

KENDRIYA VIDYALAYA SANGATHAN
REGIONAL OFFICE HYDERABAD



STUDY MATERIAL
CLASS XII (CHEMISTRY)
2023-24

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Chapter 1 : Solutions

Choose and write the correct option(s) in the following questions.

1. If we place the blood cells in a solution containing less than 0.9% (m/V) sodium chloride. They would swell. This is because:

- (a) the solution is hypotonic
- (b)) the solution is isotonic with blood
- (c) the solution is hypertonic
- (d) none of these

2. On dissolving sugar in water at room temperature, solution feels cool to touch. Under which of the following cases dissolution of sugar will be most rapid?

- (a) Sugar crystals in cold water.
- (b) Powdered sugar in cold water.
- (c) Sugar crystals in hot water.
- (d) Powdered sugar in hot water.

3. Considering the formation, breaking and strength of hydrogen bond, predict which of the following mixtures will show a positive deviation from Raoult's law?

- (a) Methanol and acetone.
- (b) Chloroform and acetone.
- (c) Nitric acid and water.
- (d) Phenol and aniline.

4. Which of the following aqueous solutions should have the highest boiling point?

- (a) 1.0 M NaOH
- (b) 1.0 M Na₂SO₄
- (c) 1.0 M NH₄NO₃
- (d) 1.0 M KN₃

5. Which of the following statements is false?

- (a) Two different solutions of sucrose of same molality prepared in different solvents will have the same depression in freezing point.
- (b) The osmotic pressure of a solution is given by the equation $\pi = CRT$ (where C is the molarity of the solution).
- (c) Decreasing order of osmotic pressure for 0.01 M aqueous solutions of barium chloride, potassium chloride, acetic acid and sucrose is BaCl₂ > KCl > CH₃COOH > sucrose.
- (d) According to Raoult's law, the vapour pressure exerted by a volatile component of a solution is directly proportional to its mole fraction in the solution.

6. At equilibrium the rate of dissolution of a solid solute in a volatile liquid solvent is
- (a) less than the rate of crystallisation
 - (b) greater than the rate of crystallisation
 - (c) equal to the rate of crystallisation
 - (d) zero
7. One kilogram of sea water sample contains 6 mg of dissolved O_2 . The concentration of O_2 in ppm in sample is
- (a) 0.06
 - (b) 60
 - (c) 6
 - (d) 0.6
8. Mole fraction of the solute in a 100 molal aqueous solution is:
- (a) 0.1770
 - (b) 0.0177
 - (c) 0.0644
 - (d) 0.2334
9. Low concentration of oxygen in the blood and tissues of people living at high altitude is due to
- (a) low temperature
 - (b) low atmospheric pressure
 - (c) high atmospheric pressure
 - (d) both low temperature and high atmospheric pressure
10. A solution of chloroform in diethylether:
- (a) obeys Raoult's law
 - (b) shows a positive deviation from Raoult's law
 - (c) shows a negative deviation from Raoult's law
 - (d) behaves like a near ideal solution
11. Vapour pressure of a pure liquid X is 2 atm at 300 K. It is lowered to 1 atm on dissolving 1 g of Y in 20 g of liquid X. If molar mass of X is 200, what is the molar mass of Y?
- (a) 20
 - (b) 50
 - (c) 100
 - (d) 200
12. In comparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.01 M $MgCl_2$ solution is_____.
- (a) the same
 - (b) about twice
 - (c) about three times

(d) about six times

13. An unripe mango placed in a concentrated, salt solution to prepare pickle, shrivels because_____.

- (a) it gains water due to osmosis.
- (b) it loses water due to reverse osmosis.
- (c) it gains water due to reverse osmosis.
- (d) it loses water due to osmosis.

14. At a given temperature, osmotic pressure of a concentrated solution of a substance_____.

- (a) is higher than that of a dilute solution.
- (b) is lower than that of a dilute solution.
- (c) is same as that of a dilute solution.
- (d) cannot be compared with osmotic pressure of dilute solution.

15. The values of Van't Hoff factors for KCl, NaCl and K_2SO_4 , respectively, are

- (a) 2, 2 and 2
- (b) 2, 2 and 3
- (c) 1, 1 and 2
- (d) 2, 1 and 2

16. Which of the following statements is false?

- (a) Units of atmospheric pressure and osmotic pressure are the same.
- (b) In reverse osmosis, solvent molecules move through a semipermeable membrane from a region of lower concentration of solute to a region of higher concentration.
- (c) The value of molal depression constant depends on nature of solvent.
- (d) Relative lowering of vapour pressure, is a dimensionless quantity.

17. The system that forms maximum boiling azeotropes is:

- (a) ethyl alcohol-water
- (b) benzene-toluene
- (c) acetone-chloroform
- (d) carbon disulphide-acetone

18. The value of Henry's constant is_____.

- (a) greater for gases with higher solubility.
- (b) greater for gases with lower solubility.
- (c) constant for all gases
- (d) not related to the solubility of gases

19. Which of the following factor(s) affect the solvent?

- (i) nature and solute (ii) temperature (iii) pressure

- (a) (i) and (iii) at constant T
- (b) (i) and (ii) at constant P
- (c) (ii) and (iii) only
- (d) (iii) only

20. Intermolecular forces between two benzene molecules are nearly of same strength as those between two toluene molecules. For a mixture of benzene and toluene, which of the following are not true?

- (a) $\Delta H_{\text{mixing}} = \text{zero}$
- (b) $\Delta V_{\text{mixing}} = \text{zero}$ (c)
- (c) These will form minimum boiling azeotrope
- (d) These will not form ideal solution

Assertion reason type questions

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.

21. Assertion: Molarity of a solution in liquid state changes with temperature.

Reason: The volume of a solution changes with change in temperature.

22. Assertion: If more volatile liquid is added to another liquid, vapour pressure of solution will be greater than that of pure solvent.

Reason: Vapour pressure of solution is entirely due to solvent molecules.

23. Assertion: When NaCl is added to water a depression in freezing point is observed.

Reason: The lowering of vapour pressure of a solution causes depression in the freezing point.

24. Assertion: When a solution is separated from the pure solvent by a semipermeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.

Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low

25. Assertion: The solubility of a gas in a liquid increases with increase of pressure.

Reason: The solubility of a gas in a liquid is directly proportional to the pressure of the gas.

26. Assertion: The vapour pressure of a liquid decreases if some non-volatile solute is dissolved in it.

Reason: The relative lowering of vapour pressure of a solution containing a non-volatile solute is equal to the mole fraction of the solute in the solution.

27.Assertion: Molecular mass of polymers cannot be calculated using boiling point or freezing point

Reason: Polymers solutions do not possess a constant boiling point or freezing point.

28.Assertion:The boiling point of 0.1 M urea solution is less than that of 0.1 M KCl solution.

ReasonElevation of boiling point is directly proportional to the number of species present

29.Assertion: Non-ideal solutions always form azeotropes.

Reason: Boiling point of an azeotrope may be higher or lower than boiling points of both components.

30.Assertion: Lowering of vapour pressure is directly proportional to osmotic pressure of the solution.

Reasonn: Osmotic pressure is a colligative property.

Answer key

1. a
2. d
3. a
4. b
5. a
6. c
7. c
8. b
9. b
10. c
11. a
12. c
13. d
14. a
15. b
16. b

17. c

18. b

19. (a),(b)

20. (c),(d)

21. a

22. c

23. a

24. c

25. a

26. b

27. c

28. a

29. d

30. b

CHAPT2 -ELECTROCHEMISTRY

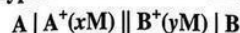
Multiple Choice Questions

Choose and write the correct option(s) in the following questions.

1. Which cell will measure standard electrode potential of copper electrode?

- (a) $\text{Pt(s)} | \text{H}_2(\text{g}, 0.1 \text{ bar}) | \text{H}^+(\text{aq}, 1 \text{ M}) || \text{Cu}^{2+}(\text{aq}, 1\text{M}) | \text{Cu}$
(b) $\text{Pt(s)} | \text{H}_2(\text{g}, 1 \text{ bar}) | \text{H}^+(\text{aq}, 1 \text{ M}) || \text{Cu}^{2+}(\text{aq}, 2\text{M}) | \text{Cu}$
(c) $\text{Pt(s)} | \text{H}_2(\text{g}, 1 \text{ bar}) | \text{H}^+(\text{aq}, 1 \text{ M}) || \text{Cu}^{2+}(\text{aq}, 1\text{M}) | \text{Cu}$
(d) $\text{Pt(s)} | \text{H}_2(\text{g}, 1 \text{ bar}) | \text{H}^+(\text{aq}, 0.1 \text{ M}) || \text{Cu}^{2+}(\text{aq}, 1\text{M}) | \text{Cu}$

2. A hypothetical electrochemical cell is shown below:



The emf measured is +0.20 V. The cell reaction is

- (a) $\text{A} + \text{B}^+ \longrightarrow \text{A}^+ + \text{B}$
(b) The cell reaction cannot be predicted.
(c) $\text{A}^+ + e^- \longrightarrow \text{A}$, $\text{B}^+ + e^- \longrightarrow \text{B}$
(d) $\text{A}^+ + \text{B} \longrightarrow \text{A} + \text{B}^+$
3. 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
4. The difference between the electrode potentials of two electrodes when no current is drawn through the cell is called _____.
- (a) Cell potential
(b) Cell emf
(c) Potential difference
(d) Cell voltage
5. Which of the following statement is not correct about an inert electrode in a cell?

- (a) It does not participate in the cell reaction.
(b) It provides surface either for oxidation or for reduction reaction.
(c) It provides surface for conduction of electrons.
(d) It provides surface for redox reaction.

6. 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

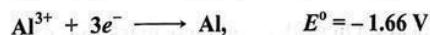
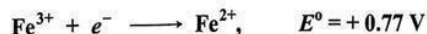
7. Standard electrode potential for $\text{Sn}^{4+}/\text{Sn}^{2+}$ couple is +0.15 V and that for the Cr^{3+}/Cr couple is -0.74 V. The two couple in their standard states are connected to make cell. The cell potential will be:

- (a) +1.19 V
(b) 0.89 V
(c) +0.18 V
(d) +1.83 V

8. Which one of the following is always true about the spontaneous cell reaction in a galvanic cell?

- (a) $E_{\text{cell}}^{\circ} > 0, \Delta G^{\circ} < 0, Q > K_c$
(b) $E_{\text{cell}}^{\circ} < 0, \Delta G^{\circ} < 0, Q < K_c$
(c) $E_{\text{cell}}^{\circ} > 0, \Delta G^{\circ} > 0, Q > K_c$
(d) $E_{\text{cell}}^{\circ} > 0, \Delta G^{\circ} < 0, Q < K_c$

9. The electrode potential data are given below



Based on the data, the reducing power of Fe^{2+} , Al , Br^- will increase in the order

- (a) $\text{Br}^- < \text{Fe}^{2+} < \text{Al}$
(b) $\text{Fe}^{2+} < \text{Al} < \text{Br}^-$
(c) $\text{Al} < \text{Br}^- < \text{Fe}^{2+}$
(d) $\text{Al} < \text{Fe}^{2+} < \text{Br}^-$

10. An electrochemical cell can behave like an electrolytic cell when _____.
- (a) $E_{\text{cell}} = 0$ (b) $E_{\text{cell}} > E_{\text{ext}}$ (c) $E_{\text{ext}} > E_{\text{cell}}$ (d) $E_{\text{cell}} = E_{\text{ext}}$
11. Which of the statements about solutions of electrolytes is not correct?
- (a) Conductivity of solution depends upon size of ions.
 (b) Conductivity depends upon viscosity of solution.
 (c) Conductivity does not depend upon solvation of ions present in solution.
 (d) Conductivity of solution increases with temperature.
12. Using the data given below find out the strongest reducing agent.
- $E_{\text{Cr}_2\text{O}_7^{2-}/\text{Cr}^{3+}}^\circ = 1.33 \text{ V}$ $E_{\text{Cl}_2/\text{Cl}^-}^\circ = 1.36 \text{ V}$
 $E_{\text{MnO}_4^-/\text{Mn}^{2+}}^\circ = 1.51 \text{ V}$ $E_{\text{Cr}^{3+}/\text{Cr}}^\circ = -0.74 \text{ V}$
- (a) Cl^- (b) Cr (c) Cr^{3+} (d) Mn^{2+}
13. Using the data given in Q. 12 find out in which option the order of reducing power is correct.
- (a) $\text{Cr}^{3+} < \text{Cl}^- < \text{Mn}^{2+} < \text{Cr}$ (b) $\text{Mn}^{2+} < \text{Cl}^- < \text{Cr}^{3+} < \text{Cr}$
 (c) $\text{Cr}^{3+} < \text{Cl}^- < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$ (d) $\text{Mn}^{2+} < \text{Cr}^{3+} < \text{Cl}^- < \text{Cr}$
14. Use the data given in Q. 12 find out the most stable oxidised species.
- (a) Cr^{3+} (b) MnO_4^- (c) $\text{Cr}_2\text{O}_7^{2-}$ (d) Mn^{2+}
15. The quantity of charge required to obtain one mole of aluminium from Al_2O_3 is _____.
- (a) 1F (b) 6F (c) 3F (d) 2F
16. The standard emf of a galvanic cell involving 3 moles of electrons in a redox reaction is 0.59 V. The equilibrium constant for the reaction of the cell is:
- (a) 10^{10} (b) 10^{20} (c) 10^{30} (d) 10^{15}
17. $\Lambda_{m(\text{NH}_4\text{OH})}^\circ$ is equal to _____.
- (a) $\Lambda_{m(\text{NH}_4\text{OH})}^\circ + \Lambda_{m(\text{NH}_4\text{Cl})}^\circ - \Lambda_{(\text{HCl})}^\circ$ (b) $\Lambda_{m(\text{NH}_4\text{Cl})}^\circ + \Lambda_{m(\text{NaOH})}^\circ - \Lambda_{(\text{NaCl})}^\circ$
 (c) $\Lambda_{m(\text{NH}_4\text{Cl})}^\circ + \Lambda_{m(\text{NaCl})}^\circ - \Lambda_{(\text{NaOH})}^\circ$ (d) $\Lambda_{m(\text{NaOH})}^\circ + \Lambda_{m(\text{NaCl})}^\circ - \Lambda_{(\text{NH}_4\text{Cl})}^\circ$
18. In the electrolysis of aqueous sodium chloride solution which of the half cell reaction will occur at anode?
- (a) $\text{Na}^+(aq) + e^- \longrightarrow \text{Na}(s);$ $E_{\text{cell}}^\circ = -2.71 \text{ V}$
 (b) $2\text{H}_2\text{O}(l) \longrightarrow \text{O}_2(g) + 4\text{H}^+(aq) + 4e^-;$ $E_{\text{cell}}^\circ = 1.23 \text{ V}$
 (c) $\text{H}^+(aq) + e^- \longrightarrow \frac{1}{2}\text{H}_2(g);$ $E_{\text{cell}}^\circ = 0.00 \text{ V}$
 (d) $\text{Cl}^-(aq) \longrightarrow \frac{1}{2}\text{Cl}_2(g) + e^-;$ $E_{\text{cell}}^\circ = 1.36 \text{ V}$
19. 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 cannot displace H_2 from acid.
20. E_{cell}° for some half cell reactions are given below. On the basis of these mark the correct answer.
- (i) $\text{H}^+(aq) + e^- \longrightarrow \frac{1}{2}\text{H}_2(g)$ $E_{\text{cell}}^\circ = 0.00 \text{ V}$
 (ii) $2\text{H}_2\text{O}(l) \longrightarrow \text{O}_2(g) + 4\text{H}^+(aq) + 4e^-$ $E_{\text{cell}}^\circ = 1.23 \text{ V}$
 (iii) $2\text{SO}_4^{2-}(aq) \longrightarrow \text{S}_2\text{O}_8^{2-}(aq) + 2e^-;$ $E_{\text{cell}}^\circ = 1.96 \text{ V}$

- (a) In dilute sulphuric acid solution, hydrogen will be reduced at cathode.
- (b) In concentrated sulphuric acid solution, water will be oxidised at anode.
- (c) In dilute sulphuric acid solution, water will be oxidised at anode.
- (d) In dilute sulphuric acid solution, SO_4^{2-} ion will be oxidised to tetrathionate at anode.

Assertion-Reason Questions

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.
21. **Assertion (A)** : Cu is less reactive than hydrogen.
Reason (R) : $E_{\text{Cu}^{2+}/\text{Cu}}^{\circ}$ is negative.
22. **Assertion (A)** : E_{cell} should have a positive value for the cell to function.
Reason (R) : $E_{\text{cathode}} < E_{\text{anode}}$
23. **Assertion (A)** : Conductivity of all electrolytes decreases on dilution.
Reason (R) : On dilution number of ions per unit volume decreases.
24. **Assertion (A)** : Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.
Reason (R) : For weak electrolytes degree of dissociation increases with dilution of solution.
25. **Assertion (A)** : Mercury cell does not give steady potential.
Reason (R) : In the cell reaction, ions are not involved in solution.
26. **Assertion (A)** : Current stops flowing when $E_{\text{cell}} = 0$.
Reason (R) : Equilibrium of the cell reaction is attained.
27. **Assertion (A)** : $E_{\text{Ag}^+/\text{Ag}}$ increases with increase in concentration of Ag^+ ions.
Reason (R) : $E_{\text{Ag}^+/\text{Ag}}$ has a positive value.
28. **Assertion (A)** : Copper sulphate cannot be stored in zinc vessel.
Reason (R) : Zinc is less reactive than copper.
29. **Assertion (A)** : Electrolysis of NaCl solution gives chlorine at anode instead of O_2 .
Reason (R) : Formation of oxygen at anode requires overvoltage.
30. **Assertion (A)** : For measuring resistance of an ionic solution an AC source is used.
Reason (R) : Concentration of ionic solution will change if DC source is used.

Answers

- | | | | | | | | |
|----------------|----------------|---------------------|---------------------|----------------|----------------|----------------|----------------|
| 1. (c) | 2. (a) | 3. (c) | 4. (b) | 5. (d) | 6. (b) | 7. (b) | 8. (d) |
| 9. (a) | 10. (c) | 11. (c) | 12. (b) | 13. (b) | 14. (a) | 15. (c) | 16. (c) |
| 17. (b) | 18. (d) | 19. (b), (d) | 20. (a), (c) | | | | |

21.(C)22.(C)23.(a)24.(a)25.(d)26.(a)27.(b)28.(C)29.(a)30.(a)

CHAPTER 3
CHEMICAL KINETICS

MCQ

1. The reaction rate constant can be defined as the rate of reaction when each reactant's concentration is _____.
 - a) Zero
 - b) Unity
 - c) Doubled the initial concentration
 - d) Infinite

2. What effect does temperature have on the half-life of a first-order reaction?
 - a) It increases
 - b) It decreases
 - c) It remains the same
 - d) Both increases as well as decrease

3. The role of catalyst is to change
 - a) Gibb's energy of the reaction
 - b) Enthalpy of the reaction
 - c) Activation energy of the reaction
 - d) Equilibrium constant

4. Activation Energy of a chemical reaction can be determined by
 - a) Determining the rate constant at standard temperature
 - b) Determining the rate constant at two temperatures
 - c) Using catalyst
 - d) Determining probability of collision

5. If half - life period of a reaction is inversely proportional to initial concentration of reactant, What is the order of reaction is
 - a) first order
 - b) second order
 - c) Third order
 - d) Zero order

6. Which of the following statement is not correct
 - a) Order of a reaction can be fractional number
 - b) Order of a reaction is experimentally determined quantity
 - c) Order of a reaction is always equal to the sum of the stoichiometric coefficient of reactant in the balanced chemical reaction
 - d) The order of the reaction is the sum of the powers of molar concentration of the reactants in the rate law expression

7. Hydrolysis of ester follows the kinetics of:

a) first order b) second order c) zero order d) pseudo first

8. Rate Law for the reaction $A + 2B \rightarrow C$ is found to be $\text{Rate} = k[A][B]$. Concentration of B is doubled keeping the concentration of A constant, the value of rate constant will be:

- a) Remain same
- b) Doubled
- c) Quadrupled
- d) Halved

9. If 75% of the first order reaction was completed in 32 minutes, 50% of the same reaction would be completed in

- a) 8 min
- b) 4 minutes
- c) 16 minutes
- d) 24 minutes

10. For Zero Order reaction

- a) $t_{1/2} \propto a$
- b) $t_{1/2} \propto 1/a$
- c) $t_{1/2} \propto a^2$
- d) $t_{1/2} \propto 1/a^2$

11. For the reaction: $2\text{NH}_3(\text{Pt}) \rightarrow \text{N}_2 + 3\text{H}_2(\text{g})$ $\text{Rate} = k[\text{NH}_3]^0$. Order of the reaction is

- a) First order
- b) Second order
- c) Zero order
- d) Third order

12. The half-life of first order reaction is 69.3 sec. The value of rate constant of the reaction is:

- a) 1.0 s^{-1}
- b) 0.1 s^{-1}
- c) 0.01 s^{-1}
- d) 0.001 s^{-1}

13. In a reaction $2A \rightarrow \text{product}$. Concentration of A decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. The rate of the reaction during the interval is

- a) $5 \text{ mol L}^{-1} \text{ min}$
- b) $0.5 \text{ mol L}^{-1} \text{ min}$
- c) $0.05 \text{ mol L}^{-1} \text{ min}$
- d) $0.005 \text{ mol L}^{-1} \text{ min}$

14. For a reaction $A + B \rightarrow \text{Product}$. The rate Law is given as $\text{rate} = k[A]^{1/2}[B]^2$. What is the order of reaction?

- a) 2
- b) $2/5$
- c) $5/2$
- d) 3

15. From the rate expressions for the following reaction determine the dimensions of the rate constant



- a) $\text{mol}^{-1} \text{ L s}^{-1}$
- b) s^{-1}
- c) $\text{mol}^{-2} \text{ L}^2 \text{ s}^{-1}$
- d) $\text{mol}^{-2} \text{ L s}^{-1}$

16. For the reaction $A + B \rightarrow C$ molecularity is?

- a) Molecularity is more than Zero
- b) Molecularity is less than Zero
- c) Molecularity is equal Zero

d) Molecularity is infinite

17. A reaction is second order with respect to reactant. How is the rate affected if the concentration of reactant is doubled

- a) increase by 2 times of initial rate
- b) decrease by 2 times of initial rate
- c) increase by 4 times of initial rate
- d) decrease by 4 times of initial rate

18. Calculate the half – life of first order reaction if rate constant is given as 4 years

- a) 1.73×10^{-1} year
- b) 1.73×10^{-1} min
- c) 2.37×10^{-2} year
- d) 17.3×10^{-1} year

19. The decomposition of NH_3 on platinum surface is zero order. What is the rate of production of H_2 if $k = 2.5 \times 10^{-4} \text{mol}^{-1} \text{L s}^{-1}$

- a) $2.5 \times 10^{-4} \text{mol}^{-1} \text{L s}^{-1}$
- b) $7.5 \times 10^{-4} \text{mol}^{-1} \text{L s}^{-1}$
- c) $25.5 \times 10^{-4} \text{mol}^{-1} \text{L s}^{-1}$
- d) $20.5 \times 10^{-4} \text{mol}^{-1} \text{L s}^{-1}$

20. Half – Life of zero order reaction is

- a) $0.693 / k$
- b) $[\text{R}]_0 / 2k$
- c) $[\text{R}]_0 / k$
- d) $t_{1/2}$ is independent of $[\text{R}]_0$

21. Elementary reactions are those reactions which takes place in

- a) multiple steps
- b) two steps
- c) single step
- d) none of the above

22. For a reaction , $\text{A} + \text{H}_2\text{O} \rightarrow \text{B}$. Rate $\propto [\text{A}]$, the order and molecularity of reaction is

- a) order = 1 & molecularity = 1
- b) order = 2 & molecularity = 2
- c) order = 3 & molecularity = 2
- d) order = pseudo order & molecularity = 2

23. In a reaction, when the concentration of reactant is increased two times, the increase in rate of reaction was four times. Order of reaction is

- (a) zero (b) 1 (c) 2 (d) 3

24. If the rate of a gaseous reaction is independent of pressure, the order of reaction is:

- (a) 0 (b) 1 (c) 2 (d) 3

25. Order of reaction can be

- (a) Zero (b) fraction (c) whole number (d) integer, fraction, Zero

26. Instantaneous rate of a chemical reaction is

- (a) rate of reaction in the beginning (b) rate of reaction at the end

(c) rate of reaction at a given instant (d) rate of reaction between two specific time intervals

27. In the rate equation, when the concentration of reactants is unity then rate is equal to

- (a) specific rate constant
- (b) average rate constant
- (c) instantaneous rate constant
- (d) None of the above

28. The activation energy in a chemical reaction is defined as

- (a) the difference in energies of reactants and products
- (b) the sum of energies of reactants and products
- (c) the difference in energy of intermediate complex with the average energy of reactants and products
- (d) the difference in energy of intermediate complex and the average energy of reactant

29. A plot of $\log(a - x)$ against time t is a straight line. This indicates that the reaction is of

- (a) zero order (b) first order (c) second order (d) third order

30. Rate of which reaction increases with temperature?

- (a) Exothermic reaction (b) Endothermic reaction (c) (a) and (b) both (d) None of the above

31. Radioactive disintegration is an example of

- (a) zero order reaction (b) first order reaction (c) second order reaction (d) third order reaction

32. The overall rate of a reaction is governed by

- (a) the rate of fastest intermediate step
- (b) the sum total of the rates of all intermediate steps
- (c) the average of the rates of all the intermediate steps
- (d) the rate of slowest intermediate step

33. For a unimolecular reaction

- (a) the order and molecularity of the slowest step are equal to one
- (b) molecularity of the reaction can be zero, one or two
- (c) molecularity of the reaction can be determined only experimentally
- (d) more than one reacting species are involved in one step

34. The unit of rate and rate constant are same for a

- (a) zero order reaction (b) first order reaction (c) second order reaction (d) third order reaction

35. The rate constant of a reaction depends upon

- (a) temperature of the reaction (b) extent of the reaction
- (c) initial concentration of the reactants (d) the time of completion of reaction

36. In chemical equation $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$ the equilibrium constant K_p depends on

- (a) total pressure
- (b) catalyst used
- (c) amount of H_2 and I_2
- (d) temperature

ANSWER KEY

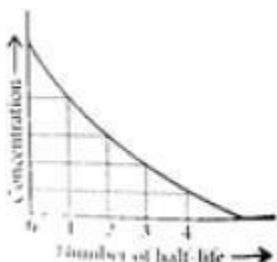
(1) b	(2) b	(3) c	(4) b	(5) b	(6) c
(7) d	(8) a	(9) c	(10) a	(11) c	(12) c
(13) d	(14) c	(15) a	(16) a	(17) c	(18) a
(19) b	(20) b	(21) c	(22) d	(23) c	(24) a
(25) d	(26) c	(27) a	(28) d	(29) b	(30) b
(31) b	(32) d	(33) a	(34) a	(35) a	(36) d

CASE BASED STUDY CHEMICAL KINETICS

1. Read the passage given below and answer the following questions:

The half-life of a reaction is the time required for the concentration of reactant to decrease by half

i.e., $[A]_t = [A]/2$ For first order reaction, $t_{1/2} = 0.693/k$ this means $t_{1/2}$ is independent of initial concentration. Figure shows that typical variation of concentration of reactant exhibiting first order kinetics. It may be noted that though the major portion of the first order kinetics may be over in a finite time, but the reaction will never cease as the concentration of reactant will be zero only at infinite time.



The following questions are multiple choice question. Choose the most appropriate answer:

(i) A first order reaction has a rate constant $k=3.01 \times 10^{-3}$ /s. How long it will take to decompose half of the reactant?

- (a) 2.303 s (b) 23.03 s (c) 230.3 s (d) 2303 s

(ii) The rate constant for a first order reaction is $7.0 \times 10^{-4} \text{ s}^{-1}$. If initial concentration of reactant is 0.080 M, what is the half-life of reaction?

- a) 990 s b) 79.2 s c) 12375 s d) $10.10 \times 10^{-4} \text{ s}$

(iii) For the half-life period of a first order reaction, which one of the following statements is generally false?

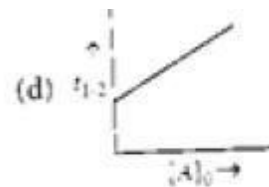
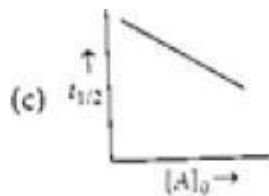
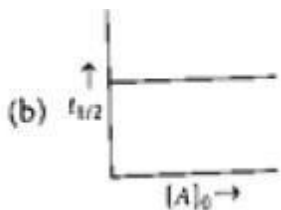
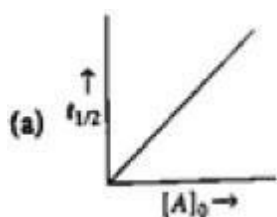
- a) It is independent of initial concentration. b) It is independent of temperature.
c) It decreases with the introduction of a catalyst. d) None of these.

(iv) The rate of a first order reaction is $0.04 \text{ mol L}^{-1} \text{ s}^{-1}$ at 10 minutes and $0.03 \text{ mol L}^{-1} \text{ s}^{-1}$ at 20 minutes after initiation. The half life of the reaction is

- a) 4.408 min b) 44.086 min c) 24.086 min d) 2.408 min

OR

The plot of $t_{1/2}$ vs initial concentration $[A]_0$ for a first order reaction is given by



Answers (i) c (ii) a (iii) b (iv) c or b

Passage – 2

Read the passage given below and answer the following questions:

The branch of physical chemistry that is concerned with understanding the rates of chemical reactions. It is to be contrasted with thermodynamics which deals with the direction in which a process occurs but in itself tells nothing about its rate. Thermodynamics is time's arrow while chemical kinetics is time's clock. Chemical kinetics relates to many aspects of cosmology, geology, biology, engineering and even psychology and thus has far-reaching implications. The principles of chemical kinetics applied to purely physical processes as well as to chemical reactions. The rate of a chemical reaction is defined in terms of the rates with which the products are formed and the reactants (the reacting substances) are consumed. For chemical systems, it is usual to deal with the concentrations of substances, which is defined as the amount of substances per unit volume. The rate can then be defined as the concentration of a substance that is consumed or produced in unit time. Sometimes it is more convenient to express rates as number of molecules formed or consumed in unit time.

READ THE STATEMENTS GIVEN AS ASSERTION & REASON BOTH AND CHOOSE THE CORRECT OPTION AS (A)/(B)/(C)/(D) AS PER THE FOLLOWING INSTRUCTIONS

(A) – if both assertion & reason are correct statements and reason is the correct explanation of assertion

(B)– if both assertion & reason are correct statements and reason is not the correct explanation of assertion

(C) if assertion is the correct statement & reason is incorrect statement.

(D) – if assertion is incorrect statement and reason is the correct statement.

1.Assertion: All collisions of reactant molecules do not lead to product formation.

Reason: Only those collisions in which molecules have correct orientation and sufficient kinetic energy lead to compound formation.

2.Assertion: The enthalpy of reaction remains constant in the presence of a catalyst

Reason: A catalyst lowers down the activation energy but the difference in energy of reactant and product remains same.

3Assertion: The rate of reaction is the rate of change of concentration of a reactant or product.

Reason: The rate of reaction remains constant during the course of a reaction.

4.Assertion: Instantaneous rate is used to predict the rate of reaction at a particular moment.

Reason: Average rate is constant for the time interval for which it is calculated.

ANSWERS

1.A 2. A 3. C 4. B

Passage – 3

Read the passage given below and answer the following questions: The principles of chemical kinetics applied to purely physical processes as well as to chemical reactions. The rate of a chemical reaction is defined in terms of the rates with which the products are formed and the reactants (the reacting substances) are consumed. For chemical systems, it is usual to deal with the concentrations of substances, which is defined as the amount of substances per unit volume. The rate can then be defined as the concentration of a substance that is consumed or produced in unit time. Sometimes it is more convenient to express rates as number of molecules formed or consumed in unit time.

II. MULTIPLE CHOICE QUESTIONS

1. A reaction is first order with respect to reactant A. What will be the initial rate, if concentration of reactant is reduced by half?

(a) Halved (b) doubled (c) tripled (d) not changed

2. What is the ratio of the rate of decomposition of N_2O_5 to the rate of formation of NO_2 ?

$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

(a) 1:4 (b) 2:1 (c) 4:1 (d) 1:2

3. In the first order reaction, the concentration of the reactant is reduced to 1/4th in 60 minutes. What will be its half-life?

(a) 120 min (b) 40 min (c) 30 min (d) 25 min

4. Which of the following reaction ends in infinite time?
(a) Zero order (b) First order (c) Second order (d) Third order
5. The rate constant of a zero order reaction is-
(a) Directly proportional to initial concentration (b) Doesn't depend on concentration
(c) Inversely proportional to initial concentration (d) Can't say
6. The first order reaction takes 80 minutes to complete 99.9%. What will be its half-life?
a) 8 min (b) 16 min (c) 24 min (d) 32 min
7. A catalyst increases the reaction rate by:
(a) decreasing enthalpy (b) increasing internal energy
(c) decreasing activation enthalpy (d) increasing activation enthalpy
8. Chemical kinetics is the study to find out:
(a) The feasibility of a chemical reaction (b) Speed of a reaction
(c) Extent to which a reaction will proceed (d) All of the above
9. The rate of a reaction:
(a) Increases as the reaction proceeds (b) Decreases as the reaction proceeds (c) Remains the same as the reaction proceeds (d) May increase or decrease as the reaction proceeds
10. Which of the following influences the reaction rate performed in a solution?
(a) Temperature (b) Activation energy (c) Catalyst (d) All of the above

passage 4:

Read the passage given below and answer the following questions:

The rate of a chemical reaction is expressed either in terms of decrease in the concentration of a reactant per unit time or increase in the concentration of a product per unit time. Rate of the reaction depends upon the nature of reactants, concentration of reactants, temperature, presence of catalyst, surface area of the reactants and presence of light. Rate of reaction is directly related to the concentration of reactant. Rate law states that the rate of reaction depends upon the concentration terms on which the rate of the reaction actually depends, as observed experimentally. The sum of powers of the concentration of the reactants in the rate law expression is called order of reaction while the number of reacting species taking part in an elementary reaction which must collide simultaneously in order to bring about a chemical reaction is called molecularity of the reaction.

1. Why do pieces of wood burn faster than log of wood of same mass?
 - a) Pieces of wood has less surface area
 - b) Pieces of wood has large surface area
 - c) Log of wood more mass
 - d) Pieces of wood has less mass
2. What is a complex reaction
 - a) Reaction which takes place in single step
 - b) Reaction takes place in two or more steps
 - c) Reaction which form complex
 - d) None of the above
3. When initial concentration of reactant is doubled the half life period of zero order reaction
 - a) Remain unchanged
 - b) is halved
 - c) is tripled
 - d) is Doubled

4. Addition of catalyst during a chemical reaction alters which of the following
a) Entropy b) Activation energy c) internal energy d) Enthalpy

OR

If the temperature of a reaction is increased by 20°C the rate of reaction increases by

- a) One time b) two times c) three times d) four times

Answer :

1. B 2. B 3. D 4. B OR D

Passage 5:

Read the passage given below and answer the following question

Temperature has a marked effect on the rate of reaction. For most of the reactions, the rate of reaction becomes nearly double for every 10° degree rise in temperature. The effect of temperature is usually expressed in terms of temperature coefficient. The quantitative dependence of reaction rate on temperature was first explained by Swante Arrhenius. Arrhenius proposed a simple equation called as Arrhenius equation : $k = A e^{-E_a/RT}$. The equation provides the relationship between the rate constant (k) of a reaction and the Temperature of the system (T). (A) is the Arrhenius factor or pre-exponential factor. (E_a) is the activation energy and (R) is gas constant.

1. Activation energy of a reaction from the slope of which of the following graph?
a) $\ln k$ vs T b) $\ln k / T$ vs T c) $\ln k$ vs $1/T$ d) $T / \ln k$ vs $1/T$
2. According to Arrhenius equation ,rate constant of a chemical reaction is equal to
a) $K = A e^{-E_a/RT}$ b) $k = A e^{E_a/RT}$ c) $k = A e^{-RT/E_a}$ d) $k = A e^{RT/E_a}$
3. Rate of a reaction is doubled for every 10°C raise in temperature. If the temperature is raised by 20°C the rate of reaction increases by
a) 2 times b) 4 times c) 3 times d) no change
4. Activation energy of a chemical reaction can be determined by
a) Determining the rate constant at standard temperature
b) Determining the rate constant at two temperatures
c) Determining probability of reaction
d) Using catalyst

ANSWER : 1 = a , 2 = a , 3 = b 4 = b

Passage 6:

Read the passage given below and answer the following question

Rate = $k [A]^x [B]^y$ x and y indicate how sensitive the rate is to the change in concentration of A and B. Sum of these exponents, i.e., $x + y$ in (3.4) gives the overall order of a reaction whereas x and y represent the order with respect to the reactants A and B respectively. Hence, the sum of powers of the concentration of the reactants in the rate law expression is called the order of that chemical reaction. Order of a reaction can be 0, 1, 2, 3 and even a fraction. A zero order reaction means that the rate of reaction is independent of the concentration of reactants. A balanced chemical equation never gives us a true picture of how a reaction takes place since rarely a reaction gets completed in one step. The reactions taking place in one step are called elementary reactions. When a sequence of elementary reactions (called mechanism) gives us the products, the reactions are called complex reactions.

1. Calculate the overall order of a reaction which has the rate expression
Rate = $k [A]^{1/2} [B]^{3/2}$
a) Second order b) first order c) Zero order d) Fraction order
2. For first order reaction which of the following statement is correct
a) $t_{1/2}$ independent of $[R]_0$
b) $t_{1/2}$ dependent of $[R]_0$
c) $t_{1/2}$ is equal to $[R]_0$
d) None of above
3. For zero order reaction rate of reaction is
a) independent of the concentration of reactants.
b) dependent of the concentration of reactants.
c) independent of the concentration of products
d) dependent of the concentration of reactants.
4. In first order reaction Which of the following statement is correct
a) Time taken for completion of 99.9% reaction is 10 times of $t_{1/2}$ of reaction
b) Time taken for completion of 99.9% reaction is 20 times of $t_{1/2}$ of reaction
c) Time taken for completion of 99.9% reaction is 99.9 times of $t_{1/2}$ of reaction
d) Time taken for completion of 99.9% reaction is equal to times of $t_{1/2}$ of reaction

ANSWERS 1- A , 2 - A , 3 – A 4 – A

CHAPTER 4 d & f block elements

1. The number of unpaired electrons in gaseous species of Mn^{3+} , Cr^{3+} and V^{3+} respectively are:
a) 4, 4 and 2
b) 3, 3 and 2
c) 4, 3 and 2
d) 3, 3 and 3
2. Gun metal is an alloy of:
a) Cu and Al
b) Cu and Sn
c) Cu, Zn and Sn
d) Cu, Zn and Ni

3. Which one of the following elements shows the maximum number of different oxidation states in its compounds?

- a) Eu
- b) La
- c) Cd
- d) Am

4. Zinc and mercury do not show variable valency like d-block elements because

- a) they are soft
- b) their d-shells are complete
- c) they have only two electrons in the outermost subshell.
- d) their d-shells are incomplete

5. The pair of elements that has similar atomic radii is

- a) Mn and Re
- b) Ti and Hf
- c) Sc and Ni
- d) Hf and Zr

6. Silver nitrate produces a black stain on the skin due to

- a) being a strong reducing agent
- b) its corrosive action
- c) formation of complex compound
- d) its reduction to metallic silver

7. The transition metal that exhibit largest number of oxidation state is

- a) Cr
- b) Mn
- c) Zn
- d) Sc

8. Mn^{2+} compounds are more stable than Fe^{2+} compounds towards oxidation in +3 state because

- a) $3d^5$ configuration is more stable than $3d^6$ configuration
- b) $3d^6$ configuration is more stable than $3d^5$ configuration
- c) $3d^5$ configuration is less stable than $3d^6$ configuration
- d) $3d^6$ configuration is less stable than $3d^5$ configuration

9. Transition metals show paramagnetic behaviour due to:

- a) Paired electrons in the (n-1)d orbital
- b) Unpaired electrons in the (n-1)d orbital
- c) Due to d^{10} configuration
- d) None of the above

10. The correct statement(s) about interstitial compounds is/are:

- a) Transition elements are large in size and contain multiple interstitial sites
- b) Transition elements can trap atoms of other elements
- c) Interstitial elements are chemically inert
- d) All the above

11. The d block elements that may not be regarded as transition elements are

- a) Mn, Fe, Ni due to partially filled d orbital
- b) Mn, Fe, Ni due to completely filled d orbital
- c) Zn, Cd, & Hg due to completely filled d orbital
- d) Zn, Cd, & Hg due to partially filled d orbital

12. Element that does not show variable oxidation state is

- a) Fe
- b) Mn
- c) Cu
- d) Zn

13. The magnetic momentum of Mn^{2+} is

- a) 5.92BM
- b) 2.80Bm
- c) 8.95Bm
- d) 3.9BM

14. The enthalpy of atomisation of transition metals is high due to

- a) High effective nuclear charge
- b) A large number of valence electrons
- c) very strong metallic bond
- d) All the above

15. Which of the following is colourless ion

- a) Cr^{4+}
- b) Sc^{3+}
- c) Ti^{3+}
- d) V^{3+}

16. The number of 3d electrons in Cr^{3+} ion is

- a) 6
- b) 3
- c) 5
- d) 4

17. Transition metals and their compounds act as good catalyst due to

- a) Variable oxidation state
- b) unstable intermediate
- c) provide a suitable surface
- d) All the above

18. Which of the following is in the correct order of increasing oxidising power?

- a) $VO_2^+ < Cr_2O_7^{2-} < MnO_4^{-1}$
- b) $VO_2^+ < MnO_4^{-1} < Cr_2O_7^{2-}$
- c) $Cr_2O_7^{2-} < VO_2^+ < MnO_4^{-1}$
- d) $Cr_2O_7^{2-} < MnO_4^{-1} < VO_2^+$

19. The electronic configuration of gadolinium (atomic no 64) is

- a) $[Xe] 4f^3 5d^5 6s^2$
- b) $[Xe] 4f^7 5d^2 6s^1$
- c) $[Xe] 4f^7 5d^1 6s^2$
- d) $[Xe] 4f^8 5d^6 6s^2$

20. Which of the following statement is correct

- a) $Cu(I)_{aq}$ is more stable
- b) $Cu(II)_{aq}$ is less stable
- c) $Cu(I)_{aq}$ & $Cu(II)_{aq}$ are equally stable
- d) stability of $Cu(I)$ & $Cu(II)$ depends upon nature of copper salt

21. The element that has maximum composition in Mischmetal and used in gas lighter is
a) Ce b) Fe c) Sm d) La
22. When neutral alkaline KMnO_4 is treated with potassium iodide, the iodide ion is converted into X. X is
a) I_2 b) IO_4^- c) IO_3^- d) IO^-
23. Different oxidation states exhibited by the lanthanoids are
a) +2, +3, +4
b) +2, +3, -4
c) -2, -3, -4
d) +2, +4, +5
24. The most stable oxidation state of lanthanoids and actinoids is
a) +5 b) +2 c) +3 d) +1
25. On addition of small amount of KMnO_4 to concentrated H_2SO_4 , a green oily compound is obtained, which is highly explosive in nature. Identify the compound
a) Mn_2O_7 b) MnO_2 c) MnSO_4 d) Mn_2O_3
26. Actinoids exhibit greater number of oxidation state than lanthanoid. The reason is
a) more energy difference between 5f, 6d than 4f and 5f
b) 4f orbitals are more diffuse than 5f orbital
c) Lesser energy difference between 5f and 6d than 4f and 5d orbitals
d) More reactive nature of actinoids than lanthanoids
27. Transition metals and their compounds show coloured salts because of
a) presence of paired electrons in d orbital
b) absence of unpaired electrons in d orbital
c) presence of unpaired electron in d orbital
d) Presence of paired electron in f orbital
28. Highest oxidation state of manganese in fluorides is +4 (MnF_4) but with oxygen is +7 (Mn_2O_7) because
a) Fluorine is more electronegative than oxygen
b) Fluorine does not contain d orbital
c) Fluorine stabilises lower oxidation state
d) In covalent compounds fluorine can form single bond while oxygen can form double bond
29. Why is HCl not used to make the medium acidic in oxidation reaction of KMnO_4 ?
a) Both HCl & KMnO_4 act as oxidising agents
b) KMnO_4 oxidises HCl to Cl_2
c) KMnO_4 is a weaker oxidising agent than HCl
d) KMnO_4 act as reducing agent in presence of HCl
30. Although Zirconium belongs to 4d transition series and Haffnium to 5d series they show similar physical and chemical properties because:
a) Both belong to d block
b) Both have same number of electrons
c) Both have similar atomic radius
d) Both belong to same group of the periodic table
31. Cu^+ is not stable in aqueous solutions because
a) In aqueous solution it undergoes disproportionation reaction to form stable Cu^{2+} ion
b) It contains d^{10} configuration
c) it is colourless in Cu^{+1} state
d) none of the above

32. Transition metals possess high melting point because

- a) presence of paired electrons
- b) of weak metallic bond
- c) due to strong metallic bond
- d) of covalent bond

33. Name a member of the lanthanide series which is well known to exhibit +4 oxidation state.

- (a) Cerium (Z=58)
- (b) Europium (Z=63)
- (c) Lanthanum (Z=57)
- (d) Gadolinium (Z=64)

34. Identify the incorrect statement among the following.

- (a) Lanthanide contraction is the accumulation of successive shrinkages.
- (b) the different radii of Zr and Hf due to consequences of the lanthanide contraction.
- (c) Shielding power of 4f electrons is quite weak.
- (d) None of the above

35. Though Silver contains completely filled d orbital (d^{10}) still called transition element

- a) It shows +1 oxidation state
- b) It shows +2 oxidation state with d^9 configuration
- c) It is a metal
- d) It is a soft metal

Answer key

- 1. c
- 2. c
- 3. d
- 4. b
- 5. d
- 6. d
- 7. b
- 8. a
- 9. b
- 10. d
- 11. c
- 12. d
- 13. a
- 14. d
- 15. b
- 16. b
- 17. d
- 18. a

- 19. c
- 20. a
- 21. a
- 22. c
- 23. a
- 24. c
- 25. a
- 26. c
- 27. c
- 28. d
- 29. b
- 30. c
- 31. a
- 32. c
- 33. a
- 34. a
- 35. b

d & f Block elements

CASEBASE STUDY

Passage -1

Read the passage given below and answer the following questions:

The f-block elements are those in which the differentiating electrons enters the (n-2)f orbitals. There are two series of f-Block elements corresponding to filling of 4f and 5f-orbitals. The series of 4f-orbitals is called lanthanides. Lanthanides show different oxidation states depending upon stability of f^0 , f^7 and f^{14} configurations, though the most common oxidation states is +3. There is a regular decrease in the size of lanthanides ions with increase in atomic number which is known as lanthanides contraction.

The following questions are multiple choice question. Choose the most appropriate answer:

(i) The atomic number of three lanthanides elements X, Y and Z are 65, 68 and 70 respectively, their Ln^{3+} electronic configuration is

- (a) $4f^8, 4f^{11}, 4f^{13}$
- (b) $4f^{11}, 4f^8, 4f^{13}$
- (c) $4f^0, 4f^2, 4f^{11}$
- (d) $4f^3, 4f^7, 4f^9$

(ii) lanthanide contraction is observed in

- (a) Gd
- (b) At
- (c) Xe
- (d) Te

(iii) Which of the following is not the configuration of lanthanide?

- (a) $[\text{Xe}]4f^{10}6s^2$
- (b) $[\text{Xe}]4f^{15}d^16s^2$
- (c) $[\text{Xe}]4d^{14}5d^{10}6s^2$
- (d) $[\text{Xe}]4f^75d^16s^2$

Or

Name a member of the lanthanide series which is well known to exhibit +4 oxidation state.

- (a) Cerium (X=58)
- (b) Europium (Z=63)
- (c) Lanthanum (Z=57)
- (d) Gadolinium (Z=64)

(iv) Identify the incorrect statement among the following.

- (a) Lanthanide contraction is the accumulation of successive shrinkages.
- (b) the different radii of Zr and Hf due to consequences of the lanthanide contraction.
- (c) Shielding power of 4f electrons is quite weak.
- (d) There is a decrease in the radii of the atoms or ions proceeds from La to Lu

Answer(i) a

(ii) a

(iii) c

or a

(iv) b

Passage 2

Read the passage given below and answer the following questions:

The D-Block elements are those elements in which the last electron enters the d-subshell of the penultimate shell. The general electronic configuration of these elements is $(n-1) d^{1-10}ns^{1-2}$, where n is the outermost shell. The d-block consisting of groups 3-12 occupies the large middle section of the periodic table. The elements of the d-block are also known as transition elements as they possess properties that are transitional between s&p block elements. A transitional element is defined as the elements which has incompletely filled d-orbitals in its ground state or any other of its oxidation states. There are four series of transition elements spread between group 3&12. First transition series are 3d series: Scandium to Zinc. Second transition series are 4d series: Yttrium to Cadmium. Third transition series are 5d series: Lanthanum to Mercury. Fourth transition series are 6d series: Begins with Actinium and is still incomplete.

1. Which block elements are called transitional elements
 - a) S – block
 - b) p – block
 - c) d – block
 - d) f – block
2. Why is the Zinc compounds are colourless
 - a. Absence of unpaired electrons in p - orbital
 - b. Presence of unpaired electrons in p - orbital
 - c. Presence of unpaired electrons in d- orbital
 - d. Absence of unpaired electrons in d- orbital
3. Though Silver contain completely filled d orbital (d^{10}) still called transition element
 - a. It shows +1 oxidation state
 - b. It shows +2 oxidation state with d^9 configuration
 - c. It is a metal
 - d. It is a soft metal
4. Which of the following d block element exist in liquid state
 - a. Zn
 - b) Mn
 - c) Hg
 - d) Fe

Or

Name the transition element used as filament in bulb

- a) Copper
- b) Iron
- c) Alluminium
- d) Tungsten

ANSWERS : 1 – C , 2 – c , 3 – b , 4 – c OR d

Passage 3:

Read the passage given below and answer the following questions:

Potassium permanganate is prepared by fusion of pyrolusite MnO_2 with KOH in the presence of an oxidizing 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 oxidizing agent in acidic, alkaline, as well as neutral medium.

1. What is the state of hybridisation of Mn in MnO_4^-
a) sp^2 b) sp^3 c) sp d) dsp^3
2. The colour of KMnO_4 is due to
a) Potassium ion
b) Charge transfer
c) d – d transition
d) K and O double bond
3. The products obtained by oxidation of KI in acid medium by KMnO_4 is
a) Iodine b) iodate ion c) water d) MnI_2
4. The number of electrons transferred when KMnO_4 act as oxidising agent in acid medium is To give Mn^{2+}
a) 3 b) 5 c) 1 d) 7

ANSWERS

1. = b, 2 = c, 3 = a, 4 = b

Passage 4.

Read the passage given below and answer the following questions:

The transition elements have incompletely filled d subshells in their ground state or in any of their oxidation states. The transition elements occupy position between s & p block in groups 3 – 12 of the periodic table. Starting from fourth period transition elements consists of four series: Sc to Zn, Y to Cd, La Hf to Hg and Ac Rf to Cn. In general electronic configuration of outer orbitals is $(n-1)d^{1-10}ns^{1-2}$. The electronic configuration of Zn, Cd, Hg are represented by general formula $(n-1)d^{10}ns^2$. All the transition elements have typical metallic properties like tensile strength, ductility, malleability. Except mercury which is a liquid at room temperature all other elements have typical metallic structure. Transition metals and their compounds exhibit catalytic property, & paramagnetic behaviour, alloy formation

1. Which of the following characteristics of transition metals is associated catalytic activity
a) High enthalpies of atomisation b) Variable oxidation state
c) Paramagnetic behaviour d) colour of hydrated ion
2. Transition elements form alloys because

- a) Same atomic number b) same electronic configuration c) nearly same atomic size d) same oxidation state
3. Transition elements form coloured compounds because
- a) nearly same atomic size b) d-d transition
- c) high charge on transition metal ion d) presence of paired electrons
4. Which of the following characteristics of transition metals is associated with complex formation
- a) nearly same atomic size b) d-d transition c) high charge on transition metal ion d) presence of paired electrons

Answers 1 – b , 2 – c , 3 - b , 4 – c

Passage 5.

Read the passage given below and answer the following questions:

The stable halides of the 3d series of transition metals. The highest oxidation numbers are achieved in TiX_4 (tetrahalides), VF_5 and CrF_6 . The +7 state for Mn is not represented in simple halides but MnO_3F is known, and beyond Mn no metal has a trihalide except FeX_3 and CoF_3 . The ability of fluorine to stabilise the highest oxidation state is due to either higher lattice energy as in the case of CoF_3 , or higher bond enthalpy terms for the higher covalent compounds, e.g., VF_5 and CrF_6 . Although V+5 is represented only by VF_5 , the other halides, however, undergo hydrolysis to give oxohalides, VOX_3 . Another feature of fluorides is their instability in the low oxidation states e.g., VX_2 (X = Cl, Br or I).

4.3.6 Trends in the M^{3+}/M^{2+} Standard Electrode Potentials
 4.3.7 Trends in Stability of Higher Oxidation States

+ 6 CrF_6 + 5 VF_5 CrF_5 + 4 TiX_4 VX_3 4 CrX_4 MnF_4 + 3 TiX_3 VX_3 CrX_3 MnF_3 FeX_3 3 CoF_3 + 2 TiX_2 III VX_2 CrX_2 MnX_2 FeX_2 CoX_2 NiX_2 CuX_2 II ZnX_2 + 1 CuX III

ever, many copper (I) compounds are unstable in aqueous solution and undergo disproportionation. $2Cu^+ \rightleftharpoons Cu^{2+} + Cu$ The stability of Cu^{2+} (aq) rather than Cu^+ (aq) is due to the much more negative hydration enthalpy of Cu^{2+} (aq) than Cu^+ , which more than compensates for the second ionisation enthalpy of Cu.

- Why is the highest oxidation state of a metal exhibited in its oxide or fluoride only?
 - Fluorine and oxygen large in size
 - Small size and high electronegativity of fluorine and oxygen
 - large size and low electronegativity of fluorine and oxygen
 - larger size and high electropositivity of fluorine and oxygen
- Which is a stronger reducing agent Cr^{2+} or Fe^{2+} and why?
 - Fe^{2+} is stronger reducing agent than Cr^{2+} Reason: $d^4 \rightarrow d^3$ occurs in case of Cr^{2+} to Cr^{3+} But $d^6 \rightarrow d^5$ occurs in case of Fe^{2+} to Fe^{3+}
 - Cr^{2+} is stronger reducing agent than Fe^{2+} Reason: $d^4 \rightarrow d^3$ occurs in case of Cr^{2+} to Cr^{3+} But $d^6 \rightarrow d^5$ occurs in case of Fe^{2+} to Fe^{3+}
 - Cr^{2+} is equal reducing agent like Fe^{2+} Reason: $d^4 \rightarrow d^3$ occurs in case of Cr^{2+} to Cr^{3+} But $d^6 \rightarrow d^5$ occurs in case of Fe^{2+} to Fe^{3+}
 - None of the above
- Explain why Cu^+ ion is not stable in aqueous solutions?
 - Cu^+ in aqueous solution undergoes disproportionation
 - Cu^{2+} in aqueous solution undergoes disproportionation
 - Cu in aqueous solution undergoes disproportionation
 - None of above

4. The lowest oxide of transition metal is basic where as the highest is acidic.because

- a) The lower oxides are ionic while higher oxides are covalent.
- b) The lower oxides are covalentwhile higher oxides are ionic
- c) The lower oxides are ionic & higher oxides are ionic
- d) The lower oxides are covalent & higher oxides are covalent

ANSWER: 1 – B , 2 – B , 3 – A , 4 - B

CHAPTER 5
COORDINATION COMPOUNDS MCQS

1. Trunbull's blue is
 - (a) Ferricyanide
 - (b) Ferrous ferricyanide
 - (c) Ferrous cyanide
 - (d) $\text{Fe}_3[\text{Fe}(\text{CN})_6]_4$

2. The complex ions $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ and $[\text{Co}(\text{NH}_3)_5(\text{ONO})]^{2+}$ are called
 - (a) Ionization isomers
 - (b) Linkage isomers
 - (c) Co-ordination isomers
 - (d) Geometrical isomers

3. Which of the following has square planar structure?
 - (a) $[\text{NiCl}_4]^{2-}$
 - (b) $[\text{Ni}(\text{CO})_4]$
 - (c) $[\text{Ni}(\text{CN})_4]^{2-}$
 - (d) None of these

4. Which of the following has magnesium?
 - (a) Chlorophyll
 - (b) Haemocyanin
 - (c) Carbonic anhydrate
 - (d) Vitamin B₁₂

5. Mohr's salt is
 - (a) $\text{Fe}_2(\text{SO}_4)_3 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
 - (b) $\text{FeSO}_4 \cdot (\text{NH}_4)_2 \cdot \text{SO}_4 \cdot 6\text{H}_2\text{O}$
 - (c) $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
 - (d) $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$

6. Which of the following shall form an octahedral complex?
 - (a) d^4 (low spin)
 - (b) d^8 (high spin)
 - (c) d^6 (low spin)
 - (d) All of these

7. EDTA is used for the estimation of
 - (a) Na^+ and K^+ ions
 - (b) Cl^- and Br^- ions
 - (c) Cu^{2+} and Cs^+ ions
 - (d) Ca^{2+} and Mg^{2+} ions

8. The solution of the complex $[\text{Cu}(\text{NH}_3)_4] \text{SO}_4$ in water will

- (a) give the tests of Cu^{2+} ion
- (b) give the tests of NH_3
- (c) give the tests of SO_4^{2-} ions
- (d) not give the tests of any of the above

9. The sum of coordination number of oxidation number of the metal M in the complex $[\text{M}(\text{en})_2 \text{C}_2\text{O}_4] \text{Cl}$ are

- (a) 7
- (b) 8
- (c) 9
- (d) 6

10. Which of the following will not give test for Cl^- with $\text{AgNO}_3(\text{aq})$ at 25°C ?

- (a) $\text{CoCl}_3 \cdot 5\text{NH}_3$
- (b) $\text{CoCl}_3 \cdot 6\text{NH}_3$
- (c) $\text{CoCl}_3 \cdot 3\text{NH}_3$
- (d) $\text{CoCl}_3 \cdot 4\text{NH}_3$

11. Which of these statements about $[\text{Co}(\text{CN})_6]^{3-}$ is true?

- (a) It has 4 unpaired electron, high spin
- (b) No unpaired electron, high spin
- (c) No unpaired electron, low spin
- (d) 4 unpaired electron, low spin

12. The correct order of the stoichiometries of AgCl formed when AgNO_3 in excess is treated with complexes: $\text{CoCl}_3 \cdot 6\text{NH}_3$, $\text{CoCl}_3 \cdot 5\text{NH}_3$, $\text{CoCl}_3 \cdot 4\text{NH}_3$ respectively is

- (a) 3 AgCl , 1 AgCl , 2 AgCl
- (b) 3 AgCl , 2 AgCl , 1 AgCl
- (c) 2 AgCl , 3 AgCl , 2 AgCl
- (d) 1 AgCl , 3 AgCl , 2 AgCl

13. Correct increasing order of wavelength of absorption in visible region for complex of Co^{3+} is

- (a) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$
- (b) $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$
- (c) $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$
- (d) $[\text{Co}(\text{en})_3]^{3+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$

14. Pick out the correct statement with respect to $[\text{Mn}(\text{CN})_6]^{3-}$

- (a) It is sp^2d^2 hybridised, tetrahedral
- (b) It is d^2sp^3 hybridised, octahedral
- (c) It is dsp^2 hybridised, square planar,
- (d) It is sp^3d^2 hybridised octahedral

15. Facial and meridional isomerism will be shown by

- (a) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
- (b) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2] \text{Cl}$
- (c) $[\text{Co}(\text{en})_3] \text{Cl}_3$
- (d) $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{Cl}_2$

16. Which one has highest molar conductivity?

- (a) $[\text{Pt}(\text{NH}_3)_2 \text{Cl}_2]$
- (b) $[\text{Co}(\text{NH}_3)_4 \text{Cl}_2] \text{Cl}$
- (c) $\text{K}_4[\text{Fe}(\text{CN})_6]$
- (d) $[\text{Cr}(\text{H}_2\text{O})_6] \text{Cl}_3$

17. Which one will show optical isomerism?

- (a) $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$
- (b) cis- $[\text{Co}(\text{en})_2 \text{Cl}_2] \text{Cl}$
- (c) trans- $[\text{Co}(\text{en})_2 \text{Cl}_2] \text{Cl}$
- (d) $[\text{Co}(\text{NH}_3)_4 \text{Cl}_2] \text{Cl}$

18. The pair having the same magnetic moment is (At No. Cr = 24, Mn = 25, Fe = 26, Co = 27)

- (a) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{CoCl}_4]^{2-}$
- (b) $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- (c) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$ and $[\text{Cr}(\text{H}_2\text{O})_6]^{2+}$
- (d) $[\text{CoCl}_4]^{2-}$ and $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

19. On treatment of 100 mL of 0.1 M $\text{CoCl}_3 \cdot 6\text{H}_2\text{O}$ with excess of AgNO_3 1.2×10^2 ions are precipitated. The complex is

- (a) $[\text{Co}(\text{H}_2\text{O})_4\text{Cl}_2]\text{Cl} \cdot 2\text{H}_2\text{O}$
- (b) $[\text{Co}(\text{H}_2\text{O})_3\text{Cl}_3]_3\text{H}_2\text{O}$
- (c) $[\text{Co}(\text{H}_2\text{O})_6] \text{Cl}_3$
- (d) $[\text{Co}(\text{H}_2\text{O})_5 \text{Cl}] \text{Cl}_2 \cdot \text{H}_2\text{O}$

20. Among the ligands NH_3 , en, CN^- and CO, the correct order of field strength is

- (a) $\text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$
- (b) $\text{CN}^- < \text{NH}_3 < \text{CO} < \text{en}$
- (c) $\text{en} < \text{CN}^- < \text{NH}_3 < \text{CO}$
- (d) $\text{CO} < \text{NH}_3 < \text{en} < \text{CN}^-$

21. Which of the following complexes formed by Cu^{2+} ions is most stable?

- (a) $\text{Cu}^{2+} + 4\text{NH}_3 \rightleftharpoons [\text{Cu}(\text{NH}_3)_4]^{2+}$,
 $\log K = 11.6$
- (b) $\text{Cu}^{2+} + 4\text{CN}^- \rightleftharpoons [\text{Cu}(\text{CN})_4]^{2-}$,
 $\log K = 27.3$
- (c) $\text{Cu}^{2+} + 2\text{en} \rightleftharpoons [\text{Cu}(\text{en})_2]^{2+}$,
 $\log K = 15.4$
- (d) $\text{Cu}^{2+} + 4\text{H}_2\text{O} \rightleftharpoons [\text{Cu}(\text{H}_2\text{O})_4]^{2+}$,
 $\log K = 8.9$

22. The stabilisation of coordination compounds due to chelation is called the chelate effect. Which of the following is the most stable complex species?

- (a) $[\text{Fe}(\text{CO})_5]$
- (b) $[\text{Fe}(\text{CN})_6]^{3-}$
- (c) $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$
- (d) $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$

23. Indicate the complex ion which shows geometrical isomerism.

- (a) $[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]^+$
- (b) $[\text{Pt}(\text{NH}_3)_3\text{Cl}]$
- (c) $[\text{Co}(\text{NH}_3)_6]^{3+}$
- (d) $[\text{Co}(\text{CN})_5(\text{NC})]^{3-}$

24. In which one of the following species does the transition metal ion have d^3 electronic configuration?

- [A] $[\text{Cr}(\text{NH}_3)_6]^{3+}$
- [B] $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$
- [C] $[\text{CoF}_6]^{3-}$
- [D] $[\text{Fe}(\text{CN})_6]^{3-}$

25. (Crystal Field Theory) When the valence d orbitals of the central metal ion are split in energy in an octahedral ligand field, which orbitals are raised least in energy?

- [A] d_{xy} and $d_{x^2-y^2}$
- [B] d_{xy} , d_{xz} and d_{yz}
- [C] d_{xz} and d_{yz}
- [D] None of the above

26. The number of ions formed, when bis (ethane-1,2-diamine)copper (II) sulphate is dissolved in water will be:

- [A] 1
- [B] 2
- [C] 3
- [D] None of the above

27. Among the following ions which one has the highest paramagnetism

- [A] $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
- [B] $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
- [C] $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$
- [D] $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$

28. A complex of certain metal has the magnetic moment of 4.91 BM whereas another complex of the same metal with same oxidation state has zero magnetic moment. The metal ion could be

- [A] Co^{2+}
- [B] Mn^{2+}
- [C] Fe^{2+}
- [D] Fe^{3+}

29. The CFSE for octahedral $[\text{CoCl}_6]^{4-}$ is $18,000 \text{ cm}^{-1}$. The CFSE for tetrahedral $[\text{CoCl}_4]^{2-}$ will be
(a) $18,000 \text{ cm}^{-1}$
(b) $16,000 \text{ cm}^{-1}$
(c) $8,000 \text{ cm}^{-1}$
(d) $20,000 \text{ cm}^{-1}$

30. Due to the presence of ambidentate ligands coordination compounds show isomerism. Palladium complexes of the type $[\text{Pd}(\text{C}_6\text{H}_5)_2(\text{SCN})_2]$ and $[\text{Pd}(\text{C}_6\text{H}_5)_2(\text{NCS})_2]$ are
(a) linkage isomers
(b) coordination isomers
(c) ionisation isomers
(d) geometrical isomers

31. The compounds $[\text{Co}(\text{SO}_4)(\text{NH}_3)_5]\text{Br}$ and $[\text{Co}(\text{SO}_4)(\text{NH}_3)_5]\text{Cl}$ represent
(a) linkage isomerism
(b) ionisation isomerism
(c) coordination isomerism
(d) no isomerism

32. A chelating agent has two or more than two donor atoms to bind to a single metal ion. Which of the following is not a chelating agent?
(a) thiosulphato
(b) oxalato
(c) glycinato
(d) ethane-1, 2-diamine

33. The solution of the complex $[\text{Cu}(\text{NH}_3)_4] \text{Cl}$ in water will
(a) give the tests of Cu^{2+} ion
(b) give the tests of NH_3
(c) give white ppt with AgNO_3
(d) not give the tests of any of the above

34. IUPAC name of $[\text{Pt}(\text{NH}_3)_3 \text{Br} (\text{NO}_2) \text{Cl}] \text{Cl}$ is
(a) triamminechlorodibromidoplatinum (IV) chloride
(b) triamminechloridobromidonitrochloride- platinum (IV) chloride
(c) triamminebromidochloridonitroplatinum (IV) chloride
(d) triamminenitrochlorobromoplatinum (IV) chloride

35. Primary and secondary valency of Pt in $[\text{Pt}(\text{en})_2\text{Cl}_2]$ are
(a) 4, 4
(b) 4, 6
(c) 6, 4
(d) 2, 6

36. The name of complex $[\text{Fe}(\text{CN})_6]^{3-}$ is
(a) Tricyanido ferrate (III) ion
(b) Hexacyanido ferrate (III) ion

- (c) Hexacyanido iron (III)
(d) Hexacyanido ferrate (II) ion

Answer key

(1) b	(2) b	(3) c	(4) a	(5) b	(6) b
(7) d	(8) c	(9) c	(10) c	(11) c	(12) b
(13) d	(14) b	(15) a	(16) c	(17) b	(18) b
(19) d	(20) a	(21) b	(22) c	(23) a	(24) a
(25) b	(26) b	(27) b	(28) c	(29) c	(30) a
(31) b	(32) a	(33) c	(34) c	(35) d	(36) b

Assertion Reason type questions

Choose the correct option:

- (a) Assertion and reason both are correct and the reason is the correct explanation of assertion.
(b) Both assertion and reason are true but the reason is not the correct explanation of assertion.
(c) Assertion is correct but Reason is incorrect
(d) Assertion is a wrong statement but the reason is a correct statement
(e) Both Assertion and Reason are incorrect

1. **Assertion:** Toxic metal ions are removed by the chelating ligands.

Reason: Chelate complexes tend to be more stable.

2. **Assertion:** Linkage isomerism arises in coordination compounds containing ambidentate ligand.

Reason: Ambidentate ligand has two different donor atoms.

3. **Assertion:** Complexes of MX_6 , MX_5L type (X and L are unidentate) do not show geometrical isomerism.

Reason: Geometrical isomerism is not shown by complexes of coordination number 6.

4. **Assertion:** $[\text{Fe}(\text{CN})_6]^{3-}$ ion shows magnetic moment corresponding to two unpaired electrons.

Reason: Because it has d^2sp^3 type hybridization.

5. **Assertion:** $[\text{Ni}(\text{CN})_4]^{2-}$ is square planar and diamagnetic

Reason: It has no unpaired electrons due to the presence of a strong ligand.

6. **Assertion:** Oxalate ion is a bidentate ligand.

Reason: Oxalate ion has two donor atoms

7. **Assertion:** $[\text{Ni}(\text{CO})_4]$ has square planar geometry while $[\text{Ni}(\text{CN})_4]^{4-}$ has tetrahedral geometry

Reason: The geometry of any complex depends upon the nature of the ligands attached.

8. **Assertion:** $[\text{FeF}_6]^{3-}$ is a low spin complex.

Reason: Low spin complexes have a lesser number of unpaired electrons.

9. **Assertion:** F^- ion is a weak ligand and forms an outer orbital complex.

Reason: F^- ion cannot force the electrons of d_{z^2} and $d_{x^2 - y^2}$ orbitals of the inner shell to occupy d_{xy} , d_{yz} .

and d_{zx} orbitals of the same shell.

10. **Assertion:** Potassium ferrocyanide and potassium ferricyanide both are diamagnetic.

Reason: Both have unpaired electrons.

11. **Assertion:** The $[\text{Ni}(\text{en})_3]\text{Cl}_2$ (en = ethylene diamine) has lower stability than $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$

Reason: In $[\text{Ni}(\text{en})_3]\text{Cl}_2$ the geometry of Ni is trigonal bipyramidal.

12. **Assertion:** The ligands nitro and nitrito are called ambidentate ligands.

Reason: These ligands give linkage isomers.

13. **Assertion:** Geometrical isomerism is also called cis-trans isomerism.

Reason : Tetrahedral complexes show geometrical isomerism.

14. **Assertion:** $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic while $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic.

Reason: $[\text{Fe}(\text{CN})_6]^{3-}$ has +3 oxidation state while $[\text{Fe}(\text{CN})_6]^{4-}$ has +2 oxidation state.

15. **Assertion:** Potassium ferrocyanide is diamagnetic whereas potassium ferricyanide is paramagnetic.

Reason: Crystal field splitting in ferrocyanide ion is greater than that of ferricyanide ion.

16. **Assertion:** NF_3 is a weaker ligand than $\text{N}(\text{CH}_3)_3$.

Reason: NF_3 ionizes to give F^- ions in aqueous solution.

17. **Assertion:** $[\text{Fe}(\text{CN})_6]^{3-}$ is weakly paramagnetic while $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic.

Reason: $[\text{Fe}(\text{CN})_6]^{3-}$ has +3 oxidation state while $[\text{Fe}(\text{CN})_6]^{4-}$ has +2 oxidation state.

18. **Assertion:** $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$ is coloured while $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$ is colourless.

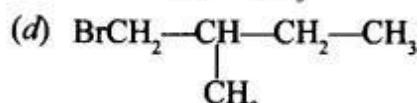
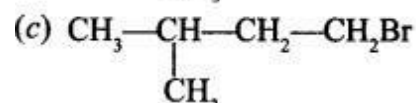
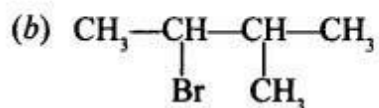
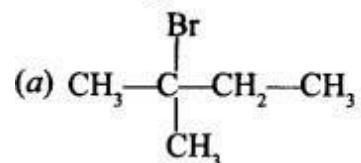
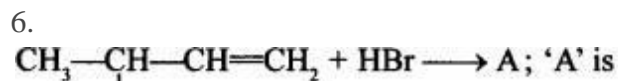
Reason: d-d transition is not possible in $[\text{Sc}(\text{H}_2\text{O})_6]^{3+}$.

Answer key

- | | | | | | |
|--------|--------|--------|--------|--------|--------|
| (1) a | (2) a | (3) c | (4) e | (5) a | (6) a |
| (7) d | (8) d | (9) a | (10) e | (11) e | (12) a |
| (13) c | (14) b | (15) c | (16) c | (17) b | (18) a |

CHAPTER 6
HALOALKANES AND HALOARENES

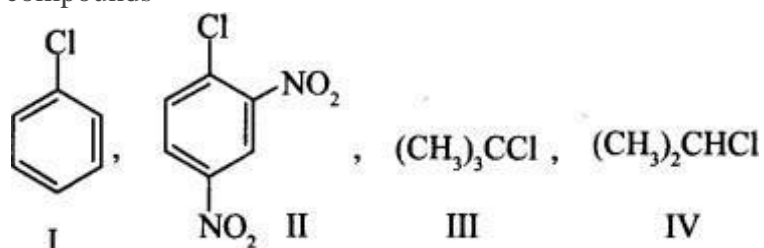
1. Which of the following is the right name for the compound $\text{H}_3\text{C}-\text{CHCl}_2$?
- 1,2-Dichloroethane
 - Ethylene dichloride
 - Ethylidene chloride
 - Vic-dichloride
2. Which of the following substances has the highest melting point?
- Chloromethane
 - Tetrachloromethane
 - Trichloromethane
 - Dichloromethane
3. Which sequence should isomeric dichlorobenzenes be boiled in?
- para>ortho>meta
 - meta>ortho>para
 - ortho>meta>para
 - para>meta>ortho
4. Which of the following undergoes nucleophilic substitution exclusively by $\text{S}_\text{N}1$ mechanism?
- Benzyl chloride
 - Ethyl chloride
 - Chlorobenzene
 - Isopropyl chloride
5. The increasing order of nucleophilicity would be
- $\text{Cl}^- < \text{Br}^- < \text{I}^-$
 - $\text{I}^- < \text{Cl}^- < \text{Br}^-$
 - $\text{Br}^- < \text{Cl}^- < \text{F}^-$
 - $\text{I}^- < \text{Br}^- < \text{Cl}^-$



7. Which of the following is most reactive towards SN1 reaction?

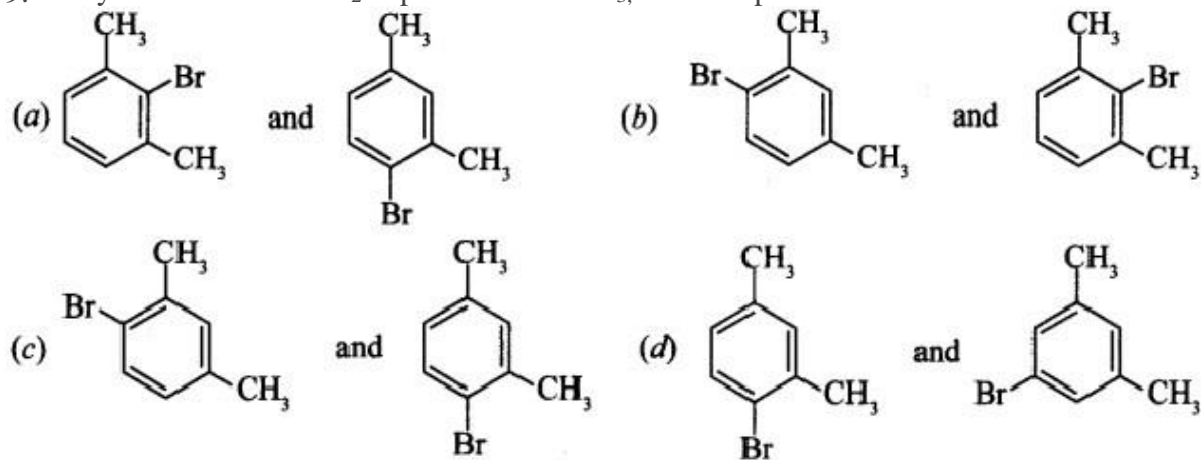
- (a) $C_6H_5C(CH_3)C_6H_5Br$
- (b) $C_6H_5CH_2Br$
- (c) $C_6H_5CH(C_6H_5)Br$
- (d) $C_6H_5CH(CH_3)Br$

8. The correct order of increasing the reactivity of C—X bond towards nucleophile in following compounds

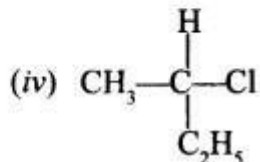
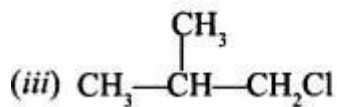
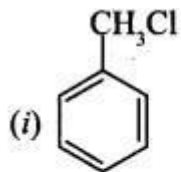


- (a) $IV < III < I < II$
- (b) $III < II < I < IV$
- (c) $I < II < IV < III$
- (d) $II < III < I < IV$

9. m-Xylene reacts with Br_2 in presence of $FeBr_3$, what are products formed



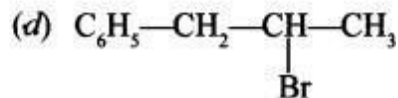
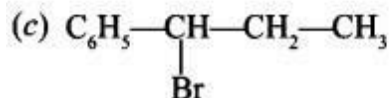
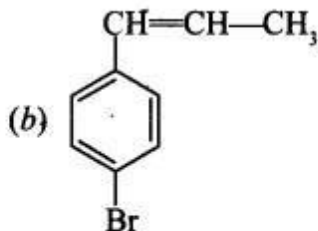
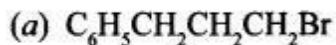
10. Which of the following compound will undergo racemisation when reacts with aq. KOH?



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

11.

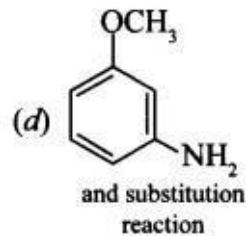
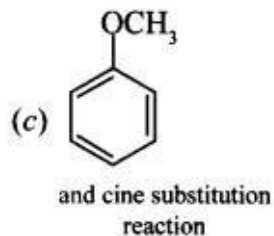
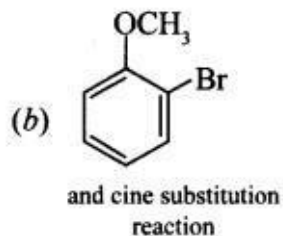
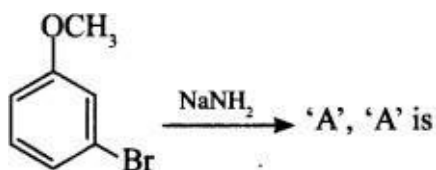
The reaction of $\text{C}_6\text{H}_5-\text{CH}=\text{CH}-\text{CH}_3$ with HBr produces



12. $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{NaCN} \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CN} + \text{NaBr}$, will be fastest in

- (a) ethanol
 (b) methanol
 (c) N, N dimethyl formamide
 (d) Water

13.



14. A dihalogen derivative 'X' of a hydrocarbon with three carbon atoms react with aq. KOH and produces hydrocarbon which forms red ppt. with ammoniacal Cu_2Cl_2 . 'X' gives an aldehyde on reaction with aq. KOH. The compound 'X' is

- (a) 1, 3-Dichloropropane
- (b) 1, 2-Dichloropropane
- (c) 2, 2-Dichloropropane
- (d) 1, 1-Dichloropropane

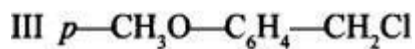
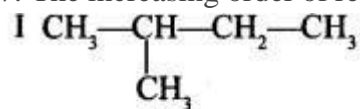
15. The synthesis of alkyl fluoride is best accomplished by

- (a) Finkelstein reaction
- (b) Swartz reaction
- (c) Free radical fluorination
- (d) Sandmeyer's reaction

16. How many chiral compounds are possible on monochlorination of 2-methyl butane?

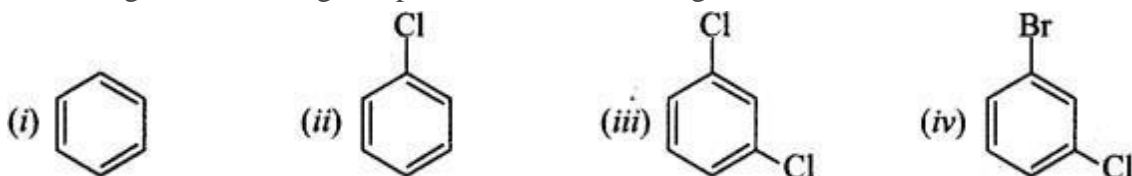
- (a) 2
- (b) 4
- (c) 6
- (d) 8

17. The increasing order of reactivity towards SN1 mechanism is



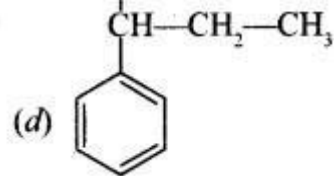
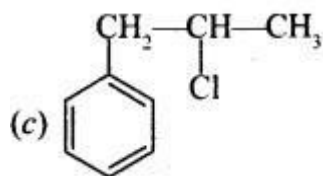
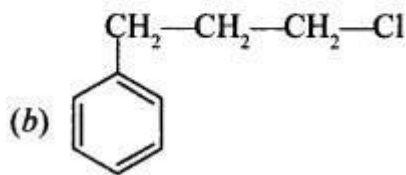
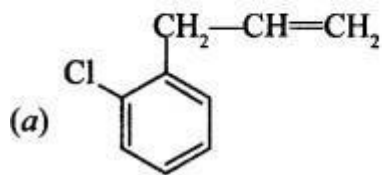
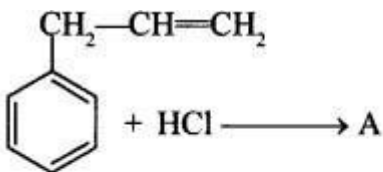
- (a) III < II < I
 (b) II < I < III
 (c) I < III < II
 (d) II < III < I

18. Arrange the following compounds in the increasing order of their densities.



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

19. What is 'A' in the following reaction?

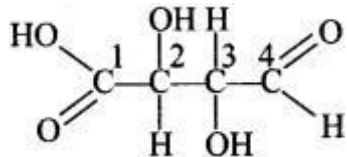


20. Which of the following alkyl halides will undergo SN1 reaction most readily?

- (a) $(\text{CH}_3)_3\text{C}-\text{F}$
 (b) $(\text{CH}_3)_3\text{C}-\text{Cl}$

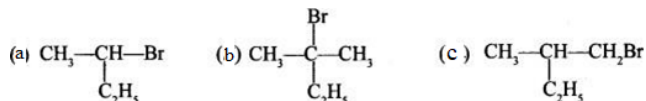
- (c) $(\text{CH}_3)_3\text{C}-\text{Br}$
 (d) $(\text{CH}_3)_3\text{C}-\text{I}$

21. Which of the carbon atoms present in the molecule given below are asymmetric?



- (a) 1, 2, 3, 4
 (b) 2, 3
 (c) 1, 4
 (d) 1, 2, 3

22. Which of the following compounds will give racemic mixture on nucleophilic substitution by OH^- ion?



23. Which of the following compounds will be least reactive towards nucleophilic substitution by OH^- ion?

1-Bromoethane, 1-Bromopropane, 1-Bromobutane, Bromobenzene

- (a) Bromobenzene
 (b) 1-Bromoethane
 (c) 1-Bromopropane
 (d) 1-Bromobutane

24. $\text{S}_{\text{N}}1$ reaction of alkyl halides lead to

- (a) Retention of configuration
 (b) Racemisation
 (c) Inversion of configuration
 (d) None of these

25. p-dichlorobenzene has higher melting point than its o- and m- isomers because

- (a) p-dichlorobenzene is more polar than o- and m- isomer.
 (b) p-isomer has a symmetrical crystalline structure.
 (c) boiling point of p-isomer is more than o- and m-isomer.
 (d) All of these are correct reasons.

26. Chloropicrin is formed by the reaction of

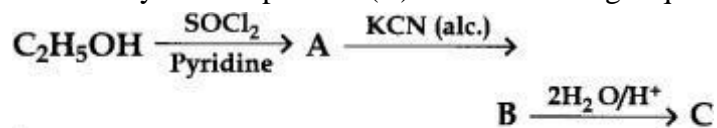
- (a) steam on carbon tetrachloride.
 (b) nitric acid on chlorobenzene.

- (c) chlorine on picric acid.
- (d) nitric acid on chloroform.

27. Fitting reaction can be used to prepare

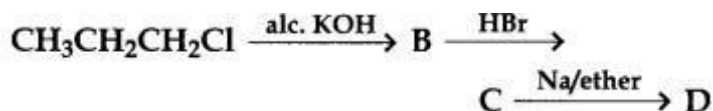
- (a) Toluene
- (b) Acetophenone
- (c) Diphenyl
- (d) Chlorobenzene

28. Identify the end product (C) in the following sequence:



- (a) $\text{C}_2\text{H}_5\text{CH}_2\text{NH}_2$
- (b) $\text{C}_2\text{H}_5\text{CONH}_2$
- (c) $\text{C}_2\text{H}_5\text{COOH}$
- (d) $\text{C}_2\text{H}_5\text{NH}_2 + \text{HCOOH}$

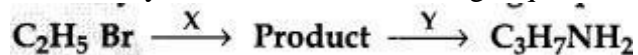
29.



In the above reaction, the product D is

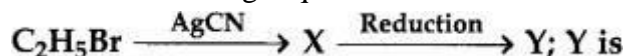
- (a) Propane
- (b) 2, 3-Dimethylbutane
- (c) Hexane
- (d) Allyl bromide

30. Identify X and Y in the following sequence



- (a) X = KCN, Y = LiAlH_4
- (b) X = KCN, Y = H_3O^+
- (c) X = CH_3Cl , Y = $\text{AlCl}_3 \text{HCl}$
- (d) X = CH_3NH_2 , Y = HNO_2

31. In the following sequence of reactions:

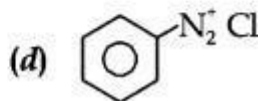
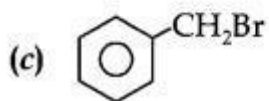
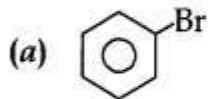


- (a) n-propylamine
- (b) isopropylamine
- (c) ethylamine
- (d) ethylmethylamine

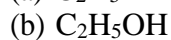
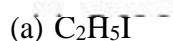
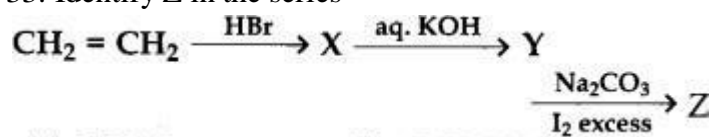
32.



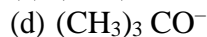
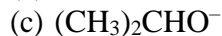
Which of the following cannot be X?



33. Identify Z in the series



34. The most reactive nucleophile among the following is



35. $\text{S}_{\text{N}}2$ reaction of alkyl halides leads to

(a) retention of configuration

(b) racemisation

(c) inversion of configuration

(d) none of these.

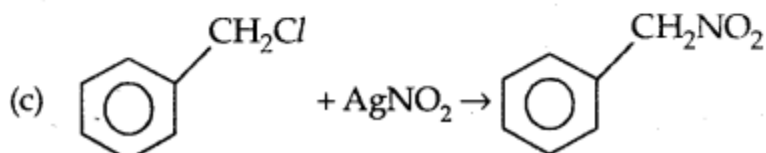
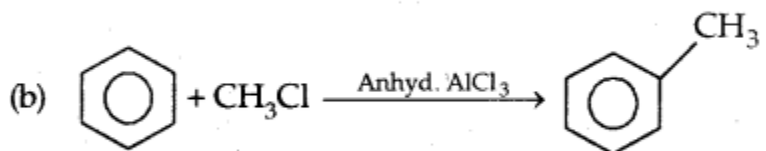
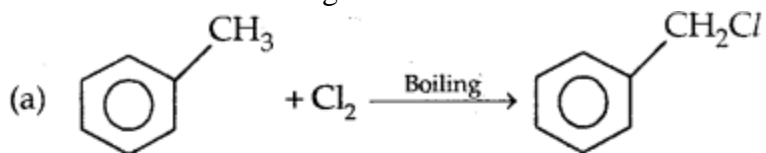
36. Nucleophilicity order is correctly represented by



37. Which of the following are arranged in the decreasing order of dipole moment?



38. Which of the following is a free radical substitution reaction?



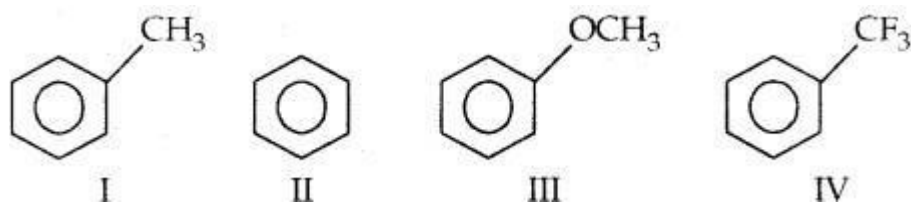
39. The reactivity order of halides for dehydrohalogenation is

- (a) $\text{RF} > \text{RCl} > \text{RBr} > \text{RI}$
- (b) $\text{RI} > \text{RBr} > \text{RCl} > \text{RF}$
- (c) $\text{RI} > \text{RCl} > \text{RBr} > \text{RF}$
- (d) $\text{RF} > \text{RI} > \text{RBr} > \text{RCl}$

40. The addition of HBr is easiest with

- (a) $\text{CH}_2 = \text{CHCl}$
- (b) $\text{ClCH} = \text{CHCl}$
- (c) $\text{CH}_3 - \text{CH} = \text{CH}_2$
- (d) $(\text{CH}_3)_2\text{C} = \text{CH}_2$

41. Among the following compounds, the decreasing order of reactivity towards electrophilic substitution is



- (a) $\text{III} > \text{I} > \text{II} > \text{IV}$
- (b) $\text{IV} > \text{I} > \text{II} > \text{III}$
- (c) $\text{I} > \text{II} > \text{III} > \text{IV}$
- (d) $\text{II} > \text{I} > \text{III} > \text{IV}$

42. Unpleasant smelling carbylamines are formed by heating alkali and chloroform with

- (a) Any aliphatic amine
- (b) Any aromatic amine
- (c) Any amine
- (d) Any primary amine

43. Which among MeX , $\text{R-CH}_2\text{X}$, R_2CHX , R_3CX is most reactive towards $\text{S}_{\text{N}}2$ reaction

- (a) MeX
- (b) RCH_2X
- (c) R_3CHX
- (d) R_3CX

44. Number of stereoisomers of the compound 2-chloro-4-methylhex-2-ene is /are

- (a) 1
- (b) 2
- (c) 4
- (d) 16

45. In chlorination of benzene, the reactive species is

- (a) Cl^+
- (b) Cl^-
- (c) Cl_2
- (d) Cl^{-2}

46. An organic compound, on treatment with Br_2 in CCl_4 gives bromo derivative of an alkene. The compound will be

- (a) $\text{CH}_3\text{-CH}=\text{CH}_2$
- (b) $\text{CH}_3\text{-CH}=\text{CH-CH}_3$
- (c) $\text{HC}\equiv\text{CH}$
- (d) $\text{H}_2\text{C}=\text{CH}_2$

47. If one H is replaced by a Cl atom in $\text{C}_4\text{H}_9\text{Cl}$, the total number of structural isomers will be

- (a) 4
- (b) 5
- (c) 7
- (d) 10

48. Anti-Markovnikov addition of HBr is not observed in

- (a) Propene
- (b) 1-Butene
- (c) But-2-ene
- (d) Pent-2-ene

49. Among the following, the molecule with the highest dipole moment is

- (a) CH_3Cl
- (b) CH_2Cl_2
- (c) CHCl_3
- (d) CCl_4

50. The number of isomers for the compound with molecular formula

C_2BrClFI is

- (a) 3
- (b) 4
- (c) 5
- (d) 6

ASSERTION REASON TYPE

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.

- (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
- (b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
- (c) If the Assertion is correct but Reason is incorrect.
- (d) If both the Assertion and Reason are incorrect.

51. **Assertion:** SN_2 reaction of an optically active aryl halide with an aqueous solution of KOH always gives an alcohol with opposite sign of rotation.

Reason: SN_2 reactions always proceed with inversion of configuration.

52. **Assertion:** Alkylbenzene is not prepared by Friedel-Crafts alkylation of benzene.

Reason: Alkyl halides are less reactive than acyl halides.

53. **Assertion:** Exposure of ultraviolet rays to human causes the skin cancer, disorder and disrupt the immune system.

Reason: Carbon tetrachloride is released into air, it rises to the atmosphere and depletes the ozone layer.

54. **Assertion:** CHCl_3 is stored in dark bottles.

Reason: CHCl_3 is oxidised in dark.

55. **Assertion:** CCl_4 is not a fire extinguisher.

Reason: CCl_4 is insoluble in water.

56. **Assertion:** Treatment of chloroethane with a saturated solution of AgCN gives ethyl isocyanide as a major product.

Reason: Cyanide ion (CN^-) is an ambident nucleophile.

57. **Assertion:** KCN reacts with methyl chloride to give methyl isocyanide.

Reason: CN^- is an ambident nucleophile.

58. **Assertion:** tert-Butyl bromide undergoes Wurtz reaction to give 2, 2, 3,3-tetramethylbutane.

Reason: In Wurtz reaction, alkyl halides react with sodium in dry ether to give hydrocarbon containing double the number of carbon atoms present in the halide.

59. **Assertion:** Presence of a nitro group at ortho or para position increases the reactivity of haloarenes towards nucleophilic substitution.

Reason: Nitro group, being an electron withdrawing group decreases the electron density over the benzene ring.

60. **Assertion:** Aryl iodides can be prepared by reaction of arenes with iodine in the presence of an oxidising agent

Reason: Oxidising agent oxidises I_2 into HI.

Answer Key:

1. C	11. C	21. B	31. D	41. A	51. D
2. B	12. C	22. A	32. A	42. D	52. C
3. A	13. D	23. A	33. C	43. A	53. B
4. A	14. D	24. B	34. A	44. C	54. C
5. A	15. B	25. B	35. B	45. A	55. D
6. A	16. A	26. D	36. C	46. C	56. B
7. A	17. B	27. C	37. B	47. D	57. D
8. C	18. A	28. C	38. A	48. C	58. A
9. C	19. C	29. B	39. B	49. A	59. A
10. D	20. D	30. A	40. D	50. D	60. C

CHAPTER -7

ALCOHOLS, ETHERS AND PHENOLS

1. Propene, $CH_3 - CH = CH_2$ can be converted to 1-propanol by oxidation. Which set of reagents among the following is ideal to effect the conversion

- (a) Alkaline $KMnO_4$ (b) B_2H_6 and alkaline H_2O_2
(c) O_3 / Zn dust (d) $OsO_4 / CH_4, Cl_2$

2. $A \xrightarrow[\text{dil. } H_2SO_4]{K_2Cr_2O_7} B \xrightarrow[H_2O]{CH_3MgI} CH_3 - \underset{\substack{| \\ OH}}{C} - CH_3$. The reactant A is

- (a) $CH_3CHOHCH_3$ (b) CH_3COCH_3
(c) C_2H_5OH (d) CH_3COOH

3. Ortho-nitrophenol is steam volatile whereas para-nitrophenol is not. This is due to

- (a) Intramolecular hydrogen bonding present in ortho-nitrophenol
(b) Intermolecular hydrogen bonding
(c) Intramolecular hydrogen bonding present in para-nitrophenol
(d) None of these

4. The strongest acid among the following aromatic compounds is

- (a) ortho-nitrophenol (b) para-chlorophenol
(c) para-nitrophenol (d) meta-nitrophenol

5. The alcohol that produces turbidity immediately with $ZnCl_2 + \text{conc. } HCl$ at room temperature

- (a) 1-hydroxybutane (b) 2-hydroxybutane
(c) 2-hydroxy-2-methylpropane (d) 1-hydroxy-2-

methylpropane

6. The compound which gives the most stable carbonium ion on dehydration is

(a) $CH_3 - CH - CH_2OH$

|
 CH_3

|
 CH_3

|

(b) $CH_3 - C - OH$

|

CH_3

(c) $CH_3 - CH_2 - CH_2 - CH_2OH$

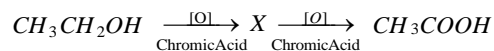
(d) $CH_3 - CH - CH_2 - CH_3$

|
 OH

7. Phenol is treated with bromine water and shaken well. The white precipitate formed during the process is

- (a) *m*-bromophenol
(b) 2, 4-dibromophenol
(c) 2, 4, 6-tribromophenol
(d) A mixture of *o*- and *p*-bromophenols

8. In the sequence of the following reactions



X is

- (a) CH_3COCH_3
(b) CH_3CHO
(c) CH_3OCH_3
(d) $\text{CH}_3\text{CH}_2\text{COOH}$

9. At low temperature phenol reacts with Br_2 in CS_2 to form

- (a) *m*-bromophenol
(b) *o*- and *p*-bromophenol
(c) *p*-bromophenol
(d) 2,4,6-tribromophenol

10. What amount of bromine will be required to convert 2 g of phenol into 2, 4, 6-tribromophenol

- (a) 4.00
(b) 6.00
(c) 10.22
(d) 20.44

11. Phenol reacts with CO_2 in presence of aqueous alkali and forms a product which on hydrolysis gives

- (a) Salicylaldehyde
(b) Salicylic acid
(c) Benzaldehyde
(d) Benzoic acid

12. In presence of NaOH , phenol react with CHCl_3 to form *o*-hydroxy benzaldehyde. This reaction is called

- (a) Riemer-Tiemann's reaction
(b) Sandmeyer's reaction
(c) Hoffmann's degradation reaction
(d) Gattermann's aldehyde

synthesis

13. Methyl-terbutyl ether on heating with HI of one molar concentration gives

- (a) $\text{CH}_3\text{I} + (\text{CH}_3)_3\text{COH}$
(b) $\text{CH}_3\text{OH} + (\text{CH}_3)_3\text{CI}$
(c) $\text{CH}_3\text{I} + (\text{CH}_3)_3\text{CI}$
(d) None of the above

14. Amongst the following, HBr reacts fastest with

- (a) Propane-1-ol
(b) Propane-2-ol
(c) 2-methyl propane-1-ol
(d) 2-methyl propane-2-ol

15. The best reagent to convert pent-3-en-2-ol into pent-3-in-2-one is

- (a) Acidic permanganate
(b) Acidic dichromate
(c) Chromic anhydride in glacial acetic acid
(d) Pyridinium chloro-chromate

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) **If both assertion and reason are true and the reason is the correct explanation of the assertion.**
- (b) **If both assertion and reason are true but reason is not the correct explanation of the assertion.**
- (c) **If assertion is true but reason is false.**
- (d) **If assertion is false but reason is true.**

16. Assertion : Phenol is more reactive than benzene towards electrophilic substitution reaction

Reason : In the case of phenol, the intermediate carbocation is more resonance stabilized

17. Assertion : Lucas reagent is a mixture of anhydrous $ZnCl_2$ and concentrate HCl

Reason : Primary alcohol produce ppt. with Lucas reagents

18. Assertion : Phenol undergo Kolbe reaction, ethanol does not.

Reason: Phenoxide ion is more basic than ethoxide ion

19. Assertion : Alcohol and phenol can be distinguished by sodium hydroxide.

Reason : Phenol is acidic while alcohol is neutral.

20. Assertion : The major products formed by heating $C_6H_5CH_2OCH_3$ with HI are $C_6H_5CH_3$ and CH_3OH .

Reason : Benzyl cation is more stable than methyl cation.

21. Assertion : Acid catalysed dehydration of *t*-butanol is slower than *n*-butanol.

Reason : Dehydration involves formation of the protonated alcohol, ROH^+ .

22. Assertion : 4-nitrophenol is more acidic than 2, 4, 6-trinitrophenol.

Reason : Phenol is a weaker acid than carbonic acid.

23. Assertion : Phenol reacts with acyl halides in presence of pyridine to form phenyl acetate.

Reason : Benzoylation of phenol is carried out in the presence of NH_4OH .

24. Assertion : Both symmetrical and unsymmetrical ethers can be prepared by Williamson's synthesis.

Reason : Williamson's synthesis is an example of nucleophilic substitution reaction.

25. Assertion : *t*-Butyl methyl ether is not prepared by the reaction of *t*-butyl bromide with sodium methoxide.

Reason : Sodium methoxide is a strong nucleophile.

Read the passage given below and answer the following questions:

An organic compound (A) having molecular formula C_6H_6O gives a characteristic colour with

aqueous FeCl_3 solution. (A) on treatment 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.

The following questions are multiple choice questions. Choose the most appropriate answer:

(26) Compound (A) is

- (a) 2-hexanol (b) dimethyl ether (c) phenol (d) 2-methyl pentanol.

(27) Number of carbon atoms in compound (D) is

- (a) 7 (b) 6 (c) 8 (d) 9

(28) The conversion of compound (A) to (C) is known as

- (a) Reimer- Tiemann reaction (b) Kolbe's reaction (c) Schimdt reaction (d) Swarts reaction

(29) Compound (A) on heating with compound (C) in presence of POCl_3 gives a compound (D) which is used

- (a) in perfumery as a flavouring agent (b) as an antipyretic (c) as an analgesic (d) as an intestinal antiseptic.

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.

The following questions are multiple choice questions. Choose the most appropriate answer:

(30) Phenols are highly acidic as compare to alcohols due to

- (a) the higher molecular mass of phenols (b) the stronger hydrogen bonds in phenols
(c) alkoxide ion is a strong conjugate base (d) phenoxide ion is resonance stabilised.

(31) The correct decreasing order of pK_a value is

- (I) m-methoxy phenol (II) p-methyl phenol (III) p-nitro phenol (IV) m-chloro phenol
(a) $\text{II} > \text{IV} > \text{I} > \text{III}$ (b) $\text{IV} > \text{II} > \text{III} > \text{I}$ (c) $\text{III} > \text{II} > \text{IV} > \text{I}$ (d) $\text{IV} > \text{I} > \text{II} > \text{III}$

32) The compound that does not liberate CO₂, on treatment with aqueous sodium bicarbonate solution is

- (a) benzoic acid (b) benzenesulphonic acid (c) salicylic acid (d) carbolic acid.

(33) Most acidic amongst the following is

- (a) o-nitro phenol (b) p-nitro phenol (c) m-nitro phenol (d) phenol

Read the passage given below and answer the following questions:

Although chlorobenzene is inert to nucleophilic substitution, however it gives quantitative yield of phenol when heated with aq. NaOH at high temperature and under high pressure. As far as electrophilic substitution in phenol is concerned the -OH group is an activating group, hence, its presence enhances the electrophilic substitution at o- and p-positions.

The following questions are multiple choice questions. Choose the most appropriate answer:

(34) Conversion of chlorobenzene into phenol involves

- (a) modified S_N1 mechanism (b) modified S_N2 mechanism
(c) both (a) and (b) (d) elimination-addition mechanism.

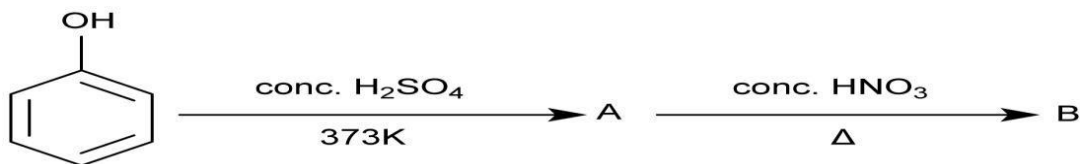
(35) Phenol undergoes electrophilic substitution more readily than benzene because

- (a) the intermediate carbo cation is a resonance hybrid of more resonating structures than that from benzene
(b) the intermediate is more stable as it has positive charge on oxygen, which can be better accommodated than on carbon
(c) in one of the canonical structures, every atom (except hydrogen) has complete octet
(d) the -OH group is o, p-directing which like all other o, p-directing group, is activating

(36) Phenol on treatment with excess of conc. HNO₃ gives

- (a) o-nitrophenol (b) p-nitrophenol
(c) o-and p-nitrophenol (d) 2,4,6-trinitrophenol

(37) The major product (B) of the following reaction is



- (a) o-nitrophenol (b) p-nitrophenol
(c) o-and p-nitrophenol (d) 2,4,6-trinitrophenol

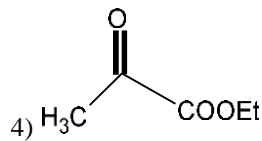
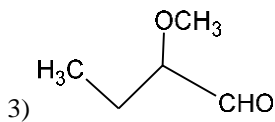
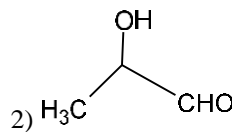
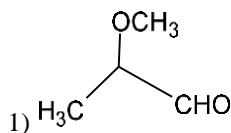
ANSWERS:

(1) b	(2) a	(3) a	(4) c	(5) c	(6) b
(7) c	(8) b	(9) b	(10) c	(11) b	(12) a
(13) b	(14) d	(15) d	(16) a	(17) c	(18) c
(19) a	(20) a	(21) d	(22) d	(23) c	(24) b
(25) b	(26) c	(27) d	(28) b	(29) d	(30) d
(31) a	(32) d	(33) b	(34) d	(35) a	(36) d
(37) d					

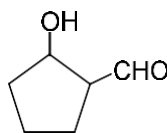
Chapter8: Aldehydes, Ketones and Carboxylic acids

Aldehydes and Ketones

1. The correct structure of the following compound is α -Methoxy propionaldehyde



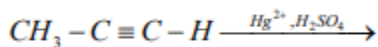
2. The correct IUPAC name of the structure



is

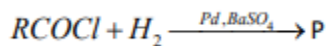
- 1) 2-Hydroxycyclopentanal
2) 2-Hydroxycyclopentane carbaldehyde
3) 4-Oxopentanal
4) 4-Fluoroacetophenone
3. The reagent to bring the transformation, Allyl alcohol to propenal is
- 1) Anhydrous CrO_3 2) DIBAL-H 3) PCC 4) $\text{O}_3/\text{H}_2\text{O}$ -Zn dust
4. The reagent to bring the transformation, But-2-ene to ethanal is
- 1) Anhydrous CrO_3 2) DIBAL-H 3) PCC 4) $\text{O}_3/\text{H}_2\text{O}$ -Zn dust

5. The product in the following reaction is



- 1) Acetaldehyde 2) Aceto phenone 3) Acetone 4) Butanone
6. Which of the following reactions will give benzophenone?
- (i) Benzoyl chloride + Benzene + AlCl_3 (ii) Benzoyl chloride + Phenylmagnesium bromide
(iii) Benzoyl chloride + Diphenyl cadmium
- 1) (i) and (ii) 2) (ii) and (iii) 3) (i) and (iii) 4) (i), (ii) and (iii)

7. In the following reaction, product (P) is

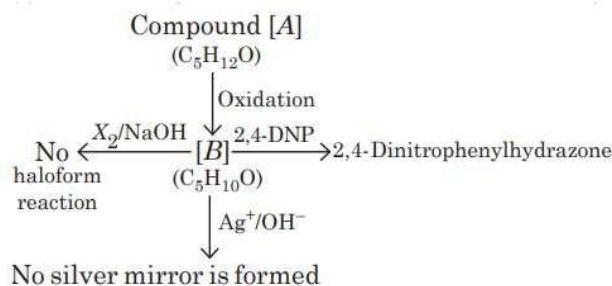


- 1) RCHO 2) RCH_3 3) RCOOH 4) RCH_2OH
8. The compound with lowest boiling point is
- 1) CH_3CHO 2) $\text{CH}_3\text{CH}_2\text{OH}$ 3) CH_3OCH_3 4) $\text{CH}_3\text{CH}_2\text{CH}_3$
9. Assertion: Benzaldehyde to be more reactive in nucleophilic addition reactions than propanal.
Reason: The carbon atom of the carbonyl group of benzaldehyde is less electrophilic than carbon atom of the carbonyl group present in propanal.
- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false 4) (A) is false, but (R) is true
10. Identify incorrect statement about reactivity of carbonyl compounds.
- 1) The polarity of the carbonyl group is increased in benzaldehyde due to resonance
2) the presence of two relatively large substituents in ketones hinders the approach of nucleophile
3) The hybridisation of carbon changes from sp^2 to sp^3 during nucleophilic addition
4) The position of the equilibrium formed during reaction with bisulphite lies largely to the righthand side for most aldehydes and to the left for most ketones due to steric reasons.
11. The compound which is most reactive in nucleophilic addition reaction is
- 1) Benzaldehyde 2) p-Tolualdehyde 3) p-Nitrobenzaldehyde 4) Acetophenone

12. Arrange the following compounds in increasing order of their reactivity in nucleophilic addition reactions.
Ethanal, Propanal, Propanone, Butanone
- 1) Butanone < Propanone < Propanal < Ethanal 2) Propanone < Butanone < Ethanal > Propanal
3) Propanal < Ethanal < Propanone < Butanone 4) Ethanal < Propanal < Propanone < Butanone
[Hint: Electron deficiency at C=O carbon (electrophilicity) and Steric factors]
13. Which among the following is most reactive to give nucleophilic addition?
1) FCH₂CHO 2) ClCH₂CHO 3) BrCH₂CHO 4) ICH₂CHO
[Hint: Electron deficiency at C=O carbon (electrophilicity) and Electronegativity of halogen]
14. Formaldehyde reacts with methyl magnesium bromide followed by hydrolysis to form
1) Methanol 2) Ethanol 3) Propanol 4) Butanol
15. Predict the product of the following reaction:

$$\text{CH}_3 - \overset{\text{O}}{\parallel}{\text{C}} - \text{CH}_3 \xrightarrow{(i)\text{NH}_2 - \text{NH}_2; (ii)\text{KOH} / \text{Glycol}, \Delta} ?$$
 1) CH₃CH₂CH₃ 2) CH₃CHOHCH₃
3) CH₃CH₂CHO 4) CH₃CONHCH₃ [Hint: Wolf-Kishner reduction]
16. The reaction of carbonyl compounds with ammonia derivatives gives N-substituted derivatives. Find the incorrect match of product.
1) Ammonia-Imine 2) Hydroxylamine-Hydrazone
3) 2,4-DNP-2,4-DN phenyl hydrazone 4) Semi carbazide-semi carbazone
17. Which of the following compounds will give butanone on oxidation with alkaline KMnO₄ solution?
1) Butan-1-ol 2) Butan-2-ol 3) But-1-ene 4) But-2-ene
18. Assertion (A): Oxidation of ketones is easier than aldehydes
Reason (R): C-C bond of ketones is stronger than C-H bond of aldehydes
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false 4) (A) is false, but (R) is true
19. In Clemmensen reduction, carbonyl compound is treated with _____.
1) zinc amalgam + HCl 2) sodium amalgam + HCl
3) Phenyl hydrazine, glycol 4) Dil. NaOH
20. Hydrocarbons are formed when aldehydes and ketones are reacted with Hydrazine, KOH and Glycol. The reaction is called
1) Cannizzaro reaction 2) Clemmensen reduction 3) Rosenmund reduction 4) Wolf-Kishner reduction
21. Which of the following reagents are not correctly matched with the reaction?
1) CH₃CH=CHCHO → CH₃CH=CHCOOH: Ammonical AgNO₃
2) CH₃CH=CHCHO → CH₃CH=CHCH₂OH: H₂/Pt
3) R-COOH → R-CH₂OH: NaBH₄
4) CH₃CH₂COCℓ → CH₃CH₂CHO: H₂, Pd/BaSO₄
22. Assertion (A): Aromatic aldehydes and formaldehyde undergo Cannizzaro reaction.
Reason (R): Aromatic aldehydes and formaldehyde do not have alpha hydrogen atoms
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false 4) (A) is false, but (R) is true
23. Which of the following will not give aldol condensation?
1) Phenyl acetaldehyde 2) 2-Methylpentanal 3) Benzaldehyde 4) 1-Phenylpropanone
24. The reagent used to distinguish acetaldehyde and benzaldehyde is
1) Sodium hydrogen sulphite 2) Phenyl hydrazine
3) Fehling's solution 3) Tollen's reagent
25. Assertion (A): Aldehydes and ketones, both react with Tollen's reagent to form silver mirror.
Reason (R): Both aldehydes and ketones contain a carbonyl group
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).

34. Study the given reactions chart carefully:



Which is correct for compounds A and B?

- | | |
|---------------------------|-----------------------------------------|
| 1) B is an aldehyde. | 2) B is a ketone but not methyl ketone. |
| 3) A is a primary alcohol | 4) B convert to A using Zn-Hg/HCl |

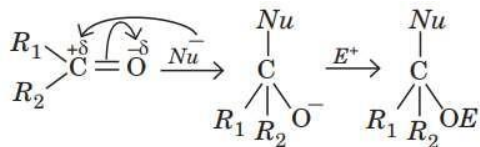
Passage-1: Read the passage given below and answer the following questions:

Aldehydes, ketones and carboxylic acids are few of the major classes of organic compounds containing carbonyl group. Aldehydes are prepared by dehydrogenation or controlled oxidation of primary alcohols and controlled or selective reduction of acyl halides. Ketones are prepared by oxidation of secondary alcohols and hydration of alkynes. Carboxylic acids are prepared by the oxidation of primary alcohols, aldehydes and alkenes by hydrolysis of nitriles and by treatment of Grignard reagents with carbon dioxide.

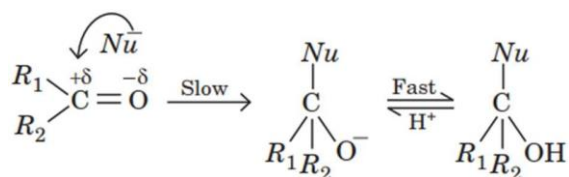
35. Name a method by which both aldehydes and ketones can be prepared.
- | | |
|----------------------------------|--------------------------|
| 1) Reduction of carboxylic acids | 2) Ozonolysis of alkenes |
| 3) Oxidation of alcohols | 4) All of the above |
36. Which of the following reaction do not give benzaldehyde as the product?
- | | |
|----------------------------------|-----------------------------------------------------|
| 1) Etard reaction | 2) Rosenmund's reduction |
| 3) Hydrolysis of Benzal chloride | 4) Oxidation of Methyl benzene with KMnO_4 |
37. Through which of the following reactions number of carbon atoms can be increased in the chain?
- | | | | |
|----------------------|------------------------|-------------------------|-----------------|
| 1) Grignard reaction | 2) Cannizzaro reaction | 3) Clemmenson reduction | 4) HVZ reaction |
|----------------------|------------------------|-------------------------|-----------------|
38. In the preparation of Benzaldehyde by Gattermann-Koch reaction, the reagent used is
- | | | | |
|--------------------------|-----------------------------------|--------------------------------------------|-----------------------------------|
| 1) CO-HCl, NaCl | 2) $\text{CO-HCl; Anhyd. AlCl}_3$ | 3) $\text{CO}_2\text{-HCl; Anhyd. AlCl}_3$ | 4) $\text{CO}_2\text{-HCl; NaOH}$ |
|--------------------------|-----------------------------------|--------------------------------------------|-----------------------------------|
39. Ethane nitrile on reaction with Phenyl magnesium bromide followed by hydrolysis yields
- | | | | |
|-----------------|-----------------|------------------|------------|
| 1) Benzaldehyde | 2) Benzophenone | 3) Aceto phenone | 4) Acetone |
|-----------------|-----------------|------------------|------------|

Passage-2: Read the passage given below and answer the following questions:

Aldehydes and ketones undergo nucleophilic addition reactions.



Carbonyl carbon is electron deficient hence acts as an electrophile. Nucleophile attacks on the electrophilic carbon atom of the carbonyl group from a direction perpendicular to the plane of the molecule.



In this process, hybridisation of carbon atom changes from sp^2 to sp^3 and a tetrahedral alkoxide ion is formed as intermediate. This intermediate captures a proton from the reaction medium to give the neutral product. Aldehydes are generally more reactive than ketones in nucleophilic addition reactions.

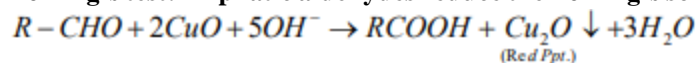
40. Aldehydes other than formaldehyde react with Grignard's reagent to give addition products which on hydrolysis give
 1) tertiary alcohols 2) secondary alcohols 3) primary alcohols 4) Alkanes
41. Which of the following compounds will undergo Cannizzaro reaction?
 1) CH_3CHO 2) CH_3COCH_3 3) C_6H_5CHO 4) $C_6H_5CH_2CHO$
42. Propanal on treatment with dilute sodium hydroxide gives
 1) $CH_3CH_2CH_2CH_2CH_2CHO$ 2) $CH_3CH_2CH(OH)CH_2CH_2CHO$
 3) $CH_3CH_2CH(OH)CH(CH_3)CHO$ 4) CH_3CH_2COOH
43. Various products formed on oxidation of 2,5-dimethylhexan-3-one are
 (i) $CH_3CH(CH_3)COOH$ (ii) $CH_3CH(CH_3)CH_2COOH$ (iii) CH_3COOH (iv) $HCOOH$
 1) (i) and (iii) 2) (i), (ii) and (iii) 3) (i), (ii), (iii) and (iv) 4) (iii) and (iv)
 [Hint: When 2,5-dimethylhexan-3-one undergoes oxidation according to Popoff's rule, the products obtained are 2-methylpropanoic acid, acetic acid and CO_2 .]
44. Assertion: Benzaldehyde is more reactive than ethanal towards nucleophilic attack.
 Reason: The overall effect of $-I$ and $+R$ effect of phenyl group decreases the electron density on the carbon atom of $C=O$ group in benzaldehyde.
 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
 2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 3) (A) is true, but (R) is false 4) (A) is false, but (R) is true

Passage-3: Read the following passage and answer the questions given below:

Test for Aldehydes and Ketones:

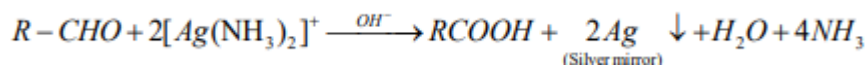
(i) Both give iodoform test when one α -hydrogen is present.

(ii) Fehling's test: Aliphatic aldehydes reduce the Fehling's solution to red cuprous oxide.



Aromatic aldehydes do not respond to this test.

(iii) Ketones are not oxidised by Tollen's reagent. Aldehydes form silver mirror with ammoniacal silver nitrate (Tollen's reagent) solution.



45. Which of the following statements is incorrect?
 1) $FeCl_3$ is used in the detection of phenols.
 2) Fehling solution is used in the detection of glucose.
 3) Tollens' reagent is used in the detection of unsaturation.
 4) $NaHSO_3$ is used in the detection of carbonyl compounds.
46. Which of the following compounds will give a coloured crystalline compound with 2,4-DNP?
 1) CH_3COCl 2) $CH_3COOC_2H_5$ 3) CH_3COCH_3 4) CH_3CONH_2
47. How will you distinguish between aldehydes and ketones?
 1) Fehling's test 2) Lucas test 3) Iodoform test 4) Hinsberg reagent
48. To differentiate between pentan-2-one and pentan-3-one a test is carried out. Which of the following is the correct answer?
 1) Pentan-2-one will give silver mirror test 2) Pentan-2-one will give iodoform test.
 3) Pentan-3-one will give iodoform test 4) Pentan-3-one will give Fehling's test
49. Assertion: Methyl Ketones can be converted into acids by haloform reaction.
 Reason: Addition of Grignard reagents to $HCHO$ followed by hydrolysis gives Primary Alcohols.
 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
 2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 3) (A) is true, but (R) is false

4) (A) is false, but (R) is true

SUBJECTIVE QUESTIONS:

50. In industry aldehydes are being prepared by controlled oxidation of primary alcohol using acidified $K_2Cr_2O_7$ or aqueous or alkaline $KMnO_4$ as oxidant. Mohan suggested the owner of factory to use Collin's reagent instead of acidic potassium dichromate. The yield of factory increased sharply.

Now answer the following questions:

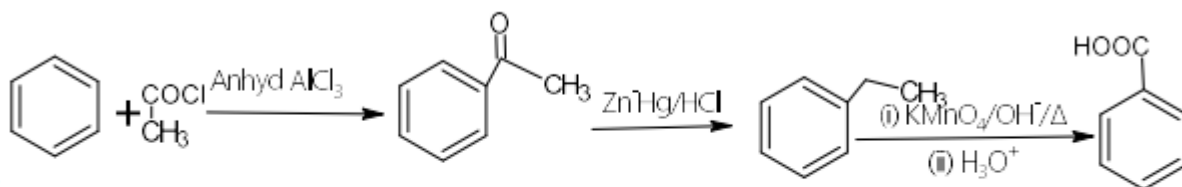
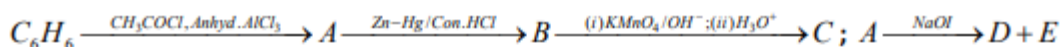
(i) What is Collin's reagent?

(ii) What are the advantages of using Collin's reagent over conventional oxidising agent?

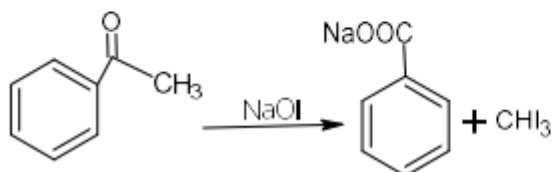
ANS: (i) Collin's reagent is a mixture of pyridine (C_5H_5N) and CrO_3 in dichloromethane (CH_2Cl_2).

(ii) Collin's reagent is a mild oxidant. It oxidises 1° -alcohols to aldehydes and 2° -alcohols are oxidised to ketones. In case of using acidic $K_2Cr_2O_7$ as oxidant, the aldehydes and ketones formed by the oxidation of alcohols undergo oxidation to give carboxylic acids

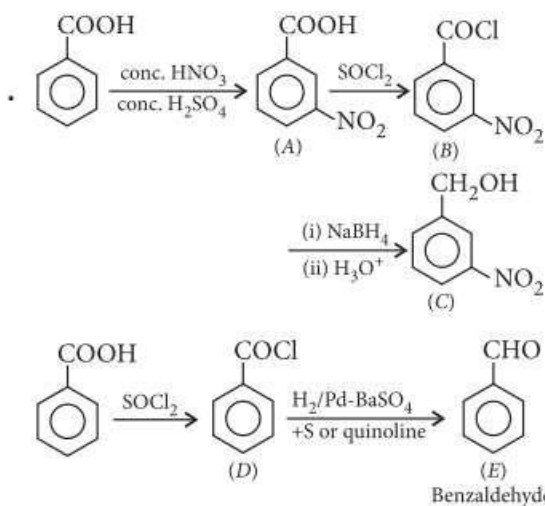
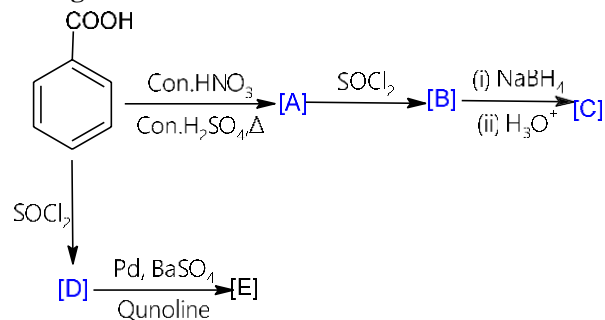
51. Write the structures of A, B, C, D and E in the following reactions:



ANS:



52. Identify A to E in the following reactions:



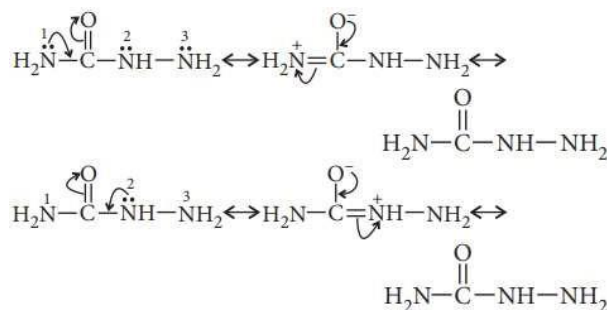
ANS:

53. Give a plausible explanation for each one of the following:

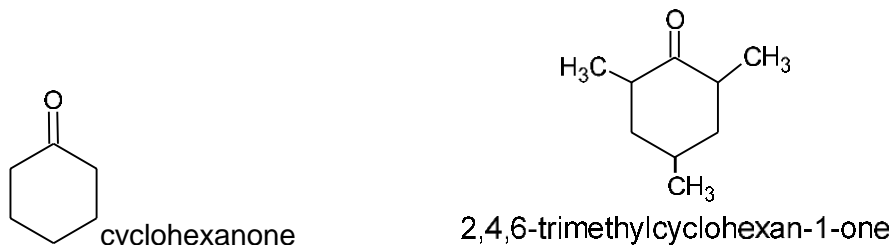
(i) There are two $-\text{NH}_2$ groups in semicarbazide. However, only one such group is involved in the formation of semicarbazones.

(ii) Cyclohexanone forms cyanohydrin in good yield but 2,4,6-trimethylcyclohexanone does not.

ANS: (i) Semicarbazide has the following resonance structures arising due to the electron withdrawing nature of the O atom. Lone pairs of N-1 and N-2 are involved in conjugation with C O group while that of N-3 is not involved in resonance thus, it is involved in the formation of semicarbazone.



(ii) Formation of cyanohydrin involves the nucleophilic attack of cyanide ions (CN^-) at the carbonyl carbon. In cyclohexanone, reaction proceeds but in 2,4,6-trimethylcyclohexanone, the methyl groups cause steric hindrance and yields are poor.

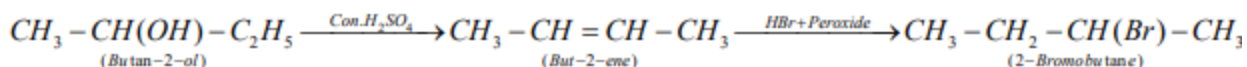
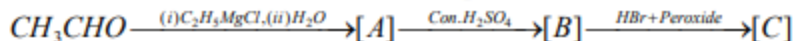


54. An organic compound with molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms 2,4-DNP derivative, reduces Tollens' reagent and undergoes Cannizzaro reaction. On vigorous oxidation it gives 1,2-benzene-dicarboxylic acid. Identify the compound.

ANS: The compound forms 2,4-DNP derivative. It shows that it is a carbonyl compound. Further it reduces Tollens' reagent which shows that it contains aldehydic group. It undergoes Cannizzaro reaction indicating that aldehyde group is without any α -hydrogen. On vigorous oxidation, it gives 1,2-benzenedicarboxylic acid which shows that there are two carbon residues on benzene ring. Since the molecular formula is $\text{C}_9\text{H}_{10}\text{O}$, it fits into the structure, 2-ethylbenzaldehyde.



55. Identify A, B and C in the following sequence of reactions:

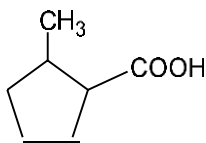


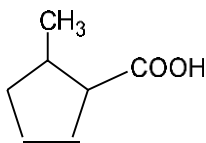
56. Explain: The reaction of carbonyl compound with pure HCN is very slow and becomes fast in presence of a base

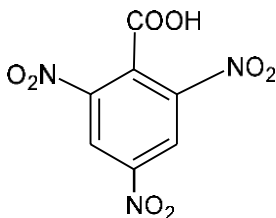
ANS: With pure HCN reaction occurs very slowly because it is a weak nucleophile. With base it produces CN^- ion which is a strong nucleophile and readily adds to the carbonyl compound

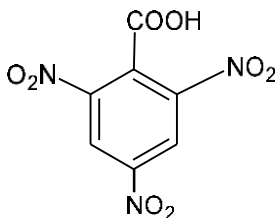
Carboxylic acids

1. Common name of Ethane-1,2-dioic acid is known as:
1) Oxalic acid 2) Phthalic acid 3) Adipic acid 4) Acetic acid
2. Which of the following IUPAC names is not correctly matched?



- 1)  : 3-Cyclo pentyl propanoic acid
2) $(\text{CH}_3)_2\text{C}=\text{CHCOOH}$: 3-Methyl but-2-enoic acid
3) $\text{PhCH}_2\text{CH}_2\text{COOH}$: 3-Phenyl propanoic acid



- 4)  : 2,4,6-Trinitro benzoic acid

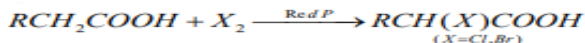
3. Which of the following will have highest boiling point?
1) CH_3CHO 2) CH_3COOH 3) CH_3COCH_3 4) $\text{CH}_3\text{CH}_2\text{OH}$
4. Assertion: Hydrogen bonding in carboxylic acids is stronger than alcohols.
Reason: Highly branched carboxylic acids are more acidic than unbranched acids.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
5. Assertion: Acetic acid in vapour state shows a molecular mass of 120.
Reason: It undergoes dimerization through intermolecular hydrogen bonding.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
6. Assertion: Carboxylic acids have higher boiling points than alkanes, alcohols and aldehydes
Reason: Carboxylic group is resonance stabilized by two equivalent resonating structures.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
7. Assertion: Nitration of benzoic acid gives m-nitrobenzoic acid as major product
Reason: Carboxyl group increases the electron density at the meta-position
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
8. Assertion (A): Benzoic acid is less reactive than benzene towards electrophilic substitution reactions.
Reason (R): The carboxyl group is activating group and undergo electrophilic substitution reaction.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true

9. Assertion (A): Aromatic carboxylic groups do not undergo Friedel-Crafts reaction.
Reason (R): Carboxyl group is deactivating and the catalyst aluminium chloride gets bonded to the carboxyl group.
- Both (A) and (R) are true, and (R) is the correct explanation of (A)
 - Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 - (A) is true, but (R) is false
 - (A) is false, but (R) is true
10. Carboxylic acids do not undergo Friedel-Craft's reaction because
- COOH group is meta directing
 - COOH group is resonance stabilised
 - carboxyl group is deactivating and gets bonded to Friedel-Craft's catalyst
 - all of above.
11. The carboxylic acid that does not undergo HVZ reaction is:
- CH₃COOH
 - (CH₃)₂CHCOOH
 - CH₃CH₂CH₂CH₂COOH
 - (CH₃)₃CCOOH
12. Which of the following will undergo HVZ reaction?
- Benzoic acid
 - Ethanoic acid
 - Methanoic acid
 - 2,2-Dimethylpropanoic acid
13. Which of the following acids does not form anhydride?
- Formic acid
 - Acetic acid
 - Propionic acid
 - n-butyric acid
14. The reaction in which the aqueous solution of sodium salt of carboxylic acids on electrolysis give alkanes:
- Soda lime decarboxylation
 - Kolbe's electrolysis decarboxylation
 - Dry distillation of calcium carboxylates
 - Reduction of carboxylic acid
15. Which of the following statements is correct regarding formic acid (Methanoic acid)?
- It is a reducing agent.
 - It is a weaker acid than acetic acid.
 - It is an oxidising agent.
 - Its calcium salt on heating forms acetone
16. What happens when a carboxylic acid is treated with lithium aluminium hydride?
- Aldehyde is formed
 - Primary alcohol is formed
 - Ketone is formed
 - Grignard reagent is formed.
17. The final product in the given reaction is: $CH_3COCH_3 \xrightarrow{I_2, NaOH} [A] \xrightarrow{H^+, NH_3} [B] \xrightarrow{\Delta} [C]$
- CH₃CH₂CN
 - CH₃CH₂CONH₂
 - CH₃CONH₂
 - CH₃COONH₄
- (A) + C₂H₅OH → (B) + (C); (C) + HOH $\xrightarrow{H^+}$ (B) + (D); (D) $\xrightarrow{(\omega)}$ (B);
(B) + Ca(OH)₂ → Ca salt + H₂O; Ca Salt $\xrightarrow{dry\ distillation}$ CH₃COCH₃ (Acetone). (A), (B), (C) and (D) in the above set of reactions are
- | | (A) | (B) | (C) | (D) |
|---|-------------------------------------|----------------------|--------------------------------------------------|----------------------------------|
| 1 | (CH ₃ CO) ₂ O | CH ₃ COOH | CH ₃ COOC ₂ H ₅ | C ₂ H ₅ OH |
| 2 | CH ₃ COCl | HCOOH | CH ₃ COOCH ₃ | CH ₃ OH |
| 3 | CH ₃ COOH | CH ₃ OH | CH ₃ COOCH ₃ | CH ₃ OH |
| 4 | CH ₃ NH ₂ | CH ₃ COOH | CH ₃ COOCH ₃ | CH ₃ OH |
19. Which of the following is the strongest acid?
- Acetic acid
 - Phenol
 - Methyl alcohol
 - Water
20. Assertion: m-Chlorobenzoic acid is a stronger acid than p-chlorobenzoic acid.
Reason: In m-chlorobenzoic acid both – I-effect and +R-effect of Cl operate but in p-chlorobenzoic acid only +R-effect of Cl operates.
- Both (A) and (R) are true, and (R) is the correct explanation of (A)
 - Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 - (A) is true, but (R) is false
 - (A) is false, but (R) is true
21. Assertion: Formic acid is a stronger acid than benzoic acid.
Reason: pKa of formic acid is lower than that of benzoic acid.
- Both (A) and (R) are true, and (R) is the correct explanation of (A)
 - Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 - (A) is true, but (R) is false
 - (A) is false, but (R) is true

22. Assertion: o-Substituted benzoic acids are generally stronger acids than benzoic acids.
Reason: Increased strength is due to ortho-effect by any group present at ortho position.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
23. Assertion (A): Carboxylic acids are more acidic than phenols.
Reason (R): -OH group in Phenols is ortho and para directing.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true

Passage-1: Read the passage given below and answer the following questions:

Carboxylic acids having an α -hydrogen atom when treated with chlorine or bromine in the presence of small amount of red phosphorus gives α -halo carboxylic acids. The reaction is known as Hell-Volhard-Zelinsky reaction.

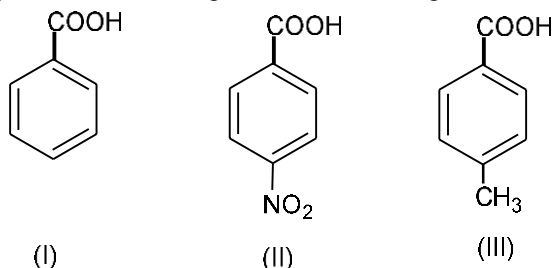


When sodium salt of carboxylic acid is heated with soda lime it loses carbon dioxide and gives hydrocarbon with less number of C-atoms.



24. Assertion (A): $(CH_3)_3CCOOH$ does not give H.V.Z. reaction. Reason (R): $(CH_3)_3CCOOH$ does not have α -hydrogen atom
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
25. Assertion (A): H.V.Z. reaction involves the treatment of carboxylic acids having α -hydrogens with Cl_2 or Br_2 in presence of small amount of red phosphorus.
Reason (R): Phosphorus reacts with halogens to form phosphorus trihalides.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
26. Assertion (A): $C_6H_5COCH_2COOH$ undergoes decarboxylation easily than $C_6H_5COCO_2H$.
Reason (R): $C_6H_5COCH_2COOH$ is a β -keto acid.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
27. Assertion (A): On heating 3-methylbutanoic acid with soda lime, isobutane is obtained.
Reason (R): Soda lime is a mixture of NaOH + CaO in the ratio 3:1.
1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
28. The correct order of increasing acidic strength is
1) Phenol < Ethanol < Chloroacetic acid < Acetic acid
2) Ethanol < Phenol < Chloroacetic acid < Acetic acid
3) Ethanol < Phenol < Acetic acid < Chloroacetic acid
4) Chloroacetic acid < Acetic acid < Phenol < Ethanol
29. Which of the following is the correct order of relative strength of acids?
1) $ClCH_2COOH > BrCH_2COOH > FCH_2COOH$ 2) $BrCH_2COOH > ClCH_2COOH > FCH_2COOH$
3) $FCH_2COOH > ClCH_2COOH > BrCH_2COOH$ 4) $ClCH_2COOH > FCH_2COOH > BrCH_2COOH$

30. Arrange the following compounds in increasing order of acid strength



- 1) (i) > (ii) > (iii) 2) (ii) < (i) < (iii) 3) (iii) < (i) < (ii) 4) (iii) > (i) > (ii)

31. -OH group present in alcohols is neutral while it is acidic in carboxylic acid because

- 1) in carboxylic acid -OH group is attached to electron withdrawing carbonyl group
- 2) in alcohols -OH group is attached to alkyl group which is electron withdrawing
- 3) carboxylic group is an electron releasing group
- 4) alcoholic group is an electron withdrawing group.

32. Which of the following orders is not correct for the decreasing order of acidic character?

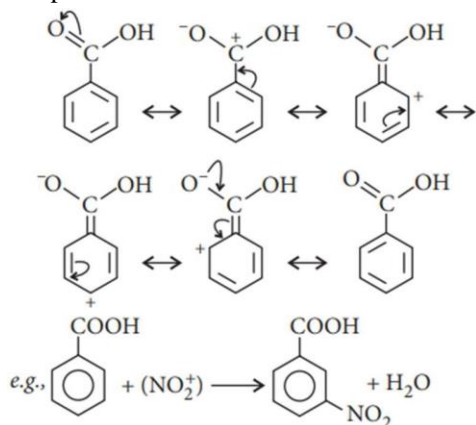
- 1) $\text{CH}_3\text{CH}_2\text{CH}(\text{Cl})\text{COOH} > \text{CH}_3\text{CH}(\text{Cl})\text{CH}_2\text{COOH} > \text{CH}_2(\text{Cl})\text{CH}_2\text{CH}_2\text{COOH} > \text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
- 2) $\text{ICH}_2\text{COOH} > \text{BrCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{FCH}_2\text{COOH}$
- 3) $\text{CCl}_3\text{COOH} > \text{CHCl}_2\text{COOH} > \text{CH}_2\text{ClCOOH} > \text{CH}_3\text{COOH}$
- 4) $\text{HCOOH} > \text{CH}_3\text{COOH} > \text{C}_2\text{H}_5\text{COOH} > (\text{CH}_3)_2\text{CHCOOH}$

SUBJECTIVE QUESTIONS:

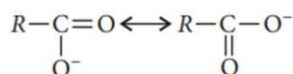
33. Give reasons:

- (i) Electrophilic substitution in benzoic acid takes place at meta-position.
- (ii) Carboxylic acids do not give the characteristic reactions of carbonyl group.
- (iii) pKa value of 4-nitrobenzoic acid is lower than that of benzoic acid.

ANS: . (i) Electrophilic substitution in benzoic acid takes place at meta-position. Due to resonance in benzoic acid, there is high electron density at meta-position. Therefore, electrophilic substitution in benzoic acid takes place at meta-position.



(ii) The carbonyl group in -COOH is inert and does not show nucleophilic addition reaction like carbonyl compound. It is due to resonance stabilization of carboxylate ion :



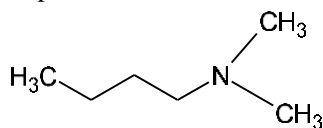
(iii) Due to presence of strong electron withdrawing group (-NO₂), 4-nitrobenzoic acid is more acidic than benzoic acid and therefore, pKa value is lower.

34. Which acid of each pair shown here would you expect to be stronger and why?

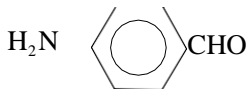
- (i) $\text{F}-\text{CH}_2-\text{COOH}$ or $\text{Cl}-\text{CH}_2-\text{COOH}$ (ii) Phenol or CH_3COOH

Chapter 9: Amines

1. Write IUPAC name of the following compound:

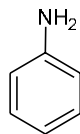


- 1) N,N-Dimethylpropanamine
2) 1,1-Dimethylbutanamine
3) N-Methylpentan-1-amine
4) N,N-Dimethylbutan-1-amine
2. The correct IUPAC name for $\text{CH}_2=\text{CHCH}_2\text{NHCH}_3$ is:
- 1) Allyl methyl amine
2) 2-amino-4-pentene
3) 4-aminoprop-1-ene
4) N-methylprop-2-en-1-amine

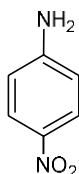


3. IUPAC name of
- 1) 4-amino benzene carbaldehyde
2) O-amino benzaldehyde
3) 3- amino benzaldehyde
4) 4- formylamine
4. Which of the following is a 3° amine?
- 1) 1-methylcyclohexylamine
2) Triethylamine
3) tert-butylamine
4) N-methylaniline
5. The compound 2-methylpropan-2-amine is isomeric with
- 1) N, N-dimethyl ethanamine
2) 2-methylpropan-1-amine
3) N-Ethyl ethanamine
4) All of the above
6. CH_3CONH_2 on reaction with NaOH and Br_2 in alcoholic medium gives:
- 1) $\text{CH}_3\text{CH}_2\text{NH}_2$
2) $\text{CH}_3\text{CH}_2\text{Br}$
3) CH_3NH_2
4) CH_3COONa
7. Propanamide on reaction with bromine in aqueous NaOH gives:
- 1) Propanamine
2) Ethanamine
3) N-Methyl ethanamine
4) Propanenitrile
8. The best reagent for converting 2-phenylpropanamide into 2-phenylpropanamine is _____.
- 1) excess H_2
2) Br_2 in aqueous NaOH
3) Iodine in the presence of red phosphorus
4) LiAlH_4 in ether
9. Benzoic acid is treated with SOCl_2 and the product (X) formed is reacted with ammonia to give (Y). (Y) on reaction with Br_2 and KOH gives (Z). (Z) in the reaction is
- 1) aniline
2) chlorobenzene
3) benzamide
4) benzoyl chloride.
10. Which one of the following reagents would not be a good choice for reducing an aryl nitro compound to an amine?
- 1) $\text{H}_2(\text{excess})/\text{Pt}$
2) LiAlH_4 in ether
3) Fe and HCl
4) Sn and HCl
11. The best method for preparing primary amines from alkyl halides without changing the number of carbon atoms in the chain is:
- 1) Hoffmann Bromamide reaction
2) Gabriel phthalimide synthesis
3) Sandmeyer reaction
4) Reaction with NH_3
12. Which of the following amines can be prepared by Gabriel synthesis?
- 1) Isobutyl amine
2) Toluene
3) N-methylbenzylamine
4) Aniline
13. Assertion (A): Aromatic 1° amines can be prepared by Gabriel Phthalimide synthesis.
Reason (R): Aryl halides do not undergo nucleophilic substitution with anion formed by phthalimide.
- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true
14. Amongst the given set of reactants, the most appropriate for preparing 2° amine is
- 1) $2^\circ \text{R}-\text{Br} + \text{NH}_3$
2) $2^\circ \text{R}-\text{Br} + \text{NaCN}$ followed by H_2/Pt

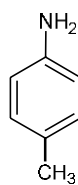
- 3) $1^\circ \text{R}-\text{NH}_2 + \text{RCHO}$ followed by H_2/Pt
 4) $1^\circ \text{R}-\text{Br}$ (2 moles) + potassium phthalimide followed by $\text{H}_3\text{O}^+/\text{heat}$.
15. Assertion (A): Solubility of amines in water decreases with increase in molar mass.
 Reason (R): Intermolecular H bonds formed by the higher amines are weaker.
- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
 2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 3) (A) is true, but (R) is false
 4) (A) is false, but (R) is true
16. The correct order of boiling points of the following isomeric amines is $\text{C}_4\text{H}_9\text{NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, $\text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2$
- 1) $\text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2 > (\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_4\text{H}_9\text{NH}_2$
 2) $(\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2 > \text{C}_4\text{H}_9\text{NH}_2$
 3) $\text{C}_4\text{H}_9\text{NH}_2 > (\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2$
 4) $(\text{C}_2\text{H}_5)_2\text{NH} > \text{C}_4\text{H}_9\text{NH}_2 > \text{C}_2\text{H}_5\text{N}(\text{CH}_3)_2$
17. Tertiary amines have lowest boiling points amongst isomeric amines because
- 1) they have highest molecular mass
 2) they do not form hydrogen bonds
 3) they are more polar in nature
 4) they are most basic in nature
18. Which of the following should be most volatile?
- (i) $\text{CH}_3\text{CH}_2\text{NH}_2$ (ii) $(\text{CH}_3)_3\text{N}$ (iii) $\text{CH}_3\text{CH}_2\text{NHCH}_3$ (iv) $\text{CH}_3\text{CH}_2\text{CH}_3$
- 1) (ii) 2) (iv) 3) (i) 4) (iii)
19. The shape of $(\text{CH}_3)_3\text{N}$ is pyramidal because
- 1) nitrogen forms three sp^3 hybridised sigma bonds with carbon atoms of methyl groups and there is one non-bonding electron pair
 2) nitrogen forms three sp^2 hybridised sigma bonds with carbon atoms of methyl groups and fourth orbital forms pi bond
 3) nitrogen has five valencies which are arranged in pyramidal shape.
 4) the unpaired electron present on nitrogen is delocalised.
20. The correct increasing order of basic strength for the following compounds is _____.



(I)



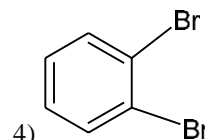
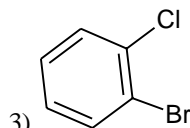
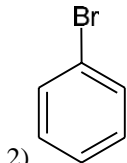
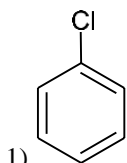
(II)



(III)

- 1) II < III < I 2) III < I < II 3) III < II < I 4) II < I < III A
21. Aniline is a resonance hybrid of:
- 1) 3 resonating structures
 2) 6 resonating structures
 3) 2 resonating structures
 4) 5 resonating structures
22. Basic strength of different alkyl amines depends upon
- 1) +I effect 2) steric effect 3) solvation effect 4) all of these
23. Methylamine reacts with HNO_2 to form _____.
- 1) $\text{CH}_3-\text{O}-\text{N}=\text{O}$ 2) $\text{CH}_3-\text{O}-\text{CH}_3$ 3) CH_3OH 4) CH_3CHO
24. The gas evolved when methylamine reacts with nitrous acid is:
- 1) NH_3 2) N_2 3) H_2 4) C_2H_6
25. Which of the following species are involved in the carbylamine test?
- 1) $\text{R}-\text{NC}$ 2) COCl_2 3) $\text{NaNO}_2 + \text{HCl}$ 4) All of the above
26. Which of the following amines will give carbylamine reaction?
- 1) $(\text{C}_2\text{H}_5)_3\text{N}$ 2) $(\text{C}_2\text{H}_5)_2\text{NH}$ 3) $\text{C}_2\text{H}_5\text{NH}_2$ 4) $\text{C}_3\text{H}_7\text{NHC}_2\text{H}_5$
27. Assertion (A): Acylation of amines gives a monosubstituted product whereas alkylation of amines gives poly substituted product.
 Reason (R): Acyl group sterically hinders the approach of further acyl groups.
- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
 2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 3) (A) is true, but (R) is false
 4) (A) is false, but (R) is true

28. Why is the activating effect of $-\text{NHCOCH}_3$ group in the above reaction less than the activating effect of amino group?
- 1) Due to mesomeric effect of benzene ring
 - 2) Due to inductive effect of alkyl group
 - 3) Due to resonance effect of acetanilide
 - 4) Due to electromeric effect of alkyl group
29. Which of the following can exist as zwitter ion?
- 1) p-Aminoacetophenone
 - 2) Sulphanilic acid
 - 3) p-Nitroaminobenzene
 - 4) p-Methoxyphenol
30. The reaction of benzenesulphonyl chloride with ethylamine yields
- 1) N-ethylbenzenesulphonamide, insoluble in alkali
 - 2) N, N-diethylbenzenesulphonamide, soluble in alkali
 - 3) N, N-diethylbenzenesulphonamide, insoluble in alkali
 - 4) N-ethylbenzenesulphonamide, soluble in alkali.
31. Hinsberg's reagent which is used to test amines is
- 1) Benzene sulphonamide
 - 2) Benzene diazonium chloride
 - 3) Benzene sulphonyl chloride
 - 4) Acetanilide
32. Assertion (A): N, N-Diethylbenzene sulphonamide is insoluble in alkali.
Reason (R): Sulphonyl group attached to nitrogen atom is strong electron withdrawing group.
- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
 - 2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 - 3) (A) is true, but (R) is false
 - 4) (A) is false, but (R) is true
33. Amino group is o, p-directing for electrophilic substitution reaction. But, on nitration the major product is m-nitroaniline because
- 1) aniline gets protonated with strong acids to give anilinium ion which is m-directing
 - 2) nitration requires nitric acid which oxidises $-\text{NH}_2$ to $-\text{NO}_2$ group
 - 3) electrophile NO_2^+ is a m-directing group
 - 4) benzene ring exerts + I effect and deactivates the ring
34. Electrophilic substitution of aniline with bromine- water at room temperature gives
- 1) 2-bromoaniline
 - 2) 3-bromoaniline
 - 3) 2, 4, 6-tribromoaniline
 - 4) 3, 5, 6-tribromoaniline
35. o-Chloroaniline is treated with a mixture of NaNO_2 and HCl and the product is reacted with cuprous bromide. The final product in the reaction will be



36. Benzene diazonium chloride on reaction with H_3PO_2 and water gives
- 1) Chloro benzene
 - 2) Benzene
 - 3) Benzene phosphate
 - 4) Phenol
37. Which of the following is incorrectly matched with the product when benzene diazonium chloride is reacted with the reagent?

	Reagent	Product
1	CuBr, HBr	Bromo benzene
2	NaBF_4, Δ	Nitro benzene
3	Cu/HCl	Chlorobenzene
4	KCN	Cyano benzene

38. Identify X, Y and Z in the given reaction: $\text{CH}_2 = \text{CH}_2 \xrightarrow{\text{Br}_2/\text{CCl}_4} \text{X} \xrightarrow{\text{NaCN}} \text{Y} \xrightarrow{\text{LiAlH}_4} \text{Z}$
- 1) $\text{X} = \text{CH}_2\text{Br}-\text{CH}_2\text{Br}$; $\text{Y} = \text{CH}_3\text{CH}_2\text{CH}_2\text{CN}$; $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$
 - 2) $\text{X} = \text{CH}_2\text{Br}-\text{CH}_2\text{Br}$; $\text{Y} = \text{CH}_3\text{CH}_2\text{CN}$; $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
 - 3) $\text{X} = \text{CH}_3\text{CH}_2\text{Br}$; $\text{Y} = \text{CH}_3\text{CH}_2\text{CN}$; $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$
 - 4) $\text{X} = \text{CH}_2\text{Br}-\text{CH}_2\text{Br}$; $\text{Y} = \text{NCCH}_2\text{CH}_2\text{CN}$; $\text{Z} = \text{H}_2\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$

39. $C_6H_5NO_2 \xrightarrow{Sn+HCl} A \xrightarrow{NaNO_2+HCl; 0^\circ C} B \xrightarrow{H_2O} C$; Correct statement regarding A, B, C is

- 1) Compound A is aniline
2) Compound B is benzene diazonium chloride
3) C is Phenol
4) All of these

40. $C_6H_5CONH_2 \xrightarrow{Br_2+KOH} A \xrightarrow{NaNO_2+HCl; 0^\circ C} B \xrightarrow{KI} C$; Compound C is the reaction is

- 1) Iodo benzene
2) Anilinium iodide
3) Acetyl iodide
4) Bromo benzene

Passage-1: Read the passage given below and answer the following questions:

Benzene ring in aniline is highly activated. This is due to the sharing of lone pair of nitrogen with the ring which results in increase in the electron density on the ring and hence facilitates the electrophilic attack. The substitution mainly takes place at ortho and para positions because electron density is more at ortho and para positions. On reaction with aqueous bromine all the ortho and para positions get substituted resulting in the formation of 2,4,6-tribromoaniline. To get a mono bromo compound, the amino group is acetylated before bromination. After bromination, the bromo acetanilide is acid hydrolysed to give the desired halogenated amine.

41. Assertion (A): Benzene ring of aniline is highly deactivated.

Reason (R): In aniline, the sharing of lone pair of nitrogen with the ring increases the electron density on the ring.

- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true

42. Assertion (A): In aniline $-NH_2$ group facilitates the electrophilic attack.

Reason (R): It is due to decrease in electron density on the ring.

- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true

43. Assertion (A): In aniline, the substitution mainly takes place at ortho and para positions.

Reason (R): The electron density is more at ortho and para positions

- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true

44. Assertion (A): The amino group of aniline is acetylated before bromination.

Reason (R): It is due to the strong deactivating effect of $-NH_2$ group.

- 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
3) (A) is true, but (R) is false
4) (A) is false, but (R) is true

Passage-2: Read the passage given below and answer the following questions:

Coniine (X) is a poisonous chemical compound with molecular formula $C_8H_{17}N$. In 399 B.C Socrates was sentenced to death by drinking a coniine containing mixture of poison hemlock. It is the murder weapon in mystery novel "Five little Pigs" by Agatha Christie. This when treated with nitrous acid does not give Nitrogen. Also, another Organic compound 'Y' when treated with HNO_2 gives nitrogen. This compound Y when reacts with Hinsberg reagent forms a compound 'Z' which is soluble in NaOH. Such chemical reactions form the basis to differentiate organic compounds and to elucidate its structure.

45. Which of the following statement is incorrect-

- 1) Compound X and Y both are nitrogenous containing organic compounds
2) Y is a Primary amine
3) X might contain N in the ring
4) X and Y both can give carbylamine reaction.

46. Compound 'Z' is soluble in NaOH due to acidic hydrogen which is attached to-

- 1) Carbon
2) Nitrogen
3) Sulphur
4) Oxygen

47. Hinsberg's reagent is
 1) Phenylisocyanide
 2) Benzenesulphonyl chloride
 3) p-toluenesulphonic acid
 4) O-dichlorobenzene
48. Which of the following compounds will dissolve in an alkali solution after it has undergone reaction with Hinsberg reagent?
 1) $(C_2H_5)_2NH$ 2) $C_6H_5N(CH_3)_2$ 3) CH_3NH_2 4) $C_6H_5NHC_6H_5$

Passage-3: Read the passage given below and answer the following questions:

The amines are basic in nature due to the presence of a lone pair of electron on N-atom of the $-NH_2$ group, which it can donate to electron deficient compounds. Aliphatic amines are stronger bases than NH_3 because of the +I effect of the alkyl groups. Greater the number of alkyl groups attached to N-atom, higher is the electron density on it and more will be the basicity. Thus, the order of basic nature of amines is expected to be $3^\circ > 2^\circ > 1^\circ$, however the observed order is $2^\circ > 1^\circ > 3^\circ$. This is explained on the basis of crowding on N-atom of the amine by alkyl groups which hinders the approach and bonding by a proton, consequently, the electron pair which is present on N is unavailable for donation and hence 3° amines are the weakest bases. Aromatic amines are weaker bases than ammonia and aliphatic amines. Electron-donating groups such as $-CH_3$, $-OCH_3$, etc. increase the basicity while electron-withdrawing substitutes such as $-NO_2$, $-CN$, halogens, etc. decrease the basicity of amines. The effect of these substituents is more at p than at m-positions

49. Which of the following has highest pK_b value?
 1) $FCH_2CH_2NH_2$ 2) $CH_3CH_2NH_2$ 3) $ClCH_2CH_2NH_2$ 4) All will have same value
50. Among the compounds: $C_3H_7NH_2$, CH_3NH_2 , $C_2H_5NH_2$ and $C_6H_5NH_2$. Which is the least basic compound?
 1) CH_3NH_2 2) $C_2H_5NH_2$ 3) $C_3H_7NH_2$ 4) $C_6H_5NH_2$
51. Assertion (A): Acetanilide is less basic than aniline.
 Reason (R): Acetylation of aniline results in decrease of electron density on nitrogen.
 1) Both (A) and (R) are true, and (R) is the correct explanation of (A)
 2) Both (A) and (R) are true, but (R) is NOT the correct explanation of (A).
 3) (A) is true, but (R) is false 4) (A) is false, but (R) is true
52. Arrange the following in increasing order of basic strength: Aniline, p-nitroaniline and p-toluidine
 1) Aniline < p-Nitroaniline < p-Toluidine 2) Aniline < p-Toluidine < p-Nitroaniline
 3) p-Toluidine < p-Nitroaniline < Aniline 4) p-Nitroaniline < Aniline < p-Toluidine
53. Which of the following statements is not correct?
 1) Methylamine is more basic than NH_3 2) Primary amines form hydrogen bonds.
 3) Ethylamine has higher boiling point than propane 4) Dimethylamine is less basic than methyl amine

SUBJECTIVE QUESTIONS:

54. Account for the following-

- i) Nitrogen of Aniline act as deactivating group on reacting with RX in presence of Anhyd. $AlCl_3$
 ii) Amines are less polar than alcohol.

ANS: i) Aniline does not react with FC Reaction due to the catalyst Anhyd. $AlCl_3$ which is Lewis acid and Nitrogen acquires +ve charge and act as deactivating group
 ii) Nitrogen is less electronegative than Oxygen

55. A colourless substance 'A' (C_6H_7N) is sparingly soluble in water and gives a water-soluble compound 'B' on treating with HCl. On reacting with $CHCl_3$ and alcoholic potash 'A' produces an obnoxious smell due to the formation of compound 'C' How will you differentiate A with benzyl amine and N, N-dimethyl benzylamine

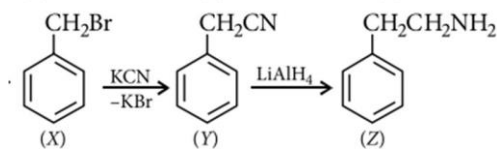
ANS: A=Aniline ($C_6H_5NH_2$) B= Anilinium Chloride ($C_6H_5NH_3^+ Cl^-$), C= Phenyl isocyanide (C_6H_5NC)
 Aniline gives red compound or dye with HONO (Cold) + β -Naphthol. Compound A (Aniline), Benzyl amine and N,N-dimethyl benzyl amine can be differentiated by Hinsberg test.

56. An organic solid compound (A) ($C_{13}H_{11}ON$) is insoluble in aqueous NaOH and aqueous HCl. However, its prolonged heating with aqueous NaOH gives a liquid (B) and a compound (C). Compound (B) can be

separated from (C) by steam distillation, Compound (B) on treatment with benzene diazonium chloride gives a yellow dye (E). Acidification of C gives white precipitate of the compound (D) ($C_7H_6O_2$) which on distillation with soda lime gives benzene. Identify compound A, B, C, D and E.

ANS: A = $C_6H_5CONHC_6H_5$ B = $C_6H_5NH_2$ C = C_6H_5COONa D = C_6H_5COOH
E = p-amino azo benzene

57. A compound X (C_7H_7Br) reacts with KCN to give Y (C_8H_7N). Reduction of Y with $LiAlH_4$ yields Z ($C_8H_{11}N$). Z gives carbylamine reaction, reacts with Hinsberg's reagent in the presence of aq. KOH to give a clear solution. With $NaNO_2$ and HCl at $0^\circ C$ (Z) gives a neutral compound which gives red colour with ammonium ceric nitrate. What are X, Y and Z?



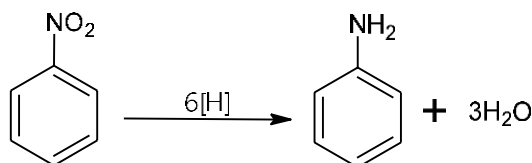
ANS:

58. Amit wants to manufacture aniline for the synthesis of dye stuff. For this he has selected tin and hydrochloric acid as reducing agent for the reduction of nitrobenzene. But his friend suggested to use iron scrap and hydrochloric acid as the reducing agent.

Now answer the following questions:

- (i) Write the chemical equation for the reduction of nitrobenzene to aniline.
(ii) Why Amit's friends have suggested to use scrap iron and HCl in place of tin and HCl?

ANS: (i) $[Fe + 2HCl \rightarrow FeCl_2 + 2H] \times 3$



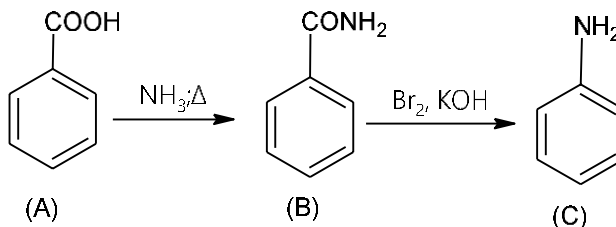
nitrobenzene

aniline

(ii) Amit's friend has suggested to use scrap iron and hydrochloric acid because in this reaction $FeCl_2$ formed gets hydrolysed to release HCl during the reaction. Thus only small amount of HCl is required to initiate the reaction and scrap iron is also cheaper

59. An aromatic compound 'A' on treatment with aqueous ammonia and heating forms compound 'B' which on heating with Br_2 and KOH forms a compound 'C' of molecular formula C_6H_7N . Write the structures and IUPAC names of compounds A, B and C.

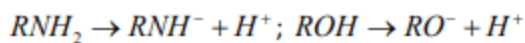
ANS: Formula of the compound 'C' indicates it to be an amine. Since it is obtained by the reaction of Br_2 and KOH with the compound 'B' so compound 'B' can be an amide. It is also indicated because 'B' is obtained from compound 'A' by reaction with ammonia following by heating. So compound 'A' could be an aromatic acid. Formula of compound 'C' shows that it is aniline, then 'B' is benzamide and compound 'A' is benzoic acid. The sequence of reactions can be written as follows:



60. Give plausible explanation for each of the following:

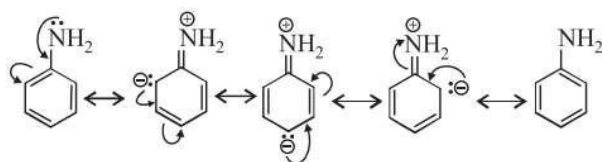
- (i) Why are amines less acidic than alcohols of comparable molecular masses?
(ii) Why do primary amines have higher boiling point than tertiary amines?
(iii) Why are aliphatic amines stronger bases than aromatic amines?

ANS: (i) In alcohols, the hydrogen atom is attached to more electronegative oxygen atom whereas nitrogen of amines is less electronegative. After the loss of H⁺ ion, the negative charge is more easily accommodated on oxygen than in case of nitrogen in amines. Hence, amines have lesser tendency to lose H⁺ ions, so they are less acidic than alcohols.



(ii) Primary amines (R – NH₂) have two hydrogen atoms on nitrogen which can undergo intermolecular hydrogen bonding whereas no such hydrogen bonding is present in tertiary amines (R₃N). So primary amines boil at a higher temperature than tertiary amines.

(iii) In aromatic amines, the lone-pair of electrons on nitrogen atom is involved in resonance with the benzene ring as shown below for aniline



It shows that this pair of electrons is less available for protonation. In case of aliphatic amines electron releasing alkyl groups increase electron density on nitrogen atom. So, aliphatic amines are stronger bases than aromatic amines

KEY-AMINES

1	2	3	4	5	6	7	8	9	10
4	4	1	2	4	3	2	4	1	2
11	12	13	14	15	16	17	18	19	20
2	1	4	3	3	3	2	2	1	4
21	22	23	24	25	26	27	28	29	30
4	4	3	2	1	3	3	3	2	4
31	32	33	34	35	36	37	38	39	40
3	1	1	3	1	2	2	4	4	1
41	42	43	44	45	46	47	48	49	50
4	3	1	3	4	2	2	3	1	4
51	52	53							
1	4	4							

Chapter 10 : BIOMOLECULES

- Glucose gives silver mirror with Tollen's reagent. It shows the presence of**
 - An acidic group
 - An alcoholic group
 - A ketonic group
 - An aldehydic group
- On complete hydrolysis of starch, we finally get**
 - Glucose
 - Fructose
 - Glucose and fructose
 - Sucrose
- Which of the following statements is right**
 - Cellulose are linear polymers of β -glucose molecules with β -1,4 - linkages
 - Starches are polymers of α - glucose molecules with β -1,4 - linkages and some β -1,6 - cross-linkages
 - Proteins are polyamides of β - amino acids
 - The structural information about their biosynthesis is contained in a class of compounds called nucleic acids, e.g. RNA and DNA
- A sugar, that is not a disaccharide, among the following is**
 - Lactose
 - Galactose
 - Sucrose
 - Maltose
- The helical structure of proteins is established by**
 - Peptide bonds
 - Dipeptide bond
 - Hydrogen bond
 - Vander Waal's forces
- Secondary structure of a protein refers to**
 - Mainly denatured proteins and structures of prosthetic groups
 - Three dimensional structure, specially the bond between amino acid residues that are distant from each other in the polypeptide chain
 - Linear sequence of amino acid residues in the polypeptide chain
 - Regular folding patterns of continuous portions of the polypeptide chain
- What is the monomer of polypeptide**
 - Amino acid
 - Glucose
 - Nucleoside
 - Nucleotide
- Amino acids usually exist in the form of Zwitter ions. This means that it consists of**
 - The basic group $-NH_2$ and the acidic group $-COOH$
 - The basic group $-NH_3^+$ and the acidic group $-CO_2^-$
 - The basic group $-CO_2^-$ and the acidic group NH_3^+
 - No acidic or basic group
- A nanopptide containspeptide linkages**
 - 10
 - 8
 - 9
 - 18

10. Which of the following statements about the assembly of nucleotides in a molecule of deoxyribose nucleic acid (DNA) is correct

- (a) A pentose of one unit connects to a pentose of another
- (b) A pentose of one unit connects to the base of another
- (c) A phosphate of one unit connects to a pentose of another
- (d) A phosphate of one unit connects to the base of another

11. In DNA, the complementary bases are

- (a) Uracil and adenine; cytosine and guanine
- (b) Adenine and thymine; guanine and cytosine
- (c) Adenine and thymine; guanine and uracil
- (d) Adenine and guanine; thymine and cytosine

12. The base present in DNA, but not in RNA is

- (a) Guanine
- (b) Adenine
- (c) Uracil
- (d) Thymine

13. A nucleoside on hydrolysis gives

- (a) A heterocyclic base and orthophosphoric acid
- (b) An aldopentose, a heterocyclic base and orthophosphoric acid
- (c) An aldopentose and a heterocyclic base
- (d) An aldopentose and orthophosphoric acid

Read the assertion and reason carefully to mark the correct option out of the options given below :

- (a) If both assertion and reason are true and the reason is the correct explanation of the assertion.
- (b) If both assertion and reason are true but reason is not the correct explanation of the assertion.
- (c) If assertion is true but reason is false.
- (d) If assertion is false but reason is true.

14. Assertion : Proteins on hydrolysis produce amino acids.

Reason : Amino acids contain $-NH_2$ and $-COOH$ groups.

15. Assertion : All Amino acids exist as Zwitter ions.

Reason : Amino acids have both $-NH_2$ and $-COOH$ group.

16. Assertion : Fructose reduces Fehling's solution and Tollen's reagent.

Reason : Fructose does not contain any aldehyde group.

17. Assertion : Sequence of bases in DNA is TGAACCCTT and sequence of bases in *m*-RNA is CATTAAACC.

Reason : In DNA nitrogenous bases have hydrogen bonds.

18. Assertion : Sucrose is a non-reducing sugar.

Reason : It has glycosidic linkage

19. Assertion : β -glycosidic linkage is present in maltose

Reason : Maltose is composed of two glucose units in which C-1 of one glucose unit is linked to C-4 of another glucose unit.

20. Assertion: Sucrose is called an invert sugar.

Reason: on hydrolysis, sucrose bring the change in the sign of rotation from dextro (+) to leavo (-)

Read the passage given below and answer the following questions:

When a protein in its native form, is subjected to physical changes like change in temperature or chemical changes like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix gets uncoiled and protein loses its biological activity. This is called denaturation of protein. The denaturation causes change in secondary and tertiary structures but primary structures remains intact.

Examples of denaturation of protein are coagulation of egg white on boiling, curding of milk, formation of cheese when an acid is added to milk.

The following questions are multiple choice questions. Choose the most appropriate answer:

(21) Mark the wrong statement about denaturation of proteins.

- (a) The primary structure of the protein does not change.
- (b) Globular proteins are converted into fibrous proteins.
- (c) Fibrous proteins are converted into globular proteins.
- (d) The biological activity of the protein is destroyed.

(22) Which structure of protein remain(s) intact during denaturation process?

- (a) Both secondary and tertiary structures
- (b) primary structure only
- (c) secondary structure only
- (d) tertiary structure

(23) α -helix and β -pleated structures of proteins are classified as

- (a) primary structure
- (b) secondary structures
- (c) tertiary structure
- (d) quaternary structure

(24) Cheese is a

- (a) globular protein
- (b) conjugated protein
- (c) denatured protein
- (d) derived protein

(25) Secondary structure of protein refers to -

- (a) mainly denatured of proteins and structures of prosthetic groups
- (b) three-dimensional structure, especially the bond between amino acid residues that are distant from each other in the polypeptide chain
- (c) linear sequence of amino acid residues in the polypeptide chain
- (d) regular folding patterns of continuous portions of the polypeptide chain.

Read the passage given below and answer the following questions:

Glucose (C₆H₁₂O₆) contains six carbon atoms and an aldehyde group and is therefore referred to as an aldohexose. The glucose molecule can exist in an open-chain (acyclic) and ring (cyclic) form in equilibrium. The latter being the result of an intramolecular reaction between the aldehyde C atom and the C-5 hydroxyl group to form an intramolecular hemiacetal. As the ring contains five carbon atoms and one oxygen atom. Which resembles the structure of pyran, the cyclic form of glucose is also referred to as glucopyranose. In this ring, each carbon is linked to a hydroxyl side group with the exception of the fifth atom, which links to a sixth carbon atom outside the ring, forming a CH₂OH group.

26. Glucose react with bromine water which product is formed

- (a) saccharic acid
- (b) gluconic acid
- (c) hexanoic acid
- (d) bromo hexane

27. The number of chiral centers in the open chain structure of glucose is

- (a) 3
- (b) 4
- (c) 5
- (d) 6

28. α-D-Glucopyranose and β-D-Glucopyranose are

- (a) Diastereomers
- (b) Meso compounds
- (c) Epimers
- (d) Anomers

29. Glycosidic linkage is

- (a) an amide linkage
- (b) an ester linkage
- (c) an ether linkage
- (d) an amine linkage

30. Glucose and Fructose can be differentiated by

- (a) Tollens reagent
- (b) Cold KMnO₄
- (c) bromine water
- (d) PCC

ANSWERS:- (1) d	(2) a	(3) b	(4) b	(5) c	(6) d
(7) a	(8) c	(9) b	(10) c	(11) b	(12) d
(13) c	(14) b	(15) a	(16) b	(17) d	(18) a
(19) d	(20) a	(21) c	(22) b	(23) b	(24) c
(25) d	(26) b	(27) b	(28) d	(29) c	(30) c