# GOVERNMENT OF KARNATAKA

## Department of School Education (Pre University)

18th Cross, Malleshwaram Bengaluru- 560 012

Web site: *https://www.pue.karnataka.gov.in/*

**and**

## Karnataka School Examination and Assessment Board

6th Cross, Malleshwaram Bengaluru- 560 003

Web site: *https://kseab.karnataka.gov.in/*

# 2025 – 26 II PUC QUESTION BANK

**SUBJECT CODE:** 34

**SUBJECT NAME:** CHEMISTRY

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# II PUC CHAPTERWISE MARKS ALLOTMENT

**TIME: 3 HOURS** **34 – CHEMISTRY** **Max Marks: 70**

| UNIT NUMBER | UNIT NAME | Marks Allotted | Page Number |
|---|---|---|---|
| 1 | SOLUTION | **12** | **01 - 24** |
| 2 | ELECTROCHEMISTRY | **13** | **25 - 48** |
| 3 | CHEMICAL KINETICS | **12** | **49 - 74** |
| 4 | THE D-BLOCK ELEMENTS | **10** | **75 - 90** |
| 5 | COORDINATION COMPOUNDS | **11** | **91 - 109** |
| 6 | HALOALKANES AND HALOARENES | **09** | **110 - 127** |
| 7 | ALCOHOLS, PHENOLS AND ETHERS | **10** | **128 - 152** |
| 8 | ALDEHYDES, KETONES AND CARBOXYLIC ACIDS | **12** | **153 - 172** |
| 9 | AMINES | **07** | **173 - 190** |
| 10 | BIOMOLECULES | **09** | **191 - 216** |
| **TOTAL** | | **105** | **---** |
| 11 | **Link for Model Question Papers, Board Exam Question Papers, Model Answers and Centum Papers** | | **218** |
| 12 | **Answers for MCQ and Fill in the Blank Questions** | | **219 - 230** |

**IN THIS QUESTION BANK, THE LETTERS GIVEN IN BRACKETS INDICATE THE DIFFICULTY LEVEL OF THE QUESTIONS: -**

**E = EASY** **A = AVERAGE** **D = DIFFICULT**

# Unit 1
# Solutions

## MULTIPLE CHOICE QUESTIONS (MCQS) (ONE MARK)

### 1.1 Types of Solutions;

1. Camphor in nitrogen gas, is an example of _____. **(E)**

   a) liquid Solutions  b) solid Solutions

   c) gaseous Solutions  d) aqueous solution

2. Out of following which one is not an example of a solution. **(E)**

   a) Air  b) Brass

   c) amalgam  d) benzene in water

3. Match the following Type solution with their examples: **(E)**

| **Type of solution** | **Example** |
|---|---|
| A. Gaseous solution | p. dissolved oxygen in drinking water |
| B. Liquid solution | q. amalgam of mercury with sodium |
| C. Solid solution | r. atmospheric air |
| | s. Silicon |

   a) A – q; B – r; C – p  b) A – r; B – p; C – q

   c) A – q; B – s; C – p  d) A – s; B – r; C – q

4. Match the items given in Column I with the type of solutions given In Column II. **(A)**

| | **Column I** | | **Column II** |
|---|---|---|---|
| (i) | Soda water | A. | A solution of liquid in solid |
| (ii) | Sugar solution | B. | A solution of gas in gas |
| (iii) | German silver | C. | A solution of solid in liquid |
| (iv) | Air | D. | A solution of solid in solid |
| | | E. | A solution of gas in liquid |

   a) (i) - B; (ii) - C; (iii) – D; (iv) – E;  b) (i) - E; (ii) - C; (iii) – D; (iv) – B;

   c) (i) - B; (ii) - E; (iii) – D; (iv) – B;  d) (i) - E; (ii) - C; (iii) – B; (iv) – D;

### 1.2 Expressing concentration of solutions;

5. The concentration term depends on temperature is **(E)**

   a) ppm  b) mole fraction

   c) molality  d) molarity

6. Which of the following is dependent on temperature? **(NEET-17) (E)**

   a) Molarity  b) Mole fraction

   c) Weight percentage  d) Molality

7. Increasing the temperature of an aqueous solution will cause **(A)**

a) decrease in molality b) decrease in molarity

c) decrease in mole fraction d) decrease in mass percentage (w/w)

8. The mass percentage (w/w) of glucose in water is 10% means **(A)**

a) 10g of glucose dissolved in 100g of water

b) 10g of glucose dissolved in 10g of water

c) 10g of glucose dissolved in 90g of water

d) 10g of glucose dissolved in 90ml of water

9. The mass percentage(w/v) of glucose in water is 10% means. **(E)**

a) 10g of glucose dissolved in 100 g of water b) 10g of glucose dissolved in 90 mL of water

c) 10g of glucose dissolved in 100 mL of water d) 10g of glucose dissolved in 90 g of water

10. The mole fraction of the solute in one molal aqueous solution is **(D)**

a) 0.009 b) 0.018

c) 0.027 d) 0.036

11. If one mole of a substance is present in one kg of solvent, then **(E)**

a) It shows molar concentration b) It shows molal concentration

c) It shows normality d) It shows strength g/g

12. A binary solution has two components 'A' and 'B'. The mole fraction of component 'A' is 0.5, then the number of moles of components 'A and 'B' in the solution is **(A)**

a) $n_A > n_B$ b) $n_A < n_B$

c) $n_A = n_B$ d) All of these

13. The concentration of fluoride ions to be present in water to prevent tooth decay is **(E)**

a) 1 ppm b) 1.5 ppm

c) 2 ppm d) 2.5 ppm

14. The concentration of pollutants in water or atmosphere is expressed in terms of **(E)**

a) $\mu g\ L^{-1}$ b) molarity

c) molality d) volume percentage (v/v)

15. Match the following concentration term of solution with their units: **(A)**

| | **Quantity** | | **Units** |
|---|---|---|---|
| A. | molarity | p. | $gmol^{-1}$ |
| B. | molality | q. | K kg/mol |
| C. | mole fraction | r. | Mol/kg |
| D. | molar mass | s. | $mol/dm^3$ |
| E. | Ebullioscopic constant/ Cryscopic constant | t. | No unit |

a) A - s; B - r; C – t; D –p; E –q b) A - s; B - t; C – p; D –r; E -q

c) A - s; B - r; C – p; D –t; E –q d) A - r; B - s; C – q; D –t; E -p

## 1.3 Solubility;

16. The tanks used by most of scuba divers are filled with air diluted with helium of around **(E)**

a) 88.3% b) 56.2%

c) 32.1% d) 11.7%

17. A student took two glasses of pure water from a water filter. He cools glass–A in a fridge and warms the other glass – B on a stove. On comparing the solubility of oxygen in $H_2O$ in glass–A and glass–B, he states that glass- 'A' contains **(A)**

a) more oxygen than glass–B. b) less oxygen than glass–B.

c) same amount of oxygen as in glass–B. d) zero concentration of oxygen.

## 1.4 Vapor Pressure of liquid Solutions;

18. The dissolution of gas is in a liquid is governed **(E)**

a) Raoult's law b) Henry's law

c) Dalton's law of pressure d) van't Hoff factor

19. $P_A$ and $P_B$ are the vapour pressures of pure liquid components, A and B, respectively of an ideal binary solution. If $X_A$ represents the mole fraction of component A, the total pressure of the solution will be **(A)**

a) $P_A + X_A (P_B – P_A)$ b) $P_A + X_A (P_A – P_B)$

c) $P_B + X_A (P_B – P_A)$ d) $P_B + X_A (P_A – P_B)$

20. The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 mole of P and 2 mol of Q would be **(D)**

a) 72 torr b) 140 torr

c) 68 torr d) 20 torr

21. Which of the following statements about the composition of the vapour over an ideal 1: 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C. (Given, vapour pressure data at 25°C, benzene 12.8 kPa, toluene = 3.85 $kP_a$). **(A)**

a) The vapour will contain equal amounts of benzene and toluene.

b) Not enough information is given to make a prediction.

c) The vapour will contain a higher percentage of benzene.

d) The vapour will contain a higher percentage of toluene.

22. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase? **(A)**

a) Addition of NaCl b) Addition of $Na_2SO_4$

c) Addition of 1.00 molal KI d) Addition of water

## 1.5 Ideal and Non-ideal Solutions;

23. The mixture which shows positive deviation from Raoult's Law is **[NEET 2020] (E)**

a) n-hexane and n-heptane
b) Bromoethane and chloroethane
c) Ethanol and Acetone
d) Chloroform and Acetone

24. The mixture which shows positive deviation from Raoult's law is **(E)**

a) ethanol + acetone
b) benzene + toluene
c) acetone + chloroform
d) chloroethane + bromoethane.

25. The mixture that forms maximum boiling azeotrope is **(E)**

a) heptane + octane
b) water + nitric acid
c) ethanol + water
d) acetone + carbon disulphide.

26. Which of the following statements is correct regarding a solution of two components A and B exhibiting positive deviation from ideal behaviour? **(E)**

a) Intermolecular attractive forces between A-A and B-B are stronger than those between A-B.
b) $\Delta V_{mix}H = 0$ at constant T and P.
c) $\Delta V_{mix}V = 0$ at constant T and P.
d) Intermolecular attractive forces between A-A and B-B are equal to those between A-B.

27. A solution containing components A and B follows Raoult's law. **(E)**

a) A-B attraction force is greater than A - A and B-B
b) A-B attraction force is less than A - A and B – B
c) A-B attraction force remains same as A - A and B-B
d) volume of solution is different from sum of volume of solute and solvent.

28. All form ideal solution except **(E)**

a) $C_6H_6$ and $C_6H_5CH_3$
b) $C_2H_6Br$and $C_2H_5I$
c) $C_6H_5Cl$ and $C_6H_5Br$
d) $C_2H_5I$ and $C_2H_5OH$

29. An ideal solution is formed when its components **(E)**

a) have no volume change on mixing.
b) have no enthalpy change on mixing.
c) have both the above characteristics.
d) have high solubility.

30. 10 ml of liquid 'A' and 20 ml of liquid 'B' are mixed at 25°C. The volume of the solution was measured to be 30.1 ml then, **(A)**

a) $\Delta H_{mix} > 0$, Solution shows negative deviation from Raoult's low.
b) $\Delta H_{mix} < 0$, Solution shows negative deviation from Raoult's low.
c) $\Delta H_{mix} > 0$, Solution shows positive deviation from Raoult's low.
d) $\Delta H_{mix} < 0$, Solution shows positive deviation from Raoult's low.

31. The mixture that forms maximum boiling azeotrope at specific concentration is **(E)**

a) heptane + octane
b) water + Nitric acid
c) ethanol + water
d) acetone + carbon disulphide

32. Match the following Type of liquid - liquid solution with their examples: **(A)**

| | **Type of liquid - liquid solution** | | **Example** |
|---|---|---|---|
| A. | Ideal solution | p. | ethanol - acetone |
| B. | Non ideal solution with positive deviation | q. | acetone - chloroform |
| C. | Non ideal solution with negative deviation | r. | benzene – toluene |

a) A - p; B - q; C – r; b) A - p; B - r; C – q;

c) A - q; B - r; C – p; d) A - r; B - p; C – q;

## 1.6 Colligative Properties and Determination of Molar mass;

33. In a solution containing non-volatile solute, the mole fraction of solvent is 0.9. The relative lowering of vapour pressure is **(A)**

a) 1 b) 0.1

c) 0.9 d) 1.1

34. During depression of freezing point in a solution the following are in equilibrium **(A)**

a) Liquid solvent, solid solvent b) Liquid solvent, solid solute

c) Liquid solute, solid solute d) Liquid solute, solid solvent

35. At 25°C the highest osmotic pressure is exhibited by 0.1 M solution of (assume complete dissociation) **(E)**

a) Glucose b) urea

c) $CaCl_2$ d) KCl

36. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression? (assume complete dissociation) **(E)**

a) KCl b) $C_6H_{12}O_6$

c) $Al_2(SO_4)_3$ d) $K_2SO_4$

37. Which of the following aqueous solution has minimum freezing point? (Assume complete dissociation) **(E)**

a) 0.01 NaCl b) 0.005m $C_2H_5OH$

c) 0.005m $MgI_2$ d) 0.005m $MgSO_4$

38. For 0.1 M solution, the colligative property will follow the order (assume complete dissociation) **(E)**

a) $NaCl > Na_2SO_4 > Na_3PO_4$ b) $NaCl < Na_2SO_4 < Na_3PO_4$

c) $NaCl > Na_2SO_4 \approx Na_3PO_4$ d) $NaCl < Na_2SO_4 = Na_3PO_4$

39. On assuming complete dissociation, the aqueous solution having highest Freezing point is **(E)**

a) 2M KCl, (i = 2) b) 2M $K_2SO_4$, (i = 3)

c) 2M $Al_2(SO_4)_3$, (i= 5) d) 2M $K_3[Fe(CN)_6]$, (i = 4)

40. When compared to $\Delta T_f$ -value of a **0.01M** glucose solution, the $\Delta T_f$ - value of **0.01M $MgCl_2$** solution
    a) increases about three times b) increases about six times **(A)**
    c) increases about ten times d) remains same

41. Which of the following compounds can be used as antifreeze in automobile radiators? **(E)**
    a) Methyl alcohol b) Nitrophenol
    c) Glycol d) Ethyl alcohol

42. If molality of the dilute solution is doubled, the value of molal depression constant ($K_f$) will be **(A)**
    a) halved b) tripled
    c) unchanged d) doubled.

43. When mercuric iodide is added to the aqueous solutions of potassium iodide then: **(D)**
    a) freezing point is raised. b) freezing point is lowered.
    c) freezing point does not change. d) boiling point does not change

44. If molality of the dilute solution is doubled, the value of the molal depression constant ($K_f$) will be **(E)**
    a) doubled b) halved
    c) tripled d) unchanged

45. As a result of osmosis, the volume of the solution: **(E)**
    a) gradually decreases b) gradually increases
    c) is not affected d) suddenly increases

46. Pure water can be obtained from sea water by **(E)**
    a) centrifugation b) plasmolysis
    c) reverse osmosis d) sedimentation.

47. The relationship between osmotic pressure at 273 K when 10 g glucose ($p_1$), 10 g urea ($p_2$), and 10 g sucrose ($p_3$) are dissolved in 250 mL of water is. **(A)**
    a) $P_2 > P_1 > P_3$ b) $P_2 > P_3 > P_1$
    c) $P_1 > P_2 > P_3$ d) $P_3 > P_1 > P_2$

48. From the colligative properties of solution, which one is the best method for the determination of molecular weight of proteins and polymers? **(E)**
    a) Osmotic pressure b) Lowering in vapour pressure
    c) Lowering in freezing point d) Elevation in boiling point

49. Blood cells retain their normal shape in solution which are **(E)**
    a) hypotonic to blood b) isotonic to blood
    c) hypertonic to blood d) not equimolar to blood.

50. During osmosis, flow of water through a semipermeable membrane is **(E)**
    a) from solution having lower concentration only
    b) from solution having higher concentration only
    c) from both sides of semipermeable membrane with equal flow rates
    d) from both sides of semipermeable membrane with unequal flow rates.

51. Solution (A) containing $FeCl_3$ is separated from solution (B) containing $K_4Fe(CN)_6$ by a semipermeable membrane. If $FeCl_3$ on reaction with $K_4[Fe(CN)_6]$ produces blue colour of $Fe_4[Fe(CN)_6]_3$, the blue colour will appear in **(D)**

a) A
b) B
c) In both A and B
d) Neither in A nor in B

52. During osmosis, the solvent molecules are moving from **(E)**

a) Hypotonic solution to hypertonic solution
b) Hypertonic solution to hypotonic solution
c) Higher concentrated solution to lower concentrated solution
d) Higher osmotic pressure solution to lower osmotic pressure solution.

53. Match the following **Colligative property with their formulae**: **(A)**

| **Colligative property** | | | **Formula** |
|---|---|---|---|
| A. | Relative lowering of vapour pressure of the solvent | i. | $= K_f m$ |
| B. | Henry's law | ii. | $= \frac{R \times M_1 \times T_f^2}{1000 \times \Delta_{fus} H}$ |
| C. | Depression in freezing point | iii. | $\frac{p_1^0 - p_1}{p_1^0} = \frac{n_2}{n_1 + n_2}$ |
| D. | Cryscopic constant | iv. | $p = K_H.x$ |

a) A - iii; B - iv; C – ii; D –i
b) A - ii; B - iv; C – iii; D –i
c) A - iii; B - iv; C – i; D –ii
d) A - ii; B - iv; C – i; D –iii

54. Match the following **Colligative property with their formulae**: **(A)**

| **Colligative property** | | **Formula** | |
|---|---|---|---|
| A. | Raoult's law | i. | $= \frac{R \times M_1 \times T_b^2}{1000 \times \Delta_{vap} H}$ |
| B. | Elevation of boiling point | ii. | $= CRT$ |
| C. | Ebullioscopic constant | iii. | $p = x_1 p_1^\circ + x_2 p_2^\circ$ |
| D. | Osmotic pressure | iv. | $= K_b m$ |

(a) A - iii; B - iv; C – ii; D –i
(b) A - ii; B - iv; C – iii; D –i
(c) A - iii; B - iv; C – i; D –ii
(d) A - ii; B - iv; C – i; D –iii

## 1.7 Abnormal Molar Masses

55. Which of the following salts has the same value of Van't Hoff factor (i) as that of $K_3[Fe(CN)_6]$? **(A)**

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

56. The van't Hoff factor i for a compound which undergoes dissociation in one solvent (ethanoic acid in water) and association in other solvent (ethanoic acid in Benzene) is respectively **(A)**

a) Greater than one and greater than one
b) Less than one and greater than one
c) Less than one and less than one
d) Greater than one and less than one

57. Compare these compounds with their van't Hoff factor value (i). **(A)**

| Column I (van't Hoff factor value (i)) | | Column II (Behaviour) | |
|---|---|---|---|
| A. | i > 1 | i. | There is association. |
| B. | i < 1 | ii. | There is dissociation. |
| C. | i = 1 | iii. | Impossible |
| D. | i = 0 | iv. | No association or dissociation |

a) A–ii, B–i, C–iv, D–iii
b) A–iii, B–ii, C–i, D–iv
c) A–iii, B–i, C–iv, D–ii
d) A–iii, B–iv, C–i, D–ii

**Each question contains STATEMENT–1 and STATEMENT–2. Each question has 4 choices (a), (b), (c) and (d) out of which ONLY ONE is correct. Choose the correct option as under: (ONE MARK)**

a) Both statement I and II are correct
b) Both statements I and II incorrect
c) Statement I is correct and statement II is incorrect
d) Statement I is incorrect and statement II is correct

**58.** **Statement–1:** One molar aqueous solution has always higher concentration than one molal solution.
**Statement–2:** One molar solution contains less solvent than one molal solution. **(E)**

**59.** **Statement – 1:** One molar aqueous solution has always lower concentration than one molal.
**Statement – 2:** The molality of a solution depends upon the density of the solution whereas molarity does not. **(E)**

**60.** **Statement – 1:** Greater the value of Henry's constant of a gas in a particular solvent, greater is the solubility of the gas at the same pressure and temperature.
**Statement – 2:** Solubility of a gas is directly proportional to its Henry's constant at the same pressure and temperature. **(E)**

**61.** **Statement I:** On adding NaCl to water its vapour pressure increases
**Statement II:** Addition of non-volatile solute increases the vapour pressure. **(E)**

**62.** **Statement – 1:** If a liquid solute more volatile than the solvent, then the solute is added to a solvent, the vapour pressure of the solution may increase, i.e., $p_s > P°$.
**Statement – 2:** In the presence of the more volatile solute, only the solute will form the vapours and solvent will not. **(A)**

**63.** **Statement–1:** If on mixing the two liquids, the solution becomes hot, it implies that it shows negative deviation from Raoult's law. **(E)**
**Statement–2:** Solutions which show negative deviation are accompanied by decrease in volume.

**64.** **Statement–1:** Vapour pressure of water is less than 1.013 bar at 373 K. **(E)**

**Statement–2:** Water boils at 373 K as the vapour pressure at this temperature becomes equal to atmosphere pressure.

**65.** **Statement – 1:** Azeotropic mixtures are formed only by non–ideal solutions and they may have boiling points either greater than or less than both the components. **(A)**

**Statement – 2:** The composition of the vapour phase is same as that of liquid phase of the azeotropic mixture.

**66.** **Statement – 1:** Cooking time is reduced in pressure cooker. **(A)**

**Statement – 2:** Boiling point inside the pressure cooker is raised.

**67.** **Statement – 1:** Addition of a non–volatile solute to a volatile solvent increases the boiling point.

**Statement – 2:** Addition of a non–volatile solute results in lowering of vapour pressure. **(E)**

**68.** **Statement – 1:** The depression in freezing point depends on the amount of the solute dissolved and not on the nature of the solute or solvent. **(E)**

**Statement – 2:** For aqueous solutions of different electrolytes, molal depression constant will have different value.

**69.** **Statement – 1:** 0.1 M aqueous solution of glucose has higher increment in the freezing point than 0.1 M aqueous solution of urea at same condition. **(E)**

**Statement – 2:** $K_f$ for both has different values.

**70.** **Statement – 1:** Higher the molal depression constant of the solvent used, higher the freezing point of the solution. **(E)**

**Statement – 2:** Depression in freezing point does not depend on the nature of the solvent.

**71.** **Statement – 1:** Out of various colligative properties, osmotic pressure is used for determination of molecular masses of polymers. **(E)**

**Statement – 2:** Polymer solutions do not possess constant boiling point or freezing point.

**72.** **Statement–I:** Any concentration of NaCl solution can be injected intravenously as NaCl, being a common table salt, is a harmless chemical. **(E)**

**Statement–2:** 0.9% (mass/volume) NaCl solution is isotonic with the fluid inside the blood cells.

**73.** **Statement I:** If red blood cells were removed from the body and placed in pure water, pressure inside the cells increases **(E)**

**Statement II:** The concentration of salt content in the cells increases.

**74.** **Statement – 1:** The molecular weight of acetic acid determined by depression in freezing point method in benzene and water is found to be different. **(E)**

**Statement – 2:** Water is polar and benzene is non–polar in nature.

**75.** **Statement – 1:** van' t Hoff factor for benzoic acid in benzene is less than one. **(E)**

**Statement – 2:** Benzoic acid behaves as a weak electrolyte in benzene.

## Fill in the blanks by choosing the appropriate word from those given in the brackets: (ONE MARK)

### Set-1

**(Plasmolysis, mole fraction, Reverse osmosis, Solid, Liquid, Molarity)**

1. Desalination of water is based on _____ **(E)**
2. The shrinking of a plant cell due to overflow of water is called_____ **(E)**
3. Hydrated salts are solutions of _____ in solid. **(E)**
4. 22 carat gold is an example of solid in _____ solution. **(E)**
5. According to Henry's law the plot of equilibrium pressure versus_____ is linear with slope equal to $K_{H.}$ **(E)**

### Set-2

**(1, 0.9, lower, saturated solution, higher, unsaturated solution)**

1. Red blood cells are isotonic with_____ % NaCl solution. **(E)**
2. For non-electrolytes, the van't Hoff factor (i) is _____ **(E)**
3. Greater the value of Henry's constant of a gas_____ is its solubility at the same partial pressure and temperature. **(E)**

1. An ionic compound dissolves in water if hydration energy is _____ than lattice energy. **(E)**
2. A solution in which no more solute can be dissolved at the same temperature and pressure is called_____ **(E)**

### Set-3

**($N_2$, Isotonic, $O_2$, hypotonic, Cellulose acetate, $CO_2$)**

1. In deep sea diving the disease called Bends is caused due to the dissolution of _____ in the blood. **(E)**
2. At Altitude, concentration of _____ in the blood is low. people feel weak and unable to think properly this disease is called anoxia. **(E)**
3. Solutions having the same osmotic pressure are called_____ **(E)**
4. A solution with lower osmotic pressure is called_____ with respect to a more concentrated solution. **(E)**
5. The semipermeable membrane generally used in the reverse osmosis is made up of_____. **(E)**

### Set-4

**(Azeotrope, solvent, association, solution, dissociation, solute)**

1. Osmotic pressure is the minimum pressure that must be applied on the_____ side to prevent the entry of solvent from solvent to solution. **(E)**
2. In osmosis, there is a net flow of solvent from _____ to solution. **(E)**
3. If van't Hoff factor is less than unity this shows that the solute undergoes_____ in the solution. **(E)**
4. If van't Hoff factor is more than unity this shows that the solute undergoes_____ in the solution. **(E)**
5. The constant boiling mixture of two miscible liquids of a definite mole fraction is called _____ **(E)**

### Set-5

**(Helium, solvent, Xenon, increase, decrease, solute)**

1. Molal elevation constant $K_b$ depend upon the nature of the _____. **(E)**
2. Colligative properties depend on the number of _____particles dissolved in solution. **(E)**
3. Value of Henry's constant $K_H$ increases with _____ in temperature. **(E)**
4. As dissolution is an exothermic process the solubility should _____ with increase of temperature. **(E)**
5. See diverse for breathing inside see use a mixture of $O_2$ and inert gas _____. **(E)**

### Set-6

**(Anoxia, Edema, More, Non-ideal, Osmotic pressure, less)**

1. People taking a lot of salt develop swelling or puffiness of their tissues. This disease is called___**(E)**
2. At the same temperature nitrogen gas is_____ soluble in water than oxygen. **(E)**
3. The best colligative property to determine the molecular mass of polymers is _____ **(E)**
4. A _____solution showing negative deviations forman azeotrope with highest boiling point. **(E)**
5. Less is the colligative property, _____ is the Molecular mass. **(E)**

### Set-7

**(One, increases, $CCl_2F_2$, decreases, concertation)**

1. The most common freon used in industries_____. **(E)**
2. As temperature **decreases** solubility of gases in liquid _____. **(E)**
3. When a non-volatile solute is added to the pure solvent, the freezing point of solvent_____ **(E)**
4. The utility or importance of solutions in life depends on their _____. **(E)**
5. The sum of mole fractions of all the components in a binary solution is equal to _____. **(E)**

## TWO MARKS QUESTIONS:

### 1.1 Types of Solutions;

1. Define the term solution. Which component determines the physical state of the binary solution? **(E)**
2. Give an example of a solution containing **(E)**
   a) gaseous solute in a gaseous solvent.
   b) liquid solute in a gaseous solvent.
   c) solid solute in gaseous solvent.
   d) gaseous solute in a liquid solvent.
   e) liquid solute in a liquid solvent.
   f) solid solute in a liquid solvent.
   g) gaseous solute in a solid solvent.
   h) liquid solute in a solid solvent.
   i) solid solute in a solid solvent.

### 1.2 Expressing concentration of solutions;

3. Differentiate between molarity and molality of a solution. How does a change in temperature influence their values? **(E)**
4. Which aqueous solution has higher concentration: 1 molar or 1 molal solution of the same solute? Give reason the answer. **(A)**

5. Define mole fraction. What is the value of sum of mole fractions of all the components in a three-component system? **(E)**

6. Define the following terms:

   i) Solution ii) Mole fraction

   iii) Molarity iv) Molality

   v) saturated solution vi) Unsaturated solution

   vii) dissolution viii) crystallisation. **(E)**

7. Molarity (M), molality (m) and mole fraction ($\chi$) are some methods for expressing concentration of solutions. Which of these are temperature dependent? Give reason. **(E)**

8. 18 g glucose (molar mass 180 g $mol^{-1}$) is present in 500 $cm^3$ of its aqueous solution. What additional data is required if the molality of the solution is required to be calculated? **(A)**

## 1.3 Solubility;

9. What is the effect of temperature and pressure on solubility of solids in liquids? **(E)**

10. What is the effect of temperature and pressure on the solubility gas in liquid? **(E)**

10. Dissolution of $CaCl_2$ in water is exothermic process and while that in ammonium nitrate is endothermic process. What is the effect of temperature on solubility of these two solutions? **(A)**

11. Write the expression the solubility of gases in water related with their Henry's constants at the same pressure and temperature. **(E)**

12. At the same temperature, hydrogen is more soluble in water than helium, which of them will have a higher value of $K_H$ and why? **(A)**

13. Mention any two applications of Henry's law. **(E)**

14. Why do gases always tend to be less soluble in liquids as the temperature increases? Explain. **(A)**

## 1.4 Vapor Pressure of liquid Solutions;

15. Define vapour pressure of a liquid. Name a law which helps us to determine partial vapor pressure of a volatile component in solution. **(E)**

16. What happens to the vapour pressure when

    (a) a volatile solute dissolve in the liquid and

    (b) the dissolved solute is non–volatile. **(A)**

17. Draw a graph to show variation of vapour pressure of solvent and solution with respect to temperature. **(A)**

18. Vapour pressure of a solution is different from that of pure solvent **(A)**

    (a) Name the law which helps us to determine partial vapour pressure of a volatile component in solution.

    (b) State the above law.

## 1.5 Ideal and Non-ideal Solutions;

19. State Raoult's law as applied to a binary solution of Non-volatile solute in a volatile solvent. **(E)**
20. What are ideal and non-ideal solutions? **(E)**
21. Give an example of Ideal solution and non-ideal solutions. **(E)**
22. What causes deviations from ideal behavior of solutions? Why do the vapour pressures of certain solutions show negative or positive deviations from the Raoult's law? **(A)**
23. When 50 mL of phenol and 50 mL of aniline are mixed, predict whether the volume of the solution is equal to, greater than or less than 100 m. Give reason for your answer. **(A)**
24. Derive the relation between molar mass of solute and relative lowering vapour pressure. **(A)**
25. What is azeotropic mixture? Give example. **(E)**
26. What are the different types of azeotropic mixtures? Explain with example. **(E)**
27. What are differences between minimum boiling azeotropes and maximum boiling azeotropes? **(E)**
28. What type of azeotropes are formed by solutions with negative deviation from Raoult's law? Give an example for it. **(E)**
29. What type of azeotropes are formed by solutions with positive deviation from Raoult's law? Give an example for it. **(E)**

## 1.6 Colligative Properties and Determination of Molar mass;

30. What are colligative properties? Name any one colligative property. **(E)**
31. Write the mathematical relation between molality and elevation in boiling point. **(E)**
32. What happens to boiling point of water when salt is dissolved in it? Which one will have greater boiling point: 0.1M NaCl, 0.1 M $BaCl_2$? **(A)**
33. What will happen to the boiling point of a solution if **(A)**
    (i) The weight of the solute dissolved is doubled
    (ii) The weight of solvent taken is halved?
34. Write the mathematical relation between molality and depression in freezing point. **(A)**
35. Write the expression to relate cryoscopic constant and change in enthalpy of fusion. Explain the terms involved in it. **(E)**
36. Define molal depression constant. Give one most important application of the phenomenon of depression in freezing point in everyday life. **(A)**
37. With the help of a suitable diagram, show that the lowering of vapour pressure of a solution than the pure solvent causes a lowering of freezing point for the solution compared to that of the pure solvent. **(A)**
38. Write a note on osmotic pressure. **(E)**
39. Define osmosis and semi permeable membrane. **(E)**
40. What is the importance of semipermeable membrane in osmosis? **(E)**

41. Define osmotic pressure. What happens when the external pressure applied becomes more than the osmotic pressure of the solution? **(E)**
42. Give an example for biological and industrial importance of osmosis. **(E)**
43. What is reverse osmosis? Mention one practical utility of it. **(E)**
44. $BaCl_2$ on reaction with $Na_2SO_4$ in aqueous solution gives white precipitate. If the same two solutions are separated by a semi-permeable membrane, will there be appearance of a white precipitate due to osmosis? **(A)**

## 1.7 Abnormal Molar Masses

45. In the solution, what are the possible values of van't Hoff factor if the solute molecules undergo
(i) Association and (ii) Dissociation **(E)**
46. What is van't Hoff factor? What is the van't Hoff factor for a compound which undergoes tetramerisation in an organic solvent? **(A)**
47. Give an example of a compound in which hydrogen bonding results in the formation of a dimer. What is the van't Hoff factor for such compounds? **(A)**

## THREE MARKS QUESTIONS:

### 1.1 Types of Solutions;

1. Name the two components present in binary solution. Which component determines the physical state of binary solution? **(E)**
2. Match the items given in Column I and Column II. **(A)**

| Column I | | Column II | |
|---|---|---|---|
| (i) | Saturated solution | (a) | A solution in solid phase. |
| (ii) | Binary solution | (b) | Solution having same osmotic pressure at a given temperature as that of given solution. |
| (iii) | Isotonic solution | (c) | A solution whose osmotic pressure is more than that of another. |
| (iv) | Hypotonic solution | (d) | A solution whose osmotic pressure is less than that of another. |
| (v) | Solid solution | (e) | Solution with two components. |
| (vi) | Hypertonic solution | (f) | A solution which contains maximum amount of solute that can be dissolved in a given amount of solvent at a given temperature. |

## 1.2 Expressing concentration of solutions;

3. Define the following terms i) Mass percentage
ii) volume percentage iii) Parts per million (ppm). **(E)**
4. Name the concentration term which is commonly used in medicine and pharmacy. Write the definition and mathematical equation for that concentration term. **(E)**

## 1.3 Solubility;

5. Name any three parameters which affects solubility of gas in liquid. **(E)**
6. State Henry's law. Write its mathematical form. What is the significance of Henry's Constant? **(A)**
7. Mention any three applications of Henry's law **(E)**

## 1.4 Vapor Pressure of liquid Solutions;

8. Derive its mathematical expression of vapour pressure for a solution of a non–volatile solute in a volatile solvent. **(A)**
9. Draw a suitable labelled diagram to express the relationship for ideal solution of A and B between vapour pressure and mole fractions of components at constant temperature. **(A)**

## 1.5 Ideal and Non-ideal Solutions;

10. State Raoult's law. Write the conditions necessary for a solution to show ideal behaviour. **(E)**
11. What are ideal and non–ideal solutions? Give reasons for the formation of such solutions. Give one example in each case. **(E)**
12. What are the different types of non–ideal solutions? Give an example for each type. **(E)**
13. Explain positive and negative deviation from ideal behaviour with suitable example of each type. **(E)**
14. Give any three differences between ideal and non-ideal solutions. **(E)**
15. Give any three differences between solutions showing positive and negative deviation from ideal behavior. **(E)**
16. Match the following Type of liquid - liquid solution with their characters: **(A)**

| **Type of liquid - liquid solution** | $\mathbf{p_A}$ | $\Delta$H mixing | $\Delta$V mixing |
|---|---|---|---|
| A. Idea solution | $> p^0_{A}x_A$ | –ve | –ve |
| B. Non ideal solution with positive deviation | $= p^0_{A}x_A$ | = 0 | +ve |
| C. Non ideal solution with negative deviation | $< p^0_{A}x_A$ | +ve | = 0 |

## 1.6 Colligative Properties and Determination of Molar mass;

17. What are colligative properties? Name the colligative property expressed in terms of mole fraction. Write the mathematical equation of that colligative property. **(E)**
18. Show that the relative lowering of vapour pressure for a solution is equal to the mole fraction of the solute when solvent alone is volatile. **(D)**
19. Derive an equation to express that relative lowering of vapour pressure for a solution is equal to the mole fraction of the solute in it when the solvent alone is volatile. **(A)**
20. Show graphically how the vapour pressure of a solvent and a solution of a non–volatile solute change with temperature? Show on this graph the boiling points of the solvent and the solution. Which is higher and Give reason for answer. **(A)**
21. Define the term molal elevation constant and Molal depression constant. Give their SI unit. **(E)**

22. With the help of vapour pressure – temperature diagram, explain the depression of freezing point of a solution of a non-volatile solute in a volatile solvent. How would you determine the molar masses of solute using the above properties? **(D)**
23. What is semi permeable membrane? Give an example each for natural and synthetic semipermeable membrane. **(A)**
24. Write three reasons to justify that osmotic pressure method has the advantage over other colligative methods for the measurement of molar mass of proteins and polymers. **(E)**
25. Write three reasons to justify that osmotic pressure method has the advantage over other colligative methods for the measurement of molar mass of the macromolecules. **(E)**
26. What is an isotonic, hypertonic and hypotonic solution? **(E)**
27. The osmotic pressure of fluid inside the blood cell is that of 0.9% (m/v) NaCl solution (Normal saline solution). What happens when blood cell placed in (mention the follow of water inside or outside the cell?)
    (a) 0.9% (m/v) NaCl solution.
    (b) Greater than 0.9% (m/v) NaCl solution.
    (c) Less than 0.9% (m/v) NaCl solution. **(A)**
28. What is reverse osmosis? Mention one of its practical uses and give an example for artificial semipermeable membrane. **(E)**
29. Match the following **(D)**

| Type of solution | Concentration of NaCl solution | Effect on water flow | On size of the cell |
|---|---|---|---|
| A. Isotonic solution | i. Less than 0.9% (m/v) | No effect or<br>Neither entre nor leaves the system | Swells |
| B. Hypertonic solution | ii. Greater than 0.9% (m/v) | Water flow into the cell | No change |
| C. Hypotonic solution | iii. equal to 0.9% (m/v) | Water flow out of the cell | Shrink |

## 1.7 Abnormal Molar Masses

30. What is abnormal molar mass? Define Van't- Hoff's factor. What would be the value of Van't Hoff factor for a dilute solution of $K_2SO_4$ in water if it undergoes complete dissociation.? **(E)**
31. Why do electrolytes show abnormal molecular masses? Name the factors responsible for abnormality. **(A)**

32. Based on their nature of the compounds, assume that the compound will undergo either 100% association or 100% dissociation. Compare these compounds with their van't Hoff factor value (i). **(A)**

| **Compound name** | **van't Hoff factor value (i)** |
|---|---|
| A. $K_2SO_4$ | i. ½ |
| B. NaCl | ii. 5 |
| C. $FeCl_3$ OR $K_3[Fe(CN)_6]$ | iii. 2 |
| D. $K_4[Fe(CN)_6]$ OR $Al_2(SO_4)_3$ | iv. 4 |
| E. Acetic acid in benzene | v. 1 |
| F. Urea or Glucose | vi. 3 |

## Give reason: (ONE MARK)

### 1.2 Expressing concentration of solutions;

1) Molality preferred over molarity in handling solutions in chemistry. **(E)**
2) The molality of a solution remains unchanged with temperature. **(E)**

### 1.3 Solubility;

3) Carbon tetra chloride and water are immiscible whereas ethanol and water are miscible in all proportions. **(E)**
4) Aquatic species like fish feel more comfortable in the lakes in winter then in summer. **(E)**
5) When cold drink bottles are placed in salt to the box containing ice, cold drink bottles are cold for a longer time. **(E)**
6) Aquatic animals are more comfortable in cold water than in warm water. **(E)**
7) Liquid ammonia bottle first cooled in ice before opening it. **(A)**
8) Dissolution of some solid compounds is exothermic while that of some others is endothermic. **(A)**

### 1.4 Vapor Pressure of liquid Solutions;

9) The vapour pressure of a liquid is constant at constant temperature. **(A)**
10) The vapour pressure of solution of a non–volatile solute in a given solvent is less than that of the pure solvent. **(A)**

### 1.5 Ideal and Non-ideal Solutions;

11) Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. **(E)**
12) An increase in temperature observed on mixing chloroform with acetone. **(A)**
13) Mixture of ethanol and acetone (**cyclohexane)** shows positive deviation from Raoult's law. **(E)**
14) Pure ethyl alcohol cannot be obtained from rectified spirit (95.4% alcohol) even by fractional distillation. **(E)**

## 1.6 Colligative Properties and Determination of Molar mass;

15) Oceans do not freeze. **(A)**

16) The boiling point of a liquid gets raised on dissolution of non–volatile solute into it. **(E)**

17) Water stops boiling when sugar is added to boiling water. **(A)**

18) The freezing point of a solvent is lowered on dissolving a non–volatile solute into it. **(A)**

19) While making ice–creams in metal or plastic cones, the ice–cream seller puts a mixture of ice and common salt around the cones and not - ice alone. **(A)**

20) NaCl solution freezes at lower temperature than water but boils at higher temperature than water. **(E)**

21) When fruits and vegetables that have dried are placed in water, they slowly swell and return to the original form. **(A)**

22) Cutting onions taken from the fridge is more comfortable than cutting onions lying at room temperature I would rather do that. **(A)**

23) Water from the soil, rise to the top of a tall tree. **(A)**

24) A person suffering from high blood pressure is advised to take minimum quantity of common salt. **(E)**

25) The preservation of fruits by adding concentrated sugar solution protects against bacterial action. **(A)**

26) Measurement of osmotic pressure method is preferred for the determination of molar masses of macromolecules such as proteins and polymers. **(A)**

## 1.7 Abnormal Molar Masses

27) When 2 g of benzoic acid is dissolved in 25 g of benzene, the experimentally determined molar mass is always greater than the true value. **(A)**

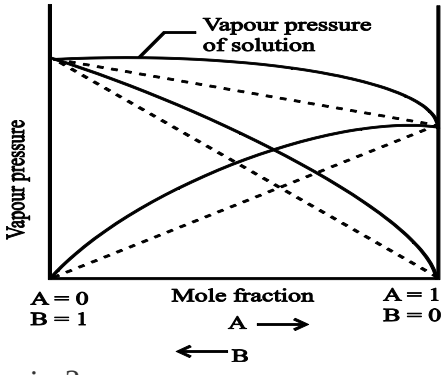
28) Elevation of boiling point of 1 M KCl solution is nearly double than that of 1 M sugar solution. **(A)**

29) Electrolytes show abnormal molecular masses. **(E)**

## DIAGRAM BASED QUESTION: (THREE MARK)

### 1.5 Ideal and Non-ideal Solutions;

1. For this graph; answer the following questions **(A)**

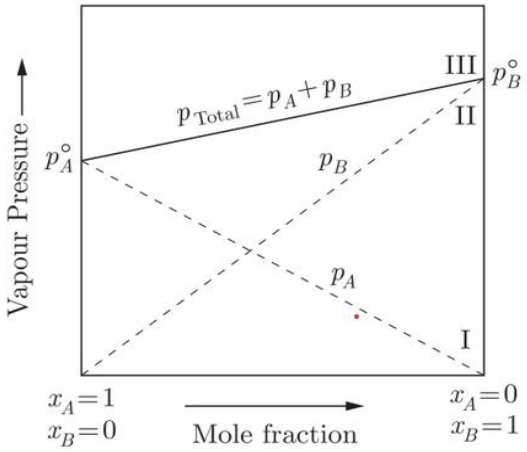



a) What type of non-ideal solution shows such a behavior?

b) Give example for such type of non - ideal solution.

c) What type of azeotrope will the mixture of A and B form?

2. Analyse the given graph and answer the following questions: **(A)**




a) Write the expression for the calculation of vapour pressure of liquid – A in the solution at any concentration.

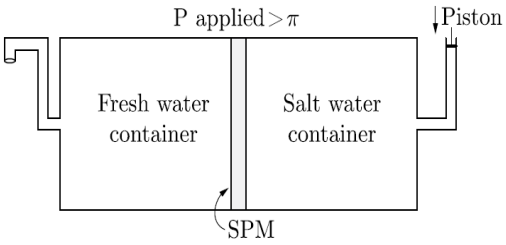
b) Give example for solutions show this type of plot.

c) Whether the formation of solution is exothermic or endothermic?

d) What is the value of $\Delta H_{mixing}$ and $\Delta V_{mixing}$ for this solution?

## 1.6 Colligative Properties and Determination of Molar mass;

3. Given below is the sketch of a plant for carrying out a process. **(A)**



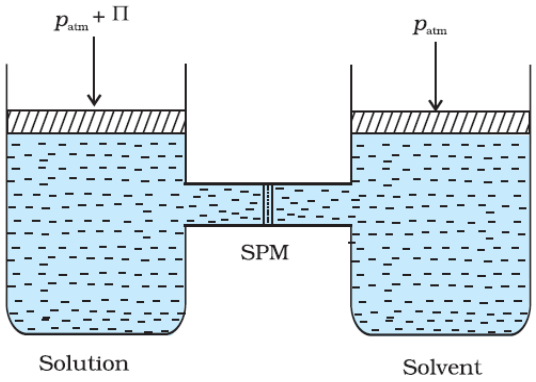

i) Name the process occurring in the given plant.

ii) To which container does the net flow of solvent take place?

iii) Name any one SPM which can be used in this plant.

iv) Give one practical use of the plant.

4. Given in the adjacent Fig. is the sketch of a plant for carrying out a process: $P_{applied} > \pi$ **(A)**




(i) Name the process occurring in the above plant.

(ii) To which container does the net flow of solvent take place?

(iii) Name one SPM which can be used in this plant.

(iv) Give one practical use of the plant.

## Problems: (THREE MARK)

## 1.2 Expressing concentration of solutions;

1. Calculate the molality and mole fraction of the solute containing 3 g of urea (molar mass = 60 g $mol^{-1}$) per 250 g of water. **[Ans: m = 0.2, $X_2$ = 0.0039]** **(A)**
2. Calculate the mole fraction of benzene and carbon tetrachloride in a solution made by dissolving 20g of benzene in 80g of carbon tetrachloride. (Molar mass of benzene =78g $mol^{-1}$, Molar mass of carbon tetrachloride =154g $mol^{-1}$). **[Ans: mole fraction of benzene = 0.33, mole fraction of $CCl_4$ = 0.67]** **(A)**
3. Calculate the molality of 20%(w/v) aqueous solution of KI. Given density of aqueous solution of KI = 1.2g$cm^{-3}$. Molar mass of KI = 166 g $mol^{-1}$. **[Ans: molality = 1.205 mol $kg^{-1}$]** **(A)**
4. Calculate the molality of 2.5g of ethanoic acid ($CH_3COOH$) in 75g of benzene. **[Ans: molarity = 0.55m]** **(A)**
5. Calculate the molarity and molality of 20 per cent aqueous ethanol ($C_2H_5OH$) solution by volume (density of the solution = 0.960 g per $cm^3$). Assume the solution to be ideal. **[Ans: molality = 3.43 M, molality = 4.28 m]** **(A)**
6. 4.0 g of NaOH is contained in one decilitre of a solution. Calculate the following in this solution.
   (i) Mole fraction of NaOH **[Ans: 0.0177]**
   (ii) Molality of NaOH **[Ans: 1 M]**
   (iii) Molarity of NaOH **[Ans: 1.002 m]** **(A)**
   (Molar mass of NaOH = 40 g $mol^{-1}$; Density of NaOH solution is 1.038 g/$cm^3$)
7. A solution contains 90 g of $H_2O$, 6.4 g of methanol and 18.4 g of glycerol. What is the mole fraction of glycerol? (Glycerol = $CH_2OH–CHOH–CH_2OH$) **[Ans: 0.037]** **(A)**
8. Calculate the molarity of a solution containing 5 g of NaOH in 450 mL Solution. **[Ans: 0.027]** **(A)**
9. Sugar syrup of weight 214.2 g contains 34.2 g of sugar ($C_{12}H_{22}O_{11}$). Calculate
   (i) molal concentration **[Ans: 0.55]**
   (ii) mole fraction of sugar in the syrup. **[Ans: 0.0099]** **(A)**
10. Calculate the mass of of $Na_2CO_3$ in grams should be dissolved in 250 g of water to prepare 0.1 m solution? **[Ans: 2.65 g]** **(A)**
11. Calculate the mole fraction of ethanol and water in a sample of rectified spirit which contains 95 per cent of ethanol by weight. **[Ans: mole fraction of ethanol and water are 0.88 and 0.12 respectively]** **(A)**
12. An aqueous solution of sodium chloride is marked 10% (w/w) on the bottle. The density of the solution is 1.071 g $mL^{-1}$. What is the molality and molarity?
    **[Ans: molality = 1.90 m molarity = 1.83 M]** **(A)**
13. Calculate the number of moles of methanol in 5 liters of its 2 m solution, if the density of the solution is 0.981 kg $L^{-1}$ (Molar mass of methanol = 32.0 g $mol^{-1}$). **[Ans: 9.22 mol]** **(A)**

14. A 10 $cm^3$ sample of human urine was found to have 5 milligrams of urea on analysis. Calculate the molarity of the given sample with respect to urea (Mol. mass of urea = 60). **[Ans: 8.33 x $10^{-3}$ M]** **(A)**
15. If 22 g of benzene is dissolved in 122 g of carbon tetrachloride, determine the mass percentage of carbon tetrachloride ($CCl_4$) and benzene ($C_6H_6$). [**Ans:** mass% of benzene= 15.28, mass% of Chloroform = 84.72] **[Ans: mass % of $C_6H_6$ and $CCl_4$ are 15.27% and 84.72% respectively]** **(A)**

## 1.3 Solubility;

16. The mole fraction of He in a saturated solution at 20°C is $1.2\times10^{-6}$. Find the pressure of helium above the solution. Given Henry's constant at 20°C = 144.97 Kbar. **[Ans: $P_{He}$ = solubility/0.174 bar]** **(A)**
17. Henry's law constant for the molality of methane in benzene at 298 K is $4.27\times10^5$ mm Hg. Calculate the mole fraction of methane in benzene at 298 K under 760 mm Hg. **[Ans: 1.78 x $10^{-3}$]** **(A)**
18. Heptane and octane form an ideal solution. At 373 K, the vapour pressures of the two liquid components are 105.2 kPa and 46.8 kPa respectively. Calculate the vapour pressure of a solution containing of 26.0 g of heptane and 35 g of octane. **[Ans: 73.581 KPa]** **(A)**

## 1.5 Ideal and Non-ideal Solutions;

19. The vapour pressure of a pure liquid A is 40 mm Hg at 310 K. The vapour pressure of this liquid in solution with liquid B is mm Hg. Calculate the mole fraction of A in the solution if the mixture obeys Raoult's law. **[Ans: $X_A$ = 0.8]** **(A)**
20. The vapour pressure of water is 12.3 k Pa at 300K, Calculate the vapour pressure of 1 molal solution of a non-volatile solute in it. **[Ans: 12.08 KPa]** **(A)**
21. The vapour pressure of pure liquids A and B are 450 mm Hg and 700 mm Hg respectively, at 350K. Find out the vapour pressure of solution 'A' if total vapour pressure is 600 mm Hg. **[Ans: $x_A$ = 0.4 and $x_B$ = 0.6]** **(A)**

## 1.6 Colligative Properties and Determination of Molar mass;

22. Calculate the mass of a non-volatile solute which should be dissolved in 114g octane to reduce its vapour pressure to 80%. [Given: Molecular formula of octane is $C_8H_{18}$; Molecular mass of solute = 40 g $mol^{-1}$]. **[Ans: 10 g]** **(A)**
23. 100 g of liquid 'A' (molar mass 140 g $mol^{-1}$) was dissolved in 1000 g of liquid 'B' (molar mass 180 g $mol^{-1}$). The vapour pressure of pure liquid 'B' was found to be 500 torr. Calculate the vapour pressure of liquid 'A' and its vapour pressure in the solution if the total vapour pressure of the solution is 475 torr. [**Ans: $p^0_A$ = 280.7 torr and $p_A$ = 32 torr**] **(D)**
24. The vapor pressure of 5% aqueous solution of a non-volatile organic substance at 373 Kelvin is 745 mm. Calculate the molar mass of the solute. **[Ans: $M_2$ = 0.8 g $mol^{-1}$]** **(A)**
25. The vapor pressure of water is 92 mm at 323 K. 18.1g of urea are dissolved in 100 g of water the vapor pressure is reduced by 5 mm Hg. Calculate the molar mass of urea. **[ Ans: 56.7 g $mol^{-1}$]** **(A)**

26. The vapour pressure of compound 'A' and compound 'B' at $25^0$ C are 90 mm Hg and 15 mm Hg respectively. If 'A' and 'B' are mixed each other such that mole fraction of 'A' in the solution is 0.6. Calculate the mole fraction of 'B' in vapour phase. **[Ans: 0.1 mm Hg]** **(A)**

27. The boiling point of benzene is 353.25 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. $K_b$ for benzene is 2.35 K Kg $mol^{-1}$. **[Ans: 57.5 g $mol^{-1}$]** **(E)**

28. Calculate the boiling point of a solution containing 25 g of urea [$NH_2CONH_2$] and 25 g of thiourea [$NH_2CSNH_2$]in 500-gram chloroform [$CHCl_3$] the boiling point of pure chloroform is 61.2°C and $K_b$ is equal to 3.63 $km^{-1}$ **[Ans: 66.616°C]** **(A)**

29. Calculate the molar elevation constant of water, it being given that 0.1 molal aqueous solution of a substance boiled at 100.052°C. [**Ans:** $K_b$= $0.52^0$C]. **(A)**

30. The boiling point of benzene is 353.23K. Calculate the mass of non-volatile solute is to be added to 90g of benzene such that it boils at 354.11K. The molar mass of solute is 58 g $mol^{-1}$ [Given: $K_b$ = 2.53 K Kg $mol^{-1}$]. **[Ans: 1.80 g]** **(E)**

31. A solution containing 34.2g of cane Sugar ($C_{12}H_{22}O_{11}$) dissolved in 500 $cm^3$of water froze at –0.374°C. Calculate the freezing point depression constant of water. **[Ans: $K_f$ = 1.87$Km^{-1}$]** **(E)**

32. A 5% solution (w/w) of cane sugar ($C_{12}H_{22}O_{11}$) in water has freezing point of 271 K. calculate the freezing point depression constant. Given freezing point of pure water is 273.15 K. **[Ans: $K_f$ = 13.97$Km^{-1}$]** **(A)**

33. Calculate the mass of Vitamin C (ascorbic acid, $C_6H_8O_6$) to be dissolved in 78 g of acetic acid to lower its melting point by 1.5°C. Given: $K_f$ of acetic acid is 3.9 K kg $mol^{-1}$. **[Ans: 5.077 g]** **(E)**

34. The solution of urea in water has a boiling point of 100.128°C. Calculate the freezing point of the same solution. Molal constants for water $K_f$ and $K_b$ are 1.86°C and 0.512°C respectively.
**[Ans: $T_f$ = –0.465$^0$C].** **(A)**

35. Two elements A and B form compounds having formulas $AB_2$ and $AB_4$. When dissolved in 20 g of benzene ($C_6H_6$), 1 g of $AB_2$ lowers the freezing point by 2.3 K, whereas 1.0 g of $AB_4$ lowers it by 1.3 K. The molar depression constant for benzene is 5.1 K kg $mol^{-1}$. Calculate the atomic masses of A and B**. [Ans: Atomic masses of A and B are 25.59 u and 42.64]** **(D)**

36. Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving 1.0 g of polymer of molar mass 185,000 in 450 mL of water at 37°C. [R = 8.314 ×$10^3$ Pa $LK^{-1}mol^{-1}$] **[Ans: 30.9 Pa].** **(A)**

37. Calculate the concentration of that solution of sugar which has osmotic pressure of 2.46 atmosphere at 300 K. **[Ans: 34.42g/L].** **(A)**

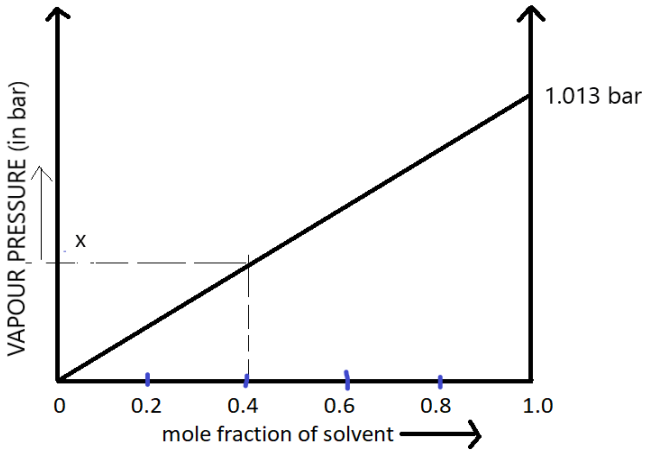
38. Determine the amount (in grams) of $CaCl_2$ (i =2.47) dissolved in 2.5L of water such that its osmotic pressure is 0.75 atm at 27°C. (R = 0.0821 L.atm.$K^{-1}$.$mol^{-1}$, molar mass of $CaCl_2$ = 111 g.$mol^{-1}$) **[Ans: 3.42 g].** **(A)**

39. 400 $cm^3$ of an aqueous solution of a protein contains 2.52g of the protein. The osmotic pressure of such a solution at 300K is found to be 2.57 x $10^{-3}$ bar. Calculate the molar mass of the protein. [R = 0.083 L bar $mol^{-1}$ $K^{-1}$] **[Ans: 61039 $gmol^{-1}$].** **(A)**

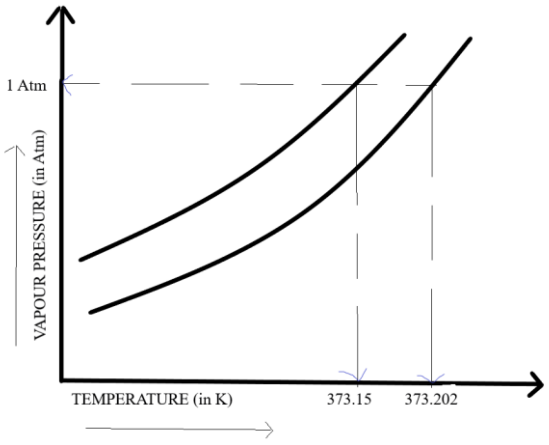
40. Calculate the osmatic pressure in pascal exerted by a solution prepared by dissolving 0.925 g of polymer of molar mass 1,85,000 in 500 mL of water at 37°C. [Given: $R = 8.314 \times 10^3\ Pa\ L\ K^{-1}\ mol^{-1}$] **[Ans: 25.7 Pa].** **(A)**

41. Calculate the osmotic pressure of 0.5% (w/v) aqueous solution sucrose at 300K. (R = 0.0083 L bar $mol^{-1}$ and molar mass of sucrose = 342 g $mol^{-1}$). **[Ans: 0.03635 Pa].** **(A)**

42. If a solution obeys Raoult's law for all concentrations, its vapour pressure would vary linearly from zero to the vapour pressure of pure solvent as shown in graph. Calculate the value of 'x'. **[Ans: 0.4052 bar].** **(A)**




43. The vapour pressure (in Atm) curve for solution containing non-volatile solid substance "G' and pure solvent is plotted against temperature (in K) is as shown in figure. Calculate the molality of the solution. (Kb for water is 0.52 K Kg $mol^{-1}$). **[Ans: 0.1 m].** **(A)**



# Unit 2
# Electrochemistry

## Multiple Choice Questions

1. When $[Zn^{2+}] = [Cu^{2+}] = 1$, the electrical potential of Daniell cell is 1.1 V. however,
   a. When $E_{ext} < 1.1$ V, current flows from Zn to Cu
   b. When $E_{ext} = 1.1$ V, current flows from Cu to Zn
   c. When $E_{ext} > 1.1$ V, current flow from Zn to Cu
   d. When $E_{ext} < 1.1$ V, electrons flow from Cu to Zn. **[E][JEE-2020]**
2. The correct statement/s about Galvanic cell is/are
   1. Current flows from cathode to anode
   2. Anode is positive terminal
   3. If $E_{cell} < 0$, then it is spontaneous reaction
   4. Cathode is positive terminal. **[E][CET-2025]**

   a. 1 and 2 only  b. 1, 2, and 3
   c. 1 and 4 only  d. 2 only
3. What occurs when an atom is oxidized in a chemical reaction?
   a. a loss of electrons and a decrease in oxidation number.
   b. a loss of electrons and an increase in oxidation number.
   c. a gain of electrons and a decrease in oxidation number.
   d. a gain of electrons and an increase in oxidation number. **[E]**
4. Which of the following statement is true for the electrochemical Daniell cell?
   a. electron flow from copper electrode to zinc electrode
   b. current flow from zinc electrode to copper electrode
   c. anions move towards copper electrode
   d. cations move towards copper electrode. **[E]**
5. Which of the following statements associated with electrochemical cells is incorrect?
   a. The function of a salt bridge in an electrochemical cell is to complete the circuit.
   b. Cell potential is the potential difference in a voltaic cell.
   c. A Bronsted-Lowry acid-based reaction can be the basis of the net reaction in a chemical cell.
   d. A half-reaction corresponds to one electrode in a voltaic cell. **[E]**
6. In an electrochemical cell, the electrons flow from
   a. cathode to anode  b. anode to anode
   c. anode to solution  d. solution to cathode. **[E]**

7. Match column I with column II and mark the appropriate choice.

| | **Column I** | | **Column II** |
|---|---|---|---|
| (A) | Electrolytic Cell | (i) | Converts chemical energy into electrical energy |
| (B) | Galvanic Cell | (ii) | Electrochemical cells used for electrolysis |
| (C) | Salt Bridge | (iii) | Maintains electrical neutrality in the cell |
| (D) | Standard Electrode Potential | (iv) | Measured under standard conditions (1M, 1 atm, 25°C) |

a. (A)- (ii), (B)-(i), (C)-(iii), (D)-(iv) b. (A)- (i), (B)-(ii), (C)-(iv), (D)-(iii)

c. (A)- (iii), (B)-(iv), (C)-(ii), (D)-(i) d. (A)- (iv), (B)-(iii), (C)-(i), (D)-(ii) **[E]**

8. Saturated solution of $KNO_3$ is used to make 'salt bridge' because

a. velocity of $K^+$ is greater than that of $NO_3^-$

b. velocity of $NO_3^-$ is greater than that of $K^+$

c. velocities of both $K^+$ and $NO_3^-$ are nearly the same

d. $KNO_3$ is higher soluble in water **[A]**

9. Which of the following is FALSE regarding the salt bridge used in voltaic cells? The salt bridge,

a. allows for the two half-cells to be kept separated

b. maintains the electrical neutrality in each half cell

c. allows mixing of the two electrode solutions

d. is made of a medium through which ions can slowly pass **[E]**

10. Which of these statements about a galvanic cell are not true?

(i) the cathode carries a positive sign

(ii) the anions migrate toward the cathode

(iii) the electrons are released through the anode

(iv) reduction occurs at the anode

a. (i) and (iii) b. (i) and (ii)

c. (ii) and (iii) d. (ii) and (iv). **[E]**

**1.2 Galvanic Cells: Measurement of Electrode Potential (SHE): Electrochemical series:**

11. Standard cell potential is

a. measured at a temperature of 25°C.

b. measured when ion concentrations of aqueous reactants are 1.00 M.

c. measured under the conditions of 1.00 atm for gaseous reactants.

d. All the above. **[E]**

12. Standard hydrogen electrode has zero potential because

a. Hydrogen can be most easily oxidized. b. Hydrogen has only one electron

c. Electro potential is assumed to be 0 d. Hydrogen is the lightest element. **[E]**

13. Platinum foil in SHE is coated with platinum black because

a. increases its surface area for adsorption

b. is a good conductor

c. maintain better electrical contact

d. prevent the electrode from damage **[E]**

14. Consider the following relations for emf of an electrochemical cell.

(i) EMF of cell = (Oxidation potential of anode) – (Reduction potential of cathode)

(ii) EMF of cell = (Oxidation potential of anode) + (Reduction potential of cathode)

(iii) EMF of cell = (Reductional potential of anode) + (Reduction potential of cathode)

(iv) EMF of cell = (Oxidation potential of anode) – (Oxidation potential of cathode)

Which of the above relations are correct?

a. (iii) and (i) b. (i) and (ii)

c. (iii) and (iv) d. (ii) and (iv) **[D][JEE-2010]**

15. Which of the following does not hold good for S.H.E?

a. The pressure of hydrogen gas is 1.5 atmosphere

b. The concentration of $H^+$ in solution is 1 M

c. The temperature is 298 K

d. The surface of platinum electrode is coated with platinum black. **[E]**

16. Which of the following represents a standard hydrogen electrode correctly?

a. pt, $H_2$ (1 atm) $|H^+$ (1 M) 298 K b. pt, $H_2$ (1 atm) $|H^+$ (0.1 M) 298 K

c. pt, $H_2$ (0.1 atm) $|H^+$ (1 M) 273 K d. pt, $H_2$ (0.1 atm) $|H^+$ (0.1 M) 273 K **[E]**

17. Stronger the oxidizing agent, greater is the

a. reduction potential b. oxidation potential

c. ionic behavior d. none of these **[E]**

18. Fluorine is best oxidizing agent because it has

a. highest electron affinity b. highest $E°$ reduction

c. highest $E°$ oxidation d. lowest electron affinity **[E]**

19. Based on the following E° values, the strongest oxidizing agent is

$[Fe(CN)_6] \rightarrow [Fe(CN)_6]^{3-} + e^-$; $E° = -0.35$ V

$Fe^{2+} \rightarrow Fe^{3+} + e^-$; $E° = -0.77$ V

a. $Fe^{3+}$ b. $[Fe(CN)_6]^{3-}$

c. $[Fe(CN)_6]^{4-}$ d. $Fe^{2+}$ **[D][2008-CET]**

20. A solution of potassium bromide is treated with each of the following. Which one would liberate bromine?

a. Hydrogen iodide b. Sulphur dioxide

c. Chlorine d. Iodine **[D][1993-IIT]**

21. Standard reduction potentials of the half reactions given below:

$F_{2(g)} + 2e^- \rightarrow 2F^-_{(aq)}$; E° = + 2.85 V, $Cl_{2(g)} + 2e^- \rightarrow 2Cl^-_{(aq)}$ ; E° = + 1.36 V

$Br_{2(g)} + 2e^- \rightarrow 2Br^-_{(aq)}$ ; E° = + 1.06 V, $I_{2(g)} + 2e^- \rightarrow 2I^-_{(aq)}$ ; E° = + 0.53 V,

the strongest oxidizing and reducing agents respectively are

a. $F_2$ and $I^-$ b. $Br_2$ and $Cl^-$

c. $Cl_2$ and $Br^-$ d. $Cl_2$ and $I_2$ **[A]**

22. The standard electrode potential (E°) values of $Al^{3+}/Al$, $Ag^+/Ag$, $K^+/K$ and $Cr^{3+}/Cr$ are –1.66 V, 0.80 V, –2.93 V and -0.74 V, respectively. The correct decreasing order of reducing power of the metal is

a. Ag > Cr> Al > K b. K > Al > Cr > Ag

c. K> Al > Ag > Cr d. Al > K > Ag > Cr **[A][NEET-2019]**

23. Standard electrode potential for $Sn^{4+}/Sn^{2+}$ is +0.15 V and that for the $Cr^{3+}/Cr$ is -0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be

a. + 1.19 V b. + 0.18 V

c. + 0.89 V d. +1.83 V **[A]**

24. Electrode potentials ($E°_{red}$) of 4 elements A, B, C and D are – 1.36, −0.32, 0, −1.26 V respectively. the decreasing reactivity order of these elements is

a. A, D, B and C b. C, B, D and A

c. B, D, C and A d. C, A, D and B **[A]**

25. Red hot carbon will remove oxygen from the oxide OA and BO but not form MO, while B will remove oxygen from AO. The activity of metals A, B and M in decreasing order is

a. A > B > M b. B > A > M

c. M > B > A d. M > A > B **[D]**

26. Give standard electrode potential:

$K^+/K$= –2.93 V, $Ag^+/Ag$ = 0.80 V

$Hg^{2+}/Hg$ = + 0.79 V, $Mg^{2+}/Mg$ = –2.37 V

$Cr^{3+}/Cr$ = –0.74 V

Which acts as better oxidizing agent?

a. $Mg^{2+}$ b. $Cr^{3+}$

c. $Ag^+$ d. $K^+$ **[A]**

27. The decreasing order of tendencies of the electrodes made up of Cu, Zn and Ag to release electrons when dipped in their respective salt solutions is

a. Zn > Ag > Cu b. Cu > Zn > Ag

c. Zn > Cu > Ag d. Ag > Cu > Zn **[A]**

28. The standard reduction potential at 298 K for the following half-cell reactions are given below:

$Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s)$; $E° = -0.762$ V, $Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$; $E° = -0.740$ V

$\mathbf{2H^+ + 2e^- \longrightarrow H_{2\,(g)}; E^0 = 0.00V}$ $\mathbf{Fe^{3+}{}_{(aq)} + e^- \longrightarrow Fe^{2+}{}_{(aq)}; E^0 = 0.77V}$

Which is the strongest reducing agent?

a. Zn(s) b. Cr(s)

c. $H_2(g)$ d. $Fe^{2+}(aq)$ **[A]**

29. What is the decreasing order of given metals in which they displace each other from the solution of their salts?

a. Fe < Cu < Zn < Al < Mg b. Cu < Fe < Mg < Zn < Al

c. Mg > Al > Zn > Fe > Cu d. Zn > Al > Mg > Cu > Fe **[A]**

30. The position of some metals in the electrochemical series in decreasing electropositive character is given below

Mg > Al > Zn > Cu > Ag

What will happen if a copper spoon is used to stir a solution of aluminum nitrate?

a. The spoon will get coated with Al b. An alloy of Cu-Al is formed

c. The solution becomes blue d. There is no reaction **[D]**

31. A student made the following observations in the laboratory

(i) clean copper metal did not react in a 1 molar $Pb(NO_3)_2$ solution

(ii) clean Pb metal dissolved in a 1 M $AgNO_3$ solution and crystals of Ag metal appeared

(iii) clean silver metal did not react with 1 molar $Cu(NO_3)_2$ solution

The order decreases in reducing character of three metals is

a. Cu, Pb, Ag b. Cu, Ag, Pb

c. Pb, Cu, Ag d. Pb, Ag, Cu **[D]**

32. Chlorine cannot displace

a. Fluorine from NaF b. Iodine from NaI

c. Bromine from NaBr d. none of these **[D]**

## 2.3 Nernst Equation:

33. The name of equation showing the relation between electrode potential(E), standard electrode potential($E^0$) and concentration of ions in solution is,

a. Kohlrausch's equation b. Nernst's equation.

c. Ohm's equation d. Faraday's equation. **[E]**

## 2.3.1 Equilibrium Constant from Nernst Equation:

34. The free energy change is related to equilibrium constant as

a. $\Delta G = RT \ln k$ b. $-\Delta G = RT \log k$

c. $-\Delta G = 2.303RT \log K$ d. $-\Delta G = (RT \log K)/2.303$ **[E]**

35. If the $E^0_{cell}$ for a given reaction has a negative value, then which of the following gives the correct relationship for the value of $\Delta G^\circ$ and $K_{eq}$?

a. $\Delta G^\circ > 0;\ K_{eq} > 1$ b. $\Delta G^\circ < 0;\ K_{eq} > 1$

c. $\Delta G^\circ < 0;\ K_{eq} < 1$ d. $\Delta G^\circ > 0;\ K_{eq} < 1$ **[A][NEET2016, CET-2011]**

36. Nernst equation $E = E^o - \frac{RT}{nF}\ln Q$ indicates that equilibrium constant $K_C$ will be equal to Q when

a. $E = E^\circ$ b. $E = 0$

c. $\frac{RT}{nF} = 1$ d. $E^\circ = 1$ **[D]**

37. The value of constant in Nernst equation $E = E^\circ - \frac{\text{constant}}{n}\ln Q$ $at$ $25^0$ C is

a. 0.0592 b. 0.0592

c. 0.0256 d. 1.36 **[A]**

38. For a given half-cell, $Al_{(aq)}^{3+} + 3e^- \rightarrow Al_{(s)}$ on increasing the concentration of aluminium ion, the electrode potential will

a. decreases b. No change

c. First increase and decreases d. increases **[A][CET-2025]**

## 2.3.2 Electrochemical Cell and Gibbs Energy the Reaction:

39. A voltaic cell has an E° value of –1.00 V. The reaction _____.

a. is spontaneous b. has a positive $\Delta G^\circ$

c. has a negative $\Delta G^\circ$ d. has K = 1 **[A]**

40. The correct relationship between Gibb's free energy change and EMF of a cell is

a. $\Delta G^\circ = nFE^\circ$ b. $\Delta G^\circ = -nFE^\circ$

c. $-\Delta G^\circ = \frac{nF}{E^\circ}$ d. $-\Delta G^\circ = \frac{-nE^\circ}{F}$ **[A]**

41. The EMF of a chemical cell is positive when free energy change of reaction

a. > 0 b. < 0

c. = 0 d. has a very large value **[A]**

## 2.4 Conductance of Electrolytic Solutions:

42. Electronic conductance depends on

a. Nature of electrolyte added b. The number of valence electrons per atom

c. Concentration of the electrolyte d. size of the ions **[E][CET-2025]**

## Measurement of the Conductivity of Ionic Solutions:

43. The unit of molar conductance of an electrolyte solution will be

a. $ohm^{-1}$ cm $mol^{-1}$ b. ohm $cm^2$ $mol^{-1}$

c. mho $cm^2$ $mol^{-1}$ d. $ohm^{-1}$ $cm^2$ $mol^{-1}$ **[A]**

44. Match column I with column II and mark the appropriate choice.

| | **Column I** | | **Column II** |
|---|---|---|---|
| (A) | Cell Potential | (i) | Volt (V) |
| (B) | Current | (ii) | Ampere (A) |
| (C) | Charge | (iii) | Coulomb (C) |
| (D) | Resistance | (iv) | Ohm (Ω) |

a. (A)- (i) , (B)-(ii), (C)-(iii), (D)-(iv) b. (A)- (ii) , (B)-(i), (C)-(iv), (D)-(iii)

c. (A)- (iii) , (B)-(iv), (C)-(ii), (D)-(i) d. (A)- (iv) , (B)-(iii), (C)-(i), (D)-(ii) **[A]**

45. The unit of specific conductivity is

a. $ohm^{-1}\ cm^{-1}$ b. $ohm\ cm^{-2}$

c. $ohm^{-1}\ cm$ d. $ohm^{-1}\ cm^{-1}$ **[E][CET-2006]**

46. The cell constant is the product of resistance and

a. conductance b. molar conductance

c. conductivity d. specific resistance **[A]**

**Variation of Conductivity and Molar Conductivity with Concentration:**

47. Specific conductivity of a solution

a. increases with dilution b. decrease with dilution

c. remains unchanged with dilution d. depends on mass of electrolyte **[A]**

48. Which one of the following statements is incorrect?

a. specific conductivity decreases with dilution

b. equivalent and molar conductivity increase with dilution

c. $\Lambda_\infty$ for weak electrolyte cannot be found by extrapolation of the graph between $\Lambda$ and concentration to zero concentration

d. molar conductivity of a strong electrolyte increases with dilution because ionization increases with dilution **[A]**

49. It is not possible to determine $\Lambda_m^\circ$ for weak electrolytes by extrapolation because

a. it increased linearly with dilution b. it does not increase linearly with dilution

c. it is not affected by dilution d. none of these **[E]**

50. The increase in the value of molar conductively of acetic acid with dilution is due to

a. decrease in interionic force b. increases in degree of ionization

c. increases in self-ionization of water d. none of these **[E]**

51. The pair of electrolytes that possess same value for the constant (A) in the Debye-Huckel-Onsagar equation, $\Lambda_m = \Lambda_m^0 - A\sqrt{C}$

a. $NH_4Cl$, NaBr b. NaBr, $MgSO_4$

c. NaCl, $CaCl_2$ d. $MgSO_4$, $Na_2SO_4$ **[D][CET-2020, 2024]**

52. The ionic conductance's of $Al^{3+}$ and $SO_4^{2-}$ at infinite dilution are $x$ and $y$ $ohm^{-1}cm^2mol^{-1}$ respectively. If Kohlrasch's law is valid, then molar conductance of aluminum sulphate at infinite dilution will be

a. $3x + 2y$ b. $2x + 3y$

c. $3x + 2y$ d. $3x + 3y$ **[A]**

53. Limiting molar conductivity $NH_4OH$ is equal to

a. $\Lambda_m^o(NH_4Cl) + \Lambda_m^o(NaCl) - \Lambda_m^o(NaOH)$ b. $\Lambda_m^o(NaOH) + \Lambda_m^o(NaCl) - \Lambda_m^o(NH_4Cl)$

c. $\Lambda_m^o(NH_4OH) + \Lambda_m^o(NH_4Cl) - \Lambda_m^o(HCl)$ d. $\Lambda_m^o(NH_4Cl) + \Lambda_m^o(NaOH) - \Lambda_m^o(NaCl)$ **[D]**

54. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_2(SO_4)_3$? Given that $\lambda^o_{Al^{3+}}$ and $\lambda^o_{SO_4^{2-}}$ are the equivalent conductance at infinite dilution of the respective ions

a. $2\lambda^o_{Al^{3+}} + 3\lambda^o_{SO_4^{2-}}$ b. $\lambda^o_{Al^{3+}} + \lambda^o_{SO_4^{2-}}$

c. $(\lambda^o_{Al^{3+}} + \lambda^o_{SO_4^{2-}}) \times 6$ d. $\frac{1}{3}\lambda^o_{Al^{3+}} + \frac{1}{2}\lambda^o_{XO_4^{2-}}$ **[A]**

## 2.5 Electrolytic Cells and Electrolysis:

55. Electrolytic cells are electrochemical cells in which _____ reactions are forced to occur by the input of electrical energy.

a. spontaneous b. non-spontaneous

c. exothermic d. endothermic **[E]**

56. During electrolysis electrons are

a. lost b. gained

c. gained by cations and lost by anions d. gained by anions and lost by cations. **[E]**

57. The reaction that takes place at anode is

a. ionization b. reduction

c. oxidation d. hydrolysis **[E]**

58. Electrolytes when dissolved in water dissociate in ion because

a. they are unstable

b. water dissolves it

c. the force of repulsion increases

d. the force of electrostatic attractions is broken down by water **[E]**

59. Electrolysis involves oxidation and reduction respectively at

a. anode and cathode b. cathode and anode

c. at both the electrodes d. none of these **[E]**

60. An electric current is passed through an aqueous solution of the given substance. Which one should decompose?

a. urea b. glucose

c. $AgNO_3$ d. ethyl alcohol **[E]**

## 2.5.1 Products of Electrolysis:

61. During the electrolysis of brine by using inert electrodes

a. $O_2$ liberates at anode b. $H_2$ liberates at anode

c. Na deposits on cathode d. $Cl_2$ liberates at anode **[E][CET-2023]**

62. The charge required for the reduction of 1 mole of $MnO_4^-$ to $MnO_2$ is

a. 1F b. 3F

c. 5F d. 7F **[E][CET-2018]**

63. The passage of current liberates $H_2$ at cathode and $Cl_2$ at anode. The solution is

a. copper chloride in water b. NaCl in water

c. $H_2SO_4$ d. water **[A]**

64. On electrolyzing a solution of dilute $H_2SO_4$ between platinum electrodes, the gas evolved at the anode is

a. $SO_2$ b. $SO_3$

c. $O_2$ d. $H_2$ **[E]**

65. Electrolysis involves _____ at the anode and _____ at the cathode.

a. de-electronation; reduction b. de-electronation; oxidation

c. electronation; oxidation d. electronation; reduction **[E]**

66. Faraday's first law of electrolysis can be expressed as

a. $W \propto Q$ b. $W \propto 1/Q$

c. $W \propto Q^2$ d. $W \propto \sqrt{Q}$ **[E]**

67. 1 coulomb is equal to

a. 96500 Faraday b. charge on $6.24\times10^{18}$ electrons

c. charge on one electron d. 965 Faraday **[E]**

68. Amount of electricity that can deposit 108 g of silver from $AgNO_3$ solution is

a. 1 ampere b. 1 coulomb

c. 1 faraday d. none of these **[E]**

69. The desired amount of charge for obtaining one mole of Al from $Al^{3+}$

a. $3\times96500$ C b. 96500 C

c. $\frac{96500}{3}$C d. $\frac{96500}{2}$C **[E]**

70. Match the following. Select the correct option for the quantity of electricity in $Cmol^{-1}$ required to deposit various metals at cathode

| | **Column I** | | **Column II ($Cmol^{-1}$)** |
|---|---|---|---|
| (A) | $Ag^{+}$ | (i) | 386000 |
| (B) | $Mg^{2+}$ | (ii) | 289500 |
| (C) | $Al^{3+}$ | (iii) | 96500 |
| (D) | $Ti^{4+}$ | (iv) | 193000 |

a. (A)- (iii) , (B)-(iv), (C)-(ii), (D)-(i) b. (A)- (i) , (B)-(iv), (C)-(iii), (D)-(ii)

c. (A)- (iii) , (B)-(iv), (C)-(i), (D)-(ii) d. (A)- (ii) , (B)-(iv), (C)-(iii), (D)-(i) **[A][CET-2025]**

71. Molten NaCl conducts electricity due to the presence of

a. free electrons b. free molecules

c. free ions d. atoms of Na and Cl **[E]**

72. Consider the following :

(i) $2H_2O(i) \rightarrow O_2(g) + 4H^+(aq) + 4e^- E^{o}_{cell} = +1.23\ V$

(ii) $2SO_4^{2-}(aq) \rightarrow S_2O_8^{+}(aq) + 2e^- E^{o}_{cell} = +1.96\ V$

Which of the following statements is true?

a. In the electrolysis of dil. $H_2SO_4$, (i) is preferred at the anode

b. In the electrolysis of conc. $H_2SO_4$, (i) is preferred at the anode

c. In the electrolysis of dil. $H_2SO_4$, (ii) is preferred at the anode

d. In the electrolysis of conc. $H_2SO_4$, both (i) and (ii) occur at anode **[A]**

## 2.6 Batteries:

73. During the charge of lead storage battery, the reaction at anode is represented by

a. $Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4$ b. $PbSO_4 + H_2O \rightarrow PbO_2 + SO_4^{2-} + 2H^+$

c. $Pb \rightarrow Pb^{2+} + 2e^-$ d. $Pb^{2+} + 2e^- \rightarrow Pb$ **[E][CET-2015]**

74. A button cell used in watches function as follows:

$Zn(s) + Ag_2O(s) + H_2O \rightleftharpoons 2Ag(s) + Zn^{2+} + 2OH^-(aq)$ If half-cell potentials are

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s) E° = -0.76V$

$Ag_2O(s) + H_2O(\ell) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq); E° = 0.34V$ The cell potential will be

a. 0.84 V b. 1.10 V

c. 1.34 V d. 0.42 V **[A][NEET-2013]**

75. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because

a. zinc is lighter than iron

b. zinc has lower melting point than iron

c. zinc has lower negative electrode potential than iron

d. zinc has higher negative electrode potential than iron. **[E]**

76. In a dry cell,
    a. the graphite rod is a anode
    b. the ammonia gas accumulates in the cell during its working
    c. the zinc vessel is an anode
    d. the cellular reaction involves the complex formation of Zn with $MnO_2$ **[E]**

77. In the lead storage battery,
    a. a reversible reaction can occur to recharge the battery
    b. lead is oxidized to create a flow of electrons
    c. lead forms the cathode when it is being reduced
    d. all the above **[E]**

78. Dry cell is
    a. a primary battery
    b. also called Leclanche cell
    c. used in transistors and clocks
    d. all the above **[E]**

79. Which out of the given batteries are rechargeable I: Dry cell battery, II: Lead storage battery, III: Nickel-Cadmium battery, IV: lithium battery
    a. I, II, III
    b. II, III, IV
    c. I, III, IV
    d. I, II, IV **[E]**

80. The anode in a dry cell is
    a. graphite rod
    b. copper rod
    c. zinc container
    d. iron rod **[E]**

81. If a lead storage battery is charged, then the incorrect statement is
    a. lead dioxide dissolves
    b. sulphuric acid is regenerated
    c. lead sulphate dissolves
    d. density of sulphuric acid increases **[A]**

82. When dry cells are discharged
    a. carbon dissolves
    b. ammonia evolved
    c. $MnO_2$ decomposed to Mn
    d. ZnO converted into Zn **[A]**

## 2.7 Fuel Cells:

83. 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. electrolyte cell **[E]**

84. The advantages of fuel cells include:
    a. they can be recharged by the addition of more material to be oxidized and/or reduced
    b. they can be made to produce little or no harmful pollutants
    c. they can be made to run very quietly
    d. all the above **[E]**

85. In Fuel cells, _____ are used as catalysts.

a. Zinc- Mercury b. lead- manganese

c. platinum palladium d. nickel cadmium **[E][CET-2022]**

86. Which of the following is wrong regarding fuel cells?

a. They are light mass b. They are efficient

c. They cause no pollution. d. They cannot work continuously **[E]**

87. The product obtained in fuel cells is

a. hydrochloric acid b. hydrogen gas

c. water d. oxygen **[E]**

88. **Statement I:** Fuel cells produce electricity through redox reactions involving fuel and an oxidant.

**Statement II:** Fuel cells are less efficient than combustion engines.

a. Both statements are correct.

b. Statement I is correct, Statement II is incorrect.

c. Statement I is incorrect, Statement II is correct.

d. Both statements are incorrect. **[A]**

## 2.8 Corrosion:

89. Corrosion involves _____ reactions

a. Oxidation b. reduction

c. displacement d. both oxidation and reduction **[E]**

90. In electrochemical corrosion of metals, the metal which is undergoing corrosion

a. becomes anode b. becomes cathode

c. becomes inert d. none of these **[E]**

91. Zinc is used to protect iron from rusting because

a. $E^{\circ}_{red}$ of $Zn > E^{\circ}_{red}$ of Fe b. $E^{\circ}_{ox}$ of $Zn > E^{\circ}_{ox}$ of Fe

c. zinc does not melt easily d. zinc is cheap **[A]**

92. The most convenient method to protect the bottom of ship made of iron is

a. coating it with red lead oxide b. white tin plating

c. connecting it with Mg block d. connecting it with Pb block. **[A]**

93. To protect iron against corrosion, the most durable metal plating on it, is

a. copper plating b. zinc plating

c. nickel plating d. tin plating **[E]**

94. Which of the following statements associated with corrosion is incorrect?

a. Iron corrodes more readily than aluminium because iron is more active than aluminium

b. Cathodic protection prevents corrosion by using a sacrificial anode.

c. A corroding metal has both anodic and cathodic areas.

d. Corrosion involves both oxidation and reduction. **[A]**

95. **Statement I:** Rusting of iron is an electrochemical process.

**Statement II:** In rusting, iron acts as the cathode and oxygen acts as the anode.

a. Both statements are correct.

b. Statement I is correct, Statement II is incorrect.

c. Statement I is incorrect, Statement II is correct.

d. Both statements are incorrect. **[A]**

96. **Statement I:** Metals higher in the electrochemical series are more likely to corrode.

**Statement II:** Noble metals like gold and platinum are highly reactive and corrode easily.

a. Both statements are correct.

b. Statement I is correct, Statement II is incorrect.

c. Statement I is incorrect, Statement II is correct.

d. Both statements are incorrect. **[A]**

97. Match column I with column II and mark the appropriate choice.

| | **Column I** | | **Column II** |
|---|---|---|---|
| (A) | Faraday's First Law | (i) | Relates electrode potential to concentration and temperature |
| (B) | Faraday's Second Law | (ii) | Limiting molar conductivity = sum of individual ion conductivities |
| (C) | Kohlrausch's Law | (iii) | Mass deposited ∝ equivalent weight of substance |
| (D) | Nernst Equation | (iv) | Mass of substance deposited ∝ quantity of electricity passed |

a. (A)- (i), (B)-(ii), (C)-(iii), (D)-(iv) b. (A)- (ii), (B)-(i), (C)-(iv), (D)-(iii)

c. (A)- (iii), (B)-(iv), (C)-(ii), (D)-(i) d. (A)- (iv), (B)-(iii), (C)-(ii), (D)-(i) **[E]**

98. **Statement I:** Electrolysis is used in the extraction of reactive metals like sodium and aluminum.

**Statement II:** Electrolysis is not used in the purification of metals.

a. Both statements are correct.

b. Statement I is correct, Statement II is incorrect.

c. Statement I is incorrect, Statement II is correct.

d. Both statements are incorrect. **[A]**

99. **Statement I:** Electrochemical processes are essential for hydrogen storage and conversion.

**Statement II:** Hydrogen economy does not involve any redox reactions.

a. Both statements are correct.

b. Statement I is correct, Statement II is incorrect.

c. Statement I is incorrect, Statement II is correct.

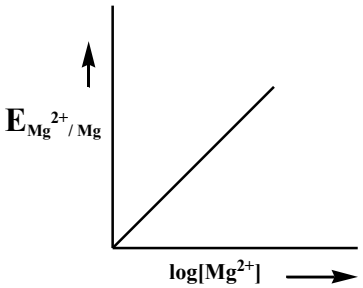
d. Both statements are incorrect. **[A]**

## NCERT-EXEMPLAR

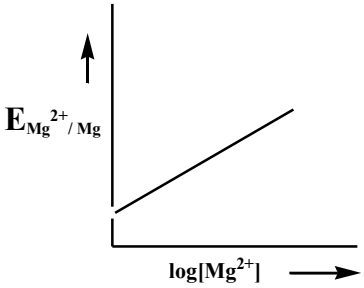
100. Electrode potential of Mg electrode varies according to the equation

$E_{Mg^{2+}/Mg} = E^0{}_{Mg^{2+}/Mg} - \frac{0.059}{2} log \frac{1}{[Mg^{2+}]}$, the graph of $E_{Mg^{2+}/Mg}$ vs log [$Mg^{2+}$] is

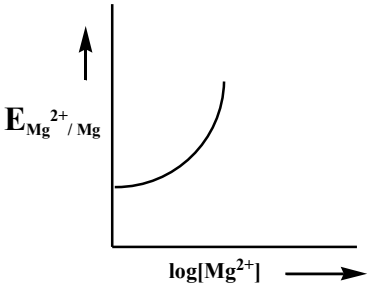
**a.**



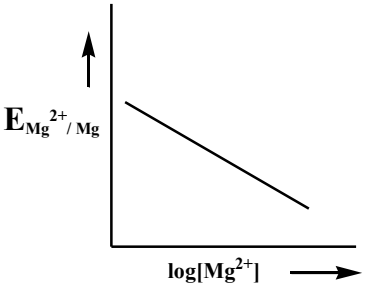

**b.**




**c.**




**d.**




**[A]**

101. Which cell will measure the standard electrode potential of copper electrode?

a. $Pt_{(s)}/\ H_2\ (g, 0.1\ bar)/\ H^+(aq., 1\ M)\ //\ Cu^{2+}(aq., 1M)/\ Cu$

b. $Pt_{(s)}/\ H_2\ (g, 1\ bar)/\ H^+(aq., 1\ M)\ //\ Cu^{2+}(aq., 2M)/\ Cu$

c. $Pt_{(s)}/\ H_2\ (g, 1\ bar)/\ H^+(aq., 1\ M)\ //\ Cu^{2+}(aq., 1M)/\ Cu$

d. $Pt_{(s)}/\ H_2\ (g, 1\ bar)/\ H^+(aq., 0.1\ M)\ //\ Cu^{2+}(aq., 1M)/\ Cu$ **[A]**

102. Which of the following statement is correct?

a. $E_{cell}$ and $\Delta_r G$ of cell reaction both are extensive properties.

b. $E_{cell}$ and $\Delta_r G$ of cell reaction both are intensive properties.

c. $E_{cell}$ is an intensive property while $\Delta_r G$ of cell reaction is an extensive property.

d. $E_{cell}$ is an extensive property while $\Delta_r G$ of cell reaction is an intensive property. **[A]**

103. 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 **[E]**

104. Which of the following statements 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. **[A]**

105. An electrochemical cell can behave like an electrolytic cell when

a. $E_{cell} = 0$ b. $E_{cell} > E_{ext}$

c. $E_{ext} > E_{cell}$ d. $E_{cell} = E_{ext}$ **[E]**

106. 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 **[E]**

107. Using the data given below find out the strongest reducing agent.

$\boldsymbol{E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V,\ E^0_{MnO_4^-/Mn^{2+}} = 1.51\,V,}$

$\boldsymbol{E^0_{Cl_2/Cl^-} = 1.36\,V,\quad E^0_{Cr^{3+}/Cr} = -0.74\,V}$

a. $Cl^-$ b. Cr

c. $Cr^{3+}$ d. $Mn^{2+}$ **[A]**

108. Using the data given below find out the strongest oxidising agent.

$\boldsymbol{E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V,\ E^0_{MnO_4^-/Mn^{2+}} = 1.51\,V,}$

$\boldsymbol{E^0_{Cl_2/Cl^-} = 1.36\,V,\quad E^0_{Cr^{3+}/Cr} = -0.74\,V}$

a. $Cl^-$ b. $Mn^{2+}$

c. $MnO_4^-$ d. $Cr^{3+}$ **[A]**

109. Using the data given below find out in which option the order of reducing power is correct

$\boldsymbol{E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V,\ E^0_{MnO_4^-/Mn^{2+}} = 1.51\,V,}$

$\boldsymbol{E^0_{Cl_2/Cl^-} = 1.36\,V,\quad E^0_{Cr^{3+}/Cr} = -0.74\,V}$

a. $Cr^{3+} < Cl^- < Mn^{2+} < Cr$ b. $Mn^{2+} < Cl^- < Cr^{3+} < Cr$

c. $Cr^{3+} < Cl^- < Cr_2O_7^{2-} < MnO_4^-$ d. $Mn^{2+} < Cr^{3+} < Cl^- < Cr$ **[A]**

110. Using the data given below find out the most stable ion in its reduced form.

$\boldsymbol{E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V,\ E^0_{MnO_4^-/Mn^{2+}} = 1.51\,V,}$

$\boldsymbol{E^0_{Cl_2/Cl^-} = 1.36\,V,\quad E^0_{Cr^{3+}/Cr} = -0.74\,V}$

a. $Cl^-$ b. $Cr^{3+}$

c. $Cr$ d. $Mn^{2+}$ **[A]**

111. Using the data given below find out the most stable oxidized species.

$\boldsymbol{E^0_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33\,V,\ E^0_{MnO_4^-/Mn^{2+}} = 1.51\,V,}$

$\boldsymbol{E^0_{Cl_2/Cl^-} = 1.36\,V,\quad E^0_{Cr^{3+}/Cr} = -0.74\,V}$

a. $Cr^{3+}$ b. $MnO_4^-$

c. $Cr_2O_7^{2-}$ d. $Mn^{2+}$ **[A]**

112. The quantity of charge required to obtain one mole of aluminium from $Al_2O_3$ is

a. 1F b. 6F

c. 3F d. 2F **[A]**

113. In the electrolysis of aqueous sodium chloride solution which of the half-cell reaction will occur at anode

a. $Na^+$ (aq) + $e^-$ → Na (s) ; $\boldsymbol{E^0_{Cell} = -2.17V}$

b. $2H_2O$ (l) → $O_2$ + $4H^+$ (aq) + $4e^-$ ; $\boldsymbol{E^0_{Cell} = 1.23V}$

c. $H^+$ (aq) + $e^-$ → ½ $H_2$ (g) ; $\boldsymbol{E^0_{Cell} = 0.00V}$

d. $Cl^-$ (aq) → ½ $Cl_2$ (g) + $e^-$ ; $\boldsymbol{E^0_{Cell} = 1.36V}$ **[A]**

## Fill in the blanks by choosing the appropriate word from those given in the brackets:

**Set-1**

**(Galvanisation, negative, Electrolytic cell, $PbO_2$, depolarizer, Galvanic cell)**

1. In galvanic cells, the electrode which acts as anode is a _____ pole. **[E]**
2. In lead storage battery, the cathode consists of_____ **[E]**
3. In Leclanche cell, $MnO_2$ acts as a _____ **[A]**
4. Protection of iron by coating with zinc is called _____ **[E]**
5. The arrangements in which electrical energy supplied brings about a redox reaction is called_____**[E]**

**Set-2**

**(less, equal, hydrogen, positive, sodium, negative)**

1. Zinc displaces copper from copper sulphate solution because the standard reduction potential of zinc is_____ than that of copper. **[E]**
2. If the value of standard electromotive force $E^0_{Cell}$ of a galvanic cell is _____then the cell reaction will be spontaneous. **[E]**
3. The cation and anion of the electrolyte used in salt bridge have _____mobility. **[A]**
4. During electrolysis of an aqueous sodium chloride solution_____ is produced at the cathode.**[E]**
5. During electrolysis of a fused sodium chloride _____ is produced at that cathode. **[E]**

**Set-3**

**($Ohm^{-1}$, non-electrolyte, electrochemical, weak electrolyte, automobiles, $cm^{-1}$)**

1. NaCl solution conduct electricity but urea cannot conduct electricity because it is a ___compound.**[E]**
2. The unit of cell constant of a conductivity cell is _____ **[E]**
3. Acetic acid is a _____ **[E]**
4. Rusting of iron is an _____process. **[E]**
5. Lead storage battery is used in _____ **[E]**

**Set-4**

**(Anode, Hg-button cell, Zinc, Electrochemical equivalent, Copper, cathode)**

1. In any electrochemical cell, the ____ is always the electrode at which some species gain electrons **[E]**
2. The site of oxidation in an electrochemical cell is_____ **[E]**
3. _____is used in pacemakers, electronic watches and hearing aids. **[A]**
4. _____is defined as the amount of substance deposited or liberated at the electrode by a charge of 1 coulomb. **[E]**
5. Metal used as a coating on steel to limit corrosion is_____ **[E]**

**Set-5**

**(three, spontaneous, oxygen, nonspontaneous, Zero, hydrogen)**

1. The positive $E^0$ value shows that the reactions are _____ **[E]**
2. Electrolysis is a process in which electrical energy is used to cause a _____chemical reaction. **[E]**
3. The reference electrode SHE has EMF of exactly _____Volt. **[E]**
4. When diluted sulfuric acid is electrolyzed between platinum electrodes the gas liberated at the anode will be _____ **[E]**
5. The amount of charge carried by 1 gram of $Al^{+3}$ ion is_____ Faraday. **[E]**

**Set-6**

**(Siemen, platinum, palladium, increases, Siemen/metre, decreases)**

1. Conductivity always _____ with decrease in concentration. **[E]**
2. Molar conductivity _____with decrease in concentration. **[E]**
3. The SI unit of conductance is _____ **[E]**
4. The SI unit of conductivity is _____ **[E]**
5. The standard hydrogen electrode consists of a _____ electrode coated with platinum black. **[E]**

**TWO/THREE MARKS QUESTIONS**

## 2.1 Electrochemical Cells:

1. What are electrochemical cells? Mention the types of electrochemical cells. **[E]**
2. Explain difference between Galvanic cells (Electrochemical cell) and Electrolytic cells? **[E]**
3. How do you represent a Daniel cell symbolically? Write the electrode reactions and the overall cell reaction. **[A][June-2024]**
4. What are the functions of salt bridge? **[E]**
5. What would happen if no salt bridge were used in an electrochemical cell (like Zn—Cu cell)? Why is it necessary to use a salt bridge in a Galvanic cell? **[A]**

## 2.2 Galvanic Cells: Measurement of Electrode Potential (SHE): Electrochemical series:

1. What do you understand by the following?
   a) Negative standard electrode potential
   b) Positive standard electrode potential. **[E]**
2. Define i) electrode potential? ii) Standard electrode potential? **[E]**
3. What is the effect of change in (a) concentration (b) temperature on the electrode potential of a given half-cell? **[A]**
4. What is an electrochemical series?
   i) How does it help in predicting whether a redox reaction is feasible in a given direction or not? **[D]**
   ii) How does it help in calculating the e.m.f. of a standard cell? **[E]**
5. Give the reason why blue copper sulphate solution is discharged slowly when an iron rod is dipped in it. Given $E^{o}_{Cu^{2+}/Cu} = 0.34\ V$, $E^{o}_{Fe^{2+}/Fe} = -0.44\ V$ **[A]**
6. What is meant by reduction electrode potentials of zinc and copper being –0.76 V and +0.34 V respectively? Can an aqueous solution of $CuSO_4$ be stored in a zinc vessel? Answer with reason. **[A]**
7. Is it safe to stir $AgNO_3$ solution with a copper spoon? Justify. Given $E^{o}_{Ag^{+}/Ag} = 0.80\ V$ volt and $E^{o}_{Cu^{2+}/Cu} = 0.34\ V$ volt. **[A]**
8. $I_2$ and $F_2$ are added to a solution containing 1 M each of $I^-$ and $F^-$. What reaction will take place? Given that the reduction potentials of $I_2$ and $F_2$ are 0.54 volt and 2.87 volts respectively. **[D]**
9. How can the reduction potential of an electrode be increased? **[E]**
10. Give reason : Copper displaces silver from silver nitrate solution. **[A]**
11. Describe the construction and working of SHE or standard hydrogen electrode. **[A][March-2025]**
12. Mention the uses of standard hydrogen electrode? **[E]**
13. Give reasons:
    i) Zinc displaces copper from copper sulphate solution.
    ii) Zinc displaces hydrogen from HCl, but copper does not.
    iii) Iron displaces copper from copper sulphate solution, but copper cannot displace iron from ferrous sulphate solution. **[A]**

## Problems (3Marks)

1. For the standard cell **Cu(s)/Cu²⁺(aq)//Ag⁺/Ag(s)** $E^{0}_{Cu^{2+}/Cu} = 0.34V, E^{0}_{Ag^{+}/Ag} = 0.80V$
   i. identify the cathode and the anode as the current is drawn from the cell.
   ii. Write the reaction taking place at the electrodes.
   iii. Calculate the standard cell potential. **[A]**
2. The Standard electrode potential for Daniel cell is 1.1 V. Calculate the standard Gibbs free energy for the reaction: $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ **[E][March-2025]**
3. The Standard electrode potential for a cell is 0.235 V. Calculate the standard Gibbs free energy for the reaction: $2Fe^{3+}(aq) + 2I^{-}(aq) \rightarrow Fe^{2+}(aq) + I_2(s)$ **[E][May-2025]**

## 2.3 Nernst Equation:

1. i) Write the relation between $E^{\circ}_{cell}$ and equilibrium constant (K) of cell reaction.
   ii) Write down the Nernst equation for electrode potential. **[E]**
2. What are the factors that electrode potential depends on? **[E]**
3. Write the Nernst equation and emf of the following cells at 298 K.
   (i) $Mg(s)|Mg^{2+}_{(0.001M)} \parallel Cu^{2+}_{(0.0001M)}|Cu(s)$
   (ii) $Fe(s)|Fe^{2+}_{(0.001M)} \parallel H^{+}_{(1M)}||H_2(g)(1bar)|Pt(s)$
   (iii) $Sn(s)|Sn^{2+}_{(0.050M)} \parallel H^{+}_{(0.020M)}|H_2(g)(1bar)|Pt(s)$ **[A]**
4. Write the Nernst equation for the following cell $Zn/Zn^{2+}_{(aq)}//Cu^{2+}_{(aq)}/Cu$. **[A]**

## Problems (3Marks)

1. Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10. **[D]**
2. Two students use same stock solution of zinc sulphate and a solution of copper sulphate the EMF of one cell is 0.03 Volt higher than the other. The concentration of copper sulphate in the cell with higher EMF value is 0.5M. Find out the concentration of copper sulphate in the other cell (2.303 RT/F=0.06). **[D]**
3. Calculate the emf of the cell in which the following reaction takes place
   $Ni(s) + 2Ag^{+}(0.002M) \rightarrow Ni^{2+}(0.160M) + 2Ag(s)$ Given that $E^{o}$ cell=1.05 V **[A]**
4. Calculate the emf of the cell in which the following reaction takes place at 298K.
   $Mg(s) + 2Ag^{+}(0.0001M) \rightarrow Mg^{2+}(0.2M) + 2Ag(s)$ Given that $E^{o}$ cell= 3.17 V. **[A][June-2025]**
5. Calculate the emf of the cell in which the following reaction takes place at 298 K.
   $Mg(s) + Cu^{2+}(0.001M) \rightarrow Mg^{2+}(0.01M) + Cu(s)$ Given that $E^{o}$ cell= 2.71 V. **[A][June-2024]**
6. If $E^{o}_1$, $E^{o}_2$ and $E^{o}_3$ are the standard electrode potential for $Fe/Fe^{2+}$, $Fe^{2+}/Fe^{3+}$ and $Fe/Fe^{3+}$ electrodes respectively derive a relation between $E^{o}_1$, $E^{o}_2$ and $E^{o}_3$. **[D]**
7. For the cell reaction $Sn(s) + Pb^{2+}(aq) \rightarrow Sn^{2+}(aq) + Pb(s)$ $E^{o}_{\frac{Sn^{2+}}{Sn}} = -0.140V, E^{o}_{Pb^{2+}/Pb} = -0.126V$. Calculate the ratio of concentration of $Pb^{2+}$ to $Sn^{2+}$ ion at which the cell reaction will be reversed? **[D]**
8. EMF of Daniel cell was found using different concentration of $Zn^{2+}$ ion and $Cu^{2+}$ion. A graph was then plotted between $E_{cell}$ and $\log\frac{Zn^{2+}}{Cu^{2+}}$. The plot was found to be linear with intercept on $E_{cell}$ axis equal to 1.10 volt. Calculate $E_{cell}$ for $Zn/Zn^{2+}_{(0.1M)} \parallel Cu^{2+}_{(0.01M)}/Cu$ **[D]**
9. The EMF of the cell corresponding to the reaction
   $Zn(s) + 2H^{+}(aq) \rightarrow Zn^{2+}_{(0.1M)} + H_{2(g,\,1atm)}$ is 0.28V at $25^{0}$C. Write the half-cell reactions and calculate the pH of the solution at hydrogen electrode. $E^{o}_{Zn^{2+}/Zn} = -0.76$ V, $E^{o}_{H^{+}/H_2} = 0.0$ V **[A]**

10. Calculate the emf of the following cell at 298 K. $Sn_{(s)}$ /$Sn^{2+}_{0.050M}$//$H^{+}_{0.020M}$/$H_{2(1bar)}$ /$Pt_{(s)}$ ; Given: $E^{0}_{Sn^{2+}/Sn} = -0.14V$. **[A]**

11. Calculate the emf of the cell in which the following reaction takes place at 298K.
Cu(s) + $2Ag^{+}_{(1\times10^{-3})}$ → $Cu^{2+}$ (0.250M) +2Ag(s) Given that E° cell= 2.97 V. **[A]**

## 2.3.1 Equilibrium Constant from Nernst Equation:

1. How can the Nernst equation be applied in the calculation of the equilibrium constant of any cell reaction? **[A]**

## 2.3.2 Electrochemical Cell and Gibbs Energy the Reaction:

1. What is free energy and free energy change? Explain how free energy is related to cell potential? Also explain its significance in predicting the feasibility of the cell reaction. **[A]**
2. What is the free energy change for (a) galvanic cell (b) electrolytic cell? **[A]**

### Problems (PART-E)

1. The cell in which of the following reaction occurs $2Fe^{3+}(aq)+2I^{-}(aq)\rightarrow 2Fe^{2+}(aq)+I_2(s)$ has $E^{o}_{cell}=0.236V$ at 298K. Calculate the standard Gibbs energy change and the equilibrium constant of the cell reaction. **[A]**
2. Calculate the equilibrium constant for the reaction.
$2Fe^{3+} + 3I^{-} \rightleftharpoons 2Fe^{2+} + I_3^{-}$. The standard reduction potentials in acidic conditions are 0.77 and 0.54 V respectively for **$Fe^{3+}/Fe^{2+}$ and $I_3^{-}/I^{-}$** **[A]**
3. Calculate the equilibrium constant of the reaction at 298 K. $Cu_{(s)}$ + $2Ag^{+}_{(aq)}$ → $Cu^{2+}_{(aq)}$ +$2Ag_{(s)}$ $E^{0}_{Cell} = 0.46V$ . **[A]**

## 2.4 Conductance of Electrolytic Solutions:

## 2.4.1 Measurement of the Conductivity of Ionic Solutions:

1. Why is alternating current used in place of direct current in measuring the electrolytic conductance? **[E]**

## 2.4.2 Variation of Conductivity and Molar Conductivity with Concentration:

1. What is conductivity? Mention the SI unit of conductivity? **[E]**
2. Write an expression for cell constant. What is SI unit of specific resistance? **[E]**
3. Write the SI units for i) Specific conductance. (ii) Molar conductance. **[E]**
4. Define molar conductivity? How does it vary with increase in concentration of solution? **[E][May-2025]**
5. What is an electrolyte? Give an example for strong and weak electrolytes. **[E]**
6. Why is it necessary to platinize the electrodes of a conductivity cell before it is used for conductance measurement? **[A]**

7. Define limiting molar conductivity and how it is related to molar conductivity of strong electrolyte? **[A]**

8. Copper is conducting as such while copper sulphate is conducting only in molten state or in aqueous solution. Explain. **[A]**

9. Which will have greater molar conductivity and why?
   Sol. A. 1 mol KCl dissolved in 200 cc of the solution.
   Sol. B. 1 mol KCl dissolved in 500 cc of the solution. **[D]**

10. In case of the following pairs, which will allow greater conduction of electricity and why?
    a) Silver wire at 20°C, Same silver wire at 50°C
    b) NaCl solution at 20°C, Same NaCl solution at 50°C
    c) $NH_4OH$ solution at 20°C, Same $NH_4OH$ solution at 50°C
    d) 0.1 M acetic acid solution, 1 M acetic acid solution. **[A]**

11. Write Debye - Onsager equation and mention the various terms. **[A]**

12. What is the effect of temperature on molar conductivity? **[E]**

13. What is the effect of dilution on conductivity and molar conductivity? **[E]**

14. Why $\boldsymbol{\Lambda_m}$ for $CH_3COOH$ cannot be determined experimentally? **[A]**

15. Out of HCl and NaCl, which do you expect will have greater value for $\boldsymbol{\Lambda^0_m}$ and why? **[E]**

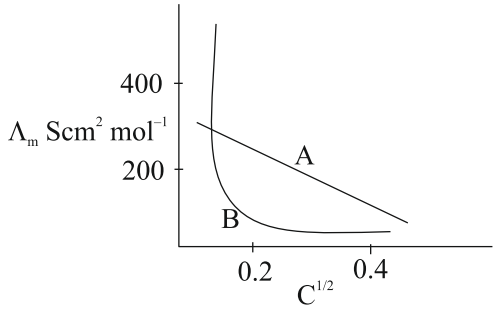
16. 0.1 M aqueous of $Na_2SO_4$ is diluted by adding water. What will happen to the values of its conductance (G), conductivity (κ) and molar conductivity ($\boldsymbol{\Lambda_m}$)? **[A]**

17. Give reason: Conductivity of an electrolyte solution decreases with the decrease in concentration. **[E]**

18. State Kohlrausch's law. What are its applications? **[A]**

19. Mention any three factors which affect electrolytic conductivity. **[A][May-2024]**

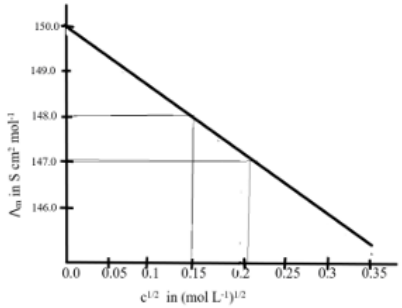
20. The curves obtained when molar conductivity $\Lambda_m$(y-axis) is plotted against the square root of concentration$C^{1/2}$ for two electrolytes A and B are shown in the given figure.
    a) What can you say about the structure of the two electrolytes A and B
    b) How do you account for the increase in the molar conductivity $\Lambda_m$ for electrolytes A and B on dilution? **[D]**



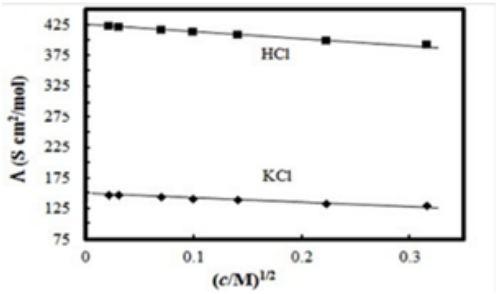

21. Depending on the magnitude of conductivity of the materials, mention the three types of materials with an example. **[A]**

## Problems (PART-E)

1. The resistance of a 0.01 N solution of an electrolyte is 100 ohms. Calculate its (a) conductance, (b) Conductivity and (c) resistivity. The cell constant of the cell is 1 cm. **[D]**
2. The molar conductivity of 0.025 $molL^{-1}$methanoic acid is 46.1 $Scm^2mol^{-1}$ Calculate its degree of dissociation and dissociation constant. Given $\lambda^0$ $(H^+)$ =349.6 $Scm^2mol^{-1}$ and $\lambda^0$ $(HCOO^-)$ = 54.6 $Scm^2mol^{-1}$. **[D]**
3. Conductivity of 0.0241M ethanoic acid is $7.896 \times 10^{-5}$ $Scm^2mol^{-1}$. Calculate its Molar Conductivity. If limiting molar conductivity for ethanoic acid is 390.5 $Scm^2mol^{-1}$. What is its degree of dissociation? **[D][May, June-2024]**
4. Show that 0.08 molar solution having conductivity equal to $2\times10^{-2}$ $\Omega^{-1}cm^{-1}$ has higher molar conductance than 0.10 molar solution having resistivity equal to 58 cm. **[D]**
5. Solutions of two electrolytes A and B each having a concentration of 0.2 M have conductivities $2\times10^{-2}$ and $4\times10^{-4}$ $cm^{-1}$ respectively. Which will offer greater resistance to the flow of current and why? **[D]**
6. The molar conductivity of acetic acid solution at infinite dilution is 390.7 $\Omega^{-1}cm^{-2}mol^{-1}$ Calculate the molar conductivity of 0.01 molar acetic acid solution given that the dissociation constant of acetic acid is $1.8\times10^{-5}$ **[D]**
7. The $\Lambda^0_m$ values for NaCl and KCl are 126.5 and 149.9 $\Omega^{-1}cm^{-2}mol^{-1}$ respectively. The ionic conductance's of $Na^+$ at infinite dilution is 50.1 $\Omega^{-1}cm^{-2}mol^{-1}$. Calculate the ionic conductance at infinite dilution for $K^+$ ion. **[A]**
8. Which of the following solutions has larger molar conductance?
   (i) 0.08 M solution having conductivity equal to 2.0 $10^{-2}$ $\Omega^{-1}cm^{-1}$
   (ii) 0.1 M solution having resistivity equal to 58 Ωm. **[A]**
9. The resistance of a conductivity cell containing 0.001M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001M KCl solution at 298 K is $0.146 \times 10^{-3}$ S $cm^{-1}$ **[A]**
10. The conductivity of 0.001028 $molL^{-1}$ acetic acid is $4.95 \times 10^{-5}$ S $cm^{-1}$. Calculate its dissociation constant if $\Lambda^0_m$ for acetic acid is 390.5 $Scm^2mol^{-1}$ **[A][March-2025]**
11. For strong electrolyte, molar conductivity increases slowly with dilution and represented by equation: $\Lambda_m = \Lambda^0_m - A\,c^{1/2}$. The plot of molar conductivity ($Scm^2mol^{-1}$) of strong electrolyte 'X' v/s $c^{1/2}$ $(molL^{-1})^{1/2}$ is as shown in the figure. Determine the value of 'A' and limiting molar conductivity for solute 'X'. **[D]**




12. The limiting molar conductivity of $CH_3COOH$ is 390 $Scm^2/mol$. Using the graph and given information calculate the limiting molar conductivity of $CH_3COOK$. **[D]**




13. A column containing 0.05 M NaOH has an area of cross section $0.785cm^2$ and length of 1m shows a resistance of $1.11\times10^4$ Ω. Calculate the molar conductivity of the solution. **[A]**
14. Calculate the limiting molar conductivity of $Cl^-$ ion by using the data: $\lambda_{Ca^{2+}}$ = 119.0 $Scm^2mol^{-1}$ and $\Lambda^0_{CaCl2}$= 271.6 $Scm^2mol^{-1}$. **[A]**

## 2.5 Electrolytic Cells and Electrolysis:

1. State Faraday's first and second law of electrolysis. Give its mathematical expression and mention any two factors that determine the product of electrolysis. **[A][June-2025]**
2. Define electrochemical equivalent. How is it related to the equivalent weight of the element? **[A]**
3. How much substance is deposited by 1 coulomb? What is it called? **[E]**
4. Why does the electrolysis of NaBr and NaI give $Br_2$ and $I_2$ respectively while that of NaF gives $O_2$ instead of $F_2$? **[D]**
5. How much electricity is required in coulomb for the oxidation of
   (i) 1mol of $H_2O$ to $O_2$? (ii) 1 mol of FeO to $Fe_2O_3$? **[A][MAY-2025]**
6. How much charge is required for the following reductions?
   (i) 1mol of $Al^{3+}$ to Al
   (ii) 1mol of $Cu^{2+}$ to Cu
   (iii) 1 mol of $MnO_4^-$ to $Mn^{2+}$ **[A][June-2024]**

## Problems (PART-E)

1. How much electricity is required in terms of Faraday to produce
   (i) 20.0 g of Ca from molten $CaCl_2$?
   (ii) 40.0 g of Al from molten $Al_2O_3$? **[A]**

2. A solution of $Ni(NO_3)_2$ is electrolyzed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of Ni is deposited at the cathode? **[A][MAY-2025]**
3. An electric current of 100 ampere is passed through a molten liquid of sodium chloride for 5 hours. Calculate the volume of chlorine gas liberated at the electrode at NTP. **[D]**
4. How long has a current of 3 amperes to be applied through a solution of silver nitrate to coat a metal surface of 80 $cm^2$ with 0.005 cm thick layer? Density of silver is 10.5 $g/cm^3$. **[D]**
5. If a current of 0.5 ampere flows through a metallic wire for 2hrs, then how many electrons flow through the wire? **[A][June-2025]**
6. How many grams of chlorine can be produced by the electrolysis of molten sodium chloride the current of 1 amp for 15 min? Also calculate the number of chlorine molecules liberated. **[D]**
7. The following electrochemical cell has been set up $Pt_1/Fe^{2+}, Fe^{3+} \parallel Ce^{4+}, Ce^{3+}/Pt_2, E^o_{Fe^{3+}/Fe^{2+}} = 0.77V, E^o_{Ce^{4+}/Ce^{3+}} = 1.61V$. If an ammeter is connected between the two platinum electrodes predict the direction of flow of current. Will the current increase or decrease with time? **[D]**

## Products of Electrolysis:

1. On electrolysis of an aqueous solution of NaCl, why is $H_2$ and not Na liberated at the cathode? **[D]**
2. Give the products obtained at each electrode respectively when molten NaCl, aqueous NaCl and acidulated $H_2O$ undergoes electrolysis. **[A]**

## Batteries:

1. Give the following information about 'Nickel-Cadmium storage cell':
   i) Electrolyte used
   ii) Reactions involved at the anode and cathode
   iii) Approximate voltage of the cell.
   iv) Material of the cathode
   v) Material of the anode **[A]**
2. Give reason: Why does a dry cell become dead after a long time even if it has not been used. **[A]**
3. Write a note on dry cells and mercury cell? **[A]**
4. What is the role of $ZnCl_2$ in a dry cell? **[A]**
5. Why does a mercury cell give a constant voltage throughout its life? **[A]**
6. What are batteries? Mention the types of batteries with examples. **[E]**
7. Write a cathodic and anodic reaction of lead storage battery at both discharge and recharge process. **[A][March-2025]**
8. Write the overall reaction of Ni-Cd battery. Mention the anode and cathode of it. **[A]**

## Fuel Cells:

1. Write a neat diagram of $H_2$-$O_2$ Fuel cell and express its cathodic and anodic reactions. **[A][May-2025]**
2. What are fuel cells? **[E][June-2024]**

## 2.8 Corrosion:

1. Describe any two of the techniques used for preventing corrosion of metals. **[A]**
2. Explain: corrosion is an electrochemical phenomenon. **[A]**
3. Rusting iron is quicker in saline water than in ordinary water. Explain. **[A]**
4. We can use aluminium in place of zinc for cathodic protection of rusting. Comment. **[A]**
5. What is corrosion? Mention the Factors which affect corrosion. **[E]**
6. Give reason:
   a) Rusting of iron pipe can be prevented by joining it with a piece of magnesium.
   b) Iron pipes are usually coated with zinc.
   c) Why is zinc better than tin protecting iron from corrosion? **[A]**
7. Three iron sheets have been coated separately with three metals A, B and C whose standard electrode potentials or given below. **[D]**

| **Metal** | $E^{\circ}_{value}$ |
|---|---|
| A | –0.46V |
| B | –0.66V |
| C | –0.20V |
| Iron | –0.44V |

Identify in which case rusting will take place faster when coating is damaged.

# Unit 3
# Chemical kinetics

## Multiple Choice Questions (ONE MARK)

1. The reactions which occurs very fast are
   a) mixing aqueous solutions of silver nitrate and sodium chloride
   b) Rusting of iron.
   c) Inversion of cane sugar
   d) Hydrolysis of starch. **[E]**

2. The slope for the plot of concentration of products Vs time will be equal to
   a) Rate b) Molecularity
   c) Order d) Half -life **[E]**

3. 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 above **[A]**

4. The rate of reaction between two specific time intervals is called
   a) Instantaneous rate b) average rate
   c) specific rate d) ordinary rate **[E]**

5. For the reaction $2A + 3B + \frac{1}{2}C \longrightarrow P$, the correct rate of the reaction is
   a) $\frac{-d[A]}{dt} = \frac{-2}{3}\frac{d[B]}{dt} = -4\frac{d[C]}{dt}$ b) $\frac{-d[A]}{dt} = \frac{-3}{2}\frac{d[B]}{dt} = \frac{-1}{4}\frac{d[C]}{dt}$
   c) $\frac{+d[A]}{dt} = \frac{+3}{2}\frac{d[B]}{dt} = \frac{+1}{2}\frac{d[C]}{dt}$ d) $\frac{+d[A]}{dt} = \frac{+2}{3}\frac{d[B]}{dt} = +4\frac{d[C]}{dt}$ **[D]**

6. For the hypothetical reaction; A → Products; rate = -*k* [A]. The negative sing used in the rate expression indicate that
   a) The rate is decreasing with time
   b) The concentration of reactants decrease with time
   c) There are repulsive forces between the reactants
   d) The reaction is reversible. **[E]**

7. For a gaseous reaction, the units of rate of reaction are
   a) L atm $S^{-1}$ b) atm $S^{-1}$
   c) atm $mol^{-1}$ $S^{-1}$ d) mol $S^{-1}$ **[E]**

8. Determination of instantaneous rate is not always convenient because.

a) measures rate at given instant of time.

b) it is measured always by determination of slope of the tangent at point 't'

c) easier to determine rate law and order of the reaction.

d) It involves differential rate equation. **[A]**

9. The term – dx/dt in a rate equation refers to:

a) The conc. of a reactant b) The decrease in conc. of the reactant with time

c) The velocity constant of reaction d) None of these **[E]**

10. For a reaction P + Q → 2 R + S, the incorrect statement is

a) Rate of disappearance of P = Rate of appearance of S

b) Rate of disappearance of Q = 2 x Rate of appearance of R

c) Rate of disappearance of Q = Rate of disappearance of P

d) Rate of disappearance of Q = 1⁄2 x Rate of appearance of R **[A]**

11. 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. **[E]**

12. During the decomposition of $H_2O_2$ to give oxygen, 48 g $O_2$ is formed per minute at a certain point of time. The rate of formation of water at this point is [AIIMS-2015] **[A]**

a) 0.75 mol/min b) 1.5 mol/min

c) 2.25 mol/min d) 3.0 mol/ min

13. 100 $cm^3$ of 1M acetic acid is mixed with 100 $cm^3$ of 2M methanol to form an ester. The change in the initial rate if each solution is diluted with equal volumes of water would be [KCET-2015] **[A]**

a) 4 times b) 0.25 times c) 2 times d) 0.5 times.

## 3.2 Factors influencing rate of a reaction

14. The acceptable value of molecularity of a reaction is

a) 1 b) $\frac{3}{2}$

c) –2 d) 0 **[D]**

15. The following factor which does not affect the rate of reaction is

a) Molecularity b) temperature

c) Catalyst d) concentration of reactant **[E]**

16. Compounds A and B react according to the following chemical equation $2A(g)+B(g)\longrightarrow 2C(g)$ concentration of either A or B were changed by keeping the concentrations of one of the reactants constant and the rates were measured as a function of initial concentration. Following results were obtained. Choose the correct option for the rate equation for this reaction.

| Experiment trial | Initial Concentration of [A] mol $L^{-1}$ | Initial Concentration of [B] mol $L^{-1}$ | Initial Concentration of [C] mol $L^{-1}$ |
|---|---|---|---|
| 1 | 0.40 | 0.40 | 0.10 |
| 2 | 0.40 | 0.80 | 0.40 |
| 3 | 0.80 | 0.40 | 0.20 |

a) Rate = k $[A]^2[B]$ b) Rate = k $[A]\,[B]^2$

c) Rate = k [A][B] d) Rate = k $[A]^2$ **[D]**

17. When the concentration of the reactant in the reaction A ---→ Products, is doubled, then the reaction is found to increase by 4 times and when tripled, the rate increased by 9 times. The rate of reaction is proportional to:

a) Concentration of A b) square of concentration of A

c) Cube root of concentration of A d) cube of concentration of A **[E]**

18. A reaction was found to be second order with respect to the concentration of carbon monoxide. If the concentration of carbon monoxide is doubled, with everything else kept the same, the rate of reaction will;

a) Remain unchanged b) triple

c) Increase by a factor of 4 d) double **[E]**

19. The decomposition of phosphine on tungsten at low pressure is a first order reaction. It is because the

a) Rate is proportional to the surface coverage

b) Rate is inversely proportional the surface coverage

c) Rate is independent of the surface coverage

d) Rate of decomposition is very low. **[NEET-2016] [E]**

20. For a reaction, $2NH_{3\,(g)} \xrightarrow[\text{Pt-Catalyst}]{1130K} N_{2\,(g)} + 3H_{2\,(g)}$ the rate is

a) $\text{Rate} = K\left[NH_3\right]^{\frac{1}{2}}$ b) $\text{Rate} = K\left[NH_3\right]$

c) $\text{Rate} = K\left[NH_3\right]^2$ d) $\text{Rate} = K$ **[A]**

21. The following results have been obtained during kinetic studies of the reaction $A_{(aq)} + 2B_{(aq)} \longrightarrow C_{(aq)}$.

Choose the correct option for the rate equation for the above reaction.

| Experiment | Concentration of [A] $\left(molL^{-1}\right)$ | Concentration of [B] $\left(molL^{-1}\right)$ | Rate of formation of 'C' $\left(molL^{-1}\,min^{-1}\right)$ |
|---|---|---|---|
| I | 0.1 | 0.1 | $6.0\times10^{-3}$ |
| II | 0.2 | 0.3 | $7.2\times10^{-2}$ |
| III | 0.1 | 0.4 | $2.4\times10^{-2}$ |
| IV | 0.4 | 0.3 | $2.88\times10^{-1}$ |

a) $Rate = K[A]^1[B]^2$ b) $Rate = K[A]^1[B]^0$

c) $Rate = K[A]^2[B]^1$ d) $Rate = K[A]^4[B]^1$ **[D]**

22. The unit of rate constant of Zero order reaction is

a) $s^{-1}$ b) $molL^{-1}s$

c) $molL^{-1}s^{-1}$ d) $mol^{-1}Ls^{-1}$ **[MAY-2023]** **[E]**

23. When initial concentration of a reactant is doubled in a reaction, its half-life period is not affected. The order of the reaction is:

a) First b) Second

c) More than zero but less than first d) Zero **[A]**

24. The order of the reaction $KClO_3 + 6FeSO_4 + 3H_2SO_4 \longrightarrow KCl + 3Fe_2(SO_4)_3 + 3H_2O$ is

a) 1 b) 2

c) 4 d) 10 **[E]**

25. The unit of rate of gaseous reaction when the concentration is expressed in partial pressure is

a) $mol\ L^{-1}s^{-1}$ b) $M\ s^{-1}$

c) $atm\ s^{-1}$ d) $atm\ L^{-1}\ s^{-1}$ **[E]**

26. 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 **[A]**

27. Order of reaction is decided by

a) Temperature b) Mechanism of reaction as well as relative concentration of reactants

c) Molecularity d) Pressure **[E]**

28. Which one of the following statements for the order of a reaction is incorrect?

a) Order can be determined only experimentally.

b) Order is not influenced by stoichiometric coefficient of the reactants.

c) Order of reaction is sum of power to the concentration terms of reactants to express the rate of reaction.

d) Order of reaction is always whole number. **[E]**

29. Units of rate constant of first and zero order reactions in terms of molarity M unit are respectively

a) $sec^{-1}$, M $sec^{-1}$ b) $sec^{-1}$, M

c) M $sec^{-1}$, $sec^{-1}$ d) M, $sec^{-1}$. **[A]**

30. Order of a reaction in which unit of rate of reaction and rate constant are same

a) 0 b) 1

c) 1/2 d) 2 **[A]**

31. The conversion of molecules X to Y follows second order kinetics. If concentration of X is increased to three times, the rate of formation of Y will

a) Increase by three times b) Decrease by three time

c) Increase by nine times d) Decrease by nine times **[D]**

32. The initial rates of reaction 3A + 2B +C → products, at different initial concentrations are given below:

| Initial rate , $ms^{-1}$ | $[A]_{0}$,M | $[B]_{o}$, M | $[C]_{o}$, M |
|---|---|---|---|
| $5.0x10^{-3}$ | 0.010 | 0.005 | 0.010 |
| $5.0x10^{-3}$ | 0.010 | 0.005 | 0.015 |
| $1.0x10^{-2}$ | 0.101 | 0.010 | 0.010 |
| $1.25x10^{-3}$ | 0.005 | 0.005 | 0.010 |

The order with respect to the reactants A, B and C are respectively

a) 3,2,0 b) 3,2,1

c) 2,1,0 d) 2,2,1 **[D]**

33. The chemical reaction 2 $O_3$ → 3 $O_2$ proceeds as follows.

i) $O_3 \rightleftharpoons O_2 + O$ ……. (fast)

ii) $O + O_3 \rightarrow 2O_2$ …….. (slow)

The rate law expression should be

a) $r=K'[O_3]^2$ b) $r=K'[O_3]^2\,[O_2]^{-1}$

c) $r=K'[O_3][O_2]$ d) unpredictable. **[D]**

34. **Statement 1:** The order of a reaction cannot have a fractional value.

**Statement 2**: The order of reaction cannot be written from the balanced chemical equation.

a) Both statement I and II are correct

b) Both statement I and II are incorrect

c) Statement I is correct and statement II is incorrect.

d) Statement I is incorrect and statement II is correct. **[E]**

35. **Statement 1:** Molecularity greater than three is not observed.

**Statement 2:** The overall molecularity of a complex reaction is equal to molecularity of the slowest step.

a) Both statement I and II are correct

b) Both statement I and II are incorrect

c) Statement I is correct and statement II is incorrect.

d) Statement I is incorrect and statement II is correct. **[E]**

36. For a certain reaction, the rate=$k[A]^2[B]$, when the initial concentration of A is tripled keeping concentration of B constant, the initial rate would

a) Increase by a factor of nine

c) Decrease by a factor of nine

b) Increase by a factor of three

d) Increase by a factor of six. **[NEET-2023] [A]**

37. When initial concentration of the reactant is doubled, the half- life period of a zero order reaction

a) is halved

b) is doubled

c) is tripled

d) remains unchanged **[NEET-2018] [A]**

## 3.3 Integrated rate equation

38. All natural and artificial radioactive decay of unstable nuclei take place by

a) zero order kinetics

b) half order kinetics

c) first order kinetics

d) second order kinetics **[E]**

39. For a zero order reaction, the intercept for the plot of concentration of reactants Vs time is equal to

a) –k

b) log k

c) $[R_0]$

d) log $[R_0]$ **[D]**

40. For a first order reaction, the slope for the plot of log of concentration of reactants Vs time is equal to

a) –2. 303 k

b) –k / 2.303

c) –2.303 / k

d) k / 2.303 **[D]**

41. For a first order reaction, the intercept for the plot of log of concentration of reactants Vs time is equal to

a) –2. 303 k

b) –k / 2.303

c) $[R_0]$

d) log $[R_0]$ **[A]**

42. For a first order reaction, the plot of log $\frac{[R_0]}{[R]}$ Vs time 't' will be

a) straight line with negative slope and positive intercept

b) straight line with positive slope and positive intercept

c) straight line with positive slope and zero intercepts

d) straight line with zero slope and zero intercepts **[A]**

43. The thermal decomposition of HI in presence of gold is an example for a reaction of

a) first order b) zero order

c) half order d) second order **[E]**

44. Decomposition of $N_2O_5$ and $N_2O$ are some examples for reaction with

a) first order kinetics b) zero order kinetics

c) half order kinetics d) second order kinetics **[E]**

45. Half life of zero order reaction is inversely proportional to

a) initial concentration b) finial concentration

c) rate constant d) rate of a reaction. **[E]**

46. When the initial concentration of reactant is doubled in a reaction, its half-life period is not affected. Then the order of the reaction is

a) First b) Second

c) More than zero but less than first d) Zero **[A]**

47. The rate law for the reaction: A + B → P is Rate = $k[A]^1[B]^1$. if 'B' is taken large excess, then the order of reaction is

a) 2 b) 1

c) 0 d) ½ **[A]**

48. In a 1st order reaction, reactant concentration *C* varies with time *t* as :

a) 1/*C* increases linearly with *t* b) log *C* decreases linearly with *t*

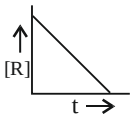
c) *C* decreases with 1/*t* d) log *C* decreases with 1/*t* **[D]**

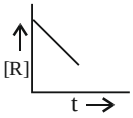
49. For a first order reaction, a plot of log (a – x) against time is a straight line with a slope equal to

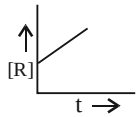
a) $\frac{-k}{2.303}$ b) $-2.303k$

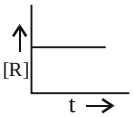
c) $\frac{2.303}{k}$ d) $-\frac{E_a}{2.303R}$ **[A]**

50. The plot that represents the zero order reaction is :

(a) 


(b) 


(c) 


(d) 

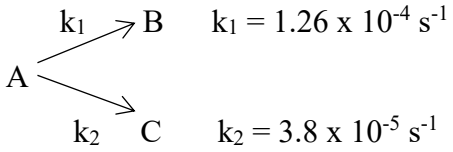

**[A]**

51. Which of the following is correct for a first order reaction?

a) $t_{1/2} \propto \alpha$ b) $t_{1/2} \propto \frac{1}{\alpha}$

c) –1 d) $t_{1/2} \propto \alpha^2$ **[E]**

52. A substance undergoes first order decomposition. The decomposition follows the parallel first order reactions as




The percentage distribution of B and C are

a) 76.83, 23.17 b) 60,40

b) 24.9, 75.1 d) 50, 50 **[D]**

53. Point out the wrong statement: For a first order reaction

a) Time for half-change ($t_{1/2}$) is independent of initial concentration

b) Change in the concentration unit does not change the rate constant ($k$)

c) Time for half-change × rate constant = 0.693

d) The unit of k is $mole^{-1}min^{-1}$ **[E]**

54. An example of a pseudo first-order reaction is,

a) The decomposition of gaseous ammonia on a hot platinum surface

b) Photochemical reaction between hydrogen and chlorine

c) Inversion of cane sugar

d) Hydrogenation of ethane **[MARCH-2025] [E]**

55. The plot of concentration of the reactant vs. time for a reaction is a straight line with a negative slope. The reaction follows a

a) zero order rate equation b) first order rate equation

c) second order rate equation d) third order rate equation **[A]**

56. **Match the following**

| **I** | | **II** | |
|---|---|---|---|
| **A** | $t_{1/2}$ =constant | p) | 1st order |
| **B** | $t_{1/2} \alpha [R]$ | q) | Third order |
| **C** | $t_{1/2} \alpha \frac{1}{[R]}$ | r) | second order |
| **D** | $t_{½} \alpha \frac{1}{[R]^2}$ | s) | zero order |

a) A-p, B-r, C-q, D- s
b) A-p, B-s , C-r, D- q
c) A-p, B-s , C-q, D- r
d) A-p, B-r, C-s, D- r **[E]**

57. Match the following

| I | | II | |
|---|---|---|---|
| A) | Rate= K x Intensity of light | i) | Second order |
| B) | Rate =K $[A]^{1/2}$ $[B]^{1/2}$ | ii) | Zero order |
| C) | Rate =K $[A]^{3/2}[B]^{1/2}$ | iii) | First order |
| D) | Rate =K $[A]^{2}[B]^{1}$ | iv) | Third order |

a) A-ii, B-iii, C-i, D- iv
b) A-iii, B-ii, C-i, D- iv
c) A-ii, B-iii, C-iv, D- i
d) A-iv, B-iii, C-i, D- ii **[E]**

58. Half -life of a reaction is found to be inversely proportional to the cube of initial concentration. The order of the reaction is

a) 3
b) 4
c) 2
d) 5 **[A]**

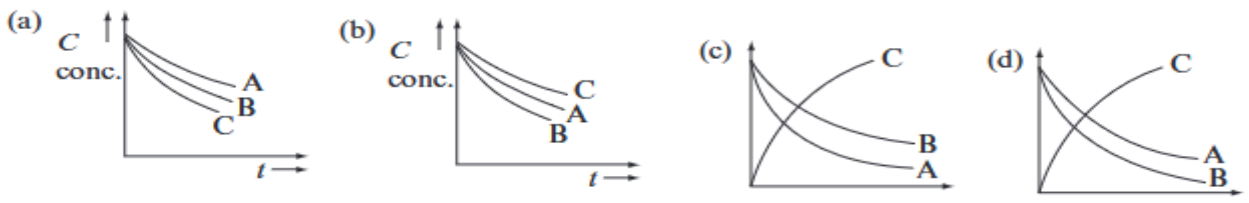
59. Which among the following is a false statement?

a) Molecularity of a reaction may be zero or fraction
b) For a first order reaction, t ½ = 0.693/k.
c) Rate of zero order reaction is independent of initial concentration of the reactant.
d) Half - life of a third order reaction is inversely proportional to the square of the initial concentration of the reactant. **[E]**

60. Which is correct about zero order reaction?

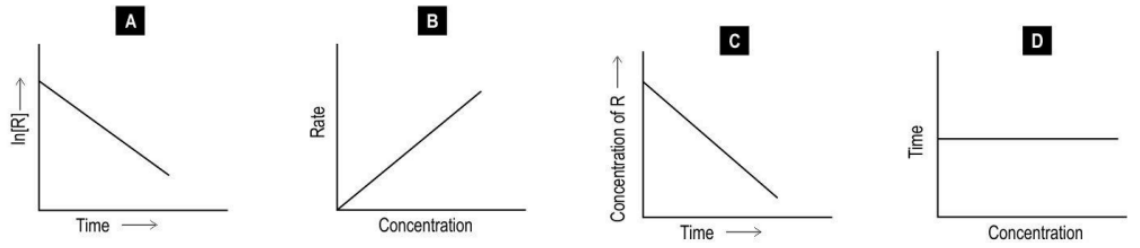
a) Rate of reaction depends on decay constant
b) Rate of reaction is independent of concentration
c) Unit of rate constant is $conc^{-1}$
d) Unit of rate constant is $conc^{-1}$ $time^{-1}$ **[E]**

61. Which of the following graphs is correct representation for the reaction of type A + 2B → C?




**[D]**

62. Which of the following graphs represents a zero-order rate of reaction?




**[D]**

63. If 50% of a reaction occurs in 100 seconds and 75% of the reaction occurs in 200 seconds, the order of this reaction is

a) 1 b) 2 c) zero d) 3 **[A]**

64. The formation of gas at the surface of tungsten due to adsorption is the reaction of order

a) 1 b) 2 c) zero d) 3 **[E]**

65. Higher-order (>3) reactions are rare due to:

a) Shifting of equilibrium towards reactants due to elastic collision

b) Loss of active species on collision

c) Low probability of simultaneous collision of all the reacting species

d) Increase in entropy and activation energy as more molecules are involved. **[E] [KCET-2021]**

66. A reaction involving two different reactants

a) Can never be second order reaction

b) Can never be unimolecular reaction

c) Can never be bimolecular reaction

d) Can never be first order reaction. [AIEEE-2015]**[E]**

67. In the sequence of reaction,

$A \xrightarrow{k} B \xrightarrow{k_2} C \xrightarrow{k_3} D$

$k_3 > k_2 > k_1$ then the rate determining step of the reaction is **[A]**

a) $A \longrightarrow B$ c) $C \longrightarrow D$

b) $B \longrightarrow C$ d) $A \longrightarrow D$

68. The following mechanism has been proposed for the reaction of NO with $Br_2$ to form NOBr;

$NO(g) + Br_2 \longrightarrow NOBr_2(g)$

$NOBr_2(g) + NO(g) \longrightarrow 2NOBr(g)$

If the second step is rate determining step, the order of the reaction with respect to NO (g) is

a) 1 b) 0

c) 3 d) 2 **[A]**

69. A reaction $A_2 + B_2 \longrightarrow 2AB$ occurs by the following mechanism

$A_2 \rightarrow A + A$ ……. (*Slow*)

$A + B_2 \rightarrow AB + B$ ……. (*Fast*)

$A + B \rightarrow AB$ ……. (*Fast*)

Its order would be

a) 3/2 b) 1

c) Zero d) 2 **[A]**

**70.** The half – time of a first order decomposition nitramide is 2.1 h at $15^0C$

$NH_2NO_2(aq) \rightarrow N_2O(g) + H_2O(l)$

If 6.2 g of nitramide is allowed to decompose then time taken for it to decompose 99% will be

a) 2.1 h b) 12 h

c) 13.96 h d) 33 h **[A]**

71. For a first order reaction A→ products, initial concentration of A is 0.1 M, which becomes 0.001M after 5 minutes. Rate constant for the reaction in $min^{-1}$ is

a) 1.3818 b) 0.9212

c) 0.4606 d) 0.2303 **[NEET-2022][A]**

72. If half- lives of a first order and zero order reactions are same, then the ratio of the initial rates of the first order reaction to that of zero order reaction is

a) 1/0.693 b) 2x0.693

c) 2/0.693 d) 6.93 **[A]**

73. The rate constant for a first order reaction is $4.606 \times 10^{-3}\ S^{-1}$. The time required to reduce 2.0 g of the reactant to 0.2 g is

a) 100 S b) 200 S

c) 500 S d) 1000 S **[NEET-2020] [A]**

74. Half -life of a reaction is found to be inversely proportional to the fifth power of its initial concentration. The order of the reaction is

a) 6 b) 4 c) 2 d) 5 **[KCET-2022] [A]**

75. A bimolecular reaction can behave as first order reaction

a) When both reactants have same concentration

b) When the reaction is in equilibrium

c) When one of the reactants is in large excess

d) When the activation energy of reaction is less. **[E]**

76. A first order reaction is completed in 45 min. How long it need 99.9% of the reaction to be completed?

a) 10 hours b) 20 hours

c) 7.5 hours d) 5 hours. **[KCET-2022] [A]**

77. If the rate constant for a first order reaction is K, the time (t) required for the completion of 99% of the reaction is given by

a) t=4.606/K b) t=2.303/K

c) t= 0.693/K d) t=6.909/K **[KCET-2021] [A]**

78. The time required for 60% completion of a first reaction is 50 min. The time required for 93.6% completion of the same reaction will be

a) 83.8 min b) 50 min

c) 150 min d) 100 min. **[KCET-2020] [A]**

## 3.3 Temperature dependence of the rate of a reactions

79. The representation of rate of reaction in terms of concentration of the reactants is known as

a) Rate law b) Law of kinetics

c) Arrhenius law d) Van't Hoff law **[E]**

80. Select the incorrect statement with respect to pre exponential factor.

a) It is also called frequency factor.

b) It is constant for a particular reaction.

c) Its value is specific for a particular reaction

d) It is represented by $E_a$ in Arrhenius equation. **[E]**

81. Kinetic energy possessed by maximum fraction of molecules is called

a) average kinetic energy b) most probable kinetic energy.

c) maximum kinetic energy. d) root mean square kinetic energy. **[E]**

82. The area under the Maxwell Boltzmann distribution curve is

a) fraction of molecules reacting at time 't' and is constant.

b) total energy of a reaction

c) activation energy of a reaction.

d) enthalpy of a reaction. **[E]**

83. **Statement I:** Catalyst alters the Gibbs energy

**Statement II:** Catalyst catalyses the forward as well as the backward reactions to the same extent

Identify the correct statement

a) Both Statement I and II are correct

b) Both Statement I and II are incorrect

c) Statement I is correct and Statement II is incorrect.

d) Statement I is in correct and Statement II is correct. **[A]**

84. Which of the following explains the increase in the reaction rate by a catalyst?

a) Catalyst decreases the rate of backward reaction so that rate of forward reaction increases

b) Catalyst provides extra energy to reacting molecules, so that they produce effective collisions

c) Catalyst provides an alternative pathway by reducing the activation energy between the reactants and products

d) Catalyst increases the number of collisions between the reacting molecules **[E]**

85. The energy required to form activated complex is known as

a) Kinetic energy b) Potential energy

c) Activation energy d) Collision frequency **[E]**

86. In Arrhenius equation, $k = Ae^{\frac{-Ea}{RT}}$ the factor $e^{\frac{-Ea}{RT}}$ corresponds to

a) The fraction of molecules that have kinetic energy greater than energy of Activation.

b) The fraction of molecules that have kinetic energy less than activation energy.

c) The fraction of molecules that have kinetic energy greater than threshold energy.

d) The fraction of molecules that have kinetic energy less than threshold energy. **[E]**

87. A catalyst

a) Increases Gibb's energy of a reaction.

b) Does not change equilibrium constant of a reaction.

c) Alters the equilibrium state.

d) Catalyses non-spontaneous reaction. **[E]**

88. Pieces of wood burn faster than a log of wood of the same mass because

a) Surface area of log of wood is larger and needs more time to burn

b) Pieces of wood have large surface area

c) All pieces of wood catch fire at the same time

d) Block of wood has higher density than pieces of the same wood **[E]**

89. If the reaction rate at a given temperature becomes slower

a) energy of activation is higher b) energy of activation is lower

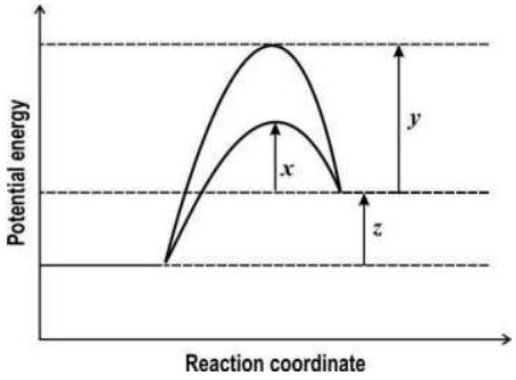
c) Entropy changes d) Initial concentration of reactants remain constant. **[E]**

90. Which of the following does not affect the rate of reaction?

a) Amount of the reactants taken b) ΔH of reaction

c) Physical state of the reactants d) Size of the vessel. **[A]**

91. The diagram below shows the potential energy variation for a reaction using a catalyst and for the same reaction without a catalyst. Which of the following represents the enthalpy change (ΔH) and activation energy ($E_a$) for the reaction with a catalyst?




a) $\Delta H$ = z and $E_a$ with catalyst = x + z  b) $\Delta H$ = z and $E_a$ with catalyst = y +

c) $\Delta H$ = x + z and $E_a$ with catalyst = x  d) $\Delta H$ = z and $E_a$ with catalyst = y **[D]**

92. The slope of Arrhenius plot (lnK *vs* 1/T) of first order reaction is $-5 \times 10^3$ K. The value of Ea of the reaction is

a) -83KJ/mol  b) 41.5 KJ/mol

c) 83.0 KJ/mol  d)166KJ/mol **[NEET-2021] [A]**

93. An increase in the concentration of the reactants of a reaction leads to change in

a) Activation energy  b) Heat of reaction

c) Threshold energy  d) Collision frequency **[NEET-2020] [E]**

94. The rate of reaction is doubled for every 10°C rise in temperature. The increase in reaction rate as a result of temperature rise from 10°C to 80°C is

a) 112  b) 512

c) 256  d) 128 **[E]**

## 3.5 Collision theory of Chemical reactions

95. Under what condition will a reaction occur according to collision theory?

a) A reaction will occur regardless of the energy of the colliding molecules.

b) A reaction will only occur if the colliding molecules have energy greater than or equal to the activation energy

c) A reaction will occur if the colliding molecules have any energy

d) A reaction will occur only if the products have lower energy than the reactants. **[E]**

96. Activation energy of any chemical reaction can be calculated if one knows the value of

a) Rate constant at standard temperature  b) Probability of collision **[NEET-2024] [E]**

c) Orientation of reactant molecules during collision  d) Rate constant at two different temperature.

97. The rate of a reaction quadruples when temperature changes from 27°C to 57°C the energy of activation is (Given R=8.314J/K/mol, log 4 = 0.6021 )

a) 38.04KJ/mol  b) 380.4KJ/mol  c) 3.80KJ/mol  d) 3804 KJ/mol. **[D] [NEET-2024]**

98. Collision theory is applicable to **[E]**

a) First order reactions b) Zero order reactions

c) Bimolecular reactions d) Intramolecular reactions

99. The activation energy of a reaction is zero. The rate constant of the reaction is

a) Increases with increase of temperature b) Decreases with increase of temperature

c) Decreases with decrease of temperature d) is nearly independent of temperature. **[A]**

100. A plot between ln K vs 1/T, the slope is equal to

a) Ea/R b) Ea/2.303R

c) –Ea/R d) –Ea/2.303R

101. Threshold energy is equal to

a) Activation energy b) Activation energy+ energy of molecules

c) Activation energy- energy of molecules d) kinetic energy **[E]**

102. In collision theory of chemical reactions, $Z_{AB}$ represents

a) The fraction of molecules with energies equal to energy of activation.

b) The fraction of molecules with energies greater than energy of activation.

c) The collision frequency of reactants A & B

d) Steric factor. **[E]**

103. The rate constant of a reaction is given by $k= PZe^{-Ea/RT}$ under standard notation. In order to speed up the reaction. Which of the following factors has to be decreased?

a) Both Z &T b) Ea

c) T d) Z **[KCET-2020]**

104. The catalyst in a chemical reaction provides an alternate pathway or reaction mechanism by decreasing:

a) activation energy b) Kinetic energy

c) Normal energy of reacting species d) Potential energy **[MARCH-2024]**

## Fill in the blanks by choosing the appropriate word from those given in the brackets: (ONE MARK)

### Set-1

**(instantaneous, decreases, balanced equation, increases, rate expression, mol $L^{-1}$)**

1. Unit of rate is ____ **[E]**
2. The rate at a particular moment of time is _____rate. **[E]**
3. With the passage of time rate of a reaction _____. **[E]**
4. The equation that relates rate of reaction and concentration of reactants is _____. **[E]**
5. Rate law for any reaction cannot be predicted by _____ **[E]**

## Set-2

**(molecularity, order, zero, elementary, rate constant, complex)**

1. Sum of powers of the concentration of the reactants in the rate law expression is called _____. **[E]**
2. The order of reaction, if the rate of reaction is independent of the concentration of reactants is ____ **[E]**
3. The reactions taking place in one step are called _____reactions. **[E]**
4. Oxidation of ethane to $CO_2$ and $H_2O$ is an example of _____ reaction. **[E]**
5. The S.I. units of _____for depends on order of reaction. **[E]**

## Set-3

**(zero, three, order, slowest step, zero order, molecularity)**

1. The number of species taking part in an elementary reaction, which collide to bring about a chemical reaction is called _____of a reaction. **[E]**
2. Reactions with the molecularity _____are slow to proceed. **[E]**
3. Molecularity of the _____ is same as the order of the overall reaction. **[E]**
4. _____of a reaction is an experimental quantity. **[E]**
5. Reactions which occur on metal surfaces are a few examples of _____reactions. **[E]**

## Set-4

**(pseudo first, $sec^{-1}$, half-life period, mol $sec^{-1}$, Joules $mol^{-1}$, first)**

1. Hydrogenation of ethene is an example of _____order reaction. **[E]**
2. For a first order reaction, _____is constant. **[E]**
3. Inversion of cane sugar is an _____ order reaction. **[E]**
4. S.I unit of rate constant of first order reaction is _____. **[E]**
5. S.I unit of activation energy is _____. **[E]**

## Set-5

**(increases, decreases, internal energy, Gibbs energy, activation energy, Pre-exponential factor)**

1. _____ is constant specific to a particular reaction. **[E]**
2. Rate of reaction _____ with raise in temperature. **[E]**
3. As activation energy _____ rate of reaction increases. **[E]**
4. Catalyst does not alter _____ . **[E]**
5. Catalyst reduces _____ **[E]**

**Set-6:**

**(kinetic gas, steric, Arrhenius, collision frequency, effective collision, equilibrium constant)**

1. Collision theory is based on _____ theory. **[E]**
2. Catalyst does not change the _____ of a reaction. **[E]**
3. The number of collisions per second per unit volume of the reaction mixture is known as _____. **[E]**
4. The collisions in which molecules collide with sufficient kinetic energy and proper orientation is called _____. **[E]**
5. _____ factor accounts for effective collision and proper orientation. **[E]**

**TWO MARK QUESTIONS**

## 3.2 Factors influencing rate of a reaction

1. Define a) order b) Molecularity **[E]**
2. State Rate Law. What is S.I unit of rate. **[E]**
3. Identify the order of the reaction from the unit of rate constants. i) $Lmol^{-1}s^{-1}$ ii) $M^{-1}$ $min^{-}$ **[A]**
4. Write the order of the reaction and unit of the rate constant for the reaction: $CH_3CHO \rightarrow CH_{4\,(g)} + CO_{\,(g)}$. Rate = $k\,[CH_3CHO]^{3/2}$ **[E]**
5. $2A \rightarrow P$; is second order reaction. How is the rate of the reaction affected if the concentration of A is (a) doubled (b) reduced to half? **[A]**
6. For the equation, $A + 2B \rightarrow C + D + E$ the following results were obtained to determine the initial rate of the reaction.

| Experiment | [A] / mol $dm^{-3}$ | [B] / mol $dm^{-3}$ | Initial rate / mol $dm^{-3}$ $s^{-1}$ |
|---|---|---|---|
| 1 | 4 | 1 | 0.50 |
| 2 | 4 | 0.5 | 0.50 |
| 3 | 2 | 0.5 | 0.25 |

(i) What is the order of reaction with respect to A and B? Justify.

(ii) Write down the overall rate equation. **[D]**

7. Differentiate between order and molecularity. **[E]**

## 3.3 Integrated rate equations

8. What is first order reaction? Write the expression for the relation between partial pressure and rate constant of first order gas phase reaction. **[E]**
9. Define half-life period. Write the relationship between half-life period and order of a reaction. **[E]**

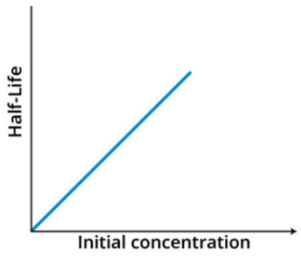
10. What are Elementary reaction and complex reaction? **[E]**

11. For a first order reaction, plot a graph of $\log\frac{[R_0]}{[R]}$ Vs time 't and write the value of slope for this graph. **[D]**

12. What is Pseudo first order reaction? Give an example. **[E]**

13. Give two examples for first order reaction. **[E]**

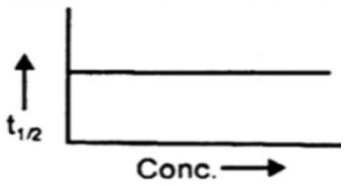
14. The following graph shows half-life ($t_{1/2}$) v/s initial reactant concentration reactant




a) What is the order of the reaction?

b) What is the unit of k for this reaction? **[D]**

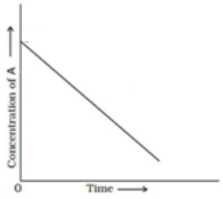
15. For the graph of $t_{½}$ vs [R] was given below




i) What is the order of the reaction?

ii) What are the unit of rate constant K for the reaction? **[D]**

16. For a general reaction A→ B, plot of concentration of A v/s time is given is figure




a) What is the order of the reaction?

b) What is the shape of the curve? **[D]**

17. What happens to half life time of a first order reaction when temperature is increased? Give reason. **[A]**

18. Draw a graph of concentration of R versus time for a zero-order reaction R → P. What is the intercept of the line equal to? **[D]**

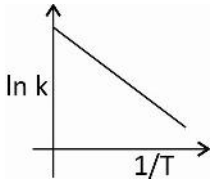
19. What is the effect of temperature on the (i) rate constant and (ii) $t_{1/2}$ of a reaction? **[E]**

20. Show that half-life of zero order reaction depends on initial concentration of reactant. **[E]**

21. Show that half-life of first order reaction is independent on initial concentration of reactant. **[E]**

## 3.4 Temperature dependence of the rate of a reaction

22. Write Arrhenius equation. Explain the terms involved in it. **[E]**
23. Write any two properties of catalyst. **[E]**
24. What is activation energy? How do its value effects rate of reaction? **[A]**
25. What is catalyst? Whether a catalyst catalyses non spontaneous reaction? **[E]**
26. Graphically represent Arrhenius equation and how do you calculate activation energy from it? **[E]**
27. Plot Maxwell Boltzmann distribution curve. Mark the position of $E_a$ **[E]**
28. What is most probable kinetic energy? How does it is affected by increase in temperature? **[E]**
29. With the help of graph explain the effect of temperature on rate of reaction. **[E]**
30. With the help of graph explain the effect of catalyst on rate of reaction. **[E]**
31. Draw the plot of the distribution curves showing the temperature dependence on the rate of the reaction at two temperature stand (t+10). Mark $E_a$ and shade the relevant regions to show that fraction of molecules having energy greater than $E_a$ doubles when temperature is increased by10°C. **[E]**
32. Illustrate graphically the effect of catalyst on activation energy
33. Catalyst has no effect on the equilibrium constant. Why? **[E]**
34. In the graph, what do the intercept and slope of the line represent? **[A]**




35. For the reaction: $H_2(g) + I_2(g) \rightarrow 2HI(g)$; draw the diagram showing plot of potential energy versus reaction coordinate to explain the role of activated complex in a reaction.
36. What is meant by chemical kinetics? Give any two importance of study chemical kinetics.
37. State rate law? Write the rate expression and differential rate equation for general reaction.

$$aA + bB \longrightarrow cC + dD.$$

## 3.5 Collision theory of chemical reactions

38. According to collision theory give any two criteria for effective collision. **[E]**
39. Give any two drawbacks of collision theory. **[E]**
40. What does P and $Z_{AB}$ represent in the equation: rate = $PZ_{AB}e^{-EaRT}$? **[E]**
41. What is collision Frequency? Give equations that represent relation between collision frequency and steric factor. **[E]**

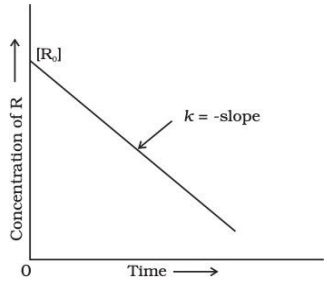
## THREE MARK QUESTIONS

## 3.2 Factors influencing rate of a reaction

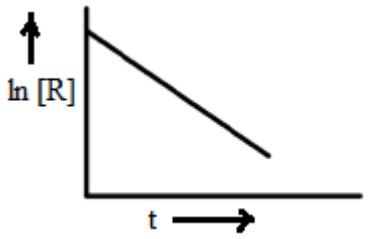
42. Write any three factors effecting rate of reaction. **[E]**

## 3.3 Integrated rate equations

43. Derive integrated rate equation for zero order reaction. **[E]**
44. Derive integrated rate equation for first order reaction. **[E]**
45. Derive integrated rate equation for first order gas phase reaction $A(g) + B(g) \longrightarrow C(g)$ **[E]**
46. A reaction is first order in X and second order in Y:
    i) Write the differential rate law of the reaction.
    ii) How is the rate affected on increasing the concentration of Y three times?
    iii) Write the SI unit for the rate constant. **[A]**
47. For a reaction $R \rightarrow P$, plot of concentration of R v/s time is given. Answer the following questions:




    i) What is the order of the reaction?
    ii) Write its integrated rate equation.
    iii) What is the unit of the rate constant? **[D]**
48. For a certain chemical reaction, variation in the concentration ***l*n[R] vs time** plot is given: For this reaction




    i) Write the Order of the reaction?
    ii) What is the unit of rate constant *k*?
    iii) What does the slope of the line indicate? **[D]**
49. Graphically represent:
    (i) Concentration of a reactant X vs time for a ZERO order reaction.
    (ii) Rate of reaction vs concentration of a reactant X for a ZERO order reaction.
    (iii) Rate of reaction vs concentration of a reactant X for a FIRST order reaction **[D]**

## 3.6 Temperature dependence of the rate of a reaction

50. Plot a graph of potential energy vs reaction coordinate. Indicate activation energy and enthalpy. **[A]**

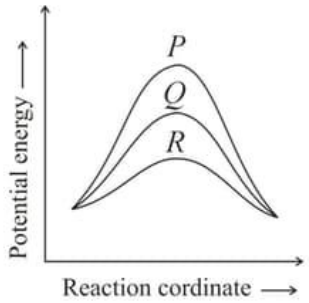
51. Explain the effects of following on rate of reaction

    a) Temperature

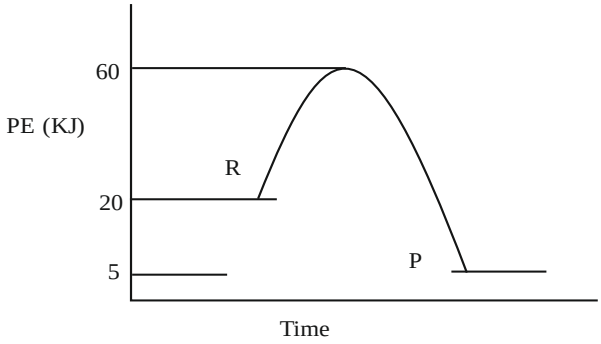
    b) Catalyst

    c) Concentration. **[E]**

52. If a homogenous catalytic reaction can take place through three alternative paths, as depicted below, the catalytically efficiency of P, Q & R respectively. Which reaction path proceeds easily or faster? Give reason. **[D]**




53. For the reaction R(s) → P(g), the potential energy diagram is given below:




By observing the above diagram, answer the following.

a) What is the value of activation energy of the reaction?

b) What is the value of ΔH of the reaction?

c) Draw potential energy diagram for the reaction P(g) → R(s). **[D]**

54. What is the effect of catalyst on a reaction with respect to its

    i) energy of activation

    ii) ΔG of the reaction

    iii) time required for 50% of the reaction to be completed? **[E]**

## PROBLEMS: (THREE MARK)

### 3.1 Rate of a chemical reaction

1. The decomposition of $N_2O_5$ in $CCl_4$ at 318K was studied. Initially the concentration of $N_2O_5$ is 2.33molL$^{-1}$ and after 184 minutes, it was reduced to 2.08molL$^{-1}$. The reaction takes place according to the equation $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$, Calculate the average rate of this reaction in terms of seconds. What is the rate of production of $NO_2$ during this period? **[A: 2.71X10$^{-3}$** mol/L/min] **[A]**
2. Mention the factors which affect the rate of a reaction. In a reaction $2A \rightarrow$ products, the concentration of A decreases from 0.5 to 0.4 mol L$^{-1}$ in 10 minutes. Calculate the rate of reaction during this interval. [A: $5\times10^{-3}$ M min$^{-1}$] **[E]**
3. Show that in a first order reaction, time required for completion of 99.9% reaction is 10 times of half-life ($t_{1/2}$) of the reaction. **[A]**
4. For the reaction $R \longrightarrow P$, the concentration of a reactant changes from 0.03M to 0.02M in 25 minutes. Calculate the average rate of reaction using units of time both in seconds. What is the rate of production of P during this period? [A:6.667x10$^{-6}$M/S] **[A]**
5. In a reaction, $2A \longrightarrow R$, Products, the concentration of A decreases from 0.5 mol L$^{-1}$ to 0.4 mol L$^{-1}$ in 10 minutes. Calculate the rate during this interval? [A:5x10$^{-3}$M/min] **[A]**
6. The initial concentration of $N_2O_5$ in the following first order reaction $N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ was $1.24 \times 10^{-2}$ mol L$^{-1}$ at 318 K. The concentration of $N_2O_5$ after 60 minutes was $0.20 \times 10^{-2}$ mol L$^{-1}$. Calculate the rate constant of the reaction at 318 K. [A:0.0304/min] **[D]**
7. The following data were obtained during the first order thermal decomposition of $N_2O_{5(g)}$ at constant volume: $2N_2O_5(g) \longrightarrow 2N_2O_4(g) + O_2(g)$. Calculate the rate constant. **[D]**

| S. No. | Time/s | Total Pressure/(atm) |
|---|---|---|
| 1 | 0 | 0.5 |
| 2 | 100 | 0.512 |

8. A first order reaction is found to have a rate constant, $k = 5.5 \times 10^{-14}$ s$^{-1}$. Find the half-life of the reaction. **[E]**
9. A first order reaction has a rate constant $1.15 \times 10^{-3}$ s$^{-1}$. How long will 5g of this reactant take to reduce to 3g? [A:444S] **[E]**
10. Time required to decompose $SO_2Cl_2$ to half of its initial amount is 60 minutes. If the decomposition is a first order reaction, calculate the rate constant of the reaction. [A: 1.925x10$^{-4}$/S] **[E]**

11. The rate constants of a reaction at 500K and 700K are $0.02s^{-1}$ and $0.07s^{-1}$ respectively. Calculate the values of $E_a$ and $A$. [A: Ea=18.228KJ/mol; A=1.604] **[A]**

12. The first order rate constant for the decomposition of ethyl iodide by the reaction $C_2H_5I(g) \longrightarrow C_2H_4(g) + HI(g)$ at 600K is $1.60 \times 10^{-5}\ s^{-1}$. Its energy of activation is 209 kJ/mol. Calculate the rate constant of the reaction at 700K. [A: $K_2=6.3552x10^{-3}/S$] **[A]**

13. The rate of the chemical reaction doubles for an increase of 10K in absolute temperature from 298K. Calculate $E_a$. [A:52.897KJ/mol] **[E]**

14. The activation energy for the reaction $2HI(g) \longrightarrow H_2 + I_2$ is $209.5kJmol^{-1}$ at 581K.Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy? [A:$1.471x10^{-19}$] **[A]**

15. The rate constant for the first order decomposition of $H_2O_2$ is given by the following equation: $\log k = 14.34 - 1.25 \times 10^4 K/T$. Calculate $E_a$ for this reaction ($R=8.314\ JK^{-1}mol^{-1}$). **[E]**

16. Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law, with $t_{1/2}$ = 3.00 hours. What fraction of sample of sucrose remains after 8 hours? [A: 1/6.34] **[E]**

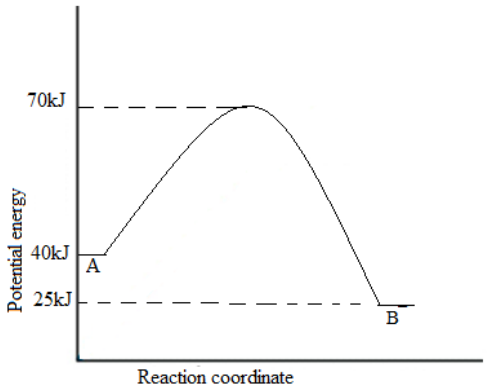
17. The rate constant for the decomposition of $N_2O_5$ at various temperatures is given below: **[A]**

| $1/T^0C$ | 0 | 20 | 40 | 60 | 80 |
|---|---|---|---|---|---|
| $10^5 \times k/s^{-1}$ | 0.0787 | 1.70 | 25.7 | 178 | 2140 |

Draw a graph between ln $k$ and $1/T$ and calculate the values of $A$ and $E_a$. [Ea=128.035KJ/mol;$A=3.38x10^{19}$]

18. For a first order action, show how time required for 99% completion is related to the time required for the completion of 90% of reaction. **[A]**

19. Look at the following graph




Calculate

a) $E_a$ for forward reaction

b) Enthalpy change of the reaction

c) $E_a$ of backward reaction. **[A]**

20. The time of half – life period of a certain reaction, A→ products is 1hr. When the initial concentration of the reactant 'A' is 2.0mol $L^{-1}$. How much time does it take for its concentration to come from 0.50mol $L^{-1}$ to 0.25mol $L^{-1}$, if it is a zero order reaction? [A:0.25hour] **[A]**

21. During the kinetic study of the reaction $2A + B \rightarrow C + D$, following result were obtained

| Run | [A] /mol $L^{-1}$ | [B]/ mol $L^{-1}$ | Initial rate of formation of D/ mol $L^{-1}$ $min^{-1}$ |
|---|---|---|---|
| 1 | 0.1 | 0.1 | $6.0\times10^{-3}$ |
| 2 | 0.3 | 0.2 | $7.2\times10^{-2}$ |
| 3 | 0.3 | 0.4 | $2.88\times10^{-1}$ |
| 4 | 0.4 | 0.1 | $2.40\times10^{-2}$ |

a) Write the rate law

b) What is the order with respect to reactant A & B. **[D]**

21. 75% of a first order reaction is completed in 30 minutes. What is the time required for 93.75% of the reaction? (In minutes) [A:60 min] **[E]**

22. The rate constant of a first order reaction increases from $2\times10^{-2}s^{-1}$ to $4\times10^{-2}s^{-1}$ when the temperature changes from 300 K to 310 K. Calculate the energy of activation ($E_a$). **[E]**
[log 2 = 0.3010, log 2.5 = 0.3979, log 4 = 0.6020, R = 8.314 $JK^{-1}mol^{-1}$]

23. A first order reaction takes 40 min for 25% completion. Calculate rate constant of the reaction. **[E]**

24. Show that in a first order reaction, time required for completion of 99.9% is 10 times of half-life ($t_{1/2}$) of the reaction. **[A]**

25. The rate constant of a reaction is given by: $\log k = 13.25 - \frac{(1.28\times10^{3})K}{T}$. Calculate the activation energy and pre-exponential factor (A). **[A]**

26. The rate of a reaction quadruples when the temperature changes from 293 K to 313 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature.
[A=52.86KJ/mol] **[A]**

27. A reaction is first order in A and second order in B.
(i) Write the differential rate equation.
(ii) How is the rate affected on increasing the concentration of 'B' three times and decreasing the concentration of 'A' by half times?
(iii) How is the rate affected when the concentrations of both 'A' and 'B' are tripled? **[A]**

28. The rate constant for a reaction is 60 $s^{-1}$. How much time will it take to reduce the initial concentration of the reactant to its $1/16^{th}$value? **[E]**

29. In the given reaction A→B, the rate constant k is 2.0 x $10^{-2}$ lit $mol^{-1}s^{-1}$, find initial rate of reaction when [A] = 0.5 M at 298K. **[A]**

30. The first order rate constant at 600 K is $2\times10^{-5}s^{-1}$ and energy of activation is 209.8 k J $mol^{-1}$ for a reaction. Calculate the rate constant at 700 K. [Given: R=8.314 $JK^{-1}mol^{-1}$] **[D]**

31. The rate of a reaction quadruples when the temperature changes from 293K to 313K. Calculate the energy of activation of the reaction assuming that it does not change with temperature. **[E]**

32. The C-14 content of an ancient piece of wood was found to have $\frac{3}{10}^{th}$ of that of living tree. Calculate the age of that piece of wood.
[Given that; Half-life of C-14 = 5730 years, log 3 = 0.4771, log 7 = 0.8540]. **[A]**

33. A first order reaction has rate constant of $2.3\times10^{-5}$ $s^{-1}$ at 500 K. At what temperature rate constant of the reaction becomes $17.25\times10^{-4}$ $s^{-1}$? ($E_a$ = 191.472 KJ $mol^{-1}$ and R =8.314 J $K^{-1}mol^{-1}$) **[D]**

34. A first order reaction has half-life of 23 min. How much time will be needed for 30% completion of the reaction? **[E]**

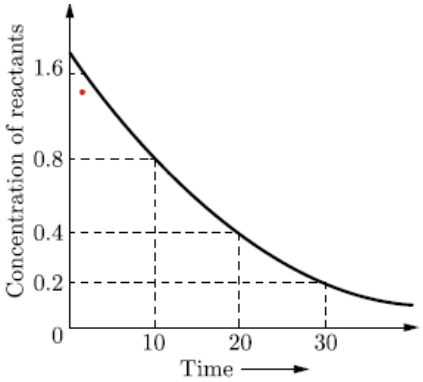
35. The following data were obtained the first order thermal decomposition of $SO_2Cl_2$ at a constant volume: Calculate the rate of the reaction.

$SO_2Cl_2\,(g) \rightarrow SO_2\,(g) + Cl_2\,(g)$ **[D]**

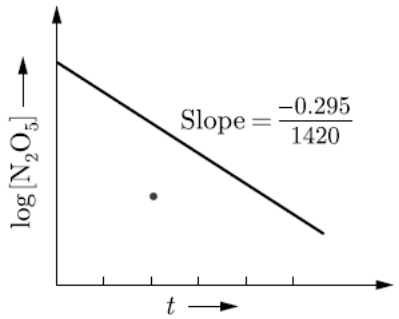
| **Experiment** | Time/$s^{-1}$ | **Total pressure/atm** |
|---|---|---|
| 1 | 0 | 0.5 |
| 2 | 100 | 0.6 |

36. The rate constants of reactions at 600 K and 700 K are 1.60 x $10^{-5}$ $s^{-1}$ and 6.40 x $10^{-3}$ $s^{-1}$ respectively. Calculate the value of Ea. **[E]**

37. Analyse the given graph, drawn between concentration of reactant in $molL^{-1}$ v/s time in minute, calculate the average rate of the reaction in terms of minutes and seconds. **[D]**



38. At 318 K, Nitrogen pentoxide decomposes according to the equation; $2N_2O_5 \rightarrow 4NO_2 + O_2$ in gas phase. The plot of log $[N_2O_5]$ v/s time 't' shows a straight line with negative slope as shown in figure. Calculate the rate constant.




39. The decomposition of a hydrocarbon follows the equation: $k = 4.5\times10^{11}\ e^{-28000/T}$. Calculate $E_a$. Given $R = 8.314\ J\ K^{-1}\ mol^{-1}$. [A: 232.79 kJ] **[E]**

40. The activation energy for a reaction at the temperature T was found to be $2.303RT\ Jmol^{-1}$. Calculate the ratio of the rate constant to Arrhenius factor. [A:$1.25\times10^{-2}$] **[A]**

41. Milk turns sour at 40°C three times faster as at 0°C. Calculate the energy of activation for souring of milk. [A: Ea=4.693 Kcal] **[E]**

42. How faster would a reaction proceed at 25°C than at 0°C if the activation energy is 65 KJ? [A: $K_2/K_1$= 11.05] **[A]**

# Unit 4

# d-and f-Block Elements

## Multiple Choice Questions (MCQs) (ONE MARK)

### 4.1 The transition Elements:

1. According to IUPAC transition metals are defined as
   a. Metals which have incomplete *d* subshell either in neutral atom or in their ions.
   b. Metals which have complete *d* subshell in neutral only atom.
   c. Metals with chemical properties were transitional between those of *s* and *p*-block elements.
   d. Metals with chemical properties were transitional between those of *p* and *f*- block elements[E]

2. The correct electronic configuration of Cr is [E]**(KCET-13)**
   a. $[Ar]4s^2 3d^4$ b. $[Ar]\ 4s^2 3d^4$
   c. $[Ar]4s^0 3d^5$ d. $[Ar]4s^1 3d^5$

3. In which of the following pairs, both the elements do not have same outer shell electronic configuration?
   a. Zn ,Cd b. Cu, Ag
   c. Cu, Zn d. Ti, Zr [E]

4. In general, the melting and boiling points of transition metals
   a. increases gradually across the period from left to right.
   b. decreases gradually across the period from left to right.
   c. first increases till the middle of the period and then decreases towards the end.
   d. first decreases regularly till the middle of the period and then increases towards the end.[E]

5. The correct order of melting point is.
   a. Cr >Mn> Fe b. Fe >Mn>Cr
   c. Cr > Fe >Mn d. Mn> Fe >Cr [A]

6. Which one of the following does not correctly represent the correct order of the property indicated against it?
   a. Ti< V < Cr <Mn : increasing number of oxidation states
   b. $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$ : increasing magnetic moment
   c. Ti< V < Cr <Mn : increasing melting points
   d. Ti< V <Mn<Cr : increasing 2nd ionization enthalpy [A]

7. The element having minimum volatility among the following is
   a. Cr b. W
   c. Os d. Zn [A]

8. The correct statement among the following is
   a. Metals with very high enthalpy of atomisation tend to be noble in their reactions.
   b. Metals with very low enthalpy of atomisation tend to be noble in their reactions.
   c. Metals with very low enthalpy of ionisation tend to be noble in their reactions.
   d. Metals with very high enthalpy of atomisation tend to be highly reactive in their reactions. [A]

9. **Statement 1:** Metals of the 4d and 5d series have greater enthalpies of atomisation than the corresponding elements of the 3d series.

   **Statement 2:** More frequent metal – metal bonding are found in compounds of the heavy transition metals.

   Identify the correct statement
   a. Statement I is correct and Statement II is incorrect
   b. Both Statement I and II are incorrect
   c. Both Statement I and II are correct
   d. Statement I is incorrect and Statement II is correct [E]

10. In transition elements( 5d and 6d series), a regular decrease in atomic radii is a result of
   a. The filling of (n-1)*f*before n*d*orbital
   b. The filling of n*f*before (n-1)*d*orbital
   c. The filling of (n-1) *f* after n *d* orbital
   d. The filling of n*f*after (n-1)*d*orbital [A]

11. The element with least density is
   a. Cr
   b. Ni
   c. Zn
   d. Sc [E]

12. Exchange energy is approximately proportional to the
   a. total number of possible pairs of parallel spins in the generate orbitals.
   b. total number of possible pairs of antiparallel spins in the degenerate orbitals.
   c. total number of possible pairs of parallel spins in the degenerate orbitals.
   d. total number of possible pairs of parallel spins in the generate orbitals [A]

## 4.3 Physical Properties:

13. The electronic configuration of Cr is $3d^5 4s^1$instead of $3d^4 4s^2$is due to
   a. The energy gap between the two sets (3*d* and 4*s*) of orbitals is big enough to prevent electron entering the 3*d* orbitals.
   b. The energy gap between the two sets (3*d* and 4*s*) of orbitals is small enough to prevent electron entering the 4sorbital.
   c. The energy gap between the two sets (3*d* and 4*s*) of orbitals is big enough to prevent electron entering the 4sorbital.
   d. The energy gap between the two sets (3*d* and 4*s*) of orbitals is small enough to prevent electron entering the 3*d* orbitals. [E]

14. The common oxidation state shown by the element with atomic number 21 is

a. +3 b. +4

c. +5 d. Both +3 and +4 [E]

15. The maximum oxidation state shown by V (Z = 23), Cr (Z = 24), Co (Z = 27), Sc (Z = 21) is respectively

a. +5, +6, +4, +3 b. +3, +4, +5, +2

c. +5, +3, +2, +1 d. +4 in each case [E]

16. Among Cu, Hg, Cd and Cn which is/are not regarded as transition elements

a. Cu only b. Hg and Cd only

c. Hg, Cd and Cn only d. Hg, Cu and Cn only [E]

17. The d-block element not having general electronic configuration of (n-1)$d^{1-10}$$ns^{1-2}$ is

a. Pt b. Pd

c. Zn d. Cr [E]

18. Four successive members of the first series of the transition metals are listed below. For which one of them the standard potential $\left(E^{0}_{M^{2+}/M}\right)$ value has a positive sign?

a. Co (Z = 27) b. Ni (Z = 28)

c. Cu (Z = 29) d. Fe (Z = 26) [D]

19. The element with highest density is

a. Cr b. Ni

c. V d. Sc [E]

20. Exchange energy is maximum in

a. Sc b. Mn

c. Ti d. Zn [A]

21. The most stable manganese compound is

a. $Mn_2O_7$ b. $MnF_4$

c. $MnO_2$ d. $MnSO_4$ [A]

22. The element having stable minimum oxidation of state (+1) is

a. Cr b. Cu

c. Zn d. Sc [E]

23. Which of the following statements is wrong? [E]**(KCET-19)**

a. In highest oxidation states, the transition metals show acidic character

b. $Mn^{3+}$ and $Co^{3+}$ are oxidising agents in aqueous solution

c. Metals in highest oxidation states are more stable in oxide than in fluorides

d. All elements of 3d series exhibit variable oxidation states.

24. Which of the following ions has the least magnetic moment?

a. $Co^{2+}$ b. $Cu^{2+}$

c. $Ni^{2+}$ d. $Fe^{2+}$ [A]

25. The element having highest magnetic moment is

a. Zn b. Cu

c. Mn d. Ni [A]

26. Identify the set of paramagnetic ions among the following. [E]**(KCET-20)**

a. $V^{2+}$, $Co^{2+}$, $Ti^{4+}$ b. $Ni^{2+}$, $Cu^{2+}$, $Zn^{2+}$

c. $Ti^{2+}$, $Cu^{2+}$, $Mn^{3+}$ d. $Sc^{3+}$, $Ti^{3+}$, $V^{3+}$

27. Identify the correct sequence of number of unpaired electrons of the following ions.

a. $Ti^{+3} > Cr^{3+} > Fe^{3+} > Ni^{2+}$ b. $Fe^{3+} > Ni^{2+} > Ti^{+3} > Cr^{3+}$

c. $Fe^{3+} > Cr^{3+} > Ni^{2+} > Ti^{+3}$ d. $Fe^{3+} > Cr^{3+} > Ti^{+3} > Ni^{2+}$ [E]

28. A compound of a metal ion $M^{x+}$ (Z = 24) has a spin only magnetic moment of $\sqrt{15}$ Bohr Magnetons. The number of unpaired electrons in the compound are

a. 2 b. 4

c. 5 d. 3 [A]

29. Which of the following does not represent property stated against it? [E]**(KCET-21)**

a. $Co^{2+} < Fe^{2+} < Mn^{2+}$ - Ionic size b. Ti< V<Mn – Number of oxidation states

c. $Cr^{2+} < Mn^{2+} < Fe^{2+}$- paramagnetic behaviour d.Sc<Cr < Fe- density

30. **Statement1:** $Fe^{+3}$ ions show paramagnetic and magnetic moment of 5.92 BM
**Statement 2:** $Fe^{+3}$ ions have $d^3$ electronic configuration
Identify the correct statement

a. Statement I is incorrect and Statement II is correct

b. Both Statement I and II are incorrect

c. Both Statement I and II are correct

d. Statement I is correct and Statement II is incorrect [A]

31. The stability of particular oxidation state of a metal in aqueous solution is determined by

a. enthalpy of sublimation of the metal b. ionisation energy

c. enthalpy of hydration of the metal ion d. all of these [E]

32. In aqueous solution, Electronic configuration of Cu(II) ion is $3d^9$ but electronic configuration of Cu(I) ion is $3d^{10}$, which of the following is correct?

a. Cu(II) ion is less stable b. Cu(II) ion is more stable

c. Cu(I) and Cu(II) ions are equally stable d. Cu(I) ion is more stable [A]

33. The stability of $Cu^{2+}$ (aq) rather than $Cu^{+}$(aq) is due to

a. Less negative $\Delta_{hyd}H^{o}$ of $Cu^{2+}$ (aq) than $Cu^{+}$

b. More negative $\Delta_{hyd}H^{o}$ of $Cu^{2+}$ (aq) than $Cu^{+}$

c. More positive $\Delta_{hyd}H^{o}$ of $Cu^{2+}$ (aq) than $Cu^{+}$

d. $\Delta_{hyd}H^{o}$ of $Cu^{2+}$ (aq) is zero and that of is $Cu^{+}$ positive [A]

34. Match the following transition metal/compounds with their catalytic activity in the corresponding processes.

| Transition metal/compounds | Name of the process |
|---|---|
| (i) $TiCl_4 + Al(CH_3)_3$ | (A. Wacker process |
| (ii) $PdCl_2$ | (B. Contact process |
| (iii) Ni | (C. manufacture of polyethene |
| (iv) $V_2O_5$ | (D) hydrogenation of fat |

a. i-B, ii-C, iii-D, iv-A b. i-C, ii-A, iii-D, iv-B

c. i-A, ii-C, iii-D, iv-B d. i-D, ii-A, iii-B, iv-C [A]

35. Which of the following is not a condition for complex formation?

a. Small atomic size b. High nuclear charge

c. Variable oxidation states d. Availability of vacant *d* orbitals [E]

## 4.4 Important Compounds of d-Block Elements:

36. The correct increasing order of oxidising power is

a. $VO_2^{+} < Cr_2O_7^{2-} < MnO_4^{-}$ b. $VO_2^{+} > Cr_2O_7^{2-} > MnO_4^{-}$

c. $Cr_2O_7^{2-} < VO_2^{+} < MnO_4^{-}$. d. $MnO_4^{-} < Cr_2O_7^{2-} < VO_2^{+}$ [D]

37. Statement–I: Potassium permanganate is a powerful oxidant.

Statement–II: $KMnO_4$ oxidises $I^{-}$ to $IO_3^{-}$ in acidic solution.

a. Both Statement I and Statement II are correct.

b. Statement I is incorrect but Statement II is correct.

c. Both Statement I and Statement II are incorrect.

d. Statement I is correct but Statement II is incorrect. [D]

38. The product obtained when $I^{-}$ reacts with $KMnO_4$ in faintly alkaline or neutral medium is

a. $IO_3^{-}$ b. $IMnO_4^{+}$

c. $I_2$ d. $I_3O^{-}$ [A]

39. Which of the following statements is NOT correct?

a. $KMnO_4$ oxidises iodide ion to iodine in acid medium

b. Permanganate is diamagnetic

c. Copper liberates hydrogen from acids

d. $Ti^{2+}$ liberates hydrogen from dilute acids [A]

40. The reaction of aqueous $KMnO_4$ with $H_2O_2$ in acidic conditions gives:

a. $Mn^{4+}$ and $O_2$ b. $Mn^{2+}$ and $O_2$

c. $Mn^{2+}$ and $O_3$ d. $Mn^{4+}$ and $MnO_2$ [A]

41. The oxidation state of chromium in the final product formed by the reaction between KI and acidified potassium dichromate solution is:

a. + 3 b. + 2

c. + 6 d. + 4 [D]

42. Which of the following statements is not correct?

a. Scandium does not exhibit variable oxidation states
b. Brass is an alloy of copper and zinc
c. Actinoid contraction is greater than lanthanoid contraction
d. $Mn^{2+}$ is colourless [A]

43. The basic oxide among the following is

a. $CrO_3$ b. $Cr_2O_3$

c. CrO d. $CrO_4$ [A]

44. The correct decreasing order of ionic character in the following oxides is

a. $Mn_2O_7 > MnO_2 > MnO$ b. $MnO > MnO_2 > Mn_2O_7$

c. $Mn_2O_7 > MnO > MnO_2$ d. $MnO > Mn_2O_7 > MnO_2$ [A]

45. The composition of chromite ore is

a. $FeCr_2O_3$ b. $FeCrO_3$

c. $FeCrO_4$ d. $FeCr_2O_4$ [E]

46. Choose the correct increasing order of the oxidation state of the central metal atom in the following oxoanions. $VO_2^+, VO^{2+}, TiO^{2+}, CrO_4^{2-}$

a. $VO^{2+} < VO_2^+ < TiO^{2+} < CrO_4^{2-}$ b. $VO^{2+} < TiO^{2+} < VO_2^+ < CrO_4^{2-}$

c. $CrO_4^{2-} < TiO^{2+} < VO_2^+ < VO^{2+}$ d. $TiO^{2+} < VO^{2+} < VO_2^+ < CrO_4^{2-}$ [E]

47. Which of the following pair of metal oxides are amphoteric?

a. $V_2O_5$, $Cr_2O_3$ b. $Mn_2O_7$, $CrO_3$

c. $V_2O_5$, $V_2O_4$ d. CrO, $V_2O_5$ [E]

48. Transition metal **A** forms highest oxidation state only with oxygen, which is acidic and covalent and its divalent ion has a maximum magnetic moment. Its oxide oxidises iodide ion to Iodate ions in neutral medium, the metal is

a. Sc b. Mn

c. Ag d. Cr [D]

49. In the dichromate dianion, the nature of bonds are

a. four equivalent Cr–O bonds

b. six equivalent Cr–O bonds and one O–O bond

c. six equivalent Cr–O bonds and one Cr–Cr bond

d. six equivalent Cr–O bonds and one Cr–O–Cr bond [D]

50. A mixture of NaCl and $K_2Cr_2O_7$ is heated with conc $H_2SO_4$ deep red vapours are formed. Which of the following statements is false? [E][KCET-19]

a. The vapours give a yellow solution with NaOH

b. The vapours contain $CrO_2Cl_2$ and $Cl_2$

c. The vapours contain $CrO_2Cl_2$ only

d. The vapours when passed into lead acetate in acetic give a yellow precipitate

51. The ability of fluorine to stabilise the highest oxidation state of transition elements is due to

a. low lattice energy and high bond enthalpy.b. high lattice energy and high bond enthalpy

c. high lattice energy and low bond enthalpy.d. low lattice energy and low bond enthalpy. [A]

52. On heating potassium permanganate, one of the following compound is not obtained: [E] [KCET-15]

a. $O_2$ b. MnO

c. $MnO_2$ d. $K_2MnO_4$

53. Match the List - I(complex) with List - Il (central metal) and select the correct option

| List I | | List II | |
|---|---|---|---|
| A. | Blood pigment | i) | Rh |
| B. | Chlorophyll | ii) | Co |
| C. | Vitamin $B_{12}$ | iii) | Mg |
| D. | Wilkinson Catalyst | iv) | Fe |

a. A - i, B - ii, C - iii, D - iv b. A - iv, B - iii, C - ii, D – i

c. A - iv, B - ii, C - iii, D - i d. A - i, B - iii, C- ii, D – iv [D]

54. Which of the following transition metals cannot displace $H_2$ from acids?

a. Sc b. Ti

c. Zn d. Cu [A]

55. Statement I: Cu displaces $H_2$ gas from dilute acids.

Statement II: $Cu^{2+}$ ions get reduced more easily than H+ ions.

a. Both Statement I and Statement II are correct.

b. Statement I is incorrect but Statement II is correct.

c. Both Statement I and Statement II are incorrect.

d. Statement I is correct but Statement II is incorrect. [D]

## 4.5 Lanthanoids:

56. Lanthanoids react with water to form

a. $Ln(OH)_2$ b. LnOH

c. $Ln_2O_3$ d. $Ln(OH)_3$ [E]

57. The radius of $La^{3+}$ (Z = 57) is 106 pm. Which one of the following given values will be closest to the radius of $Lu^{3+}$ (Z = 71)?

a. 160 pm b. 140 pm

c. 106 pm d. 85 pm [A]

58. Which of the following oxidation states is the most common among the lanthanoids?

a. 3 b. 4

c. 2 d. 5 [E]

59. What is the percentage of lanthanoid metal in mischmetall?

a. 90% b. 20%

c. 5% d. 95% [E]

60. Incorrect statement with reference to Ce (Z=58) is [E] [KCET-19]

a. $Ce^{4+}$ is a reducing agent.

b. Ce in +3 oxidation state is more stable than in +4.

c. atomic size of Ce is more than that of Lu.

d. Ce shows common oxidation states of +3 and +4.

61. Although +3 is the characteristic oxidation state for lanthanoids but cerium also shows + 4 oxidation state because of

a. Cerium+ 4 has less stable half filled $4f^7$-orbital.

b. Cerium+ 4 has more stable half filled $4f^7$-orbital

c. Cerium + 4 has noble gas configuration $4f^0\ 5d^0\ 6s^0$.

d. Cerium + 4 has more stable completely filled $4f^{14}$-orbital. [A]

62. The correct statement is [E] [KCET-14]

a. The extent of actinoid contraction is almost the same as lanthanoid contraction.

b. $Ce^{+4}$ in aqueous solution is not known.

c. The earlier members of lanthanoid series resemble calcium in their chemical properties.

d. In general, lanthanoids and actinoids do not show variable oxidation states.

63. Trivalent lanthanoid ions to be colourless is/are

a. Eu b. La

c. Er d. Ce [A]

64. Lanthanoids on heating with carbon produces

a. mixtures of $Ln_3C$, $Ln_2C_3$ and $LnC_2$ b. mixtures of $Ln_2C$, $LnC_3$ and LnC

c. mixtures of $LnC_4$ and LnC d. only LnC [A]

65. Reason of lanthanoid contraction is: -

a. Negligible screening effect of '*f* ' orbitals. b. Increasing nuclear charge.

c. Decreasing nuclear charge. d. Decreasing screening effect. [E]

66. Identify the incorrect statement from the following: -

a. Zirconium and Hafnium have identical radii of 160 pm and 159 pm, respectively as a consequence of lanthanoid contraction.

b. Lanthanoids reveal only +3 oxidation state.

c. The lanthanoids other than the $f^0$ type and the $f^{14}$ type are all paramagnetic.

d. The overall decrease in atomic and ionic radii from lanthanum to lutetium is called lanthanoid contraction. [A]

67. Because of lanthanoid contraction, which of the following pairs of elements have nearly same atomic radii? (Numbers in the parenthesis are atomic numbers).

a. Zr (40) and Nb (41) b. Zr (40) and Hf (72)

c. Zr (40) and Ta (73) d. Ti (22) and Zr (40) [E]

68. Match the following d and f - block elements with their properties or reactions: -

| **Column A (Elements/Compounds)** | **Column B (Properties/Reactions)** |
|---|---|
| A. Potassium Dichromate | 1. Shows +3 and +5 oxidation states |
| B Manganese (Mn) | 2. Used in Breathalyzer test for detecting alcohol |
| C Lanthanum (La. | 3. Shows multiple oxidation states from +2 to +7 |
| D Chromium (Cr) | 4. Exhibits +3 oxidation state and is a typical lanthanoid |

a. A - 2 B - 3 C - 4 D – 1 b. A - 1 B - 2 C - 4 D – 3

c. A - 2 B - 1 C - 3 D – 4 d. A - 3 B - 1 C - 2 D – 4 [D]

## 4.6 Actinoids:

69. Actinoids to show maximum oxidation states is

a. Ac b. No

c. Np d. U [E]

70. The reason for greater range of oxidation states in actinoids is attributed to :

a. Actinoid contraction. b. 5*f*, 6*d* and 7*s* levels having comparable energies.

c. 4*f* and 5*d* levels being close in energies. D. The radioactive nature of actinoids. [E]

71. The incorrect statement among the following is [E] [NEET-21]

a. actinoids are highly reactive metals, especially when finely divided.

b. actinoid contraction is greater for element to element than lanthanoid contraction.

c. most of the trivalent lanthanoid ions are colourless in the solid state.

d. lanthanoids are good conductors of heat and electricity.

## Fill in the blanks by choosing the appropriate word from those given in the brackets: (ONE MARK)

### Set - 1

**(exchange energy, increase, chromium, oxidation number, scandium)**

1. Ionization energies _____only slightly along the 3*d* series. [E]
2. The loss of _____ increases the stability. [E]
3. All the transition metals except _____form ionic metal oxides. [E]
4. As the _____of a metal increase, ionic character decreases. [E]
5. Element with more unpaired electron in 3d series is _____ [E]

### Set - 2

**(Chromate, $KClO_4$, $K_2Cr_2O_7$, Zr, Ln, melting point)**

1. The high _____ of $6^{th}$ group elements is due to more unpaired electrons. [E]
2. The _____ ion is tetrahedral. [E]
3. _____ is the primary standard in volumetric analysis. [E]
4. Potassium permanganate crystals are isostructural with _____. [E]
5. Hf and _____ have almost identical radii. [E]

### Set - 3

**(Carbon dioxide, sodium dichromate, zinc, tin, Ln, +3)**

1. Some_____ oxides are used as phosphors in television screens. [E]
2. Actinoids generally show _____ oxidation state. [E]
3. Acidified permanganate solution oxidises oxalates to _____. [E]
4. Sodium chromate when acidified with sulphuric acid gives _____. [E]
5. Brass is an alloy of copper and _____. [E]

### Set - 4

**(Cu, Zero, Interstitial, $Cr^{2+}$, catalytic, $Mn^{+2}$)**

1. Spin only magnetic moment of _____is 5.9 BM. [E]
2. The element of 3d series to have positive standard electrode potential is _____. [E]
3. The oxidation state of Fe in $Fe(CO)_5$ is _____. [E]
4. The ion _____is strong reducing agents and will liberate hydrogen from a dilute acid. [E]
5. _____ compounds are usually non stoichiometric. [E]

### Set - 5

**(zinc sulphate, $Zn^{2+}$, increases, Interstitial, unpaired electrons, decrease)**

1. Lanthanoid contraction is a overall _____in atomic radii from La to Lu. [E]
2. Manganous salt is oxidised to $MnO_2$in the presence of _____ [E]
3. _____ compounds chemically inert. [E]
4. The magnetic moment _____ with the increasing number of unpaired electrons. [E]
5. _____ forms colourless compounds. [E]

**Set - 6**

**(Ag, high, Ti, low, +3, Hf)**

1. Zr and _____ have similar atomic radii. [E]
2. _____ salts show light sensitive properties. [E]
3. Mn has _____ 3rd ionisation properties. [E]
4. Oxide of _____ used in pigment industry [E]
5. The common oxidation states of lanthanoids is _____ [E]

**Set - 7**

**(unpaired, Ce, Cu, +3, Hydrogen, +4)**

1. Paramagnetismarised from the presence of _____ electrons. [E] [E1-2025]
2. The element of 3d series to have positive standard electrode potential is____ [E] [E3-2025]
3. A number of lanthanoid series which is well known to exhibit +4 oxidation state is___[E] [E3-2024]
4. The gas liberated when lanthanoids (Ln) react with acids is_____ [E]
5. The general oxidation state of actinoids _____ [E]

**Set – 8**

**(ferromagnetic, +2, +3, polyethylene, 0, 2.84BM,)**

1. Oxidation state of 'Ni' in [ Ni $(CO)_4$] is ---------- [E]
2. Ziegler catalyst is used in manufacture of ---------- [E]
3. Spin only magnetic moment of $Ti^{2+}$ is ---------- [E]
4. The lowest common oxidation state of first row transition metals is ---------- [E]
5. The substances which are attracted very strongly to the magnetic field are said to be -------- [E]

## TWO MARKS QUESTIONS:

## 4.2. Electronic Configurations of the d-Block Elements

1. Write the electronic configuration of Cr and Cu. [E]
2. On what ground can you say that scandium (Z=21) is a transition element but zinc (Z=30) is not? [A][S-2021]

## 4.3. General Properties of the Transition Elements

3. Name the 3d series elements having
   a) Maximum melting point
   b) Minimum melting point [A]
4. Why do the transition elements exhibit higher enthalpies of atomisation? [A]
5. Why do the transition elements exhibit higher enthalpies of atomisation? [A]
6. The atomic sizes of Fe, Co, Ni are nearly same. Explain with reason [D]
7. Why density increases from Ti (Z=22) to Cu (Z=29)? [A]
8. For what reason transition metals have high melting points? [E]

### 4.3.3 Ionisation Enthalpies

9. Which element has highest 2nd ionisation enthalpy and lowest enthalpy of atomisation in first transition series? [A]
10. Give reason: Ionisation enthalpy increases along transition elements from left to right. [A]

### 4.3.4 Oxidation States

11. Why Manganese exhibit maximum oxidation of +7 only with oxide? [D]
12. To what extent does electronic configuration decide stability of oxidation states? Give example. [D]
13. Name the transition metal which exhibits its higher oxidation state of +7 only with oxide. Give reason. [D]
14. Which metal in the first series of transition metal exhibits +1 oxidation state most frequently and why? [A]

### 4.3.5. Trends in the $M^{2+}$ /M Standard Electrode Potentials

15. Give reasons: $Cu^{+2}$ (aq) is more stable than $Cu^{+}$
16. Why is $Cr^{2+}$ reducing and $Mn^{3+}$ oxidising when both have $d^4$ configuration? [A]
17. The $E^{o}(M^{2+}/M)$ value for copper is positive (+0.34V). Give reason for this? [A]
18. Why is the $E^{o}$ value for the $Mn^{3+}/Mn^{2+}$ couple much more positive than that for $Cr^{3+}/Cr^{2+}$ or $Fe^{3+}/Fe^{2+}$? Explain. [E]
19. Which is a stronger reducing agent $Cr^{2+}$ or $Fe^{2+}$ and why? [A]

### 4.3.7. Trends in Stability of Higher Oxidation States

20. To what extent do the electronic configurations decide to stability of oxidation states in the first series of transition elements? Illustrate your answer with example. [D]
21. Give any two examples for amphoteric oxides of 3d series. [E]
22. Give any two examples for acidic oxides of 3d series. [E]
23. The lowest oxidation state of manganese is basic while the highest is acidic. Explain. [A]

### 4.3.9. Magnetic Properties

24. Calculate the magnetic moment of $Ti^{3+}$ ion? [E][S-2019] [Ans: 1.73 BM]

### 4.3.10. Formation of Coloured Ions

25. Transition elements forms colour compounds, Give two reasons? [E][S-2014]

### 4.3.12 Catalytic Properties

26. The transition metals and their compounds are known for their catalytic activity. Give two reasons. [E] [A-2019,2020,2024, S-2018]
27. Iron (III) catalyses the reaction between iodide and persulphate ions in the reaction: $2I^{-} + S_2O_8^{2-} \longrightarrow I_2 + 2SO_4^{2-}$. Explain the catalytic action of catalyst iron (III) by using chemical reactions. [D]

### 4.3.13 Formation of Interstitial Compounds

28. Write any two characteristics of interstitial compounds. [E][E$^1$-2025]

### 4.3.14 Alloy Formation

29. What are the compositions of alloy a) Brass b) Bronze? [E][A-2022]

### 4.4. Some Important Compounds of Transition Elements

30. Draw the structure of dichromate ion? What is the value of bond angle of Cr-O-Cr in it? [A]
31. Draw the structure of permanganate ion (MnO4and magnate ion (MnO4 )2- . [A]

### The Lanthanoids

### 4.5.3 Oxidation States

32. What is the common oxidation state shown by Lanthanoids? Mention any one consequence of Lanthanoid contraction. [E]

### 4.5.4. General Characteristics

33. What is lanthanoid contraction? **(A-14, S-16, A-17, S-18, E$^1$-24)** [A-2014, 2017, S-2016,2018, E$^1$-24]
    How Lanthanoid contraction influence on covalent nature of d block elements. [A]
34. Write any two differences between Lanthanoids and actinoids? [E]
35. What is the composition of Mischmetall? Write one use of it. [A]
36. Give reason: i) Separation of lanthanoids is difficult from their natural occurrence [A]
    ii) Study of actinoids is difficult. [E]

37. Which organic compounds conversion is involved in Wacker process? Write the formula of the catalyst. [A]

### 4.7. Some Applications of d- and f-Block Elements

38. Tungsten metal is used as a filament in bulb but zinc metal cannot be used in bulb. Why? [A]
39. Write one use of lanthanoids and actinoids. [A]

## THREE MARKS QUESTIONS:

### 4.3. General Properties of the Transition Elements

1. The transition metals form a large number of complex compounds. Give three reasons. [A]**[MQP]**
2. a) Give a reason for each of the following: [E]**[2024E1]**
   i) The spin only magnetic moment of $Sc^{3+}$ is zero.
   ii) Alloys are readily formed by transition metals. [E]
3. Write any 3 characteristic properties of interstitial compounds. [E] **[2024E2]**
4. a) Calculate the magnetic moment of $Fe^{2+}$ by using spin only formula. (Atomic no. of Fe = 26) [E]
   [Ans: 4.89 BM]
   b) Write the equation for the reaction of lanthanoids with oxygen. [A]**[2025E2]**

5. Give reason for the following: [E]**[2025E2]**

   a) $Zn^{+2}$ is colourless.

   b) Cerium shows +4 oxidation state.

   c) Zr and Hf exhibit similar radii.

   d) The melting points of transition metals increase up to $d^5$configuration. Give reason. [A]

6. What are interstitial compounds? Write any two characteristics of them. [E]**[2024E3] [2025E2]**

7. What are interstitial compounds? Give two examples. [E]**[MQP]**

8. Calculate the spin only magnetic moment of $M^{3+}$ ion. (Z = 24). [E][Ans: 3.87 BM]

9. Considering the elements of 3d transition series, write the element which is

   (i) Unable to form a monoxide.

   (ii) Having positive $E^0$ $(M^{2+}/M)$ value.

   (iii) a base element of Ziegler Catalyst used to manufacture polythene. [D]

10. Name the oxometal anions of the first series of the transition metals in which the metal exhibits the oxidation state equal to its group number. [D]

11. In general, transition metal ions of same charge in a given series show progressive decrease in atomic and ionic radius with increase in their atomic number. Give two reasons this change in radius. Name the phenomenon associated with this decrease. [A]

12. The enthalpies of atomization of Zinc and Copper are given. Match the correct enthalpies of atomization of Zinc and Copper correctly. Give reason for your answer. [D]

| Element | Enthalpy of atomisation/ $kJmol^{-1}$ |
|---|---|
| Zinc | 339 |
| Copper | 130 |

13. The graph below shows the first, second and third ionisation energies of a first series of transition elements. In the graph, we can see a deviation in the fifth element in the trend for second ionisation energy and a deviation in the sixth element in the trend for third ionisation energy. Identify the elements and give reason for the deviation occurs. [D]

14. Use the data to answer the following and also justify giving reasons:

| | Cr | Mn | Fe | Co |
|---|---|---|---|---|
| $E^0(M^{2+}/M)$ | -0.91 | -1.18 | -0.44 | -0.28 |
| $E^0(M^{3+}/M^{2+})$ | -0.41 | +1.57 | +0.77 | +1.97 |

   Give reason:

   (i) Among $Cr^{2+}$ or $Fe^{2+}$; which is a stronger reducing agent in aqueous medium.

   (ii) Which is the most stable ion in +2 oxidation state? [D]

15. a) which metal in the first series of transition metal exhibhits +1 oxidation state most frequently and why? [A]

   b) What are interstitial compounds? [E]

## 4.4. Some Important Compounds of Transition Elements

16. Write the balanced chemical equations for the reactions involved in preparation of potassium permanganate from $MnO_2$. Write the structure of manganate ion. [A]**[MQP]**

17. Write the balanced chemical equations for the reactions involved in preparation of potassium dichromate from chromite ore. [A]**[2024E1][2025E1][2025E3]**

18. Write the balanced chemical reaction for the following. [D]**[MQP]**
    a) Reaction between potassium dichromate and iodide ion in acidic medium.
    b) Reaction between potassium dichromate and sulphide ion in acidic medium.
    c) Reaction between potassium dichromate and stannous ion in acidic medium.

19. Write the balanced chemical reaction for the following [D]**[MQP]**
    a) Reaction between potassium permanganate and iodide ion in acidic medium.
    b) Reaction between potassium permanganate and iodide ion in neutral medium.
    c) Reaction between potassium permanganate and oxalate ion in acidic medium.

20. a) How does $MnO_4^-$ reacts with iodide in acid solution and neutral solution? [D]**[2024E3]**
    b) Write formula to calculate spin only magnetic moment. [E]

21. Among sulphuric acid and hydrochloric acid, which acid will be preferred for permanganate titrations?Give reason. [D]**[MQP]**

22. a) Name the ore used in the preparation of Potassium dichromate [E]**[2024E2]**
    b) Complete the following equations:
    (i) $Cr_2O_7^{2--} + 14\ H^+ + 6\ Fe^{+2}$ -------→
    (ii) $10\ I^{--} + 2\ MnO_4^{--} + 16\ H^+$ -------→ [A]

23. With the help of chemical reaction show that chromate and dichromate ions are inter convertible in aqueous solution depending upon pH of the solution. Write the structure of dichromate ion. [A]

24. When a chromite ore "A" is fused with sodium carbonate in free excess of air and the product is dissolved in water, a yellow solution of compound "B" is obtained. After treatment of this yellow solution with $H_2SO_4$ , compound "C" can be crystallised from the solution. When the compound "C" is treated with KCl, orange crystals of compound "D" is crystallised out. Write all reactions involved in the conversion of "A" to "D". [D]**[MQP]**

25. A blackish brown coloured solid 'A' when fused with alkali metal hydroxide in presence of air produces a dark green coloured compound 'B' which on electrolytic oxidation in alkaline medium givesa dark purple coloured compound 'C'. Identify A, B and C. [D] **[MQP]**

26. Explain the structure of dichromate ion ($Cr_2O_7^{2-}$ ). [A]

27. a) ---------- + $Na_2CO_3 + 7O_2$ -------→$8\ Na_2CrO_4 + 2\ Fe_2O_3 + 8CO_2$ [A]

b) $MnO_2 \xrightarrow[\text{Oxidised with air}]{\text{Fussed with KOH}}$

c) $2\ KMnO_4 \xrightarrow{513\ K} K_2MnO_4 + O_2 +$ ----------

28. Explain the preparation of potassium permanganate from $MnO_2$ with balanced equations. Mention the gas evolved when $KMnO_4$ is heated at 513 K.

## 4.5.4 General Characteristics of Lanthanoids and actinoids

## 8.5.2 Atomic and Ionic Sizes

29. What is Lanthanoid Contraction? Mention two consequences of it. [E]**[2024E1]**

30. Write the products formed when lanthanoids reacts with [A]**[MQP]**

    a) Carbon b)Nitrogen c) acids

31. Give reasons for the following [A]**[MQP]**

    a) Actinoids show higher oxidation states.

    b) Actinoids contraction is greater from element to element than lanthanoid contraction.

    c) Chemical properties of actinoids are less known.

32. (a) Among lanthanoids and actinoids which series has more radioactive elements?[A]**[2024E2]**

    (b) Write any two consequences of lanthanoid contraction.

33. a) What is lanthanoid contraction? Mention the cause for it. [E]**[2024E3]**

    b) Which gas is liberated when lanthanoids reacts with acids? [A]

34. What is lanthanoid contraction? Write one comparison and one difference between lanthanoids and actinoids with respect to oxidation states shown by them. [A]**[2025E1]**

35. Mention the lanthanoid product formed in the following reactions: [A]**[MQP]**

    i) $Ln + C \xrightarrow{2773K}$

    ii) $Ln + C \rightarrow$

    iii) $Ln + S \xrightarrow{Heat}$

36. Write the formula of the three different types of compounds formed when lanthanoids reacts with carbon or heated with carbon? [A]**[MQP]**

37. Give reason for the following.; [D]**[MQP]**

    (i) Ce(III) is easily oxidised to Ce(IV).

    (ii) Actinoids show wide range of oxidation states.

    (iii) The second and third transition series elements have almost similar atomic radii.

38. a) Name two trivalent lanthanoid ions that is colourless. [A]**[2025E3]**

    b) What type of lanthanoid compounds are employed as catalyst in petroleum cracking?[A]

39. a) Among lanthanoid and actinoid series, which series show contraction greater from element to element? Why? [E]**[MQP]**

    b) Name the element of actinoids that does not exhibit +3 oxidation state. [D]

## 4.7 Some Applications of d- and f-Block Elements

40. Write the composition for the following [A]**[MQP]**
    a) UK copper
    b) Silver UK coins
    c) Ziegler catalyst.
41. Name the catalyst used in the following. [A]**[MQP]**
    a) Haber process
    b) Wacker process
    c) Hydrogenation of fats.
42. Write any three uses of lanthanoids and actinoids. [A]**[MQP]**

# UNIT - 5
# COORDINATION COMPOUNDS

## Multiple Choice Questions (MCQs) (ONE MARK)

### 5.1 Werner's theory of coordination compounds

1. For each mole of $PdCl_2.4NH_3$ gives 2 moles of AgCl on reaction with excess of $AgNO_3$. The secondary valency of metal is

a) 6 b) 2 c) 0 d) 4 **[A]**

2. The conductivity of $[CoCl_2(NH_3)_4]Cl$ in solution corresponds to

a) 1 mole of ions b) 2 moles of ions

c) 3 moles of ions d) 4 moles of ions **[D]**

3. Which among the following has highest molar conductivity?

a) $K_4[Fe(CN)_6]$ b) $[Co(NH_3)_6]Cl_3$

c) $[Cu(NH_3)_4]SO_4$ d) $[Ni(CO)_4]$ **[A]**

4. The primary and secondary valencies of $[Fe(C_2O_4)_3]^{3-}$ complexes are [KCET-2025]

a) 3 and 3 b) 3 and 6

c) 6 and 3 d) 0 and 3 **[A]**

5. Which of the following octahedral complex has least conductivity in aqueous solution?

a) $Co(NH_3)_5Cl_3$ b) $Co(NH_3)_6Cl_3$

c) $Co(NH_3)_4Cl_3$ d) $Co(NH_3)_3Cl_3$ **[D]**

6. The compound does not give test of sulphate ion in aqueous solution is

a) $K_2SO_4.Al_2(SO_4)_3.24H_2O$ b) $[Cu(H_2O)_4]SO_4.H_2O$

c) $FeSO_4.(NH_4)_2SO_4.6H_2O$ d) $[CoSO_4(NH_3)_5]Br$ **[A]**

7. When a complex $K_4\left[Fe(CN)_6\right]$ is dissolved in $H_2O$, it dissociates in to

a) $Fe^{2+}$ and 6 $CN^-$ ions b) $4K^+$ and $[Fe(CN)_6]^{4-}$ ions

c) $4K^+$, $Fe^{2+}$ and 6 $CN^-$ ions d) $4K^+$, $Fe^{3+}$ and 6 $CN^-$ ions **[D]**

8. A purple compound 'M' has a formula $Co(NH_3)_6Cl_3$, on adding excess $AgNO_3$ to one mole of 'M' produces 2 moles of AgCl. If secondary valence of Co is 6 then correct formula of the complex will be?

a) $[CoCl_3(NH_3)_6]$ b) $[Co(NH_3)_6]Cl_3$

c) $[Co(NH_3)_5Cl]Cl_2.NH_3$ d) $[Co(NH_3)_6Cl]Cl_2$ **[D]**

9. Which among the following is not a double salt?

a) Mohr's Salt b) Potash Alum

c) Carnallite d) Potassium ferrocyanide. **[E]**

10. The correct order of the stoichiometries of AgCl formed when $AgNO_3$ in excess is treated with the complexes: $CoCl_3.6NH_3$, $CoCl_3.5NH_3$, $CoCl_3.4NH_3$ respectively is (coordination valency is 6):

a) 3 AgCl, 1 AgCl, 2 AgCl
b) 3 AgCl, 2 AgCl, 1 AgCl
c) 2 AgCl, 3 AgCl, 1 AgCl
d) 1 AgCl, 3 AgCl, 2 AgCl [NEET-17] **[D]**

11. In Complex compounds the metal atom or ion acts as

a) Lewis acid
b) Lewis base
c) Bronsted acid
d) Bronsted base **[E]**

12. The complex $PtCl_2.4NH_3Br_2$ is treated with excess of $AgNO_3$ solution, two mole of AgBr is precipitated. The primary and secondary valence of this complex is

a) 6 and 1
b) 6 and 2
c) 4 and 6
d) 3 and 6 **[D]**

13. When one mole of complex $Pt.Br_2.4NH_3$ is treated with excess of silver nitrate solution, two moles of silver bromide is precipitated then the primary and secondary valence of this complex is respectively,

a) 2 and 6
b) 6 and 2
c) 4 and 6
d) 2 and 4 **[A]**

14. Coordination number of the central atom/ion is determined by

a) only by the number of pi bonds formed by the ligand with the central atom/ion.
b) both by the number of sigma and pi bonds formed by the ligand with the central atom/ion.
c) only by the number of sigma bonds formed by the ligand with the central atom/ion.
d) by the total number of electrons present in ligand. **[E]**

15. In the complex ion $[Fe(C_2O_4)_3]^{3-}$, the co-ordination number of Fe is **[E]** [KCET-2025]

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

16. On treating 100 mL of 0.1 M aqueous solution of the complex $CrCl_3 \cdot 6H_2O$ with excess of $AgNO_3$, 2.86g of AgCl was obtained. The complex is **[E]** [KCET-2024]

a) $[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$
b) $[Cr(H_2O)_5 Cl^-]Cl_2 \cdot H_2O$
c) $[Cr(H_2O)_6 Cl_3]$
d) $[Cr(H_2O)_3 Cl_3] \cdot 3H_2O$

17. The complex hexamineplatinum(IV)chloride will give number of ions on ionisation. **[E]** [KCET-2022]

a) 5
b) 2
c) 3
d) 4

18. The coordination number of Fe and Co in the complex ions, $Fe(C_2O_4)_3]^{3-}$ and $[Co(SCN)_4]^{2-}$ are respectively **[A]** [KCET-2020]

a) 6 and 8
b) 3 and 4
c) 6 and 4
d) 4 and 6

19. Out of the following complex compounds, which of the following compound will be having minimum conductance in solution? **[A]** [NEET-2025]

a) $[Co(NH_3)_4Cl_2]$ b) $[Co(NH_3)_6]Cl_3$

c) $[Co(NH_3)_3Cl_3]$ d) Both (A) and (C)

20. Cobalt(III)chloride forms several octahedral complexes with ammonia. Which of the following will not give test chloride ions with silver nitrate at 25°C? [NEET-2015]

a) $CoCl_3.6H_2O$ b) $CoCl_3.3H_2O$

c) $CoCl_3.5H_2O$ d) $CoCl_3.4H_2O$

21. Match the coordination number and type of hybridization with distribution of hybrid orbitals in space based on valence bond theory [NEET-2020]

| Coordination number and type of hybridization | Distribution of hybrid orbitals in space |
|---|---|
| i. 4, $sp^3$ | p. trigonal bipyramidal |
| ii. 4, $dsp^2$ | q. octahedral |
| iii. 5, $sp^3d$ | r. tetrahedral |
| iv. 6, $d^2sp^3$ | s. square planar |

a) i-q, ii-r, iii-s, iv-p b) i-s, ii-p, iii-q, iv-r

c) i-r, ii-p, iii-s, iv-q d) i-r, ii-s, iii-p, iv-q

## 5.2 Definitions of some important terms pertaining to coordination compounds

22. $H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2$ is a:

a) Monodentate ligand b) Chelating ligand

c) ambidentate ligand d) Cationic ligand **[E]**

23. Which of the following is true about metal in 3d series and EDTA complex?

a) The ratio of moles of metal & EDTA in complex is 1:6

b) The ratio of moles of metal & EDTA in complex is 6:1

c) 3d metal ion cannot bonded with EDTA

d) The ratio of moles of metal & EDTA in complex is 1:1 **[E]**

24. Which of the following is homoleptic complex?

a) $\left[Co(NH_3)_3Cl_3\right]$ b) $\left[Co(NH_3)_5Cl\right]Cl_2$

c) $\left[Co(NH_3]_4(H_2O)_2\right]Cl_3$ d) $[Co(NH_3)_6]Cl_3$ **[E]**

25. Metal-Isothiocyanato is indicated by

a) M-NCS b) M-SCN

c) M-CNS d) M-CSN **[E]**

26. Donar atoms in $EDTA^{4-}$ are [NEET-21]

a) N and O b) N and H

c) N and C d) N and N **[E]**

27. An ambidentate ligand is

a) $Cl^-$ b) $CN^-$

c) $OH^-$ d) $NO_2^+$ **[E]**

28. The ligand which forms more stable coordination complexes is

a) $NH_3$ b) $C_2O_4^{2-}$

c) $CN^-$ d) $H_2O$ **[A]**

29. The counter ion in the coordination compound $[Co(NH_3)_5(NO_2)]Cl_2$ is

a) Ammine b) Cobalt

c) Chloride d) Nitro **[E]**

30. Which of the following complex does not have chelation?

a) $K_3[Al(C_2O_4)_3]$ b) $[Pt(en)_2]Cl_2$

c) $K_2[Ni(EDTA)]$ d) $[Ag(NH_3)_2]Cl$ **[A]**

31. Which is the most stable complex among the following?

a) $[Fe(H_2O)_6]^{3+}$ b) $[Fe(NH_3)_6]^{3+}$

c) $[Fe(C_2O_4)_3]^{3-}$ d) $[FeCl_6]^{3-}$ **[A]**

32. Match the ligand given in column I with property in column II:

| **Ligand** | **Property** |
|---|---|
| (A) $H_2NCH_2CH_2NH_2$ | (P) bidentate |
| (B) $EDTA^{4-}$ | (Q) ambidentate |
| (C) $NO_2$ | (R) Tridentate |
| (D) $NH(CH_2CH_2NH_2)_2$ | (S) hexadentate |

a) A→R, B→P, C→P, D→Q b) A→P, B→R, C→P, D→P

c) A→P, B→S, C→Q, D→R d) A→P, B→ Q, C→P, D→ R **[E]**

33. A ligand which has two different donor atoms and either of the two ligates with the central metal atom/ion in the complex is called **[E]** [KCET-2025]

a) Ambidentate ligand b) Unidentate ligand

c) Polydentate ligand d) Chelate ligand

34. Homoleptic complexes among the following are **[E]** [KCET-2021]

(A) $K_3[Al(C_2O_4)_3]$ (B) $[CoCl_2(en)_2]^+$ (C) $K_2[Zn(OH)_4]$

a) C only b) A and B only

c) A only d) A and C only

35. Ethylene diaminetetraacetate ion is a/an: **[E]** [NEET-2024]

a) bidentate ligand b) monodentate ligand

c) hexadentate ligand d) ambidentate ligand

36. Which of the following is not an ambidentate ligand? [NEET-2024]

a) $SCN^-$ b) $C_2O_4^{2-}$

c) $NO_2^-$ d) $CN^-$

37. Given below are two statements: [NEET-2024]

Statement I: $[Co(NH_3)_6]^{3+}$ is a homoleptic complex whereas $[Co(NH_3)_4Cl_2]^+$ is a heteroleptic complex.

Statement II: Complex $[Co(NH_3)_6]^{3+}$ has only one kind of ligands but $[Co(NH_3)_4Cl_2]^+$ has more than one kind of ligands.

In the light of the above statements, choose the correct answer from the options given below.

a) Statement I is true but Statement II is false

b) Both Statement I and Statement II are false

c) Statement I is false but Statement II is true

d) Both Statement I and Statement II are true

38. Homoleptic complex from the following complexes is: [NEET-2024]

a) Diamminechloridonitrito - N-platinum (II) b) Triamminetriaquachromium (III) chloride

c) Potassium trioxalatoaluminate (III) d) Pentaamminecarbonatocobalt (III) chloride

39. 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? [Examplar]

a) thiosulphato b) oxalato

c) glycinato d) ethane-1,2-diamine

## 5.3 Nomenclature of coordination compounds

40. The correct IUPAC name of $K_3[Cr(C_2O_4)_3]$ is

a) Potassiumtrioxalatochromium(III) b) Potassiumtrioxalatochromate(III)

c) Potassiumtrisoxalatochromate(III) d) Potassium oxalatochromate(III) **[A]**

41. IUPAC name for the complex $[Cu(NH_3)_4]\,SO_4$ is

a) cuprammonium sulphate b) copper tetraammonia sulphate

c) tetraamminecopper(II) sulphate d) copper ammonium(IV )sulphate **[A]**

42. The IUPAC name of the complex $[Ni(NH_3)_6]Cl_2$

a) Hexaammine nickel(II) Chloride b) Hexaammine nickel(IV) Chloride

c) Nickel(II) hexaammine Chloride d) Nickel(IV) hexaammine Chloride **[A]**

43. The formula of the complex tris (ethylene diamine) cobalt (III) sulphate is

a) $[Co(en)_2SO_4]$ b) $[Co(en)_3SO_4]$

c) $[Co(en)_3]SO_4$ d) $[Co(en)_3]_2(SO_4)_3$ **[A]**

44. Which formula and its name combination is incorrect? **[KCET-2025]**

a) $[Pt(NH_3)_2Cl(NO_2)]$, Diamine chloridonitrito−N− Platinum (II)

b) $[CoCl_2(en)_2]Cl$, Dichloridobis (ethane - 1,2 - dimine) cobalt (III) chloride

c) $K_3[Cr(C_2O_4)_3]$, Potassium trioxalatochromate (III)

d) $[Co(NH_3)_5(CO_3)]Cl$, Pentaamine carbonylcobalt (III) chloride

45. Which formula and name combination is incorrect? **[KCET-2023]**

a) $K_3[Al(C_2O_4)_3]$ − Potassium trioxalatoaluminate (III)

b) $[Pt(NH_3)_2Cl(NO_2)]$ − Diamminechloridonitrito -N-platinum (II)

c) $[Co(NH_3)_4(H_2O)Cl]Cl_2$ − Tetraammineaquachloridocobalt (HI) chloride

d) $[CoCl_2(en)_2]Cl$ − Dichloridodiethylenediammine cobalt (II) chloride

46. The correct IUPAC name of cis-platin is **[KCET-2022]**

a) diamminedichloridoplatinum (II)

b) dichloridodiammineplatinum (IV)

c) diamminedichloridoplatinum (IV)

d) diamminedichloridoplatinum (0)

47. The IUPAC name of $[Co(NH_3)_5(CO_3)]Cl$ is **[KCET-2021]**

a) carbonatopentamminecobalt (III) chloride

b) pentaammine cobalt (III) carbonate chloride

c) pentaamminecarbonatocobalt (III) chloride

d) pentaamminecarbonatocobaltate (III) chloride

48. The formula of penta aquanitrato chromium (III) nitrate is, **[KCET-2019]**

a) $[Cr(H_2O)_6](NO_2)_2$

b) $[Cr(H_2O)_5(NO_3)](NO_3)_2$

c) $[Cr(H_2O)_5(NO_2)]NO_3$

d) $[Cr(H_2O)_6](NO_3)_3$

## 5.4 Isomerism in coordination compounds

49. In a complex, the ligand that shows linkage isomerism is

a) $NO_2^-$

b) $NH_3$

c) CO

d) $H_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2$ **[A]**

50. $[Pt(NH_3)_4Cl_2]Br_2$ complex can show:

a) Hydrated as well as ionization isomerism

b) Ionization as well as geometrical isomerism

c) Linkage as well as geometrical isomerism

d) Ionization as well as optical isomerism **[D]**

51. Possible isomerism in complexes $[Co(NH_3)_3(NO_2)_3]$ and $[Co(NH_3)_5(NO_2)]Cl_2$, respectively are:

a) Linkage and optical

b) Geometrical and linkage

c) Optical and ionization

d) Linkage and ionization **[A]**

52. Which of the following coordination entity form racemic mixture when mixed in equimolar concentration?

a) trans-$[Co(en)_2Cl_2]^+$

b) $[Cr(OX)_3]^{3-}$

c) $[Co(en)Cl_4]^-$

d) All **[D]**

53. The complexes $[Co(NO_2)(NH_3)_5]Cl_2$ and $[Co(ONO)(NH_3)_5]Cl_2$ are the examples of

a) Coordination isomerism

b) Ionisation isomerism

c) Geometrical isomerism

d) Linkage isomerism **[E]**

54. The number of geometrical isomers of $[Co(NH_3)_3(NO_3)_3]$ are :

a) 0 b) 2

c) 3 d) 4 **[E]**

55. Both geometrical and optical isomerism are shown by

a) $[Cr(H_2O)_2(C_2O_4)_2]^+$ b) $[Co(en)_3]^{3-}$

c) $[Co(NH_3)_4Cl_2]^+$ d) $[Co(NH_3)_5Cl]^{+2}$ **[D]**

56. In the reactions $[CoCl_2(NH_3)_4]^+ + Cl^- \rightarrow [CoCl_3(NH_3)_3] + NH_3$ two isomers of the product are obtained. The initial complex is

a) *cis* isomer b) *trans* isomer

c) *cis* or *trans* isomers d) None of these **[D]**

57. Which of the following is not a subdivision of structural isomerism?

a) Coordination isomerism b) Linkage isomerism

c) Ionisation isomerism d) Geometrical isomerism **[E]**

58. Square planar complex of the type [MABXL] (where A, B, X, L are unidentate) shows

a) Two Cis and one Trans b) Two cis and Two trans

c) One Cis and two Trans d) one Cis and One Trans **[E]**

59. Which type of complexes shows geometrical isomerism?

a) $[MX_4]$ Tetrahedral. b) $[MX_4]$ Square planar

c) $[MX_2L_2]$ Square planar d) $[MX_2L_2]$ Tetrahedral **[E]**

60. Which type of complexes doesn't shows geometrical isomerism?

a) $[MX_2L_2]$ Tetrahedral. b) [MABXL] Square planar

c) $[MX_2L_2]$ Square planar d) $[MX_4L_2]$ Octahedral **[E]**

61. The optical active complex is

a) trans -$[PtCl_2(en)_2]^{2+}$ b) Cis -$[PtCl_2(en)_2]^{2+}$

c) trans- $[CrCl_2(ox)_2]^{3-}$ d) both a) and c) **[A]**

62. Linkage isomerism arises in a coordination compound containing

a) ambidentate ligand b) unidentate ligand

c) bidentate ligand d) Chelate ligand **[E]**

63. The type of isomerism arises from the interchange of ligands between cationic and anionic entities of different metal ions present in a complex is

a) Linkage isomerism b) ionisation isomerism

c) Solvate isomerism d) co-ordination isomerism **[A]**

65. The complex compounds $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$ are [KCET-2024]

a) optical isomers b) coordination isomers

c) ionisation isomers d) geometrical isomers

64. Match the coordination compounds given in column I with type of isomerism exhibited by them in column II:

| **Column I (Coordination compound)** | **Column II (Isomerism)** |
|---|---|
| i. $[Co(en)_3]Cl_3$ | A. Linkage isomerism |
| ii. $[Co(NH_3)_6][Cr(CN)_6]$ | B. Optical isomerism |
| iii. $[Co(NH_3)_5(SCN)]^{+2}$ | C. Geometrical isomerism |
| iv. $[Co(NH_3)_3Cl_2]^+$ | D. Coordination isomerism |

a) i→ B, ii→ D, iii→ A, iv→ C  b) i→C, ii→ D, iii→ A, iv→ B

c) i→ D, ii→ A, iii→ A, iv→ C  d) i→ B, ii→ A, iii→ C, iv→ D **[A]**

66. Number of stereoisomers exhibited by $[Co(en)_2Cl_2]^+$ is **[KCET-2020]**

a) 5  b) 2

c) 3  d) 4

## 5.5 Bonding in coordination compounds

67. Among $[Ni(CN)_4]^{2-}$ and $[NiCl_4]^{2-}$

a) $[Ni(CN)_4]^{2-}$ is diamagnetic and $[NiCl_4]^{2-}$ is paramagnetic

b) $[Ni(CN)_4]^{2-}$ is paramagnetic and $[NiCl_4]^{2-}$ is diamagnetic

c) Both $[Ni(CN)_4]^{2-}$ and $[NiCl_4]^{2-}$ are diamagnetic

d) Both $[Ni(CN)_4]^{2-}$ and $[NiCl_4]^{2-}$ are paramagnetic **[A]**

68. The complex ion $[Co(NH_3)_6]^{3+}$ is diamagnetic, while $[CoF_6]^{3-}$ is paramagnetic. This is due to

a) coordination number of cobalt  b) oxidation state of cobalt

c) nature of ligand  d) charge on complex ion **[A]**

69. $sp^3d^2$ hybridisation is present in

a) $[CoF_6]^{3-}$  b) $[Ni(CO)_4]$

c) $[Co(NH_3)_6]^{3+}$  d) $[Ni(CN)_4]^{2-}$ **[A]**

70. The inner orbital complex is

a) $[Co(NH_3)_6]^{3+}$  b) $[CoF_6]^{3+}$

c) $[Co(H_2O)_6]^{3+}$  d) $[CoCl_6]^{3+}$ **[D]**

71. The high spin complex is

a) $[Co(NH_3)_6]^{3+}$  b) $[Co(CN)_6]^3$

c) $[Co(en)_3]^{3+}$  d) $[CoF_6]^{3+}$ **[A]**

72. The tetrahedral complex is

a) $[Ni(CN)_4]^{2-}$  b) $[Ni(NH_3)_4]^{2+}$

c) $[NiCl_4]^{2-}$  d) $[Ni(en)_2]^{2+}$ **[D]**

73. Square complex is

a) $[Ni(CN)_4]^{2-}$  b) $[NiF_4]^{2-}$

c) $[NiCl_4]^{2-}$  d) $[Ni(CO)_4]^{2+}$ **[D]**

74. Complex with maximum magnetic moment is

a) $K_4[Fe(CN)_6]$ b) $K_3[Fe(CN)_6]$

c) $[CoF_6]^{3-}$ d) $[Co(NH_3)_6]^{3+}$ **[D]**

75. $[Mn(CN)_6]^{3-}$ and $[FeF_6]^{3-}$ are

a) Inner orbital and outer orbital complexes respectively.

b) Both inner orbital complexes.

c) Outer orbital and inner orbital complexes respectively.

d) Both outer orbital complexes. **[A]**

76. The incorrect statement about Valence Bond theory

i. It involves a number of assumptions.

ii. It gives quantitative interpretation of magnetic data.

iii. It does not explain the colour exhibited by coordination compounds.

iv. It gives a quantitative interpretation of the thermodynamic or kinetic stabilities of coordination compounds.

a) i only b) i and iv

c) ii and iv d) iii and iv **[A]**

77. **Statement 1:** The crystal field theory (CFT) is an electrostatic model which considers the metal-ligand bond to be ionic.

**Statement 2:** The crystal field theory (CFT) considers ligands as point dipoles in case of neutral molecules

Identify the correct statement **[A]**

a) Both Statement I and II are correct c) Statement I is correct and Statement II is incorrect.

b) Both Statement I and II are incorrect d) Statement I is in correct and Statement II is correct

78. The degeneracy of d-orbitals of isolated gaseous metal is maintained when

a) Negative charges of dipole molecules surround the central metal.

b) Spherically symmetrical field of negative charges surrounds the metal.

c) Spherically unsymmetrical field of negative charges surrounds the metal.

d) Non spherical unsymmetrical field of negative charges surrounds the metal. **[E]**

79. In a complex with secondary valence six, the set of d-orbitals which experience more repulsion with electrons of ligands are

a) $d_{x^2-y^2}$ & $d_{z^2}$ b) $d_{xy}$, $d_{yz}$ & $d_{zx}$

c) $d_{xy}$, $d_{yz}$ & $d_{x^2-y^2}$ d) $d_{yz}$, $d_{zx}$ & $d_{z^2}$ **[E]**

80. Arrange the following complexes in the increasing order of crystal field splitting;

$[Co(CN)_6]^{3-}$, $[CoF_6]^{3-}$, $[Co(H_2O)_6]^{3+}$ and $[NiCl_4]^{2-}$

a) $[NiCl_4]^{2-} < [CoF_6]^{3-} < [Co(H_2O)_6]^{3+} < [Co(CN)_6]$

b) $\left[Co(CN)_6\right]^{3-} < \left[Co(H_2O)_6\right]^{3+} < \left[CoF_6\right]^{3-} < \left[NiCl_4\right]^{2-}$

c) $\left[Co(CN)_6\right]^{3-} < \left[Co(H_2O)_6\right]^{3+} < \left[Nicl_4\right]^{2-} < \left[CoF_6\right]^{3-}$

d) $\left[CoF_6\right]^{3-} < \left[Nicl_4\right]^{2-} < \left[Co(H_2O)_6\right]^{3+} < \left[Co(CN)_6\right]^{3-}$

**[D]**

81. According to spectral chemical series, the strongest field ligand is [KCET-2019]

a) CO b) $NH_3$

c) $H_2O$ d) $F^-$ **[E]**

82. The correct electronic configuration of $d^4$ coordination entities in a weak field ligand is

a) $t_{2g}^3\ e_g^1$ b) $t_{2g}^4\ e_g^0$

c) $t_{2g}^2\ e_g^2$ d) $t_{2g}^1\ e_g^3$ **[A]**

83. In an octahedral crystal field, the $t_{2g}$ orbitals are

a) Raised in energy by $0.4\Delta_o$ b) Lowered in energy by $0.4\Delta_o$

c) Raised in energy by $0.6\Delta_o$ d) Lowered in energy by $0.6\Delta_o$ **[E]**

84. If $\Delta_o > P$, the correct electronic configuration for $d^4$ system will be:-

a) $t_{2g}^4\ e_g^0$ b) $t_{2g}^3\ e_g^1$

c) $t_{2g}^0\ e_g^4$ d) $t_{2g}^2\ e_g^2$ **[A]**

85. In octahedral complex $ML_6^{n+}$, $M^{n+}$ has five d-electrons and L is Strong field ligand. According to crystal field theory, the magnetic properties of the complex ion correspond to how many unpaired electrons

a) 5 b) 1

c) 2 d) 3 **[D]**

86. The arrangement of ligands in the increasing order of ligand field strength based on spectrochemical series is

a) $I^- < Cl^- < OH^- < H_2O < CO$ b) $CO < H_2O < OH^- < Cl^- < I^-$

c) $I^- < Cl^- < H_2O < OH^- < CO$ d) $H_2O < CO < I^- < Cl^- < OH^-$ **[E]**

87. The magnitude of CFSE (crystal field splitting complex, $\Delta_0$) can be related to the configuration of d-orbitals in a coordination entity is

a) if $\Delta_0 < P$, the configuration is $t^3_{2g}e^1_g$ b) if $\Delta_0 > P$, the configuration is $t^3_{2g}e^1_g$

c) if $\Delta_0 > P$, the configuration is $t^2_{2g}e^2_g$ d) if $\Delta_0 < P$, the configuration is $t^4_{2g}e^0_g$ **[D]**

88. If ethane-1,2-diamine is progressively added to green coloured $[Ni(H_2O)_6]^{2+}$ in the molar ratios en:Ni, 1:1, 2:1, 3:1, then the correct order of colour changes of complexes would be

a) green, pale blue, blue, colourless b) green, pale blue, blue, violet

c) green, violet, blue, pale blue d) green, violet, pale blue, blue **[E]**

89. The relation between crystal field splitting energy of octahedral and tetrahedral complexes is

a) $\Delta_t = (4/9)\ \Delta_o$ b) $\Delta_o = (4/9)\ \Delta_t$

c) $4\Delta_t = 9\Delta_o$ d) $\Delta_t = (9/4)\ \Delta_o$ **[E]**

90. Match the coordination compounds given in column I with wavelength of light absorbed in column II:

| **Column I (Coordination compound)** | **Column II (wavelength of light absorbed)** |
|---|---|
| 1. $[CoCl(NH_3)_5]^{2+}$ | A. 475nm |
| 2. $[Co(NH_3)_5(H_2O)]^{3+}$ | B. 310nm |
| 3. $[Co(NH_3)_6]^{3+}$ | C. 500nm |
| 4. $[Co(CN)_6]^{3-}$ | D. 535nm |

a) 1→ B, 2→ D, 3→ A, 4→ C b) 1→C, 2→ D, 3→ A, 4 → B

c) 1→ D, 2→ C, 3→ A, 4→ B d) 1→ B, 2→ A, 3→ C, 4→ D **[A]**

91. Which of the following statements are true about $[NiCl_4]^{2-}$ ? [KCET-2025]

(A) The complex has tetrahedral geometry

(B) Co-ordination number of Ni is 2 and oxidation state is +4

(C) The complex is $sp^3$ hybridised

(D) It is a high spin complex

(E) The complex is paramagnetic

a) A, C, D and E b) A, B, C and D

c) B, C, D and E d) A, B, D and E

92. Which of the following statements are true about $[CoF_6]^{3-}$ ion? [KCET-2024]

I. The complex has octahedral geometry.

II. Coordination number of Co is 3 and oxidation state is +6 .

III. The complex is $sp^3d^2$ hybridised.

IV. It is a high spin complex.

a) II and IV b) II, III and IV

c) I, II and IV d) I, III and IV

93. If a didentate ligand ethane-1, 2-diamine is progressively added in the molar ratio en : Ni ::1:1, 2:1, 3:1 to $[Ni(H_2O)_6]^{2+}$ aq solution, following co-ordination entities are formed.

I. $[Ni(H_2O)_4\ en]^{2+}{}_{(aq)}$ – pale blue

II. $[Ni(H_2O)_2(en)_2]^{2+}{}_{(aq)}$ – blue/purple

III. $[Ni(en)_3]^{2+}{}_{(aq)}$ – violet

94. The wavelength in nm of light absorbed in case of I and III are respectively [KCET-2023]

a) 300nm and 475nm b) 600nm and 535nm

c) 475nm and 310nm d) 310nm and 500nm

95. Which of the following system in an octahedral complex has maximum unpaired electrons?

a) $d^6$(low spin) b) $d^9$ (high spin)

c) $d^7$ (high spin) d) $d^4$ (low spin) [KCET-2023]

96. The correct order for wavelengths of light absorbed in the complex ions $[CoCl(NH_3)_5]^{2+}$ , $[Co(NH_3)_6]^{3+}$ and $[Co(CN)_6]^{3-}$ is [KCET-2021]

a) $[Co(NH_3)_6]^{3+} > [CoCl(NH_3)_5]^{2+} > [Co(CN)_6]^{3-}$

b) $[Co(CN)_6]^{3-} > [CoCl(NH_3)_5]^{2+} > [Co(CN)_6]^{3-}$

c) $[Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-} > [CoCl(NH_3)_5]^{2+}$

d) $[CoCl(NH_3)_5]^{2+} > [Co(NH_3)_6]^{3+} > [Co(CN)_6]^{3-}$

97. Which of the following are paramagnetic? [NEET-2025]

A. $[NiCl_4]^{2-}$ B. $Ni(CO)_4$ C. $[Ni(CN)_4]^{2-}$

D. $[Ni(H_2O)_6]^{2+}$ E. $Ni(PPh_3)_4$

Choose the correct answer from the options given below:

a) B and E only b) A and C only

c) A, D and E only d) A and D only

98. The correct order of the wavelength of light absorbed by the following complexes is, [NEET-2025]

A. $[Co(NH_3)_6]^{3+}$ B. $[Co(CN)_6]^{3-}$

C. $[Cu(H_2O)_4]^{2+}$ D. $[Ti(H_2O)_6]^{3+}$

Choose the correct answer from the options given below:

a) B<A<D<C b) B<D<A<C

c) C<A<D<B d) C<D<A<B

99. Given below are two statements: [NEET-2024]

Statement I: Both $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ complexes are octahedral but differ in their magnetic behaviour.

Statement II: $[Co(NH_3)_6]^{3+}$ is diamagnetic whereas $[CoF_6]^{3-}$ is paramagnetic.

In the light of the above statements, choose the correct answer from the options given below:

a) Statement I is false but Statement II is true

b) Both Statement I and Statement II are true

c) Statement I is true but Statement II is false

d) Both Statement I and Statement II are false

## 5.6 Bonding in metal carbonyls

100. The shape of pentacarbonyl iron(0) is

a) square pyramidal b) tetrahedral

c) trigonal bipyramidal d) Octahedral **[E]**

101. The number of bridged CO groups in Octacarbonyldicobalt (0) is

a) 2 b) 3

c) 4 d) 0 **[E]**

102. No. of Bridging CO ligands in $Mn_2(CO)_{10}$ is

a) Zero b) two

c) one d) three **[E]**

103. The structure of tetracarbonyl nickel(0) is,

a) tetrahedral b) trigonal bipyramidal

c) octahedral d) square pyramidal **[E]**

104. $[Mn_2(CO)_{10}]$ and $[Co_2(CO)_8]$ structures have [NEET-2024]

A. Metal-Metal linkage B. Terminal CO groups

C. Bridging CO groups D. Metal in zero oxidation state

Choose the correct answer from the options given below

a) Only A, B, C b) Only B, C, D

c) Only A, B, D d) Only A, C, D

105. Iron carbonyl, $Fe(CO)_5$ is: **[E]**

a) tetranuclear b) dinuclear

c) mononuclear d) trinuclear

## 5.7 Importance and applications of coordination compounds

106. In black and white photography, the developed film is fixed by washing with hypo solution which dissolves the undecomposed AgBr to form a complex ion, the formed complex ion is:

a) $[Ag(S_2O_3)_2]^{3-}$ b) $[Ag(SO_4)_2]^{3-}$

c) $[Ag(S_2O_8)_2]^{3-}$ d) $[Ag(S_2O_4)_2]^{3-}$ **[E]**

107. Match the coordination compounds given in column I with central metal atom in column II:

| **Column I (Coordination compound)** | **Column II (Central metal atom)** |
|---|---|
| 1. Chlorophyll | A. Rhodium |
| 2. Blood | B. Cobalt |
| 3. Wilkinson catalyst | C. Magnesium |
| 4. Vitamin $B_{12}$ | D. Iron |

a) 1→ B, 2→ D, 3→ A, 4→ C b) 1→C, 2→ D, 3→ A, 4 → B

c) 1→ D, 2→ A, 3→ A, 4→ C d) 1→ B, 2→ A, 3→ C, 4→ D **[E]**

108. Wilkinsons catalyst, $[Rh\ (PPh_3)_3\ Cl]$ is used for

a) Hydrogenation of oils b) Polymerisation of alkenes

c) Hydrogenation of alkenes d) Hydrogenation of alkynes **[E]**

**FILL IN THE BLANKS BY CHOOSING THE APPROPRIATE WORD FROM THOSE GIVEN IN THE BRACKETS: (ONE MARK)**

**Set-1**

**(Primary, potash alum, Lewis acids, *Ferricyanide, polyhedra,* secondary)**

1. The number of groups bound directly to the metal ion is _____valence **[E]**
2. The _____ valences are normally ionisable. **[E]**
3. The spatial arrangements are called coordination_____. **[E]**
4. _____dissociate into simple ions completely when dissolved in water. **[E]**
5. In a coordination entity central atoms/ions are referred as _____ **[E]**

**Set-2**

**(ambidentate, Octahedral, sigma bonds, Homoleptic, Square planar, chelate)**

1. When a ligand uses its two or more donor atoms simultaneously to bind a single metal ion, then it is a _____ ligand. **[E]**
2. Ligand which has two different donor atoms and either of the two ligetes in the complex is called_____ ligand. **[E]**
3. Coordination number of the central atom is determined by the number of _____ formed by the ligand with the central atom. **[E]**
4. _____ complexes do not show geometric isomerism. **[E]**
5. Fac-Mer isomerism is shown by _____complexes of the form $MX_3L_3$ **[E]**

**Set-3**

**(EDTA, ambidentate, trigonal bipyramidal, Werner, VBT, cis)**

1. Example for polydentate ligand is _____ **[E]**
2. In a coordination entity $[PtCl_2(en)_2]^{2+}$ _____isomer shows optical activity. **[E]**
3. Linkage isomerism arises in a coordination compound containing _____ligand. **[E]**
4. _____ theory fails to explain the bonds in coordination compounds have directional properties. **[E]**
5. $sp^3d$ hybrid orbitals have _____ shape. **[E]**

**Set-4**

**(high spin, diamagnetic, zero, $Sp^3$, $dsp^2$, $[Co(CN)_6]^{3-}$)**

1. $[Co(NH_3)_6]^{3+}$forms _____ octahedral complex. **[E]**
2. $[NiCl_4]^{2+}$ is a _____ complex. **[E]**
3. _____ is an inner orbital complex. **[E]**
4. The oxidation state of Ni in $[Ni(CO)_4]$ complex is _____ **[E]**
5. The hybridisation of $[Ni(CN)_4]^{2-}$ is _____ **[E]**

### Set -5

**(Weak, tetrahedral, paramagnetic, five, four, Ethylenediaminetetra acetate]**

1. _____ion can bind through two nitrogen and four oxygen atoms to a central metal ion. **[E]**
2. $[Ni(CO)_4]$ complex _____ and diamagnetic. **[E]**
3. $[FeF_6]^{3-}$ has a paramagnetic moment of ____unpaired electrons. **[E]**
4. $[MnCl_6]^{3-}$ is outer orbital _____ complex. **[E]**
5. According to spectrochemical series Iodide ion is _____ ligand. **[E]**

### Set -6

**(tetrahedral, crystal field, colourless, valence bond, violet, $t^3_{2g}\ e^1_g$)**

1. In high spin complexes $d^4$ has _____configuration. **[E]**
2. In crystal field splitting the subscript 'g' is not used for _____ complex.
3. If a complex having $d^1$ electron absorbs light with energy in blue-green region than complex appears to be _____ . **[E]**
4. The ____theory attributes the colour of the coordination compounds to *d-d* transition of the electron. **[E]**
5. Removal of water from $[Ti(H_2O)_6]Cl_3$ on heating gives _____compound. **[E]**

### Set-7

**(Cobalt, magnesium, $NO_2^-$, zero, one)**

1. ambidentate ligand is_____. **[E]**
2. Vitamin $B_{12}$ is a coordination compound of _____metal. **[E]**
3. Oxidation State of 'Ni' in $[Ni(CO)_4]$ is _____. **[E]**
4. Chlorophyll is a coordination compound of metal _____. **[E]**

## TWO/THREE MARKS QUESTIONS:

### 5.1 Werner's theory of coordination compounds

1. Write any two differences between double salt and coordination complex. **[E]**
2. What is meant by double salt? Give one example. **[E]**
3. Write any two differences of primary and secondary valencies. **[E]**
4. In a given complex $[MnCl_6]^{3-}$ indicate primary and secondary valencies. **[A]**
5. If secondary valence of $Co^{3+}$ is 6 then number of moles of AgCl formed when excess $AgNO_3$ is added to
   a) $CoCl_3.6NH_3$ b) $CoCl_3.5NH_3$ is. **[D]**
6. Indicate the type of valences having following properties
   i) Ionisable and satisfied by negative ions:
   ii) Valences having characteristic spatial arrangements: **[A]**
7. What are primary and secondary valences if a complex with formula $PdCl_2.4NH_3$ precipitates 2 moles of AgCl per mole of compound with excess $AgNO_3$? **[D]**

8. The complex $NiCl_2.6H_2O$ gives 2moles of AgCl on reaction with excess of $AgNO_3$. Formulate the complex and how many moles of ions were obtained for each mole of complex dissolved in excess of water. **[D]**

9. Give the postulates of Werner theory of coordination compounds. **[E]**

10. One mole of a complex having empirical formula $CoCl_3.4NH_3$ gives one mole of AgCl on reaction with excess of $AgNO_3$. Formulate the complex and write the possible geometrical isomers. **[D]**

11. Write the IUPAC name of i) $[Ti(H_2O)_6]^{3+}$ ii) $[Mn(H_2O)_6]^{2+}$ iii) $[Co(en)_3]^{3+}$ **[A]**

12. For the complex $[Fe(en)_2Cl_2]Cl$ (At.No.Fe:26)

i) What is the oxidation state of metal ion?

ii) Mention the geometry of hybrid orbitals.

iii) How many moles of $AgNO_3$ is required to react with one mole of the complex **[A]**

13. For the complex, Mercury (I) tetrathiocyanato-S-cobaltate (III)

a) What is coordination number of Co.

b) Identify the ligand present in this complex.

c) Does ionization isomer for the following compound exist? **[A]**

14. Differentiate $[Fe(CO)_5]$ and $K[Fe(NH_3)_2(CN)_4]$ with respect to

i) Oxidation state of metal

ii) shape

iii) in which complex synergic bond will formed **[A]**

## 5.2 Definitions of some important terms pertaining to coordination compounds

15. What is chelate ligand? Give one example. **[E]**

16. What is a) co-ordination polyhedral b) counter ions. **[E]**

17. What are heteroleptic complex? Give an example. **[E]**

## 5.3 Nomenclature of coordination compounds

18. Using IUPAC names write the formulae for the following: (1markeach)

Tetrahydroxidozincate(II)

Tris(ethane-1,2-diamine)platinum(II)nitrate

Potassiumtrioxalatochromate(III)

Dichloridobis(ethane-1,2-diamine)platinum(IV)nitrate.

Potassiumtetracyanatonickelate(II)

Pentaamminenitrito-O-cobalt(III) **[A]**

19. Write the IUPAC name of the following (1mark each)

| Sl. No | Co-ordination compound |
|---|---|
| 1 | $K[Au(CN)_2]$ |
| 2 | $[Fe(en)_3]Cl_3$ |
| 3 | $[Co(NH_3)_6]Cl_3$ |
| 4 | $[Co(NO_2)_3(NH_3)_3]$ |
| 5 | $[Ag(CN)_2]^-$ |
| 6 | $K_3[Fe(CN)_5(CO)]$ |
| 7 | $K_3[Co(C_2O_4)_2Cl_2]$ |
| 8 | $[Cr(NH_3)_3(H_2O)_3]Br_3$ |
| 9 | $[Cr(C_2O_4)_3]^{3-}$ |
| 10 | $[Ag(NH_3)_2][Ag(CN)_2]$ |
| 11 | $[Co(SCN)_4]^-$ |

**[A]**

## 5.4 Isomerism in coordination compounds

20. Explain geometrical isomerism in coordination compounds with an example. **[E]**

21. Explain optical isomerism in coordination compounds with suitable example. **[E]**

22. What type of isomerism is exhibited by the following pairs of complexes?

i) $[Co(NH_3)_6][Cr(CN)_6]$ and $[Co(CN)_6][Cr(NH_3)_6]$

ii) $[Cr(H_2O)_6]Cl_3$ and $[Cr(H_2O)_5Cl]Cl_2H_2O$ **[A]**

23. Draw structure of geometrical isomers of $[Co(NH_3)_4Cl_2]^+$. **[A]**

24. Draw structures of geometrical isomers of $[Co(NH_3)_3(NO_2)_3]$. **[A]**

25. Draw the geometrical isomers of $[Pt(NH_3)_2Cl_2]$. **[E]**

26. Among tetrahedral and square planar complex, which will not show geometrical isomerism? Why? **[E]**

27. Draw structures of optical isomers of $[Co(en)_3]^{3+}$. **[D]**

28. Draw structures of optical isomers of $[PtCl_2(en)_2]^{2+}$ **[D]**

29. Indicate the types of isomerism exhibited by the following complexes

(i) $K[Cr(H_2O)_2(C_2O_4)_2]$

(ii) $[Co(en)_3]Cl_3$ **[D]**

30. The ratio of metal (M), didentate ligand (L-L) and monodentate ligand (X) in a complex is 1:2:2. Draw the geometrical isomers of the complex and mention the optically active isomer. **[D]**

31. Mention the number of cis and trans isomers are possible for the complex $[Pt(NH_3)(Br)(Cl)(Py)]$ and how many of these will exhibit optical isomerism? **[A]**

32. Write the geometrical isomers of $[Pt(NH_3)(Br)(Cl)(Py)]$ **[D]**

33. For the complex $[Co(NH_3)_2(en)_2]$. Write the IUPAC name and draw the optical isomers. **[D]**

34. Two complexes A and B have same empirical formula $CoClSO_4.5NH_3$. For each mole complexes, complex 'A' give 1mole of $BaSO_4$ on reaction with excess of $BaCl_2$ but does not react with $AgNO_3$ and complex 'B' give 1mole of AgCl on reaction with excess of $AgNO_3$ but does not react with $BaCl_2$ solution. Name the type of isomerism exhibited by the complexes and formulate the complex A and B. **[D]**
35. Write the Geometrical isomers and mention the secondary valency for $[Cr(NH_3)_3(H_2O)_3]Cl_3$ complex. **A]**
36. For the complex $[Co(NH_3)_5(NO_2)]Cl_2$. Write the linkage isomer and IUPAC name of both isomers. **[A]**

## 5.5 Bonding in coordination compounds

37. $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain. **[A]**
38. Why $[Co(NH_3)_6]^{3+}$is an inner orbital complex where as $[CoF_6]^{3-}$ is an outer orbital complex? **[E]**
39. The spin only magnetic moment of $[MnBr_4]^{+2}$ is 5.9 B.M. predict the geometry of the complex. **[D]**
40. Write any two merits of crystal field theory. **[E]**
41. What is crystal field splitting? Why subscript 'g' is not used for tetrahedral complexes. **[A]**
42. Both anhydrous $CuSO_4$ and $CuSO_4.5H_2O$ contains unpaired electrons but anhydrous $CuSO_4$ is colourless while $CuSO_4.5H_2O$ is blue in colour. Why? **[A]**
43. How does nature of ligands ($NH_3$, $H_2O$, $Cl^-$, $CN^-$) affect the absorption wavelength of complex having $Co^{3+}$ central metal ion? **[A]**
44. Write the energy level diagram for the crystal field splitting in octahedral complex. **[E]**
45. Explain crystal field splitting in tetrahedral co-ordination entities with a neat labelled diagram. **[E]**
48. How does the crystal field splitting effect the electronic configuration of a metal ion ($d^6$) in weak field and strong field ligand of octahedral complex? **[A]**
48. Using Crystal field theory, explain the colour of $[Ti(H_2O)_6]^{3+}$complex. **[E]**
49. Illustrate the influence of ligand on colour in $[Ni(H_2O)_6]^{2+}$ complex. **[A]**
50. Write any 3 limitations of valence bond theory. **[E]**
51. Using VBT explain hybridisation, magnetic property and shape of $[Ni(CN)_4]^{2-}$ complex. **[E]**
52. Using valence bond theory account for hybridization, geometry and magnetic property of $[CoF_6]^{3-}$. **[E]**
53. Using valence bond theory account for hybridization, geometry and magnetic property of $[Co(NH_3)_6]^{3+}$. **[E]**
54. Write the name, structure and magnetic behavior of the complex $K_2[NiCl_4]$, which is a low spin complex. **[E]**
55. Applying VBT, predict the number of unpaired electrons in the square planar $[Pt(CN)_4]^{-2}$ ion. (Given outer EC of Pt = $5d^96s^1$) **[A]**
56. Draw energy level diagram of crystal field splitting in octahedral complex. What is spectrochemical series? **[E]**

57. A metal complex has $t_{2g}^5e_g^0$ electronic configuration, then

i) What is the coordination number of the metal?

ii) What is the nature of the ligand

iii) How many unpaired electrons are present **[D]**

58. a) Based on crystal field theory, write the configuration for metal with $d^6$ electron system, when

i) $\Delta_o < P$ ii) $\Delta_o > P$.

b) What is pairing energy? **[E]**

## 5.6 Bonding in metal carbonyls

59. Name the Metal present in a) hemoglobin b) vitamin $B_{12}$. **[E]**

60. How are M-C σ and M-C π bond formed in metal carbonyls? **[E]**

61. How many square pyramidal units are present in Decacarbonyldimanganese (0)? Write the formula and structure of Decacarbonyldimanganese (0). **[E]**

62. Write the formula and structure of Octacarbonyldicobalt (0). How many bridged carbonyl ligands are present in it? **[E]**

63. With the help of structure explain synergic effect in metal carbonyls? How it effects on M-CO bond strength in such compounds? **[E]**

## 5.7 Importance and applications of coordination compounds

64. Write the structure of $(EDTA)^{2-}$ ion. Explain how $Na_2EDTA$ is used to estimate hardness of water by simple titration method? **[E]**

65. Give one example each for the applications of coordination compounds in

a) Extraction of metals b) Analytical chemistry c) Biological systems **[E]**

# Unit 6

# Haloalkanes and Haloarenes

## Multiple Choice Questions (MCQs) (ONE MARK)

### 6.1 Classification;

1. Chlorine containing antibiotic, produced by microorganisms which is very effective for the treatment of typhoid fever is **(E)**

   a) Chloramphenicol  b) Thyroxine

   c) Chloroquine  d) Halothane.

2. The halogen containing compound used as anaesthetic during surgery. **(E)**

   a) Chloramphenicol  b) Thyroxine

   c) Chloroquine  d) Halothane.

3. Match the items List-I with match List II **(E)**

| List-I | | List-II | |
|---|---|---|---|
| **A)** | *Chloramphenicol* | **i)** | Anaesthetic |
| **B)** | *Thyroxine* | **ii)** | Typhoid fever |
| **C)** | Chloroquine | **iii)** | *Goiter* |
| **D)** | Halothane | **iv)** | Malaria |
| | | **v)** | Potential blood substitutes |

   a) A-(ii), B- (iii), C-(iv), D-(i)  b) A-(iii), B-(v), C-(iv), D-(i)

   c) A-(ii), B-(i), C-(v), D-(iv)  d) A-(iii), B-(ii), C-(iv), D-(i)

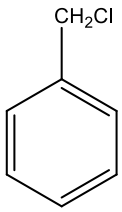
### 6.2 Nomenclature;

4. 1,1 Dichloroethane is also called **(A)**

   a) Ethylidene chloride  b) Ethane chloride

   c) Ethylene dichloride  d) Pyrene.

5. The IUPAC name of the given compound is **(E)**




   a) Chlorotoluene  b) Benzoyl chloride

   c) Chlorophenyl methane  d) Chloromethyl benzene

6. Vicinal dihalides are obtained from reaction of **(A)**

a) Alkene and HBr
b) Alkene and $Br_2$
c) Alkanes and $Br_2$
d) Alkanes and HCl

7. An example of vinyl halide is **(E)**

a) 1-Chloro-cyclohex-1-ene
b) 1-Chloro-cyclohex-2-ene
c) 1-Chloro-cyclohexane
d) 2-Chlorocyclohexane

8. Sym-Tribromobenzene is **(E)**

a) 1,2,3-Tribromobenzene
b) 1,1,1-Tribromobenzene
c) 2,4,6-Tribromobenzene
d) 1,3,5-Tribromobenzene.

9. An example of allyl halide is **(E)**

a) Chloroethene
b) 2-Chloropropene
c) 3-Chloropropene
d) Isopropyl chloride

10. 1,2-Dichloroethane is an example of (E)

a) Alkylene dihalides
b) Alkylidene halides
c) Vinyl dihalides
d) Gem-dihalides.

11. Match the items List-I with match List II **(A)**

| **List-I** | | **List-II** | |
|---|---|---|---|
| **A)** | sec-Butyl chloride | **i)** | Chloroethene |
| **B)** | neo-Pentyl bromide | **ii)** | 2-Bromo-2-methylpropane |
| **C)** | Vinyl chloride | **iii)** | 1-Bromo-2,2-dimethylpropane |
| **D)** | Allyl bromide | **iv)** | 2-Chlorobutane |
| | | **v)** | 3-Bromopropene |

a) A-(ii), B- (iii), C-(iv), D-(i)
b) A-(iv), B-(iii), C-(i), D-(v)
c) A-(iv), B-(iii), C-(ii), D-(v)
d) A-(iii), B-(ii), C-(iv), D-(i)

12. Which of the following is an example for vicinal dihalides? **(A)**

a) Dichloromethane
b) Allyl chloride
c) Ethylidene dichloride
d) 1,2-Dichloroethane

## 6.3 Nature of C-X Bond

13. The total number of structural isomers possible for compound having molecular formula $C_5H_{11}Br$ is **(D)**

a) 4
b) 5
c) 8
d) 6

14. Which among the following has chiral carbon? **(A)**

a) 2-Chloro propane
b) 3-Chloro-pentane
c) 2-Chloro butane
d) 2-Chloro-2-methyl-propane.

15. The number of isomers possible for compound having formula $C_4H_9Br$ **(A)**

a) 4 b) 3

c) 2 d) 1

16. The alkyl compound having largest C-X bond length **(A)**

a) $CH_3 – Cl$ b) $CH_3 – Br$

c) $CH_3 – I$ d) $CH_3 – F$

17. The alkyl compound having highest C-X bond enthalpy **(A)**

a) $CH_3 – Cl$ b) $CH_3 – Br$

c) $CH_3 – I$ d) $CH_3 – F$

18. The alkyl compound having least dipole moment **(A)**

a) $CH_3 – Cl$ b) $CH_3 – Br$

c) $CH_3 – I$ d) $CH_3 – F$

19. The compound having highest dipole moment **(E)**

a) $CH_3$-F b) $CH_3$-Cl

c) $CH_3$-Br d) $CH_3$-I

## 6.4 Methods of Preparation of Haloalkanes;

20. The best reagent used to produce pure alkyl halides from alcohols is **(A)**

a) Concentrated HCl b) Concentrated HBr

c) $SOCl_2$ d) NaBr

21. $SOCl_2$ replaces -OH group of a compound to -Cl group, the halo compound that cannot be obtained from this method is **(A)**

a) Benzyl chloride b) Chlorobenzene

c) Benzoyl chloride d) Isopropyl chloride.

22. Aryl halide cannot be prepared from phenol because **(D)**

a) Phenol is more reactive than aryl halide.

b) Aryl halide is more reactive than phenol.

c) Carbon-oxygen bond in phenols has a partial double bond character.

d) Carbon-oxygen bond in phenols has a less bond energy.

23. Good yields of R—I may be obtained by heating alcohols with sodium or potassium iodide in **(E)**

a) 95% Orthophosphoric acid b) 98% Orthophosphoric acid

c) 78% Orthophosphoric acid d) 48% Orthophosphoric acid

24. The reaction that produces single haloalkane in low yield. **(E)**

a) Reaction between alcohol and Concentrated HCl in presence of $ZnCl_2$

b) Reaction between alcohol and $SOCl_2$ in presence of pyridine.

c) Reaction between alkene and HBr in presence of $H_2O_2$

d) Free radical chlorination of alkanes.

25. Free radical chlorination or bromination of alkanes is not preferred to prepare halo alkanes.
i) Reaction takes place in sunlight. ii) Reaction produces single product
iii) Difficult to separate pure compounds iv) Yield of single product is low.
The correct reason that justify above statement is/are **(A)**
a) iii only b) iii and iv only
c) i, ii and iii d) iv only

26. Addition of bromine to alkene in $CCl_4$ is an important method for detection of unsaturation (double bond), the product formed in this method is **(A)**
a) Tertiary halo compounds b) Allyl halides
c) Geminal dihalides d) Vicinal dihalides

27. In Finkelstein reaction NaX formed is precipitated by dry Acetone and favours forward reaction, this is according to **(E)**
a) Markovnikov's rule. b) Anti Markovnikov's rule.
c) Le Chatelier's Principle d) Zaitsev Rule.

28. Match the items List-I with match List II **(A)**

| List-I | | List-II | |
|---|---|---|---|
| **A)** | $ROH + SOCl_2$ | **i)** | R-I |
| **B)** | $CH_2=CH_2 + Br_2$ | **ii)** | R-Cl |
| **C)** | R-Br + NaI | **iii)** | R-OH |
| **D)** | R-Cl + aq NaOH | **iv)** | $BrCH_2\text{-}CH_2Br$ |

a) A-(ii), B- (iii), C-(iv), D-(i) b) A-(iv), B-(iii), C-(i), D-(ii)
c) A-(ii), B-(iv), C-(i), D-(iii) d) A-(iii), B-(ii), C-(iv), D-(i)

29. Among the isomeric alkanes of molecular formula $C_5H_{12}$, identify the one that on photochemical chlorination yields A single monochloride **(E)**
a) n-Pentane b) 2-Methyl butane
c) Cyclo pentane d) 2,2-Dimethyl-propane

30. Among the isomeric alkanes of molecular formula $C_5H_{12}$, identify the one that on photochemical chlorination yields three isomeric monochlorides **(A)**
a) n-Pentane b) 2-Methylbutane
c) Cyclopentane d) 2,2-Dimethyl-propane

31. Among the isomeric alkanes of molecular formula $C_5H_{12}$, identify the one that on photochemical chlorination yields four isomeric monochlorides **(A)**
a) n-Pentane b) 2-Methyl butane
c) Cyclopentane d) 2,2-Dimethyl-propane

32. The alkanes which on monochlorination produces chiral compounds **(A)**
a) Propane b) Ethane
c) Butane d) Methane.

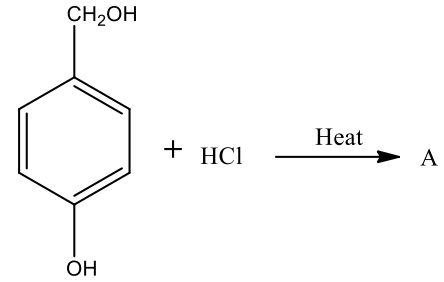
33. When an alkene reacts with a component 'X' in $CCl_4$ reddish brown colour of component 'X' disappears to yield vicinal dihalide. Component 'X' is **(A)**

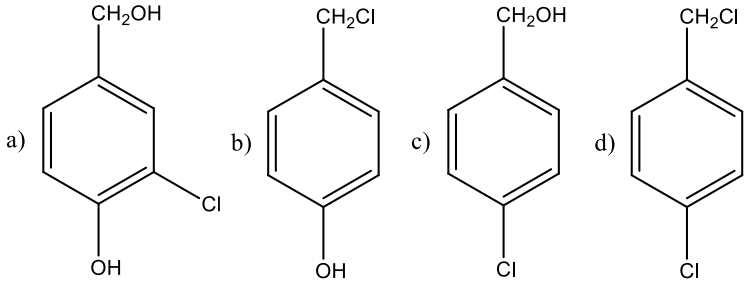
a) $Cl_2$ b) HBr

c) $Br_2$ d) $I_2$

## 6.5 PREPARATION OF HALOARENES;

34. The major product **A** obtained in the **(E)**




35. Dry acetone is used in Finkelstein reaction because. **(D)**

a) It is volatile solvent.

b) It contains ketone group

c) NaCl and NaBr formed is precipitated and favours forward reaction.

d) R-I formed is precipitated and favours forward reaction.

36. Metallic fluoride not used in Swartz reaction is. **(A)**

a) AgF b) NaF

c) $SbF_3$ d) $Hg_2F_2$

37. **Statement I**: Iodination of benzene are reversible.

**Statement II**: Iodination of benzene requires the presence of an oxidising agent to oxidise HI formed.

Identify the correct statement **(D)**

a) Both Statement I and II are correct

b) Both Statement I and II are incorrect

c) Statement I is correct and Statement II is incorrect.

d) Statement I is incorrect and Statement II is correct.

38. Select the incorrect match **(A)**

i) Swartz reaction ----- $CoF_2$ ii) Finkelstein reaction---NaI

iii) Sandmeyer's reaction---$CuCl_2$ iv) Wurtz reaction ----Na/dry ether

a) i only b) i and iii

c) iii only iv) i and ii

39. A compound **X** with molecular formula $C_2H_4$ reacts with HBr to give compound **Y**, which on further reacts with NaI in dry acetone to give compound **Z**. Identify compound **Z** **(D)**

a) $C_2H_5I$ b) $C_2H_5F$

c) $C_2H_5Br$ d) $C_2H_4IBr$

40. The correct name of the reaction $R-X + NaI \xrightarrow{\text{Dry acetone}} R-I + NaX$ is **(E)**

a) Finkelstein reaction b) Wurtz reaction

c) Swarts reaction d) Friedel –Craft reaction

41. The haloarene cannot be prepared from Sandmeyer's reaction is **(A)**

a) $C_6H_5$-Cl b) $C_6H_5$-Br

c) $C_6H_5$-F d) Both a and b

42. A hydrocarbon $C_5H_{10}$ does not react with chlorine in dark but gives a single monochloro compound $C_5H_9Cl$ in bright sunlight. The hydrocarbon is **(D)**

a) 2-Pentene b) 2-Methyl but-2-ene

c) Cyclopentane d) 2,2-Dimethyl-propane

43. **Statement I:** Replacement of the diazonium group by iodine does not require the presence of cuprous halide.

**Statement II:** Iodobenzene is difficult to prepare from diazonium salts. **(A)**

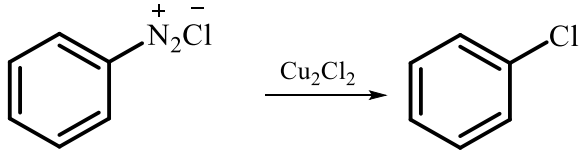
Identify the correct statement

a) Both statement I and II are correct

b) Both statement I and II are incorrect

c) Statement I is correct and statement II is incorrect.

d) Statement I is incorrect and statement II is correct.

44. 

+ $N_2$, Name of the reaction is **(E)**

a) Swarts reaction b) Sandmeyer reaction

c) Wurtz reaction d) Fittig reaction

45. Match the items List-I with match List II **(E)**

| List-I | | List-II | |
|---|---|---|---|
| **A)** | $Cu_2Cl_2$ | **i)** | Swarts reaction |
| **B)** | $CoF_2$ | **ii)** | Finkelstein reaction |
| **C)** | NaI | **iii)** | Sandmeyer's reaction |
| **D)** | Na/Dry ether | iv) | Wurtz reaction |

a) A-(ii), B- (iii), C-(iv), D-(i)
b) A-(iii), B-(i), C-(ii), D-(iv)
c) A-(ii), B-(iv), C-(i), D-(iii)
d) A-(iii), B-(ii), C-(iv), D-(i)

46. The reagent used in Sandmeyer's reaction is **(E) (May-2025, MQP- 2025)**

a) $Cu_2Cl$
b) Cu and HCl
c) $Cu_2Cl_2$
d) $CuCl_2$

## 6.6 Physical Properties;

47. Gaseous halo compound at room temperature. **(D)**

a) Pyrene
b) Ethylchloride
c) Chlorobenzene
d) Chloroform

48. The boiling points of alkyl halides decrease in the order: **(A)**

a) RI > RBr > RCl > RF
b) RI < RBr < RCl < RF
c) RBr >RCl > RI > RF
d) RBr < RCl < RI < RF

49. Select the correct order of melting points of isomeric dichlorobenzenes. **(A) (March-2025)**

a) o-dichlorobenzene > m-dichlorobenzene > p-dichlorobenzene
b) p-dichlorobenzene > m-dichlorobenzene > o-dichlorobenzene
c) p-dichlorobenzene > o-dichlorobenzene > m-dichlorobenzene
d) m-dichlorobenzene > o-dichlorobenzene > p-dichlorobenzene

50. Four haloalkane compounds represented by the letters **M**, **N**, **O** and **P** having boiling point are 24.2°C, 38°C, 3.56°C and 101.6°C respectively. Among the four compounds N most likely to be **(A)**

a) $CH_3Cl$
b) $CH_3Br$
c) $C_2H_5Br$
d) $C_3H_7I$

51. **Statement I**: Alkyl halides are colourless when pure

**Statement II**: Bromides and iodides develop colour when exposed to light

Identify the correct statement **(E)**

a) Both Statement I and II are correct
b) Both Statement I and II are incorrect
c) Statement I is correct and Statement II is incorrect.
d) Statement I is incorrect and Statement II is correct.

52. **Statement I**: Many volatile halogen compounds have sweet smell **(E)**

**Statement II**: Molecules of organic halogen compounds are generally nonpolar.

Identify the correct statement

a) Both Statement I and II are correct

b) Both Statement I and II are incorrect

c) Statement I is correct and Statement II is incorrect.

d) Statement I is incorrect and Statement II is correct.

53. **Statement I**: Boiling points of isomeric dihalobenzenes are in the order of Ortho isomer> Para isomer > Meta isomer **(E)**

**Statement II**: Melting points of isomeric dihalobenzenes are in the order of Para isomer > Ortho isomer > Meta isomer

Identify the correct statement

a) Both Statement I and II are correct

b) Both Statement I and II are incorrect

c) Statement I is correct and Statement II is incorrect.

d) Statement I is incorrect and Statement II is correct.

54. Compounds **P** and **Q** have the same molecular formula $C_4H_9Br$. Compound **P** on reaction with aqueous KOH gives racemic mixture and Compound **Q** on reaction with aqueous KOH gives alcohol that reacts with Lucas reagent only on heating. Compound **P** and **Q** are **(D)**

a) **P**= 2-Bromo, 2-Methyl propane, **Q** = 2-Bromo butane

b) **P** = 2-Bromo butane , **Q** = 1-Bromo propane

c) **P** = Tertiary butyl bromide. **Q** = 1-Bromo butane.

d) **P** = 1-Bromo butane, **Q** = Tertiary butyl bromide

55. Para-isomers of dihalobenzenes have high melting points compared to their ortho and meta-isomers. It is due to **(D)**

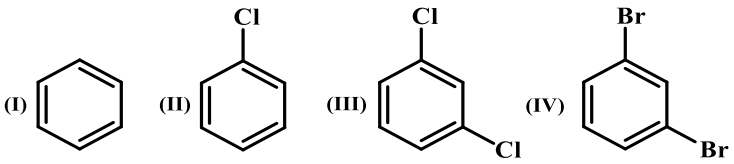
a) Lower dipole moment of para isomer.

b) Lesser repulsion in para isomer.

c) Symmetry of *para*-isomers that fits in crystal lattice better.

d) Unsymmetry of *para*-isomers that fits in crystal lattice better.

56. Arrange the following compounds in the increasing order of their density **(A)**




a) I < III < IV < II

b) IV < III < II < I

c) I < II < III < IV

d) II < IV < III < I

## 6.7 Chemical Reactions;

57. Match the items List-I with match List II **(A)**

| **List-I** | | **List-II** | |
|---|---|---|---|
| **A)** | $C_2H_5$-Br + KCN | **i)** | $C_2H_5$-NC |
| **B)** | $C_2H_5$-Br + AgCN | **ii)** | $C_2H_5OH$ |
| **C)** | $C_2H_5$-Br + alcoholic NaOH | **iii)** | $C_2H_5$-CN |
| **D)** | $C_2H_5$-Br + aq NaOH | **iv)** | $CH_2=CH_2$ |

a) A-(ii), B- (iii), C-(iv), D-(i) b) A-(iv), B-(iii), C-(i), D-(ii)

c) A-(ii), B-(iv), C-(i), D-(iii) d) A-(iii), B-(i), C-(iv), D-(ii)

58. The number of atoms/groups bonded to carbon of transition state in $S_N2$ mechanism is/are **(A)**

a) 4 b) 5

c) 3 d) 2

59. The haloalkane which reacts fast with $S_N2$ mechanism **(E)**

a) Methyl chloride b) Methyl iodide

c) Isopropyl chloride d) Tertiary butyl bromide.

60. The haloalkane which reacts fast with $S_N1$ mechanism **(E)**

a) Methyl chloride b) Methyl iodide

c) Isopropyl chloride d) Tertiary butyl bromide.

61. The incorrect statement among the following is **(D)**

a) Enantiomers possess identical physical properties.

b) Enantiomers only differ with respect to the rotation of plane polarised light.

c) Enantiomers are stereoisomers which are non-superimposable mirror images.

d) Enantiomers are optically inactive.

62. The alkyl halide which produce racemic mixture in $S_N1$ reaction is. **(D) (May-2025)**

a) Isopropyl chloride b) Tertiary butyl bromide

c) 2- Chloro butane d) Methyl iodide

63. The major product formed when (+) 2-Bromo butane reacts with aqueous NaOH **(D)**

a) (+) 2-Butanol b) (-) 2-Butanol

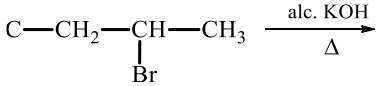
c) (±) 2-Butanol d) (+) 2-Butene

64. The main product obtained when alkyl halides react with AgCN is **(A)**

a) Alkyl cyanide b) Alkyl Isocyanide

c) Alkyl nitrite d) Nitroalkane

65. The major product formed in the following reaction is **(A)**



a) 1-Butene b) 2-Butanol

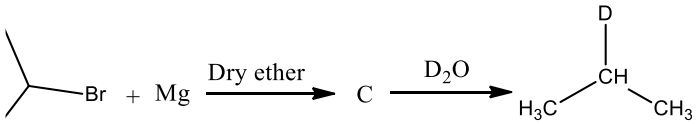
c) 1-Bromobutane d) 2-Butene

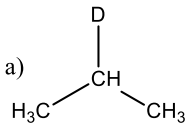
66. The major product formed when 2-bromopentane reacts with alcoholic KOH **(A)**

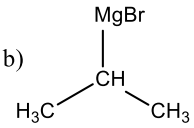
a) Pent-1-ene b) Pent-2-ene

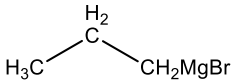
c) Pent-2-ol d) Pent-1-ol

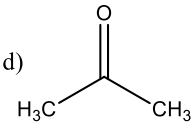
67. Identify C in the following compound **(D)**




a) 


b) 


c) 


d) 


68. The alkyl halide that produces equimolar mixture of dextro and leavorotatory isomers in $S_N1$ reaction is **(A)**

a) Tertiary butyl bromide b) 2-Bromobutane

c) Isopropyl chloride d) Methyl chloride

69. Statement I: Enantiomers are non-superimposable mirror images on each other. **(A)**

Statement II: A racemic mixture shows zero optical rotation.

Identify the correct statement

a) Both statement I and II are correct

b) Both statement I and II are incorrect

c) Statement I is correct and statement II is incorrect.

d) Statement I is incorrect and statement II is correct.

## 6.8 Polyhalogen Compounds.

70. Synthetic halogen compounds used for the treatment of malaria is **(E)**

a) Chloroquine b) Halothane

c) Chloramphenicol d) Thyroxine

71. In animals DDT is deposited and stored in **(E)**

a) Stomach b) Blood

c) Fatty tissues d) Lungs.

72. The chemical that is effectiveness against the mosquito that spreads malaria and lice that carry typhus is **(E)**

a) Chloramphenicol b) Thyroxine

c) Chloroquine d) DDT.

73. The chemical name of phosgene is **(E)**

a) Chromyl chloride b) Triphenylphosphine

c) Phosphorusoxychloride d) Carbonyl chloride.

74. Triiodomethane was used earlier as an antiseptic. The antiseptic properties are due to **(A)**

a) Presence of iodoform. b) Liberation of iodine.

c) Objectionable smell. d) Presence of methane.

75. Match the items List-I with match List II **(A)**

| **List-I** | | **List-II** | |
|---|---|---|---|
| **A)** | Dichloromethane | **i)** | Liver Cancer |
| **B)** | Chloroform | **ii)** | Typhus |
| **C)** | Tetrachloromethane | **iii)** | *Phosgene* |
| **D)** | DDT | **iv)** | Human central nervous system |

a) A-(iv), B- (iii), C-(i), D-(ii) b) A-(iii), B-(i), C-(ii), D-(iv)

c) A-(ii), B-(iv), C-(i), D-(iii) d) A-(iii), B-(ii), C-(iv), D-(i)

76. Match the items List-I with match List II **(E)**

| **List-I** | | **List-II** | |
|---|---|---|---|
| **A)** | Chlorination | **i)** | Freons |
| **B)** | Swarts reaction | **ii)** | Biphenyl |
| **C)** | β-elimination | **iii)** | Chlorobenzene |
| **D)** | Fittig reaction | **iv)** | Alkenes |

a) A-(iv), B- (iii), C-(i), D-(ii) b) A-(iii), B-(i), C-(iv), D-(ii)

c) A-(ii), B-(iv), C-(i), D-(iii) d) A-(iii), B-(ii), C-(iv), D-(i)

77. The synthesis of alkyl fluorides is best accomplished by **(E) (NEET-15)**

a) Finkelstein reaction b) Swarts reaction

c) Free radical fluorination d) Sandmeyer's reaction

78. The first chlorinated organic insecticide prepared is: **(A) (KCET-2024)**

(a) Gammexane (b) Chloroform

(c) $COCl_2$ (d) DDT

79. Identify chiral molecule in the following compounds. **(A) (March 2023)**

a) 2-Bromobutane b) 1-Bromobutane

c) 2-Bromopropane d) 2-Bromo-2-methyl-propane.

80. The stereo isomers related to each other as non-superimposable mirror images are called **(E)(March 2024)**

a) Enantiomers b) Diastereomers

c) Anomers d) Racemic mixture

## FILL IN THE BLANKS BY CHOOSING THE APPROPRIATE WORD FROM THOSE GIVEN IN THE BRACKETS: (ONE MARK)

### Set-1

**(hydrocarbon, carbocation, ionic, Grignard reagent, alkyl cyanides, covalent)**

1. Alkyl halide reacts with magnesium in dry ether to produce ____ **(E)**
2. Grignard reagent on hydrolysis with water yields _____. **(A)**
3. $S_N1$ reaction involves _____intermediate **(E)**
4. The carbon magnesium bond in Grignard reagent is _____ and polar **(E)**
5. Haloalkanes react with KCN to form _____ as major product. **(A)**

### Set-2

**(Increases, $S_N1$, density, $Cu_2Cl_2$, alkyl isocyanides, $S_N2$)**

1. Haloalkanes react with AgCN to form _____ as cheif product **(A)**
2. With the increase in size and mass of halogen atom boiling point_____ **(E)**
3. The_____ increases with increase in number of carbon atoms. **(E)**
4. The catalyst used in Sandmeyer's reaction is _____. **(E)**
5. The reaction involving in two step mechanism is _____. **(E)**

### Set-3

**(Swartz, Dehydrohalogenation, Sandmeyer's, Finkelstein, Wurtz, Fitting)**

1. _____ reaction produces hydrocarbon with double the carbon in haloalkanes. **(A)**
2. The reaction that converts bromo ethane to fluoro ethane is _____ reaction **(E)**
3. Chlorobenzene is prepared from benzenediazonium chloride in _____ reaction **(E)**
4. In _____ reaction bromo ethane yields ethene **(A)**
5. Alkyl iodides are prepared by the reaction of alkyl bromides with NaI in dry acetone. This reaction is known as _____reaction. **(E)**

### Set-4

**($S_N2$, inversion, achiral, Zaitsev, retention, $S_N1$)**

1. _____reactions are generally carried out in polar protic solvents. **(A)**
2. _____ reaction follows single step reaction mechanism. **(E)**
3. $S_N2$ reactions forms products with _____ in configuration. **(E)**
4. Propan-2-ol is an _____molecule. **(E)**
5. Dehydrohalogenation of halo alkanes follows_____ rule. **(E)**

## Set-5

**(less, Grignard reagent, electron withdrawing, more, toluene, biphenyl)**

1. Bromo benzene on reaction with Na in dry ether forms _____. **(E)**
2. Methyl chloride and chlorobenzene on heating with sodium produces _____. **(A)**
3. Haloarenes are _____ reactive for nucleophilic reactions. **(E)**
4. An example for organometallic compounds is _____. **(E)**
5. The presence of _____groups increase nucleophilic reaction of halo arenes. **(A)**

## Set -6

**(Methylene chloride, iodoform, tetrachloromethane, freons, Chloroform, phosgene)**

1. Chloroform on oxidation with air in presence of light forms _____ . **(E)**
2. _____harms the human central nervous system. **(E)**
3. _____was widely used as a cleaning fluid. **(E)**
4. The unreactive, non toxic and easily liquifiable gases is _____. **(E)**
5. Earlier_____was used as antiseptic. **(E)**

## Set -7

**(geminal dihalide, vicinal dihalides, allyl halide, Isopropyl chloride, alkenes, alcohols,)**

1. _____ is an example of secondary halo alkanes. **(E)**
2. Ethylidene chloride is a _____ **(E)**
3. Alkyl halides are best prepared from____. **(E)**
4. Addition of bromine in $CCl_4$ to an alkene results in synthesis of _____ **(E)**
5. A halo alkane with beta hydrogen atom is heated with alcoholic KOH yields _____ **(E)**

## Set -8

**(non polar, electron withdrawing group, alkanes, racemisation, (+)-octan-2-ol, polar)**

1. In the Grignard reagent, the carbon-magnesium bond is covalent and highly _____ . **(E)**
2. Rate of nucleophilic reaction of halo arenes are increased by presence of _____ group **(E)**
3. The process of conversion of enantiomer into a racemic mixture is known as _____. **(E)**
4. When (–)-2- Bromooctane is reacted with sodium hydroxide, the product formed is _____. **(E)**
5. In Wurtz reaction, alkyl halides react with sodium in dry ether to gives _____. **(E)**

## Set -9

**(Carbonyl chloride, liver, freon, DDT, Tetrachloromethane, Chloroform)**

1. The polyhalo compound used as an anesthetic during surgery was _____. **(E)**
2. Chloroform is metabolised to phosgene in _____. **(E)**
3. Phosgene is also known as _____. **(E)**
4. Using Swartz reaction Freon12 is manufactured from _____. **(E)**
5. In Stratosphere, natural ozone balance is upset by initiation of radical chain reactions by _____ **(E)**

# TWO MARKS QUESTIONS:

## 6.1 Classification;

1. Classify the following into geminal and vicinal dihalides **(A)**
   a) Ethylene dichloride
   b) Methylene chloride.
2. Classify the following into allyl and vinyl halides **(A)**
   a) 3-Chloropropene
   b) 1-Chloro ethene.
3. Give one example for each of the following.
   a) Geminal dichloride b) Vicinal dihalides

## 6.4 Methods of Preparation of Haloalkanes;

4. Why the free radical halogenation of alkane's method is not advised for the preparation of haloalkanes? **(D)**
5. Halo arenes cannot be prepared from phenols. Why? **(D)**
6. Explain Swartz reaction with an example. **(E)**
7. Explain Finkelstein reaction with an example. **(E)**

## 6.5 Preparation of Haloarenes;

8. Write the product obtained when toluene reacts with i) $Cl_2$ in sunlight ii) $Cl_2$ with $FeCl_3$ **(A)**
9. Why Iodobenzene and fluorobenzene cannot be prepared from halogenation of benzene. **(D)**
10. Write the structures of different dihalogen derivatives of propane. **(A)**
11. Write the reactions involved in the preparation of bromobenzene from Aniline. **(A)**
12. Explain Sandmeyer's reaction with an example. **(E)**

## 6.6 Physical Properties;

13. Haloalkanes are very slightly soluble in water? Give reasons. **(A)**
14. Explain why halo alkanes are more soluble in organic solvents than in water? **(A)**
15. Boiling points of chlorides, bromides and iodides are higher than hydrocarbon of comparable molecular mass. Justify your answer with two reasons. **(A)**

## 6.7 Chemical Reactions;

16. Give two differences between $S_N2$ and $S_N1$. **(E)**
17. What are optically active compounds? Name the instrument used to measure optical activity. **(E)**
18. How the plane polarized light is produced? Name the instrument used to measure optical rotation **(E)**
19. What are enantiomers? Name one physical property which differentiates enantiomers. **(E)**
20. Write the product obtained when ethyl bromide reacts with
    i) alcoholic KCN ii) $AgNO_2$ **(A)**

21. What are ambident nucleophiles? Give an example. aa **(E)**

22. What is Grignard reagent? Write its general formula. **(E)**

23. Complete the following reaction and name the reaction. $C_6H_5-Br+CH_3Br \xrightarrow{Na/dry\ ether} X+2NaBr$ **(A).**

24. Which of the following compound will react faster in $S_N2$ reaction with $^-OH$? **(E)**

(i) $CH_3Br$ or $CH_3I$ (ii) $(CH_3)_3CCl$ or $CH_3Cl$.

26. What is meant by racemic modification? "Racemic mixtures are optically inactive". Give reason. **(A)**

27. Complete the following reaction

i) $C_6H_5MgBr+C_2H_5ONa \longrightarrow$ **(A)**

ii) $CH_3Br+KNO_2 \longrightarrow B$ **(A)**

28. Although chlorine is an electron withdrawing group, yet it is ortho-, para- directing in electrophilic aromatic substitution reactions. Why? **(D)**

29. Explain Zaitsev (Saytzeff) rule with an example. **(E) (MAY-2025)**

30. Explain Wurtz reaction with suitable example. **(E) (March 2019, March 2025)**

31. Explain Wurtz-Fittig reaction with suitable example. **(E)**

32. Explain Fittig reaction with suitable example. **(E) (March 2016, March 2018, MAY-2025)**

33. Explain Friedel-Craft's alkylation for chlorobenzene. Give equation. **(E)**

34. Which of the following alkyl halide more reactive towards $S_N^2$ mechanism? **(A)**

i) $CH_3$–Br or $(CH_3)_3C$–Br

ii) $(CH_3)_3CCH_2Br$ or $C_2H_5$–Br

35. Identify (A) and (B) in the following reactions. **(A)**

i) $A+Na \xrightarrow{Dry\ ether} (CH_3)_3C-C(CH_3)_3+NaBr$

ii) $B+O_2 \xrightarrow{hv} COCl_2+HCl$

36. Why Grignard reaction should be carried out in dry condition? **(A)**

37. With the help of chemical reaction show that presence of electron withdrawing group fastens nucleophilic reactions of haloarenes. **(D)**

38. Write the IUPAC name of major product obtained when chlorobenzene reacts with acetyl chloride in presence of anhydrous $AlCl_3$. Name this reaction. **(A)**

39. *p*-Dichlorobenzene has higher m.p. than those of *o*- and *m*-isomers. Give reasons. **(A)**

40. Write the structure of DDT and mention one of its uses. **(E)**

41. Name the reaction involved in the preparation of Freon-12 from tetrachloromethane. Mention one of its uses. **(A)**

42. Mention one use of chloroform in each field of medical and industry. **(E)**

43. What is racemic mixture? Represent the butan-2-ol in racemic mixture form. **(E)**

44. Write the IUPAC name of product obtained when ethyl bromide reacts with sodium iodide in dry acetone. Name the reaction. **(A)(March-2024)**

45. Complete the following equation: **(A)**

a) $2C_6H_5\text{-}X + 2Na \longrightarrow$ _____ $+ 2NaX$ **(March 2014)**

b) $H_2C{=}CH_2 + Br_2 \xrightarrow{CCl_4}$ _____ **(March-2024)**

c) $C_2H_5OH + SOCl_2 \longrightarrow$ _____ **(March-2014)**

46. Write the IUPAC name of product obtained when chlorobenzene reacts with sodium in dry ether. Name the reaction. **(A) (March-2015)**

## THREE MARKS QUESTIONS.

### 6.4 Methods of Preparation of Haloalkanes;

1. Compound **(M)** with formula $C_3H_6$ on reaction with HBr forms a compound **(N),** compound **N** on heating with Na metal in dry ether produces hydrocarbon **X.** Write the IUPAC names of compound **M**, **N** and **X.** **(D).**
2. Complete the following reaction sequences.

$C_6H_6 + Br_2 \xrightarrow{FeBr_3} Y \xrightarrow{Mg/dry\ ether} Z \xrightarrow{RNH_2}$ **(A).**

3. When alkyl chlorides are reacts with sodium iodide in dry acetone gives alkyl iodide. **(A)**
   (i) Name this reaction.
   (ii) Write the general equation.
   (iii) Mention the role of dry acetone.

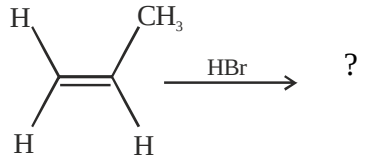
### 6.7 Chemical Reactions;

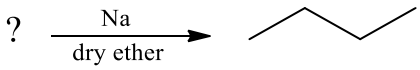
4. Write the steps involved in the mechanism of conversion of 2-Chloro-2-methyl butane in to 2-Methyl-butan-2-ol. Which type of solvent favors such reaction? **(A)**
5. Write the steps involved in mechanism of conversion of Ethyl chloride in to ethanol. What order of kinetics it follows? **(A)**
6. Why Haloarenes are least reactive towards Nucleophilic reactions Mention three reasons. **(E)** **(March-2014, March 2017, March-2023)**
7. With the help of resonance structures show that presence of nitro group on meta positions does not effects reactivity of haloarenes towards nucleophilic reactions. **(D)**
8. With the help of resonating structures explain why chlorine directs electrophile towards ortho and para positions of haloarenes in spite of its electron withdrawing nature? **(D)**
9. Illustrate Zaitsev rule with an example. **(A)**
10. Primary alkyl halide $C_4H_9Br$ **(A)** reacted with alcoholic KOH to give compound **(B)**.Compound **(B)** is reacted with HBr to give **(C)** which is an isomer of **(A)**. Write the structure of **A**, **B** and **C.** **(D)**
11. Define the following a) Racemic mixtures b) Enantiomers c) Optical isomers. **(E)**

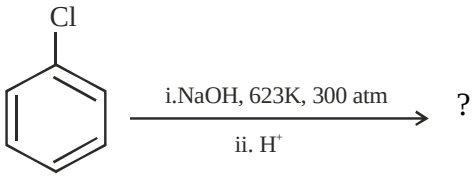
12. Write the equations for the steps involved in the mechanism for the conversion of tert-butyl bromide to tert-butyl alcohol. Among polar protic solvent and non-polar solvent, which solvent is generally used in $S_N1$ reaction. **(A)**

13. Out of $C_6H_5CH_2Cl$ and $C_6H_5CHClC_6H_5$, which is more easily hydrolysed by aqueous KOH? Justify your answer. **(A)**

14. Complete the following equation: **(A)**

i) 


ii) 


iii) 

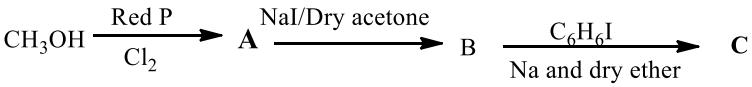

15. Write the chemical reaction for the conversion of 1-Bromo-propane to 2-Bromo-propane. Name the rules/principles involved in the above conversions. **(A)**

16. The treatment of alkyl chlorides with aqueous KOH leads to the formation of alcohols but in the presence of alcoholic KOH, alkenes are the major products. Explain **(A)**

17. Write the $S_N2$ mechanism for the conversion of chloromethane to methanol. Mention its order **(M-2024, March 2016, M-2025)** **(E).**

18. Explain $S_N1$ mechanism of conversion of tertiary butyl bromide to tertiary butyl alcohol. **(March-2014, March 2015, March 2016, March 2018, March 2019, March-2023, MAY-2025).**

19. Identify the product of A, B and C in the following equation. **(March 2015)**




## FIVE MARKS QUESTIONS.

## CASE STUDY TYPE QUESTIONS

1. Primary alkyl halide $C_4H_9Br$ **(A)** reacted with alcoholic KOH to give compound **(B)**. Compound **(B)** is reacted with HBr to give **(C)** which is an isomer of **(A)**. When **(A)** is reacted with sodium metal it gives compound (**D**), $C_8H_{18}$ which is different from the compound formed when n-butyl bromide is reacted with sodium. Give the structural formula of (**A**) and write the equations for all the reactions. **(D).**

2. A compound **M** with molecular formula $C_3H_6$ reacts with HBr to give compound **N** which on reaction with sodium metal in dry ether produces compound **P.** Compound **N** on reaction with some reagent **R** yields compound **M.** Compound **M** on reaction with reagent **X** produces isomer of Compound N. Write the structure of **M**, **N** and **P.** Mention reagents **R** and **X.** **(D)**

3. A researcher performed reaction of 1-Butene with HCl yielded a compound **A**, which rotated plane polarised light towards right. He then treated compound **A** with aqueous KOH to produces compound **B**. When compound **A** was heated with reagent **C** he got a compound **D** that was isomer of 1-butene. Write the structures of Compound **A**, **B** and **D**. Mention reagent C. What will be the optical activity of compound **B?** **(D)**

4. Benzene on reaction with $Cl_2$ and $FeCl_3$ gives compound **A.** Compound **A on** reacting with $CH_3Cl$ and anhydrous $AlCl_3$ produces compound **B.** Compound **B** can also be prepared from compound A by other reagent **X.** Write the structures of Compound A and B. Indicate the other reagent **X**. Name the two reactions involved in conversion of compound A to compound B**.** **(D)**

5. In laboratory, a student named Sanju of class 2nd PU reacted organic compound **X (**$C_3H_6$**)** with HBr to obtained compound **Y** and later he repeated same reaction along with hydrogen peroxide to get compound **Z.** He made to react compound **Y** with sodium metal in ether to get compound **A**. Similarly, Sanju reacted compound **Z** with sodium metal in another reaction vessel separately to get compound **B.** Write the structures of **X, Y, Z, A and B.** **(D)**

# Unit 7
# Alcohols, Phenols and Ethers

## MULTIPLE CHOICE QUESTIONS (MCQS) (ONE MARK)

### 7.1 Classification:

1. The general formula of an aliphatic alcohol is

   a) R-H  b) R-OH

   c) R-CHO  d) R-COOH **[E]**

2. The chemical formula of glycerol is,

   a) $C_3H_6O_2$  b) $C_3H_3O_3$

   c) $C_2H_8O_2$  d) $C_3H_8O_3$ **[A]**

3. In glycerol,

   a) One – OH group is attached to $1^0$ – carbon and one at $2^0$ – carbon

   b) Both – OH groups attached to $2^0$ – carbon

   c) One – OH group is attached to $1^0$ – carbon and two at $2^0$ – carbon

   d) Two –OH groups attached to $1^0$ – carbon and one at $2^0$ – carbon **[D]**

4. The dihydric alcohol is

   a) isobutyl alcohol  b) ethylene glycol

   c) glycerol  d) secondary butyl alcohol **[A]**

### 7.2 Nomenclature:

5. Match the column I with column II and mark the appropriate choice

| Column I | | Column II | |
|---|---|---|---|
| A) | Tertiary alcohol | i) | Butan – 2 – ol |
| B) | Allylic alcohol | ii) | 2 – Methylpropano – 2 – ol |
| C) | Secondary alcohol | iii) | Propan – 1 – ol |
| D) | Primary alcohol | iv) | Prop – 2 – en – 1 – ol |

   a) A-ii, B-iv, C-i, D-iii  b) A-ii, B-i, C-iv, D-iii

   c) A-i, B-ii, C-iii, D-iv  d) A-i, B-iv, C-iii, D-ii **[D]**

6. In allylic and benzylic alcohols, – OH group is attached to

   a) $sp^2$and $sp^2$ – hybridized carbon atom respectively

   b) $sp^3$and $sp^3$ – hybridized carbon atom respectively

   c) $sp^2$and $sp^3$ – hybridized carbon atom respectively

   d) $sp^3$and $sp^2$ – hybridized carbon atom respectively **[A]**

7. In vinylic alcohols, – OH group is bonded to

a) $sp^2$ – hybridized carbon atom of the benzene ring

b) $sp^3$ – hybridized carbon atom of alkane

c) $sp^2$ – hybridized carbon atom of alkene

d) Both a and c **[E]**

8. Match the column I with column II and mark the appropriate choice

| Column I | | Column II | |
|---|---|---|---|
| A) | $2^0$ – alcohol | i) | $CH_2 – CH(OH) – CH = CH_2$ |
| B) | Allylic alcohol | ii) | $CH_2 = CH – OH$ |
| C) | Benzylic alcohol | iii) | $CH_2 – CH(OH) – CH_2 – CH_2$ |
| D) | Vinylic alcohol | iv) | $C_6H_5 – CH_2 – OH$ |

a) A-iii, B-iv, C-ii, D-i b) A-i, B-ii, C-iv, D-iii

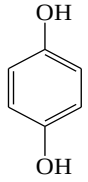
c) A-iii, B-iv, C-i, D-ii d) A-iii, B-i, C-iv, D-ii **[D]**

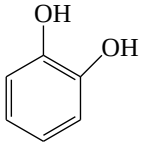
9. Catechol is an example of

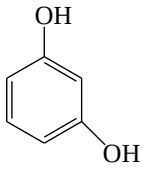
a) Dihydric alcohol b) Monohydric alcohol

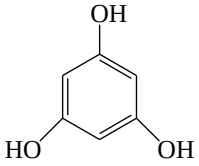
c) Trihydric alcohol d) Benzylic alcohol **[E]**

10. Quinol is

a) 


b) 


c) 


d) 


**[E]**

11. The correct IUPAC name of Isobutyl alcohol is

a) Butan – 2 – ol b) Butan – 1 – ol

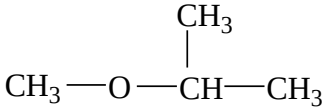
c) 2 – Methylpropan – 1 – ol d) 2 – Methylpropan – 1 – ol **[A]**

12. Match the List – I with List – II

| List – I | | List – II | |
|---|---|---|---|
| A) | m – Cresol | i) | Benzene – 1,4 – diol |
| B) | Resorcinol | ii) | Propane – 1,2,3 – triol |
| C) | Hydroquinol | iii) | 3 – Methyl phenol |
| D) | Glycerol | iv) | Benzene – 1,3 – diol |

a) A-iii, B-ii, C-iv, D-i b) A-iii, B-iv, C-i, D-ii

c) A-iii, B-ii, C-iv, D-ii d) A-iii, B-i, C-iv, D-ii **[D]**

13. The common and IUPAC name of the fallowing compound  are

a) methylpropyl ether and 2 – methoxypropane

b) diethyl ether and 1 – methoxylpropane

c) ethylmethy ether and 1 – methoxypropane

d) methylisopropyl ether and 2 – methoxypropane **[A]**

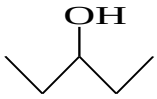
## 7.3 Structures of Functional Groups:

14. The C – O bond length in phenol is less than that in methanol due to
    a) Partial double bond character of oxygen with aromatic ring
    b) $sp^2$– hybridized carbon atom to which oxygen atom attached
    c) Unshared electron pairs of oxygen conjugated with the aromatic ring
    d) All the above **[A]**
15. The correct order of C – O bond length in ethanol, phenols and methoxymethane are
    a) ethanol> phenols >methoxymethane
    b) ethanol≅ phenols > methoxymethane
    c) ethanol≅ methoxymethane > phenols
    d) phenols>methoxymethane> ethanol **[D]**
16. The C – O – H bond angles of P, Q and R are found to be 111.7°, 109°, 108.9° respectively, compound P, Q and R are
    a) P = Phenol, Q = Methanol,R = Methoxy Methane.
    b) P = Methoxy Methane, Q = Methanol, R = Phenol.
    c) P = Methanol, Q = Phenol, R = Methoxy Methane.
    d) P = Methoxy Methane, Q = Phenol, R = Methanol. **[D]**
17. **Statement I:** The C – O – C bond angle in ethers is slightly greater than the tetrahedralangle
    **Statement II:** The C – O – C bond angle in ethers is slightly greater than alcohols due to the greater repulsive interaction between the two bulky (–R) groups.
    a) Both statement I and II are correct b) Statement I is correct and II is incorrect
    c) Statement I is incorrect and II is correct d) Both statement I and II are incorrect **[A]**

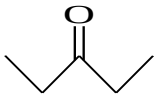
## 7.4. Alcohols and Phenols

### 7.4.1 Preparation of Alcohols:

18. An alkene $CH_3CH=CH_2$ is trated with $B_2H_6$ in presence of $H_2O_2$. The final product formed is **[D]**

a) 
b) 

c) 

d) 


19. The hydroboration – oxidation reaction of alkene takes place accordance with the
    a) Markovnokov's rule b) Saytzeff's rule
    c) Anti – markovnokov's rule d) None of these **[E]**
20. The markovnikove's rule is not fallowed in
    a) Reaction of HBr with symmetric alkenes b) Oxymercuration–demercuration
    c) Alkenes react with $H_2O$ in the presence of acid d) Hdroboration–oxidation **[D]**

21. Compound $C_3H_6$ on hydrolysis with dil. acid give a product 'X' and the same compound on hydroboration oxidation give a product 'Y'. Find X and Y

a) X= 1 – propanol and Y= 1 – propanol
b) X= 2 – propanol and Y= 2 – propanol
c) X= 1 – propanol and Y= 2 – propanol
d) X= 2 – propanol and Y= 1 – propanol **[E]**

22. The compound that is most difficult to protonate is

a) Ph – O – H
b) $H_2O$
c) $CH_3OH$
d) $CH_3 – O – CH_3$ **[D]**

23. Identify the product A of the following reaction, $R - CHO + H_2 \xrightarrow{Pd \text{ or } Pt} A$

a) RCOR
b) R – H
c) $R – CH_2 – OH$
d) None of these **[A]**

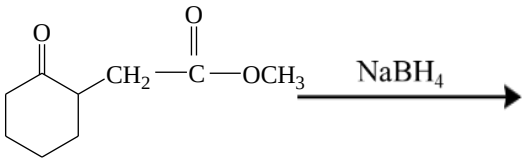
24. The reducing agent used to reduce ketone to secondary alcohols is

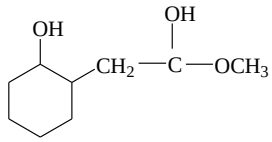
a) $K_2Cr_2O_7/H^+$
b) $NaBH_4$
c) $KMnO_4/H^+$
d) All the above **[A]**

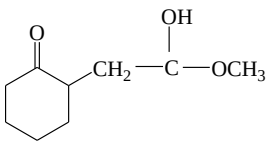
25. The reducing agent used to reduce carboxylic to primary alcohols in excellent yield is

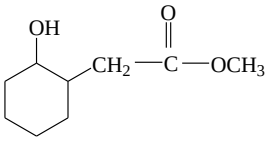
a) Palladium
b) $LiAlH_4$
c) $NaBH_4$
d) Nickel **[A]**

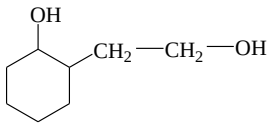
26. Find the product 'A' in the following reaction **[E]**




a) 


b) 


c) 


d) 


27. Primary alcohols can be prepared by the reaction of

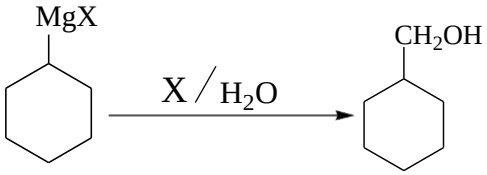
a) Formaldehyde and methyl magnesium iodide
b) Acetaldehyde and methyl magnesium iodide
c) Acetaldehyde and ethyl magnesium iodide
d) Acetone and ethyl magnesium iodide **[E]**

28. IUPAC name of the product obtained when reaction of ethanal with methyl magnesium bromide fallowed by hydrolysis

a) Propan – 1 – ol
b) Butan – 2 – ol
c) Propan – 2 – ol
d) 2 – methylpropan – 2 – ol **[A]**

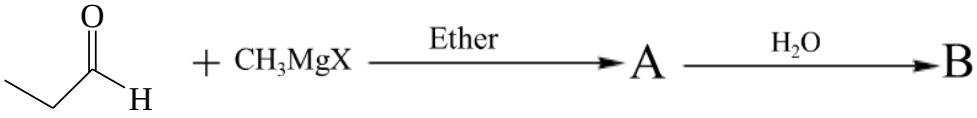
29. IUPAC name of the product obtained when reaction of acetone with methyl magnesium iodide followed by hydrolysis is

a) Propan – 2 – ol
b) Butan – 2 – ol
c) Butan – 2 – ol
d) 2 – Methylpropan – 2 – ol **[E]**

30. 


a) X= HCHO
b) X= $CH_3CHO$
c) X= $CH_2OH$
d) X=$H_2O$ **[A]**

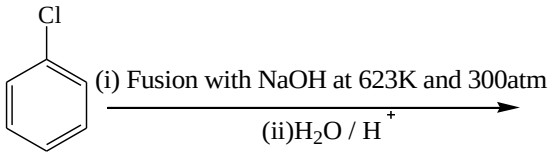
31. The IUPAC name of the product 'B' in the fallowing reaction is

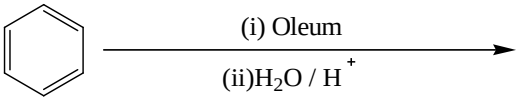


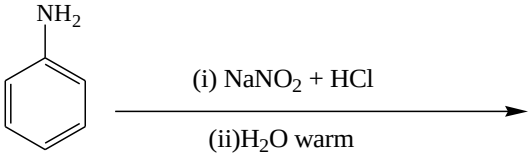

a) 2 – Methylbutan – 3 – ol
b) 2 – Methylbutan – 2 – ol
c) Butan – 2 – ol
d) 3 – Methylbutan – 2 – ol **[A]**

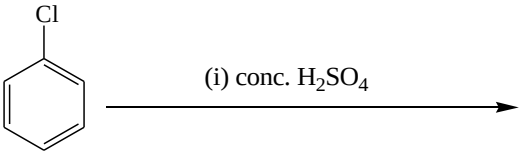
## 7.4.2 Preparation of Phenols:

32. In which of the following reaction will not yield phenol? **[E]**

a) 

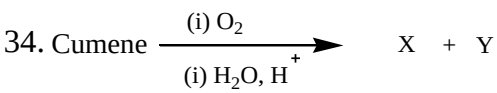

b) 


c) 


d) 

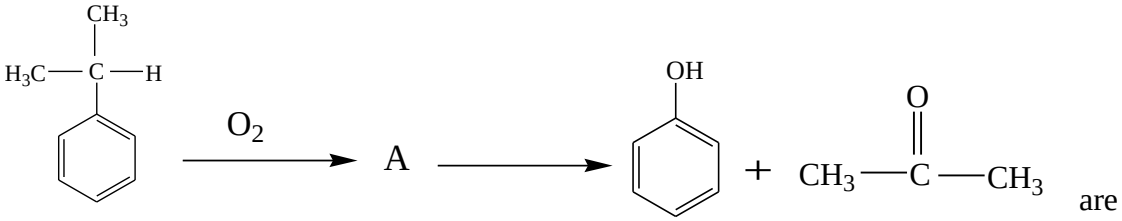

33. The chemical name of Cumene is

a) Isomethylbenzene
b) Isopropylbenzene
c) Neopropylbenzene
d) Neomethylbenzene **[E]**

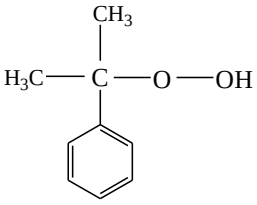
34. 

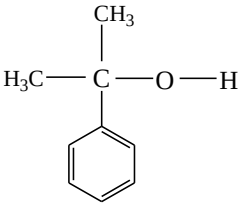

a) Phenol + Ethanol
b) Phenol + Acetaldehyde
c) Phenol + Acetone
d) Toulene + Acetone **[E]**

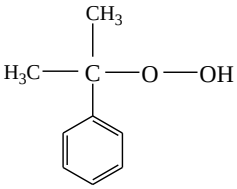
35. The name and structure of intermediate 'A' in the following reaction **[D]**

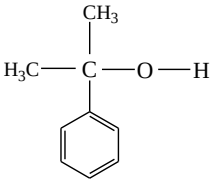



are

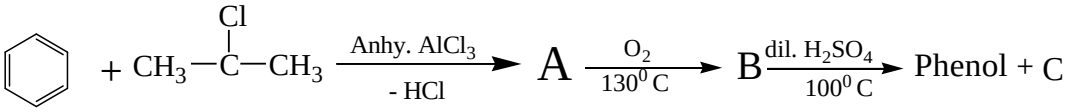
a) Cumene hydroperoxideoxide, 


b) Cumene oxide, 


c) Cumene hydroperoxideoxide, 


d) Cumene oxide 


36. The product 'C' in the following reaction is **(CET-2018)**




a) Propanone b) Water

c) Ethanol d) Methanol **[A]**

37. Most popular worldwide production of phenol is from

a) Haloarene b) Diazonium salt

c) Benzenesulphonic acid d) Cumene **[E]**

## 7.4.3 Physical Properties:

38. The correct order of boiling points for $1^0$–alcohols

a) $CH_3OH > C_2H_5OH > C_3H_7OH > C_4H_9OH$

b) $C_4H_9OH > C_3H_7OH > C_2H_5OH > CH_3OH$

c) $C_4H_9OH > C_2H_5OH > C_3H_7OH > CH_3OH$

d) $CH_3OH > C_4H_9OH > C_3H_7OH > C_2H_5OH$ **[E]**

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

i) Propan–1–ol ii) Butan–1–ol

iii) Butan–2–ol iv) Pentan–1–ol

a) (iv) > (ii) > (iii) > (i) b) (iv) > (iii) > (ii) > (i)

c) (i) > (ii) > (iii) > (iv) d) (i) > (iii) > (ii) > (iv) **[A]**

40. Arrange the following sets of compounds in the order of their decreasing boiling points

i) Propan – 2 – olii) Butan – 2 – ol iii) Butan – 1 – ol iv)2–Methylpropan – 2 – ol

a) 2 – methylpropan – 2 – ol>Butan – 2 – ol>Butan – 1 – ol>Propan – 2 – ol

b) 2 – methylpropan – 2 – ol>Butan – 1 – ol>Butan – 2 – ol>Propan – 2 – ol

c) Butan – 1 – ol>Butan – 2 – ol> 2 – Methylpropan – 2 – ol>Propan – 2 – ol

d) Butan – 1 – ol>Butan – 2 – ol>Propan – 1 – ol> 2 – Methylpropan – 2 – ol **[A]**

41. **Statement I:** The boiling point of alcohols and phenols are higher than ethers and hydrocarbons.

**Statement II:** Due to intramolecular hydrogen bonding in ethers and hydrocarbons, boiling point decreases.

a) Both statement I and II are correct b) Statement I is correct and II is incorrect

c) Statement I is incorrect and II is correct d) Both statement I and II are incorrect **[E]**

42. The correct orders of increasing boiling points of the compound is

i) Pentan – 1 – ol ii) n – Butane

iii) Pentanal iv) Ethoxyethane

a) n – butane <Ethoxyethane<Pentanal<Pentan – 1 – ol

b) n – butane <Ethoxyethane<Pentan – 1 – ol<Pentanal

c) n – butane <Pentan – 1 – ol<Ethoxyethane<Pentanal

d) n – butane <Pentan – 1 – ol<Pentanal<Ethoxyethane **[A]**

43. Solubility of alcohols in water is due to

a) their ability to form hydrogen bonds with $H_2O$ molecules

b) they are lighter than water

c) they do not form hydrogen bonds with $H_2O$ molecules

d) None of the above **[E]**

## 7.4.4 Chemical Reactions:

44. Ability of alcohols and phenols to donate a proton to stronger base demonstrates that they are
    a) Lewis acids b) Bronsted acids
    c) Lewis bases d) Arrhenius acids **[A]**

45. The acidic character of alcohols is due to
    a) lone pairs of electrons on 'O' atom b) they can accept a proton from strong acid
    c) they can accept a proton from strong base d) the polar nature of –OH bond **[E]**

46. The increasing order of acidic strength of $1^0$, $2^0$ and $3^0$ – alcohols are
    a) $3^0$ – alcohols < $2^0$ – alcohols < $1^0$ – alcohols
    b) $1^0$ – alcohols < $2^0$ – alcohols < $3^0$ – alcohols
    c) $1^0$ – alcohols < $3^0$ – alcohols < $2^0$ – alcohols
    d) $3^0$ – alcohols < $1^0$ – alcohols < $2^0$ – alcohols **[A]**

47 **Statement I:** Alcohols react with aqueous sodium hydroxide to form sodium alkoxide.
**Statement II:** Alkoxide ion is not a better proton acceptor than hydroxide ion.
    a) Both statement I and II are correct
    b) Statement I is correct and II is incorrect
    c) Statement I is incorrect and II is correct
    d) Both statement I and II are incorrect **[A]**

48. Find the incorrect statement regarding phenol
    a) Phenoxide ion is more resonance stabilized than phenol
    b) Phenols are more acidic than alcohols
    c) In phenols, 'O' atom attached to $sp^2$ hybridised carbon
    d) There is more hydrogen bonding in phenol than alcohol **[D]**

49. **Statement I:** $p^{Ka}$ value of phenol is 10.0 and $p^{Ka}$ value of ethanol is 15.9
**Statement II:** Phenol is million times more acidic than ethanol
    a) Both statement I and II are correct b) Statement I is correct and II is incorrect
    c) Statement I is incorrect and II is correct d) Both statement I and II are incorrect **[A]**

50. The correct increasing order of their acidic strength is
    a) Methanol < Ethanol <Propan – 1 – ol<Butan – 1 – ol
    b) Methanol <Propan – 1 – ol< Ethanol <Butan – 1 – ol
    c) Butan – 1 – ol<Propan – 1 – ol< Ethanol < Methanol
    d) Butan – 1 – ol< Ethanol <Propan – 1 – ol< Methanol **[A]**

51. The correct increasing order of their acidic strength is
    a) Propan – 1 – ol<Propan – 2 – ol< 2 – Methylpropan – 2 – ol< $H_2O$
    b) 2 – Methylpropan – 2 – ol<Propan – 2 – ol<Propan – 1 – ol< $H_2O$
    c) $H_2O$ < 2 – Methylpropan – 2 – ol < Propan – 2 – ol < Propan – 1 – ol
    d) $H_2O$ < Propan – 1 – ol < Propan – 2 – ol < 2 – Methylpropan – 2 – ol **[A]**

52. The correct increasing order of their acidic strength is **[E](CET-2017)**

a) Phenol < o – nitrophenol< o,p – dinitrophenol< Picric acid

b) Picric acid < Phenol < o – nitrophenol< o,p – dinitrophenol

c) Picric acid < o,p – dinitrophenol< o – nitrophenol< Phenol

d) Phenol < Picric acid < o – nitrophenol< o,p – dinitrophenol

53. The correct increasing order of their acidic strength is **[D] (CET-2017)**

a) Phenol < p – Cresol < m – Cresol < o – Cresol

b) p – Cresol < m – Cresol < o – Cresol< Phenol

c) m – Cresol < p – Cresol < Phenol < o – Cresol

d) m – Cresol < Phenol < o – Cresol < p – Cresol

54. Match the column I with column II and mark the appropriate choice **[A] (CET-2019)**

| **Column I** | | **Column II** | |
|---|---|---|---|
| A) | Ethanol | i) | $p^{Ka}$ = 15.9 |
| B) | Phenol | ii) | $p^{Ka}$ = 10.0 |
| C) | m – cresol | iii) | $p^{Ka}$ = 10.1 |
| D) | o – nitrophenol | iv) | $p^{Ka}$ = 7.2 |

a) A – iv, B – iii, C – ii, D – i b) A – i, B – ii, C – iii, D – iv

c) A – iv, B – iii, C – i, D – ii d) A – iii, B – i, C – ii, D – iv

55. The reaction between alcohol and carboxylic acid gives

a) ketone b) aldehyde

c) ether d) ester **[E]**

56. Esterification is the reaction of

a) alcohols and phenols with carboxylic acids in presence of small amount of conc. sulphuric acid

b) alcohols and phenols with acid chlorides in presence of small amount of conc.sulphuric acid

c) alcohols and phenols with acid anhydrides in presence of pyridine

d) All the above **[A]**

57. **Assertion:** Alcohols and phenols react with acid chloride to form ester in presence of pyridine base

**Reason:** Pyridine is used to neutralize HCl formed during the reaction

a) If both assertion and reason are correct and reason is a correct explanation of assertion

b) If both assertion and reason are correct and reason is not a correct explanation of assertion

c) If assertion is correct and reason is not correct

d) If both assertion and reason are not correct **[E]**

58. In the esterification reaction, the correct order of reactivity of alcohols is

a) $(CH_3)_2CHOH > C_2H_5OH > CH_3OH$ b) $CH_3OH > C_2H_5OH > (CH_3)_2CHOH$

c) $(CH_3)_2CHOH > CH_3OH > C_2H_5OH$ d) $CH_3OH > (CH_3)_2CHOH > C_2H_5OH$ **[A]**

59. For a given alcohol, the order of reactivity of carboxylic acids towards esterificationreaction is

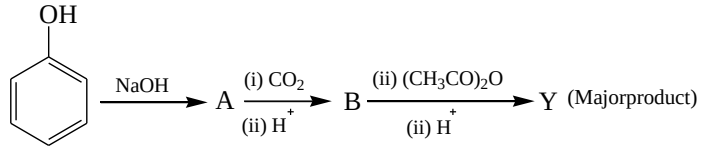
a) $C_2H_5COOH > CH_3COOH > HCOOH$ b) $C_2H_5COOH > HCOOH > CH_3COOH$

c) $HCOOH > CH_3COOH > C_2H_5COOH$ d) $CH_3COOH > HCOOH > C_2H_5COOH$ **[A]**

60. The role of conc. Sulphuric acid during esterification reaction is

a) Catalyst b) Dehydrating agent

c) Both a and b d) None of the above **[A]**

61. 

; Y in the fallowing reaction is

a) picric acid b) Spsalicylic acid

c) aspirin d) cumene **[A]**

62. Aspirin synthesis is an example of

a) acidification b) acetylation

c) alkylation d) esterification **[A]**

63. The property/ies of aspirine is/are

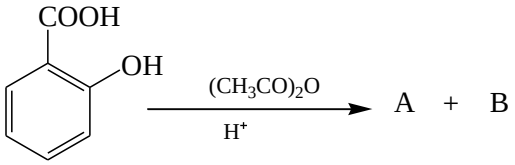
a) analgesic b) anti-pyretic

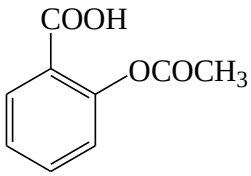
c) anti – inflammantory d) All the above **[A]**

64. The correct IUPAC name of aspirin is

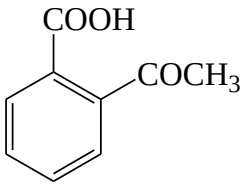
a) o – Acetylsalicylicacid b) 2 – Acetoxybenzoicacid

c) o – Acetoxybenzoicacid d) 2 – Acetylsalicylicacid **[E]**

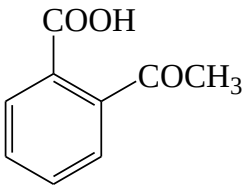
65. 


a) 

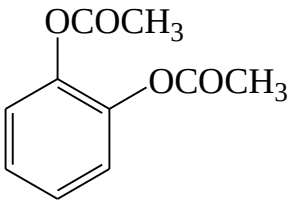
+ $CH_3COOH$

b) 

+ $CH_3COOH$

c) 

+ $CH_3CHO$

d) 

+ $CH_3CHO$ **[A]**

66. Choose the incorrect statement

a) Lucas test is a distinguish test for alcohols

b) Lucas reagent is a mixture of conc. HCl and anhydrous $ZnCl_2$

c) Primary alcohols give turbidity at room temperature

d) Secondary and tertiary alcohols give turbidity at room temperature **[E]**

67. Choose the incorrect statement

a) Tertiary alcohols do not produce turbidity at room temperature

b) Tertiary alcohols produce turbidity at room temperature

c) Primary alcohols produce turbidity on heating

d) Secondary alcohols produce turbidity after few minutes **[E]**

68. $CH_3CH(OH)CH_3$ on reaction with Lucas reagent gives

a) immediate turbidity b) turbidity on heating

c) turbidity after few minutes d) no turbidity **[A]**

69. Ethanol undergoes dehydration by

a) conc.$H_2SO_4$ b) conc. $H_3PO_4$

c) $Al_2O_3$ d) All the above **[A]**

70. Secondary alcohols are dehydrated by

a) 20% $H_3PO_4$ b) 85% $H_3PO_4$

c) Both a and b d) None of the above **[A]**

71. The correct order regarding the ease of dehydration in alcohols is

a) $1^0$ – alcohols < $2^0$ – alcohols < $3^0$ – alcohols

b) $3^0$ – alcohols < $2^0$ – alcohols < $1^0$ – alcohols

c) $1^0$ – alcohols < $3^0$ – alcohols < $2^0$ – alcohols

d) $3^0$ – alcohols < $1^0$ – alcohols < $2^0$ – alcohols **[E]**

72. Primary alcohols on oxidation to give

a) aldehydes b) carboxylic acid

c) ketones d) Both a and b **[A]**

73. Better reagent for oxidation of primary alcohols to aldehydes in good yield is **[E] (CET-2023)**

a) PCC b) $KMnO_4 / H^+$

c) $K_2CrO_7 / H^+$ d) Both b and c

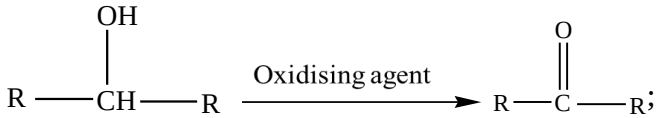
74. Pyridiniumchlorochromate (PCC) is **[A] (CET-2024)**

a) A complex of chromium trioxide with pyridine and HCl

b) A complex of chromium with pyridine and HCl

c) A complex of chromium trioxide with pyridine and chlorine

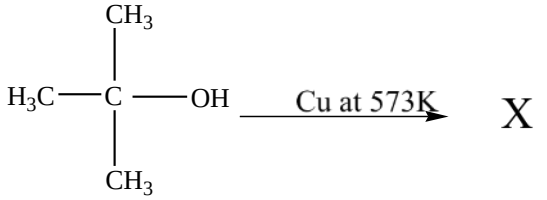
d) A complex of chromium trioxide with pyridine, HCl and chlorine

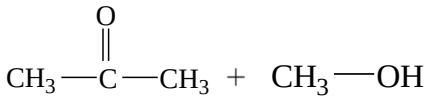
75. 

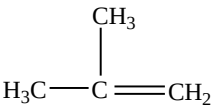
; The oxidizing agent used for this conversion is

a) $CrO_3$ b) Cu / Ag at 573K

c) $K_2CrO_7 / H^+$ d) Both a and b **[D]**

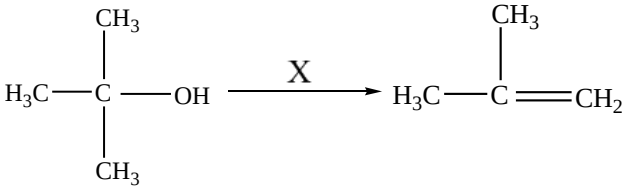
76.  ; identify 'X' **[E]**

a) 

b) 

c) $2CH_3—CH_2—OH$

d) No reaction

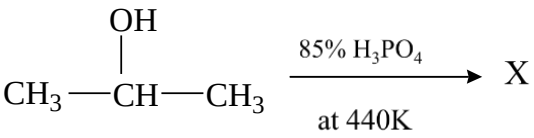
77. 

a) Cu at 573K

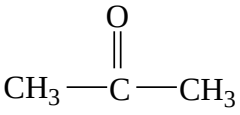
b) conc.$H_2SO_4$

c) 20% $H_3PO_4$ at 358K

d) All the above **[D]**

78.  ; the product 'X' in the following reaction is

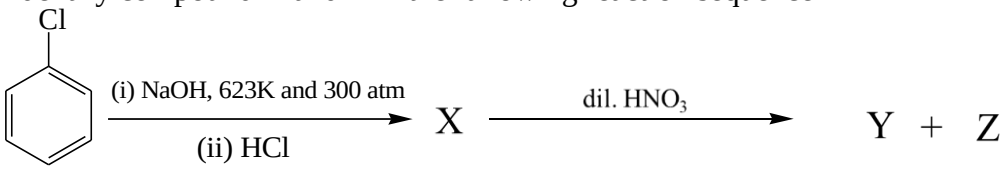
a) $CH_3—CH=CH_2$

b) 

c) $CH_3—CH_2—CHO$

d) No reaction **[A]**

79. Identify compound Y and Z in the fallowing reaction sequence



a) o – nitrophenol + p – nitrophenol

b) o – nitrophenol + m – nitrophenol

c) p –nitrophenol + m – nitrophenol

d) Phenol + m – nitrophenol **[E]**

80. The method used for the separation of ortho and paranitrophenol is

a) evoparation

b) filtration

c) steam distilation

d) condensation **[E]**

81. Between ortho and paranitrophenol, the one which is steam volatile is

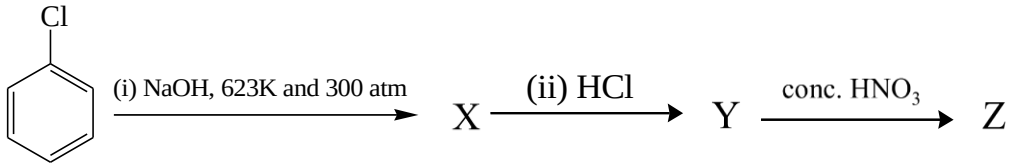
a) p – nitrophenol due to intramolecular hydrogen bonding

b) o – nitrophenol due to intramolecular hydrogen bonding

c) p – nitrophenol due to intermolecular hydrogen bonding

d) o – nitrophenol due to intermolecular hydrogen bonding **[A]**

82. Identify compound Z in the fallowing reaction sequence

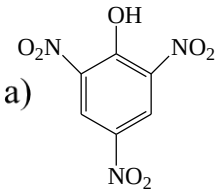


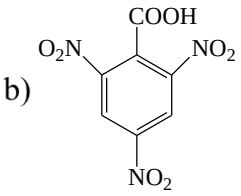

a) o – nitrophenol
b) p – nitrophenol
c) o and p – nitrophenol
d) picric acid **[D]**

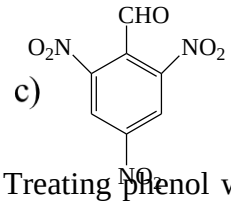
83. The correct IUPAC name of picric acid is

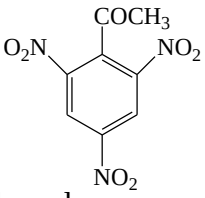
a) 2,4,6 – trinitrophenol
b) 2,4 – dinitrophenol
c) 2 – nitrophenol
d) 2,3,5 – trinitrophenol **[E]**

84. The structure of picric acid is

a) 


b) 


c) 


d) 

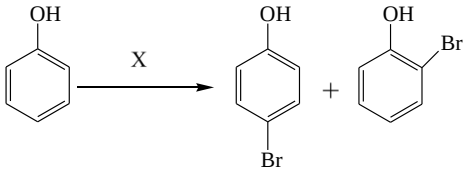

**[A]**

85. Treating phenol with concentrated sulphuric acid produces compound 'X' and then 'X' reacts with conc. $HNO_3$ to form a product 'Y'. Find 'X' and 'Y'.

a) X= Phenol – 2 – sulphonic acid, Y=2,4,6 – trinitrophenol
b) X= Phenol –2,4 – disulphonic acid, Y=2,4, – dinitrophenol
c) X= Phenol – 2,4 – disulphonic acid, Y=2,4,6 – trinitrophenol
d) X= Phenol – 2 – sulphonic acid, Y=2 – nitrophenol **[D]**

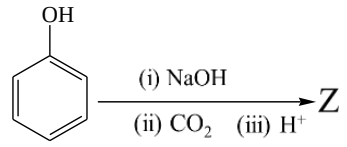
86. The major product obtained when phenol is treated with excess of bromine water is

a) 4 – bromophenol
b) 2,4 – dibromophenol
c) 2,4,6 – tribromophenol
d) 2,3,5 –tribromophenol **[E]**

87. 


; the reagent X for this conversion is,

a) bromine water at low temperature
b) bromine in $CS_2$ at low temperature
c) bromine in ethanoic acid at high temperature
d) $CH_3Br$ in $CS_2$ at high temperature **[A]**

88. 

; the correct IUPAC name of the compound Z is

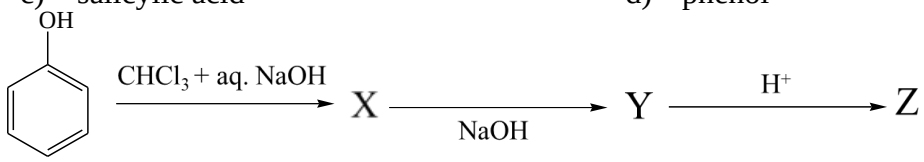
a) o-hydroxybenzoicacid
b) o-hydroxybenzoicacid
c) 1-hydroxybenzoicacid
d) 2-hydroxybenzoicacid **[A]**

89. In Kolbe's reaction, the reagents used is

a) NaOH, $CO_2$, $H^+$
b) $CHCl_2$, aqueous NaOH
c) conc. $H_2SO_4 + O_2$
d) conc. $HNO_3 + O_2$ **[A]**

90. The product obtained in the Kolbe's reaction is

a) salicylaldehyde
b) benzoic acid
c) salicylic acid
d) phenol **[E]**

91. 

**[A] (CET-2023)**

; the correct IUPAC name of the compound Z is

a) 2-hydroxybenzoic acid
b) 2-hydroxybenzaldehyde
c) 2-hydroxybenzophenone
d) phenol

92. On treatment of phenol with chloroform in the presence of sodium hydroxide, a –CHO group is introduced at ortho position of benzene ring. This reaction is known as

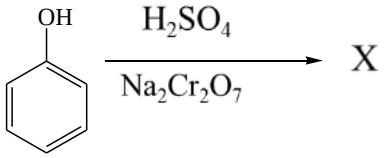
a) Kolbe's reaction
b) Reimer – Tiemann reaction
c) Oxidation reaction
d) Reduction reaction **[E]**

93. The intermediate _____ hydrolysed in the presence of alkali to produce salicylaldehyde.

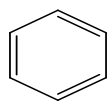
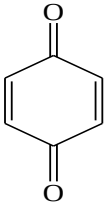
a) benzene
b) benzaldehyde
c) benzoic acid
d) substituted benzal chloride **[D]**

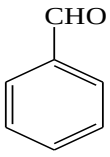
94. Phenol is treated with Zn dust, to give

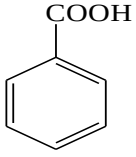
a) hydroquinol
b) benzaldehyde
c) benzene
d) benzoic acid **[E]**

95. 

; the product X in the following reaction is

a) 
b) 

c) 

d) 

**[A]**

96. In the presence of air, phenols are slowly oxidised to produce

a) benzoic acid b) benzaldehyde

c) benzene d) quinone **[D]**

## 7.5 Some Commercially Important Alcohols:

97. Wood spirit is known as

a) ethanol b) methanol

c) ethanal d) methanal **[E]**

98. $CO + 2\ H_2 \xrightarrow[200-300\ atm \quad 573-673K]{X\ (catalyst)} CH_3OH$. The catalyst 'X' in the reaction is

a) $ZnO - Cr_2O_3$ b) Fe

c) $V_2O_5$ d) $Al_2O_3$ **[A]**

99. The alcohol which is commercially obtained by the fermentation of sugar cane juice is

a) propanol b) methanol

c) butanol d) ethanol **[E]**

100. In fermentation process, the enzyme which converts sucrose into glucose and fructose is

a) Zymase b) Maltase

c) Invertase d) Lipase **[A]**

101. Ethanol is mixed with copper sulphate and pyridine to make unfit for drinking is called

a) denaturation of alcohol b) hydrolysis of alcohol

c) oxidation of alcohol d) reduction of alcohol **[E]**

## 7.6 Ethers:

### 7.6.1 Preparation of Ethers:

102. Ethanol is converted in to ethoxyethane **[D] (CET-2025)**

a) by heating excess of ethanol with conc.$H_2SO_4$ at $140^0C$

b) by heating excess of ethanol with conc.$H_2SO_4$ at 443K

c) by treating with conc. $H_2SO_4$ at room temperature

d) by treating with conc. $H_2SO_4$ at 273K

103. $CH_3ONa + CH_3Br \longrightarrow CH_3OCH_3 + NaBr$ ; the reaction fallows

a) radical mechanism b) $S_N2$ mechanism

c) $S_N1$ mechanism d) E1 mechanism **[A]**

104. $(CH_3)_3CONa + CH_3Br \longrightarrow (CH_3)_3CO\ CH_3 + NaBr$ ; the reaction fallows

a) $S_N1$ mechanism b) $S_N2$ mechanism

c) E1 mechanism d) E2 mechanism **[D]**

105. The method used to prepare $(CH_3)_3OC_2H_5$, with a good yield

a) mixing $(CH_3)_3CBr$ with $C_2H_5ONa$ b) mixing $C_2H_5Br$ with $(CH_3)_3CONa$

c) mixing $C_2H_5OH$ with $(CH_3)_3COH$ d) mixing $C_2H_5COOH$ with $(CH_3)_3COH$ **[D]**

106. The major product obtained in the reaction of $(CH_3)_3CBr$ with $CH_3ONa$ and this reaction follows
   a) ether and nucleophilic substitution reaction
   b) ether and elimination reaction
   c) alkene and nucleophilic substitution reaction
   d) alkene and elimination reaction **[D]**

## 7.6.2 Physical Properties:

107. The boiling point of ethyl alcohol is much higher than that of dimethyl ether thoughboth have the same molecular weight because
   a) ether is insoluble in water
   b) methyl groups are attached to oxygen in ether
   c) dipole moment of ethyl alcohol is less
   d) ethyl alcohol shows hydrogen bonding **[E]**

## 7.6.3 Chemical Reactions:

108. Anisole is obtained by the action of
   a) phenol with methyl magnesium iodide
   b) phenol with methanol
   c) iodobenzene with sodium methoxide
   d) sodium phenate with methyl iodide **[A]**

109. $CH_3 – O – C_2H_5 + HI \rightarrow X + Y$ ; X and Y are
   a) $CH_3OH + C_2H_5I$
   b) $CH_3I + C_2H_5OH$
   c) $CH_3OH + C_2H_5OH$
   d) $CH_3I + C_2H_5I$ **[A]**

110. The heating of ethyl phenyl ether with HI produces
   a) phenol and ethyl iodide
   b) iodo benzene and ethyl alcohol
   c) iodo benzene with ethyl iodide
   d) phenol and ethyl alcohol **[A]**

111. Phenetole $+HI \rightarrow X + Y$; X and Y are
   a) $C_6H_5I + CH_3OH$
   b) $C_6H_5I + CH_3CH_2OH$
   c) $C_6H_5OH + CH_3CH_2I$
   d) $C_6H_5OH + CH_3I$ **[D]**

112. The one which produce methyl alcohol on treatment with hot concentrated HI is
   a) $(CH_3)_3CO\ CH_3$
   b) $CH_3 – CH(CH_3) – O – CH_3$
   c) $CH_3 – CH_2 – CH_2 – CH_2 – O – CH_3$
   d) $CH_3 – CH_2 – CH(CH_3) – O – CH_3$ **[D]**

113. The order of reactivity of HX to break the C – O – C bond in ether is
   a) HCl>HBr> HI
   b) HBr>HCl> HI
   c) HI >HBr>HCl
   d) HI >HCl>HBr **[A]**

114. $CH_2 = CH – O – CH_2 – CH_3$ reacts with one mole of HI, the product formed is
   a) ethane
   b) ethanol
   c) ethanal
   d) iodoethane **[D]**

115. An ether (A), $C_5H_{12}O$, when heated with excess of hot concentrated HI produced two alkyl halides which when treated with NaOH yielded compounds (B) and (C) Oxidation of (B) and (C) gave a propanone and an ethanoic acid respectively. The IUPAC name of the ether(A) is:

a) Ethoxypropane b) 2 – Methoxybutane

c) 2 – Ethoxypropane d) Methoxybutane **[D]**

116. **Statement I:** Anisole undergoes bromination with $Br_2$ in ethanoic acid

**Statement II:** Anisole undergoes bromination even in the absence of $FeBr_3$

a) Both statement I and II are correct b) Statement I is correct and II is incorrect

c) Statement I is incorrect and II is correct d) Both statement I and II are incorrect **[D]**

117. Methyl phenyl ether on reaction with methyl chloride in presence of anhydrous aluminium chloride gives

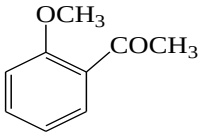
a) 2 – Methoxytoulene and 3 – Methoxytoulene

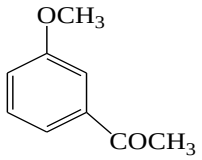
b) 2 – Methoxytoulene and 4 – Methoxytoulene

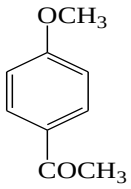
c) 3 – Methoxytoulene and 4 – Methoxytoulene

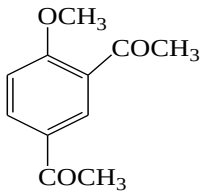
d) Toulene and benzene **[A]**

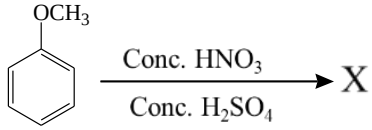
118. A compound (A) with molecular formula $C_7H_8O$ react with ethanoyl chloride to produce'X' and 'Y' with molecular formula $C_9H_{11}O_2$ . The major product obtained is

a) 


b) 


c) 


d) 


119. 

; The 'X' is **[D]**

a) 2 – nitroanisole b) 4 – nitroanisole

c) 3 – nitroanisole d) 4 – nitrophenol **[E]**

120. Match the following column and choose the correct option.

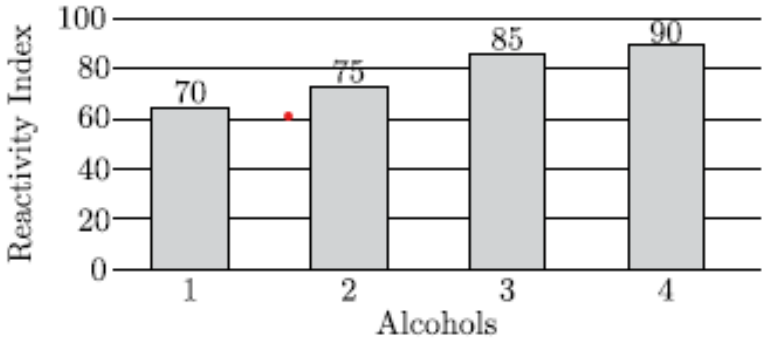
| Column A (Compounds) | | Column B (Properties/Uses) | |
|---|---|---|---|
| A) | Ethanol | 1. | Used as a solvent and antiseptic |
| B) | Phenol | 2. | Exhibits acidic nature and used as disinfectants |
| C) | Methanol | 3. | Widely used as an anaesthetic and organic solvent |
| D) | Diethyl ether | 4. | Used as antifreeze and can cause blindness if ingested |

a) A - 1 B - 2 C - 4 D - 3 b) A - 4 B - 2 C - 3 D – 1

c) A - 1 B - 3 C - 2 D – 4 d) A - 3 B - 1 C - 2 D – 4 **[A]**

## Graph based questions:

121. Study the graph showing the reactivity of alcohols with sodium metal and identify the compounds:



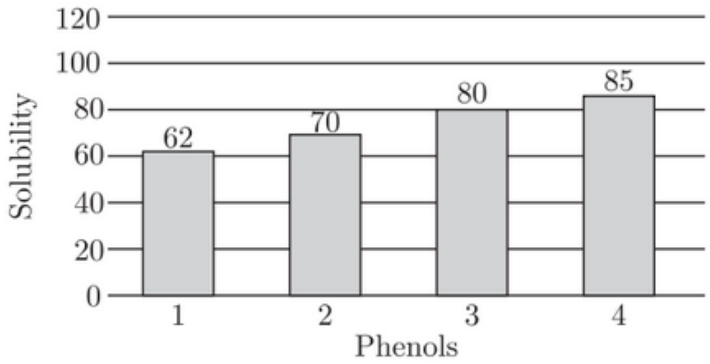

a) 1 = Methanol, 2 = Ethanol, 3 = Propanol, 4 = Butanol

b) 1 = Ethanol, 2 = Propanol, 3 = Methanol, 4 = Butanol

c) 1 = Butanol, 2 = Methanol, 3 = Ethanol, 4 = Propanol

d) 1 = Propanol, 2 = Methanol, 3 = Butanol, 4 = Ethanol **[A]**

122. Study the graph showing the reactivity of alcohols with sodium metal and identify the compounds:



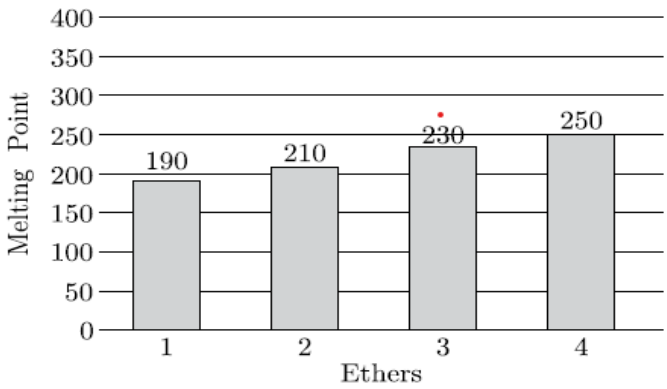

a) 1= phenol, 2- cresol, 3= hydroquinone, 4= catechol

b) 1 = catechol, 2- cresol, 3= hydroquinone, 4= phenol

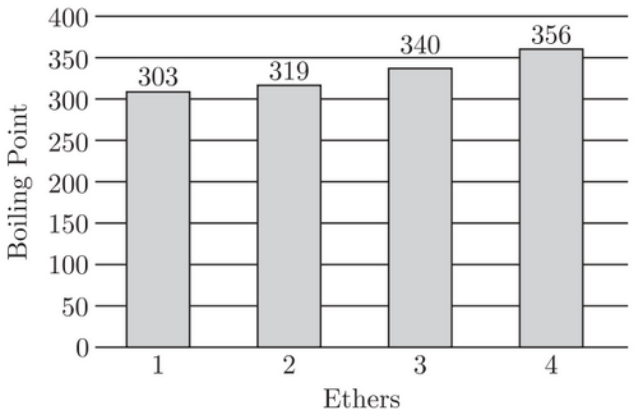
c) 1= catechol, 2= hydroquinone, 3 = cresol, 4= phenol

d) 1- cresol, 2 = catechol, 3= phenol, 4= hydroquinone **[D]**

123. Study the graph showing the melting (BOILING) points of ethers and identify the compounds:




OR




a) 1 = Dimethyl ether, 2 = Ethyl methyl ether, 3 = Diethyl ether, 4 = Propyl ethyl ether

b) 1 = Ethyl methyl ether, 2 = Propyl ethyl ether, 3 = Dimethyl ether, 4 = Diethyl ether

c) 1 = Diethyl ether, 2 = Dimethyl ether, 3 = Propyl ethyl ether, 4 = Ethyl methyl ether

d) 1 = Propyl ethyl ether, 2 = Diethyl ether, 3 = Ethyl methyl ether, 4 = Dimethyl ether **[D]**

## Fill in the blanks by choosing the appropriate word from those given in the brackets: (ONE MARK)

### Set - 1

**(dihydric, $sp^3$, phenol, three, alcohols, thrihydric)**

1. Hydroxyl (−OH) derivatives of alkane are called _____. **[E]**
2. In allylic alcohols hydroxyl group is attached to _____ hybridized carbon adjacent to the carbon – carbon double bond. **[A]**
3. The simplest hydroxy derivative of benzene is _____. **[E]**
4. Ethylene glycol is an example for _____ alcohol. **[A] (E3-2025)**
5. Glycerol containing _____ hydroxyl groups. **[D]**

### Set - 2

**(ol, Two, carbolicacid, cyclo, tert-butylalcohol, one)**

6. Phenol, also known as _____, was first isolated in the early nineteenth century from coal tar. **[E]**
7. _____ is the suffix used in the IUPAC names of the alcohols. **[E]**
8. Cyclic alcohols are named using the prefix _____. **[A]**
9. The number of −OH groups present in 1,4-benzenediol are _____. **[A]**
10. _____ is the common name of 2-Methylpropan-2-ol. **[D]**

### Set - 3

**(Morkovnikov's, primary, sigma, anti-Morkovnikov's, greater, secondary)**

11. In alcohols, the oxygen of the – OH group is attached to carbon by a _____ bond. **[A]**
12. The bond angle in alcohols is slightly _____ than the tetrahedral angle. **[A]**
13. In hydroboration – Oxidation, the product formed in accordance with _____ rule. **[A]**

14. Ethene react with water in the presence of acid as catalyst to form 2 – ethanol. The reaction takes place in accordance with_____. **[D]**

15. Aldehyde react with $H_2$ in presence of finely divided palladium to give ____ alcohols. **[A]**

**Set - 4**

**(nitrous acid, cumene hydroperoxide, oleum, formaldehyde, acetone, secondary)**

16. Ketone reacts with sodium borohydride to give _____ alcohols. **[A]**

17. Grignard reagent with _____ produces a primary alcohol. **[D]**

18. When benzene is sulphonated with _____ gives benzene sulphonic acid. **[E]**

19. A diazonium salt is formed by treating an aromatic primary amine with _____. **[E]**

20. _____ is produced when isopropyl benzene is oxidised in the presence of air. **[A]**

**Set - 5**

**(weaker, Phenol, Bronsted bases, Benzene diazoniumchloride, Acetone)**

21. _____ are hydrolysed to phenols by warming with water. **[D]**

22. In the manufacture of phenol from cumene, _____ a by-product formed. **[A]**

23. Alcohols are _____ acids than water. **[A]**

24. Alcohols act as _____ due to the presence of unshared electron pairs on oxygen. **[A]**

25. _____ is obtained by acidification of sodium phenoxide. **[A]**

**Set - 6**

**(phenol, increase, decrease, intermolecular, alkoxides, intramolecular)**

26. Cresols are less acidic than _____. **[A]**

27. The boiling points of alcohols and phenols _____ with increase in the number of carbon atoms. **[E]**

28. In alcohols, the boiling points _____ with increase of branching in carbon chain. **[A]**

29. The –OH group in alcohols and phenols is involved in _____hydrogen bonding. **[A]**

30. Alcohols react with active metals such as sodium, potassium and aluminium to yield corresponding _____. **[E]**

**Set - 7**

**(ethoxybenzene, cumene, picric acid, esters, stronger, weaker)**

31. The reaction of phenol with aqueous sodium hydroxide indicates that phenols are _____ acids than alcohols and water. **[A]**

32. Alcohols and phenols react with carboxylic acids, acid chlorides and acid anhydrides to form _____. **[E]**

33. 2,4,6-trinitrophenolis commonly known as _____. **[E]**

34. In the presence of air, _____ are slowly oxidized to dark coloured mixture containing quinones. **[D]**

35. Phenetole is also called as _____. **[A]**

**Set - 8**

**(FeBr$_3$, mixed, picric acid, CS$_2$, greater)**

36. Unsymmetrical ethers are also called as _____ ethers. **[E]**

37. The bond angle of ether is _____ than bond angle of alcohol. **[A]**

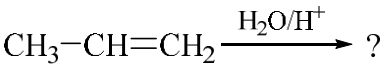
38. Mono bromination of phenol is carried out with low polarity solvents $CHCl_3$ or ____. **[A]**

39. Methylphenylether undergo bromination with bromine in ethanoic acid even in the absence of _____catalyst. **[D]**

40. Nitration of phenol with conc. $HNO_3$ yields _____. **[E]**

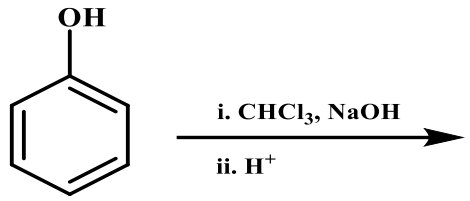
## TWO-MARK QUESTIONS

1. What are vinyl alcohols? Give an example. **[E]**
2. What are allylic alcohols? Give an example. **[E]**
3. What are Benzylic alcohols? Give an example. **[E]**
4. What are symmetrical ethers? Give an example. **[A]**
5. What are unsymmetrical ethers? Give an example. **[A]**
6. Write a short note on bonding C–O–H in alcohols. **[D]**
7. Write a short note on bonding C–O–H in phenol. **[D]**
8. Alcohols are comparatively more soluble in water than hydrocarbons of comparable molecular masses. Give reason. **[A]**
9. Identify the major product formed in the following reaction. Write its IUPC name.



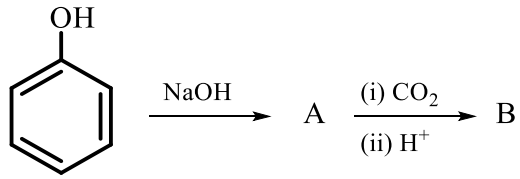
**[A]**

10. Explain the preparation of alcohol from aldehyde by catalytic hydrogenation with suitable example. **[A]**
11. Name the class of alcohol formed when ketones react with sodium borohydride. Write the chemical equation. **[A]**
12. Write the general reaction for the conversion of ketone to alcohol by using Grignard reagent. **[D]**
13. Give the structures and IUPAC names of the products expected from the following reactions:
    a) Catalytic reduction of butanal. **[A]**
    b) Reaction of propanone with methyl magnesium bromide followed by hydrolysis. **[A]**
14. What is Lucas reagent? Which class of alcohol does produces turbidity immediately with it? **[E] (E1-2025)**
15. How is phenol prepared from chlorobenzene? Write the chemical reaction. **[A]**
16. Explain the preparation of phenol from benzene sulphonic acid. Write chemical equation. **[E]**
17. How does tert-butyl alcohol react with aluminium? Write chemical equation. **[D]**
18. How does butan-2-ene-1-ol react with PCC? Write chemical equation. **[A]**
19. Write the reactions involved in preparation of phenol from cumene. **[E]**
20. Comparing the solubility of 1-butanol and 1-pentanol in water, which is likely to be less soluble in water? and give reason. **[A]**
21. How do you convert isopropyl benzene into phenol? Write equations. **[D](E2-2025)**
22. Explain Kolbe's reaction with an example. **[E]**
23. Write the reaction for acetylation of salicylic acid with acetic anhydride. Name the aromatic product of this reaction. **[D]**
24. Complete the following equation and name the reaction.




**[A]**

25. Identify 'A' and 'B' in the following reaction.




**[A]**

26. Explain Reimer-Tiemann reaction with an example. **[E]**

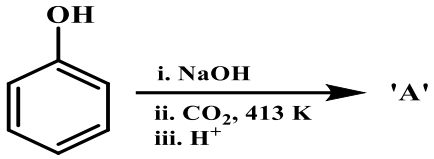
27. How does anisole react with methyl chloride? **[E] (E-2020)**

28. How anisole react with bromine in ethanoic acid? write the chemical equation for the reaction. **[E] (E-2018)**

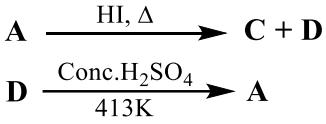
29. What is the action of bromine in ethanoic acid on anisole? Give equation. **[E] (E-2016)**

30. What is the effect of following groups on the acidity of phenol? I) $-CH_3$ II) $-NO_2$ **[A] (E-2016)**

31. Name the following reaction and identify product 'A'.




32. Compound has a molecular formula $C_4H_{10}O$. Considering the reactions given below, identify compound A and write its IUPAC name.




**[D]**

33. Explain Williamson's ether synthesis. **[E] (E1-2025)**

34. Explain the preparation of methoxyethane by Willamson's synthesis. Give equation. **[E]**

35. Classify anisole and methoxymethane into simple ether and mixed ether. **[A]**

36. The boiling points of four compounds, an ether, an aldehyde, an alcohol, and a haloalkane of comparable molecular weights, are given (not necessarily in the same order) in the table below. Identify which of the four compounds is the alcohol? **[A]**

| Compound | Boiling point |
|---|---|
| P | 35 $^0$C |
| Q | 76 $^0$C |
| R | 47 $^0$C |
| S | 118 $^0$C |

37. How does phenol react with conc. nitric acid? Give equation. **[E]**

38. While separating a mixture of ortho and paranitrophenols by steam distillation, name the isomer which will be steam volatile. Give reason. **[A] (E1-2025)**

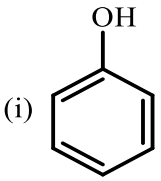
39. Between p-nitrophenoland p-cresol, which has highest $p^{Ka}$ and least $p^{Ka}$ values? **[D]**

40. Name the product formed when phenol is treating with acidified solution of $Na_2Cr_2O_7$. Write chemical equation. **[A]**

41. Among alcohols and phenols, which one is more acidic? and why? **[A] (E-2018)**

42. Write the products formed when anisole reacts with ethanoyl chloride in the presence of anhydrous $AlCl_3$ catalyst. **[E] (E-2017)**

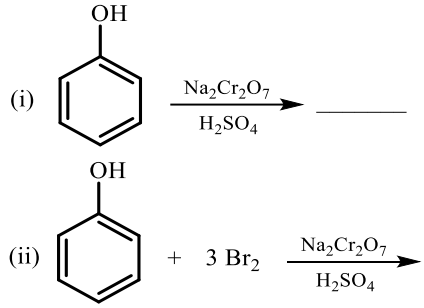
43. Complete the following equations: **[A] (E2-2025)**




(i) + 3 $Br_2$ ⟶ ____ + 3 HBr

(ii) $C_2H_5Br$ + $C_2H_5ONa$ ⟶ ____ + NaBr

44. Complete the following reactions;




**[A]**

45. Name the enzyme involved in fermentation of glucose into ethanol and write its chemical equation. **[E]**

46. Distinguish between: (i) ethanol and phenol (ii) propan-2-ol and 2-methylpropan-2-ol **[A]**

## THREE-MARK QUESTIONS

1. What are primary, secondary and tertiary alcohols? **[E]**

2. An alcohol has the formula $C_5H_{11}OH$. Draw the structural formulae of any one of its isomers that satisfy following conditions:
   (i) a primary alcohol and has an IUPAC name based on propane
   (ii) a secondary alcohol and has a IUPAC name based on butane
   (iii) a tertiary alcohol **[D]**

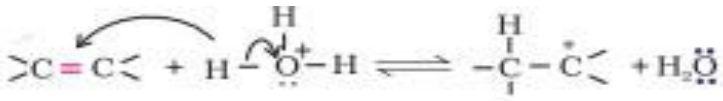
3. Lucas reagent is an important reagent which helps to distinguish between three classes of alcohols. Write the chemical composition of the Lucas reagent and explain how the above reagent helps to distinguish $1^0$ and $3^0$-alcohols? **[D](E1-2025)**

4. Write the mechanism involved in the acid catalysed hydration of propene. **[D]**

5. Write the steps in mechanism of acid catalysed hydrolysis of ethene to ethanol. **[A] (E3-2025)**

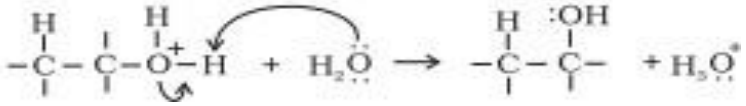
6. The mechanism of formation of alcohols from alkenes is given below. identify the errors in the mechanism and rewrite the corrected steps.

STEP 1



STEP 2

STEP 3



**[A]**

7. Explain the preparation of phenol from cumene. Write chemical equation. **[E] (E-2014)**
8. Explain the preparation of phenol from aniline. Write chemical equation. **[A]**
9. What is the effect of;
   (i) Electron withdrawing group on acidity of phenols. **[E]**
   (ii) Electron donating group on acidity of phenols. **[E]**
   (iii) Boiling point of alcohols on increasing number of carbon atoms. **[A]**
10. Write the mechanism of acid catalysed dehydration of ethanol to ethene. **[E] (E2-2025)**
11. Mention the products obtained when the vapours of primary, secondary and tertiaryalcohols are passed over heated copper at 573 K. **[A]**
12. Write the organic products of the following reactions.
    (i) $C_2H_5OH \xrightarrow[443K]{H_2SO_4}$ **[A],** (ii) $HCHO \xrightarrow[(ii)\ H_2O]{(i)\ CH_3MgX}$ **[E]**
    (iii) $CH_3CH(OH)CH_3 \xrightarrow[573K]{Cu}$ **[A]**
13. Three different types of alcohols prepared by using three different compounds P, Q, and R with methyl magnesium bromide followed by hydrolysis.
    (a) ‘’P’’ forms an alcohol with molecular formula $C_2H_6O$.
    (b) Compounds ‘’Q’’ and ‘’R’’ are isomers with the molecular formula $C_3H_6O$.
    (c) Compound ‘’Q’’ does not form any silver mirror with Tollen's reagent
    (d) Compounds ‘’P’’ and ‘’R’’ form silver mirror with Tollen's reagent.
        (i) Give the IUPAC name of compound P.
        (ii) Give the IUPAC names of the compounds formed from Q and R.
        (iii) Write the reaction showing the formation of the primary and tertiary alcohols. **[A]**
14. How is salicylic acid prepared from phenol? Explain with an equation. **[A]**
15. Write the three steps involved in the acid catalysed dehydration of ethanol to ethoxy ethane at 413 K.**[E]**
16. Give the details of two commercially important alcohols. What is denaturation of alcohol? **[A]**

17. How do you prepare aspirin from salicylic acid? Write chemical equation and deduce its IUPAC name. **[E]**

18. Phenol reacts with dil. $HNO_3$ at low temperature. The products are separated into two beakers. The boiling point of the compounds, are as given in the tables below:

| Beaker Number | 1 | 2 |
|---|---|---|
| Boiling Point | 489 K | 387 K |

Identify the compounds present in beaker -1 and beaker -2. Give a reason for your answer. **[A]**

19. An alkene X ($C_3H_6$) reacts with $H_2O/H^+$ to give compound Y, compound Y further undergoes reaction with $CrO_3$-$H_2SO_4$ to produce compound Z. Write the IUPAC name of compounds X, Y and Z. **[D]**

20. An organic compound 'A' having molecular formula $C_3H_6$ on treatment with aqueous $H_2SO_4$ gives 'B' which on treatment with $HCl/ZnCl_2$ gives 'C'. The compound C on treatment with ethanolic KOH gives back the compound 'A'. Identify the compounds A,B,C. **[D]**

21. An organic compound 'A' having molecular formula $C_6H_6O$ gives a characteristic colour with aq. $FeCl_3$ solution. When 'A' is treated with $CO_2$ and NaOH at 400 K under pressure 'B' is formed. The compound 'B' on acidification gives 'C' which reacts with acetyl chloride to form 'D' which is popular pain killer. Write the structure of A, B, C and D. **[A]**

22. What happens when

(i) Phenol reacts with bromine water? **[E]**

(ii) Ethanol reacts with $CH_3COCl$ /pyridine? **[A]**

(iii) Anisole reacts with HI? **[E]**

Write the chemical equations involved in the above reactions.

23. An alcohol 'A' ($C_4H_{10}O$) on oxidation with acidified $K_2Cr_2O_7$ gives a carboxylic acid 'B' ($C_4H_8O_2$). Treatment of 'C' with warm aq. $H_2SO_4$ gives 'D'($C_4H_{10}O$), an isomer of 'A'. The compound 'D' is resistant to oxidation. Identify compounds A, B, C and D. Write all the reactions involved. **[D]**

# Unit 8

# Aldehydes, Ketones and Carboxylic Acids

## MULTIPLE CHOICE QUESTIONS (MCQS) (ONE MARK)

### Introduction:

1. Which of the following compounds do not contain a carbonyl group?

   a) Alcohol  b) Aldehyde

   c) Ketone  d) Carboxylic acid  **[E]**

2. How many carbon atoms does formaldehyde has?

   a) 0  b) 1

   c) 2  d) 3  **[E]**

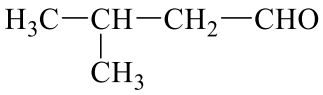
### 8.1 Nomenclature:

3. What is the common name of the compound which has a -CHO group attached to the $sp^2$ hybridised carbon of a benzene ring?

   a) Benzanal  b) Benzaldehyde

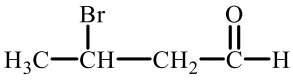
   c) Benzenecarbaldehyde  d) Phthaldehyde  **[A]**

4. Which of the following is the incorrect name for the following compound?



   a) 3-Methylbutanal  b) Isovaleraldehyde

   c) β-Methylbutyraldehyde  d) γ-Methylbutyraldehyde  **[A]**

5. The IUPAC name of 

   a) 3-Bromobutyraldehyde  b) 2-Bromopropanaldehyde

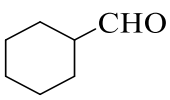
   c) 3-Bromobutanal  d) 2-Bromobutanal  **[A]**

6. The prefix valer is generally used for naming aldehydes with how many carbon atoms in the structure?

   a) 3  b) 4

   c) 5  d) 6  **[D]**

7. What is the correct IUPAC naming of the compound shown below?



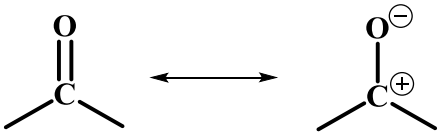
   a) Benzenecarbaldehyde  b) Cyclohexanal

   c) Cyclohexyl aldehyde  d) Cyclohexanecarbaldehyde  **[A]**

8. $CH_3$-CO-$CH_2$-$CH_2$-$CH_3$ IUPAC name of this compound is
   a) Butan-1-one b) Butan-2-one
   c) Pentan-1-one d) Pentan-2-one **[A]**
9. _____ ketones are named by prefixing the word phenone with the name of the acyl group.
   a) Methyl ethyl b) Dialkyl
   c) Alkyl phenyl d) Phenyl alkyl **[E]**
10. Butanal's common name
   a) iso-Butyraldehyde b) Butanaldehyde
   c) Butyraldehyde (n-Butyraldehyde) d) None of these **[E]**
11. Which of the following ketone has the common term acetone?
   a) Dimethyl ketone b) Ethyl methyl ketone
   c) Diethyl ketone d) N-propyl ketone **[E]**
12. According to IUPAC nomenclature, the suffix used for naming open-chain aldehydes is
   a) -ol b) -one
   c) -al d) -oic acid **[E]**
13. The common name for the simplest ketone, $CH_3COCH_3$, is
   a) Acetaldehyde b) Acetone
   c) Propanone d) Formaldehyde **[E]**

## 8.1.2 Structure of the Carbonyl Group:

14. The angle between the carbonyl >C=O bond and the bond between the carbonyl carbon and the atom connected to it is
   a) 60 degrees b) 90 degrees
   c) 120 degrees d) 135 degrees **[D]**
15. The carbon-oxygen double bond in carbonyl compounds is polar, making the carbon atom
   a) Non-polar b) Amphoteric
   c) Nucleophilic (Lewis base) d) Electrophilic (Lewis acid) **[A]**
16. In the following resonating structures "A" and "B", the number of unshared electrons in valence shell present on oxygen respectively are _____.



**(A)** **(B)**

   a) 2,4 b) 2,6
   c) 4,6 d) 6,4 **[D]**
17. The carbonyl group (>C=O) consists of a carbon-oxygen double bond. The hybridization of the carbonyl carbon atom is
   a) $sp^2$ b) $dsp^2$
   c) $sp^3$ d) sp **[A]**

## 8.2.1 Preparation of Aldehydes and Ketones:

18. Which of the following methods cannot produce aldehydes?

a) Oxidation of primary alcohols b) Dehydrogenation of secondary alcohols

c) Ozonolysis of alkenes d) Hydration of ethyne with acid **[E]**

19. Which of the following reactions can produce ketones?

a) Oxidation of primary alcohols b) Dehydrogenation of primary alcohols

c) Dehydrogenation of tertiary alcohols d) Oxidation of secondary alcohols **[E]**

20. Toluene on oxidation using $CrO_3$ in the presence of acetic anhydride followed hydrolysis gives

a) acetophenone b) benzophenone

c) benzoic acid d) benzaldehyde **[E]**

21. What is the catalyst used in the hydrogenation of acetyl chloride to produce ethanal?

a) Pt over $BaSO_4$ b) Pt over $CuSO_4$

c) Pd over $BaSO_4$ d) Pd over $CuSO_4$ **[E]**

22. Which of the following carbonyl compounds can be prepared from Rosenmund reaction?

a) Methanal b) Acetone

c) Butanone d) Benzaldehyde **[E]**

23. The Rosenmund reduction involves the hydrogenation of an acyl chloride using palladium on barium sulphate catalyst to produce

a) An alcohol b) A ketone

c) A carboxylic acid d) An aldehyde **[E]**

24. The Stephen reaction involves the reduction of nitriles using stannous chloride and HCl, followed by hydrolysis, to yield

a) Carboxylic acids b) Ketones

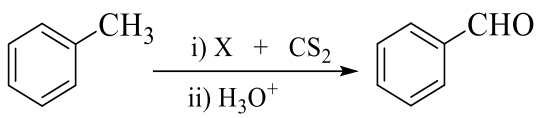
c) Aldehydes d) Amines **[E]**

25. Oxidation of methylbenzene (toluene) with chromyl chloride ($CrO_2Cl_2$) followed by hydrolysis yields benzaldehyde. This reaction is called **(KCET 2025)**

a) Etard reaction b) Clemmensen reduction

c) Rosenmund reduction d) Gatterman-Koch reaction **[E]**

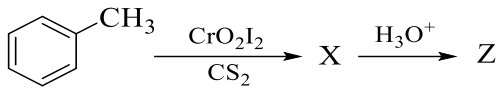
26. Identify 'X' in the reaction given below.




a) $CrO_3$ b) $CrO_2Cl_2$

c) Alkaline $KMnO_4$ d) Anhydrous $AlCl_3$ **[D]**

27. In the following reaction,




a) benzoic acid b) benzaldehyde
c) acetophenone d) benzene **[D] (KCET 2018)**

28. Friedel-Crafts acylation of benzene with an acyl chloride (RCOCl) in the presence of anhydrous $AlCl_3$ produces
a) An aldehyde b) A ketone
c) A carboxylic acid d) An alkylbenzene **[A]**

29. The catalyst used in Rosenmund's reduction is
a) $HgSO_4$ b) Anhyd. $AlCl_3$
c) $Pd/BaSO_4$ d) Anhyd. $ZnCl_2$ **[E]**

30. Conversion of alkyl cyanide to aldehyde using $SnCl_2$ and HCl is known as
a) Etard reaction b) Stephen reaction
c) Rosenmund reduction d) Gatterman-Koch reaction **[A]**

## 8.3 Physical properties of aldehydes and ketones:

31. If the boiling points of methoxyethane and propan-1-ol are 281 K and 370 K respectively, predict the boiling point of propanal.
a) 273 K b) 281 K
c) 322 K d) 370 K **[A]**

32. Which of the following has the least pungent odour?
a) Methanal b) Ethanal
c) Propanal d) Butanal **[D]**

33. Two compounds 'A' and 'B' were being tested for their boiling points. It was observed that 'A' started boiling after 'B', when both were subjected to same conditions. If the compound 'B' is acetone, which of the following can be compound 'A'?
a) Methoxyethane b) Propan-1-ol
c) Propanal d) n-Butane **[D]**

34. Which compound has a higher boiling point, propanal ($CH_3CH_2CHO$) or propan-1-ol ($CH_3CH_2CH_2OH$)?
a) Propanal b) Propan-1-ol
c) Cannot be determined d) They have nearly identical boiling points **[A]**

## 8.4 Chemical reactions of aldehydes and ketones:

35. Aldehydes and ketones undergo _____ reactions.
a) electrophilic addition b) electrophilic substitution
c) nucleophilic addition d) nucleophilic substitution **[A]**

36. What is the correct order of reactivity of the following towards nucleophilic addition?

a) Methanal > Ethanal > Acetone b) Acetone > Ethanal > Methanal

c) Methanal > Acetone > Ethanal d) Ethanal > Methanal > Acetone **[D]**

37. What is the correct order of reactivity towards nucleophilic addition?

a) Benzaldehyde > Benzophenone > Acetophenone

b) Benzophenone > Benzaldehyde > Acetophenone

c) Acetophenone > Benzaldehyde > Benzophenone

d) Benzaldehyde > Acetophenone > Benzophenone **[D]**

38. Identify the catalyst in the nucleophilic addition of HCN to acetone.

a) NaOH b) HCl

c) NaCl d) NaCN **[A]**

39. Acetone reacts with ethylene glycol in dry HCl gas to form _____

a) hemiacetals b) acetals

c) cyclic acetals d) cyclic ketals **[E]**

40. Which of the following products is formed when an aldehyde reacts with an amine in acidic medium?

a) Imine b) Schiff's base

c) Oxime d) Hydrazone **[E]**

41. The product of Clemmensen reduction on acetophenone is

a) Benzaldehyde b) Methyl benzene

c) Ethyl benzene d) Benzophenone **[E]**

42. A compound on treatment with hydrazine followed by heating up to 473K with KOH in ethylene glycol gives propane. Identify the compound.

a) Methanal b) Ethanal

c) Propanal d) Acetone **[D]**

43. Tollens' reagent is

a) Ammoniacal silver nitrate solution

b) Aqueous copper sulphate

c) Alkaline sodium potassium tartaratel

d) Mixture of sodium carbonate, sodium citrate and $Cu^{2+}$ complex **[A]**

44. When an aldehyde is heated with Fehling's solution, a reddish-brown precipitate is formed due to which compound?

a) CuS b) AgBr

c) $Cu_2O$ d) CdS **[E]**

45. The following compounds can be distinguished from iodoform test is

a) Benzaldehyde and benzophenone b) Benzaldehyde and formaldehyde

c) Acetophenone and acetaldehyde d) Acetophenone and benzophenone **[A]**

46. Pentan-2-one and Pentan-3-one be differentiated from
    a) Iodoform test
    b) Benedict's test
    c) Fehling's test
    d) Aldol condensation test **[D]**

47. Which of the following is used in the preservation of biological specimens?
    a) Methanal
    b) Ethanal
    c) Benzaldehyde
    d) Acetone **[E]**

48. Aldol condensation is
    a) electrophilic substitution reaction
    b) nucleophilic substitution reaction
    c) elimination reaction
    d) addition reaction **[D]**

49. Which compound is obtained when acetaldehydes are treated with a dilute solution of caustic soda?
    a) Sodium acetate
    b) Aldol
    c) Ethyl acetate
    d) Resinous mass **[D]**

50. Aldol condensation involves:
    a) Acidic medium
    b) Basic medium
    c) Neutral medium
    d) Alcoholic medium **[A]**

51. Benzaldehyde does NOT show positive test with
    a) Schiff reagent
    b) Tollens' reagent
    c) Sodium bisulphite solution
    d) Fehling solution **[D]**

52. Tollens' reagent is used to test for:
    a) Ketones
    b) Aldehydes
    c) Carboxylic acids
    d) Alcohols **[E]**

53. Which of the following gives iodoform test?
    a) Acetone
    b) Formaldehyde
    c) Benzaldehyde
    d) Formic acid **[E]**

54. Aldehydes are generally more reactive than ketones towards nucleophilic addition reactions because
    a) Aldehydes are less polar
    b) Ketones have stronger C=O bonds
    c) Ketones form more stable intermediates
    d) Aldehydes have less steric hindrance and a more electrophilic carbonyl carbon **[D]**

55. In Clemmensen reduction, carbonyl compound is treated with
    a) Zinc amalgam + conc. $HNO_3$
    b) Zinc amalgam + conc. HCl
    c) Sodium amalgam + conc. $HNO_3$
    d) Sodium amalgam + conc. HCl **[A]**

56. The addition of HCN to aldehydes or ketones yields
    a) Cyanohydrins
    b) Oximes
    c) Hydrazones
    d) Acetals **[E]**

57. The formation of cyanohydrin from a ketone is an example of:
    a) electrophilic addition
    b) nucleophilic addition
    c) nucleophilic substitution
    d) electrophilic substitution **[D]**

58. The reaction of aldehydes and ketones with ammonia derivatives ($H_2N$-Z) typically involves nucleophilic addition followed by
    a) Hydrolysis
    b) Reduction
    c) Dehydration (loss of water)
    d) Oxidation **[D]**

59. Which reagent is used in the Clemmensen reduction to reduce the carbonyl group (>C=O) to a methylene group (-$CH_2$-)? **[D]**
    a) Hydrazine and KOH/ethylene glycol
    b) $LiAlH_4$
    c) $NaBH_4$
    d) Zinc-amalgam (Zn-Hg) and concentrated HCl

60. Tollens' test involves the reaction of an aldehyde with ammoniacal silver nitrate solution and results in the formation of
    a) Evolution of $CO_2$ gas
    b) A bright silver mirror (Ag)
    c) A red precipitate ($Cu_2O$)
    d) A yellow precipitate ($CHI_3$) **[D]**

61. Fehling's solution B is
    a) Rochelle salt
    b) potassium citrate **[E]**
    c) alkaline $CuSO_4$
    d) mixture of alkaline $CuSO_4$ and sodium potassium tartarate

62. The haloform reaction (e.g., iodoform test) is given by aldehydes and ketones that possess which structural feature?
    a) An aromatic ring
    b) At least one alpha-hydrogen
    c) A carbon-carbon double bond
    d) A methyl group attached to the carbonyl carbon ($CH_3CO$–) **[D]**

63. The Aldol condensation reaction occurs between two aldehyde or ketone molecules possessing
    a) An aromatic ring
    b) No alpha-hydrogens
    c) At least one alpha-hydrogen
    d) Only beta-hydrogens **[A]**

64. Aldehydes lacking alpha-hydrogens undergo which reaction when treated with concentrated alkali?
    a) Cannizzaro reaction
    b) Haloform reaction
    c) Wolff-Kishner reduction
    d) Etard reaction **[E]**

65. As a result of Wolff-Kishner reduction, the following conversions can be made:
    a) Benzaldehyde into Benzyl alcohol
    b) Cyclohexanol into Cyclohexane
    c) Cyclohexanone into Cyclohexanol
    d) Benzophenone into Diphenylmethane **[A]**

66. Acetone reacts with hydrazine to form:

a) Oxime b) Hydrazone

c) Semicarbazone d) Phenylhydrazone **[A]**

67. In Cannizaro reaction:

a) aldehyde is converted into alcohol

b) alcohol is converted into aldehyde

c) a primary amine is converted into isocyanide

d) aldehyde is converted into alcohol and salt of carboxylic acid **[E]**

68. Cannizzaro reaction is shown by

a) Formaldehyde b) Acetone

c) Propanal d) Acetaldehyde **[E]**

69. Cannizzaro reaction is not given by

a) Formaldehyde b) Trimethyl acetaldehyde

c) Benzaldehyde d) Acetaldehyde **[E]**

70. Benzaldehyde undergoes Cannizzaro reaction to give

a) sodium benzoate and benzyl alcohol b) benzoic acid and benzyl alcohol

c) phenol and benzoic acid d) sodium benzoate and methyl alcohol **[A]**

71. Match List-I with List-II

| **List-I (Products formed)** | **List-II (Reaction of carbonyl compound with)** |
|---|---|
| (A) Cyanohydrin | (i) $NH_2OH$ |
| (B) Acetal | (ii) $RNH_2$ |
| (C) Schiff's base | (iii) Alcohol |
| (D) Oxime | (iv) HCN |

a) A-ii, B-iii, C-iv, D-i b) A-i, B-iii, C-ii, D-iv

c) A-iv, B-iii, C-ii, D-i d) A-iii, B-iv, C-ii, D-i **[D]**

72. Silver mirror test is given by

a) aldehyde b) ketone

c) amines d) ethers **[E]**

73. Arrange the following compounds in their decreasing order of reactivity towards Nucleop addition reaction.

$CH_3COCH_3$, $CH_3COC_2H_5$, $CH_3CHO$

a) $CH_3CHO > CH_3COCH_3 > CH_3COC_2H_5$

b) $CH_3COCH_3 > CH_3CHO > CH_3COC_2H_5$

c) $CH_3COC_2H_5 > CH_3COCH_3 > CH_3CHO$

d) $CH_3CHO > CH_3COC_2H_5 > CH_3COCH_3$ **[D] (KCET 2025)**

74. The general name of the compound formed by the reaction between aldehyde and alcohol is

a) acetal b) glycol

c) acetate d) ester **[A] (KCET 2022)**

75. The test to differentiate between pentan-2-one and pentan-3-one is

a) Benedict's test b) Fehling's test

c) Iodoform test d) Baeyer's test **[D] (KCET 2022)**

76. The carbonyl compound that does not undergo aldol condensation is

a) acetone b) dichloro acetaldehyde

c) trichloro acetaldehyde d) acetaldehyde **[A] (KCET 2020)**

77. Which of the following compounds undergoes haloform reaction?

a) $CH_3COCH_3$ b) HCHO

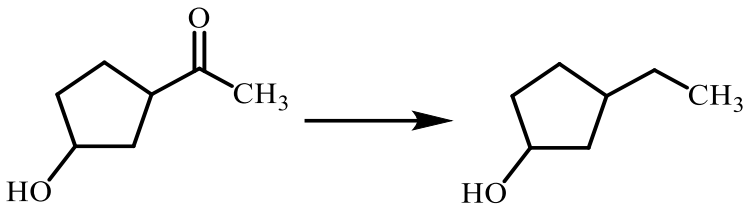
c) $CH_3CH_2Br$ d) $CH_3$-O-$CH_3$ **[D] (KCET 2018)**

78. Nucleophilic attack on carbonyl carbon atom changes its hybridization from;

a) sp to $sp^2$ b) $sp^2$ to $sp^3$

c) $sp^3$ to $sp^2$ d) sp to $sp^3$ **[A]**

79. The appropriate reagent for the following transformation is




a) Zn-Hg/HCl b) $H_2N$-$NH_2$, KOH/ethylene glycol

c) $Ni/H_2$ d) $NaBH_4$ **[D] (KCET 2018)**

80. The product formed by the reaction of aldehyde with primary amine is

a) Schiff base b) benzaldehyde

c) carboxylic acid d) ketone **[E]**

## 8.5 Uses of Aldehydes and Ketones:

81. Formalin is

a) Pure aldehyde b) 40% formaldehyde in water

c) Mixture of formaldehyde and alcohol d) 10% formic acid in water **[E]**

82. Phenol-formaldehyde resin is called

a) urea b) bakelite

c) formalin d) urea-formaldehyde glues **[A]**

83. Which among following is commonly used as food preservative?

a) Sodium benzoate b) Sodium ethanoate

c) Sodium methanoate d) Silver benzoate **[A]**

84. A bakelite is obtained from formaldehyde by reacting it with

a) benzene b) chlorobenzene

c) nitrobenzene d) phenol **[E]**

## 8.6 Nomenclature and Structure of Carboxyl Group:

85. The carboxylic group is represented as:

a) –CO– b) –OH

c) –COH d) –COOH **[E]**

86. Dicarboxylic acid is

a) Acetic acid b) Formic acid

c) Oxalic acid d) Benzoic acid **[E]**

87. Carboxyl group is not present in

a) aspirin b) picric acid

c) benzoic acid d) ethanoic acid **[E]**

## 8.7 Methods of preparation of Carboxylic acids:

88. How can ethyl magnesium bromide be converted to propanoic acid?

a) Jones reagent b) $KMnO_4$-KOH; heat

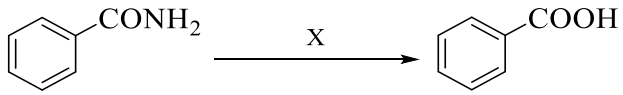
c) $H_3O^+$; heat d) $CO_2$-dry ether; $H_3O^+$ **[D]**

89. Jones reagent is

a) $KMnO_4$ in alkaline medium b) $CrO_3$ in $H_2SO_4$

c) $K_2Cr_2O_7$ in acidic medium d) $KMnO_4$ in $H_2SO_4$ **[A]**

90. Identify X in the following conversion.




a) Alkaline $KMnO_4$; $H_3O^+$ b) KOH; heat

c) $H_3O^+$; heat d) $KMnO_4$–KOH; heat **[D]**

91. Toluene can be oxidized to benzoic acid by

a) $KMnO_4$ (acidic) b) $Pd/BaSO_4$

c) $K_2Cr_2O_7$ (Alkaline) d) Anhyd. $AlCl_3$ **[A]**

92. Carboxylation of alkyl magnesium halide in dry ether followed by hydrolysis gives

a) a carboxylic acid b) an alcohol

c) an anhydride d) an aldehyde **[E]**

93. $C_6H_5MgBr \xrightarrow[(ii)H_3O^+]{(i)CO_2} P$, in the given reaction product 'P' is

a) $C_6H_5COOH$ b) $C_6H_5CHO$

c) $C_6H_5CH_2COOH$ d) $C_6H_5OH$ **[A]**

## 8.8 Physical Properties of Carboxylic acids:

94. The correct order of boiling points of the following
    a) HCOOH > $CH_3COOH$ > $C_2H_5COOH$ b) $C_2H_5COOH$ > $CH_3COOH$ > HCOOH
    c) HCOOH > $C_2H_5COOH$ > $CH_3COOH$ d) $CH_3COOH$ > HCOOH > $C_2H_5COOH$ **[D]**
95. Carboxylic acid having higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass due to
    a) formation of intramolecular H-bonding
    b) formation of carboxylate ion
    c) more extensive association of carboxylic acid via van der Waals force of attraction
    d) formation of intermolecular H-bonding **[D]**
96. In vapour phase, most of the carboxylic acids exists as a
    a) monomers b) dimers
    c) trimers d) polymers **[E]**

## 8.9 Chemical Reactions of Carboxylic acids:

97. Carboxylic acids are generally stronger acids than phenols because
    a) Alcohols are stronger acids than carboxylic acids
    b) The phenoxide anion is more resonance stabilized than the carboxylate anion
    c) Phenols cannot form hydrogen bonds
    d) The carboxylate anion is more resonance stabilized than the phenoxide anion **[D]**
98. The Hell-Volhard-Zelinsky (HVZ) reaction involves the halogenation of carboxylic acids (having an alpha-hydrogen) at the
    a) Gamma-position b) Alpha-position
    c) Beta-position d) Carbonyl carbon **[E]**
99. Which among the following does not undergo HVZ reaction?
    a) HCOOH b) $CCl_3COOH$
    c) $C_6H_5COOH$ d) All **[E]**
100. Which among the following undergo HVZ reaction?
    a) HCOOH b) $CCl_3COOH$
    c) $C_6H_5COOH$ d) $CH_3COOH$ **[E]**
101. The HVZ reaction is used in the synthesis of
    a) ketones b) aldehydes
    c) acid halides d) α-halocarboxylic acids [**E**]
102. Benzoic acid reacts with _____ to give ammonium benzoate salt, which on further dehydration gives benzamide.
    a) $N_2$ b) $NH_3$
    c) $NH_4OH$ d) $HNO_3$ **[A]**

103. The acidity of carboxylic acid is due to:

a) >C=O group b) –OH group

c) Presence of alkyl group d) Resonance stabilization of carboxylate ion **[A]**

104. Esterification of carboxylic acid is carried out in the presence of:

a) KOH b) $H_2SO_4$

c) NaOH d) NaCl **[E]**

105. Carboxylic acids undergo decarboxylation (lose $CO_2$) when their sodium salts are heated with

a) $LiAlH_4$ b) Red phosphorus and HI

c) Sodalime (NaOH + CaO) d) Concentrated $H_2SO_4$ **[A]**

106. Strongest acid is

a) Formic acid b) Acetic acid

c) Benzoic acid d) Propanoic acid **[E]**

107. Which of the following statement is not true about the acidic nature of carboxylic acids?

a) Smaller the pKa value, stronger is the acid

b) The presence of electron donating group on the phenyl of aromatic carboxylic acid increases their acidity

c) The presence of electron withdrawing group on the phenyl ring of aromatic carboxylic acid increases their acidity.

d) Carboxylic acids are weaker than mineral acids **[D]**

108. Given below are two statements:

Statement I: Benzoic acid does not undergo Friedel Craft reaction.

Statement II: Carboxylic carbon is less electrophilic than carbonyl carbon.

choose the most appropriate answer from the options given below:

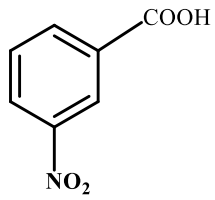
(a) Statement I is incorrect but Statement II is correct.

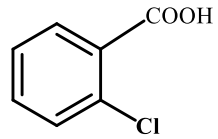
(b) Both Statement I and Statement II are correct.

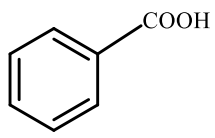
(c) Both Statement I and Statement II are incorrect.

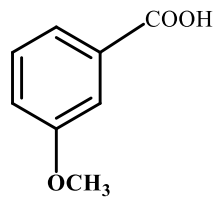
(d) Statement I is correct but Statement II is incorrect. **[D]**

109. Weakest acid is

a) 


b) 


c) 


d) 


**[A]**

## 8.10 Uses of Carboxylic Acids:

110. Carboxylic acid is used in the manufacturing of nylon-6,6 is

a) Propanedioic acid b) Butanedioic acid

c) Pentanedioic acid d) Hexanedioic acid **[E]**

111. _____ is used as vinegar in food industry.

a) Formic acid b) Acetic acid

c) Benzoic acid d) Propanoic acid **[A]**

112. Higher fatty acids are used for the manufacture of

a) rubber b) bakelite

c) soaps and detergents d) plastic **[E]**

## FILL IN THE BLANKS BY CHOOSING THE APPROPRIATE WORD FROM THOSE GIVEN IN THE BRACKETS: (ONE MARK)

### Set - 1

**($sp^2$, $sp^3$, polarised, fragrance, electrophilic, carbonyl group)**

1. The organic compounds containing carbon-oxygen double bond (>C=O) called _____. **[E]**
2. Aldehydes, ketones add _____ and flavour to nature. **[E]**
3. The carbonyl carbon atom is _____ hybridised. **[A]**
4. The carbon-oxygen double bond is _____ due to higher electronegativity of oxygen relative to carbon. **[E]**
5. In a carbonyl group the carbonyl carbon is an _____ in nature. **[E]**

### Set - 2

**(oxidation, reduction, Lewis base, acetaldehyde, ozonolysis, volatile)**

1. In a carbonyl group the carbonyl oxygen acts as _____. **[A]**
2. Aldehydes and ketones are generally prepared by _____ of primary and secondary alcohols, respectively. **[E]**
3. In the preparation of Aldehydes and Ketones by oxidation of alcohols method is suitable for ____ alcohols. **[E]**
4. By _____ of alkenes followed by reaction with zinc dust and water gives aldehydes, ketones or a mixture of both depending on the substitution pattern of the alkene. **[E]**
5. Addition of water to ethyne in the presence of $H_2SO_4$ and $HgSO_4$ gives _____. **[A]**

## Set - 3

**(benzaldehyde, methyl group, imine, alcohol, ketone, anhydrous aluminium chloride)**

1. Nitriles are reduced to corresponding _____ with stannous chloride in the presence of hydrochloric acid. **[E]**
2. Chromyl chloride oxidises _____of toluene to a chromium complex, which on hydrolysis gives corresponding benzaldehyde. **[E]**
3. Side chain chlorination of toluene gives benzal chloride, which on hydrolysis gives _____. **[A]**
4. Treating a nitrile with Grignard reagent followed by hydrolysis yields a _____. **[E]**
5. _____ is the catalyst used in Friedel-Crafts acylation reaction. **[E]**

## Set - 4

**(higher, propiophenone, gas, increases, decreases, miscible)**

1. When benzene is treated with propanoyl chloride in the presence of anhydrous $AlCl_3$ and $CS_2$ gives _____. **[E]**
2. Methanal is a _____ at room temperature. **[E]**
3. The boiling points of aldehydes and ketones are _____ than hydrocarbons and ethers of comparable molecular masses. **[E]**
4. The lower members of aldehydes and ketones such as methanal, ethanal and propanone are _____ with water in all proportions. **[E]**
5. The solubility of aldehydes and ketones _____ rapidly on increasing the length of alkyl chain. **[E]**

## Set - 5

**(planar, electronic, nucleophilic, electrophilic, addition, cyanohydrins)**

1. The aldehydes and ketones undergo _____ addition reactions. **[E]**
2. The structure of carbonyl group is _____. **[E]**
3. Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and _____ reasons. **[E]**
4. Aldehydes and ketones react with hydrogen cyanide (HCN) to yield _____. **[E]**
5. Sodium hydrogensulphite adds to aldehydes and ketones to form the _____ products. **[A]**

## Set - 6

**(Ketones, Aldehydes, copper sulphate, bright silver mirror, hemiacetals, dimer)**

1. Aldehydes react with one equivalent of monohydric alcohol in the presence of dry hydrogen chloride to yield alkoxyalcohol intermediate, known as _____. **[E]**
2. _____ react with ethylene glycol under similar conditions to form cyclic products known as ethylene glycol ketals. **[A]**
3. On warming an aldehyde with freshly prepared ammoniacal silver nitrate solution, a _____ is produced. **[E]**
4. Fehling solution A is aqueous _____. **[E]**
5. In fact, most carboxylic acids exist as _____ in the vapour phase or in the aprotic solvents. **[E]**

## 8.1 Nomenclature:

**TWO-MARK QUESTIONS**

1. Write the structures of the following compounds.
   (i) $\alpha$ – Methoxypropionaldehyde (ii) 3-Hydroxybutanal **[D]**
2. Draw the structures of the following:
   (i) p-Methylbenzaldehyde (ii) 4-Methylpent-3-en-2-one **[D]**
3. Name the following compounds according to IUPAC system of nomenclature:
   (i) $CH_3CH(CH_3)CH_2CH_2CHO$ (ii) $CH_3COCH_2COCH_3$ **[D]**
4. Draw the structures of the following compounds. **[D]**
   (i) 4-Chloropentan-2-one (ii) 4-Methylpent-3-en-2-one
5. Write the structure and IUPAC name of salicylic acid. **[D]**

## 8.1.2 Structure of the Carbonyl Group:

**TWO-MARK QUESTIONS**

6. Mention the geometry of carbonyl group and write the hybridization of carbonyl carbon. **[E]**

**THREE-MARK QUESTIONS**

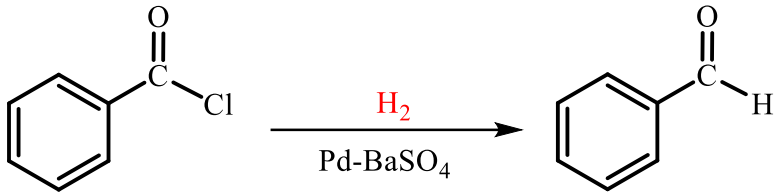
7. Explain the structure of carbonyl Group. **[A]**

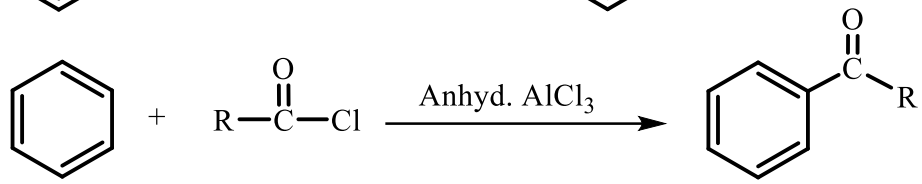
## 8.2.1 Preparation of Aldehydes and Ketones:

**TWO-MARK QUESTIONS**

8. Explain Rosenmund reduction with an equation. **[E] (Mar-2018)**
9. Explain Rosenmund's reduction of benzoyl chloride. **[E] (Mar-2014)**
10. How would you prepare acetaldehyde from acetyl chloride? Name the reaction. **[D] (Mar-2015/May-2015)**
11. Explain Stephen reaction with suitable example. **[E]**
12. Write the general reaction of conversion of alkyl nitrile to aldehyde by using DIBAL-H and expand DIBAL-H. **[D]**
13. How benzene is converted into benzaldehyde by Gatterman-Koch reaction? Write equation. **[D] (Mar-2017)**
14. Write the IUPAC name and structure of the product obtained when benzene reacts with acetyl chloride in presence of anhyd. $AlCl_3$. **[D]**
15. How does benzene react with acetyl chloride in the presence of anhydrous $AlCl3$? Give equation. **[D] (Mar-2019)**
16. Explain Gatterman–Koch reaction with an example. **[E]**
17. Does aldehyde have a higher or lower boiling point than alcohols of comparable molecular masses? Justify your answer. **[D]**

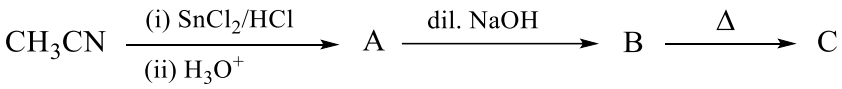
18. Mention the name of the following reactions.

(i) 


(ii) 


### THREE-MARK QUESTIONS

19. Illustrate Etard reaction with equation. **[E]**
20. How do you convert toluene to benzaldehyde by using chromic oxide? Write chemical equation. **[D]**
21. How do you prepare benzaldehyde by side chain chlorination of toluene? Write chemical equation. **[D]**
22. Explain the conversion of ethyl cyanide to propiophenone with equation. **[A]**
23. Give names of the reagents to bring about the following transformations:
    (i) Hexan-1-ol to hexanal.
    (ii) Cyclohexanol to cyclohexanone.
    (iii) Allyl alcohol to propenal **[D]**
24. How is benzoyl chloride converted into benzaldehyde? Write the equation and name the reaction. **[D]** **(Mar-2020)**
25. Write the reaction for the conversion of toluene to benzaldehyde using chromyl chloride. Name the reaction. **[A]**
26. Write structures of compounds A, B and C in the following reactions:



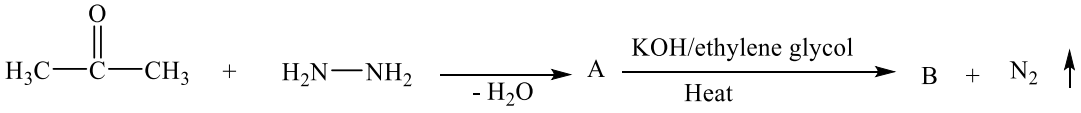

**[D]**

## 8.4 Chemical reactions of aldehydes and ketones:

### TWO-MARK QUESTIONS

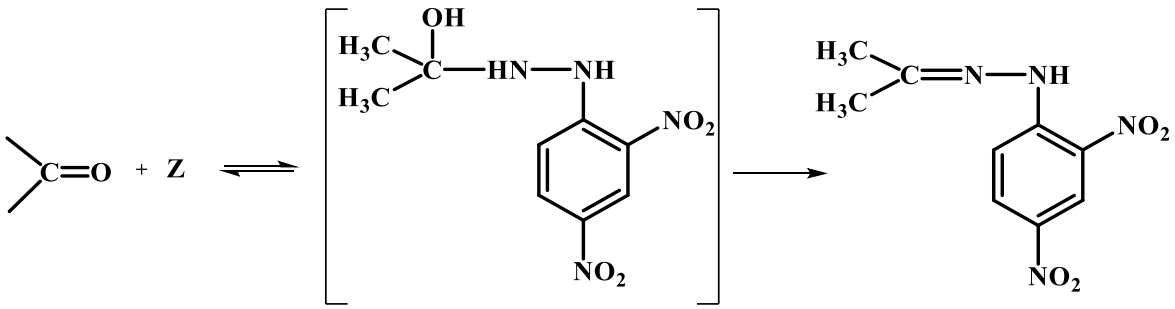
27. Write the composition Fehling reagent. **[E]**
28. Aldehydes are more reactive than ketones in nucleophilic addition reactions. Give two reasons. **[D]** **(May-2016)**
29. What is Tollens' reagent? Write one usefulness of this reagent. **[A]**
30. Write the general equation involved in addition of ammonia and its derivatives to carbonyl group. **[A]**
31. How does propanone reacts with hydrazine? Give equation. **[A]**
32. Illustrate Clemmensen reduction with suitable reaction. **[E] (Mar-2016/May-2024)**
33. Explain haloform reaction with general equation. **[E] (Mar-2024)**

34. Among butan-2-one and Pentan-3-one which compound is oxidised by sodium hypohalite? Write its chemical equation. **[D] (May-2024)**
35. What is aldol condensation reaction? Give the IUPAC name of the aldol condensation product obtained when propanone undergoes aldol condensation reaction. **[D]**
36. What is crossed aldol condensation reaction? Give an example. **[E] (Mar-2016)**
37. Identify A and B in the following reaction. $2C_6H_5CHO + conc.NaOH \rightarrow \boldsymbol{A} + \mathrm{B}$. **[A] (Mar-2015)**
38. Write the chemical equation for the reaction, when benzaldehyde is heated with concentrated alkali. Name the reaction. **[D] (May-2024)**
39. How does benzaldehyde reacts with acetophenone in presence of a dilute alkali? Give equation. **[D]**
40. Explain Cannizzaro's reaction with an example. **[E] (May-2018/ May-2017)**
41. Explain Cannizzaro's reaction taking benzaldehyde as an example. **[D] (Mar-2020)**
42. Among methanal and ethanal, which one undergoes Cannizaro reaction? Give reason. **[A]**
43. Acetaldehyde does not undergo Cannizzaro's reaction. Why? **[D] (May-2016)**
44. Explain the nitration of benzaldehyde with chemical equation. **[A]**
45. What is Tollens' reagent? Write one usefulness of this reagent. **[A]**
46. Write Wolff-Kishner's reduction for the conversion of carbonyl group into –CH2– group. **[A] (May-2020)**
47. Identify A and B in the following reaction.




**[D] (Mar-2024)**

48. Explain aldol condensation reaction for acetaldehyde. Write equation. **[D] (May-2019)**
49. Write the equation for the reaction between benzaldehyde and concentrated $NaOH$ solution. Name the reaction. **[D] (Mar-2019)**
50. How does benzaldehyde react with acetophenone in presence of a dilute alkali? **[D] (May-2016)**
51. What is the action of dil. NaOH on ethanol (acetaldehyde)? Name the reaction. **[D] (Mar-2016)**
52. How does propanone ($CH_3COCH_3$) react with hydrazine? Give equation. **[D] (Mar-2018)**
53. In a given chemical reaction, write the structure and name of compound 'Z'. **[D]**




54. What happens when carbonyl compounds are treated with hydrazine? Write the reaction. **[D] (Mar-2014)**

55. How does methanal react with hydroxylamine? Explain with equation. **[D] (Mar-2024)**

56. Draw the structure of the following derivatives:
    (i) Cyanohydrin of propanone.
    (ii) Hemiacetal of ethanal. **[D]**

**THREE-MARK QUESTIONS**

57. Write the mechanism of addition of HCN to carbonyl group in presence of a base. **[E] (Mar-2016)**
58. Explain preparation of propane by Wolff-Kishner reduction. Write chemical equation. **[E]**
59. Explain the following conversion with equation: Ethanol to but-2-enal. **[A]**
60. What happens when propanone is treated with methyl magnesium iodide and then hydrolyzed? Write chemical equation. **[D]**
61. Provide the general reaction to prepare Haloform from methyl ketones. Name a reagent which is used to detect the presence of α – methyl group in a carbonyl compound. **[D]**
62. Write main product formed when propanal reacts with the following reagents:
    (i) Hydrogen cyanide in presence of base.
    (ii) Dilute NaOH.
    (iii) $H_2N\text{-}NH_2$ followed by heating with KOH in ethylene glycol. **[D]**

## 8.7 Methods of preparation of Carboxylic acids:

**TWO-MARK QUESTIONS**

63. Write the chemical equation for the conversion of toluene to benzoic acid. **[D]**
64. Explain the oxidation of primary alcohol to carboxylic acid with chemical equation. **[A]**
65. What is the final organic product obtained on hydrolysis of benzamide? Write the chemical equation. **[D]**
66. What is the final organic product obtained on hydrolysis of ethanamide? Write the chemical equation. **[D]**
67. What happens when benzoic anhydride treated with water? Write chemical equation. **[D]**
68. Write the general equation for the formation of carboxylic acid from Grignard reagent. **[D] (Mar-2020/Mar-2018/May-2015/Mar-2024)**
69. How are carboxylic acids prepared from nitriles? **[A] (May-2015)**
70. Name the two products formed when benzoic ethanoic anhydride undergoes hydrolysis. **[A]**

**THREE-MARK QUESTIONS**

71. Explain the preparation of carboxylic acids from Grignard reagent. Give equation. **[E]**
72. What is Jones reagent? How do you convert 1-decanol to decanoic acid by using it? Write chemical equation. **[A]**
73. Explain the conversion of toluene to benzoic acid with chemical equation. **[A]**

74. What is the final organic and inorganic product obtained on hydrolysis of benzamide? Write the chemical equation. **[D]**

75. What is the final organic and inorganic product obtained on hydrolysis of ethanamide? Write the chemical equation. **[D]**

## 8.9 Chemical Reactions of Carboxylic acids:

### TWO-MARK QUESTIONS

76. Among methanoic acid and ethanoic acid, which is more acidic and why? **[D]**

77. Explain esterification reaction with an example. **[E] (May-2018)**

78. What is the action of ammonia ($NH_3$) on benzoic acid? Write equation. **[A] (May-2018)**

79. How is benzamide obtained from benzoic acid? **[A] (Mar-2016/Mar-2014)**

80. Explain HVZ (Hell-Volhard-Zelinsky) reaction with equation. **[E] (Mar-2015/May-2024)**

81. Explain the nitration of benzoic acid with chemical equation. **[A]**

82. Carboxylic acids do not give characteristic reactions of carbonyl group. Why? **[D]**

83. Arrange the following compounds in increasing order of their property as indicated:
(i) $CH_3COCH_3$, $C_6H_5COCH_3$, $CH_3CHO$ (reactivity towards nucleophilic addition reaction)
(ii) Cl—$CH_2$—COOH, F—$CH_2$—COOH, $CH_3$—COOH (acidic character) **[D]**

84. Give reasons:
(i) Benzoic acid is a stronger acid than acetic acid.
(ii) Methanal is more reactive towards nucleophilic addition reaction than ethanal. **[D]**

85. Between acetic acid and monochloroacetic acid, which is more acidic? Give reason. **[A] (Mar-2024)**

86. Account for the following:
(i) Aromatic carboxylic acids do not undergo Friedel-Crafts reaction.
(ii) pKa value of 4-nitrobenzoic acid is lower than that of benzoic acid. **[D]**

87. Place the following in decreasing order or sequence of their acidic power. Also, explain the reason behind your answer.
$CH_3CH_2OH$, $CH_3COOH$, $ClCH_2COOH$, $FCH_2COOH$, $C_6H_5CH_2COOH$ **[D]**

88. Among 4-nitro benzoic acid and 4-methoxy benzoic acid, which is more acidic? Give one reason. **[D] (Feb-2020)**

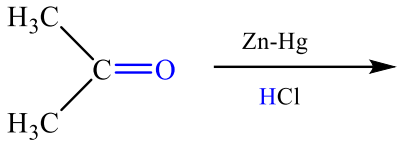
89. The $pK_a$ values of 4-methoxybenzoic acid, benzoic acid and 4-nitrobenzoic acid are 4.46, 4.19 and 3.41 respectively. Arrange them in the increasing order of their acid strength. Justify the arrangement. **[D]**

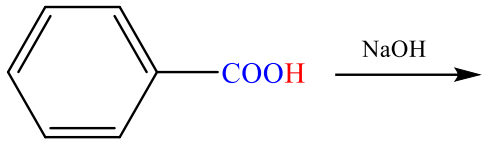
90. Among methanoic acid and ethanoic acid, which is more acidic and why? **[D] (May-2017/May-2016)**

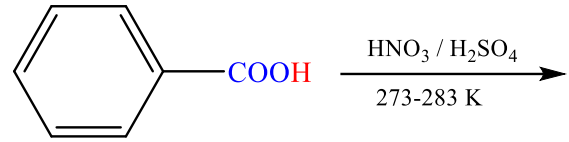
91. Explain decarboxylation reaction with an example. **[E] (Mar-2019/Mar-2016)**

## THREE-MARK QUESTIONS

92. Write the final organic products in the following:

(i) 


(ii) 


(iii) 


**[D]**

93. Write the reactions involved in the conversion of benzene-1,2-dicarboxyllic acid to phthalimide. **[A]**

94. Write the chemical equations for the following reactions:

(i) Ethanamide undergoes hydrolysis.

(ii) Methyl magnesium bromide is treated with carbon dioxide in dry ether followed by hydrolysis.

(iii) Acetic acid treated with sodium hydrogen carbonate. **[D]**

## CASE STUDY TYPE QUESTIONS (ONE MARK)

95. An organic compound (A) (molecular formula, $C_8H_{16}O_2$) was hydrolysed with dilute sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with chromic acid produced (B). (C) on dehydration gives but-1-ene. Write equations for the reactions involved. **[D]**

96. An organic compound (A) molecular formula $C_4H_8O_2$ was hydrolysed with dil. sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with Jones reagent produces (B). (C) On dehydration with conc. $H_2SO_4$ at 443 K gives ethene. Write equations for the reactions involved in this. **[D]**

97. An organic compound 'A' (molecular formula $C_7H_8$) is heated with acidic $KMnO_4$ gives compound 'B' (molecular formula $C_7H_6O_2$). Compound 'B' on reaction with NaOH gives compound 'C'. When compound 'C' is heated with mixture of NaOH and CaO, it gives compound 'D'.

Write the chemical reactions with names of A, B, C and D. **[D] (May-2024)**

98. Write structures of compounds A, B and C in each of the following reactions. Write the names of the reactions involved in first two steps.

$$CH_3CN \xrightarrow[(ii)H_3O^+]{(i)SnCl_2/HCl} A \xrightarrow{Dil.NaOH} B \xrightarrow{\Delta} C$$ **[D]**

99. $$CH_3MgBr + A \xrightarrow[(ii)H_3O^+]{(i)Dry\ ether} B \xrightarrow[(ii)H_2O]{(i)Cl_2/Red\ P} C$$

(a) Identify the compound A, B and C in the above reaction.

(b) Name the reaction for the conversion of compound B to C.

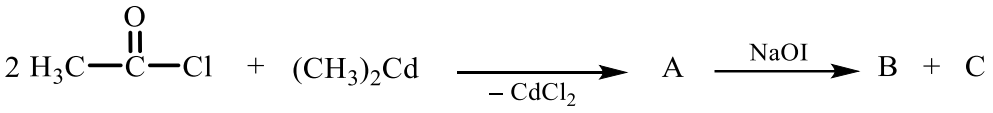
(c) Compound 'C' is more acidic than 'B'. Give reason **[D]**

100. The compound "A" has molecular formula $C_7H_8$ is heated with alkaline $KMnO_4$ followed by acidification gives compound "B" of the molecular formula $C_7H_6O_2$. This compound "B" turns blue litmus to red. The sodium salt of compound "B" is heated with reagent "X" gives hydrocarbon "C" of molecular mass 78 g $mol^{-1}$.

(a) Write the structure of compounds "A", "B" and "C".

(b) Identify "X" and mention its role in the reaction. **[D]**

101. (a) Identify the compounds 'A', 'B' and 'C' in the following reaction.



(b) An organic compound 'P' ($C_7H_6O_2$) reacts with thionyl chloride gives product 'Q'. 'Q' on the further undergoes hydrogenation in the presence of Pd-$BaSO_4$ forms compound 'R'. Write the equations involved in the chemical reactions. **[D]**

102. An Organic compound with molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollens reagent and undergoes Cannizaro reaction. On vigorous oxidation, it gives benzene-1,2-dicarboxylic acid. Identify the compound. Write all the reactions involved. **[D]**

103. Compound "A" undergoes Rosenmund reduction to give compound "B' with molecular formula $C_7H_6O$. compound "B" does not answer Fehling's test. But reacts with conc. NaOH to give compounds "C" and "D". Write two equations involved in this. **[D]**

104. An organic compound 'A' on treatment with ethanoic acid in the presence of hydrochloric acid gas as a catalyst produces an ester 'B'. 'A' on oxidation with $CrO_3$ in an anhydrous medium gives 'C'. 'C' is heated with concentrated KOH followed by acidification with dilute HCl generates 'A' and 'D'. Three moles of 'D' reacts with $PCl_3$ gives three moles of compound with molecular formula HCOCl and 'E'. 'D' is reduced to 'A' by lithium aluminium hydride followed by hydrolysis. Write the molecular formulas of the compound 'A', 'B', 'C', 'D' and 'E'. **[D] (Mar-2025)**

# Unit 9

# Amines

## MULTIPLE CHOICE QUESTIONS (MCQS) (ONE MARK)

## Introduction:

1. Amines are considered to be organic derivatives of **(E)**
   a) hydrazine b) ammonia
   c) amides d) all the above.
2. Biologically active compounds containing secondary amino group that are used to increase blood pressure are **(E)**
   a) adrenaline and ephedrine b) novacain and ephedrine
   c) benadryl and novacain d) adrenaline and benadryl
3. A synthetic amino compound used as an anaesthetic in dentistry is **(E)**
   a) novacain b) adrenaline
   c) benadryl d) ephedrine
4. Which of the following biomolecules do not contain amino group in them? **(A)**
   a) proteins b) vitamins
   d) alkaloids d) carbohydrates.
5. Quaternary ammonium salts are used as **(E)**
   a) surfactants b) pain killer
   c) anaesthesia d) antihistaminic
6. Identify the amino compounds not correctly matched with respect to the use given with them. **(A)**
   a) Adrenaline and ephedrine: increase blood pressure
   b) Novacain: anaesthetic in dentistry
   c) Benadryl: antihistaminic drug
   d) Halothane: iodine containing hormone.

## 9.1 Structure of amines:

7. Which of the following is true about amines? **(E)**
   a) orbitals of nitrogen are $sp^3$ hybridised
   b) geometry of amines is pyramidal
   c) carbon –nitrogen-carbon or carbon-nitrogen-hydrogen bond in amines is less than normal tetrahedral angle.
   d) all the above.
8. The hybridisation of 'N' atom in trimethyl amine is, **(E)**
   a) $sp^3$ b) $sp^2$ c) sp d) $dsp^2$

9. The fourth $sp^3$ hybridised orbital of nitrogen in all amines contains **(E)**

a) bonded electrons b) unpaired electrons

c) unshared pair of electrons d) both bond pair and unshared pair of electrons

10. Carbon-nitrogen-carbon bond angle in trimethylamine and carbon-nitrogen-hydrogen bond angle in methanamine respectively are **(A)**

a) $108^0$ and less than $109.5^0$ b) $107^0$and less than $109.5^0$

c) $109.5^0$ and less than $110.5^0$ d) $105^0$ and less than $120^0$

11. The C–N–E bond angle in amines, (where E is C or H) is less than 109.5°. It is due to **(A)**

a) presence of only bonded pair of electrons. b) presence of empty orbitals

c) presence of unshared pair of electrons d) presence of filled orbitals.

## 9.2 Classification:

12. Which one of the following is a correct match with respect to the type of amine mentioned with it? **(A)**

a) simple amine: N-Methylmethanamine b) Mixed amine: N-Methylmethanamine

c) Primary amine: N-Methylmethanamine d) Aryl amine: Methanamine.

13. N,N-Diethylbutan-1-amine is a **(E)**

a) primary amine b) secondary amine

c) tertiary amine d) quaternary ammonium salt

14. Diethylamine and Isopropylmethyl amine show, **(A)**

a) chain isomerism b) metamerism

c) position isomerism d) functional isomerism.

15. **Statement I:** Amines are said to be ‘simple’ when all the alkyl or aryl groups are the same, and ‘mixed’ when they are different.

**Statement II:** In secondary amines, the second alkyl/aryl group must be same. **(A)**

In the light of the above statements, choose the appropriate answer from the options given below:

a) Statement I is incorrect but statement II is correct

b) Both statement I and statement II are correct

c) Both statement I and statement II are incorrect

d) Statement I is correct but statement II is incorrect

16. A secondary amine is

a) compound with an $–NH_2$ group on the carbon atom in number-2 position.

b) a compound in which 2 of the hydrogen of $NH_3$ have been replaced by organic groups

c) an organic compound with two carbon atoms and an $–NH_2$ group.

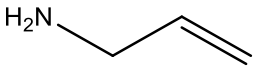
d) a compound with two carbon atoms and an $NH_2$ group. **A (KCET 2022)**

## 9.3 Nomenclature:

17. In IUPAC system, primary aliphatic amines are named as **(A)**

a) alkanamines b) alkenamines

b) aminoalkanes d) diamines.

18. IUPAC name of the compound  is **(E)**

a) Prop-1-en-1-amine b) Prop-2-en-1-amine

c) But-1-en-1-amine d) But-2-en-1-amine.

19. IUPAC name of p-Bromoaniline is **(E)**

a) 4-Bromobenzenamine b) 2-Aminotoluene

c) N,N-Dimethylbenzenamine d) Ethanamine

20. The IUPAC name of allylamine is **(E)**

a) N-Methylethanamine b) Prop-2-en-1-amine

c) Propan-2-amine d) Benzenamine

## 9.4 Preparation of amines:

21. Reduction of nitrobenzene using iron and hydrochloric acid gives, **(E)**

a) aniline b) hexanamine

c) azo benzene d) amide.

22. The reagent which is more preferred choice for reducing nitrobenzene to aniline **(A)**

a) $H_2$ / Pd, ethanol b) Fe and HCl

c) Sn and HCl d) $LiAlH_4$

23. **Statement I:** Ammonolysis of alkyl halides has the disadvantage of yielding a mixture of primary, secondary and tertiary amines and also a quaternary ammonium salt. **(A)**

**Statement II:** Tertiary amine is obtained as a major product by taking large excess of ammonia in ammonolysis of alkyl halides.

In the light of the above statements, choose the appropriate answer from the options given below:

a) Statement I is incorrect but statement II is correct

b) Both Statement I and statement II are correct

c) Both statement I and statement II are incorrect.

d) Statement I is correct but statement II is incorrect.

24. The final product obtained in ammonolysis of excess of alkyl halides is **(A)**

a) quaternary ammonium salt b) primary amine

c) secondary amine d) tertiary amine.

25. The major product obtained in ammonolysis of excess of ammonia is **(A)**

a) quaternary ammonium salt b) primary amine

c) secondary amine d) tertiary amine

26. Among $CH_3F$, $CH_3Cl$, $CH_3Br$, $CH_3I$ , the haloalkane cleaved easily by the nucleophile ammonia is
    a) $CH_3Cl$ b) $CH_3I$
    c) $CH_3Br$ d) $CH_3F$ **(A)**
27. The method that is having disadvantage in the preparation of primary amines is **(A)**
    a) Reduction of nitro compounds b) Reduction of nitriles.
    c) Ammonolysis of alkyl halides d) Reduction of amides.
28. **Statement I:** In ammonolysis, the primary amine obtained behaves as a nucleophile and can further react with alkyl halide to form secondary and tertiary amines, and finally quaternary ammonium salt.
    **Statement II:** The free amine can be obtained from the ammonium salt by treatment with a strong base: **(A)**
    In the light of the above statements, choose the appropriate answer from the options given below:
    a) Statement I is incorrect but statement II is correct
    b) Both statement I and statement II are correct
    c) Both statement I and statement II are incorrect.
    d) Statement I is correct but statement II is incorrect.
29. In the reaction, **(A)**

$$CH_3 - X \xrightarrow{X} CH_3 - CN \xrightarrow{LiAlH_4} Y$$

    X and Y respectively are
    a) alcoholic silver cyanide and ethanamine b) alcoholic potassium cyanide and ethanamine
    c) aqueous potassium cyanide and ethanamine d) aqueous potassium cyanide and bezenamine
30. Compounds which are used for ascent of amine series. **(A)**
    a) Nitro alkanes b) Nitriles
    c) Amides d) Esters
31. Which one of the following amine cannot be prepared by Gabriel phthalimide synthesis? **(E)**
    a) $CH_3NH_2$ b) $C_6H_5NH_2$
    c) $C_2H_5NH_2$ d) $CH_3\ CH_2NH_2$
32. Gabriel phthalimide synthesis method can be used to prepare **(E)**
    a) priamry aliphatic amines only b) primary Aromatic amines only
    c) mixture of both primary and secondary amines. d) quaternary ammonium salts only
33. Acid amide on heating with potassium hypobromite (bromine in an aqueous or alcoholic sodium hydroxide) gives **(A)**
    a) a secondary amine
    b) a primary amine with one carbon lesser than the original amide.
    c) a primary amine with one carbon higher than the original amide.
    d) none of these.

34. The method of reaction that involves migration of aryl/alkyl group from carbonyl carbon of the amide to the nitrogen atom is **(A)**

a) Gabriel phthalimide synthesis b) Hoffmann bromamide reaction.

d) Sandmeyer reaction d) carbylamine reaction.

35. The halide that does not undergo nucleophilic substitution with the anion formed by phthalimide is **(A)**

a) $C_6H_5Cl$ b) $CH_3Cl$

c) $C_6H_5CH_2Cl$ d) $CH_3CH_2CH_2Cl$

36. Hoffmann bromamide reaction can be used to prepare **(E)**

a) primary aliphatic amines only b) primary aromatic amines only

c) both aliphatic and aromatic primary amines. d) only quaternary ammonium salts.

37. Consider the given reaction: $RCONH_2 + Br_2 + 4\,NaOH \longrightarrow RNH_2 + Na_2CO_3 + 2\,NaBr + 2\,H_2O$;

If the molecular formula of an amine is $CH_5N$, then the molecular formula of amide will be **(D)**

a) $C_2H_6NO$ b) $C_2H_5NO$

c) $CH_5NO$ d) $C_2H_4NO$

38. The most preferred method for the conversion of benzene to aniline is **(A)**

a) halogenation of benzene followed by Gabriel phthalimide synthesis

b) nitration of benzene followed by reduction using Sn and hydrochloric acid.

c) chlorination of benzene followed by ammonolysis.

d) nitration of benzene followed by alkali hydrolysis

39. Which one of the following gives amines on heating with amide? **(A)**

a) $Br_2$ in aqueous KOH b) $Br_2$ in $KNO_3$

c) $Cl_2$ in sodium d) sodium in ether

40. The source of nitrogen in Gabriel phpthalimide synthesis of amines is **(A)**

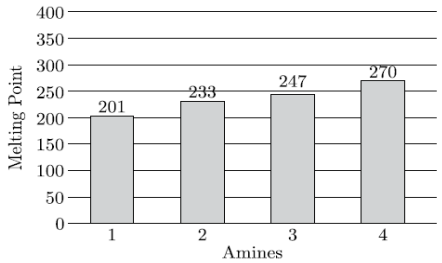
a) sodium amide, $NaNH_2$ b) sodium azide, $NaN_3$

c) potassium cyanide, KCN d) potassium phthalimide, $C_6H_4(CO)_2N^-K^+$

**(NCERT EXEMPLAR PROBLEMS)**

## 9.5 Physical properties:

41. Study the graph showing the melting points of amines and identify the compounds: **(A)**




a) 1 = Methanamine, 2 = Ethanamine, 3 = Propanamine, 4 = Butanamine

b) 1 = Ethanamine, 2 = Propanamine, 3 = Butanamine, 4 = Methanamine

c) 1 = Butanamine, 2 = Methanamine, 3 = Propanamine, 4 = Ethanamine

d) 1 = Propanamine, 2 = Butanamine, 3 = Methanamine, 4 = Ethanamine

42. Among isomeric amines, **(E)**

a) primary amines have the least boiling points

b) secondary amines have the least boiling points

c) tertiary amines have the least boiling points

d) none of these.

43. Which of the following amine is expected to be a gas at room temperature? **(E)**

a) Methanamine b) Benzenamine

c) Butanamine d) Pentanamine.

44. The correct order of solubility of amines is **(A)**

a) Methanamine < Aniline b) Butanamine < Ethanamine

c) Methanamine > Aniline d) Pentanamine > Methanamine

45. **Statement I**: Butan-1-ol is more soluble in water than butan-1-amine **(D)**

**Statement II**: Electronegativity of oxygen is more than that of nitrogen.

Identify the correct statement:

a) Both the statements I and II are incorrect

b) Statement II is the correct explanation of statement I

c) Statement I is correct, but the statement II is incorrect

d) Statement I is incorrect, but the statement II is correct

46. Identify the INCORRECT information for the compounds given and the property mentioned with it. **(D)**

a) Intermolecular hydrogen bond: $CH_3NH_2 < CH_3OH$

b) Boiling point: n-$C_4H_9$ $NH_2 > (C_2H_5)_2$ NH.

c) $pK_b$ value: aniline < methanamine

d) Stability: Alkyldiazonium salts < Aryldiazonium salts

47. Which of the following is least soluble in water at 298K?

a) $CH_3NH_2$ b) $(CH_3)_3N$

c) $(CH_3)_2NH$ d) $C_6H_5NH_2$ **(KCET 2019)**

48. Which of the following methods of preparation of amines will not give the same number of carbon atoms in the chain of amines as in the reactant?

a) Reaction of alkyl nitrile with $LiAlH_4$

b) Reaction of amide with $LiAlH_4$ followed by treatment with water

c) Heating of alkyl halide with potassium salt of phthalimide followed by hydrolysis

d) Treatment of amide with bromine in aqueous solution of sodium hydroxide.

**(NCERT EXEMPLAR PROBLEMS)**

49. Which of the following should be most volatile?

a) $CH_3\ CH_2\ CH_2NH_2$ b) $(CH_3)_3N$

c) $CH_3\ CH_2$-NH- $CH_3$ d) $CH_3\ CH_2CH_3$ **(NCERT EXEMPLAR PROBLEMS)**

50. Benzylamine may be alkylated as shown in the following equation:

$C_6H_5CH_2NH_2 + R\text{-}X \rightarrow C_6H_5CH_2NHR + HX$

Which of the following alkyl halides is best suited for this reaction through $S_N1$ mechanism?

a) $CH_3Br$ b) $C_2H_5Br$

c) $C_6H_5CH_2Br$ d) $C_2H_5Br$ **(NCERT EXEMPLAR PROBLEMS)**

## 9.6 Chemical reactions:

51. Amines are **(E)**

a) Bronsted acids b) Bronsted bases

c) Both a and b d) none of these.

52. Which of the following has the highest $pK_b$ value in pure form? **(A)**

a) Methyl amine b) ammonia

c) Dimethyl amine d) Trimethyl amine.

53. The correct order of basic strength in case of ethyl substituted amines in aqueous solution is **(A)**

a) $(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2 > NH_3$

b) $(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2 > NH_3$

c) $(C_2H_5)_3N > C_2H_5NH_2 > (C_2H_5)_2NH > NH_3$

d) $NH_3 > (C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2$

54. The most basic amine in aqueous solution is **(A)**

a) methyl amine b) dimethylamine

c) trimethylamine d) tetramethylammonium ion

55. Which one of the following groups when present at para position increases the basic strength of aniline? **(A)**

a) $–NO_2$ b) –Br

c) $–NH_2$ d) –COOH

56. Among the following, the most basic compound in aqueous medium is **(A)**

a) $(C_2H_5)_2\ NH$ b) $(C_2H_5)_3\ N$

c) $C_2H_5NH_2$ d) $NH_3$

57. Which of the following is a false statement? **(D)**

a) anilinium ion is not stabilized by resonance

b) cation $CH_3N^+H_3$ is stabler than ammonium ion

c) cation $CH_3N^+H_3$ is stabilized by +I effect of methyl group.

d) cation $CH_3N^+H_3$ is conjugate base of methyl amine.

58. Methyl amine reacts with nitrous acid to form, **(A)**

a) methane b) nitromethane

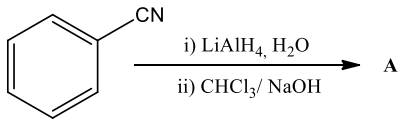
c) diazonium salt d) methanol

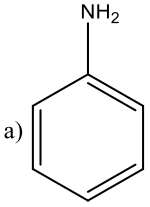
59. The amine which can form isocyanide with chloroform and alcoholic potassium hydroxide is **(A)**

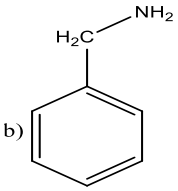
a) N-Methylmethanmine b) N,N-Dimethylmethanamine

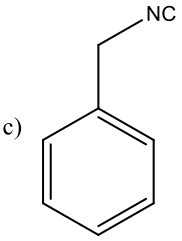
c) N-Ethylethanamine d) Benzenamine.

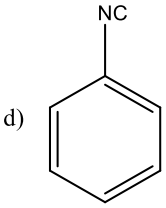
60. The product formed from the following reaction sequence is **(D)**




a) 


b) 


c) 


d) 


61. An amine with the molecular formula $C_4H_{11}N$ reacts with Hinsberg's reagent to form a product which is insoluble in sodium hydroxide. This product shows metamerism with, **(D)**

a) $CH_3$- $CH_2$- $CH_2$- $CH_2$-$NH_2$ b) $CH_3NH$- $C_3H_7$

c) both a and b d) none of these.

62. N-Ethylbenzenesulphonamide is soluble in alkali because **(A)**

a) It does not contain any hydrogen atom attached to nitrogen atom and is not acidic.

b) It contains hydrogen atom attached to nitrogen atom and is strongly acidic.

c) It contains hydrogen atom attached to nitrogen atom but is not acidic.

d) It does not contain any hydrogen atom attached to nitrogen atom but is acidic.

63. The general test for primary amines is **(E)**

a) sodium bicarbonate test b) esterification test

c) carbylamine test d) neutral ferric chloride test.

64. The chemical formula of Hinsberg's reagent is **(E)**

a) $C_6H_6SOCl$ b) $C_6H_5SOCl_2$

c) $C_6H_5SO_2Cl$ d) $C_6H_5SO_3H$

65. Acylation of *N*-ethylethanamine is carried out in the presence of a base stronger than the amine (like pyridine) because it removes **(D)**

a) HCl and shifts the equilibrium to the left.

b) NaOH and shifts the equilibrium to the right.

c) NaOH and shifts the equilibrium to the left.

d) HCl and shifts the equilibrium to the right.

66. Halogenation of amines with excess of bromine water gives 2,4,6-tribromoaniline. In this bromination, monohalogenated derivative is got by **(A)**

a) bromination followed by acetylating amino group.

b) acetylating the amino group followed by bromination and hydrolysis

c) hydrolysis, bromination and acetylation

d) bromination, acetylation and hydrolysis.

67. The compound that cannot exist as zwitter ion in aqueous solution is **(A)**

a) sulphanilic acid b) glycine

c) phenol d) alanine

68. The compound that does not undergo Friedel-Crafts reaction is **(E)**

a) benzene b) anisole

c) aniline d) chlorobenzene

69. The purpose of acylating aniline before electrophilic substitution reaction is **(A)**

a) to activate $NH_2$ group of aniline b) to decrease activity effect of -$NH_2$ group

c) to get only meta substitution d) to get only ortho substitution.

70. During nitration, along with ortho and para substituted nitro derivatives, meta nitro derivative is also obtained in large quantity (47%) because **(D)**

a) in acidic medium anilinium formed is meta directing.

b) electrophile -$NO_2^+$ always adds to meta position

c) –$NH_2$ group is predominantly meta directing

d) –$NH_2$ group always direct electrophile towards ortho, meta, para directing.

71. Aniline does not undergo Friedel-Crafts reaction. **(A)**

a) due to salt formation with aluminium chloride.

b) –$NH_2$ is a strong deactivating group

c) aniline gives mixture of ortho, para and meta products

d) both (a) and (b)

72. An aromatic compound A ($C_7H_9N$) on reacting with $NaNO_2$ / HCl at 0 $^0$C forms benzyl alcohol and nitrogen gas. The number of isomers possible for the compound A is

a) 5 b) 7 c) 3 d) 6 **(KCET 2014)**

73. The correct sequence of reactions to be performed to convert benzene into m-bromoaniline is

a) nitration, reduction, bromination b) bromination, nitration, reduction

c) nitration, bromination, reduction d) reduction, nitration, bromination. **(KCET 2014)**

74. One of the following amides will not undergo Hoffmann bromamide reaction.

a) $CH_3CONHCH_3$ b) $CH_3\ CH_2CONH_2$

C) $CH_3CO\ NH_2$ d) $C_6H_5CONH_2$ **(KCET 2015)**

75. In the given set of reactions:

2-Bromopropane $\xrightarrow{alc.AgCN\ and\ heat}$ X $\xrightarrow{LiAlH4}$ Y.

The IUPAC name of the product Y is

a) N-isopropylmethanamine b) N-methylpropan-2-amine

c) N-methylpropanamine d) butan-2-amine **(KCET 2015)**

76. In the following sequence of reactions;

A $\xrightarrow{Reduction}$ B $\xrightarrow{HNO2}$ $CH_3CH_2OH$

The compound A is

a) propane nitrile b) ethane nitrile

c) nitromethane d) methyl isocyanate **(KCET 2016)**

77. An organic compound A on reduction gives compound B, which on reaction with trichloromethnae and caustic potash forms C. The compound C on catalytic reduction gives N-methylbenzenamine, the compound A is

a) nitrobenzene b) nitromethane

c) methanamine d) benzenamine **(KCET 2016)**

78. Gabriel phthalimide synthesis is used in the preparation of primary amines from phthalimide. Which of the following is not used during the process?

a) NaOH b) HCl c) KOH d) Alkyl halides **(KCET 2017)**

79. Which of the following is more basic than aniline?

a) Diphenylamine b) Triphenylamine

c) p-Nitroaniline d) Benzylamine **(KCET 2018)**

80. In carbylamines test for primary amines the resulting foul smelling product is

a) $CH_3NC$ b) $CO\ Cl_2$

c) $CH_3NCl_2$ d) $CH_3CN$ **(KCET 2022)**

81. If aniline is treated with 1:1 mixture of con.$HNO_3$ and con. $H_2SO_4$ , p-nitroaniline and m-nitroaniline are formed nearly in equal amounts. This is due to

a) m-directing property of $NH_2$ group

b) protonation of $–NH_2$ group which causes deactivation of benzene ring.

c) m and p directing nature of $–NH_2$ group

d) isomerisation of some p-nitroaniline into m-nitroaniline. **(KCET 2019)**

82. $C_6H_5CH_2Cl \xrightarrow{NH3}$ A $\xrightarrow{2CH3Cl} B$. The product B is

a) N, N-dimethylphenylmethanamine b) N,N-dimethylbenzenamine

c) N-benzyl-N-methylmethanamine d) phenyl-N,N-dimethylmethanamine **(KCET 2021)**

83. Which of the following reagents are suitable to differentiate between Aniline and N-methylaniline chemically?

a) Bromine water

b) con. Hydrochloric acid and anhydrous zinc chloride

c) chloroform and alcoholic potassium hydroxide

d) acetic anhydride. **(KCET 2025)**

84. Match the compounds given in List-I with the items given in List –II

| **List-I** | **List-II** |
|---|---|
| i) Benzenesulphonyl chloride | A) zwitter ion |
| ii) sulphanilic acid | B) Hinsberg reagent |
| iii) alkyl diazonium salts | C) dyes |
| iv) aryl diazonium salts | D) conversion to alcohols |

a) i-A, ii-C, iii-B, iv-D

b) i-C, ii-A, iii-D, iv-B

c) i-B, ii-A, iii-D, iv-C

d) i-C, ii-B, iii-A, iv-D **(KCET 2025)**

85. Aniline does not undergo

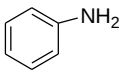
a) nitration

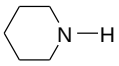
b) sulphonation

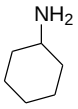
c) Friedel-Crafts reaction

d) bromination. **(KCET 2023)**

86. Which of the following is the weakest Bronsted base?

a) 


b) 


c) 


d) $CH_3NH_2$.

**(NCERT EXEMPLAR PROBLEMS)**

87. In the nitration of benzene using a mixture of con.$H_2SO_4$ and con. $HNO_3$ , the species which initiates the reaction is

a) $NO_2$

b) $NO^+$

c) $NO_2^+$

d) $NO_2^-$ **(NCERT EXEMPLAR PROBLEMS)**

88. Acid anhydrides on reaction with primary amines give

a) amide

b) imide

c) secondary amine

d) imine. **(NCERT EXEMPLAR PROBLEMS)**

## II Diazonium salts:

89. The general formula of diazonium salts is **(E)**

a) RMgX b) $RN_2^+X^-$

c) R-X d) $LiAlH_4$

90. p-Aminoazobenzene is prepared from benzenediazonium chloride and aniline in **(E)**

a) acidic medium b) basic medium

c) neutral medium d) both acidic and basic medium.

91. The reagent that can be used to convert benzene diazonium chloride to benzene is **(A)**

a) $H_3PO_2 + H_2O$ b) $SnCl_2/HCl$

c) $LiAlH_4$ d) $H_3PO_4$

92. The reagent that can be used to convert benzenediazonium chloride to nitobenzene is **(A)**

a) $HBF_4$ and $NaNO_2$ b) $HNO_3$ and HCl

c) $HNO_3$ and $H_2SO_4$ d) $NaNO_2$ and $HNO_3$

93. The reagent that can be used to convert benzenediazonium chloride to fluorobenzene is **(E)**

a) $HBF_4$ b) HF

c) AgF d) aqueous KF

94. Chlorine or bromine can also be introduced in the benzene ring by treating the diazonium salt solution with corresponding halogen acid in the presence of copper powder. This is referred as **(E)**

a) Gatterman reaction. b) Sandmeyer reaction

c) Gatterman -Koch reaction d) diazotisation reaction.

95. The process of conversion of a primary aromatic amine into its diazonium salt is called **(E)**

a) acetylation b) coupling

c) diazotization d) deamination.

96. The water insoluble diazonium salt is **(E)**

a) Benzene diazonium chloride b) Benzenediazonium fluoroborate

c) Benzene diazonium hydrogen sulphate d) none of these.

97. p-Hydroxyazobenzene is formed by the reaction of benzene diazonium chloride with phenol. It is **(A)**

a) an electrophilic substitution reaction b) a nucleophilic substitution reaction

c) a hydrogenation reaction d) a halogenation reaction.

98. Which of the haloarene cannot be prepared by direct halogenation? (**E)**

a) Chloro benzene b) Iodobenzene

c) Bromo toluene d) Chloro Toulene

99. Statement I: Chlorobenzene cannot be converted to cyanobenzene by nucleophilic substitution reaction.
Statement II: Diazonium salts are good intermediates for the introduction of –F, -OH into aromatic ring.
Identify the correct statement. **(A)**

a) Both statements I and II are correct

b) Both statements I and II are incorrect

c) Statement I is correct and statement II is incorrect

d) Statement I is incorrect and statement II is correct.

100. Which of the following will be the most stable diazonium salt ($RN_2^+X^-$)?

a) $CH_3N_2^+X^-$ b) $C_6H_5N_2^+X^-$

c) $CH_3CH_2N_2^+X^-$ d) $CH_3CH_2N_2^+X^-$ **(KCET 2018)**

101. The reaction of benzenediazonium chloride with aniline yields yellow dye. The name of the yellow dye is

a) p-hydroxyazobenzene b) p-aminoazobenzene

c) p-nitroazobenzene d) o-nitroazobenzene. **(KCET 2018)**

102. In the reaction , Aniline $\xrightarrow{NaNO2\ and\ dil.HCl}$ P $\xrightarrow{Phenol,\ NaOH}$ Q. The compound Q is

a) $C_6H_5N_2Cl$ b) ortho-hydroxyazobenzene

c) para-hydroxyazobenzene d) meta-hydroxyazobenzene **(KCET 2024)**

## Fill In the Blanks by Choosing the Appropriate Word from Those Given in the Brackets: (ONE MARK)

### Set-01

**(Hinsberg's reagent, ammonia, Ethanamine, adrenaline, methyl group, ethyl group )**

1. The secondary amino group is present in _____ **(E)**
2. The amines are the derivatives of _____ **(E)**
3. Ethylamine has the IUPAC name _____ **(E)**
4. Migration of ____ takes place from carbonyl carbon of the ethanamide to the nitrogen atom in Hoffmann bromamide degradation reaction. **(E)**
5. Benzenesulphonyl chloride is called _____ **(E)**

### Set-02

**(pyramidal, surfactants, tertiary amines, primary aliphatic, gases, octahedral)**

1. The lower aliphatic amines are _____ with fishy odour. **(E)**
2. Intermolecular hydrogen bond is not seen in _____ **(E)**
3. Gabriel phthalimide synthesis can be used to prepare_____amines. **(E)**
4. The geometry of amines is _____ **(E)**
5. Quaternary ammonium salts are used as _____

**Set-03**

**(sulphanilic acid, 2-Aminotoluene, tertiary amine, primary amine, N-methyl benzamide, Friedel-Crafts)**

1. The IUPAC name of o-Toluidine is _____ **(E)**
2. Nitriles on reduction with lithium aluminium hydride produce_____ **(E)**
3. Benzoylation of methanamine gives _____ **(E)**
4. p-aminobenzene sulphonic acid is called _____ **(E)**
5. Aniline does not undergo_____reaction. **(E)**

**Set-04**

**(simple amine, Lewis bases, an yellow dye, N-Methylbenzamide, potassium iodide, copper(I) ion)**

1. Amines are _____ **(E)**
2. The reagent used to convert benzenediazonium chloride to iodobenzene is _____ **(E)**
3. In Sandmeyer reaction, $Cl^-$ is introduced in the benzene ring in the presence of _____ **(E)**
4. p-Aminoazobenzene is _____ **(E)**
5. N- Methylmethanamine is a _____ **(E)**

**Set-05**

**(primary aliphatic amines, Tollen's reagent test, ammonia, isocyanide test, acetanilide, nitrogen)**

1. Aniline reacts with ethanoic anhydride to form_____ **(E)**
2. _____is a test for primary amines. **(E)**
3. Aniline is a weaker base than _____- **(E)**
4. Orbitals of ____ in amines are $sp^3$ hybridised. **(E)**
5. The type of amines which cannot form the stable alkyldiazonium salts is _____ **(E)**

**Set-06**

**(Ammonolysis, novocain, 2,4,6-tribromoaniline, deammination, aniline, methanamine)**

1. A synthetic amino compound used as anaesthetic in dentistry is _____ **(E)**
2. _____involves the cleavage of C-X bond by ammonia molecule. **(E)**
3. The product formed when $CH_3NH_3^+X^-$ .is treated with a strong base like NaOH is _____ **(E)**
4. The organic product formed when aniline reacts with bromine water at room temperature is ____ **(E)**
5. The simplest aromatic primary amine is _____ **(E)**

## TWO MARK QUESTIONS:

### 9.1 Structure of Amines;

1. Discuss about the bond angle and hybrid orbitals of nitrogen in amines. **(A)**
2. Name any one biologically active amino compound used in the following: **(E)**
   (i) to increase blood pressure (containing secondary amino group)
   (ii) as an anaesthetic in dentistry (a synthetic amino compound)

## 9.2 Classification;

3. What is a simple amine? Write one example. **(E)**
4. Write the structures of all isomeric amines having the formula $C_4H_{11}N$. **(D)**
5. Classify these into primary and secondary amines: Aniline and diethylamine **(E)**

## 9.3 Nomenclature:

6. Write the IUPAC name of
   i) $(CH_3)_2CHNH_2$. ii) $(CH_3)_2N\text{-}CH_2\text{-}CH_2\text{-}NH_2$ **(E)**
7. Write IUPAC names of the following compounds
   i) *m*–$BrC_6H_4NH_2$ ii) $C_6H_5NHCH_3$ **(E)**
8. Write the IUPAC name of simplest arylamine. What is its formula? **(E)**

## 9.4 Preparation of Amines;

**9.** Write the chemical equation for
   a) the reaction between ethanenitrile and sodium amalgam in ethanol. **(A)**
   b) reduction of amides using lithium aluminium hydride to produce amines. **(A)**
10. How is aniline obtained from nitrobenzene? Write the chemical equation. **(A)**
11. Give reason: Reduction of nitrobenzene with iron scrap and hydrochloric acid is preferred. Name the organic compound which is formed as product formed in this reaction. **(D)**
12. Write the chemical equations for the reaction of chloroethane with ethanolic ammonia. **(A)**
13. Write the chemical reaction for the ammonolysis of 2 moles of benzyl chloride. **(A)**
14. How does 1 mole of benzylamine react with 2 moles of chloromethane? Write the equations. **(D)**
15. How is benzamide converted into aniline? Write the chemical equation. **(A)**
16. Explain Hoffmann bromamide degradation reaction by taking butanamide as an example. **(A)**
17. How is methanamine prepared by Hoffmann bromamide degradation? Write the equation. **(A)**
18. Write the equation for the reaction of amide with bromine in ethanolic solution of sodium hydroxide that gives a primary amine. Name this reaction. **(D)**
19. Explain carbylamine reaction with an example. **(E)**
20. a) Aromatic primary amines cannot be prepared by Gabriel phthalimide synthesis. Why?
    b) Write the equation for obtaining methanamine from $CH_3NH_3^+X^-$ and NaOH. **(D)**
21. A simple amine '**X**' with the formula $C_4H_{11}N$ consumes two moles of chloromethane per mole of amine to form quaternary ammonium salt. Write the structure and IUPAC name of this isomeric amine '**X**'. **(D)**
22. Write the chemical equation involved in preparation of aniline from benzene. **(D)**

## 9.5 Physical Properties;

23. Ethylamine is soluble in water whereas aniline is not. Justify the statement. **(A)**
24. Arrange the following: **(A)**
    a) in the increasing order of boiling point: $C_2H_5OH$, $(CH_3)_2NH$, $C_2H_5NH_2$
    b) in the increasing order of solubility in water: $C_6H_5NH_2$, $(C_2H_5)_2NH$, $C_2H_5NH_2$

## 9.6 Chemical Reactions;

25. Between aryl amines and ammonia which one is more basic and why? **(A)**
26. $pK_b$ of aniline is more than that of methanamine. Give reasons **(A)**
27. Arrange the following: **(A)**
    (i) in the decreasing order of the p$K_b$ values: $C_2H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2NH$ and $C_6H_5NH_2$
    (ii) in the increasing order of basic strength: $C_6H_5NH_2$, $C_6H_5N(CH_3)_2$, $(C_2H_5)_2NH$ and $CH_3NH_2$
28. How do primary aliphatic amines react with nitrous acid? Write the chemical equation. **(A)**
29. Write the chemical equation for the reaction between ethanamine and benzenesulphonyl chloride. **(A)**
30. Write the equations for the conversion of aniline into 4-Bromoaniline. **(A)**
31. Between of ethanamine and trimethyl amine, which one does not react with Hinsberg's reagent? Give reason. **(A)**
32. N, N-diethnamine answers Hinsberg's reagent but is insoluble in alkali. Why? **(D)**
33. How is aniline converted into sulphanilic acid? Write the chemical equation. **(A)**
34. Identify the compounds "X" and "Y" in the following conversion. **(A)**

$$C_6H_5\text{–}NH_2 \xrightarrow[273\text{–}278K]{NaNO_2 + 2HCl} \text{"X"} \xrightarrow{\text{"Y"}} C_6H_5\text{–}I + KCl + N_2$$

35. How do you distinguish primary amine, secondary amine and tertiary amine using Hinsberg's reagent? **(A)**
36. Explain Hoffmann bromamide degradation of benzamide. **(A)**
37. Which of the following amine react with p-toluenesulphonyl chloride to produce a sulphonyl amide which is soluble in alkali? Trimethylamine, dimethylamine, ethanamine. **(A)**

## 9.7 Method of Preparation of Diazonium Salts;

**38.** Write the equation for the reaction of the following with nitrous acid:
    i) aromatic primary amines and
    ii) aliphatic primary amines. **(A)**

## 9.9 Chemical Reactions;

39. Write the equation for the preparation of p-hydroxyazobenzene. **(A)**
40. Discuss the coupling reaction of benzenediazonium chloride with aniline. Give the equation. **(A)**
41. How do you convert benzene diazonium chloride into p-aminoazobenzene? Give the equation. **(A)**
42. Write the chemical equation for the preparation of p-hydroxyazobenzene from diazonium salt. What is the colour of the dye formed? **(A)**
43. Explain Gatterman reaction for the preparation of bromobenzene. **(E)**
44. How does benzenediazonium chloride react with ethanol? Write the equation. **(A)**
45. Write the equation for the conversion of benzenediazonium chloride into benzene. **(A)**
46. Identify the compounds "X" and "Y" in the following conversion. **(A)**

$$C_6H_5{-}NH_2 \xrightarrow[273-278K]{NaNO_2 + 2HCl} \text{"X"} \xrightarrow{\text{"Y"}} C_6H_5{-}I + KCl + N_2$$

47. Complete the following reaction:

$$C_6H_5N_2Cl \xrightarrow[ii)\ NaNO_2/Cu,\ \Delta]{i)\ HBF_4} \_\_\_\_\_ + \_\_\_\_\_ + N_2$$

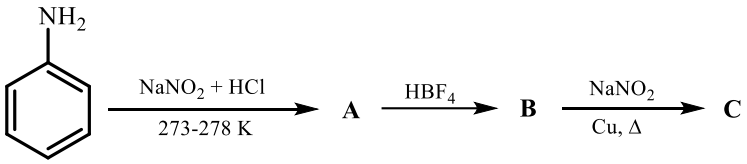
## THREE MARK QUESTIONS:

## 9.4 Preparation of Amines;

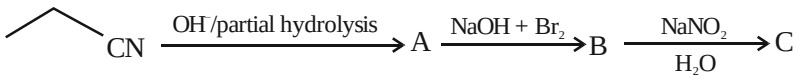
1. Write the chemical equations involved in the preparation of an aliphatic primary amine in Gabriel phthalimide synthesis. **(E)**
2. Write the chemical equations involved in Gabriel pthalimide synthesis for the preparation of methylamine. **(A)**
3. Explain Hoffmann broamamide degradation reaction by taking propanamide as an example. Give the IUPAC name of the organic compound formed as product. **(A)**

## 9.6 Chemical Reactions;

4. Mention any three factors which decide the basic strength of alkyl amines in aqueous solution. **(E)**
5. What is Hinsberg's reagent? How do you distinguish between primary amine and secondary amine using Hinsberg's reagent? **(A)**
6. Aniline on acetylation, followed by nitration and hydrolysis gives p-nitroaniline as the major product. Write the chemical equations involved.
7. Identify the products A, B and C in the following. **(A)**




8. Write the chemical equation for: **(A)**
   a) preparation of cyanobenzene from benzenediazonium chloride.
   b) reduction of benzenediazonium chloride to benzene.
   c) conversion of benzenediazonium chloride to phenol.
9. Which type of amines answer for carbylamine reaction (isocyanide test)? Describe carbylamine reaction with a suitable example. **(A)**
10. Identify the product A, B and C. **(A)**




11. An aromatic compound 'A' on treatment with aqueous ammonia followed by heating forms compound 'B' . The compound 'B' on heating with $Br_2$ and KOH forms the compound 'C' with the molecular formula $C_6H_7N$. Write the IUPAC name of A, B and C. **(D)**

12. An amine ‘A’ can be prepared by Gabriel phthalimide synthesis. The compound ‘A’ reacts with nitrous acid to give the organic compound ‘B’. The functional isomer of ‘B’ is $CH_3$-O- $CH_3$. The compound ‘A’ can be prepared by the reduction of amide ‘C’. Identify the compounds A, B and C. **(D)**
13. An amine ‘X’ with the molecular formula $C_3H_9N$ does not react with Hinsberg’s reagent. X is more basic than its isomer ‘Y’ in their pure form. The compound Y reacts with Hinsberg’s reagent to form a product that contains no acidic hydrogen. The compound Y reacts with Z to form N,N-Dimethylmethanamide. Identify X, Y and Z. **(D)**
14. A hydrocarbon A with the molecular formula $C_4H_8$ on treatment with hydrochloric acid gives a compound B with the formula $C_4H_9Cl$. This compound B on reaction with 1 mole of ammonia gives the compound C. The compound C reacts with nitrous acid followed by reaction with water gives an optically active alcohol D. Ozonalysis of A gives 2 molecules of acetaldehyde. Identify the compounds A, B and D. **(D)**

# Unit 10

# Biomolecules

## MULTIPLE CHOICE QUESTIONS (MCQS) (ONE MARK)

### 10. INTRODUCTION:

1. The living systems are made up of various complex biomolecules. Which of the following is not a biomolecule?
   a) Carbohydrate b) lipids
   c) proteins d) ethanol **(E)**
2. Life is due to the coordination of various chemical reactions in living organisms. Which of the following is not a biochemical reaction?
   a) Synthesis of insulin in the human body
   b) Digestion of food
   c) Flow of water from root to leaf in the plants.
   d) Photosynthesis **(E)**

### 10.1 CARBOHYDRATES

1. Which of the following chemical compounds do not belong to the vast group of carbohydrates?
   a) Polyhydroxy ketones b) Polyhalo aldehydes
   c) Polyamino aldehydes d) Polyhydroxy carboxylic acids **(E)**
2. Which of the following carbohydrates do not satisfy the formula $C_x(H_2O)_y$?
   a) Fructose b) Deoxyribose
   c) Glucose d) Lactose **(E)**
3. Which of the following carbohydrates do not have the formula $C_{12}H_{22}O_{11}$?
   a) Galactose b) Sucrose
   c) Allolactose d) Maltose **(E)**
4. Sugars are
   a) Soluble in water but have no taste b) soluble in water but have sweet taste
   c) Insoluble in water but has no taste d) insoluble in water but have sweet taste **(E)**
5. The monosaccharide containing four carbon atom and aldehyde group are called as
   a) aldotetrose b) tetroaldose
   c) aldohexose d) ketotetrose **(E)**
6. Among the following, carbohydrate is
   a) Thiamine b) Lactose
   c) Glycerol d) Insulin **(E)**
7. A pyranose form is a

a) 5 -membered ring
b) 6 -membered ring
c) 4-membered ring
d) 6 -membered straight chain **(A)**

8. An aldohexose or ketohexose is represented by
a) $C_{12}H_{22}O_{11}$
b) $(C_6H_5O)_n$
c) $C_6H_{12}O_6$
d) $(CHO)_n$ **(E)**

9. Disaccharides have the molecular formula
a) $C_6H_{12}O_6$
b) $C_{12}H_{22}O_{11}$
c) $(C_6H_5O)_n$
d) $C_{18}H_{32}O_{18}$ **(E)**

10. Among the following, the carbohydrate which cannot be hydrolysed to further simple carbohydrate is;
a) Sucrose
b) Maltose
c) Glucose
d) Starch **(E)**

11. Which among the following is the simplest sugar?
a) Glucose
b) Starch
c) Cellulose
d) lactose **(E)**

12. Which of the following monosaccharide is pentose?
a) Glucose
b) Fructose
c) ribose
d) Galactose **(A)**

13. Which of the following carbohydrates is not a sugar?
a) Glucose
b) Fructose
c) Lactose
d) Cellulose **(E)**

14. Which of the following is not a polysaccharide?
a) Cellulose
b) Sucrose
c) Starch
d) Glycogen **(E)**

15. Identify the monosaccharide from the following.
a) Deoxyribose
b) Sucrose
c) Maltose
d) Fructose **(E)**

16. When converting a disaccharide to monosaccharides, which bond is hydrolyzed?
a) Disulfide bond
b) Glycosidic bond
c) Phosphodiester bond
d) Hydrogen bond **(E)**

17. Which of the following disaccharides gives two same monosaccharide units on hydrolysis?
a) Maltose
b) Sucrose
c) Lactose
d) Lactulose **(A)**

18. The monosaccharide units present in sucrose are

a) Fructose, galactose b) Fructose, glucose

c) Galactose, glucose d) Glucose, glucose **(E)**

19. Which of the following is a non-reducing sugar?

a) Galactose b) Glucose

c) Fructose d) Sucrose **(E)**

20. Which of the following monosaccharides is a ketohexse?

a) Glucose b) Galactose

c) Fructose d) Mannose **(E)**

21. When glucose reacts with bromine water, the main product obtained is

a) Gluconic acid b) Glyceraldehyde

c) Saccharic acid d) Acetic acid **(A)**

22. Glucose gives silver mirror test with Tollen's reagent. It shows the presence of

a) acidic group b) alcoholic group

c) ketonic group d) aldehyde group **(E)**

23. The reaction of glucose with which of the following proves the presence of an aldehydic group?

a) Potassium iodide b) Hydroxylamine

c) Bromine water d) Acetic anhydride **(E)**

24. Which of the following reaction of glucose can be explained only by its cyclic structure?

a) Glucose forms pentaacetate

b) Glucose reacts with hydroxylamine to form an oxime.

c) Pentaacetate of glucose does not react with hydroxylamine

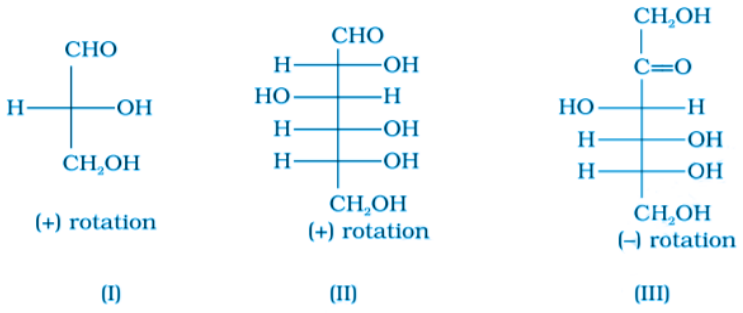
d) Glucose is oxidized by Nitric acid to gluconic acid **(A)**

25. Number of hydroxy groups in glucose confirmed by reaction of glucose with acetic anhydride are

a) 3 b) 4

c) 5 d) 6 **(E)**

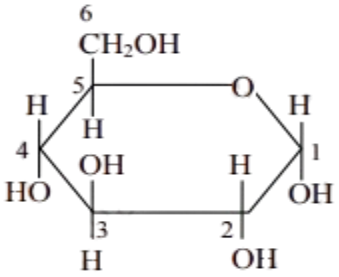
26. Optical rotations of some compounds, along with their structures, are given below. Which of them have a D configuration?




a) I, II, III b) II, III

c) I, II d) III **(A)**

27. Identify the compound from the Haworth projection shown below

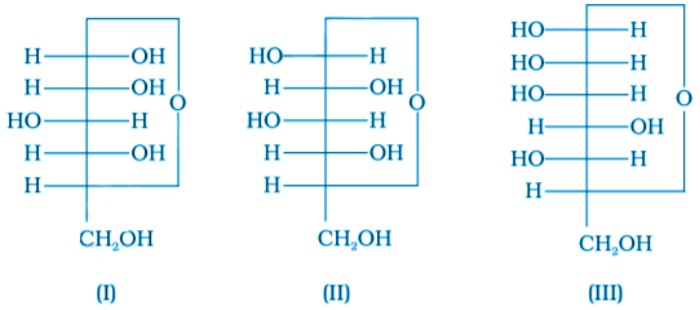



a) α-D-(+)-glucopyranose
b) β-D - (+)-glucopyranose
c) α-D-(+)-glucofuranose
d) β-D - (+)-glucofuranose **(A)**

28. The α-D-glucose and β-D-glucose isomers of glucose are known as _____

a) Enantiomers
b) stereoisomers
c) anomers
(d) glycomers **(E)**

29. Three cyclic structures of monosaccharides are given below, which of these are anomers.

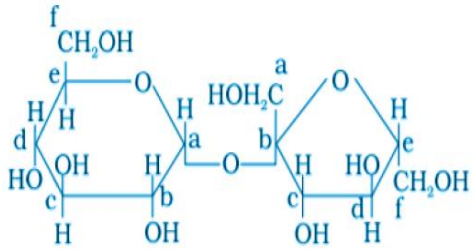



a) I and II
b) II and III
c) I and III
d) III is anomers of I and II **(D)**

30. The process of conversion of disaccharides into two same or different monosaccharides by treatment with dilute HCl is

a) hydration
b) hydrolysis
c) oxidation
d) carbonation **(A)**

31. Structure of a disaccharide formed by glucose and fructose is given below. Identify anomeric carbon atoms in monosaccharide units.




a) 'a' carbon of glucose and 'a' carbon of fructose.
b) 'a' carbon of glucose and 'e' carbon of fructose.
c) 'a' carbon of glucose and 'b' carbon of fructose.
d) 'f' carbon of glucose and 'f ' carbon of fructose. **(D)**

32. Which glycosidic linkage is present in maltose?
    a) α–D – (+)–Glucose($C_1$) – O –($C_2$) – β–D – (–) – glucose
    b) β–D – (+)–Glucose ($C_1$) – O – ($C_4$) –β–D – (+) – glucose
    c) α–D – (+)–Glucose ($C_1$) – O – ($C_4$) –α–D – (+) – glucose
    d) β–D – (+)–Glucose ($C_1$) – O – ($C_4$) –α–D – (–) – glucose **(D)**

33. The union of 2 or more monosaccharide units is an example of
    a) Condensation reaction b) addition reaction
    c) Substitution reaction d) displacement reaction **(E)**

34. Two monosaccharides are joined through a _____ bond to form a disaccharide.
    a) ionic b) peptide
    c) glycosidic d) phosphodiester **(E)**

35. The linkage that binds two monosaccharides present in disaccharides is
    a) ionic b) peptide
    c) glycosidic d) phosphodiester **(E)**

36. The change in optical rotation (with time) of freshly prepared solutions of sugar is known as:
    a) Specific rotation b) Inversion
    c) Rotatory motion d) Mutarotation **(D)**

37. Sucrose is made of which of the following monosaccharides?
    a) α-D-glucose, α-D-fructose b) α-D-glucose, β-D-fructose
    c) β-D-glucose, α-D-fructose d) β-D-glucose, β-D-fructose **(E)**

38. Which of the following statements is incorrect with respect to starch?
    a) It is a reducing carbohydrate b) It is a polymer of α-D-glucose
    c) It gives blue colour with iodine d) It consists of branched chains **(A)**

39. The sugar that is characteristic of milk is
    a) maltose b) ribose
    c) lactose d) galactose **(E)**

40. On hydrolysis of starch, we finally get
    a) Glucose b) Fructose
    c) Both (a) and (b) d) Sucrose **(E)**

41. The cell membranes are mainly composed of
    a) Fats b) Proteins
    c) Phospholipids d) Carbohydrates **(E)**

42. Cellulose is a _____ saccharide.
    a) reducing b) branched chain
    c) oligo d) β-glucose straight chain **(A)**

43. Which of the following is laevorotatory in nature?

a) sucrose b) alpha D – glucose

c) beta-D- fructose d) beta -D- glucose **(E)**

44. Which examples of carbohydrates exhibit α-link, (α-glycosidic link) in their structure?

a) Maltose and Lactose

b) Amylose and Amylopectin

c) Cellulose and Glycogen

d) Glucose and Fructose **(A)(KCET-2025)**

45. α–D – (+)–Glucose and β–D – (+)– glucose are

a) enantiomers b) conformers

c) epimers d) anomers **(E)(KCET-2024)**

46. Sucrose is dextrorotatory but after hydrolysis the mixture show laevorotation, this is because of

a) laevorotation of glucose is more than dextrorotation of fructose.

b) sucrose is non-reducing agent.

c) racemic mixture is formed.

d) laevorotation of fructose is more than dextrorotation of glucose. **(A)(KCET-2023)**

47. $C_1$-$C_4$ glycosidic bond is not found in

a) maltose b) sucrose

c) lactose d) starch **(A)(KCET-2020)**

48. The glycosidic linkage involved in linking the glucose units in amylase part of starch is

a) $C_1$-$C_4$ β-linkage b) $C_1$-$C_6$ α- linkage

c) $C_1$-$C_6$ β- linkage d) $C_1$-$C_4$ α- linkage **(E)(KCET-2018)**

49. Which of the following gives positive Fehling's solution test?

a) Sucrose b) Glucose

c) Fats d) Protein **(E)(KCET-2016)**

## 10.2 proteins

1. Proteins are polymers of

a) α-amino acids b) β-amino acids

c) γ-amino acids d) δ-amino acids **(E)**

2. Which of the following amino acids is optically inactive?

a) Glycine b) Alanine

c) Lysine d) Valine **(E)**

3. Sulphur containing amino acid is;

a) cysteine b) tyrosine

c) histidine d) proline **(A)**

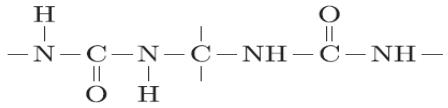
4. α - Amino acids are the building blocks of
   a) fats b) proteins
   c) vitamins d) carbohydrates **(E)**
5. Which of the following is able to form Zwitterion?
   a) Glucose b) Lactose
   c) Alanine d) sucrose **(A)**
6. Glycine is an optically inactive α-amino acid due to
   a) Presence of asymmetric carbon atom b) absence of asymmetric carbon atom
   c) α-carbon attached to 4 different groups d) its acidic nature. **(E)**
7. Which of the following amino acids are aromatic in nature?
   a) Methionine b) Isoleucine
   c) Proline d) Histidine **(A)**
8. Which of the following is a non-essential amino acid?
   a) Threonine b) Glutamine
   c) Phenylalanine d) Valine **(A)**
9. Which of the following is a neutral amino acid?
   a) Glycine b) Lysine
   c) Arginine d) Histidine **(E)**
10. The type of amino acid to which Cysteine belongs is
   a) sulphur containing b) essential
   c) aromatic d) acidic **(A)**
11. The number of peptide bonds present in a tetrapeptide is;
   a) One b) Two
   c) Three d) Four **(E)**
12. Molecular mass of three amino acids glycine (Gly), Alanine (Ala) and Valine (Val) are 63, 77 and 102 respectively. Molecular mass of tripeptide "Gly-Ala-Val" is (molar mass of water = 18 $gmol^{-1}$).
   a) 206 b) 242
   c) 260 d) 188 **(D)**
13. Which of the following protein destroy the antigen when it enters in to body cell?
   a) Antibodies b) Phosphoprotein
   c) Chromoprotein d) Insulin **(A)**
14. Identify the correct statement.
   a) Peptide bond is formed by the loss of water molecule
   b) A protein is made of only one type of amino acid
   c) Dipeptides consists of different amino acids
   d) Glycylalanine is a tripeptide **(A)**

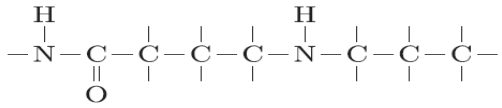
15. Among the following which is not a fibrous protein?

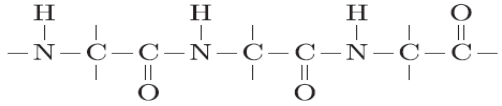
a) Keratin b) Myosin

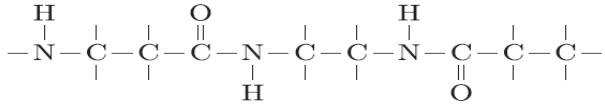
c) Collagen d) Albumin **(E)**

16. Which one of the following structures represents the peptide chain?

(a) 

(b) 

(c) 

(d) 

**(A)**

17. The fibrous protein is

a) Insulin b) Myoglobin

c) Collagen d) Haemoglobin **(E)**

18. The specific sequence in which amino acids are arranged in a protein is called its

a) Primary structure b) Secondary structure

c) Tertiary structure d) Quaternary structure **(E)**

19. An alpha helix and a beta sheet are examples of

a) Primary structure b) Secondary structure

c) Tertiary structure d) Quaternary structure **(E)**

## 10.3 enzymes

1. Enzymes are regarded as

a) biocatalysts b) messengers

c) inhibitors d) antibodies **(E)**

2. Enzymes are made up of

a) edible proteins b) proteins with specific structure

c) nitrogen containing carbohydrates d) carbohydrates **(E)**

3. Enzymes are chemically

a) nucleic acids b) carbohydrates

c) proteins d) fats **(E)**

4. The function of enzymes in the living system is to

a) catalyse biochemical reactions b) provide energy

c) provide immunity d) Transport oxygen **(E)**

5. The enzyme which catalyse the oxidation of one substrate with simultaneous reduction of another substrate is
   a) Oxidoreductase b) reductooxidase
   c) maltase d) ribase **(E)**
6. Receptors are proteins and crucial to body communication process. These receptors are embedded in
   a) cell membrane b) protein
   c) endocrine gland d) chromosomes **(E)(KCET-2023)**

## 10.4 Vitamins

1. The following compounds are usually not produced by the human body.
   a) Hormones b) Nucleic acids
   c) Vitamins d) Enzymes **(E)**
2. The water soluble vitamins is
   a) A b) C
   c) D d) $B_{12}$ **(E)**
3. The 'B' group vitamins which can be stored in our body is
   a) Vitamin $B_1$ b) Vitamin $B_2$
   c) Vitamin $B_6$ d) Vitamin $B_{12}$ **(E)**
4. The vitamins stored in liver and adipose tissues is
   a) $B_{12}$ b) C
   c) $B_2$ d) $B_1$ **(A)**
5. Incorrect statement regarding vitamins is
   a) Excess vitamin intake is harmful b) Most of the vitamins contain amino groups
   c) Vitamins can be produced by plants d) Vitamin deficiency causes diseases **(A)**
6. Ascorbic acid is a chemical name of
   a) Vitamin A b) Vitamin D
   c) Vitamin C d) Vitamin K **(E)**
7. In the following acids, vitamin is
   a) ascorbic acid b) adipic acid
   c) aspartic acid d) saccharic acid **(E)**
8. Doctor advised a 50-year-old woman enough exposure to sunlight and addition of fish and egg yolk to her diet. Name the vitamin deficiency for the possible disease diagnosed by the doctor.
   a) Vitamin D b) Vitamin A
   c) Vitamin C d) Vitamin $B_{12}$ **(A)**
9. The fat-soluble vitamin is
   a) Thiamine b) Pyridoxine
   c) Riboflavin d) Vitamin E **(E)**

10. A major vitamin present in the fish liver oil is

a) Vitamin D b) Vitamin A

c) Vitamin C d) Vitamin $B_{12}$ **(E)**

11. The vitamin deficiency which causes increased blood clotting time is

a) Vitamin A b) Vitamin D

c) Vitamin C d) Vitamin K **(E)(KCET-2019)**

12. Match the following given in column I with column II and choose the correct option.

| Column I | Column II |
|---|---|
| (i) Vitamin A | (A) Rickets |
| (ii) Vitamin D | (B) Pernicious Anemia |
| (iii) Vitamin $B_{12}$ | (C) Increased blood clotting time |
| (iv) Vitamin K | (D) Xeropthalmia |

a) i-B, ii-D, iii-A, iv-C b) i-D, ii-A, iii-B, iv-C

c) i-D, ii-A, iii-C, iv-B d) i-A, ii-D, iii-B, iv-C **(D)**

13. Which one of the following vitamins is not stored in adipose tissue?

a) A b) $B_6$

c) D d) E **(A)(KCET-2020)**

14. Hypothyroidism is caused by the deficiency of

a) vitamin B-12 b) adrenalin

c) thyroxine d) glucocorticoid **(A)(KCET-2020)**

15. Pick the wrong statement from the following

a) Sources of Vitamin $B_1$ are yeast, milk, green vegetables and cereals

b) Deficiency of Vitamin $B_6$ (pyridoxine) results in convulsions

c) Consumption of citrus fruits and green leafy vegetables in food prevents scurvy

d) Deficiency of vitamin D causes xerophthalmia **(E)(KCET-2027)**

## 10.5 Nucleic acids

1. Nucleic acids are

a) Polymers of nucleotides

b) Polymers of nucleosides

c) Polymers of purine bases through phosphate ester bonds

d) Phosphate ester bonds **(E)**

2. The base which is not present in DNA is

a) Adenine b) Guanine

c) Thymine d) Uracil **(E)(KCET-2018)**

3. In DNA, the linkage between different nitrogenous bases is
   a) phosphate linkage b) glycosidic linkage
   c) peptide linkage d) hydrogen bonding **(E)**
4. In DNA, thymine is held by two hydrogen bonds with the base
   a) Adenine b) Cytosine
   c) Thymine d) Guanine **(E)**
5. Adenosine is an example of
   a) Nucleotide b) Pyrimidine base
   c) Nucleoside d) Purine base **(E)**
6. Among the following, which is not a pyrimidine base?
   a) Uracil b) Cytosine
   c) Thymine d) Guanine **(E)**
7. Dinucleotide is obtained by joining two nucleotides together by phosphodiester linkage. Between which carbon atoms of pentose sugars of nucleotides are these linkages present?
   a) 5′ and 3′ b) 1′ and 5′
   c) 5′ and 5′ d) 3′ and 3′ **(A)**
8. RNA contains
   a) Ribose sugar and thymine b) Ribose sugar and uracil
   c) Deoxyribose sugar and uracil d) Deoxyribose sugar and thymine **(E)**
9. In DNA, the complementary bases are
   a) Adenine and thymine; guanine and cytosine
   b) Uracil and adenine; cytosine and guanine
   c) Adenine and guanine; thymine and cytosine
   d) Adenine and thymine; guanine and uracil **(E)**
10. The reason for double helical structure of DNA is operation of
    a) dipole-dipole interaction b) hydrogen bonding
    c) Electrostatic attractions d) van der Waals' forces **(A)**
11. The segment of DNA which acts as the instrumental manual for the synthesis of the protein is
    a) ribose b) gene
    c) nucleoside d) nucleotide **(E)**
12. RNA molecule is of three types, which of the following is not a type of RNA molecules?
    a) m-RNA b) n-RNA
    c) t-RNA d) r-RNA **(E)**
13. The message for the synthesis of particular protein is present in
    a) m-RNA b) DNA
    c) carbohydrates d) r-RNA **(E)**

14. The type of linkage present between nucleotides is

a) phosphoester linkage b) phosphodiester linkage

c) amide linkage d) glycosidic linkage **(E)(KCET-2024)**

15. A nucleic acid, whether DNA or RNA gives on complete hydrolysis, two purine bases, two pyrimidine bases, a pentose sugar and phosphoric acid. Nucleotides which are intermediate products in the hydrolysis contain

a) a purine base, pentose sugar and ortho-phosphoric acid

b) purine or pyrimidine base and ortho-phosphoric acid

c) purine or pyrimidine base, a pentose sugar and ortho-phosphoric acid

d) purine or pyrimidine base and pentose sugar **(D)(KCET-2022)**

16. RNA and DNA are chiral molecules; their chirality is due to the presence of

a) D-sugar component b) L-sugar component

c) chiral base d) chiral phosphate ester unit **(A)(KCET-2021)**

17. Primary structure in a nucleic acid contains 3 bases as GATGC ... The chain which is complementary to this chain is

a) GGTGA… b) TGAAG…

c) CTACG… d) TTTAG… **(A)(KCET-2021)**

## 10.6 Hormones

1. Glucocorticoids are

a) steroid hormones b) polypeptide hormones

c) amino acid derivatives d) vitamins **(E)**

2. The molecules that are produced by endocrine glands & act as intercellular messengers are;

a) Vitamins b) Nucleic acids

c) Hormones d) Proteins **(E)**

3. Insulin production and its action in human body are responsible for the level of diabetes. This compound belongs to which of the following categories?

a) An enzyme b) A hormone

c) A co-enzyme d) An antibiotic **(E)**

4. The steroid hormone is

a) Cholesterol b) Adrenaline

c) Thyroxine d) Progesterone **(E)**

5. In the following hormones, the one which is not a sex hormone is

a) Testosterone b) Progesterone

c) Thyroxine d) Estradiol **(E)**

6. The hormones which regulate blood sugar level in body are

a) Insulin and thyroxin b) Insulin and glucagon

c) Glucagon and thyroxin d) Insulin and endorphins **(E)**

7. The steroid hormone is

a) Cholesterol b) Adrenaline

c) Progesterone d) Thyroxine **(E)**

8. Which one of the following is a peptide hormone?

a) Testosterone b) Thyroxin

c) Adrenaline d) Glucagon **(E)**

9. Match the following

| **List-I** | **List-II** |
|---|---|
| A) Glucocorticoids | i) Responsible for development of secondary female characteristics. |
| B) Mineralocorticoids | ii) Responsible for preparing the uterus for implantation of fertilised egg |
| C) Testosterone | iii) Control carbohydrates metabolism |
| D) Estradiol | iv) Responsible for development of secondary male characteristics. |
| | v) Control level of excretion of water and salt by kidney. |

a) A-(iv), B- (v), C-(ii), D-(i) b) A-(iii), B-(v), C-(iv), D-(i)

c) A-(ii), B-(i), C-(v), D-(iv) d) A-(iii), B-(ii), C-(iv), D-(i) **(A)**

10. Match the following

| LIST-I | LIST-II |
|---|---|
| (i) Phosphodiester Linkage | (A) Amino Acids |
| (ii) Glycosidic Linkage | (B) Nucleotides |
| (iii) Peptide Linkage | (C) Monosaccharides |
| ----- | (D) Phenols |

a) i – C, ii – D, iii – B b) i – C, ii – A, iii – B

c) i – B, ii – C, iii – D d) i – B, ii – C, iii – A **(A)**

11. The correct sequence of α-amino acids, hormone, vitamin, carbohydrates respectively is

a) Thiamine, Thyroxine, Vitamin A, Glucose

b) Glutamine, Insulin, Aspartic acid, Fructose

c) Arginine, Testosterone, Glutamic acid, Fructose

d) Aspartic acid, Insulin, Glutamic acid, rhamnose **(E)(KCET-2025)**

12. Thyroxine produced in the thyroid gland is an iodinated derivative of

a) threonine b) lysine

c) tyrosine d) tryptophan **(E)(KCET-2023)**

13. Hormones are secreted by ductless glands of human body. Iodine containing hormone is

a) Adrenoline b) Thyroxine

c) Testosterone d) Insulin **(E)(KCET-2027)**

**Each question contains STATEMENT – 1 and STATEMENT – 2. Each question has four choices: a), b), c) and d). Out of which ONLY ONE is correct. Select the correct option from the given choices. (ONE MARK)**

a) Statement-I and Statement-II are correct

b) Statement-I is correct and Statement-II is incorrect

c) Statement-I and Statement-II are incorrect

d) Statement-I is incorrect and Statement-II is correct

## 10.1 Carbohydrates

1. Statement-I: The pursuit of knowledge of what goes on chemically within a living system falls in the domain of biochemistry.
   Statement-II: Proteins and carbohydrates are essential constituents of our food. **(E)**
2. Statement-I: Sucrose and Fructose cannot give positive Tollen's test
   Statement-II: Sucrose and Fructose do not contain an aldehyde group. **(E)**
3. Statement-I: In sucrose, the aldehydic group of glucose and ketonic group of fructose are not free.
   Statement-II: Sucrose is a non-reducing sugar. **(E)**
4. Statement-I: Hydrolysis of sucrose is known as inversion of cane sugar.
   Statement-II: Sucrose is a disaccharide. **(E)**
5. Statement-I: Maltose is a reducing sugar which gives two moles of D-glucose on hydrolysis.
   Statement-II: Maltose has β (1-4)-glycosidic linkage **(E)**

## 10.2 Proteins

1. Statement-I: Proteins on hydrolysis produce amino acids.
   Statement- II: Amino acids contain-$NH_2$ and –COOH group. **(E)**
2. Statement-I: Alpha (*a*)- amino acids exist as internal salt in solution as they have amino and carboxylic acid groups in near vicinity.
   Statement-II: $H^+$ ion given by carboxylic group (-COOH) is captured by amino group (-$NH_2$) having lone pair of electrons. **(E)**
3. Statement-I: All naturally occurring α-amino acids except glycine are optically active.
   Statement-II: Most naturally occurring amino acids have 'D' configuration. **(E)**
4. Statement-I: All amino acids are solid at 20°C.
   Statement-II: Amino acids can form zwitter ions. The ionic nature of the zwitter ions gives amino acids relatively strong intermolecular forces of attraction. **(E)**
5. Statement-I: During denaturation, secondary and tertiary structures of proteins are destroyed.
   Statement-II: Proteins are made up of *α*–amino acids. **(E)**
6. Statement-I: The change in colour and appearance of egg during cooking is due to denaturation.
   Statement-II: Disruption of the natural structure of a protein is called denaturation. **(E)**

## 10.3 Enzymes

1. Statement-I: Enzymes are needed only in small quantities for the progress of a reaction.
   Statement-II: enzymes are reducing the magnitude of activation energy. **(E)**

## 10.4 Vitamins

1. Statement-I: Vitamins A and K reduce excess body fat in humans.
   Statement-II: Vitamins A and K are fat soluble. **(E)**
2. Statement-I: Vitamin D cannot be stored in our body
   Statement-II: Vitamin D is fat soluble vitamin and is excreted from the body in urine. **(E)**

## 10.5 Nucleic Acids

1. Statement-I: Nucleus of a living cell is responsible for this transmission of inherent characters called heredity.
   Statement-II: The particles in nucleus of the cell, responsible for heredity are called chromosomes. which are made up of amino acids. **(A)**
2. Statement-I: DNA is more stable than RNA.
   Statement-II: DNA contains deoxyribose sugar, whereas RNA contains ribose sugar. **(E)**
3. Statement-I: DNA has double strand helix structure.
   Statement-II: In secondary structure of RNA single stranded helics is present which sometimes folds front on itself. **(E)**
4. Statement-I: The message for the synthesis of a particular protein is present in RNA.
   Statement-II: A DNA molecule is capable of self-duplication during cell division and identical DNA strands are transferred to daughter cells. **(E)**

## 10.6 Hormones

1. Statement-I: Hormones help to maintain the balance of biological activities in the body
   Statement-II: Thyroxine produced in the thyroid gland is an iodinated derivative of amino acid tyrosine. **(E)**
2. Statement-I: Glucocorticoids control the carbohydrate metabolism,
   Statement-II: Estradiol is the main female sex hormone and responsible for preparing the uterus for implantation of fertilised egg. **(E)**

## Fill in the Blanks by Choosing the Appropriate word from those given in the Brackets:

## (ONE MARK)

### Set-1

**(lactose, oligosaccharides, monosaccharide, polysaccharides, sugars, glucose)**

1. Carbohydrates, which are sweet in taste, are also called _____. **(E)**
2. The sugar present in milk is known as _____. **(E)**
3. A carbohydrate that cannot be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone is called a _____. **(E)**
4. On hydrolysis of carbohydrates which yield two to ten monosaccharide units are called _____. **(E)**
5. The example for monosaccharide is _____. **(E)**

### Set-2

**(insoluble, soluble, zwitter ion, non-essential, α-amino acids, carbohydrates)**

1. Amylopectin is _____ in water. **(E)**
2. The essential components for life in both plants and animals are _____. **(E)**
3. All proteins are polymers of _____. **(E)**
4. The amino acids, which can be synthesised in the body, are known as _____ amino acids. **(E)**
5. _____ is neutral but contains both positive and negative charges. **(E)**

### Set-3

**(saccharic acid, acetylation, ketohexose, aldohexose, bromine water, dextrorotatory)**

1. Glucose gets oxidised to gluconic acid on reaction with a mild oxidising agent like _____. **(E)**
2. Glucose reacts with acetic anhydride gives glucose penta acetate. The process is called _____. **(E)**
3. On oxidation with nitric acid, glucose yield _____. **(E)**
4. Fructose is an important _____. **(E)**
5. Sucrose is _____. **(E)**

### Set-4

**(monosaccharide, insoluble, milk sugar, plants, α-glucose, soluble)**

1. Lactose is more commonly known as _____. **(E)**
2. Polysaccharides contain a large number of _____ units. **(E)**
3. Starch is the main storage polysaccharide of _____. **(E)**
4. Starch is a polymer of _____. **(E)**
5. Amylose is water _____. **(E)**

### Set-5

**(reducing, phosphodiester, carbohydrate, oxime, glycogen, starch)**

1. The hormone glucorticoids control the _____ metabolism. **(E)**
2. The carbohydrates which reduce Fehling's solution and Tollen's reagent are called as _____ sugars. **(E)**
3. Storage polysaccharide present in animals is _____ **(E)**
4. Nucleotides are joined together by _____ linkage between 5′ and 3′ carbon atoms of pentose sugar. **(E)**
5. Glucose reacts with hydroxylamine to form _____. **(E)**

### Set-6

**(cellulose, nucleotides, glucagon, insulin, thymine, amylose)**

1. Water soluble component of starch is _____. **(E)**
2. The most abundant organic substance in plant kingdom is _____. **(E)**
3. In double helical structure of DNA, the base complementary to adenine is _____. **(E)**
4. Nucleic acids are the long chain polymers of _____. **(E)**
5. The hormone which increases sugar level in blood is _____. **(E)**

### Set-7

**(hydrolysis, ketone, aldehyde, oxime, glucose, dextrose)**

1. If a monosaccharide contains a _____ group, it is known as a ketose. **(E)**
2. Commercially glucose is obtained by boiling of starch with dilute $H_2SO_4$ at 393 K under pressure. The process is _____. **(E)**
3. Glucose is an aldohexose and is also known as _____. **(E)**
4. On prolonged heating with HI, _____ forms n-hexane. **(E)**
5. Glucose reacts with hydroxylamine to form a _____. **(E)**

### Set-8

**(reducing sugars, polysaccharides, Sucrose, glucose, ketose, aldose)**

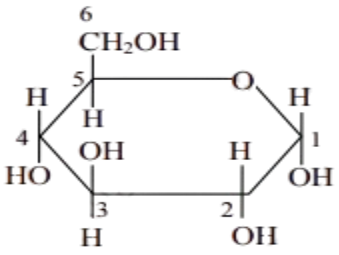
1. Carbohydrates which yield a large number of monosaccharide units on hydrolysis are called ___. **(E)**
2. All monosaccharides whether aldose or ketose are _____. **(E)**
3. If a monosaccharide contains an aldehyde group, it is known as an _____. **(E)**
4. Equal amount of Glucose and fructose are obtained by boiling _____ with dilute HCl or $H_2SO_4$ in alcoholic solution. **(E)**
5. Ripe grapes contain large amount of _____, **(E)**

## IV. Two mark questions:

## 10.1 Carbohydrates

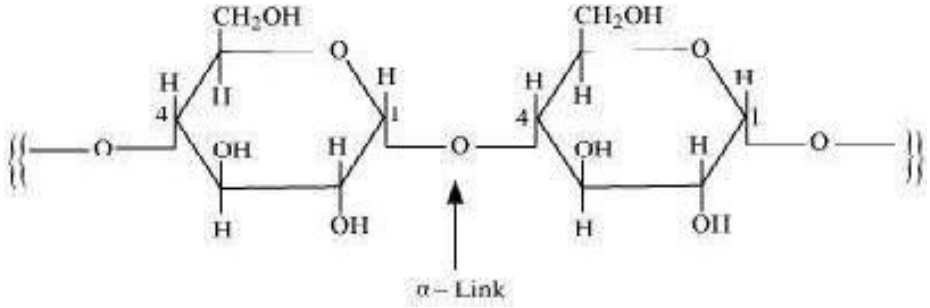
1. What are carbohydrates? Name the compound that does not fit into the formula $C_x(H_2O)_y$, but is a carbohydrate. **(A)**
2. What are monosaccharides? Give an example. **(E)**
3. What are oligosaccharides? Give an example. **(E)**
4. What are polysaccharides? Give an example. **(E)**
5. What are reducing sugars? Give an example. **(E)**
6. What are non-reducing sugars? Give an example. **(E)**
7. Explain the preparation of glucose from sucrose with equation. **(E)**
8. Explain the preparation of glucose from starch with equation. **(E)**
9. Give an example for aldohexose and ketohexose. **(E)**
10. How many moles of acetic anhydride are needed for acetylation of glucose? What does it confirm? **(A)**

11. How do you show that glucose contains a linear chain of six carbon atoms? Write equation for it. **(A) (Mar-2016)**
12. How do you show that glucose contains five hydroxyl groups? Write equation for it. **(A)**
13. How do you show that glucose contains aldehyde group? Write equation for it. **(A)**
14. How do your account for the absence of free aldehyde group in the pentaacetate of D-glucose? **(A)**
15. Glucose is a monosaccharide and an aldohexose. Which oxidising agent should be used to bring about oxidation of only the aldehydic group present in glucose? Write the chemical equation. **(A)**
16. Propose a scheme for the conversion of open chain structure of glucose into cyclic hemiacetal structure**.** **(A)**
17. Draw the six membered pyranose structures of $\alpha$ -D-glucose and $\beta$-D-glucose. **(A)**
18. How do the two cyclic hemiacetal forms of glucose differ? What are these two forms called? **(A)**
19. Write the structures showing conversion from Fischer projection formula to Haworth projection formula for glucose. **(A)**
20. Write the meaning of D and L-notation. **(E)**
21. What is meant by pyranose structure of glucose? **(E)**
22. What is an anomeric carbon? Find anomeric carbon in given structure. **(A)**




23. Write the Haworth's structure for α -D (+) fructofuranose. **(A)**
24. What are disaccharides? Give an example. **(E)**
25. What do you mean by glycosidic linkage? Name any one compound containing this linkage. **(E)**
26. What is the main source of sucrose? Sucrose is a non-reducing sugar. Give reason. **(A)**
27. Write the Haworth structure of α – D – (+)- Glucopyranose. **(A) (May-2014)**
28. Write the Haworth structure of maltose. Maltose shows reducing property. Give reason. **(A) (Mar-2014/Mar-2015/May-2015/Mar-2016/Mar-2017/Mar-2019/May-2020/May-2024/June-2025)**
29. Write the Haworth structure of lactose. Name the linkage present between monosaccharides in it. **(A) (Mar-2016/May-2017/Mar-2018/May-2025)**
30. What are the hydrolytic products of maltose? Why is it a reducing sugar? **(A)**
31. Which sugar is called invert sugar? Why is it called so? **(E)**
32. What is the composition of invert sugar? How is it obtained? **(A)**
33. What are the expected products of hydrolysis of lactose? **(E)**
34. Identify the carbohydrates and give any one difference between these carbohydrates present in cane sugar and carbohydrate present in milk. **(A)**

35. What are polysaccharides? Identify the monomer for the polysaccharide: **(A)**




36. Give two differences between amylose and amylopectin units of starch. **(A)**
37. What is the basic structural difference between starch and cellulose? **(A)**
38. What is glycogen? How is it different from starch? **(A)**
39. Write two main functions of carbohydrates in plants. **(E)**
40. Which polymer is important to plant cells? Give reason for this importance. **(A)**
41. Name the polysaccharide which is the main constituent of cell wall in plants. What are the expected products of hydrolysis of this polysaccharide? **(E)**
42. Glycogen is a kind of polysaccharide and is the storage form of monosaccharide "X" present in humans and other vertebrates. It is the animal equivalent of starch.
    (i) What is "X"?
    (ii) Where in the body can Glycogen stored in animals? **(D)**
43. What are fibrous proteins? Give an example. **(E) (May-2016)**
44. Write the Haworth structure of sucrose. **(E) (Mar-2024)**
45. Amylose and Amylopectin are two components starch. Write any two differences between them. **(D) (Mar-2025)**

## 10.2 Proteins

1. Name the functional groups present in amino acids and write the general structure of α – amino acid. (Give the general representation for α – L - amino acid). **(E)**
2. What is zwitter ion? Write the structure. **(E)**
3. Explain the amphoteric behaviour of amino acids. **(E)**
4. Give the name, three letter symbol and one letter code of α- amino acid which is
    (i) optically inactive.
    (ii) First obtained from cheese. **(E)**
5. What are essential amino acids? Give an example. **(E) (Mar-2016/Mar2017/Mar-2024)**
6. What are non-essential amino acids? Give an example. **(E) (Mar-2018)**
7. What is the difference between acidic amino acid and basic amino acid? **(A)**
8. What is peptide bond or peptide linkage? Give an example for dipeptide. **(E) (Mar-2019/May-2025)**
9. How many peptide bonds are present in a pentapeptide? **(E)**

10. Name the compounds which are biopolymers of α - amino acids. What type of linkage is responsible for the formation this biopolymer? **(A)**
11. Explain the preparation Glycylalanine with equation. **(A)**
12. Draw the structure of Glycylalanine. Mark the peptide linkage in it. **(A)**
13. Identify the proteins and give any one difference between these proteins, the protein present in the hair and the protein present in egg albumin. **(D)**
14. Differentiate between globular and fibrous proteins with one example for each. **(A)**
15. Classify the following as globular or fibrous proteins. **(E)**

    (i) Keratin (ii) Myosin

    (iii) Insulin (iv) Myoglobin

    (v) Collagen (vi) Haemoglobin
16. Explain the terms primary and secondary structure of proteins. **(A)**
17. What are the common types of secondary structures of proteins? **(E)**
18. What type of bonding helps in stabilising $\alpha$ - helix structure of proteins? **(E)**
19. What is the difference between α - helix and β - pleated sheet structure of proteins? **(A)**
20. What are the forces that stabilises the 2° and 3° structures of proteins? **(E)**
21. What does tertiary structure of proteins represent? Give its two major molecular shapes. **(E)**
22. What is a native protein? Explain how it gets denatured? **(A)**
23. During curdling of milk, what happens to sugar present in it? **(E)**
24. Give reason: **(E)**

    (i) The solubilityof amino acids in water is generally higher than that of the corresponding halo acids.

    (ii) In zwitter ion form amino acids are amphoteric.

    (iii) Amino acids are usually colourless, crystalline solids. They behave like salts rather than simple amines or carboxylic acids. Give reason for this behavior.

    (iv) One of the essential amino acid is lysine. Lysine is considered an essential amino acid.
25. What are globular proteins? Give one example for it. **(A) (June-2025)**

## 10.3 Enzymes

1. What are enzymes? Name the enzyme which responsible for conversion of maltose to glucose. **(E)**
2. What are oxidoreductase enzymes? Give an example. **(E)**

## 10.4 Vitamins

1. What are vitamins? How are vitamins classified? **(E)**
2. Write names of vitamins present in the following sources: **(A)**

    a) Rice b) Egg yolk

    c) Sweet potato d) Orange

3. Name the vitamin deficiency of which leads to convulsions. Name any one source which will provide this vitamin. **(E)**
4. Name the vitamin whose deficiency in our body results in impaired clotting of blood. Name any one source which will provide this vitamin**.** **(E)**
5. Vitamins are classified into two groups depending upon their solubility in water or fat. In which class will you place vitamin D? **(E)**
6. Name the vitamin whose deficiency caused pernicious anaemia. Name any one source which will provide this vitamin. **(E)**
7. What are fat soluble vitamins? Give an example. **(E)**
8. What are water soluble vitamins? Name a water-soluble vitamin which is a powerful antioxidant. **(E)**
9. Name two fat storing tissues found in human body that stores fat soluble vitamins. **(E)**
10. A person "A" suffering from gums bleeds frequently. The doctor's prescription mentioned that person "A" is suffering from scurvy. Mention any one food source to help person "A" recover faster. **(A)**

## 10.5 Nucleic Acids

1. What are nucleic acids? What is the difference between a nucleoside and a nucleotide? **(A)**
2. Mention their two important functions. **(E)**
3. Name the sugar moiety and the purines present in DNA molecule. **(E)**
4. What is the information is given by primary structure of DNA? **(E)**
5. The two strands in DNA are not identical but are complementary to each other. Give reason. **(E)**
6. Complete hydrolysis of DNA (or RNA) yields a pentose sugar, phosphoric acid and nitrogen containing heterocyclic compounds called bases. Name the bases found only in
   (i) RNA (ii) DNA. **(E)**
7. Write the name and structure of pentose sugar found in DNA molecule. **(A)**
8. Write the name and structure of pentose sugar found in RNA molecule. **(A)**
9. In DNA, between which carbon atoms of deoxyribose sugars of nucleotide are phosphodiester linkages present? **(E)**
10. Name the type linkage present in Dinucleotide obtained by joining two nucleotides. Write the simplified version of nucleic acid chain. **(E)**
11. List the any two nitrogenous bases commonly found in both RNA and DNA**.** **(D) (Mar-2025)**

## 10.6 Hormones

1. What are hormones? Name a hormone that mediates responses to external stimuli. **(E) (May-2015)**
2. Hormones have several functions in the body. They help to maintain the balance of biological activities in the body. Where are they produced in the body? How they transport them to the site of action? **(E)**
3. Name the disease caused due to deficiency of iodine in our body? How it is characterised? **(A)**

4. Name the hormone which is an iodinated derivative of amino acid Tyrosine (contains iodine). What is the function of this hormone? **(E)**
5. What are the symptoms of hypothyroidism? How hypothyroidism is controlled? **(E)**
6. Name the hormone which
   (i) Controls the level of excretion of water and salt from kidneys.
   (ii) Response to the rapid rise in blood glucose level.
   (iii) Responsible for development of secondary female characteristics and participates in the control of menstrual cycle
   (iv) Responsible for development of secondary male characteristics
   (v) For preparing the uterus for implantation of fertilised egg. **(E)**
7. If the adrenal cortex does not function properly then name the disease caused due to this. How it is characterised? **(E)**
8. Give an example for female sex hormone and write its function**.** **(E)**
9. Name the hormone released rapidly due to rise in blood glucose level to keep the blood glucose level within the narrow limit. Mention the number of amino acids present in this hormone. **(E)**
10. Give reason: Hormones are needed in adequate quantities in our body. **(A)**

## V. Three marks questions:

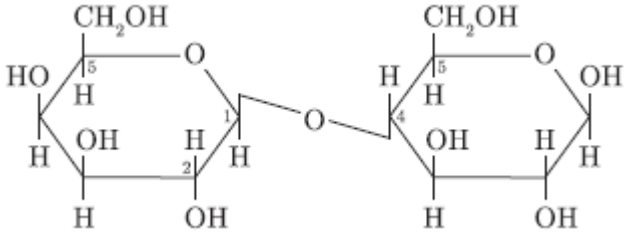
### 10. Introduction:

1. Define Biomolecules. Name two most essential biomolecule constituents of our food. **(E)**

### 10.1 Carbohydrates

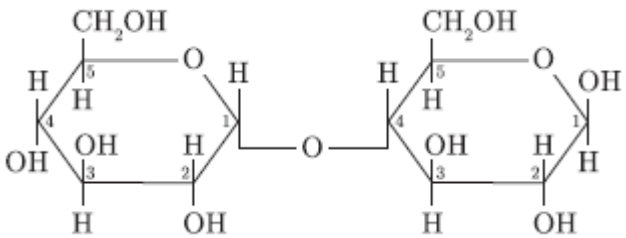
1. Give the classification of carbohydrates on the basis of their behavior on hydrolysis. Mention their names. **(E)**
2. Give the classification of monosaccharides on the basis of the presence of functional group. Mention their names. **(E)**
3. What are aldose and ketose? Name the functional group common to both glucose and fructose. **(E)**
4. Name the functional groups in the glucose and fructose. Mention the disaccharide containing these two carbohydrates. **(E)**
5. Write the equations, when D-glucose is treated with the following reagents.
   (i) HI (ii) $NH_2OH$
   (iii) HCN (iv) bromine water
   (v) Acetic anhydride (vi) $HNO_3$ **(A)**
6. Write the products of oxidation of glucose with:
   (a) Bromine water, (b) Nitric acid, (c) Acetic anhydride **(A)**
7. Mention two reactions and facts that cannot be explained by the open chain structure of glucose**.** **(A)**

8. What does α, D, (+) in the name α D (+) glucose signifies? **(A)**
9. What are anomers? Give the structures of two anomers of glucose. **(E)**
10. Write three the test to indicate the absence of free aldehyde group in the pentaacetate of glucose. OR
    Enumerate the reactions of D-glucose which cannot be explained by its open chain structure. **(A)**
11. Mention the two components present in starch. Name the water-soluble component of starch. **(E)**
12. From the following polysaccharides: glycogen, cellulose, amylose, answer the followings:
    a) Which one is a linear polymer of α- glucose?
    b) Which one is a polymer of α – glucose?
    c) Which one is a polymer present in liver and muscle? **(D)**
13. Whenever glucose levels drop in our body, a bipolymer breaks down to release glucose.
    a) Name this bipolymer
    b) Where in the body, it can store in animals?
    c) It is structurally similar to which polymer? **(D)**
14. Write any three importance's of carbohydrates.
15. Classify the following sugars into monosaccharides, polysaccharide and disaccharides:
    Fructose, Glucose, Maltose, Starch, Ribose, 2-deoxyribose, Maltose, Galactose, and Lactose **(A)**
16. Name the sugar present in milk. How many monosaccharide units are present in it? What are such oligosaccharides called? **(A)**
17. Name the two components of starch. Which of the two components of starch is water soluble? Which component of starch is a branched polymer of $\alpha$ -glucose and insoluble in water? **(E)**
18. Shown structure is the sugar in milk:



    i) Name the sugar.
    ii) Name the hydrolytic products of the sugar.
    iii) Which carbon atoms are involved in the formation of glycoside bond in it? **(D)**

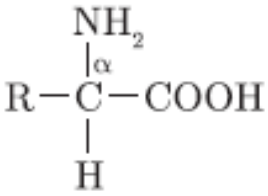
19. Shown structure is a reducing sugar:



    i) Name the sugar.
    ii) Name the hydrolytic products of the sugar.
    iii) What are such oligosaccharides called?
    iv) Why it shows reducing properties? **(D)**

## 10.2 Proteins

1. What are α - amino acids? Give any two examples of α - amino acids. **(E)**
2. What are the types of amino acids classified on the basis of relative number of amino and carboxyl groups in their molecule? Give an example for each. **(E)**
3. Shown structure is biomolecule:

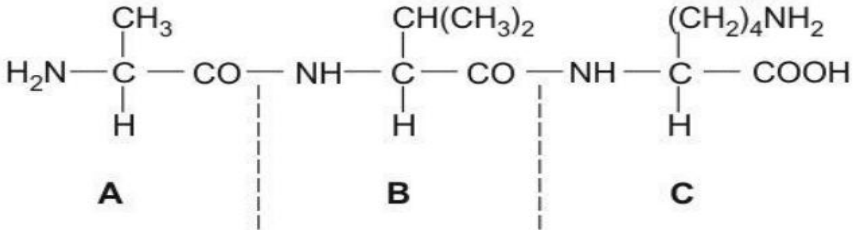


   i) Name the biomolecules.
   ii) Identify the R group in alanine.
   iii) Mention the physical state and colour of this compound.
   iv) Write the zwitter ionic form, **(D)**
4. Draw structures of glycine and alanine. Show the peptide linkage in glycylalanine. **(A)**
5. Match the items in A, B and C correctly **(A)**

| A | B | C |
|---|---|---|
| Valine | Non-essential amino acid | Basic amino acid |
| Aspartic acid | Essential amino acid | Neutral amino acid |
| Lysine | Essential amino acid | Acidic amino acid |

6. Classify the following as globular or fibrous proteins.
   (i) Keratin (ii) Myosin (iii) Insulin
   (iv) Myoglobin (v) Collagen (vi) Haemoglobin **(E)**
7. What type of linkages is responsible for the formation of
   (a) Primary structure of proteins
   (b) Cross linking of polypeptide chains
   (c) α - helix formation **(A)**
8. Name four types of intermolecular forces which stabilize structure of proteins. **(E)**
9. Write a short note for the following;
   (a) Primary structure of proteins
   (b) Secondary structure of proteins
   (c) Tertiary structure of proteins **(D)**
10. What is denaturation of proteins? What is the effect of denaturation on the structure of proteins? Mention the structure of protein remains intact during this process. **(A) (Mar-2015/Mar-2020/May-2020/May-2024)**

11. Shown below is the tripeptide formed by three amino acids A, B, C. Write the structure of the original amino acids A, B and C from this structure. How many water molecules would be required to hydrolyse this peptide to amino acid molecules? **(D)**




## 10.4 Vitamins

1. Name the:
   (a) water soluble vitamin.
   (b) A fat soluble vitamin.
   (c) The disease caused by deficiency of vitamin D. **(E)**
2. Name the vitamin deficiency of which causes:
   (a) Xerophthalmia (hardening of cornea of eye)
   (b) Beri beri (loss of appetite, retarded growth)
   (c) Cheilosis (fissuring at corners of mouth and lips) or digestive disorders and burning sensation of the skin.
   (d) Convulsions
   (e) Pernicious anaemia (RBC deficient in haemoglobin)
   (f) Scurvy (bleeding gums)
   (g) Rickets (bone deformities in children) and osteomalacia (soft bones and joint pain in adults)
   (h) Increased fragility of RBCs and muscular weakness
   (i) Increased blood clotting time **(E)**
3. Mention one source for the following vitamins.

| | | |
|---|---|---|
| a) Vitamin A | b) Vitamin $B_1$ | c) Vitamin $B_2$ |
| d) Vitamin $B_6$ | e) Vitamin $B_{12}$ | f) Vitamin C |
| g) Vitamin D | h) Vitamin E | i) Vitamin K **(E)** |

6. Give the list of some important vitamins, their sources and their deficiency diseases. **(A)**
7. Match the items in A, B and C correctly: **(A)**

| A | B | C |
|---|---|---|
| Vitamin A | Green vegetables | Scurvy |
| Vitamin C | Carrot | Beri beri |
| Vitamin $B_1$ | Citrus fruit | Night blindness |

8. Give reason: **(E)**
   (a) Vitamin C cannot be stored in our body.
   (b) water- soluble vitamins are supplied regularly in the diet.
   (c) Vitamin A deficiency affects vision and overall immune function.
   (d) Deficiency in vitamin K impact blood clotting mechanisms in the body.
   (e) Lack of vitamin C in the diet impact overall health.

## 10.5 Nucleic Acids

1. Write the chemical compositions of DNA and RNA. **(E)**
2. Name the products that would be formed when a nucleotide is completely hydrolysed? **(E)**
3. With respect to DNA; answer the following questions
   (a) What is backbone?
   (b) Name of the linkage between nucleotides?
   (c) Which component makes chiral? **(A)**
4. Explain primary and secondary structure of DNA. How is the 2° structure of DNA stabilised? **(A)**
5. List the three nitrogenous bases commonly found in both RNA and DNA. **(E)**
6. Mention the three types of RNA**.** **(E)**
7. Give differences between RNA and DNA with respect to: **(D)**
   (a) Sugar moiety (b) N-base
   (c) structure (d) biological function

## 10.6 Hormones

1. Write the function of each of the following: a) thyroxine b) insulin. Name the endocrine glands which secrete these hormones. **(E)**
2. Match the items in A, B and C correctly:

| A | B | C |
|---|---|---|
| Glucagon | pancreas | Decreases blood glucose |
| Thyroxin | Pancreas | Increases blood glucose |
| Insulin | Thyroid | Stimulates metabolism |

3. Name the linkage that joins:
   (a) Two monosaccharides
   (b) two α-amino acids
   ( c) two nucleotides **(E)**

# LINK FOR MODEL QUESTION PAPERS, BOARD EXAM QUESTION PAPERS, MODEL ANSWERS AND CENTUM PAPERS

**1. 2024 - 25 MODEL QUESTION PAPER:**

https://dpue-exam.karnataka.gov.in/kseabdpueqpue/Modelquetionpaper2026

**2. 2025 - 26 MODEL QUESTION PAPER:**

https://dpue-exam.karnataka.gov.in/kseabdpueqpue/StudentCorner2026#

**3. 2025 BOARD EXAM QUESTION PAPERS AND MODEL ANSWER:**

https://dpue-exam.karnataka.gov.in/kseabdpueqpue/QueBnkStdCorner

**4. CENTUM ANSWER PAPERS:**

https://dpue-exam.karnataka.gov.in/kseabdpueqpue/StudentCorner2026#

**5. II PUC OTHER SUBJECTS QUESTION BANK:**

https://dpue-exam.karnataka.gov.in/kseabdpueqpue/QuestionBankPage

# Unit 1 - SOLUTIONS:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | c | 11 | b | 21 | c | 31 | b | 41 | c | 51 | d | 61 | b | 71 | a |
| 2 | d | 12 | c | 22 | d | 32 | d | 42 | c | 52 | d | 62 | c | 72 | d |
| 3 | b | 13 | a | 23 | c | 33 | b | 43 | a | 53 | a | 63 | a | 73 | c |
| 4 | b | 14 | a | 24 | a | 34 | a | 44 | d | 54 | c | 64 | a | 74 | a |
| 5 | d | 15 | a | 25 | b | 35 | c | 45 | b | 55 | b | 65 | a | 75 | a |
| 6 | a | 16 | d | 26 | a | 36 | c | 46 | c | 56 | d | 66 | a | | |
| 7 | b | 17 | a | 27 | c | 37 | a | 47 | a | 57 | a | 67 | a | | |
| 8 | c | 18 | b | 28 | d | 38 | b | 48 | a | 58 | a | 68 | a | | |
| 9 | c | 19 | d | 29 | c | 39 | a | 49 | b | 59 | c | 69 | c | | |
| 10 | b | 20 | a | 30 | c | 40 | a | 50 | d | 60 | b | 70 | c | | |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| SET–1 | SET–2 | SET–3 | SET–4 |
|---|---|---|---|
| 1. Reverse osmosis<br>2. Plasmolysis<br>3. liquid<br>4. Solid<br>5. mole fraction | 1. 0.9 %<br>2. 1<br>3. lower<br>4. higher<br>5. saturated solution | 1. $N_2$<br>2. $O_2$<br>3. isotonic<br>4. hypotonic<br>5. cellulose acetate | 1. solution<br>2. solvent<br>3. association<br>4. dissociation<br>5. azeotrope |
| **SET–5** | **SET–6** | **SET–7** | |
| 1. solvent<br>2. solute<br>3. increase<br>4. decrease<br>5. Helium | 1. Edema<br>2. less<br>3. Osmotic pressure<br>4. non-ideal<br>5. more | 1. $CCl_2F_2$<br>2. increases<br>3. decreases<br>4. concentration<br>5. one | |

# Unit 2 -ELECTROCHEMISTRY:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | c | 11 | d | 21 | c | 31 | c | 41 | b | 51 | a | 61 | d | 71 | c | 81 | a | 91 | b | 101 | c | 111 | a |
| 2 | c | 12 | c | 22 | b | 32 | a | 42 | b | 52 | b | 62 | b | 72 | a | 82 | b | 92 | c | 102 | c | 112 | c |
| 3 | b | 13 | a | 23 | c | 33 | b | 43 | d | 53 | d | 63 | b | 73 | b | 83 | c | 93 | b | 103 | b | 113 | b |
| 4 | D | 14 | d | 24 | a | 34 | c | 44 | a | 54 | a | 64 | c | 74 | b | 84 | d | 94 | a | 104 | d | | |
| 5 | c | 15 | a | 25 | c | 35 | d | 45 | d | 55 | b | 65 | a | 75 | d | 85 | c | 95 | b | 105 | c | | |
| 6 | a | 16 | a | 26 | c | 36 | b | 46 | c | 56 | c | 66 | a | 76 | c | 86 | d | 96 | b | 106 | c | | |
| 7 | a | 17 | a | 27 | c | 37 | c | 47 | b | 57 | c | 67 | b | 77 | d | 87 | c | 97 | d | 107 | b | | |
| 8 | c | 18 | b | 28 | a | 38 | d | 48 | d | 58 | d | 68 | c | 78 | d | 88 | b | 98 | b | 108 | c | | |
| 9 | c | 19 | a | 29 | c | 39 | b | 49 | b | 59 | a | 69 | a | 79 | b | 89 | d | 99 | b | 109 | b | | |
| 10 | d | 20 | a | 30 | d | 40 | b | 50 | b | 60 | c | 70 | a | 80 | c | 90 | a | 100 | b | 110 | d | | |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| SET-1 | SET-2 | SET-3 |
|---|---|---|
| 1. Negative | 1.Less | 1. Non-electrolyte, |
| 2.$PbO_2$ | 2.Positive | 2.cm–1 |
| 3.Depolarizer | 3.Equal | 3.Weak electrolyte |
| 4.Galvanisation | 4.Hydrogen | 4.Electrochemical |
| 5.Electrolytic cell | 5.Sodium | 5.automobiles |
| **SET-4** | **SET-5** | **SET-6** |
| 1.cathode | 1.spontaneous | 1.Decreases |
| 2.Anode | 2.nonspontaneous | 2.Increases |
| 3.Hg-button cell | 3.Zero | 3.Siemen |
| 4.Electrochemical equivalent | 4.oxygen | 4.Siemen/metre |
| 5.Zinc | 5.three | 5.Platinum |

# Unit 3 - CHEMICAL KINETICS:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 11 | c | 21 | c | 31 | c | 41 | d | 51 | c | 61 | d | 71 | b | 81 | b | 91 | a | 101 | b |
| 2 | a | 12 | d | 22 | c | 32 | c | 42 | b | 52 | a | 62 | c | 72 | b | 82 | a | 92 | b | 102 | c |
| 3 | a | 13 | b | 23 | a | 33 | b | 43 | b | 53 | d | 63 | a | 73 | c | 83 | d | 93 | d | 103 | b |
| 4 | b | 14 | a | 24 | b | 34 | a | 44 | a | 54 | c | 64 | c | 74 | a | 84 | c | 94 | b | 104 | a |
| 5 | a | 15 | a | 25 | c | 35 | c | 45 | c | 55 | a | 65 | c | 75 | c | 85 | c | 95 | b | | |
| 6 | b | 16 | b | 26 | c | 36 | c | 46 | a | 56 | b | 66 | b | 76 | c | 86 | a | 96 | d | | |
| 7 | b | 17 | b | 27 | b | 37 | b | 47 | b | 57 | a | 67 | a | 77 | a | 87 | b | 97 | a | | |
| 8 | b | 18 | c | 28 | d | 38 | c | 48 | b | 58 | b | 68 | d | 78 | b | 88 | b | 98 | c | | |
| 9 | b | 19 | a | 29 | a | 39 | c | 49 | a | 59 | a | 69 | a | 79 | a | 89 | a | 99 | d | | |
| 10 | a | 20 | d | 30 | a | 40 | b | 50 | a | 60 | b | 70 | a | 80 | d | 90 | b | 100 | c | | |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| Set-1 | Set-2 | Set-3 |
|---|---|---|
| 1. mol $L^{-1}$ | 1. order | 1. molecularity |
| 2. instantaneous | 2. zero | 2. three |
| 3. decreases | 3. elementary | 3. slowest step |
| 4. rate expression | 4. complex | 4. order |
| 5. balanced equation | 5. rate constant | 5. zero order |
| **Set-4** | **Set-5** | **Set-6** |
| 1. first | 1. Pre-exponential factor | 1. kinetic gas |
| 2. half-life period | 2. increases | 2. equilibrium constant |
| 3. pseudo first | 3. decreases | 3. collision frequency |
| 4. sec–1 | 4. Gibbs energy | 4. effective collision |
| 5. Joules mol–1 | 5. activation energy | 5. steric |

# Unit 4 - d AND f BLOCK ELEMENTS:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 11 | d | 21 | d | 31 | d | 41 | a | 51 | b | 61 | c | 71 | c |
| 2 | d | 12 | c | 22 | b | 32 | b | 42 | d | 52 | b | 62 | c | | |
| 3 | c | 13 | d | 23 | d | 33 | b | 43 | c | 53 | b | 63 | b | | |
| 4 | c | 14 | a | 24 | b | 34 | b | 44 | b | 54 | d | 64 | a | | |
| 5 | c | 15 | a | 25 | c | 35 | c | 45 | d | 55 | b | 65 | a | | |
| 6 | c | 16 | c | 26 | c | 36 | a | 46 | b | 56 | d | 66 | b | | |
| 7 | b | 17 | b | 27 | c | 37 | d | 47 | a | 57 | d | 67 | b | | |
| 8 | a | 18 | c | 28 | d | 38 | a | 48 | b | 58 | a | 68 | a | | |
| 9 | c | 19 | b | 29 | c | 39 | c | 49 | c | 59 | d | 69 | c | | |
| 10 | a | 20 | b | 30 | d | 40 | b | 50 | b | 60 | a | 70 | b | | |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| **Set-1** | **Set-2** | **Set-3** | **Set-4** |
|---|---|---|---|
| 1. **increases** | 1. **melting point** | 1.**Ln** | 1. $Mn^{+2}$ |
| 2. **exchange energy** | 2. **chromate** | **2. +3** | **2. Cu** |
| 3. **scandium** | 3. **$K_2Cr_2O_7$** | **3. Carbon dioxide** | **3. Zero** |
| 4. **oxidation number** | 4. **$KClO_4$** | **4. sodiumdichromite** | **4. $Cr^{2+}$** |
| 5. **chromium** | 5. **Zr** | **5. zinc** | **5. Interstitial** |
| **Set-5** | **Set-6** | **Set-7** | |
| **1. decrease** | **1. Hf** | **1. unpaired** | |
| **2. zinc sulphate** | **2. Ag** | **2. Cu** | |
| **3. Interstitial** | **3. high** | **3. Ce** | |
| **4. increases** | **4. Ti** | **4. Hydrogen** | |
| **5. $Zn^{2+}$** | **5. +3** | **5. +3** | |

# Unit 5 - COORDINATION COMPOUNDS:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | d | 11 | a | 21 | b | 31 | c | 41 | c | 51 | d | 61 | b | 71 | d | 81 | a | 91 | a | 101 | a |
| 2 | b | 12 | c | 22 | b | 32 | c | 42 | a | 52 | b | 62 | a | 72 | c | 82 | a | 92 | d | 102 | a |
| 3 | a | 13 | d | 23 | d | 33 | a | 43 | d | 53 | d | 63 | d | 73 | a | 83 | b | 93 | c | 103 | c |
| 4 | b | 14 | c | 24 | d | 34 | d | 44 | d | 54 | b | 64 | a | 74 | c | 84 | a | 94 | c | 104 | c |
| 5 | d | 15 | b | 25 | a | 35 | c | 45 | d | 55 | a | 65 | c | 75 | a | 85 | b | 95 | d | 105 | a |
| 6 | d | 16 | b | 26 | a | 36 | a | 46 | b | 56 | a | 66 | c | 76 | c | 86 | a | 96 | d | 106 | b |
| 7 | b | 17 | a | 27 | b | 37 | d | 47 | a | 57 | d | 67 | a | 77 | a | 87 | a | 97 | a | 107 | c |
| 8 | c | 18 | c | 28 | c | 38 | a | 48 | b | 58 | a | 68 | a | 78 | b | 88 | b | 98 | b | | |
| 9 | d | 19 | d | 29 | c | 39 | c | 49 | a | 59 | d | 69 | c | 79 | a | 89 | a | 99 | c | | |
| 10 | b | 20 | b | 30 | d | 40 | b | 50 | b | 60 | a | 70 | b | 80 | a | 90 | c | 100 | a | | |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| Set-1 | Set-2 | Set-3 | Set-4 |
|---|---|---|---|
| 1. **secondary**<br>2. **Primary**<br>3. **polyhedra**<br>4. **potash alum**<br>5. **Lewis acids** | 1. **chelate**<br>2.**ambidentate**<br>3.**sigma bonds**<br>4. **Homoleptic**<br>5. **Octahedral** | 1.**EDTA**<br>**2. cis**<br>**3. ambidentate**<br>**4. Werner**<br>**5.trigonal bipyramidal** | 1. **diamagnetic**<br>**2. high spin**<br>**3. [Co(CN)6]3–**<br>**4. Zero,**<br>**5.dsp2** |
| **Set-5**<br>**1. Ethylenediaminetetra acetate**<br>**2. tetrahedral**<br>**3. five**<br>**4. paramagnetic**<br>**5. Weak** | **Set-6**<br>**1.$t^3_{2g}$ $e^1_g$**<br>**2. tetrahedral**<br>**3. violet**<br>**4. crystal field**<br>**5. colourless** | **Set-7**<br>**1. $NO_2^-$**<br>**2. Cobalt**<br>**3. zero**<br>**4.magnesium** | |

# Unit 6 - Haloalkanes and Haloarenes

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 11 | B | 21 | b | 31 | b | 41 | c | 51 | a | 61 | D | 71 | c |
| 2 | d | 12 | D | 22 | c | 32 | c | 42 | c | 52 | c | 62 | C | 72 | d |
| 3 | a | 13 | C | 23 | a | 33 | c | 43 | c | 53 | a | 63 | C | 73 | d |
| 4 | a | 14 | C | 24 | d | 34 | b | 44 | b | 54 | b | 64 | B | 74 | b |
| 5 | c | 15 | A | 25 | b | 35 | c | 45 | b | 55 | c | 65 | D | 75 | a |
| 6 | b | 16 | C | 26 | d | 36 | b | 46 | c | 56 | c | 66 | B | 76 | b |
| 7 | a | 17 | D | 27 | c | 37 | a | 47 | b | 57 | d | 67 | B | 77 | b |
| 8 | d | 18 | C | 28 | c | 38 | c | 48 | a | 58 | b | 68 | B | 78 | d |
| 9 | c | 19 | A | 29 | d | 39 | a | 49 | c | 59 | b | 69 | A | 79 | a |
| 10 | a | 20 | C | 30 | a | 40 | a | 50 | c | 60 | d | 70 | A | 80 | a |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| SET-1 | SET-2 | SET-3 |
|---|---|---|
| 1. Grignard reagent<br>2. hydrocarbon<br>3. Carbocation<br>4. Covalent<br>5. alkyl cyanides | 1. alkyl isocyanides<br>2. Increases<br>3. density<br>4. $Cu_2Cl_2$<br>5. $S_N1$ | 1. Wurtz<br>2. Swartz.<br>3. Sandmeyer's<br>4. Dehydrohalogenation.<br>5. Finkelstein |
| **SET-4** | **SET-5** | **SET -6** |
| 1. $S_N1$<br>2. $S_N2$<br>3. Inversion<br>4. achiral<br>5. Zaitse | 1. biphenyl<br>2. toluene<br>3. less<br>4. Grignard reagent.<br>5. electron withdrawing. | 1. Phosgene<br>2. Methylene chloride<br>3. Tetrachloromethane<br>4. freons<br>5. iodoform |
| **SET-7** | **SET-8** | **SET-9** |
| 1. isopropyl chloride<br>2. geminal dihalide<br>3. alcohols<br>4. vicinal dihalides<br>5. alkenes | 1. Polar<br>2. Electron withdrawing<br>3. Racemisation<br>4. (+)-octan-2-ol<br>5. alkanes | 1. Chloroform<br>2. Phosgene<br>3. Carbonyl chloride<br>4. Tetrachloromethane<br>5. freon |

# Unit 7- Alcohols, Phenols and Ether:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | b | 11 | c | 21 | d | 31 | c | 41 | b | 51 | b | 61 | c | 71 | a | 81 | a | 91 | b | 101 | a | 111 | c | 121 | a |
| 2 | d | 12 | b | 22 | a | 32 | d | 42 | a | 52 | a | 62 | b | 72 | a | 82 | d | 92 | b | 102 | a | 112 | a | 122 | d |
| 3 | d | 13 | d | 23 | c | 33 | b | 43 | a | 53 | c | 63 | d | 73 | a | 83 | a | 93 | d | 103 | c | 113 | c | 123 | a |
| 4 | b | 14 | d | 24 | b | 34 | c | 44 | b | 54 | b | 64 | b | 74 | a | 84 | a | 94 | c | 104 | b | 114 | b | | |
| 5 | a | 15 | c | 25 | b | 35 | a | 45 | d | 55 | d | 65 | b | 75 | d | 85 | c | 95 | b | 105 | b | 115 | c | | |
| 6 | b | 16 | a | 26 | c | 36 | a | 46 | a | 56 | d | 66 | c | 76 | b | 86 | c | 96 | d | 106 | d | 116 | a | | |
| 7 | a | 17 | a | 27 | a | 37 | d | 47 | a | 57 | a | 67 | a | 77 | d | 87 | b | 97 | b | 107 | d | 117 | b | | |
| 8 | d | 18 | c | 28 | c | 38 | b | 48 | d | 58 | b | 68 | c | 78 | b | 88 | d | 98 | a | 108 | d | 118 | c | | |
| 9 | a | 19 | c | 29 | d | 39 | a | 49 | a | 59 | c | 69 | d | 79 | a | 89 | a | 99 | d | 109 | b | 119 | b | | |
| 10 | a | 20 | d | 30 | a | 40 | d | 50 | c | 60 | c | 70 | b | 80 | c | 90 | c | 100 | c | 110 | a | 120 | a | | |

**Fill in the blanks by choosing the appropriate word from those given in the brackets:**

| SET-1 | SET-2 | SET-3 | SET-4 |
|---|---|---|---|
| 1. alcohols<br>2. $sp^3$<br>3. phenol<br>4. dihydric<br>5. three | 1. carbolicacid<br>2. ol<br>3. cyclo<br>4. two<br>5. tert-butylalcohol | 1. sigma<br>2. greater<br>3. anti-morkovnikov's<br>4. morkovnikov's<br>5. primary | 1. secondary<br>2. formaldehyde<br>3. oleum<br>4. nitrous acid<br>5. acetone |
| **SET-5** | **SET-6** | **SET-7** | **SET-8** |
| 1.benzenediazoniumchloride<br>2. acetone<br>3. weaker<br>4. bronsted bases<br>5. phenol | 1. phenol<br>2. increases<br>3. decreases<br>4. intermolecular<br>5. alkoxide | 1. stronger<br>2. aster<br>3. picreic<br>4. cumene<br>5. ethoxybenzene | 1. mixed<br>2. greater<br>3. $CS_2$<br>4. $FeBr_3$<br>5. picric acid |

# Unit 8 - Aldehydes, Ketones and Carboxylic acids:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | a | 11 | a | 21 | c | 31 | c | 41 | c | 51 | d | 61 | d | 71 | c | 81 | b | 91 | a | 101 | d | 111 | b |
| 2 | b | 12 | c | 22 | d | 32 | a | 42 | d | 52 | b | 62 | d | 72 | a | 82 | b | 92 | a | 102 | b | 112 | c |
| 3 | b | 13 | b | 23 | d | 33 | b | 43 | a | 53 | a | 63 | c | 73 | a | 83 | a | 93 | a | 103 | d | | |
| 4 | c | 14 | c | 24 | b | 34 | b | 44 | c | 54 | d | 64 | a | 74 | a | 84 | d | 94 | b | 104 | b | | |
| 5 | c | 15 | d | 25 | a | 35 | c | 45 | c | 55 | b | 65 | d | 75 | c | 85 | d | 95 | d | 105 | c | | |
| 6 | c | 16 | c | 26 | b | 36 | a | 46 | a | 56 | a | 66 | b | 76 | c | 86 | c | 96 | b | 106 | a | | |
| 7 | d | 17 | a | 27 | b | 37 | d | 47 | a | 57 | b | 67 | d | 77 | a | 87 | b | 97 | d | 107 | b | | |
| 8 | d | 18 | b | 28 | b | 38 | a | 48 | d | 58 | c | 68 | a | 78 | b | 88 | d | 98 | b | 108 | b | | |
| 9 | c | 19 | d | 29 | c | 39 | d | 49 | d | 59 | d | 69 | d | 79 | b | 89 | b | 99 | d | 109 | d | | |
| 10 | c | 20 | d | 30 | b | 40 | b | 50 | b | 60 | b | 70 | a | 80 | a | 90 | c | 100 | d | 110 | d | | |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| | | |
|---|---|---|
| **SET-1**<br>1. carbonyl group.<br>2. fragrance.<br>3. $sp^2$<br>4. polarised<br>5. electrophilic | **SET-2**<br>1. Lewis base<br>2. Oxidation<br>3. Volatile<br>4. Ozonolysis<br>5. acetaldehyde | **Set-3**<br>1. imine<br>2. methyl group<br>3. benzaldehyde<br>4. ketone<br>5. anhydrous aluminium chloride |
| **Set-4**<br>1. propiophenone<br>2. gas<br>3. higher<br>4. miscible<br>5. decreases | **Set-5**<br>1. nucleophilic<br>2. Planar<br>3. Electronic<br>4. Cyanohydrins<br>5. Addition | **Set-6**<br>1. Hemiacetals<br>2. Ketones<br>3. bright silver mirror<br>4. copper sulphate<br>5. dimer |

# Unit 9 – Amines:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | b | 11 | c | 21 | a | 31 | b | 41 | a | 51 | b | 61 | b | 71 | a | 81 | b | 91 | a | 101 | b |
| 2 | a | 12 | a | 22 | b | 32 | a | 42 | c | 52 | b | 62 | b | 72 | a | 82 | a | 92 | a | 102 | c |
| 3 | a | 13 | c | 23 | b | 33 | b | 43 | a | 53 | a | 63 | c | 73 | c | 83 | c | 93 | a | | |
| 4 | d | 14 | b | 24 | a | 34 | b | 44 | c | 54 | b | 64 | c | 74 | a | 84 | c | 94 | a | | |
| 5 | a | 15 | d | 25 | d | 35 | a | 45 | b | 55 | c | 65 | d | 75 | b | 85 | c | 95 | c | | |
| 6 | d | 16 | b | 26 | b | 36 | a | 46 | c | 56 | a | 66 | b | 76 | b | 86 | a | 96 | b | | |
| 7 | d | 17 | a | 27 | c | 37 | b | 47 | d | 57 | d | 67 | c | 77 | a | 87 | c | 97 | a | | |
| 8 | a | 18 | b | 28 | b | 38 | b | 48 | d | 58 | d | 68 | c | 78 | b | 88 | a | 98 | b | | |
| 9 | c | 19 | a | 29 | b | 39 | a | 49 | b | 59 | d | 69 | b | 79 | d | 89 | b | 99 | a | | |
| 10 | a | 20 | b | 30 | b | 40 | d | 50 | c | 60 | c | 70 | a | 80 | a | 90 | a | 100 | b | | |

## KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS

| SET-1 | SET-2 | SET-3 |
|---|---|---|
| 1. adrenaline | 1. gases | 1. 2-Aminotoluene |
| 2. ammonia | 2. tertiary amines | 2. primary amine |
| 3. Ethanamine | 3. primary aliphatic amines | 3. N-methyl benzamide |
| 4. methyl group | 4. pyramidal | 4. sulphanilic acid |
| 5. Hinsberg reagent | 5. surfactants | 5. Friedel-Crafts |
| **SET-4** | **SET-5** | **SET -6** |
| 1. Lewis bases | 1. acetanilide | 1. novocain |
| 2. potassium iodide | 2. isocyanide test | 2. Ammonolysis |
| 3. copper(I) ions | 3. ammonia | 3. methanamine |
| 4. an yellow dye | 4. nitrogen | 4. 2,4,6-tribromoaniline |
| 5. simple amine | 5. primary aliphatic amines | 5. aniline |

# Unit 10 - Biomolecules:

## KEY ANSWERS FOR MULTIPLE CHOICE QUESTIONS:

| Introduction | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **1** | **2** | | | | | | | | |
| **d** | **c** | | | | | | | | |
| **10.1 CARBOHYDRATES** | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **b** | **b** | **a** | **b** | **a** | **b** | **b** | **c** | **b** | **c** |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **a** | **c** | **d** | **b** | **d** | **b** | **a** | **b** | **d** | **c** |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| **a** | **d** | **c** | **c** | **c** | **a** | **a** | **c** | **a** | **b** |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| **c** | **c** | **a** | **c** | **c** | **d** | **b** | **a** | **c** | **a** |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | |
| **c** | **d** | **c** | **b** | **d** | **d** | **b** | **d** | **b** | |
| **10.2 proteins** | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **a** | **a** | **a** | **b** | **c** | **b** | **d** | **b** | **a** | **a** |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
| **b** | **a** | **a** | **d** | **a** | **c** | **b** | **a** | **b** | |
| **10.3 enzymes** | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| **a** | **b** | **c** | **a** | **a** | **a** | | | | |
| **10.4 Vitamins** | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **c** | **b** | **d** | **a** | **b** | **c** | **a** | **a** | **d** | **b** |
| 11 | 12 | 13 | 14 | 15 | | | | | |
| **d** | **b** | **b** | **c** | **d** | | | | | |
| **10.5 Nucleic acids** | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **b** | **d** | **d** | **a** | **a** | **d** | **a** | **b** | **a** | **b** |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | | | |
| **b** | **b** | **b** | **b** | **c** | **a** | **c** | | | |

| 10.6 Hormones | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **a** | **c** | **b** | **d** | **c** | **b** | **c** | **d** | **b** | **d** |
| 11 | 12 | 13 | | | | | | | |
| **d** | **c** | **c** | | | | | | | |
| **10.1 Carbohydrates** | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | | | | | |
| **a** | **c** | **a** | **a** | **b** | | | | | |
| **10.2 Proteins** | | | | | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 | | | | |
| **a** | **a** | **b** | **a** | **a** | **a** | | | | |
| **10.3 Enzymes** | | | | | | | | | |
| 1 | | | | | | | | | |
| **a** | | | | | | | | | |
| **10.4 Vitamins** | | | | | | | | | |
| 1 | 2 | | | | | | | | |
| **a** | **c** | | | | | | | | |
| **10.5 Nucleic Acids** | | | | | | | | | |
| 1 | 2 | 3 | 4 | | | | | | |
| **b** | **a** | **a** | **a** | | | | | | |
| **10.6 Hormones** | | | | | | | | | |
| 1 | 2 | | | | | | | | |
| **a** | **a** | | | | | | | | |

**KEY ANSWERS FOR FILL IN THE BLANKS QUESTIONS**

| Set-1 | | Set-2 | |
|---|---|---|---|
| 1 | **sugars** | 1 | **Insoluble** |
| 2 | **lactose** | 2 | **Carbohydrates** |
| 3 | **monosaccharide** | 3 | **α-amino acids** |
| 4 | **oligosaccharides** | 4 | **non-essential** |
| 5 | **glucose** | 5 | **zwitter ion** |

| Set-3 | | Set-4 | |
|---|---|---|---|
| 1 | **bromine water** | 1 | **milk sugar** |
| 2 | **acetylation** | 2 | **Monosaccharide** |
| 3 | **saccharic acid** | 3 | **Plants** |
| 4 | **ketohexose** | 4 | **α-glucose** |
| 5 | **dextrorotatory** | 5 | **Soluble** |
| **Set-5** | | **Set-6** | |
| 1 | **carbohydrate** | 1 | **Amylose** |
| 2 | **Reducing** | 2 | **Cellulose** |
| 3 | **Glycogen** | 3 | **Thymine** |
| 4 | **phosphodiester** | 4 | **Nucleotides** |
| 5 | **Oxime** | 5 | **Glucagon** |
| **Set-7** | | **Set-8** | |
| 1 | **Ketone** | 1 | **polysaccharides** |
| 2 | **Hydrolysis** | 2 | **reducing sugars** |
| 3 | **Dextrose** | 3 | **aldose** |
| 4 | **Glucose** | 4 | **Sucrose** |
| 5 | **Oxime** | 5 | **glucose** |

**GOVERNEMENT OF KARNATAKA**

**KARNATAKA SCHOOL EXAMINATION AND ASSEMENT BOARD**

6th CROSS, MALLESHWARAM, BENGALURU-560003

**2025-26 II PUC PRACTICE QUESTION PAPER - 1**

**Subject:** 34 - Chemistry **Maximum Marks:** 70

**Time:** 3.00 Hours **No. of Questions:** 46

**Instructions**

1. Question paper has FIVE parts. All parts are compulsory.
2. a. Part-A carries 20 marks. Each question carries 1 mark.
   b. Part-B carries 06 marks. Each question carries 2 marks.
   c. Part-C carries 15 marks. Each question carries 3 marks.
   d. Part-D carries 20marks. Each question carries 5 marks.
   e. Part-E carries 09 marks. Each question carries 3 marks.
3. In Part-A questions, **first attempted answer** will be considered for awarding marks.
4. Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.
5. Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.
6. Use log tables and simple calculator if necessary (use of scientific calculator is not allowed).
7. For a question having circuit diagram/figure/ graph/ diagram, alternate questions are given at the end of question paper in a separate section for visually challenged students.

## PART-A

**I. Select the correct option from the given choices.** **15 ×1 = 15**

1. The concentration of fluoride ions to be present in water to prevent tooth decay is

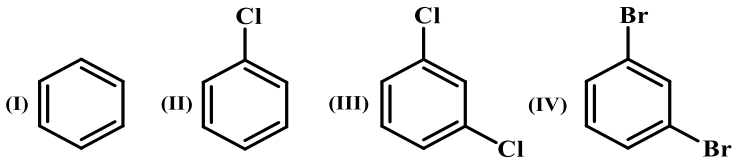
   (a) 1 ppm (b) 1.5 ppm (c) 2 ppm (d) 2.5 ppm

2. In aqueous solution, Electronic configuration of Cu(II) ion is $3d^9$ but electronic configuration of Cu(I) ion is $3d^{10}$, which of the following is correct?

   (a) Cu(II) ion is less stable (b) Cu(II) ion is more stable

   (c) Cu(I) and Cu(II) ions are equally stable (d) Cu(I) ion is more stable

3. Arrange the following compounds in the increasing order of their density




   (a) I < III < IV < II (b) IV < III < II < I

   (c) I < II < III < IV (d) II < IV < III < I

4. Molecular mass of three amino acids glycine (Gly), Alanine (Ala) and Valine (Val) are 63, 77 and 102 respectively. Molecular mass of tripeptide "Gly-Ala-Val" is (molar mass of water = 18 $gmol^{-1}$).

   (a) 206 (b) 242 (c) 260 (d) 188

5. Statement I: Conductivity of all electrolytes decreases on dilution.

Statement II: On dilution, number of ions per unit volume decreases.

(a) Both Statement I and Statement II are correct.

(b) Statement I is incorrect but Statement II is correct.

(c) Both Statement I and Statement II are incorrect.

(d) Statement I is correct but Statement II is incorrect.

6. The plot of concentration of the reactant vs. time for a reaction is a straight line with a negative slope. The reaction follows a

(a) zero order rate equation (b) first order rate equation

(c) second order rate equation (d) third order rate equation

7. The products formed when phenol is treated with dilute nitric acid at low temperature (298K) is/are

(i) o-nitrophenol (ii) p-nitrophenol (iii) 2,4,6- trinitrophenol

(a) only (ii) (b) only (iii)

(c) all (ii) and (iii) (d) both (i) and (ii)

8. Which of the following condition does make the propan-2-ol to undergo dehydration?

(a) Conc. $H_2SO_4$ at 443 K (b) 85% $H_3PO_4$ at 440 K

(c) 20% $H_3PO_4$ at 358 K (d) dil. $H_2SO_4$ at 400 K

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

(a) $\left[Fe(CO)_5\right]$ (b) $\left[Fe(CN)_6\right]^{3-}$ (c) $\left[Fe(C_2O_4)_3\right]^{3-}$ (d) $\left[Fe(H_2O)_6\right]^{3+}$

10. The counter ion in the coordination compound $[Co(NH_3)_5(NO_2)]\ Cl_2$ is

(a) Ammine (b) Cobalt (c) Chloride (d) Nitro

11. Match the following given in list-I with List-II.

| LIST-I | LIST-II |
|---|---|
| (A) Aldol Condensation | (i) Con NaOH |
| (B) Cannizaro reaction | (ii) $H_2$/ Pd-$BaSO_4$ |
| (C) Haloform reaction | (iii) Dilute NaOH |
| (D) Rosenmund reduction | (iv) NaOI |

(a) A-(iv), B-(iii), C-(ii), D-(i)

(b) A-(iii), B-(i), C-(iv), D-(ii)

(c) A-(iii), B-(i), C-(ii) , D-(iv)

(d) A-(iii), B-(ii), C-(iv), D-(i)

12. An organic compound with molecular formula $C_9H_{10}O_2$ gives directly carboxylic acid on hydrolysis and a salt of carboxylic acid on base hydrolysis. The organic compound is

    (a) 2-ethylbenzoic acid (b) 2-methyl methyl benzoate

    (c) 2-ethylbenzaldehyde (d) ethyl benzoate

13. Colligative properties depend on _____

    (a) the nature of the solute particles dissolved in solution

    (b) the number of solute particles in solution

    (c) the physical properties of the solute particles dissolved in solution

    (d) the nature of solvent particles

14. An acylation of *N*-ethylethanamine is carried out in the presence of a base stronger than the amine (like pyridine) because it removes

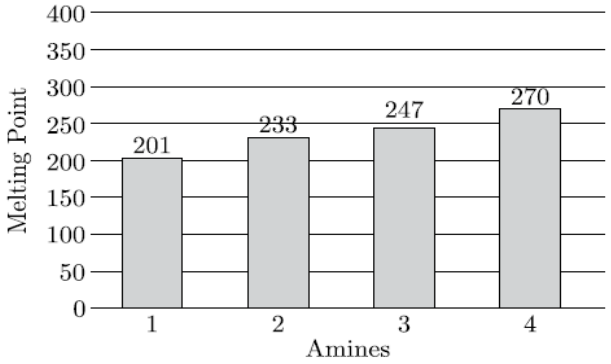
    (a) HCl and shifts the equilibrium to the left.

    (b) NaOH and shifts the equilibrium to the right.

    (c) NaOH and shifts the equilibrium to the left.

    (d) HCl and shifts the equilibrium to the right.

15. Study the graph showing the melting points of amines and identify the compounds:




    (a) 1 = Methanamine, 2 = Ethanamine, 3 = Propanamine, 4 = Butanamine

    (b) 1 = Ethanamine, 2 = Propanamine, 3 = Butanamine, 4 = Methanamine

    (c) 1 = Butanamine, 2 = Methanamine, 3 = Propanamine, 4 = Ethanamine

    (d) 1 = Propanamine, 2 = Butanamine, 3 = Methanamine, 4 = Ethanamine

**II. Fill in the blanks by choosing the appropriate word from those given in the brackets:**

**(Thymine, freezing point, $CH_2Cl_2$, grain, wood, polythene) 5 ×1 = 5**

16. The chemical used to remove paint is _____.

17. The lowering of vapour pressure of a solution causes a lowering of the _____ compared to that of the pure solvent.

18. Ziegler catalyst is used in manufacture of _____.

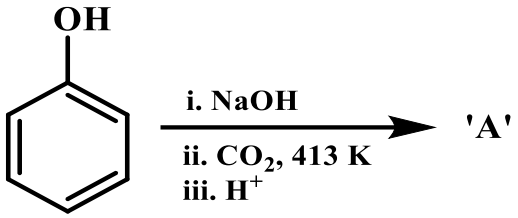
19. $CH_3OH$ is called as a _____ alcohol.

20. In double helical structure of DNA, the base complementary to adenine is _____.

## PART – B

**III. Answer any three of the following. Each question carries 2 marks.** **3 × 2 = 6**

21. Which organic compounds conversion is involved in Wacker Process? Write the formula of catalyst.
22. Explain Swarts reaction with an example.
23. What are effective collisions? Mention one drawback of collision theory.
24. Name the hormone which is an iodinated derivative of amino acid Tyrosine. How hypothyroidism is controlled?
25. Name the following reaction and identify product 'A'.




## PART – C

**IV. Answer any three of the following. Each question carries 3 marks.** **3 × 3 = 9**

26. Mention the co-ordination number and co-ordination polyhedral of the following complex ions.

$$\text{(i)}\left[PtCl_4\right]^{2-} \qquad \text{(ii)}\left[Co(NH_3)_4Cl_2\right]^{+} \qquad \text{(iii)}\left[Co(en)_3\right]^{3+}$$

27. A blackish brown coloured solid 'A' when fused with alkali metal hydroxides in presence of air produces a dark green coloured compound 'B' which an electrolytic oxidation in alkaline medium gives a dark purple coloured compound 'C'. Identify A, B and C and write the reactions involved.
28. What is the denticity of the ligand in the Fe(III) EDTA complex. Name the atom/atoms of ligand through which it can bind to the central metal ion.
29. What are metal carbonyls? How the M-C σ and M-C π bonds are formed in them?
30. In general, transition metal ions of same charge in a given series show progressive decrease in atomic and ionic radius with increase in their atomic number. Give two reasons this change in radius. Name the phenomenon associated with this decrease.

**V. Answer any two of the following. Each question carries 3 marks.** **2 × 3 = 6**

31. State rate law? Write the rate expression and differential rate equation for general reaction.

$$aA + bB \longrightarrow cC + dD.$$

32. For the standard hydrogen electrode (SHE):
    (i) Write the electrode representation.
    (ii) What is the concentration of hydrogen ion?
    (iii) Name the metal used in electrode. **(1+1+1)**

33. What is semi permeable membrane? Give an example each for natural and synthetic semipermeable membrane.

34. Mention any three factors affecting electrolytic conductance.

## PART – D

**VI. Answer any four of the following. Each question carries 5 marks.** **4 × 5 = 20**

35. (a) Write the reactions involved in the conversion of benzene-1,2-dicarboxyllic acid to phthalimide.

(b) The $pK_a$ values of 4-methoxybenzoic acid, benzoic acid and 4-nitrobenzoic acid are 4.46, 4.19 and 3.41 respectively. Arrange them in the increasing order of their acid strength. Justify the arrangement. **(3+2)**

36. (a) Write the equations for the two steps involved in the mechanism for the conversion of 2-bromo-2-methylpropane to 2-methyl-propan-2-ol. Mention the rate determining step. **(3+2)**

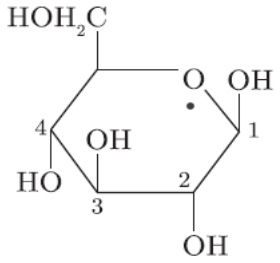
(b) How the plane polarized light is produced? Name the instrument used to measure optical rotation.

37. (a) Write the three equations involved in the mechanism of acid catalyzed hydration of $C_2H_4$ to $C_2H_5OH$.

(b) Explain Kolbe's reaction with general equation. **(3+2)**

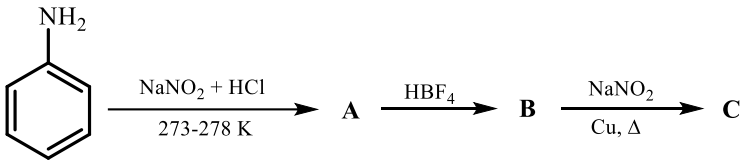
38. (a) Name the two major molecular shapes formed due to the folding of secondary structure of proteins.

(b) What are the anomers? Find anomeric carbon in given structure.




(c) A person "A" suffering from gums bleeds frequently. The doctor's prescription mentioned that person "A" is suffering from scurvy. Mention any one food source to help person "A" recover faster. **(2+2+1)**

39. (a) Identify the products A, B and C in the following.




(b) Mention the IUPAC name of simplest arylamine and write its formula. **(3+2)**

40. An Organic compound with molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollens reagent and undergoes Cannizaro reaction. On vigorous oxidation, it gives benzene-1,2-dicarboxylic acid. Identify the compound. Write all the reactions involved.

## PART – E (PROBLEMS)

**VII. Answer any three of the following. Each question carries 3 marks.** **3 × 3 = 9**

41. Calculate the molality of 2.5g of ethanoic acid ($CH_3COOH$) in 75g of benzene.

42. The first order rate constant for the decomposition of ethyl iodide by the reaction $C_2H_5I(g) \longrightarrow C_2H_4(g) + HI(g)$ at 600 K is $1.60\times10^{-5}s^{-1}$. Its energy of activation is 209 $kJmol^{-1}$. Calculate the rate constant of the reaction at 700 K.

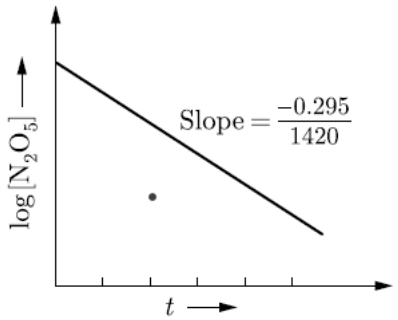
43. The conductivity of 0.00241 M acetic acid is $7.896\times10^{-5}$ $Scm^{-1}$. Calculate its molar conductivity and if $\Lambda_m^o$ for acetic acid is $390.5\,S\,cm^2mol^{-1}$, what is its dissociation constant?

44. The vapour pressure of water is 12.3 k Pa at 300K, Calculate the vapour pressure of 1 molal solution of a non-volatile solute in it.

45. Calculate the emf of the following cell at 298 K $Sn(s)|Sn^{2+}_{(0.050M)}||H^+_{(0.020M)}|H_2(g)(1bar)|Pt(s)$;

    Given: $E^o_{\frac{Sn^{2+}}{Sn}} = -0.14\,V$.

46. At 318 K, Nitrogen pentoxide decomposes according to the equation; $2N_2O_5 \rightarrow 4NO_2 + O_2$ in gas phase. The plot of log $[N_2O_5]$ v/s time 't' shows a straight line with negative slope as shown in figure. Calculate the rate constant.




## PART - F

**(For visually challenged students only)**

15. The amine having highest melting point is

    (a) Methanamine (b)Ethanamine (c) Propanamine (d) Butanamine

38. (b) Name two monosaccharides present in sucrose.

46. The rate of a reaction triples when the temperature changes from 298 K to 318 K. Calculate the energy of activation of the reaction assuming that it does not change with temperature. (Given R = 8.314 $JK^{-1}mol^{-1}$, log 3 = 0.4771)

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**KARNATAKA SCHOOL EXAMINATION AND ASSEMENT BOARD**
6th CROSS, MALLESHWARAM, BENGALURU-560003
**2025-26 II PUC PRACTICAL QUESTION PAPER- 2**

**Subject:** 34 - Chemistry **Maximum Marks:** 70
**Time:** 3.00 Hours **No. of Questions:** 46

**Instructions**

1. Question paper has FIVE parts. All parts are compulsory.
2. a. Part-A carries 20 marks. Each question carries 1 mark.
   b. Part-B carries 06 marks. Each question carries 2 marks.
   c. Part-C carries 15 marks. Each question carries 3 marks.
   d. Part-D carries 20marks. Each question carries 5 marks.
   e. Part-E carries 09 marks. Each question carries 3 marks.
3. In Part-A questions, **first attempted answer** will be considered for awarding marks.
4. Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.
5. Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.
6. Use log tables and simple calculator if necessary (use of scientific calculator is not allowed).
7. For a question having circuit diagram/figure/ graph/ diagram, alternate questions are given at the end of question paper in a separate section for visually challenged students.

## PART-A

**I. Select the correct option from the given choices.** **15 ×1 = 15**

1. When mercuric iodide is added to the aqueous solutions of potassium iodide then:
   (a) freezing point is raised. (b) freezing point is lowered.
   (c) freezing point does not change. (d) boiling point does not change.
2. The concentration of pollutants in water or atmosphere is expressed in terms of
   (a) $\mu gmL^{-1}$ (b) molarity (c) molality (d) volume percentage (v/v)
3. The lowest standard reduction potential of lithium electrode for the reduction reaction $Li^+ + e^- \longrightarrow Li$, indicates that
   (a) Lithium is the most powerful oxidising agent
   (b) Lithium is the most powerful reducing agent
   (c) Lithium ion is the strongest oxidising agent
   (d) Lithium is the weakest reducing agent
4. The rate law for the reaction: A + B → P is Rate = k[A][B]. if 'B' is taken large excess, then the order of reaction is
   (a) 2 (b) 1 (c) 0 (d) ½
5. Lanthanoids react with water to form
   (a) $Ln(OH)_2$ (b) LnOH (c) $Ln_2O_3$ (d) $Ln(OH)_3$
6. The arrangement of ligands in the increasing order of ligand field strength based on spectrochemical series is
   (a) $I^- < Cl^- < OH^- < H_2O < CO$ (b) $CO < H_2O < OH^- < Cl^- < I^-$
   (c) $I^- < Cl^- < H_2O < OH^- < CO$ (d) $H_2O < CO < I^- < Cl^- < OH^-$

7. If ethane-1,2-diamine is progressively added to green coloured $[Ni(H_2O)_6]^{2+}$ in the molar ratios en:Ni, 1:1, 2:1, 3:1, then the correct order of colour changes of complexes would be

(a) green, pale blue, blue, colourless (b) green, pale blue, blue, violet

(c) green, violet, blue, pale blue (d) green, violet, pale blue, blue

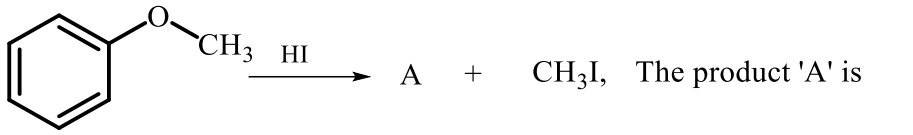
8. The reagent that does not respond both to acetone and benzaldehyde is,

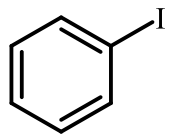
(a) sodium hydrogen sulphite (b) phenyl hydrazine

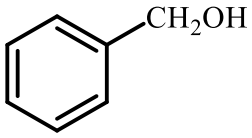
(c) Fehling's reagent (d) Grignard reagent

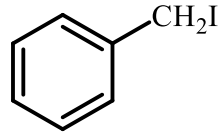
9. Phenol is less acidic than

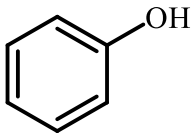
(a) ethanol (b) o-nitrophenol (c) o-cresol (d) water

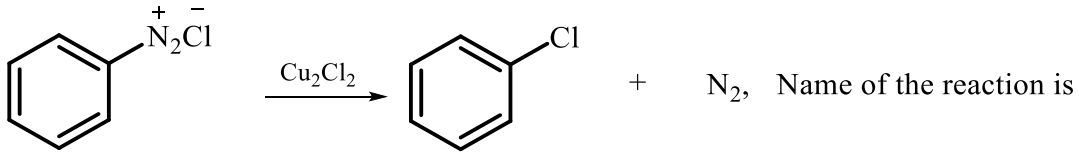
10. 


(a) 


(b) 


(c) 


(d) 


11. 


(a) Swarts reaction (b) Wurtz reaction (c) Sandmeyer reaction (d) Fittig reaction

12. The compound that can undergo Hell-Volhard-Zelinsky reaction in the following is

(a) $CH_3COCH_3$ (b) $CH_3CHO$ (c) $(CH_3)_2CHCOOH$ (d) $C_6H_5COOH$

13. The reagent which is more preferred choice for reducing nitrobenzene to aniline

(a) $H_2$ / Pd, ethanol (b) Fe and HCl (c) Sn and HCl (d) $LiAlH_4$

14. The halide that does not undergo nucleophilic substitution with the anion formed by phthalimide is

(a) $C_6H_5Cl$ (b) $CH_3Cl$ (c) $C_6H_5CH_2Cl$ (d) $CH_3CH_2CH_2Cl$

15. Glucocorticoids are

(a) vitamins (b) polypeptide hormones

(c) amino acid derivatives (d) steroid hormones

**II. Fill in the blanks by choosing the appropriate word from those given in the brackets:**

**(**oxime, toluene, vinylic, 2.84BM, composition, tetrachloromethane**)** **5 × 1 = 5**

16. The utility or importance of solutions in life depends on their _____.

17. Spin only magnetic moment of $Ti^{2+}$ is _____.

18. Freon-12 is manufactured from _____ by Swarts reaction.

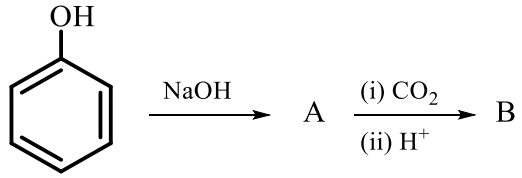
19. $CH_2$ = CH-OH is a _____ alcohol.

20. Glucose reacts with hydroxylamine to form _____.

## PART – B

**III. Answer any three of the following. Each question carries 2 marks.** **3 × 2 = 6**

21. Define rate of a chemical reaction. How does decrease in concentration of the reactants on the passage of time impact the rate at a given temperature?
22. Transition metals and their compounds are known for their catalytic activity. Give any two reasons.
23. Explain Finkelstein reaction with an example.
24. Identify 'A' and 'B' in the following reaction.




25. Name the two components of starch.

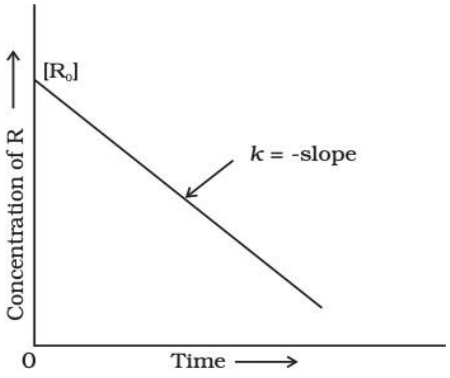
## PART – C

**IV. Answer any three of the following. Each question carries 3 marks.** **3 × 3 = 9**

26. Among sulphuric acid and hydrochloric acid, which acid is preferred to be used for permanganate titrations? Give reason.
27. Give reason for the following.;
    (i) Ce(III) is easily oxidised to Ce(IV).
    (ii) actinoids show wide range of oxidation states.
    (iii) The second and third transition series elements have almost similar atomic radii.
28. Write any three postulates of Werner's theory of coordination compounds.
29. With respect to coordination compounds; what are
    (i) isomers (ii) enantiomers (iii) unidentate ligand.
30. Write the IUPAC name of $\left[PtCl_2\left(en\right)_2\right]^{2+}$ ion. Draw the optical isomers of it.

**V. Answer any two of the following. Each question carries 3 marks.** **2 × 3 = 6**

31. Write four differences between metallic conductors and electrolytic conductors.
32. State Henry's law. Write its mathematical form. Mention one of its applications.
33. What are fuel cells? Write the anode and cathode reactions of $H_2-O_2$ fuel cell.
34. For the following graph, Write the
    (i) Order of reaction,
    (ii) Its integrated rate equation.
    (iii) SI unit of the rate constant.



## PART – D

**VI. Answer any four of the following. Each question carries 5 marks.** **4 × 5 = 20**

35. (a) Give reason for the following:

(i) 2-chloroproapne is an achiral molecule.

(ii) A mixture containing equal proportion of (+)-butan-2-ol and (-)-butan-2-ol shows zero optical rotation.

(iii) $3^0$ alkyl halides undergo $S_N1$ reactions faster than $2^0$ and $1^0$alkyl halides

(b) Write the structure of different dihalogen derivatives of Ethane. **(3+2)**

36. (a) Write the organic products of the following reactions.

(i) $C_2H_5OH \xrightarrow[443K]{H_2SO_4}$

(ii) $HCHO \xrightarrow[(ii)\ H_2O]{(i)\ CH_3MgX}$

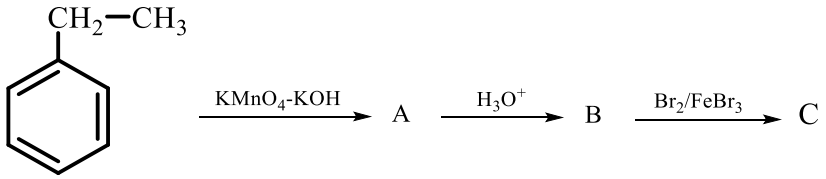
(iii) $CH_3CH(OH)CH_3 \xrightarrow[573K]{Cu}$

(b) Write the chemical equation for acetylation of salicylic acid with acetic anhydride. Name the aromatic product of this reaction. **(3+2)**

37. (a) Write the steps involved in the mechanism of nucleophilic addition of HCN with aldehyde/ ketone.

(b) Compound "A" undergoes Rosenmund reduction to give compound "B' with molecular formula $C_7H_6O$. compound "B" does not answer Fehling's test. But reacts with conc. NaOH to give compounds "C" and "D". Write two equations involved in this. **(3+2)**

38. (a) Identify 'A', 'B' and 'C' in the following reaction.




(b) Name any one simple test to distinguish between

(i) Propanal and Propanone. (ii) Acetophenone and Benzophenone. **(3+2)**

39. (a) What is Hinsberg's reagent? Write the equations for the reaction of primary and secondary amines with Hinsberg's reagent.

(b) Explain Hoffmann bromamide degradation of benzamide. **(3+2)**

40. (a) Answer the following

(i) Name the protein present in silk.

(ii) Give an example for an optically inactive alpha amino acid?

(iii) Name the vitamin whose deficiency causes Xerophthalmia.

(b) Write the structural and functional difference between DNA and RNA. **(3+2)**

## PART – E (PROBLEMS)

**VII. Answer any three of the following. Each question carries 3 marks.** **3 × 3 = 9**

41. The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. $K_b$ for the benzene is 2.53 $Kkgmol^{-1}$.

42. The rate constants of reactions at 600 K and 700 K are $1.60 \times 10^{-5}\ s^{-1}$ and $6.40 \times 10^{-3}\ s^{-1}$ respectively. Calculate the value of Ea.

43. Calculate the mass of non-volatile solute (molar mass 40 $gmol^{-1}$) which should be dissolved in 114 g octane to reduce its vapour pressure 80%. (Molar mass of octane = 114 $gmol^{-1}$).

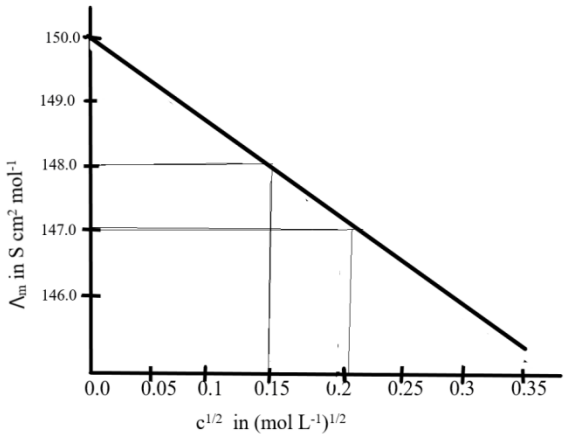
44. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using a current of 10 amperes for 30 minutes. What mass of Ni is deposited at cathode? (Atomic mass of Ni = 58.7, 1 F = 96500 C)

45. The following data were obtained the first order thermal decomposition of $SO_2Cl_2$ at a constant volume: Calculate the rate of the reaction.

$$SO_2Cl_2\,(g) \rightarrow SO_2\,(g) + Cl_2\,(g)$$

| **Experiment** | Time/s-1 | **Total pressure/atm** |
|---|---|---|
| 1 | 0 | 0.5 |
| 2 | 100 | 0.6 |

46. For strong electrolyte, molar conductivity increases slowly with dilution and represented by equation: $\Lambda_m = \Lambda^0_m - A\,c^{1/2}$. The plot of molar conductivity (S $cm^2$ $mol^{-1}$) of strong electrolyte 'X' v/s $c^{1/2}$ (mol $L^{-1})^{1/2}$ is as shown in the figure. Determine the value of 'A' and limiting molar conductivity for solute 'X'




**PART - F**

**(For visually challenged students only)**

34. Define collusion frequency. According to collusion theory, write two factors responsible for effective collusion.

46. At 298 K calculate the emf of the cell in which following reaction takes place

$$Ni(s) + 2Ag^+_{(0.002M)} \longrightarrow Ni^{2+}_{(0.160M)} + 2Ag(s); \quad E^o_{cell} = 1.05V$$

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6th CROSS, MALLESHWARAM, BENGALURU-560003

# 2025-26 II PUC PRACTICE QUESTION PAPER - 3

**Subject:** 34 - Chemistry **Maximum Marks:** 70

**Time:** 3.00 Hours **No. of Questions:** 46

**Instructions**

1. Question paper has FIVE parts. All parts are compulsory.
2. a. Part-A carries 20 marks. Each question carries 1 mark.
   b. Part-B carries 06 marks. Each question carries 2 marks.
   c. Part-C carries 15 marks. Each question carries 3 marks.
   d. Part-D carries 20marks. Each question carries 5 marks.
   e. Part-E carries 09 marks. Each question carries 3 marks.
3. In Part-A questions, **first attempted answer** will be considered for awarding marks.
4. Write balanced chemical equations and draw neat labeled diagrams and graphs wherever necessary.
5. Direct answers to the numerical problems without detailed steps and specific unit for final answer will not carry any marks.
6. Use log tables and simple calculator if necessary (use of scientific calculator is not allowed).
7. For a question having circuit diagram/figure/ graph/ diagram, alternate questions are given at the end of question paper in a separate section for visually challenged students.

## PART-A

**I. Select the correct option from the given choices.** **15 ×1 = 15**

1. The mixture that forms maximum boiling azeotrope at specific concentration is

   (a) heptane + octane (b) water + Nitric acid

   (c) ethanol + water (d) acetone + carbon disulphide

2. When the initial concentration of reactant is doubled in a reaction, its half-life period is not affected.

   Then the order of the reaction is

   (a) First (b) Second (c) More than zero but less than first (d) Zero

3. Statement I: Cu displaces $H_2$ gas from dilute acids.

   Statement II: $Cu^{2+}$ ions get reduced more easily than $H^+$ ions.

   (a) Both Statement I and Statement II are correct.

   (b) Statement I is incorrect but Statement II is correct.

   (c) Both Statement I and Statement II are incorrect.

   (d) Statement I is correct but Statement II is incorrect.

4. Which of the following is an example for vicinal dihalides?

   (a) Dichloromethane (b) Allyl chloride

   (c) Ethylidene dichloride (d) 1,2-Dichloroethane

5. The correct IUPAC name of $K_3\left[Cr(C_2O_4)_3\right]$

   (a) Potassiumtrioxalatochromium(III) (b) Potassiumtrioxalatochromate(III)

   (c) Potassiumtrioxalatochromate(II) (d) Potassiumoxalatochromate (IV)

6. The element having highest magnetic moment is

(a) Zn (b) Cu (c) Mn (d) Ni

7. The oxidation of alcohol to aldehydes involves the cleavage of the bond/s

(a) $O-H$ (b) $C-H$ (c) $O-H$ and $C-H$ (d) $C-C$

8. What will be the change in hybridization of carbon, when a nucleophile attacks the electrophilic center of the carbonyl group?

(a) $sp^2$ to sp (b) $sp^3$ to $sp^2$ (c) $sp^2$ to $sp^3$ (d) sp to $sp^2$

9. Phenol is less acidic than

(a) Ethanol (b) water (c) o-methyl phenol (d) o-nitrophenol

10. An organic compound 'X' on treatment with Pyridinium chlorochromate gives compound 'Y'. Compound 'Y' reacts with $I_2$ and alkali to form triiodomethane, the compound 'X' is

(a) $CH_3COCH_3$ (b) $CH_3CHO$ (c) $C_2H_5OH$ (d) $CH_3COOH$

11. In Arrhenius equation, $k = Ae^{\frac{-Ea}{RT}}$ the factor $e^{\frac{-Ea}{RT}}$ corresponds to

(a) The fraction of molecules that have kinetic energy greater than energy of Activation.

(b) The fraction of molecules that have kinetic energy less than activation energy.

(c) The fraction of molecules that have kinetic energy greater than threshold energy.

(d) The fraction of molecules that have kinetic energy less than threshold energy.

12. The correct electronic configuration of $d^4$ coordination entities in a weak ligand is

(a) $t_{2g}^3 e_g^1$ (b) $t_{2g}^4 e_g^0$ (c) $t_{2g}^2 e_g^2$ (d) $e_{2g}^3 t_g^1$

13. The major product formed when 2-bromopentane reacts with alcoholic KOH

(a) pent-1-ene (b) pent-2-ene (c) pent-2-ol (d) pent-1-ol

14. Among the following, the most basic compound in aqueous phase is

(a) $(C_2H_5)_2NH$ (b) $(C_2H_5)_3N$ (c) $C_2H_5NH_2$ (d) $NH_3$

15. Match the following given in column I with column II and choose the correct option.

| Column I | Column II |
|---|---|
| (i) Vitamin A | (A) Rickets |
| (ii) Vitamin D | (B) Pernicious Anemia |
| (iii) Vitamin $B_{12}$ | (C) Increased blood clotting time |
| (iv) Vitamin K | (D) Xeropthalmia |

(a) i-B, ii-D, iii-A, iv-C (b) i-D, ii-A, iii-B, iv-C

(c) i-D, ii-A, iii-C, iv-B (d) i-A, ii-D, iii-B, iv-C

**II. Fill in the blanks by choosing the appropriate word from those given in the brackets:**

**(magnesium, iron, pseudo first, secondary amine, glucagon, picric acid)** **5 ×1 = 5**

16. The hormone which increases sugar level in blood _____.

17. Chlorophyll is a coordination compound of metal _____.

18. N-methylmethanamine is an example for _____.

19. 2,4,6-trinitrophenol is commonly known as _____.

20. Inversion of cane sugar is an _____ order.

## PART – B

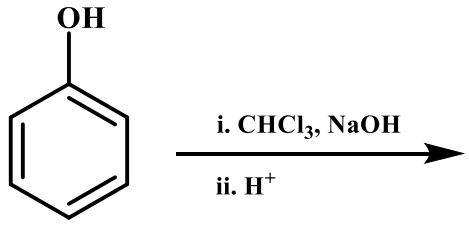
**III. Answer any three of the following. Each question carries 2 marks.** **3 × 2 = 6**

21. What is reverse osmosis? Mention one application of it.

22. What is an ambidentate ligand? Name the type of structural isomerism arises when such ligand presents in the complex.

23. Toluene on treatment with $Cl_2$ in sunlight gives benzyl chloride whereas when treated with $Cl_2$ in dark gives o-chlorobenzene and p-chlorobenzene. Give reason.

24. Complete the following equation and name the reaction.




25. Write the chemical equation to show that glucose contains,

(a) Five hydroxyl groups. (b) Aldehyde group.

## PART – C

**IV. Answer any three of the following. Each question carries 3 marks.** **3 × 3 = 9**

26. The enthalpies of atomization are given in table below. Select the correct enthalpies of atomization of Zinc and Copper correctly. Justify your answer.

| Enthalpy of atomisation/ $kJmol^{-1}$ |
|---|
| 339 |
| 130 |

27. (a) Which metal in the first series of transition metal exhibits +1 oxidation state most frequently and why?
(b) What are interstitial compounds? **(2+1)**

28. Write any three uses of lanthanoids and actinoids.

29. Explain the hybridisation, geometry and magnetic property of $[NiCl_4]^{2-}$ ion on the basis of Valence Bond Theory. [Atomic mass of Ni = 28]

30. Draw the energy level diagram for the splitting of d-orbital in tetrahedral crystal field. Give an example metal complex showing this type of splitting. **(2+1)**

**V. Answer any two of the following. Each question carries 3 marks.** **2 × 3 = 6**

31. Derive an integrated rate equation for the rate constant of a first order reaction.

32. Draw the neat labelled diagram of Standard Hydrogen Electrode. Write its value of electrode potential and half-cell reaction.

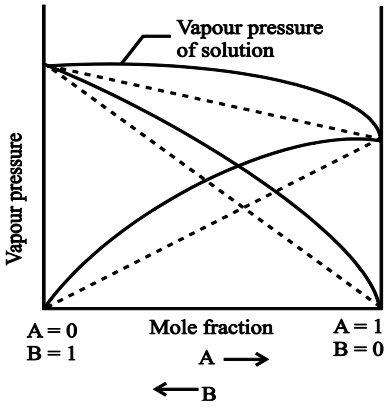
33. State Kohlrausch law. Mention two applications of it.

34. For this graph; answer the following questions

a) What type of non-ideal solution shows such a behavior?

b) Give example for such type of non - ideal solution.

c) What type of azeotrope will the mixture of A and B form?




## PART – D

**VI. Answer any four of the following. Each question carries 5 marks.** **4 × 5 = 20**

35. (a) Identify the carbohydrates and give any one difference between these carbohydrates present in cane sugar and carbohydrate present in milk.

(b) What are essential amino acids? Give an example.

(c) Name the nitrogenous base present in RNA but not in DNA. **(2+2+1)**

36. (a) How do you convert benzene diazonium chloride to p-aminoazobenzene? Give the equation.

(b) How is methanamine prepared by Hoffmann's bromamide degradation? Write equation.

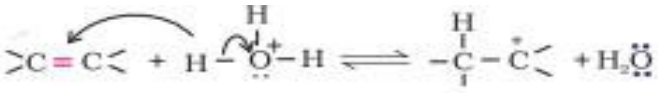
(c) Give the IUPAC name of $(CH_3)_2N–C_2H_5$ **(2+2+1)**

37. (a) How is benzoyl chloride converted to benzaldehyde? Write the chemical equation and name the reaction.

(b) Explain Aldol condensation reaction with an example. **(3+2)**

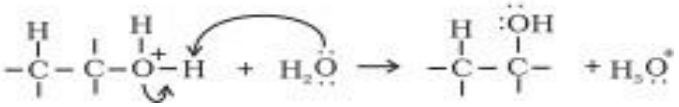
38. (a) The mechanism of formation of alcohols from alkenes is given below. identify the errors in the mechanism and rewrite the corrected steps.

STEP 1



STEP 2

STEP 3



(b) Write the equations for the reaction of concentrated Hydrogen iodide with

(i) Methoxybenzene (ii) Methoxyethane **(3+2)**

39. (a) An organic compound (A) molecular formula $C_4H_8O_2$ was hydrolysed with dil. sulphuric acid to give a carboxylic acid (B) and an alcohol (C). Oxidation of (C) with Jones reagent produces (B). (C) On dehydration with conc. $H_2SO_4$ at 443 K gives ethene. Write equations for the reactions involved in this.

(b) Explain Hell-Volhard-Zelinsky reaction with an example. **(3+2)**

40. (a) Write the equations for the steps involved in the mechanism for the conversion of tert-butyl bromide to tert-butyl alcohol. Among polar protic solvent and non-polar solvent, name the type of solvent generally used in $SN^1$ reaction.

(b) Explain Friedel-Craft's alkylation for chlorobenzene. Give equation. (3+2)

**PART – E (PROBLEMS)**

**VII. Answer any three of the following. Each question carries 3 marks. 3 × 3 = 9**

41. 100 g of liquid 'A' (molar mass $140\,g\,mol^{-1}$) was dissolved in 1000 g of liquid 'B' (molar mass $180\,g\,mol^{-1}$). The vapour pressure of pure liquid 'B' was found to be 500 torr. Calculate the vapour pressure of liquid 'A' and its vapour pressure in the solution if the total vapour pressure of the solution is 475 torr.

42. Calculate the equilibrium constant of the reaction at 298 K. $Cu_{(s)} + 2Ag^{+}_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + 2Ag_{(s)}$.

Given $E^{o}_{cell} = 0.46\,V$.

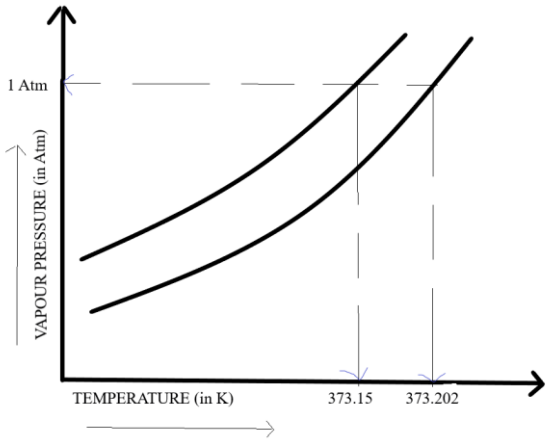
43. The molar conductivity of 0.025 $molL^{-1}$ methanoic acid is 46.1 $Scm^2mol^{-1}$. Calculate its degree of dissociation. Given: $\lambda_{(H^+)} = 349.6\ Scm^2mol^{-1}$ and $\lambda_{(HCOO^-)} = 54.6\ Scm^2mol^{-1}$.

44. The rate of a reaction quadruples when the temperature changes from 293 K to 313. Calculate the energy of activation of the reaction assuming that it does not change with temperature.

[Given: $R = 8.314\,JK^{-1}mol^{-1}$]

45. Sucrose decomposes in acidic solution into glucose and fructose according to the first order rate law with $t_{\frac{1}{2}} = 3.00$ hrs. What fraction of sample of sucrose remains after 8 hours?

46. The vapour pressure (in Atm) curve for solution containing non-volatile solid substance "G' and pure solvent is plotted against temperature (in K) is as shown in figure. Calculate the molality of the solution. (Kb for water is 0.52 K Kg $mol^{-1}$).




**PART - E**

**(For visually challenged students only)**

34. Write any three differences between ideal and non-ideal solutions. **(3 M)**

46. The boiling point of benzene is 353.25 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. $K_b$ for benzene is $2.35\,K\,Kg\,mol^{-1}$. **(3 M)**

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**Department of School Education (Pre-University),** 18th Cross, Malleshwaram Bengaluru- 560012;

**and**

**Karnataka School Education and Assessment Board,** 6th Cross, Malleshwaram Bengaluru- 560003

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