acid



Case based; Source based Integrated Questions

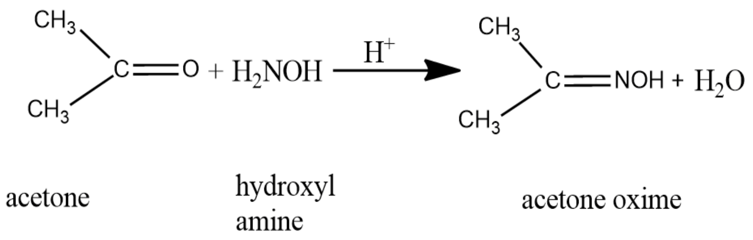
38.) Read the following passage and answer the questions given below the passage.

Reductive alkylation is the term applied to the process of introducing alkyl groups into ammonia or a primary or secondary amine by means of an aldehyde or ketone in the presence of a reducing agent. The present discussion is limited to those reductive alkylations in which the reducing agent is hydrogen and a catalyst or "nascent" hydrogen, usually from a metal acid combination; most of these reductive alkylations have been carried out with hydrogen and a catalyst. The principal variation excluded is that in which the reducing agent is formic acid or one of its derivatives; this modification is known as the Leuckart reaction. The process of reductive alkylation of ammonia consists in the addition of ammonia to a carbonyl compound and reduction of the addition compound or its dehydration product. The reaction usually is carried out in ethanol solution when the reduction is to be affected catalytically Since the primary amine is formed in the presence of the aldehyde it may react in the same way as ammonia, yielding an addition compound, a Schiff's base (RCH= NCH_2R) and finally, a secondary amine. Similarly, the primary amine may react with the imine, forming an addition product which also is reduced to a secondary amine Finally, the secondary amine may react with either the aldehyde or the imine to give products which are reduced to tertiary amines. Similar reactions may occur when the carbonyl compound employed is a ketone

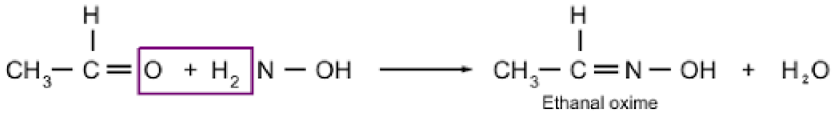
A] Write equations for the following reactions.

(i) Acetone with hydroxyl amine (ii) Ethanal with ammonia

Ans (i)Acetone with hydroxyl amine



(ii) Ethanal with ammonia



B] A compound gives 2,4 DNP test, further it reduces Tollen's reagent. what conclusions can be drawn from this information?

Ans: As the compound gives 2,4-DNP test.it must be an aldehyde or ketone. Further as it gives Tollen's test it is an aldehyde.

C]What type of reaction takes place when aldehydes or ketones are treated with ammonia and its derivatives?

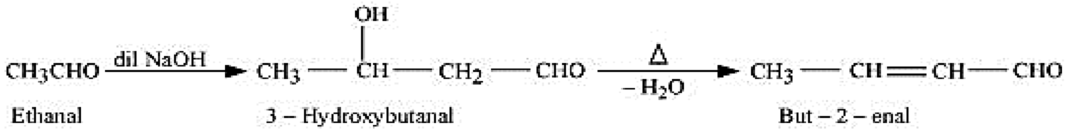
Ans: Nucleophilic addition reaction.

39.) Read the following passage and answer the questions given below the passage.

The addition reaction of enol or enolate to the carbonyl functional group of aldehyde or ketone is known as aldol addition. The b-hydroxy aldehyde or b-hydroxyketone so obtained undergo dehydration in second step to produce a conjugated enone. The first part of reaction is an addition reaction and the second part is an elimination reaction. Carbonyl compound having alpha-hydrogen undergoes aldol condensation reaction. When an aldehyde with no alpha-hydrogen reacts with concentrated aqueous NaOH, half the aldehyde is converted to carboxylic acid salt and other half is converted to an alcohol. In other words, half of the reactant is oxidized and another half is reduced. This reaction is known as Cannizzaro reaction.

A] How will you convert ethanol to But-2-enal?

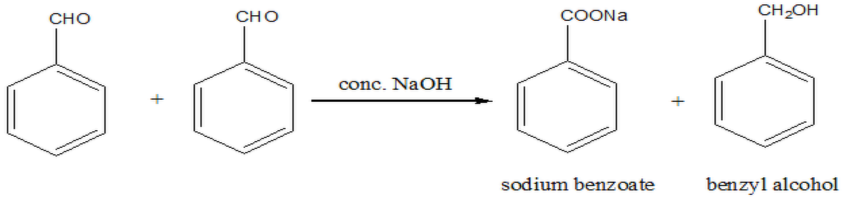
Ans:



B] Name the products of aldol condensation of Propanone and Ethanal.

Ans: 1) But-2-enal 2)2-Methylpent-2-enal
3)Pent-2-enal 4) 2-methyl but -2-enal

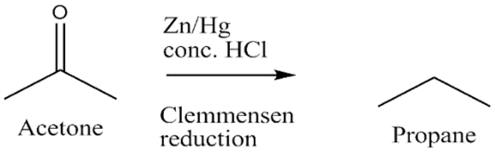
C] What happens when Benzaldehyde is treated with Conc. NaOH?



40.) Read the following passage and answer the questions given below the passage.

The carbonyl group of aldehydes and ketones is reduced to -CH_2- group on treatment with zinc amalgam and concentrated hydrochloric acid [Clemmensen reduction] or with hydrazine followed by heating with sodium or potassium hydroxide in high boiling solvent such as ethylene glycol (Wolf-Kishner reduction). Aldehydes differ from ketones in their oxidation reactions. Aldehydes are easily oxidised to carboxylic acids on treatment with common oxidising agents like nitric acid, potassium permanganate, potassium dichromate, etc. Even mild oxidising agents, mainly Tollens' reagent and Fehling's reagent also oxidise aldehydes. Ketones are generally oxidised under vigorous conditions, i.e., strong oxidising agents and at elevated temperatures. Their oxidation involves carbon-carbon bond cleavage to afford a mixture of carboxylic acids having lesser number of carbon atoms than the parent ketone.

A] Write a chemical equation to convert Propanone to propane. Mention the name of the reaction.

Ans: 

and Wolff –Kishner reduction

B]Name the reagents used in the following conversions?

i) Butan-1-ol to Butanal ii) Ethanal to Ethanoic acid

Ans: i) PCC / CrO_3-H_2SO_4 ii) Acidified $KMnO_4$/$K_2Cr_2O_7$

C] You are given two test tubes. One contains aliphatic aldehyde and the other one contains aromatic aldehyde. How will you identify the test tube containing aromatic aldehyde?

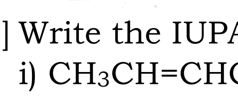
Ans: Both the given compounds are subjected to Fehling's test. The compound which does not give Fehling's test is an aromatic aldehyde

41.) Read the following passage and answer the questions given below the passage.

Aldehydes and ketones are the simplest and most important carbonyl compounds. In aldehydes, the carbonyl group is bonded to a carbon and hydrogen while in the ketones, it is bonded to two carbon atoms. The IUPAC names of open chain aliphatic aldehydes and ketones are derived from the names of the corresponding alkanes by replacing the ending –e with –al and –one respectively. In case of aldehydes the longest carbon chain is numbered starting from the carbon of the aldehyde group while in case of ketones the numbering begins from the end nearer to the carbonyl group. The substituents are prefixed in alphabetical order along with numerals indicating their positions in the carbon chain. The same applies to cyclic ketones, where the carbonyl carbon is numbered one. When the aldehyde group is attached to a ring, the suffix carbaldehyde is added after the full name of the cycloalkane. The numbering of the ring carbon atoms starts from the carbon atom attached to the aldehyde group. The name of the simplest aromatic aldehyde carrying the aldehyde group on a benzene ring is benzene carbaldehyde. However, the common name benzaldehyde is also accepted by IUPAC. Other aromatic aldehydes are hence named as substituted benzaldehydes.

A] Write the structures of 4-Fluoroacetophenone & 2-Hydroxybutanal.

Ans:i) ii)



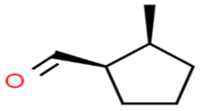
2-hydroxybutanal

B] Write the IUPAC names of the following ketones and aldehydes.

i) $CH_3CH{=}CHCHO$ ii) $CH_3CH_2COCH(C_2H_5)CH_2CH_2Cl$

Ans: i) But-2-en-1-al or But-2-enal ii) 6-Chloro-4-ethylhexan-3-one

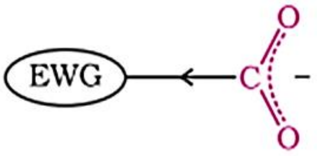
C] Name the compound represented by the formula



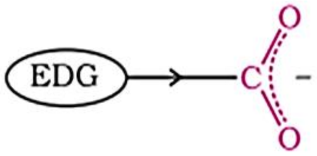
Ans: 2- methylcyclopentane carbaldehyde

42.) Read the following passage and answer the questions given below the passage.

Effect of substituents on the acidity of carboxylic acids: Substituents may affect the stability of the conjugate base and thus, also affect the acidity of the carboxylic acids. Electron withdrawing groups increase the acidity of carboxylic acids by stabilising the conjugate base through delocalisation of the negative charge by inductive and/or resonance effects. Conversely, electron donating groups decrease the acidity by destabilising the conjugate base.



Electron withdrawing group (EWG) stabilises the carboxylate anion and strengthens the acid



Electron donating group (EDG) destabilises the carboxylate anion and weakens the acid

A] Which is more acid Acrylic acid CH_2=CHCOOH or Propanoic acid ? Why?

Ans: Acrylic acid is more acidic than Propanoic acid. In case of acrylic acid, the carbon atom of the carboxylic group (-COOH) is attached with SP^2hybridised carbon atom which has more s- character (33%) than SP^3hybridised carbon atom (25%), hence SP^2 hybridised carbon atom become more electronegative so the electron density shifts towards SP^2 carbon atom, then due to inductive effect oxygen acquires positive charge hence it becomes easier to remove H^+ ion.

B] Dichloroacetic acid is stronger acid than chloroacetic acid. Why?

Ans: The more the number of electron withdrawing groups the more is the acidic nature.

C] Arrange the following acids in the increasing order of acidic strength

Benzoic acid, 4- nitrobenzoic acid, 3,4-dinitro benzoic acid,4- methoxy benzoic acid

Ans: 4- methoxy benzoic acid<benzoic acid<4-nitrobenzoic acid<3,4- dinitrobenzoic acid.

9. AMINES

MULTIPLE CHOICE QUESTIONS (1 MARKS)

Q: 1 The correct IUPAC name for $CH_3 - CH_2 - CH_2 - N(CH_3) - C_2H_5$ is

(a) N, N- diethyl propan-1-amine (c) N, N-dimethyl propan-1-amine
(b) N-Ethyl –N-methyl propan-1-amine (d) N-methyl 1- pentanamine

Q: 2 Which of the following statement is not correct?

(a) Primary amines show intermolecular hydrogen bonding.
(b) Secondary amines show intermolecular hydrogen bonding.
(c) Tertiary amines show intermolecular hydrogen bonding.
(d) Amines have lower boiling points as compared to those of alcohols and carboxylic acids of comparable molar masses.

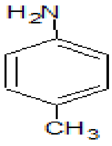
Q: 3 Which of the following statement is correct?

(a) The pK_b of ammonia is more than that of methanamine.
(b) The K_b of ammonia is more than that of methanamine
(c) The pK_b of ammonia is more than that of aniline.
(d) The pK_b of ammonia is less than that of methanamine.

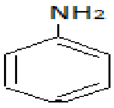
Q: 4 Atharv heated a mixture of primary amine and chloroform with ethanolic potassium hydroxide (KOH) to form isocyanides which has foul smelling. What is the name of the reaction involved in the statement?

(a) Hoffmann bromide degradation reaction (c) Gabriel Phthalimide reaction
(b) Hinsberg's Test (d) Carbylamine reaction

Q: 5 The correct increasing order of basic strength for the following compounds is:



(I)



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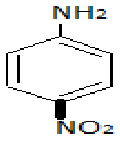


(III)

(a) II < III < I (c) III < II < I
(b) III < I < II (d) II < I < II

Q: 6 The reaction $C_6H_5N_2Cl \xrightarrow{Cu,HCl} C_6H_5Cl + N_2$ **is named as**

(a) Sandmeyer reaction (b) Gattermann reaction
(c) Claisen reaction (d)Carbylamine reaction

Q: 7 The -NH_2 group is o-, p- directing and strongly activates the aromatic ring. Therefore, aromatic amines undergo electrophilic substitution reactions readily and it is difficult to stop the reaction at the monosubstitution stage. However, sometimes monosubstitution product is required. How can the activating effect of -NH_2 group be controlled to get monosubstitution product?

(a) Protecting -NH_2 group by chlorination with chlorine
(b) Protecting -NH_2 group by nitration with nitric acid
(c) Protecting -NH_2 group by alkylation with alkyl chloride
(d) Protecting -NH_2 group by acetylation with acetic anhydride

Q: 8 A and B in the folowing reactions are:

(a) A = Nitrobenzene, B = Nitrobenzene	(c) A=Nitrobenzene,B = Nitrotoluene
(b) A = Nitrobenzene, B = benzamide	(d) A = benzamide, B = Nitrobenzene

Q: 9 Gabriel phthalimide reaction is used for the preparation of:

(a) Primary aromatic amine	(c) Secondary amine
(b) Primary aliphatic amine	(d)Tertiary amine

Q: 10 Hinsberg's reagent is:

(a) Phenylisocyanide	(c) benzensulphonyl chloride
(b) p- toluenesulphonic acid	(d) o-dichlorobenzene

ASSERTION REASON TYPE QUESTIONS(1MARKS)

In the Following questions a statement of Assertion(A) is followed by a statement of Reason(R). Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

The question given below consist of an assertion and a reason. Use the following key to choose.

11. Assertion(A): Primary aromatic amines cannot be prepared by Gabriel phthalimide synthesis.
    Reason(R): Aryl halides undergo nucleophilic substitution with anion formed by phthalimide.
12. Assertion(A): Among isomeric amines, 3^0 amines have lowest boiling point.
    Reason(R): Tertiary amines do not have intermolecular association due to absence of H- atoms linked to nitrogen.
13. Assertion(A): Aliphatic amines are stronger bases than ammonia.
    Reason(R): Aromatic amines are weaker bases than ammonia.
14. Assertion(A): Very high amount of HCl is required in reduction of nitro compounds with iron scrap
    Reason(R): $FeCl_2$ formed gets hydrolysed to release HCl during the reaction.
15. Assertion(A): Aniline reacts with bromine water to give 2,4,6-tribromoaniline.
    Reason(R): The -NH_2 group is o-, p- directing and strongly activates the aromatic ring.

VERY SHORT ANSWER TYPE QUESTIONS (2 MARKS)

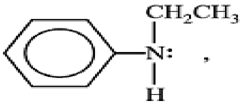
Q: 16 Give the IUPAC name of (i) $H_2N - CH_2 - CH_2 - CH = CH_2$

(ii) $CH_3—NH—CH_2CH_3$.

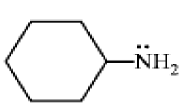
Answer: (i) But-3-en-1-amine (ii) N-methylethanamine

Q: 17 Which of the following are tertiary amines

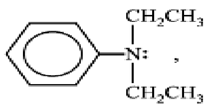
(i)



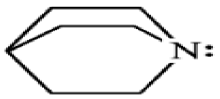
(ii)



(iii)



(iv)



Answer: (iii) and (iv) are tertiary amines

Q: 18 Name the IUPAC names of following.

(i) The amine produced by the Hoffmann bromamide degradation of propanamide.

(ii) The product produced after acylation of aniline.

Answer: (i) Ethanamine ($CH_3 - CH_2 - NH_2$)

(ii) N-Phenyl ethanamide (CH_3CONH- C_6H_5)

Q: 19 Write the main products of the following reactions:

(i) $C_6H_5N_2^+Cl^- + C_6H_5OH \xrightarrow{PH=9-10}$

(ii) $C_6H_5N_2^+Cl^- + H_3PO_2 + H_2O \rightarrow$

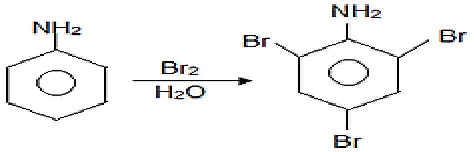
Answer: (i) $C_6H_5N=NC_6H_4OH$

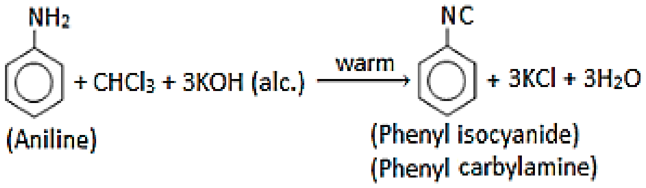
(ii) $C_6H_6 + N_2 + H_3PO_3 + HCl$

Q: 20 Write the chemical equations involved when aniline is treated with the following reagents:

(i) Br_2 water (ii) $CHCl_3$ + KOH

Answer:





Q:21 How will you convert the following:

(*i*) Ethanoic acid to methanamine (*ii)* Benzene diazonium chloride to phenol

Answer:

(i) Ethanoic acid to methanamine

$$CH_3COOH \xrightarrow[\Delta]{NH_3} CH_3CONH_2 \xrightarrow[\text{Hoffmann bromide degradation}]{Br_2/KOH} CH_3NH_2$$

(ii) Benzene diazonium chloride to phenol

$$C_6H_5N_2^+Cl^- + H_2O \rightarrow C_6H_5OH + N_2 + HCl$$

Q: 22 Give the chemical tests to distinguish between the following pairs of compounds:

(i)Ethylamine and Aniline (ii)Aniline and Benzylamine

Answer:

Ethylamine and aniline: Azo-dye test

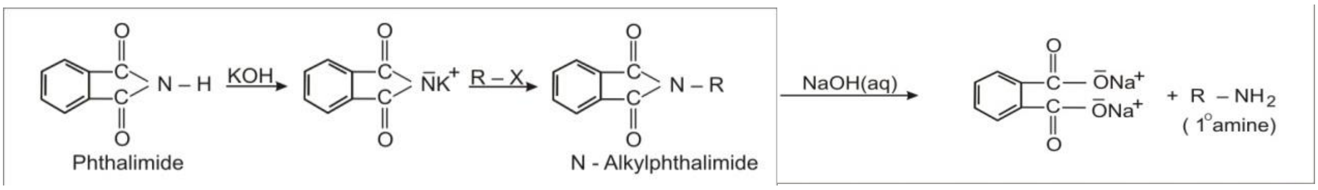
(i)Aniline reacts with $C_6H_5N_2^+Cl^-$, forms a yellow dye. Ethylamine does not form dye.

(ii) Aniline reacts with $C_6H_5N_2^+Cl^-$, forms a yellow dye. Benzylamine does not form dye.

Q: 23 Write the reactions involved in the following:

(i) Gabriel phthalimide synthesis (ii) Sandmeyer reaction

Answer: (i)



(ii) $C_6H_5N_2^+X^- + CuCl/HCl \rightarrow C_6H_5Cl + N_2$

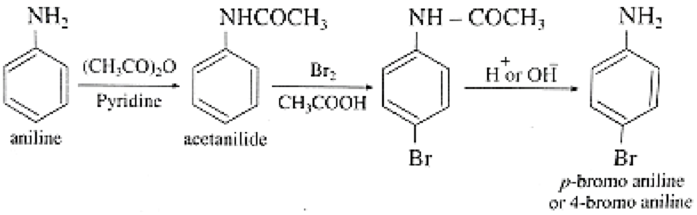
Q: 24 How will you bring about the following conversions?

(*a*) Ethanamine into methanamine (*b*) Aniline into 4-bromoaniline

Answer:

(i) $CH_3CH_2NH_2 \xrightarrow{HNO_2} CH_3CH_2OH \xrightarrow{CrO_3, H_2SO_4} CH_3COOH \xrightarrow{NH_3, \Delta} CH_3\ CONH_2 \xrightarrow{Br_2, KOH} CH_3NH_2$

(ii)



Q: 25 (i) Arrange the following in increasing order of pK_b values:

$C_6H_5CH_2NH_2$, $C_6H_5NHCH_3$, $C_6H_5NH_2$

(ii) Arrange the following in decreasing order of solubility in water:

$(C_2H_5)_2NH$, $C_2H_5NH_2$, $C_6H_5NH_2$

Answer: (i) $C_6H_5CH_2NH_2 < C_6H_5NHCH_3 < C_6H_5NH_2$

(ii) $C_2H_5NH_2 > (C_2H_5)_2NH > C_6H_5NH_2$

SHORT ANSWER TYPE QUESTIONS (3 MARKS)

Q:26 How will you convert the following?

(i) Aniline to chlorobenzene

(ii) Methyl chloride to ethylamine

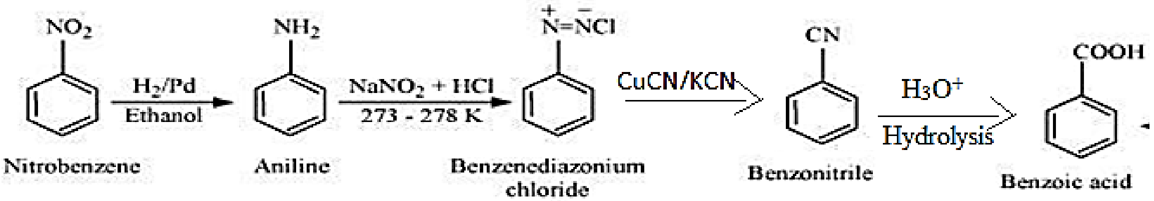
(iii) Nitrobenzene to benzoic acid

Answer:

(i) $C_6H_5 - NH_2 \xrightarrow{NaNO_2 + HCl} C_6H_5N_2^+Cl^- \xrightarrow{Cu_2Cl_2/HCl} C_6H_5Cl$

(ii) $CH_3Cl \xrightarrow{alc.KCN} CH_3CN \xrightarrow{LiAlH_4} CH_3CH_2NH_2$

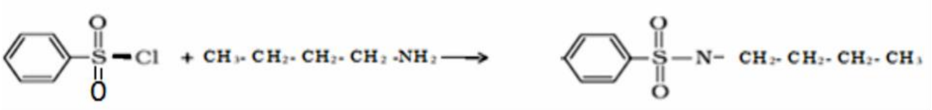
(iii)



Q: 27 Mr. Krishna, a chemistry teacher gave his class students a sample of an amine "P" having molecular formula $C_4H_{11}N$ to test, identify and write the reaction. The students observed that it reacts with Hinsberg's reagent to form an alkali soluble product. A student Ranu wrote the reaction as follows.

Identify the mistakes committed by Ranu. Write the type of amine in sample "P" and correct chemical equation.

Answer: The formula of Hinsberg's reagent and sample of P were written by Ranu are incorrect. The Sample "P" belongs to primary amine. Therefore, sample "P" is Butanamine. The correct chemical equation is as follows:



Q: 28 Account for the following:

(i) Aniline does not undergo Friedel-Crafts reaction.
(ii) Diazonium salts of aromatic amines are more stable than those of aliphatic amines
(iii) pK_b of methylamine is less than that of aniline.

Answer: (i) Aniline being a Lewis base, reacts with Lewis acid $AlCl_3$ to form a salt. Due to this N atom of aniline acquires positive charge and hence acts as a strong deactivating group for further reaction.

(ii) The diazonium salts of aromatic amines are more stable than those of aliphatic amines due to dispersal of the positive charge on the benzene ring.

(iii) In aniline due to resonance the lone pair of electrons on the nitrogen atom are delocalized over the benzene ring. As a result, the electron density on the nitrogen decreases. On the other hand, in methyl amine +I effect of CH_3 increases the electron density on the nitrogen atom. Therefore, aniline is a weaker base than methyl amine and hence its pKb value is higher than that of methyl amine

Q: 29 Arrange the following:

(i) CH_3NH_2, $(CH_3)_2NH$, NH_3, $(CH_3)_3N$ [in decreasing order of basic strength in gaseous phase]
(ii) $C_2H_5NH_2$, $C_6H_5NH_2$, NH_3, $C_6H_5CH_2NH_2$ and $(C_2H_5)_2NH$ [in increasing order of basic strength]
(iii) $C_6H_5NH_2$, $C_6H_5N(CH_3)_2$, $(C_2H_5)_2NH$ and CH_3NH_2 [in increasing order of basic strength]

Answer: (i) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3$

(ii) $C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2NH$
(iii) $C_6H_5NH_2 < C_6H_5N(CH_3)_2 < CH_3NH_2 < (C_2H_5)_2NH$

Q: 30 Complete the following reactions:

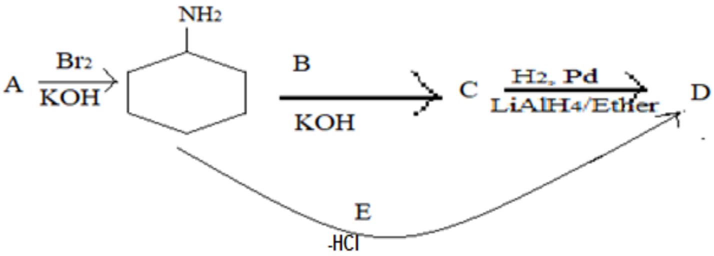
(i) $CH_3CONH_2 + Br_2 + NaOH \rightarrow$ ………. $+ Na_2CO_3 + H_2O$
(ii) ………. $+ H_2 \xrightarrow{Pd} CH_3\text{-}CH_2\text{-}NH_2$
(iii) $CH_3CONH_2 \xrightarrow{\text{(i)}LiAlH_4\text{(ii)}H_2O}$

Answer:

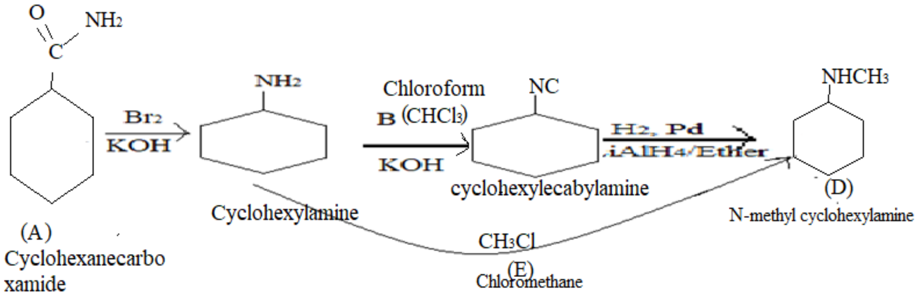
(i) $CH_3CONH_2 + Br_2 + 4NaOH \rightarrow CH_3NH_2. + Na_2CO_3 + 2H_2O + 2NaBr$
(ii) $CH_3\text{-}CH_2\text{-}NO_2 + H_2 \xrightarrow{Pd} CH_3\text{-}CH_2\text{-}NH_2$
(iii) $CH_3CONH_2 \xrightarrow{\text{(i)}LiAlH_4\text{(ii)}H_2O} CH_3CH_2NH_2$

LONG ANSWER TYPE QUESTIONS (5 MARKS

Q: 31 in the following reaction chart identify A, B, C, D and E. Write their IUPAC name and rewrite the following reaction



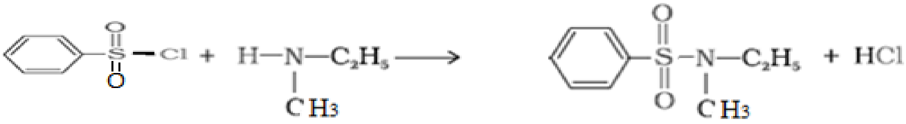
Answer: A = cyclohexane carboxamide B= Chloroform
C = cyclohexylcarbylamine D= N- methylcyclohexylamine E = Chloromethane



Q: 32 (i) An amine "X" with formula C_3H_9N reacts with benzenesulphonyl chloride to give a precipitate which is insoluble in alkali. Give the structure and IUPAC name of amine "X". Write the chemical reaction

(ii) How will bring out the following conversions: (A) Aniline to Phenol (B) Aniline to Iodobenzene.

Answer: (i) N methyl ethanamine (C_2H_5 NH CH_3)



(ii) (a) $C_6H_5 - NH_2 + HNO_2 \xrightarrow{273-278K} C_6H_5 - N_2^+Cl^- + NaCl + 2H_2O$

$C_6H_5N_2^+Cl^- + H_2O \overset{\Delta}{\rightarrow} C_6H_5OH + N_2 + HCl$

(b) $C_6H_5 - NH_2 + HNO_2 \xrightarrow{273-278K} C_6H_5 - N_2^+Cl^- + NaCl + 2H_2O$

$C_6H_5N_2^+Cl^- + KI \rightarrow C_6H_5I + N_2 + KCl$

CASE BASED QUESTIONS

Q 33.Amines are organic bases having the general formula RR'_2N, where R is a hydrocarbon group, 'R' may be H or a hydrocarbon group. As with ammonia, the reaction of amines with water is

$RNH_2 + H_2O \rightarrow RNH_3^+ + OH^-$

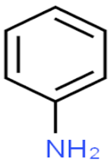
Like all bases, amines form salts when allowed to react with acids.

$CH_3NH_2 + HCl \rightarrow CH_3N^+H_3Cl$

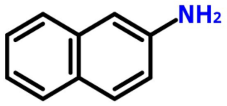
These salts are usually colourless, odourless solids.

Aromatic amines are used mainly in the manufacture of dyes.

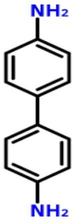
Aniline, the simplest aromatic amine itself is a toxic compound; a number of other aromatic amines such as 2-naphthylamine and benzidine are potent carcinogens.



Aniline



2- naphthylamine



Benzidine

Q(i) Arrange the following in the increasing order of Pk_b value

$C_6H_5NH_2$, $C_2H_5NH_2$, CH_3NH_2, NH_3 .

(ii) Draw the structure of sulphanilic acid

(iii)In cold conditions, aniline is diazotised to form a compound, which is treated with phenol to form a coloured product. Write the necessary equations.

OR

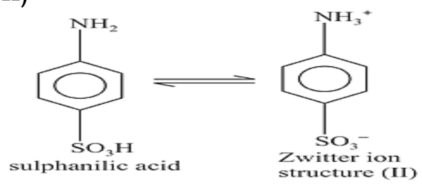
Give reasons

(a) Aniline on nitration gives considerable amount of meta product along with ortho and para.

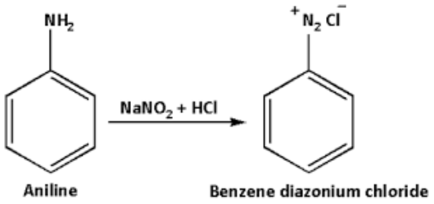
(b) Aniline is less basic than ammonia.

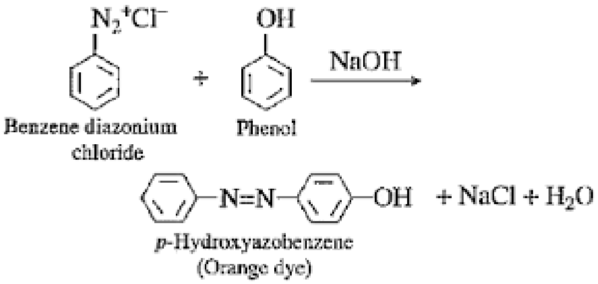
Answers (i) $C_2H_5NH_2$, CH_3NH_2, NH_3, $C_6H_5NH_2$.

(ii)



(iii)





OR

(a)Aniline being basic, reacts with acid to form anilinium ion, which is meta directing.

(b) The lone pair of electrons on N in aniline are not readily available due to delocalization with the benzene ring.

10. BIOMOLECULES

MULTIPLE CHOICE QUESTIONS (1 MARKS)

1. α–D (+)-glucose and β–D (+)-glucose are-
(A) Anomers (B) Epimers (C) Enantiomers (D) Geometrical isomers

2. Which of the following statements about maltose is incorrect?
(A) It consists of two glucopyranose units
(B) It is a disaccharide
(C) Glycosidic bond between C1 of one unit and C4 of the other unit
(D) It is a non-reducing sugar

3. Which of the following acids is a vitamin?
(A) Aspartic acid (B) Ascorbic acid (C) Adipic acid (D) Saccharic acid

4. Which of the following statements is not true about glucose?
(A) It is an aldohexose (B) On heating with HI it forms n-hexane
(C) It is present in Pyranose form (D) It does not give 2,4-DNP test

5. The helical structure of protein is stabilized by:
(A) Peptide bond (B) Dipeptide bond (C) Hydrogen bonds (D) Vander Waal's forces

6. The symbols D and L in the name of Carbohydrate represents
(A) Dextro rotatory nature
(B) Laevo rotatory nature
(C) The relative configuration of a particular isomer
(D) The optical activity of compounds

7. DNA and RNA compose of similar-
(A) Sugar (B) Purines bases (C) Pyrimidines bases (D) Both (A) and (B)

8. Which of the following is/are example(s) of denaturation of protein?
(A) Coagulation of egg white (B) Curding of milk
(C) Clotting of blood (D) Both (A) and (B)

9. What are the hydrolysis products of lactose?
(A) β–D-galactose and β –D-Glucose (B) α –D-Galactose and α –D-Glucose
(C) α –D-Glucose and β –D-Fructose (D) None of these

10. Dinucleotide is obtained by joining two nucleotides together by phosphodiester linkage. Between which carbon atoms of pentose sugars of nucleotides are these linkages present?
(A) 5' and 3' (B) 1' and 5' (C) 5' and 5' (D) 3' and 3'

ASSERTION REASON TYPE QUESTIONS(1MARKS)

1. **Two statements are given below- one labelled Assertion (A) and the other labelled Reason (R).**

   ASSERTION – Vitamin C can't be stored in our body.

   REASON – Vitamin C is water soluble and is excreted from the body through urine.

   (a) A and R both statements are correct and R is the correct explanation of A.
   (b) A and R both statements are correct and R is not the correct explanation of A.
   (c) A is correct statement but R is not the correct statement.
   (d) A is incorrect statement but R is the correct statement.
2. **Two statements are given below- one labelled Assertion (A) and the other labelled Reason (R).**

ASSERTION – Proteins are polymers of alpha amino acids connected by peptide bonds.
REASON – A tripeptide contains 3 amino acids linked by 3 peptide bonds.
(a) A and R both statements are correct and R is the correct explanation of A.
(b) A and R both statements are correct and R is not the correct explanation of A.
(c) A is correct statement but R is not the correct statement.
(d) A is incorrect statement but R is the correct statement.

3. **Two statements are given below- one labelled Assertion (A) and the other labelled Reason (R).**
ASSERTION – Change in pH and heating leads to denaturation of proteins.
REASON – Change in pH and heating cause loss of biological activity of proteins.
(a) A and R both statements are correct and R is the correct explanation of A.
(b) A and R both statements are correct and R is not the correct explanation of A.
(c) A is correct statement but R is not the correct statement.
(d) A is incorrect statement but R is the correct statement.

4. **Two statements are given below- one labelled Assertion (A) and the other labelled Reason (R).**
ASSERTION – Adenine and Guanine are the purines present in both nucleic acids.
REASON – Thiamine and Uracil are the pyrimidine present in DNA.
(a) A and R both statements are correct and R is the correct explanation of A.
(b) A and R both statements are correct and R is not the correct explanation of A.
(c) A is correct statement but R is not the correct statement.
(d) A is incorrect statement but R is the correct statement.

5. **Two statements are given below- one labelled Assertion (A) and the other labelled Reason (R).**
ASSERTION – Amylopectin is water soluble and contributes 15-20% of starch.
REASON – Amylopectin has C_1-C_4 & C_1-C_6 glycosidic linkages.
(a) A and R both statements are correct and R is the correct explanation of A.
(b) A and R both statements are correct and R is not the correct explanation of A.
(c) A is correct statement but R is not the correct statement.
(d) A is incorrect statement but R is the correct statement.

VERY SHORT ANSWER QUESTIONS (1M)

1. **What is the basic structural difference between glucose and fructose?**
A. Glucose has aldehyde group whereas fructose has keto group.

2. **Name the carbohydrate used as storage molecule to store energy in animals?**
A. Glycogen

3. **Name the vitamin whose deficiency cause pernicious anemia?**
A. Vit B_{12}

4. **Write down the vitamin which is responsible for the coagulation of blood?**
A. Vit K

5. **Give one example each for Fibrous protein and Globular protein**.
A. Fibrous protein – Keratin, Globular protein – Insulin

6. **What type of linkage is responsible for the formation of proteins?**
A. Peptide linkage.

7. **Name the unit formed by the attachment of a base to 1^1 positions of sugar.**
A. Nucleoside

8. **Write the products obtained after hydrolysis of DNA.**

A. Pentose sugar, phosphoric acid and Nitrogen containing heterocyclic compounds as bases.

9. Name the base that is found in nucleotide of RNA only ?

A. Uracil

10. Name

a) A major sex hormone produced in males b) The main female sex hormone

A. a) Testosterone

b) Estradiol

SHORT ANSWER QUESTIONS TYPE – 1 (2M)

1. What is the difference between nucleotide and nucleoside?

A. Nucleoside contains ribose or deoxyribose sugar and heterocyclic base. Nucleotide contains phosphoric acid residue along with heterocyclic base and pentose sugar.

2. Name a water-soluble vitamin which is a powerful antioxidant? Give one of its sources.

A. Vit C, citrus fruits like orange, lemon etc.

3. Write 2 differences between RNA and DNA.

A. RNA – a) It has ribose sugar with adenine, uracil, cytosine, guanine as heterocyclic bases.

b) It is single helix.

DNA – a) It has deoxyribose sugar along with adenine, thiamine, cytosine, guanine as heterocyclic bases.

b) It is double helix.

4. What are the two types of secondary structure of proteins? How will you differentiate between them?

A. Alpha – helix and Beta pleated helix structure.

Those polypeptide chains stabilized by intramolecular hydrogen bonds are alpha helix structure.

Beta pleated structure of proteins are stablilised by intermolecular hydrogen bonding.

5. What are polysaccharides? Give two examples.

A. Those carbohydrates which on hydrolysis give large number of monosaccharides. Eg:- Starch, Cellulose.

SHORT ANSWER QUESTION TYPE – 2 (3M)

1. Differentiate between

a) Amylose and Amylopectin

b) Peptide linkage and Glycosidic linkage

c) Fibrous proteins and Globular proteins.

A. a) Amylose is a branched chain polymer of alpha glucose, water soluble. Amylopectin is a branched chain polymer of alpha glucose, water insoluble.

b) The bond CONH between two or more amino acids in polypeptides and proteins is called peptide linkage. The oxide linkage between two or more monosaccharide units in oligosaccharides and polysaccharides is called glycosidic linkage.

c) Fibrous proteins - Thread like structures, insoluble in water. Eg – Keratin, Myosin

Globular proteins – Chains of polypeptides coil around spherical shape, soluble in water. Eg – Insulin, Albumin.

2. Define the following with a suitable example.

a) Oligosaccharides
b) Denaturation of proteins
c) Vitamins

A. a) Gives two to ten units of monosaccharides on hydrolysis.
Eg – Lactose, Raffinose

b) On heating or change in pH hydrogen bonds are disturbed, globules unfold and helix get uncoiled and leads to loss of biological activity. Eg – Coagulation of egg white, milk converted to curd.

c) Group of organic compounds which are required in very small amounts for healthy growth and functioning of organism. They cannot be made by organism and so have to be part of our diet. The deficiency of a Vitamin can cause a specific disease. Eg – Fat soluble vitamins – A, D, E, K
Water soluble vitamins – B (except B_{12}), C

3. What are essential and non – essential amino acids? Give two examples of each.

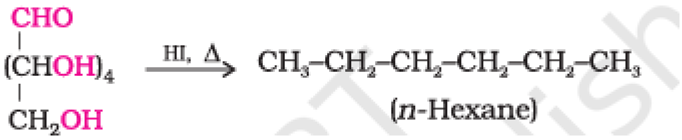
A. Amino acids which cannot be synthesized in the body and must be obtained through diet are known as essential amino acids. Eg – Valine, Leucine

Amino acids which can be synthesized in the body are known as non-essential amino acids. Eg – Alanine, Glutamic acid.

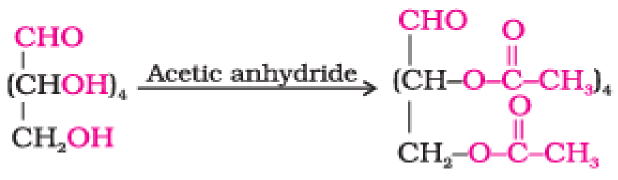
4. Write chemical reactions to show that open structure of D-glucose contains the following

a) Straight chain
b) 5 alcohol groups
c) Aldehyde as carbonyl group

A. a) Glucose when reacted with Red P and HI gives n-hexane. It indicates the presence of straight chain of 6 carbon atoms in glucose.



b) On acetylation wit acetic anhydride glucose gives a Pentaacetate.



c) Glucose on oxidation with a mild oxidizing agent like bromine water gives gluconic acid containing the same 6 carbon atoms as present in glucose.

5. a) Why Vit C cannot be stored in our body?

b) Write the name of Vitamin whose deficiency causes bone deformities in children.

c) Deficiency of which Vitamin cause night blindness.

A. a) Vit C is soluble in water and regularly excreted in urine and hence cannot be stored in body.

b) Vit D

c) Vit A

LONG ANSWER QUESTIONS (5M)

1. Give reasons for the following observations.

a) Amino acids behave like salts rather than simple amines or carboxylic acids.

b) Amino acids show amphoteric behavior.

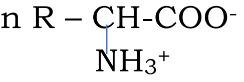
c) The two strands of DNA are complementary to each other.

d) Pentaacetate of glucose does not react with hydroxyl amine.

e) Starch and cellulose both contain glucose units as monomers yet they are structurally different.

A. a) Due to the presence of both acidic (carboxyl group) and basic (amino group) groups in the same molecule.

b) They exist as Zwitter ions in



$R - \underset{NH_3^+}{\underset{|}{CH}}\text{-}COO^-$

In Zwitter ionic form amino acids show amphoteric behaviour as they react both with acids and bases.

c) Since there is specific hydrogen bonding between heterocyclic bases, A can form hydrogen bond with T, C can form hydrogen bond with G and vice versa.

d) As glucose forms a six membered ring in which – CHO group combines with – OH group at C5, pentaacetate of glucose does not react with hydroxyl amine due to absence of free – CHO group.

e) The basic structural difference between starch as cellulose is of linkage between the glucose units. In starch there is α- D – glycosidic linkage. Both the components of starch, amylose and amylopectin are polymers of α- D – glycose. On the other hand, cellulose is a linear polymer of β – D- glucose in which C1 of one glucose unit is connected to C4 of the other through β – D- glycosidic linkage.

2. a) Which sugar is called invert sugar? Why is it called so?

b) How can reducing and non-reducing sugars be distinguished?

Mention the structural feature characterizing reducing sugars

A. a) Mixture of glucose and fructose is called invert sugar. It is called invert sugar because dextro-rotatory sucrose gives mixture of glucose and fructose on hydrolysis which is laevo-rotatory. Therefore, it is called invert sugar.

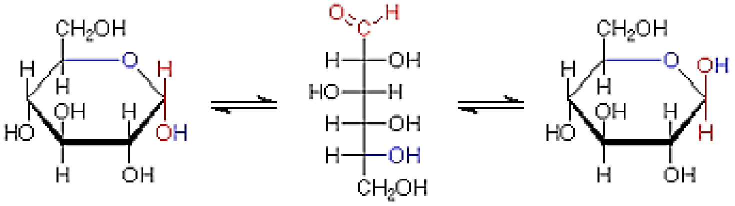
b) Those carbohydrates which reduce Tollens' reagent to give silver mirror or form brick red precipitate with Fehling's solution are called reducing sugars whereas those which do not are non-reducing sugars.

All monosaccharides are reducing sugars due to the presence of aldehyde group or α-keto group. Those disaccharides like sucrose are not reducing sugar because aldehydic and ketonic groups not free. All polysaccharides are non-reducing.

Case Based Questions

1. Read the paragraph carefully and give the answers of the questions followed.

Glucose, Galactose, and fructose have the same chemical formula but they differ in the organization of their atoms. The sugars we have looked at so far are linear molecules (straight chains). That may seem odd because sugars are often drawn as rings. As it turns out both are correct: many five- and six-carbon sugars can exist either as a linear chain or in one or more ring-shaped forms. Cyclic sugars show mutarotation. The optical rotation of the solution depends on the optical rotation of each anomers and their ratio in the solution. Mutarotation was discovered by French chemist Augustin-Pierre Dubrunfaut in 1844, when he noticed that the specific rotation of aqueous sugar solution changes with time. These forms exist in equilibrium with each other, but equilibrium strongly favours the ring forms (particularly in aqueous, or water-based, solution). For instance, in solution, glucose's main configuration is a six-membered ring. Over 99% of glucose is typically found in this form.



(A) (B) (C)

Even when glucose is in a six-membered ring, it can occur in two different forms with different properties. During ring formation, the 'O' from the carbonyl, which is converted to a hydroxyl group, will be trapped either "above" the ring (on the same side as the CH_2OHCH_2OH) or "below" the ring (on the opposite side from this group).

Answer the following questions:

- **(a) Why D- Glucose does show mutarotation?**
- **(b) What will be the condensation product of glucose and fructose? Which linkage is responsible for condensation of monosaccharides?**
- **(c) Mention the difference in anomeric forms of glucose and evidence to support the cyclic forms of glucose.**

OR

- **(c)Under what conditions glucose is converted to gluconic and saccharic acid? Write chemical reactions.**

Answer

(a) D- Glucose shows mutarotation because it undergoes interconversion between its α and β (+) Glucopyranose structures.

(b) Sucrose. Glycosidic linkage

(c) In the α-anomer, the hydroxyl on the anomeric carbon is on the opposite side of the ring from the terminal $-CH_2OH$ group (i.e., pointing down). In the β-anomer, it is on the same side of the ring (pointing up).

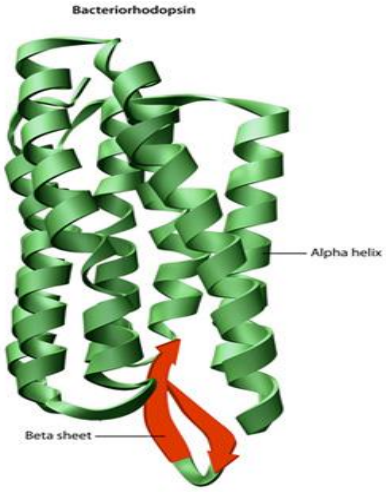
Glucose does not give Schiff's test; Hydrogen sulphite addition product is not formed with $NaHSO_3$.The reaction of Pentaacetate of glucose with hydroxylamine does not take place. (any one)

OR

(c) Glucose is converted to gluconic acid by oxidization with bromine water and to saccharic acid when oxidation is carried by conc. HNO_3.

$$\begin{matrix} CHO \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{matrix} \xrightarrow{Br_2\ water} \begin{matrix} COOH \\ | \\ (CHOH)_4 \\ | \\ CH_2OH \end{matrix}$$

2. Read the paragraph carefully and give the answers of the questions followed.



Proteins are the polymers of α -amino acids and they are connected to each other by peptide bond or peptide linkage. Chemically, peptide linkage is an amide formed between–COOH group and $-NH_2$ group. The reaction between two molecules of similar or different amino acids proceeds through the combination of the amino group of one molecule with the carboxyl group of the other. This results in the elimination of a water molecule and formation of a peptide bond –CO–NH–. The product of the reaction is called a dipeptide because it is made up of two amino acids. For example, when carboxyl group of glycine combines with the amino group of alanine we get a dipeptide, glycylalanine. Structure and shape of proteins can be studied at four different levels, i.e., primary, secondary, tertiary and quaternary, each level being more complex than the previous one.

The final shape adopted by a newly synthesized protein is typically the most energetically favourable one. As proteins fold, they test a variety of conformations before reaching their final form, which is unique and compact. Folded proteins are stabilized by thousands of noncovalent bonds between amino acids. In addition, chemical forces between a protein and its immediate environment contribute to protein shape and stability. For example, the proteins that are dissolved in the cell cytoplasm have hydrophilic (water-loving) chemical groups on their surfaces, whereas their hydrophobic (water-averse) elements tend to be tucked inside. In contrast, the proteins that are inserted into the cell membranes display some hydrophobic chemical groups on their surface, specifically in those regions where the protein surface is exposed to membrane lipids. It is important to note, however, that fully folded proteins are not frozen into shape. Rather, the atoms within these proteins remain capable of making small movements.

Answer the following questions:

(a) Name the forces responsible for secondary and tertiary structure.

(b) Where does the water present in the egg go after boiling the egg?

(c) Write one difference between α-helix and β-pleated sheet structure of protein

OR

(c) What is the difference between native protein and denatured protein?

Answer

(a) The forces which are responsible for tertiary structure of proteins are hydrogen bonds, disulphide linkage, Vander walls and electrostatic forces of attraction.

(b) On boiling the water-soluble globular proteins unfold and helix get uncoiled. During this change intermolecular hydrogen bond get disturbed. The water molecule gets attached to the uncoiled proteins molecule through hydrogen bond.

(c) α-Helix structure: The polypeptide chains are held together (stabilized) by Intramolecular H-bonding. β-Pleated sheet structure: The two neighbouring polypeptide chains are held together by intermolecular H-bonding.

OR

(c) Proteins found in a biological system with unique 3D-structure and biological activity is called native protein. When native protein is subjected to physical and chemical change, protein loses its biological activity and is called denatured protein.

3. Read the paragraph carefully and give answers of the questions followed.

Information regarding the sequence of nucleotides in the chain of a nucleic acid is called its primary structure. Nucleic acids have a secondary structure also. James Watson and Francis Crick gave a double strand helix structure for DNA. Two nucleic acid chains are wound about each other and held together by hydrogen bonds between pairs of bases. The two strands are complementary to each other because the hydrogen bonds are formed between specific pairs of bases. Adenine forms hydrogen bonds with thymine whereas cytosine forms hydrogen bonds with guanine. In secondary structure of RNA single stranded helix is present which sometimes folds back on itself. RNA molecules are of three types and they perform different functions. DNA is the chemical basis of heredity and may be regarded as the reserve of genetic information. DNA is exclusively responsible for maintaining the identity of different species of organisms over millions of years. A DNA molecule is capable of self-duplication during cell division and identical DNA strands are transferred to daughter cells.

Answer the following questions:

(a) Name the segment of DNA which acts as the instrumental manual for the synthesis of proteins.

(b) Name the chemical change in DNA that leads to the synthesis of proteins with different amino acids.

(c) (i) Write the sequence of chemicals present in nucleic acids.
(ii) What are the different types of RNA found in the cell?

OR

(c) Write the main functional differences between DNA and RNA.
Of the four bases name those which are common to both DNA and RNA.

Answer

3. (a) Gene
(b) Mutation
(c) (i)Phosphate- sugar-base
(ii) m-RNA, t-RNA, r-RNA

OR

(c) DNA is the chemical basis of heredity and RNA molecules are responsible for protein synthesis. Common bases in DNA and RNA Adenine, Guanine and Cytosine.

4. **Read the paragraph carefully and give answers of the questions followed**

An average Indian derives 61 to 64% of energy from consumption of food rich in carbohydrates. A study published in the journal diabetes care has recommended reducing this to 49 to 56% for remission or prevention of type-2 diabetes one of the leading causes of death worldwide. Along with reducing carbohydrates intake the study suggests that one should also increase protein intake. (14-20%) of the total energy consumption. Fats should contribute not more than 21 to 27% of the total energy consumption. In simple words 50% of plate should consist of fruits and green vegetables, 25% carbohydrates of choice, 25% contain food rich in protein. Physically inactive, obese and older individuals as well as presiding in urban locations may require greater reduction in carbohydrate intake. The keto diet, very low-calorie diet is best.

Answer the following questions:

a) **Why do elderly people reduce more intake of carbohydrates than younger people?**
b) **Which carbohydrate are healthier out of polysaccharides, monosaccharides and disaccharides? Give reason.**
c) **i)Which hormone controls blood sugar in our body?**
ii) Why should diabetic patients do mild exercise like walking every day?

OR

c) **i) Why should protein be increased in diet especially for growing children?**
ii) Why should our plate have 50% fruits and vegetables.

Answer

a) It is because rate of metabolism is slow in elderly people than younger people.
b) Polysaccharides are healthier because they produce energy slowly.
c) i) Insulin
ii) It is because rate of metabolism will increase and blood sugar will decrease.

OR

c) i) Proteins are essential for growth and development of body. They strengthen muscles of our body.
ii) Fruits and vegetables are rich in vitamins, minerals and fibers which help in digestion and keep our body healthy.

5. **Read the paragraph carefully and give answers of the questions followed**

Vitamins are vital for life. A, D, E, K are fat soluble vitamins whereas B_1, B_2, B_3, B_5, B_6, B_7, B_9, C are water soluble vitamins. Vitamin A helps in improving eye sight. Vitamin C prevents scurvy and increases immunity. Vitamin D helps in strong bones and teeth. Our requirement of vitamin D is 15mcg. We get vitamin D from sunlight, eggs, dairy products, orange, oats and mushroom etc. Citrus fruits contain vitamin C. Carrot contains vitamin A. We should include chick pea flour in our diet to prevent inflammation. It has phytonutrients and fibres which have anti-inflammatory properties. It prevents accumulation of fats. It contains Fe, Cu, Mg, fibre, K which are essential to control our wait. It increases our immune system. It contains proteins, amino acids, Mg, vitamin B and P. Pomegranates are good source of vitamin C which our body needs to make collagen. It is rich source of B-complex, vitamin B5 folates pyridoxine and vitamin K. It contains essential minerals like Ca, Cu, Mg and Mn. Pomegranates are rich source of insoluble fibres which help us keep fuller for longer time and regulate bowel function.

Answer the following questions:

a) Why should vitamin B and C must be taken regularly in diet?

b) Which vitamin deficiency causes pernicious anemia? Is it fat or water soluble?

c) i) What is meant by vitamin B-complex?

ii) What is deficiency decease and source of vitamin E

OR

c) i) Which vitamin deficiency leads to bleeding for long time? What is its source?

ii) What is the role of fibre in our body?

Answer

a) It is because vitamin B and C are water soluble and excreted through urine. So it should be taken regularly.

b) Vitamin B_{12}. It is neither fat nor water soluble

c) i) It consists of vitamin B_1, B_2, B_3, B_5, B_6, B_7, B_9 and B_{12}.

ii) Vitamin E deficiency leads to dry skin and loss of reproductive power. Its source is oils like cotton seed oil.

OR

c) i) Vitamin K. It is present in green leafy vegetables.

ii) Fiber helps in digestion and helps to reduce weight.