CLASS-XII (CBSE)

Chemistry

Workbook Cum Question Bank with Answers

SCHEDULED CASTES & SCHEDULED TRIBES
RESEARCH & TRAINING INSTITUTE (SCSTRTI)
ST & SC DEVELOPMENT DEPARTMENT
BHUBANESWAR

CHEMISTRY

Workbook Cum Question Bank with Answers

CLASS-XII (CBSE)

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UNIT - I

SOLUTIONS

I. Select the correct answer from the choices given under each bit :

1. Molality is expressed in

(a) g/L (b) L/mol.

(c) mol L^{-1} (d) mol. kg^{-1}

2. The relative lowering of vapour pressure is proportonal to the ratio between the number of _____

(a) solute molecules to solvent molecules

(b) solute molecules to the total number of molecules in solution

(c) solvent molecules to total number of molecules in solution

(d) solvent molecules to total number of ions in solution

3. At 398 K, the highest osmotic pressure is expected by 0.1 M solution of _____

(a) $CaCl_2$ (b) KCl

(c) Glucose (d) Urea

4. Which of the following salts will have the same value of Van't Hoff factor (i) as that of potassium ferrocyanide ?

(a) NaCl

(b) Aluminium Chloride

(c) Ferric sulphate

(d) Ferrous sulphate

5. An elevation of boiling point of solution of 10% of solute (Mol. Mass = 100) is 100g of water is ΔT_b. The ebullioscopic constant for water is_____

(a) 10 (b) $10\Delta T_b$

(c) ΔT_b (d) $\Delta T_b / 10$

6. Which of the following concentration term is not affected by temperature ?

(a) Normality (b) Molality

(c) Molarity (d) Formality

7. A 5% solution of canesugar (Molar Mass = 342 g/mol) is isotonic with 1% solution of a substance X. The molar mass of x is _____

(a) 171.2 (b) 68.4

(c) 34.2 (d) 136.2

8. Which of the following has highest b.p. under 1 atm pressure?

(a) 0.1 M NaCl (b) 0.1 M sucrose

(c) 0.1 M $BaCl_2$ (d) 0.1 M glucose

9. An aqueous solution freezes at -0.186^{0}C (K_f = 1.86 K. kg mol^{-1}, K_b = 0.512 K. kg. mol^{-1}). The b.p. of the solution will be _____ ^{0}C.

(a) 100.186 (b) 100.512

(c) 100.86 (d) 100.512

10. For determination of molar mass of colloids, polymers and proteins, colligative property preferred is _____.

(a) diffusion pressure

(b) relative lowering of vapour pressure

(c) osmotic pressure

(d) depression in freezing point

11. Colligative properties of solutions are those properties which depend on :

(a) shape of the particles

(b) nature of solvent

(c) nature of particles

(d) number of particles

12. 2.5 L of 1 M NaOH is mixed 3L of 0.5 M HCl. The solution is _____ and molarity is _____.

(a) alkaline, 0.18 m.

(b) acidic, 0.1 m.

(c) alkaline, 1.8 m

(d) alkaline, 0.018 m.

13. What is the concentration of KCl (aq) that could be used in blood stream to have the osmotic pressure 7.8 bar at 310K ?

(a) 0.16 m (b) 0.32 m

(c) 0.60 m (d) 0.45 m

14. The Van't Hoff factor for a solute that associates in solution is _____.

(a) Zero (b) 1.0

(c) Less than 1.0 (d) more than 1.0

15. For an ideal solution of two volatile liquids (1 and 2), the total vapour P_{total} is represented as :

(a) $P_{total} = x_1 p_1^0 + x_2 p_2^0$

(b) $P_{total} = p_1^0 + (p_2^0 - p_1^0)x_2$

(c) the total vapour pressure over the solution varies linearly with mole fraction of one component

(d) all are correctly represented

16. Choose the incorrect statement :

(a) The composition of vapour phase i.e. above the solution obeys Dalton's law

(b) At equilibrium, vapour phase will be always rich in the component which is more volatile

(c) When $x_2 = 0$, the vapour pressure represents p_2^0

(d) Higher the alue of K_H at a given pressure lower is the solubility of the gas in liquid

17. Increasing the temperature of an aqueous solution will cause

(a) molality to decrease

(b) molarity to decrease

(c) mole fraction to decrease

(d) wt % to increase

18. The boiling point of equimolal aqueous solution will be minimum for

(a) benzene diazonium chloride

(b) calcium nitrate

(c) silver chloride

(d) glucose

19. An X molal solution of a compound in benzene has mole fraction of solute equal to 0.2. The value of X is nearly _____.

(a) 14 (b) 3.2

(c) 1.4 (d) 2

20. molarity of liquid HCl if density of solution is 1.17 g/mL is

(a) 36.5 (b) 18.25

(c) 32.05 (d) 42.10

21. The depression in freezing point, ∇T_f is directly proportional to

(a) mole fraction of the solution

(b) molarity of the solution

(c) molality of the solution

(d) moles of the solvent

22. Normality of 0.3 M phosphorous acid (H_3PO_3) is _____.

(a) 0.5 (b) 0.6

(c) 0.9 (d) 0.1

23. An azeotropic solution of two liquids has boiling point lower than either of two when it :

(a) shows a negative deviation from Raoult's law

(b) shows no deviation from Raoult's law

(c) shows positive deviation from Raoult's law

(d) is saturated

24. Benzoic acid undergoes dimerization in benzene solution. The Van't Hoff factor (i) is related to the degree of association (x) of the acid as

(a) $i = 1 - x$ (b) $i = 1 + x$

(c) $i = 1 - \frac{x}{2}$ (d) $i = 1 + \frac{x}{2}$

25. Which of the following 0.1 m eqeous solution will have the lowest freezing point?

(a) $Al_2(SO_4)_3$ (b) $C_6H_{12}O_6$

(c) Urea (d) KI

26. The volume of water to be added in 100 cc of 0.5 N H_2SO_4 to get decinormal solution is :

(a) 100 cc (b) 450 cc

(c) 400 cc (d) 500 cc

27. 18g glucose is dissolved in 1 kg of water in a saucepan, the boiling point of the solution is _____ K.

(a) 373.052 (b) 100.052

(c) 101 (d) 273

28. The boiling point of benzene is 353.23 K. When 1.80g of non-volatile solute was dissolved in 90g benzene, the boiling point is raised to 354.11 K. The molar mass of the solute is_____. (K_b for benzene is 2.53 K. kg. mol^{-1})

(a) 57.5 (b) 56.5

(c) 5.75 (d) 157.5

29. Which of the following is not the characteristic of ideal solution?

(a) $\Delta_{mix} H = 0$

(b) $\Delta_{mix} V = 0$

(c) A - A and B - B interaction $\neq$ A - B interaction

(d) Cohesive interaction is same as adhesive interaction

30. Which of the following is not an ideal solution?

(a) n-hexane, n-heptane

(b) Bromoethane and Chloroethane

(c) Benzene and toluene

(d) Acetone and Chloroform

31. The molal depression constant depends upon

(a) nature of the solute

(b) nature of the solvent

(c) vapour pressure of the solution

(d) heat of solution of the solute in the solvent

32. Equimolar solutions in the same solvent have

(a) same b.p (boiling point) but different freezing point

(b) same freezing point but different boiling point

(c) same boiling point and same freezing point

(d) different boiling point and different freezing point.

33. Which of the following is a colligative property?

(a) boiling point

(b) freezing point

(c) osmotic pressure

(d) vapour pressure

34. Which of the following expression represents Van't Hoff factor ?

(a) $i = \frac{\text{normal molar mass}}{\text{abnormal molar mass}}$

(b) $i = \frac{\text{abnormal molar mass}}{\text{normal molar mass}}$

(c) $i = \frac{\text{normal colligative property}}{\text{observed colligative property}}$

(d) None of the above

35. During osmosis, flow of water through a semipermeable membrane is

(a) from both sides of semipermeable membrane with unequal flow rates

(b) from solution having higher concentraton only

(c) from solution having lower concentration only

(d) from both sides of semipermeable membrane with equal flow rates

36. If an aqueous solution of glucose is allowed to freeze, then crystals of which will be separated out first.

(a) glucose (b) water

(c) both of these (d) none of these

37. Concentrated aqueous H_2SO_4 is 98% by mass and has density of 1.80 $g.mL^{-1}$. Volume of the acid required to make 1 litre of 0.1 M H_2SO_4 is

(a) 5.55 ml (b) 11.10 ml

(c) 16.65 ml (d) 22.20 ml

38. A solution of acetone in ethanol

(a) behaves like a near ideal solution

(b) Obeys Raoult's law

(c) shows a negative deviation from Raoult's law

(d) shows positive deviation from Raoult's law

39. Comphor is often used in molecular mass determination because

(a) it is readily available

(b) it has a very high cryoscopic constant

(c) it is volatile

(d) it is solvent for organic substance

40. A pressure cooker reduces cooking time because :

(a) heat is more evenly distributed

(b) the higher pressure tenderises the food

(c) the boiling point of water inside the cooker is elevated

(d) the boiling point of water inside the cooker is depressed

41. Azeotropic mixture of HCl and H_2O has

(a) 48% HCl (b) 20.2% HCl

(c) 22.2% HCl (d) 36% HCl

42. The depression in freezing point for 1M urea, 1M glucose and 1 M NaCl are in ratio

(a) 3 : 2 : 2

(b) 1 : 2 : 3

(c) 1 : 1 : 2

(d) none of the above

43. The aqueous solution that has lowest vapour pressure at a given temperature is

(a) 0.1 molal barium chloride

(b) 0.1 molal sodium chloride

(c) 0.1 molal glucose

(d) 0.1 molal sodium phosphate

44. A solute is soluble in two immiscible liquids which are present in a mixture. The concentration of the solute in the upper layer will be :

(a) less than in the lower layer

(b) more than in the lower layer

(c) in fixed ratio with that in the lower layer

(d) same as in the lower layer

45. The averge osmotic pressure of human blood is 7.8 bar at 37^0C. What is the concentration of an aqueous NaCl solution that could be used in the blood stream ?

(a) 0.60 mol/L (b) 0.45 mol/L

(c) 0.30 mol/L (d) 0.15 mol/L

46. Maximum freezing point falls in

(a) Naphthalene (b) Camphor

(c) Water (d) Benzene

47. If α is the degree of dissociation of Na_2SO_4, the Van't Hoff factor (i) used for calculating the molecular mass is

(a) $1-\alpha$ (b) $1-2\alpha$

(c) $1+\alpha$ (d) $1+2\alpha$

48. The ionic strength of a solution containing 0.1 mol/kg of KCl and 0.2 mole/kg of $CuSO_4$ is :

(a) 0.3

(b) 0.9

(c) 0.6

(d) 0.2

49. Which has the highest freezing point ?

(a) 1 m KCl solution

(b) 1 m $K_4[Fe(CN)_6]$ solution

(c) 1 m $C_6H_{12}O_6$ solution

(d) 1 m rock salt solution

50. The solution which has the lowest freezing point is

(a) 0.1 M potassium nitrate

(b) 0.1 M potassium sulphate

(c) 0.1 M alumunium sulphate

(d) 0.1 M potassium chloride

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

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

II. Short Questions

Q.1. Which out of molality, molarity and mole fraction of a solution will remain unchanged on raising the temperature and why?

Ans. Mole fraction and molality depend upon masses and do not change with temperautre. Where as molarity depends upon volume which changes with change in temperature.

Q.2. State Raoult's law. Derive its mathematical expression.

Ans. The vapour pressure of the solution containing non-volatile solute is directly proportional to the mole fraction of the solvent.

In a solution containing two components A (solvent) and B (solute-non-volatile). So the vapour pressure $P_A = P_A^0 X_A$ and $P_B = P_B^0 X_B$ where X_A and X_B are mole fractions and P_A^0, P_B^0 are vapour pressure at pure state of each component.

Total $P = P_A + P_B = P_A^0 X_A + P_B^0 X_B = P_A^0 (1 - X_B) + P_B^0 X_B$

$= P_A^0 - P_A^0 X_B + P_B^0 X_B = P_A^0 - (P_A^0 - P_B^0) X_B$

So the total pressure is a linear function of mole fraction.

Q.3. Show that the relative lowering of vapour pressure for a solution is equal to the mole fraction of the solute in volalile solvent.

Ans. Vapour pressure of solution = molefraction of the solvent x vapour pressure of pure solvent

i.e. $P_S = X_1 x P_0$ or $\frac{P_S}{P_0} = X_1 = \frac{n_1}{n_1 + n_2}$ or $1 - \frac{P_S}{P_0} = 1 - \frac{n_1}{n_1 + n_2}$ or $\frac{P_0 - P_S}{P_0} = \frac{n_2}{n_1 + n_2} = X_2$

(mole fraction of solute)

Q.4. Explain the term ideal solution.

Ans. The ideal solution in which

(i) no change in volume on mixing the two components, $\Delta V_{mix} = 0$

(ii) no change in ethalpy, $\Delta H_{mix} = 0$

Q.5. How does non-ideal solution differ from ideal solution ?

Ans.

Ideal solution	**Non-ideal solution**
(i) Obey's Raoult's law i.e. $P_A = P_A^0 X_A$ and $P_B = P_B^0 X_B$	(i) $P_A \neq P_A^0 X_A$, $P_B \neq P_B^0 X_B$
(ii) $\Delta H_{mix} = 0$	(ii) $\Delta H_{mix} \neq 0$
(iii) $\Delta V_{mix} = 0$	(iii) $\Delta V_{mix} \neq 0$

Q.6. Define the term calligative property.

Ans. Those properties of ideal solutions which depend only on the number of particles of the solute dissolved in a difinite amount of the solvent and do not depend on the nature of solute, are called colligative property.

Q.7. Show that relative lowering of vapour pressure is a colligative property.

Ans. $P_A = P_A^0 X_A$ Where P_A = Vap. pr. of solvent P_A^0 = vapour pressure of solvent at pure state and X_A= molefraction of solvent.

But mole fraction of solute $= X_B = \frac{n_B}{n_A + n_B}$

As $X_A + X_B = 1$ or $X_A = 1 - X_B$

On substitution $P_A = P_A^0(1 - X_B) = P_A^0 - X_B P_A^0$ or $P_A^0 - P_A = P_A^0 X_B$ or $\frac{P_A^0 - P_A}{P_A^0} = X_B$

Where $\frac{P_A^0 - P_A}{P_A^0} =$ relative lowering of vapour pressure

and X_B depends upon number of moles of solute.

Q.8. Define Osmosis and Osmotic pressure.

Ans. **Osmosis :** The spontaneous flow of solvent molecules from the solvent to the solution or from a less concentrated solution to a more concentrated solution through a semipermeable membrane is called osmosis.

Osmotic Pressure : The excess hydrostatic pressure that has to be applied on the solution to prevent the entry of solvent into the solution through the semiprermeable membrane is called osmotic pressure.

Q.9. How the osmotic pressure depends upon the number of moles of the solute?

Ans. The osmotic pressure (π) is related to concentration and temperature i.e. $\pi \alpha$ C x T or $\pi = R'CT$ where R' = solution constant.

But $C = \frac{n}{V}$ where n = number of moles, V = volume of the solution

$\therefore \pi = R' \frac{n}{V} T$ or $\pi V = nR'T$

This equation is known as Van't Hoff's solution equation.

Q.10. Explain why freezing point is lowered on dissolving a non-volatile solute into it.

Ans. When non-volatile solute is added to the solvent, the solute molecules occupy the space on the surface, so vapour pressure decreases. Hence freezing point is lowered.

Q.11. Why do electrolytes show abonormal molecular masses ? Name the factors responsible for abnormality.

Ans. In case of aqueous solutions of electrolyte; some acids and some inorganic bases like NaOH, KOH or salts like NaCl, KCl, KNO_3 dissociate and the number of particles in solution increaes. Similarly certain substances associate such as CH_3COOH and benzoic acid in benzene. So number of particles decreases. As a result colligative property changes so as the molecular mass.

Q.12. What is Van't Hoff's factor?

Ans. It is the ratio of the experimental value of the colligative property to the calculated value of the colligative property, that is Van't Hoff's factor (i).

$$i = \frac{\text{Experimental Colligative Property}}{\text{Calculated Value of Colligative Property}}$$

$$= \frac{\text{Normal (Calculated) Molar Mass}}{\text{Observed (experimental) Molar Mass}}$$

Q.13. State Henry's Law what is its significance?

Ans. The solubility of a gas at a given temperature is directly proportional to the pressure of the gas at which it is dissolved. It is written as $P_A = K_H X_A$ (where P_A = Partial pressure, X_A= Mole fraction, K_H = Henery's constant)

At constant temperature for the same partial pressure of different gases, $X_A \alpha \frac{1}{K_H}$. That is the solubility is inversely proportional to Henry's constant of the gas. Higher the value of K_H, lower is the solubility.

Q.14. What is molal elevation constant?

Ans. Molal elevation constant is the elevation in its boiling point when one mole of non-volatile solute is dissolved per kilogram of solvent. (Unit is K. kg. mol^{-1})

Q.15. Derive the relationship between depression in freezing point and the molality.

Ans. The depression in freezing point is $\Delta T_f = K_f m$. Where K_f= molal depression constant.

And m (molality of the solution) $= \frac{W_B}{M_B} \frac{1000}{W_A}$.

Where W_A = Mass of solvent, W_B = Mass of solute. M_B = Molar mass of the solute.

$$\therefore M_B = \frac{K_f \times W_B \times 1000}{W_A \times \Delta T_f}$$

Q.16. What are isotonic solutions ? Give one example.

Ans. Solutions having equal osmotic pressure eg. 0.1 M glucose and 0.1 M sucrose solutions.

Q.17. Define molal depression constant.

Ans. The depression in freezing point that takes place when the molality of the solution is unity.

Q.18. What is the purpose of sprinkling common salt on ice slit ?

Ans. Common salt lowers the freezing point of water to such an extent that it does not freeze to form ice. hence it is used to sprinkle on ice slit.

Q.19. Why NaCl solution freezes at lower temperature than water but boils at higher temperature than water ?

Ans. When the solute (NaCl) is dissolved ina solvent (water), the vapour pressure decreases. As a result, the solution boils at a higher temperature while solvent freezes at lower temperature.

Q.20. When the Vant' Hoff factor is more than one ?

Ans. When the solute undergoes dissociatoin in the solution, then i>1.

Q.21. How is molality of a solution different from its molarity ?

Ans. Molality of a solution is the number of moles of the solute present in 1 kg of the solvent and does not change with temperautre. Molarity of a solution is the number of moles of the solute present in 1 litre of the solution and changes with temperature.

Q.22. What is reverse osmosis ?

Ans. Reverse osmosis occurs when pressure greater than osmotic pressure is applied on the solution.

Q.23. Why does water from the soil rise to the top of a tall tree ?

Ans. Due to osmosis, the roots pass the water which acts as semipermeable membrane of root cell walls and pass to the top of the tall tree.

Q.24. Which substance usually added into water in the car radiator to act as antifreeze?

Ans. Ethyleneglycol is added to water to lower the freezing point.

Q.25. What is the condition of non-ideal solutions to show negetive deviation ?

Ans. If new forces of interaction between the components are greater than those in the pure components, then only non-ideal solution will show negative deviation.

UNIT - II

ELECTROCHEMISTRY

I. Select the correct answer from the choices given under each bit :

1. The unit of equivalent conductance is :

(a) $Ohm^{-1} . cm^{-1}$ (b) $Ohm^{-1} . cm^{-2}$

(c) $Ohm^{-1} . cm^{-2}$ (d) None of these

2. Effect of dilution on conductance is :

(a) Specific conductance increases, molar conductance decreases

(b) Specific conductance decreases, molar conductance increases

(c) Both decrease in dilution

(d) Both increase in dilution

3. In Daniell cell, $Zn/ZnSO_4$ II $CuSO_4/Cu$

(a) Zinc undergoes oxidation and copper undergoes reduction

(b) Zinc undergoes reduction and copper undergos oxidation

(c) Oxidation reduction does not take place

(d) Oxidation takes place both sides

4. In the electrolytic cell, flow of electrons is from

(a) Cathode to anode in the solution

(b) Anode to cathode through internal supply

(c) Cathode to anode through external supply

(d) Cathode to anode through internal supply

5. The molar conductivity of a strong electrolyte :

(a) increases linearly with concentration

(b) increases with square root of concentration in a linear fashion

(c) decreases linearly with concentration

(d) decreases with square root of concentration in a linear fashion

6. Which of the following is false ?

(a) Saline water increases rusting

(b) In Daniell cell, if concentrations of the solutions are doubled, the emf of the cell is also doubled

(c) Emf of the cell is intensive quantity and free energy change in extensive quality

(d) Galvanised iron sheets remain protected from rusting even if a crack is developed

7. Conductivity of an electrolytic solution depends on :

(a) nature of electrolyte

(b) concentration of electrolyte

(c) power of AC source

(d) distance between the electrodes

8. **Arrange the following metals in order of reactivity.**
Cu, Fe, Zn, Ag

(a) Zn > Cu > Fe > Ag

(b) Zn > Fe > Ag > Cu

(c) Zn > Fe > Cu > Ag

(d) Fe > Zn > Cu > Ag

9. **The metal is used for cathodic protection of iron against rusting**

(a) Zn (b) Cu

(c) Cd (d) Pb

10. **In an electrochemical cell**

(a) Potential energy changes into electrical energy

(b) Chemical energy changes into electrical energy

(c) Kinetic energy decreases

(d) Potential energy decreases

11. **Which of the following decreases with dilution**

(a) Conductance

(b) Specific conductance

(c) Equivalent conductance

(d) Molar conductance

12. **The standard electrode potential of Normal Hydrogen Electrode (NHE) is**

(a) 1 (b) 1.5

(c) 100 (d) Zero

13. **The salt bridge is used in an electrochemical cell because :**

(a) electrons flow from anode to cathode

(b) ions flow from one solution to the other

(c) it enhances the +ve ions in the solution

(d) it may be eliminated to achieve electrical neutrality

14. **If n-electrons are involved in the electrode reaction, the passage of electricity required to liberate one mole of the substance is :**

(a) 24125 C (b) 96500 C

(c) $\frac{96500}{n}$ C (d) n x 96500 C

15. **For strong electrolytes, the plot of molar conductnce vs $\sqrt{c}$ is**

(a) parabolic (b) circular

(c) linear (d) sinusoidal

16. **The best way to prevent rusting of iron is by**

(a) making iron anode

(b) making iron cathode

(c) putting it in saline water

(d) none of these

17. **In which cell the free energy of chemical reaction is directly converted into electricity.**

(a) Leclanche cell

(b) Concentration cell

(c) Fuel cell

(d) Lead storage battery

18. The electrolysis of aqueous NaCl solution gives.

(a) Na and Cl_2 (b) Na & Cl

(c) H_2 and Cl_2 (d) Na and H_2

19. For measuring electrolytic conductance, the current is used

(a) Only AC (b) Only DC

(c) Both AC & DC (d) None of these

20. Conductance is

(a) directly proprotional to resistance

(b) inversibly proportional to resistance

(c) equal to the resistane

(d) none of these

21. Each ion makes a definite contribution to the total molar conductivity of an electrolyte at infinite dilution, is

(a) Ohm's Law

(b) Arrhenius Rule

(c) Nernst Rule

(d) Kohlrausch's Rule

22. The relationship between free energy ΔG and EMF of the cell is

(a) $\Delta G = nFE$ (b) $\Delta G = -nFE$

(c) $E = \frac{\Delta G}{n}F$ (d) $\Delta G = \frac{EF}{n}$

23. Zinc reacts with dilute H_2SO_4 to give gas but copper does not, because

(a) Zinc has higher oxidation potential than hydrogen

(b) Zinc has lower oxidation potential than hydrogen

(c) Copper has higher oxidation potential than hydrogen

(d) none of these

24. The EMF of the cell is

(a) The difference between electropotentials of two half cells

(b) The differene between potentials of two cells

(c) The electrode potential of two cells

(d) The electrode potential of different cells

25. The reduction potential of an electrode increases.

(a) with decrease in concentration of the ions

(b) with addition of other salt solution

(c) with increase in concentration of ions

(d) with the removal of power suply to the cell

26. The EMF of the cell, when the cell attains equlibrium is :

(a) 1 (b) Zero

(c) Maximum (d) 0.0591

27. Which metal can be used in cathodic protection of iron.

(a) Na (b) Cd

(c) Li (d) Zn

28. Which type of cell is used in hearing aids ?

(a) Zn/MnO_2 Cell

(b) Zn / HgO

(c) Lead Storge Battery

(d) Fuel Cell of H_2 - O_2

29. An electrochemical cell stops working after sometime because.

(a) one of the electrodes is consumed

(b) electrode potentials of both electrodes go on decreasing

(c) electrode potential of both the electordes becomes equal in magnitude

(d) electrode potential of both the electrodes go on increasing

30. Which of the following statement is true for Daniell Cells

(a) Current flows from Zn electrode to Cu electrode

(b) Cations move towards Cu electrode

(c) Electrons flow from Cu electrode to Zn electrode

(d) Cations move towards Zn electrode

31. Which of the following materials are used in making mercury cell

(a) Mercury - Zinc oxide

(b) Zinc - Zinc oxide

(c) Zinc - Mercuric oxide

(d) Mercury - ammonium chloride

32. The unit of conductance is

(a) $S\ m^2\ mol^{-1}$ (b) $S\ m^{-1}$

(c) m^{-1} (d) S (Siemens)

33. Specific conductance

(a) decreases with dilution

(b) decreases with increse in concentration

(c) shows no variation with dilution

(d) has no effect on concentration

34. When lead storage battery is discharged

(a) SO_2 is evolved

(b) lead sulphate is consumed

(c) lead is formed

(d) sulphuric acid is consumed

35. Which of the following ions has highest limiting molar conductivity ?

(a) Mg^{2+} (b) Ca^{2+}

(c) Na^+ (d) K^+

36. A standard hydrogen electrode has zero electrode potential because

(a) hydrogen is easier to oxidise

(b) this electrode potential is assumed to be zero

(c) hydrogen atom has only one electron

(d) hydrogen is the lightest element

37. Zn gives H_2 gas with H_2SO_4 and HCl but not with NHO_3 because

(a) Zn acts as an oxidising agent when reacts with HNO_3

(b) HNO_3 is weaker acid than H_2SO_4 and HCl

(c) In electrochemical series, Zn is above hydrogen

(d) NO_3^- is reduced in preference to hydronium ion

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

(a) Velocity of K^+ is greater than than 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 highly soluble in water

39. The conductivity of strong electrolyte

(a) increases slightly on dilution

(b) decreaes on dilution

(c) does not change with dilution

(d) depends upon the density of electrolyte

40. The molar conductivities $\overset{0}{\Lambda}_{NaOAc}$ and $\overset{0}{\Lambda}_{HCl}$ at infinite dilution in water at 25^0C are 91.0 and 426.2 $ohm^{-1}.cm^2.mol^{-1}$ respectively. To calculate $\overset{0}{\Lambda}_{HOAC}$ the additional value required is

(a) $\overset{0}{\Lambda}_{NaOH}$ (b) $\overset{0}{\Lambda}_{NaCl}$

(c) $\overset{0}{\Lambda}_{H_2O}$ (d) $\overset{0}{\Lambda}_{KCl}$

41. If half cell reaction $A + e^- \rightarrow A^-$ has a large negative reduction potential, it follows that

(a) A is readily reduced

(b) A^- is readily reduced

(c) A is readily oxidised

(d) A^- is readily oxidised

42. For the cell reaction

$Cu^{2+}_{(C_1\ aq)} + Zn(S) \rightarrow$

$Zn^{2+}(C_2 aq) + Cu(S)$

of an electrochemical cell, the change in free energy ΔG, at a given temperature is a function of

(a) $\ln C_2$ (b) $\ln C_1$

(c) $\ln(C_2/C_1)$ (d) $\ln(C_1 + C_2)$

43. Equivalent conductance of NaCl and C_2H_5COONa at infinite dilution are 126.45, 42.16 and 91 $ohm^{-1}.cm^2$ respectively. The equivalent conductance of C_2H_5COOH is

(a) 390.71 $ohm^{-1}.cm^2$

(b) 698.28 $ohm^{-1}.cm^2$

(c) 540.48 $ohm^{-1}.cm^2$

(d) 201.28 $ohm^{-1}.cm^2$

44. The ionic conductance of Ba^{2+} and Cl^- are respectively 127 and 76 $ohm^{-1}.cm^2$ at infinite dilution. The equivalent conductance (in $ohm^{-1}.cm^2$) of $BaCl_2$ at infinite dilution will be

(a) 101.5 (b) 139.5

(c) 203 (d) 279

45. As lead storage battery is charged

(a) lead electrode becomes coated with lead sulphate

(b) lead dioxide dissolves

(c) sulphuric acid is regenerated

(d) the concentration of sulphuric acid decreases

46. In electrolysis of NaCl, when platinum electrode is taken, then H_2 is liberated at the cathode while with mercury cathode it forms sodium amalgam. This is because

(a) Hg is more inert than Pt.

(b) Na is dissolved in Hg while it does not dissolve in Pt.

(c) more voltage is required to reduce H^+ at Hg than Pt.

(d) Conc. of H^+ ions is larger when Pt. electrode is taken

47. What is the emf of the given cell ?

$Pt|H_2(p_1)|H^+(aq)|H_2(p_2)|Pt$

(a) $\frac{RT}{F}\ln\frac{p_1}{p_2}$ (b) $\frac{RT}{F}\ln\frac{p_2}{p_1}$

(c) $\frac{RT}{2F}\ln\frac{p_1}{p_2}$ (d) none of these

48. The highest electrical conductivity of the following aqueous solutions is of

(a) 0.1 M difluoroacetic acid

(b) 0.1 M fluoracetic acid

(c) 0.1 M chloroacetic acid

(d) 0.1 M acetic acid

49. The charge required for the reduction of 1 mol of $KMnO_4^-$ to MnO_2 is

(a) 5 F (b) 6 F

(c) 3 F (d) 1 F

50. When a strip of copper is dipped in a solution of ferrous sulphate,

(a) copper is precipitated

(b) iron is deposited on the copper strip

(c) copper dissolves

(d) no reaction occurs

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

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

II. Short Questions

Q.1. Illustrate the differences between electrochemical cell and electrolytic cell.

Ans.

Electrochemical Cell	**Electrolytic Cell**
(i) It is the device to convert chemical energy into electrical enregy.	(i) It is the device to convert electrical energy to chemical energy.
(ii) It is spontaneous redox reaction	(ii) It is non-spontaneous redox reaction.
(iii) Salt bridge is used	(iii) No salt bridge is used

Q.2. What is the relationship between Gibb's free energy ΔG and electrial energy E_{Cell}?

Ans. $-\Delta G = nFE_{Cell}$ where ΔG = Gibb's free energy. (Work done)
Electrical work done where n = number of electrons.
F= Faraday, E_{Cell} = EMF fof the Cell

Q.3. Calculate E^0_{Cell} of the cell Zn/Zn^{2+} II Cu^{2+}/Cu.
Where $E^0_{Zn,Zn^{2+}} = -0.76$ Volt , $E^0_{Cu,Cu^{2+}} = 0.34$ Volt

Ans. E^0_{Cell} = Standard Electrode Potential of Right hand side - Standard Electrode Potential of Left hand side
= Reduction potential of Cu electrode - Reduction Potential of Zn electrode
= 0.34 Volt - (- 0.76) Volt
= 1.10 Volt

Q.4. State Kohlrausch's law. How will you calculate λ^0 of $Ba(OH)_2$ with the help of this law ?

Ans. Kohlrausch law for Ax By = $x\lambda^0_+ + y\lambda^0_-$
For $Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$
$\wedge^0_{Ba(OH)_2} = \lambda^0_{Ba^{2+}} + 2\lambda^0_{OH^-}$

Q.5. Define the terms : specific conductance and equivalent conductance.

Ans. Specific Conductance = Conductance of one centrimeter cube of the solution of the electrolyte i.e. $K = \frac{1}{\rho} x \frac{l}{a}$

Equivalent Conductance $\wedge_{eq} = K \times \frac{1000}{\text{Normality}}$

Q.6. Write notes on reduction and oxidation potential.

Ans. Oxidation potential, if oxidation takes place at the electrode with respect to standard hydrogen electrode.

Reduction potential, if reduction takes place at the electrode with respect to standard hydrogen electrode.

Q.7. What is secondary cell? Give the cell reaction of Nickel-Cadmium storage cell.

Ans. The secondary cells are those which can be recharged by passing an electric current through them and then can be used over and again.

Nickel - Cadmium cell consists of a cadmium electrode (as anode) and a metal containing Nickel (IV) oxide (as cathode) immersed in KOH solution.

At anode $Cd(s) + 2OH^-_{aq} \rightarrow Cd(OH)_{2(S)} + 2e^-$

At cathode $NiO_{2(S)} + 2H_2O + 2e^- \rightarrow Ni(OH)_{2(S)} + 2OH^-_{aq}$

Q.8. Why a dry cell becomes dead after a long time even if it has not been used ?

Ans. In dry cell NH_4Cl is used. This corrodes the zinc container even if not used for long time.

Q.9. Explain the terms specific, equivalent and molar conductivity. How they are inter-related?

Ans. $\wedge^0_{eq} = K \times \frac{1000}{\text{Normality}}$ and $\wedge^0_m = K \times \frac{1000}{\text{Normality}}$, K = Specific conductivity

Q.10. Describe the construction of Daniell Cell and the reaction involved. How is it represented ?

Ans. Daniel Cell : The Zinc electrode dipped into Zinc sulphate solution and copper electrode dipped into copper sulphate solution. Oxidation takes place at Zn electrode and reduction takes place at Cu electrode. Both solutions are connected with salt bridge. The reactions are:

Oxidation reaction : $Zn \rightarrow Zn^{2+} + 2e^-$

$$\frac{\text{Reduction reaction : } Cu^{2+} + 2e^- \rightarrow Cu}{\text{Total Reaction : } Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu}$$

The cell is represented as. $Zn/ZnSO_4$ II $CuSO_4$ I Cu.

Q.11. Give short notes of corrosion ? How can it be prevented ?

Ans. **Corrosion :** The process of slowly eating away of the metal due to attack of the atmospheric gases on the surface of the metal resulting into the formation of compound. It can be protected :

(i) By coating with paint

(ii) The metal is convered with more active metal

(iii) Making cathodic protections

(iv) Using anti rust solution

Q.12. What is difference between Galvanic Cell (electrochemical cell) and electrolytic cell?

Ans. Galvanic cell is an electrochemical cell and Electrolytic cell is the conversion of electrical energy to chemical energy.

Q.13. Why is it necessary to use salt bridge in a galvanic cell?

Ans. Salt bridge is used to complete the inner circuit and maintain the electrical neutrality in the solution.

Q.14. Equilibrium constant is related to E^0_{Cell} but not E_{Cell}. Explain why?

Ans. When equilibrium is reached in the cell reaction, E_{Cell} becomes zero. Hence applying Nernst equation at the cell reaction.

$$Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$$

$$E_{Cell} = E^0_{Cell} - \frac{RT}{nF} \ln \frac{[Zn^{2+}]}{[Cu^{2+}]} \text{ or } E^0_{Cell} = \frac{RT}{nF} \ln \frac{[Zn^{2+}]}{[Cu^{2+}]} = \frac{RT}{nF} \ln K_C$$

Q.15. Why a mercury cell gives a constant voltage throughout its life ?

Ans. Because the electrolyte KOH is not consumed in the reaction.

Q.16. Which type of Cells are rechargeable?

Ans. The rechargeable cell in which the product fromed during discharge are deposited on the electrodes and these can e decomposed when electrical energy is supplied.

Q.17. Give the relationship between molar conductivity and specific conductivity.

Ans. $\wedge^0_m = K \times \frac{1000}{\text{Molarity}}$ Where K = specific conductivity.

Q.18. What is EMF of a Cell?

Ans. The difference between the electrode potentials of the two half cells is known a EMF of the cell.

Q.19. How Nernst equation can be applied in the calculation of equilibrium constant of any cell reaction?

Ans. Let us take the cell as $Zn/ZnSO_4$ ll $CuSO_4/Cu$

At equilibrium the flow of electrons from Zn to Cu stops.

When $E_{Zn^{2+}/Zn}$ equals with $E_{Cu^{2+}/Cu}$.

Applying Nernst equation for the cell potential

$$E_{Cell} = E^0_{Cell} + \frac{RT}{nF} l\,n \frac{[Cu^{2+}]}{[Zn^{2+}]} = E^0_{Cell} - \frac{RT}{nF} l\,n \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

Taking $\frac{[Zn^{2+}]}{[Cu^{2+}]} = K_c$ then the equation is $O = E^0_{Cell} - \frac{RT}{nf} l\,n\, K_C$

or $E^0_{Cell} = \frac{RT}{nF} l\,n\, K_C$.

Q.20. Why does galvanic cell become dead after sometime?

Ans. During lapse of time concentrations of electrolytic solutions change so as electrode potentials. When the electrode potentials of the two half cells becomes equal, the cell stops working.

Q.21. Why rusting of iron is more in saline water than in pure water.

Ans. In saline water Na^+ and Cl^- ions are more which increases the conductance of the solution in contact with metal surface. This accelerates the formation of Fe^{2+} ion and helps for rusting.

Q.22. Why does conductivity of a solution decrease with dilution ?

Ans. When electrolytic solution is diluted the concentration of ion in each centimeter cube of the solution decreases. As a result the conductivity of the electrolytic decreases.

Q.23. Can you store copper sulphate solution in Zinc pot ?

Ans. As $E^0_{Zn^{2+}/Zn(-0.76V)}$ is lower than $E^0_{Cu^{2+}/Cu(+0.34V)}$, therefore Cu^{2+} can oxidise Zn to Zn^{2+} ions. $Cu^{2+}(aq) + Zn(s) \rightarrow Zn^{2+}(aq) + Cu(s)$. Hence $CuSO_4$ solution can not be stored in zinc pot.

Q.24. What is emf of the cell when the cell reaction attains equilibrium ?

Ans. Zero.

Q.25. How is cell constant calculated from conductance values ?

Ans. $\text{Cell constant} = \dfrac{\text{Specific conductance}}{\text{Observed conductance}}$

Q.26. What is the overall electrochemical reaction taking place in rusting ?

Ans. $2Fe(s) + O_2(g) + 4H^+_{(aq)} \rightarrow 2Fe^{2+}_{(aq)} + 2H_2O(l)$

Q.27. What is the basic reason that a lead storage battery can be recharged ?

Ans. $PbSO_4$ is deposited on the electrodes. So the electrode reaction can be reversed.

Q.28. Why Zinc reacts with dilute H_2SO_4 to give gas but copper does not ?

Ans. Zinc has higher oxidation potential than hydrogen where as copper has lower oxidation potential than hydrogen, therefore Zinc reacts with dil H_2SO_4 to give gas.

Q.29. Why is it not possible to measure the single electrode potential ?

Ans. Oxidation and reduction takes place simultaneously but not alone. It is a relative tendency and can be measured with respect to a reference electrode only.

Q.30. Which type of metal can be used in cathodic protection of iron against rusting ?

Ans. A metal which is more elctropositive than iron can be used in cthodic protection, such as Al, Zn and Mg.

Q.31. Write the names of the electrodes used in a fuel cell ?

Ans. Hydrogen and oxygen electrodes.

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UNIT - III

CHEMICAL KINETICS

I. Select the correct answer from the choices given under each bit :

1. The rate at which a substance reacts depends upon its

(a) atomic mass

(b) equivalent mass

(c) molecular mass

(d) active mass

2. The rate of reaction that does not involve gases, is not dependent on

(a) pressure (b) temperature

(c) concentration (d) catalyst

3. According to collision theory

(a) all collisions are sufficiently violent

(b) all collisions are responsible for product formation

(c) all collisions are effective

(d) only a fraction of collisions are effective which have enough energy to form products

4. Activation energy of the reaction is

(a) the energy released during the reaction

(b) the energy evolved when activated complex is formed

(c) minimum amount of energy needed to overcome the potential energy barrier

(d) the energy needed to form one mole of the product

5. Which one of the following is not a first order reaction?

(a) $CH_3COOCH_3 + H_2O \xrightarrow{H^+} CH_3COOH + CH_3OH$

(b) $CH_3COOC_2H_3 + NaOH \rightarrow CH_3COONa + C_2H_5OH$

(c) $2H_2O_2 \rightarrow 2H_2O + O_2$

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

6. For a reaction $2A + B \rightarrow C + D$, the concentration of B is kept constnt and that of A is tripled, the new rate of reaction will be

(a) nine times (b) three times

(c) same (d) zero

7. For the reaction $A \rightarrow B$, the rate of the reaction is quadrupled when the concentration of A is doubled, the rate of the reaction is $r = K[A]^n$, the value of 'n' is

(a) 1 (b) zero

(c) 3 (d) 2

8. A zero order reaction is one

(a) in which the reactants do not react

(b) in which one of the reactants is in large excess

(c) whose rate is uniform and not affected by time

(d) whose rate increases with time

9. For which of the following, the units of rate and rate constant of the reaction are identical ?

(a) first order reaction
(b) zero order reaction
(c) second order reaction
(d) fractional order reaction

10. 75% of a first order reaction was completed in 32 minutes, when was 50% of the reaction completed?

(a) 4 minutes (b) 8 minutes
(c) 24 minutes (d) 16 minutes

11. In a first order reaction, the concentration of reactant decreases from 1.0 M to 0.25 M in 20 minutes. The value of specific rate is

(a) 69.32 (b) 6.932
(c) 0.6932 (d) 0.06932

12. If the rate expression for a reaction is $\frac{dx}{dt} = K[A]^{1/2}[B]^{3/2}$ **the overall order of the reaction is**

(a) 2 (b) $\frac{1}{2}$
(c) $\frac{3}{2}$ (d) 1

13. Which of the following statements regarding molecularity of the reaction is wrong?

(a) it may be either whole number or fractional
(b) it is calculated from the reaction mechanism
(c) it depends on the rate determining step
(d) it is number of molecules of reactants taking part in a single step chemical reaction

14. A graph between time (t) and the substance consumed at any time is found to be a straight line passing through the origin. This indicates that the reaction is of

(a) Second order
(b) First order
(c) Zero order
(d) Fractional order

15. In pseudo-unimolecular reactions

(a) one of the reactants is present in large excess
(b) both the reactants have same concentration
(c) both the reactants are present in low concentration
(d) one of the reactants is less reactive

16. Which plot can give us the value of activation energy?

(a) K versus T
(b) $\frac{1}{K}$ versus T
(c) Log K versus $\frac{1}{T}$
(d) C versus T

17. The rate of a reaction can be increased in general by all the following factors except

(a) by increasing the temperature
(b) using a suitable catalyst
(c) by increasing the concentration of reactants
(d) by an increase in activation energy

18. Radioactive disintegration is an example of

(a) zero order reaction

(b) first order reaction

(c) second order reaction

(d) third order reaction

19. The half life period of a first order reaction A → products is 10 minutes. In what period of time is the concentration of A is reduced to 10% of the original concentration ?

(a) 26 minutes (b) 71 minutes

(c) 33 minutes (d) 90 minutes

20. The number of molecules of the reactants taking part in a single step of the reaction tells about

(a) Molecularity of the reactoin

(b) Mechanisms of the reaction

(c) Order of reaction

(d) All of the above

21. For a first order reaction, the half life is independent of

(a) initial concentration

(b) cube root of initial concentration

(c) first power of final concentration

(d) square root of final concentration

22. Activation energy of a chemical reaction can be determined by

(a) changing the concentration of reactants

(b) evaluating rate constant at standard temperature

(c) evaluating rate constants at two different temperatures

(d) evaluating velocities of reaction at two different temperatues

23. For a first order reactives A→ Prodcuts, the half life time is 100 seconds. The rate constant of the reaction is

(a) 6.93×10^{-3} Sec^{-1}

(b) 6.9×10^{-2} Sec^{-1}

(c) 6.93×10^{-4} Sec^{-1}

(d) 6.93×10^{-1} Sec^{-1}

24. In a first order reaction, the concentration of the reactant decreases from 0.8 M to 0.4M in 15 minutes. The time taken for the concentration to change from 0.1 M to 0.025 M is

(a) 30 minutes

(b) 15 minutes

(c) 7.5 minutes

(d) 60 minutes

25. Which of these does not influene the rate of reaction ?

(a) Nature of the reactants

(b) Concentration of the reactants

(c) Temperature of the reaction

(d) Molecularity of the reaction

26. $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$

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

(a) 1 : 2 (b) 2 : 1

(c) 1 : 4 (d) 4 : 1

27. The time requied for 100% completion of a zero order reaction is

(a) ak (b) $\frac{a}{2k}$

(c) $\frac{a}{k}$ (d) $\frac{2k}{a}$

28. A first order reaction has a rate constant 1.15×10^{-3} s^{-1}. How long will 5 g of this reactant take to reduce to 3 g?

(a) 444 s (b) 402 s

(c) 442 s (d) None of these

29. The half-life period of a first order chemical reaction is 6.93 min. The time required for the completion of 99% of the chemical reaction will be (log 2=0.301)

(a) 230.3 min. (b) 23.03 min.

(c) 46.06 min. (d) 460.6 min.

30. By increase in temperature by 10K, the rate of reaction becomes double. How many times the rate of reaction will be if the temperature is increased from 303K to 353 K?

(a) 4 (b) 8

(c) 16 (d) 32

31. Activation energy of a reaction

(a) is independent of temperature

(b) increases with temperature

(c) gets doubled for every 10 degree rise of temperature

(d) decreases with the rise in temperature

32. Which one of the following statement for order of reaction is not correct ?

(a) order can be determined experimentally

(b) order of a reaction is equal to sum of the power of concentration terms in differential rate law

(c) it is not affected with stoichiometric coefficient of the reactants

(d) order can not be fractional

33. The minimum energy required to the reacting molecules to undergo reaction is

(a) Potential energy

(b) Kinetic energy

(c) Thermal energy

(d) Activation energy

34. A reaction involving two different reactants can never be

(a) biomolecular reaction

(b) second order reaction

(c) first order reaction

(d) unimolecular reaction

35. The inversion of cane sugar is represented by

$C_{12}H_{22}O_{11} + H_2O \xrightarrow{H^+} C_6H_{12}O_6 + C_6H_{12}O_6$.

It is a reaction of

(a) second order

(b) unimolecular

(c) pseudo unimolecular

(d) zero order

36. For the reaction $A \rightarrow B$, the rate law is, rate = K [A]. Which of the following statements is incorrect ?

(a) the reaction follows first order kineties

(b) the $t_{\frac{1}{2}}$ of the reaction depends on initial concentration

(c) K is constant for the reaction at a constant temperature

(d) the rate law provides a simple way of predicting the concentration of reactions at any time after the start of the reaction

37. The unit of rate of reaction is :

(a) time X concentration

(b) concentration X time

(c) concentration X $time^{-1}$

(d) none of the above

38. The rate of a chemical reaction can be expressed in :

(a) grams per mole

(b) energy consumed per mole

(c) volume of gas per unit time

(d) moles formed per litre of solution

39. The addition of catalyst to a reaction:

(a) increases the average kinetic energy of the reacting molecules

(b) deceases the activation energy

(c) increase the frequency of caollisions of the reacting species

(d) decreases the enthalpy of reaction

40. Which of the following factors affects the rate of heterogeneous reaction only ?

(a) nature of reactants

(b) temperature of system

(c) surface area of reactants

(d) concentration of reactants

41. When a catalyst is added to an exothermic reaction, the heat evolved during the reaction ?

(a) increases

(b) decreases

(c) remains unchanged

(d) may increase or decrease

42. How does the addition of a catalyst increase the reaction rate of an endothermic reaction ?

(a) It reduces the ΔH of the reaction

(b) It increases the ΔH of the reaction

(c) It reduces the required activation energy

(d) It causes the reaction to become exothermic

43. Which of the following reactions ends in finite time ?

(a) 0 order

(b) 1st order

(c) 2nd order

(d) 3rd order

44. The rate constant of a chemical reaction has units L. $mol^{-1}.s^{-1}$. Order of the reaction will be :

(a) 0 (b) 1

(c) 2 (d) 3

45. The rate of a reaction can be expressed by Arrhenius equation as $K = Ae^{-E/RT}$. In this reaction, E represents.

(a) the total energy of the reacting molecules at a temperautre T.

(b) the fraction of molecules with energy greater than the activation energy of the reaction.

(c) the energy above which all the colliding molecules will react.

(d) the energy below which colliding molecules will not react.

46. In Arrhenius plot, intercept is equal to :

(a) - E / R (b) ln A

(c) ln K (d) $\log_{10}a$

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

1.	(d)	16.	(c)	31.	(d)
2.	(a)	17.	(d)	32.	(d)
3.	(d)	18.	(b)	33.	(d)
4.	(c)	19.	(c)	34.	(d)
5.	(b)	20.	(a)	35.	(c)
6.	(a)	21.	(a)	36.	(b)
7.	(d)	22.	(c)	37.	(c)
8.	(c)	23.	(a)	38.	(c)
9.	(b)	24.	(a)	39.	(b)
10.	(d)	25.	(d)	40.	(c)
11.	(d)	26.	(b)	41.	(c)
12.	(a)	27.	(c)	42.	(c)
13.	(a)	28.	(a)	43.	(a)
14.	(c)	29.	(c)	44.	(c)
15.	(a)	30.	(d)	45.	(c)
				46.	(b)

II. Short Questions

Q.1. Powdered sugar dissolves faster than crystalline sugar, explain.

Ans. Powdered sugar has greater surface area than crystalline sugar. Sugar molecules come closer to water molecules with greater ease and thus dissolve faster than crystalline sugar.

Q.2. Hydrogen and oxygen do not react at room temperature. Explain.

Ans. At room temperature, there is no reaction between hydrogen and oxygen as the activation energy of the reaction is very high.

Q.3. State average rate of reaction.

Ans. The rate measured over a long time interval is called the average rate.

Average rate of reaction =

$$-\frac{\text{decrease in conc. of reactant}}{\text{Time taken}} = +\frac{\text{increase in conc. of product}}{\text{Time taken}}$$

Q.4. What is half-life period of a reaction ?

Ans. The time taken to react half of the initial concentration or it is the time required for the completion of half of the reaction.

Q.5. What do you mean by Pseudo unimolecular reaction ?

Ans. Some reactions involve two molecules, but the concentration of one molecule changes with time. But the conc. change of the second molecule has little effect on the reaction. Hence the rate only depends upon the conc. of the molecule which changes with respect to time. This is Pseudo unimolecular reaction.

Q.6. Write the rate equation for a zero order reaction.

Ans. $K = -\frac{d[A]}{dt} = \frac{a_0 - a}{t}$

Where A = reactant molecule, a_0 = initial conc. of A and a = conc. at time 't'.

Q.7. What is specific reaction rate ?

Ans. The specific reaction rate of the reaction when the molar conc. of each reactant is unity. The rate K when either conc. of each reactant is 1 Mol. L^{-1} or order with respect to each reactant is zero, i.e. reaction is zero order.

Q.8. What is temperature co-efficient?

Ans. The ratio of rate constants of a reaction at two temperatures differing by 10^0C is known as temperature co-efficient.

Q.9. What do you mean by threshold energy ?

Ans. The minimum amount of energy which must be associated with molecules so that their mutual collisions result in chemical reaction is called threshold energy.

Q.10. What is rate determining step ?

Ans. The slowest step is called the rate determining step.

Q.11. What is the difference between rate law and law of Mass Action ?

Ans. Rate law is an experimental law where as law of Mass Action is a theoritical law based on the balanced chemical reaction.

Q.12. What is rate of reaction ?

Ans. The rate of reaction is the change in concentration of any one reactants or products per unit time.

Q.13. For what type of reactions the rate constant shall have the same units as the rate of reactions ?

Ans. Zero order reaction.

Q.14. Can a reaction have zero activation energy ?

Ans. If activation energy (E_a)=0, then the expression

$$K = A.e^{-Ea/RT} = A.e^{0} = A$$

So the rate constant becomes equal to collision frequency. this means that every collision results into a chemical product, which is not true.

Q.15. If the rate of formation of oxygen gas is 48 g.mm^{-1}. What is the rate of dissapearance of N_2O_5?

Ans. The rate of reaction is always expressed in terms of mol. L^{-1}, therefore rate of formation of O_2 gas.

$$O_2 = \frac{48}{32} = 1.5 \text{ mol.mm}^{-1}$$

The rate of dissapearance of

$$N_2O_5, -\frac{1}{2}\frac{\Delta[N_2O_5]}{\Delta t} = \frac{\Delta[O_2]}{\Delta t} = 2 \text{ x } 1.5 = 3.0 \text{ Mol. mm}^{-1}$$

Q.16. What is half life of Zero order reaction ?

Ans. The integrated equation of zero order reaction is

$[R] = [R]_0 - Kt$ Where $[R]_0$ = initial concentration

[R] = concentration at time 't'

So $t_{1/2} = [R]_{0/2}$

or $\frac{[R]_0}{2} = [R]_0 - Kt_{1/2}$

or $Kt_{1/2} = [R]_0 - \frac{[R]_0}{2}$

or $Kt_{1/2} = \frac{[R]_0}{2}$

or $t_{1/2} = \frac{[R]_0}{2K}$

or $t_{1/2} \ \alpha \ [R]_0$

Therefore half life period of zero order reaction is directly proportional to initial concentration.

Q.17. What is the unit of first order rate constant ?

Ans. time $^{-1}$.

Q.18. Give an example where the order and molecularity are equal.

Ans. $2HI \rightarrow H_{2(g)} + I_{2(g)}$

Q.19. Give an example of pseudo first order reaction.

Ans. The hydrolysis of ethyl acetate in acid catalysed reaction.

$$CH_3COOC_2H_5 + H_2O \xrightarrow{H^+} CH_3COOH + C_2H_5OH$$

$$\text{Rate} = K[CH_3COOC_2H_5]\ [H_2O]^0$$

Q.20. The reaction $A + B \rightarrow C$ has zero order. What is the rate equation ?

Ans. Rate $= K[A]^0\ [B]^0$ (where K = rate constant).

Q.21. A reaction is 50% complete in 2 hours and 75% complete in 4 hours. What is the order of the reaction ?

Ans. $t_{1/2}$ = 2 hours. And 75% complete in 4 hours i.e. it takes two half lives, this shows $t_{1/2}$ is independent of initial concentration. Hence the reaction is first ofder.

Q.22. What is the molecularity of the reaction

$$Cl \rightarrow \frac{1}{2}Cl_{2(g)}$$

Ans. One

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UNIT - IV

d- AND f - BLOCK ELEMENTS

I. Select the correct answer from the choices given under each bit :

1. d-Block elements form coloured ions because

(a) they absorb some energy for d-s transition

(b) they absorb some energy for p-d transition

(c) they absorb some energy for d-d transition

(d) they do not absorb any energy

2. The characteristics of transition metals to form the complex ion is

(a) having d-subshell unpaired electrons

(b) having paired d-subshell electrons

(c) providing empty d-orbitals

(d) having small charge / size ratio

3. Which of the following properties shows that iron is a transition element ?

(a) it forms double salts

(b) it forms stable complexes

(c) it decomposes steam at high temp

(d) it rusts on moist air

4. Which of the following elements involves gradual filling of 5-f level ?

(a) transition metals

(b) lanthanoids

(c) coinage metals

(d) actinides

5. 18 carat gold contains

(a) 18% gold (b) 24% gold

(c) 60% gold (d) 75% gold

6. The general electronic configuration of transition elements is

(a) ns^2nd^{1-10}

(b) $(n-1)d^{1-10}\,ns^{0-2}$

(c) $(n-1)d^{1-10}\,ns^2$

(d) $ns^{0-2}(n-1)d^{10}$

7. Permanent magnets are generally made of alloys of

(a) Fe

(b) Co

(c) Ni

(d) Any one of them

8. Which of the ions will give colourless aqueous solution ?

(a) Cu^{2+} (b) Cu^{+}

(c) Ni^{2+} (d) Fe^{2+}

9. Which of the following belongs to the actinide series of elements ?

(a) Y (b) U

(c) Yb (d) Ta

10. Which of the following compounds will not give positive chromyl chloride test ?

(a) $HgCl_2$ (b) $ZnCl_2$

(c) $CuCl_2$ (d) $C_6HN^+H_3Cl^-$

11. Which metal in the Ist transition series exhibit +1 oxidation state most frequently ?

(a) Zn (b) Sc

(c) Cu (d) Cd

12. Which of the following oxides of Mn is amphoteric in nature MnO, MnO_2, Mn_2O_3, Mn_2O_7 ?

(a) MnO (b) MnO_2

(c) Mn_2O_3 (d) Mn_2O_7

13. Which of the following form an alloy?

(a) Zn + Pb (b) Fe + Hg

(c) Fe + C (d) Pt + Hg

14. Which of the following are transition elements Zn, Ag, Cd, Au?

(a) Zn, Ag (b) Zn, Cd

(c) Ag, Cd (d) Ag, Au

15. The formula of chromyl chloride is

(a) $Cr_2O_5Cl_2$ (b) $Cr_2O_2Cl_2$

(c) CrO_2Cl_2 (d) Cr_2OCl_2

16. Chromic acid mixture used for cleaning glassware is

(a) $K_2Cr_2O_7$ + Conc H_2SO_4

(b) $K_2Cr_2O_7$ + Conc HCl

(c) Cr_2O_3 + Conc H_2SO_4

(d) Cr_2O_3 + Conc HNO_3

17. The compound whose transition metal has +7 oxidation states :

(a) $K_2Cr_2O_7$ (b) $KMnO_4$

(c) K_2MnO_4 (d) Cr_2O_3

18. Cadmium salts are

(a) green (b) blue

(c) white (d) red

19. Which element/s of actinide series has maximum oxidation state

(a) Am and Cf (b) U and Pu

(c) U and Am (d) Np and Pu

20. Which of the following has maximum number of unpaired electrons ?

(a) Fe^{2+} (b) Mg^{2+}

(c) V^{3+} (d) Ti^{3+}

21. The inner transition series element has electronic configuration :

(a) $(n-1)f^{1-14}(n-2)d^{0-1}ns^2$

(b) $(n-2)f^{1-14}(n-1)d^{0-9}ns^2$

(c) $(n-2)f^{1-14}nd^{0-9}(n+1)s^2$

(d) $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$

22. The lanthanide contraction is responsible for the fact that

(a) Regular decrease in atomic and ionic radii with increasing number in lanthanoid series.

(b) Regular increase in atomic and ionic radii with increasing number in lanthanoid series.

(c) Both the d-block and f-block elements have decrease in atomic size.

(d) f-block elements having same oxidation state with increasing atomic number.

23. Which of the following elements belongs to lanthanide series ?

(a) Nobelium (b) Cerium

(c) Thorium (d) Tellurium

24. Lanthanide contraction is due to increase in

(a) shielding by 4f electrons

(b) atomic number

(c) effective nuclear charge

(d) size of 4-f orbital

25. The highest magnetic moment is in the transition metal having

(a) $3d^2$ (b) $3d^7$

(c) $3d^5$ (d) $3d^9$

26. Lanthanides are

(a) 14 elements in the sixth period of atomic No. 90 to 103 that are filling 4f sub shell.

(b) 14 elements in the seventh period of atomic No. 90 to 103 that are filling 5f sub shell.

(c) 14 elements in the sixth period of atomic No. 58 to 71 that are filling 4f sub shell.

(d) 14 elements in the seventh period of atomic No. 58 to 71 that are filling 4f sub shell.

27. Lanthanides and actinides resemble in :

(a) electronic configuration

(b) oxidation state

(c) ionization energy

(d) formation of complexes

28. Which of the following factor may be regarded as the main cause of lanthanide contraction ?

(a) Poor shielding of one of the 4-f electrons by another in the sub shell.

(b) Effective shielding of one of the 4-f electrons by another in the sub shell.

(c) Poorer shielding of 5-d electrons by 4-f electrons.

(d) Greater shielding of 5-d electrons by 4-f electrons.

29. The main reason for large number of oxidation states exhibited by the actinoids than the corresponding lanthanoids is :

(a) lesser energy difference between 5f and 6d orbitals than between 4f and 5d orbitals.

(b) more energy difference between 5f and 6d orbitals than between 4f and 5d orbitals.

(c) greater reactive nature of the actinoids than the lanthanoids.

(d) larger atomic size of the actinoids than the lanthanoids.

30. Which of the following is not an actinoid ?

(a) Curium (b) Californium

(c) Thorium (d) Terbium

31. The transition metal exists in its highest oxidation state. It is expected to behave as :

(a) a chelating agent

(b) a reducing agent

(c) an oxidising agent

(d) a central metal in a coordination compound

32. $K_2Cr_2O_7$ reacts with NH_4Cl in presence of ConcH_2SO_4, gives

(a) Chromyl chlorate with green vapour

(b) Chromous chloride with white vapour

(c) Chromous chloride with blue vapour

(d) Chromyl chloride with red vapour

33. $Cr_2O_7^{2-} \xrightarrow{H^+} Cr^{3+}$ equivalent weight of $Cr_2O_7^{2-}$ is

(a) Mol. wt/6 (b) Mol. wt/3

(c) Mol. wt/4 (d) Mol. wt/1

34. Least paramagnetic property is shown by

(a) Fe (b) Ni

(c) Cu (d) Mn

35. One mole of acidified $K_2Cr_2O_7$ on reaction with excess of KI will liberate moles of I_2

(a) 6 (b) 7

(c) 2 (d) 3

36. $KMnO_4$ is a strong oxidising agent in acid medium. To provide acid medium H_2SO_4 is used instead of HCl because

(a) H_2SO_4 is a stronger acid than HCl

(b) HCl is oxidized by $KMnO_4$ to Cl_2

(c) H_2SO_4 is a dibasic acid

(d) Rate is faster in presence of H_2SO_4

37. $K_2Cr_2O_7$ can be converted into potassium chromate (K_2CrO_4) using

(a) H_2SO_4 (b) KOH

(c) KCl (d) KNO_2

38. The purple colour of $KMnO_4$ is due to the

(a) charge transfer from O to Mn

(b) charge transfer from Mn to O

(c) transition of d - d

(d) transition of p - d

39. +3 oxidation state is most common in

(a) Fe (26) (b) Ni (28)

(c) Zn (30) (d) Cu (29)

40. Which of the following belong to 3d series ?

(a) copper (d) gold

(c) silver (d) platinum

41. Transition elements have greater tendency to form complexes because

(a) they have large size

(b) they have vacant d orbitals

(c) they have two electrons in their outermost shells

(d) none of the above

42. The colour of transition metal ions is due to

(a) d - d transition

(b) change in geometry

(c) small in size

(d) none of these

43. $K_4[Fe(CN)_6]$ is used for the detection of

(a) Cu^{2+} (b) Cu^{+}

(c) Fe^{3+} (d) Ni^{2+}

44. When H_2O_2 is added to acidified $K_2Cr_2O_7$, a blue colour is produced due to formation of

(a) CrO_3 (b) CrO_5

(c) Cr_2O_3 (d) CrO_4^{2-}

45. Which of the following is coloured Cu^+, VO^{2+}, Sc^{3+}, Ni^{2+} ?

(a) Cu^+ (b) VO^{2+}

(c) Sc^{3+} (d) Ni^{2+}

46. Which of the following lanthanoids have one electron in 5d subshell ?

(a) Cerium & Europium

(b) Neodymium & Samarium

(c) Gadolinium & Lutetium

(d) Lanthanum & Yetterbium

47. Which of the following exhibit oxidation states upto +7 ?

(a) uranium (b) plutorium

(c) callifornium (d) curium

48. Which of the following compound has oxidation state +6 ?

(a) $KMnO_4$ (b) K_2MnO_4

(c) $K_2Cr_2O_7$ (d) Cr_2O_3

49. The most common oxidation state of lanthanoids is

(a) + 4 (b) + 6

(c) + 2 (d) + 3

50. Which of the following metals is used in incandascent lamps ?

(a) Chromium

(b) Tungsten

(c) Zirconium

(d) Molybodenum

51. The disproportionate reaction combination of the following is

(i) $3MnO_4^{2-} + 4H^+ \rightarrow$

$2MnO_4^- + MnO_2 + 2H_2O$

(ii) $2MnO_4^- + 3Mn^{2+} + 2H_2O \rightarrow$

$5MnO_2 + 4H^+$

(iii) $2Cu^+ \rightarrow Cu^{2+} + Cu$

(iv) $2KMnO_4 \rightarrow$

$K_2MnO_4 + MnO_2 + O_2$

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

(c) (i) and (iii) (d) (iii) and (iv)

52. Which ion gives coloured solution?

(a) Cu^+ (b) Zn^{2+}

(c) Ag^+ (d) Fe^{2+}

53. The maximum oxidation state of actinide is

(a) + 7 (b) + 6

(c) + 5 (d) + 3

54. Ni^{2+} gives coloured salts due to

(a) complete filled d-orbitals

(b) incompletely filled d-orbitals

(c) presence of p-orbitals

(d) presence of f-orbitals

55. Manganese exhibits maximum oxidation state in :

(a) MnO_2 (b) Mn_3O_4

(c) $KMnO_4$ (d) K_2MnO_4

56. Which chromium compound is widely used for tanning of leather ?

(a) $K_2SO_4 . Cr_2(SO_4)_3 . 24H_2O$

(b) $CrCl_3$

(c) CrO_2Cl_2

(d) Cr_2O_3

57. Ammonium dichromate is used in fire works. The green coloured powder bloom in the air is :

(a) CrO_3 (b) Cr

(c) $CrO(O_2)$ (d) Cr_2O_3

58. On heating ammonium dichromate, the gas evolved is :

(a) Nitrogen (b) Nitrous oxide

(c) Oxygen (d) Ammonia

59. Which compound does not dissolve in hot dillute HNO_3?

(a) CdS (b) CuS

(c) $CuCl_2$ (d) HgS

60. Which of the following oxides of Chromium is basic in nature ?

(a) CrO (b) Cr_2C_3

(c) CrO_3 (d) CrO_5

61. The outer electronic configuration of Chromium is :

(a) $4s^1\,3d^5$ (b) $4s^2\,3d^4$

(c) $4s^0\,3d^6$ (d) $4s^2\,3d^5$

62. The electronic configuration of a transition element X in +2 oxidation state is $[Ar]3d^{10}$. The atomic number of the element is :

(a) 27 (b) 28

(c) 29 (d) 30

63. $KMnO_4$ acts as an oxidising agent in acidic medium. The number of moles of $KMnO_4$ required to oxidise one moles of sulphide ion in acidic medium is :

(a) $\frac{1}{5}$ (b) $\frac{2}{5}$

(c) $\frac{3}{5}$ (d) $\frac{4}{5}$

64. In the first transition series, the element with highest melting point is:

(a) Mn (b) Fe

(c) Cr (d) Cu

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

1.	(a)	12.	(b)	23.	(b)	34.	(c)	45.	(d)	56.	(a)
2.	(c)	13.	(c)	24.	(c)	35.	(d)	46.	(c)	57.	(d)
3.	(b)	14.	(d)	25.	(c)	36.	(b)	47.	(b)	58.	(a)
4.	(d)	15.	(c)	26.	(c)	37.	(b)	48.	(c)	59.	(d)
5.	(d)	16.	(a)	27.	(b)	38.	(a)	49.	(d)	60.	(a)
6.	(b)	17.	(b)	28.	(a)	39.	(a)	50.	(b)	61.	(a)
7.	(d)	18.	(c)	29.	(a)	40.	(a)	51.	(c)	62.	(d)
8.	(b)	19.	(d)	30.	(d)	41.	(b)	52.	(d)	63.	(a)
9.	(b)	20.	(a)	31.	(c)	42.	(a)	53.	(a)	64.	(c)
10.	(a)	21.	(d)	32.	(d)	43.	(c)	54.	(b)		
11.	(c)	22.	(a)	33.	(a)	44.	(b)	55.	(c)		

II. Short Questions

1. Cu, Ag, Au have completely filled d-orbitals, why are they considered as transition metals ?

Ans. The cations have only partially filled d-orbitals, show the transition properties.

2. Which of 3d transition series has maximum oxidation state & why ?

Ans. Manganese (Atomic number 25) shows maximum number of oxidation states. It has maximum number of electrons to lose. All 3d subshells are unpaired and s-subshell is doubly occupied. So Mn shows oxidation state from + 2 to + 7 (+ 2, + 3, + 4, + 5, + 6 and + 7).

3. To what extent do the electronic configuration decide the stability of oxidation states in the 1st transition series elements ?

Ans. For the 1st transition series the electronic configuration of $3d^{1\text{-}10}4s^2$, but Mn has maximum oxidation state from +2 to +7 and Mn^{2+} is most stable having half filled $3d^5$ configuration. Similarly Sc^{3+} and Zn^{2+} are more stable having $3d^0$ and $3d^{10}$ configurations respectively.

4. What are transition elements ? Give example.

Ans. The 'd' block elements present between 's' block and 'p' block elements are called transition elements.

1st transition series from ^{21}Sc to ^{30}Zn.

2nd transition series from ^{39}Y to ^{48}Cd etc.

5. Write electronic configuration of Cu^{2+} and Cr^{3+} ions.

Ans. The electronic configuration of

$Cu^{2+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9$

$Cr^{3+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^3$

6. Name the d-block elements which do not have partially filled d-orbitals in their atoms or in their simple ions.

Ans. $Sc^{3+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

$Ti^{4+} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

both having no partially filled ‘d’ orbitals.

7. Why does a transition metal form alloys with other transition metals easily ?

Ans. The 'd' block transition metals have almost similar atomic sizes. Therefore, these elements can mutually substitute their position in their crystal lattices. In this way many alloys are possible between transition metals.

8. Why is $CuSO_4\ 5H_2O$ coloured ?

Ans. In presence of H_2O molecule, the 'd' orbital of Cu^{2+} split into two sets having slightly different energies. Hence, d-d transitions become possible in hydrated $CuSO_4$ and acquires blue colour due to absorption of visible light.

9. Why is CuCl is colourless but $CuCl_2$ is blue ?

Ans. In CuCl, Cu^+ has fully filled subshell, hence it can not give d-d transition. Therefore, it is colourless. But $CuCl_2$, the Cu^{2+} ion has d^9 (half filled) orbitals. It can give d-d transition, hence it is coloured.

10. Why is E^0 values of Mn^{3+}/Mn^{2+} couple much more positive than Cr^{3+}/Cr^{2+} ?

Ans. The high reduction potential of Mn^{3+}/Mn^{2+} couple is due to the reason that Mn^{3+} ($3d^4$) by accepting an electron acquires very stable $3d^5$ electron configuration. But Cr^{3+}/Cr^{2+} the reduction potential is small.

11. Why 2nd and 3rd transition series elements show similar size ?

Ans. In 3rd transition series after lanthanum, there is lanthanide contraction. Due to this contraction the size of any atom of the third transition series is almost the same as that of the element lying just above in the second transition series. This leads to similarity in their properties.

12. Why is the separation of lanthanide elements difficult ?

Ans. Due to lanthanide contraction, the change in atomic or ionic radii of these elements is very small. Hence their chemical properties are similar. Thus, their separation is difficult.

13. Why are lanthanide paramagnetic in nature ?

Ans. All lanthanides except La^{3+} and Lu^{3+} contain unpaired electrons and therefore paramagnetic in nature.

14. On what ground Sc (At. No. = 21) is a transition element, but Zn (At. No. 30) is not?

Ans. Sc (At. No. 21) has incomplete 3d orbital ($3d^1$), but Zn(At. No. 30) has complete 3d orbital ($3d^{10}$), Hence Zn is not considered as transition element.

15. Why mercury (I) ion exist as Hg_2^{2+} ion while copper (I) exist as Cu^+ ?

Ans. The electronic configuration of Hg^+ is [Xe] $4f^{14}5d^{10}, 6s^1$, thus has one electron in 6s orbital, which shows paramagnetic. But it shows diamagnetic, so the single filled Hg^+ should overlap with another Hg^+ single filled s-orbital forming Hg-Hg covalent bond. Thus shows dimeric species. Where as in Cu^+ it is filled $3d^{10}$ orbital and no unpaired electrons to form dimeric species, so it exists as Cu^+ ion.

16. Explain copper (I) is diamagnetic where as Copper (II) is paramagnetic.

Ans. Cu^{+} has complete $3d^{10}$ electrons (no unpaired shells), so diamagnetic but Cu^{++} has $3d^{9}$ (having unpaired d-orbital) shows paramagnetic.

17. What is lanthanoid contraction ?

Ans. The regular decrease (contraction) in the atomic and ionic radii with increasing atomic number is known as lanthanide contraction.

18. Why transition metals show coloured compounds ?

Ans. Due to presence of unpaired 'd' orbitals.

19. What happens when

(a) $K_2Cr_2O_7$ is heated

(b) $KMnO_4$ is heated

(c) KI solution is treated with alkaline $KMnO_4$ solution

(d) SO_2 is passed through acidified solution of $K_2Cr_2O_7$

Ans. (a) $K_2Cr_2O_7 \xrightarrow{\Delta} 4K_2CrO_4 + 2Cr_2O_3 + 3O_2$

(b) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$

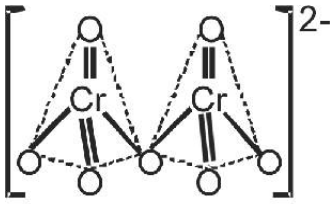
(c) $2KMnO_4 + H_2O + KI \longleftarrow 2MnO_2 + 2KOH + KIO_3$

(d) $K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 3H_2O$

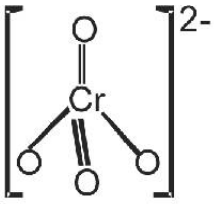
20. Describe the structure of

(a) dichromate ion (b) chromate ion (c) manganate ion

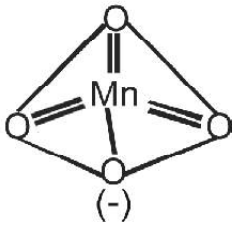
Ans.



dichromate



Chromate



Permanganate

21. In the titration of $FeSO_4$ with $KMnO_4$ in the acidic medium, why is dil H_2SO_4 used instead of dil HCl ?

Ans. In titration of $FeSO_4$ with $KMnO_4$ if HCl (acid) is added, the oxygen produced from $KMnO_4$ + HCl is partly used up to oxidise HCl to chlorine.

22. Why Zn^{2+} salts are white Cu^{2+} salts are blue ?

Ans. Zn^{2+} salts having $3d^{10}$ filled orbital shows white, but Cu^{2+} having $3d^{9}$ (unpaired) electrons shows colour.

23. Explain the following observations.

(a) transition metals form cloloured compounds.

(b) transition metals exhibit variable oxidation state.

Ans. (a) Transition metals form coloured compounds due to unpaired 'd' orbitals.

(b) The energies of (n-1)d and ns orbitals have very close hence both can participate to show variable valence.

24. What is the basic difference between electronic configuration of the transition and inner transition elements ?

Ans. Electronic configuration of transition series is $(n-1)d^{1-10}\ ns^{0-2}$ and electronic configuration of inner transition series is $(n-2)\ f^{1-14}\ (n-1)d^{0-1}ns^2$.

25. Why Zn, Cd and Hg are soft and have low m.p.

Ans. As there are no unpaired electrons in Zn, Cd, Hg, they are soft and low m.p.

26. What are the differences between lanthanide contraction and actinide contraction?

Ans. Lanthanide contraction refers to the gradual decrease in size of the lanthanoids and their trivalent ions where as actinoids refers to the gradual decrease in the size of the actinoids or their ions. They differ in actinoid series, the contraction is greater from element to element due to poor shielding by 5f electrons than by 4f electrons.

27. What is disproportionation of an oxidation state ? Give an example.

Ans. Disproportion of an oxidation state means the oxidation state of an element either increase or decrease in the products e.g.

$$\overset{VI}{3MnO_4^{2-}} + 4H^+ \longrightarrow \overset{VII}{MnO_4^-} + \overset{IV}{MnO_2} + 2H_2O$$

28. Silver has completely filled orbitals ($4d^{10}$) in its ground state. How can it is placed in transition elements ?

Ans. Silver has Ag^+ and Ag^{2+} states. In +2 oxidation state Ag has $3d^9$ i.e. incomplete 'd' orbitals. Hence, placed in transition elements.

29. What are characteristics of the transition elements and why are they called transition elements ?

Ans. Characteristics of transition elements :

(i) the atomic radii of the elements are in between s and p block elements

(ii) they have high ionization energy, more electro positive and show variable oxidation state

(iii) most elements form coloured compounds and are paramagnetic

(iv) they have tendency to form complexes

The elements which lie between s & p block elements are called transition elements.

30. Why is +2 oxidation state of manganese quite stable while the same is not true for iron ? (Mn = 25, Fe = 26)

Ans. The electronic configuration of Mn^{2+} is $3d^5$ which has stable half filled 'd' shell. So it is difficult to form Mn^{3+}. Where as Fe^{2+} has $3d^6$ configuration, hence one more electron can be taken out to for Fe^{3+} having stable $3d^5$ configuration. Hence Fe^{3+} is more stable than Fe^{2+}.

31. Why is separation of lanthanide elements difficult ?

Ans. Due to lanthanide contraction, the change in atomic and ionic radii is very small and the chemical properties are similar. So separation is difficult.

32. Why the properties of IIIrd transition series are very similar to second transition series ?

Ans. See question no. 11.

33. Why Sc^{3+} salts are diamagnetic ?

Ans. Sc^{3+} : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

So all the electronic shells are paired. Hence Sc^{3+} salts are diamagnetic.

34. Why +IV oxidation state is more state for Pt than Ni where as +II state is more stable for Ni than Pt ?

Ans. The sum of the first four ionisatoin enthalpies is less for Pt than Ni where as sum of first two ionisaton enthalpies is less for Ni than Pt. Hence Pt (IV) is more stable than Ni (IV) where as Ni (II) is more stable than Pt (II).

35. Why d^4 species of Cr^{2+} is strongly reducing while manganse (III) is strongly oxidising ?

Ans. For Chromium +III state is more stable as compared to +II state. Therefore, Cr^{2+} readily changes into Cr^{3+} and behaves as a strong reducing agent. On the otherhand for manganese, +II state is more stable than +III state. Hence, Mn^{3+} readily changes inot Mn^{2+} ($3d^S$) by gaining an electron and behaves as strong oxidising agent.

36. Why Cu^+ ion is not stable in aqueous solution ?

Ans. Cu^+ in aqueous solution undergoes disproportionation.

$$2Cu^+_{(aq)} \rightarrow Cu^{2+}_{(aq)} + Cu(s)$$

The E^0 value for this is favourable.

37. In what way is the electronic configuration of the transition elements different from that of the non-transition elements ?

Ans. Transition elements have partially filled 'd' subshell belonging to penultimate energy level whereas non-transition elements do not have any partially filled d-subshell. In non-transition elements, the last electron enters the s or p subsell whereas in transition elements the last electron enters the 'd' subshell of penultimate energy level.

38. Which metal in the first transition series exhibits +1 oxidation state most fequently and why ?

Ans. Copper exhibits +1 oxidation state most frequently in fist transition series. Because Cu(I) has stable electronic configuratoin.Cu (I) . [Ar] $3d^{10}$.

39. there is grater range of oxidation states among the actinoids than that in Lanthanoids. Why ?

Ans. Lanthonoids mainly exhibit oxidation states of +3 (besides +2 and +4). Actinoids also exhibit oxidation states of +3 but they also show higher oxidation states from +4 to +7. This is due to nearly equal energis of 5f, 6d and 7s sub shells.

40. Can Lanthonum (Z=57) exhibit +4 oxidation state ? Explain.

Ans. Lanthanum has electronic configuration

$_{57}La : [Xe]5d^1 6s^2$

La^{3+} has stable electronic configuration of Xenon. In order to give +4 oxidation state, the stable electronic configuration of La^{3+} would have to be distrubed and hence La^{4+} does not exist.

41. What is the common oxidation state of Cu, Ag and Au.

Ans. All these three metals show a common oxidation state +1.

42. Why do transition metals show similarities along the horizontal period.

Ans. All the metals of transition elements contain incompletely filled 'd' subshell where as the outer shell electronic configuratoin remains the same.

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UNIT - V

COORDINATION COMPOUNDS

I. Select the correct answer from the choices given under each bit :

1. Among the following which is not a complex compound.

(a) $K_2SO_4 . Al_2(SO_4)_3\ 24H_2O$

(b) $K_4[Fe(CN)_6]$

(c) $[Co(NH_3)_6]Cl_3$

(d) $[Ni(CO)_4]$

2. Secondary valency of Pt in $[Pt(NH_3)_6]Cl_4$ is

(a) 4 (b) 6

(c) 0 (d) 2

3. Among the following which has highest paramagnetism property ?

(a) $[Cr(H_2O)_6]^{3+}$ (b) $[Fe(H_2O)_6]^{2+}$

(c) $[Cu(H_2O)_6]^{2+}$ (d) $[Zn(H_2O)_6]^{2+}$

4. 2 moles of AgCl is precipitated per mole of the compound $NiCl_2 . 6H_2O$. Total number of ions produced are :

(a) 2 (b) 3

(c) 4 (d) 0

5. $EDTA^{4-}$ is a :

(a) unidented ligand

(b) didented ligand

(c) hexadented ligand

(d) tridented ligand

6. The oxidation number of Fe in $K_3[Fe(C_2O_4)_3]$ is

(a) 0 (b) +3

(c) +4 (d) +2

7. $[Cr(NH_3)_6][Co(CN)_6]$ show

(a) Co-ordination isomerism

(b) Ionization isomerism

(c) Linkage isomerism

(d) Hydrate isomerism

8. In $[Ni(CO)_4]$ nickel has

(a) sp^3 hybridization

(b) dsp^2 hybridization

(c) sp^2 hybridization

(d) sp^3d hybridization

9. Among the following which is a outer orbital complex ?

(a) $[Co\ F_6]^{3-}$ (b) $[Co(NH_3)_6]^{3+}$

(c) $[Fe(CN)_6]^{4-}$ (d) $[Fe(CN)_6]^{3-}$

10. $NiCl_2\ 6H_2O$ give 2 moles of AgCl precipitated per mole of the compound with excess $AgNO_3$. The secondary valency of nickel is

(a) 2 (b) 4

(c) 6 (d) 8

11. Tetraammineaquachlorido cobalt (III) chloride is

(a) $[Co(NH_3)_4\ H_2O.Cl]\ Cl_2$

(b) $[Co(NH_3)_4\ Cl_2]Cl$

(c) $[Co(NH_3)_3\ Cl_3]$

(d) $[Co(NH_3)_4\ (H_2O)_2]\ Cl_3$

12. The number of ions produced from the complex $[Co(NH_3)_6]\ Cl_2$ in solution is :

(a) 2 (b) 3

(c) 4 (d) 6

13. The oxidation number of cobalt in $[Co(NH_3)_6]\ Cl_3$ is

(a) + 1 (b) + 2

(c) + 3 (d) 0

14. Among the following, the most stable complex is

(a) $[Fe(H_2O)_6]^{3+}$ (b) $[Fe(CN)_6]^{3-}$

(c) $[Fe(C_2O_4)_3]^3$ (d) $[Fe\ Cl_6]^{3-}$

15. Which one of the following species, the transition metal ion has d^3 electronic configuration ?

(a) $[Cr(NH_3)_6]^{3+}$ (b) $[CoF_6]^{3-}$

(c) $[Fe(CN)_6]^{3-}$ (d) $[Ni\ (H_2O)_6]^{2+}$

16. Which one of the following species has a square planner structure ?

(a) $[Pt\ (NH_3)_2Cl_2]$

(b) $[BeF_4]^{2-}$

(c) $[Hg(NH_3)_2]\ Cl_2$

(d) SF_6

17. The maximum co-ordination number of EDTA is

(a) 2 (b) 4

(c) 6 (d) 3

18. The I U P A C name of sodium nitro prusside is

(a) Sodium nitroferricyanide

(b) Sodium nitroferrocyanide

(c) Sodium pentacyanonitrosyl ferrate (III)

(d) None of these

19. The oxidation state of Fe in brown ring complex $[Fe(H_2O)_5NO]SO_4$ is

(a) +1 (b) +2

(c) + 3 (d) +4

20. Which compound will yield Fe^{3+} ion in solution ?

(a) $FeSO_4(NH_4)_2SO_4\ .\ 6H_2O$

(b) $Fe_2(SO_4)_3$

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

(d) $[Fe(CN)_6]^{3-}$

21. The chemical formula of nitro pentaminecobalt (III) chloride.

(a) $[Co(NH_3)_5NO_2]\ Cl_2$

(b) $[Co(NH_3)_4(NO_2)_2]\ Cl_2$

(c) $[Co(NH_3)_5(NO_2)]Cl$

(d) $[Co(NH_3)_5(NO_2)]Cl_3$

22. In which of the following complex the nickel is in highest oxidation state ?

(a) $Ni(CO_4)$

(b) $K_2[NiF_6]$

(c) $[Ni(NH_3)_6](BF_4)_2$

(d) $K_4[Ni(CN)_6]$

23. In which of the following compound, the metal is in the lowest oxidation state ?

(a) $[Co(NH_3)_5 Br_2] SO_4$

(b) $Fe_3 [Fe(CN)_6]_2$

(c) $[Mn_2(CO)_{10}]$

(d) $K[PtCl_3(C_2H_4)]$

24. Which of the following observation / statement is correct ?

(a) Anhydrous $CuSO_4$ becomes blue in aqueous medium due to the complex formation.

(b) $Ni(CN)_2$ dissolves in KCN giving an orange-red solution.

(c) $Fe(OH)_3$ can be precipitated by adding NH_4OH to $K_3[Fe(CN)_6]$.

(d) None of the above.

25. The correct structure of $Fe(CO)_5$ is

(a) Octahedral

(b) Tetrahedral

(c) Square pyramidal

(d) Trigonal bipyramidal

26. The IUPAC name of $Na_3[Co(NO_2)_6]$ is

(a) Sodium cobaltinitrite

(b) Sodium hexanitritocobaltate (III)

(c) Sodium hexanitrocobalt (III)

(d) Sodium hexanitritocobaltate (II)

27. Which of the following species represents the example of dsp^2 hybridization ?

(a) $[Fe(CN)_6]^{3-}$ (b) $[Ni(CN)_4]^{2-}$

(c) $[Ag(CN)_2]^-$ (d) $[Co(CN)_6]^{3-}$

28. Copper Sulphate dissolves in excess of KCN to give

(a) $[Cu(CN)_4]^{2-}$ (b) $Cu(CN)_2$

(c) CuCN (d) $[Cu(CN)_4]^{3-}$

29. When excess ammonia is added to $CuSO_4$ solution, the deep blue complex obtained is :

(a) Tetrahedral and paramagnetic

(b) Tetrahedral and di-magnetic

(c) Square plannar and di-magnetic

(d) Square planner and paramagnetic

30. The dark blue colour solution formed when excess of ammonia is added to a solution of copper (II) sulphate is due to the presence of the ion

(a) $[Cu(OH)_4(H_2O)_2]^{2-}$

(b) $[Cu(NH_3)_2(H_2O)_4]^{4+}$

(c) $[Cu(NH_3)_2(H_2O)_4]^{2+}$

(d) $[Cu(NH_3)_4(H_2O)_4]^{2+}$

31. The ligand : NO is named as

(a) Nitrosonium (b) Nitronium

(c) Nitrosyl (d) Nitro

32. Prussian blue is obtained by mixing together aqueous solution of Fe^{3+} salt with

(a) Ferricyanide

(b) Ferrocyanide

(c) Hydrogen cyanide

(d) Sodium cyanide

33. According to crystal field theory, five 'd' orbitals in an octahedral field split to give

(a) two orbitals with lower energy and three orbitals with higher energy

(b) three orbitals with lower energy and two orbitals with higher energy

(c) one orbitals with lower energy and four orbitals with higher energy

(d) four orbitals with lower energy and one orbitals with higher energy

34. The central metal in a complex behaves as

(a) Lewis acid

(b) Lewis base

(c) Neutral compound

(d) None

35. A group of atoms can act as ligand when

(a) it is a small molecule

(b) it is a negativity charged ion

(c) it has lone pair of electrons

(d) it is positively charged ion

36. The group present outside the co-ordination sphere in a complex is

(a) ionic (b) covalent

(c) co-ordinate (d) None

37. An ambidentate ligand is one which

(a) is linked to the metal through two donor atom

(b) has two donor atoms but only one of them has capacity to form a co-ordinate bond

(c) has two donor atoms but either of two can form a co-ordinate bond

(d) form chelate rings

38. The formula of tetra ammine nickel (II) hexa cyanoferrate (III) is

(a) $[Ni\ (NH_3)_6]_4\ [Fe(CN)_6]$

(b) $[Ni\ (NH_3)_4]_3\ (Fe(CN)_6]_4$

(c) $[Ni(NH_3)_4]_4\ [Fe(CN)_6]_2$

(d) $[Ni\ (NH_3)_4]_3[Fe(CN)_6]_2$

39. Chlorophyll is a co-ordination compound having metal atom of

(a) Ca (b) Mg

(c) Na (d) K

40. Which is not the co-ordination compound among the following

(a) Potassium Ferricyanide

(b) Potassim Ferrocyanide

(c) Ferrous ammonium sulphate

(d) Tetraammine copper sulphate

41. The correct name of $[Cr(NH_3)_6]Cl_3$ is :

(a) hexamminechromium (III) Chlorids

(b) hexamninechromium (II) chloride

(c) hexammoniachromium (III) chlorid

(d) chromium (III) hexammine chloride

42. Which reagent can be used to identify nickel ion ?

(a) Resorcinol

(b) Diphenyl benzidine

(c) Dimethyl glyoxime

(d) Potassium ferrocyanide

43. Which of the following name is correct ?

(a) $[Cu(H_2O)(NH_3)Br_2]$: Amminoaquodibromo copper (I)

(b) $Na_3[Al(C_2O_4)_3]$: Trisodium trioxalatoaluminate (III)

(c) Na_2 [Ni(EDTA)] : Sodium ethylenediaminetetracetatonickel (II)

(d) $[Co(NH_3)_5ONO]SO_4$: Pentamminenitro cobalt (III) Sulphate.

44. The correct IUPAc name of the complex : $[FeF_4(H_2O)_2]^-$?

(a) diaquairon (III) tetrofluerate ion

(b) diaquatetrafluorido ferrate (III) ion

(c) diaquatetrafluoro iron (III) ion

(d) tetrafluorodihydroxyferrate (III) ion

45. Which of the following gives the correct coordination number and oxidation number of the transition metal atom in $[Co(NH_3)_2(H_2O)_2Cl_2]^+$?

(a) C.N. = 3, O.N. = +1

(b) C.N. = 4, O.N. = +2

(c) C.N. = 6, O.N. = +1

(d) C.N.=6, O.N. = +3

46. The correct formula of the complex tetrammineaquathiocyanate - N-cobalt (III) Chloride is :

(a) $[CO(NH_3)_4(H_2O)(NCS]Cl_2$

(b) $[Co(H_2O)(NH_3)_4(NCS)]Cl_2$

(c) $[Co(CNS)(H_2O)(NH_3)_4]Cl_2$

(d) $[Co(NCS)(NH_3)_4(H_2O)]Cl_2$

47. Which name formula combination is not correct ?

(a) $[Co(NH_3)_4(OH_2)I]SO_4$: tetrammineaquaiodocobalt (III) sulphate

(b) $K[Cr(NH_3)_2Cl_4]$: Potassium diamminetetrachloro chromate (III)

(c) $[Mn(CN)_5]^{2-}$: Pentacyanomanganate (II) ion

(d) $[Ni(CO_4)]$: tetracarbonylnickel(O)

48. The complex which has no 'd' electrons in the central metal atom is :

(a) $[MnO_4]^-$ (b) $[Fe(CN)_6]^{3-}$

(c) $[Cr(H_2O)_6]^{3+}$ (d) $[Co(NH_3)_6]^{3+}$

49. The cationic complex is :

(a) Cuprammonium ion

(b) Ferrocyonide ion

(c) Mercuriciodide ion

(d) Argentocyanide ion

50. 2 : 4 dinitrophenyl hydrazine is an example for :

(a) tridentate ligand

(b) didented ligand

(c) monodentate ligand

(d) polydental ligand

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

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

II. Short Questions

Q1. On the basis of valence bond theory explain $[Ni(CN)_4]^{2-}$ ion with square planar structure having diamagnetic and $[Ni\ Cl_4]^{2-}$ ion is tetrahedral and paramagnetic.

Ans. $[Ni(CN)_4]^{2-}$ and $[Ni\ Cl_4]^{2-}$ entities seems to be similar but $[Ni(CN)_4]^{2-}$ shows dsp^2 hybridization giving square planner structure having no unpaired electrons hence diamagnetic. But $[NiCl_4]^{2-}$ shows sp^3 hybridization having two unpaired electrons in 'd' orbital, hence it is paramagnetic.

Q2. A co-ordination compound has the formula $CoCl_3\ 4NH_3$. It does not liberate ammonia but precipitates chloride ions as silver chloride. Give the IUPAC name of the complex and write its formula.

Ans. $[Co(NH_3)_4\ Cl_2]\ Cl$. As Cobalt has C. N. 6, then the compound is $[Co(NH_3)_4Cl_2]\ Cl$. tetraamminedichlorido cobalt (III) chloride.

Q3. Which of the two compounds is more stable and why ?
$K_4[Fe(CN)_6]$, $K_3[Fe(CN)_6]$

Ans. $K_4\ [Fe(CN)_6]$ is more stable than $K_3\ [Fe\ (CN)_6]$. The effective atomic number of metal complex is the number of electrons present in the metal ion plus the number of electrons donated to it by the ligand. The calculation EAN = At No -Oxd^n state + 2x C.N.

For $K_4\ [Fe\ (CN)_6]^{4-}$, EAN = 26 - 2 + 2 x 6 = 36 i.e. Kr

For $K_3\ [Fe\ (CN)_6]$, EAN = 26-3+2x6 = 35

So $K_4[Fe(CN)_6]^{4-}$ is more stable.

Q4. What is crystal field splitting ?

Ans. In free transition metal ion, all the 5d-orbitals are degenerate but when it is involved in a complex formation, the degeneracy is split. This is called crystal field splitting.

Q5. $[Fe\ (H_2O)_6]^{3+}$ is strongly paramagnetic where as $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain.

Ans. In both the complexes, Fe is in +3 oxidation state with $3d^5$ configuration. In the presence of 3d electrons pair up leaving only one unpaired electron. There is d^2sp^3 hybridization forming inner orbital complex with CN^- strong ligand.

H_2O is a weak ligand. In the presence of H_2O ligand, the 3d electrons do not pair up. The hybridization is sp^3d^2 forming an outer orbital complex containing five unpaired electrons. Hence it is strongly paramagnetic.

Q6. Why metal carbonyls are called organometallics ?

Ans. Metal carbonyls are called organometallics because the 'C' atom of the CO is linked to the metal atom. So that the metal - carbon bonds have both σ and π character.

Q7. A co-ordination compound with the molecular formula $CrCl_3 . 4H_2O$ precipitates AgCl with $AgNO_3$ solution. Its molar conductivity is found to be equivalent to two ions. What is the structural formula of the compound ?

Ans. Cr has co-ordination number 6. But there are 4 neutral H_2O ligands, hence two more ligands are taken as Cl^- and the other Cl^- will be present outside entity. So the structure is $[Cr(H_2O)_4Cl_2]$ Cl - tetraaquadichloridochromium (III) chloride.

Q8. Using IUPAC norms write the names of the following.

(a) $K_4[Fe(CN)_6]$ (b) $[Ni\ Cl_4]^{2-}$ (c) $[Co\ (en)_3]^{3+}$

Ans. $K_4\ [Fe(CN)_6]$ - Potassium hexacyanoferrate (II)

$[Ni\ Cl_4]^{2-}$ - Tetrachloridonickelate (II) ion

$[Co\ (en)_3]^{3+}$ - Tris (ethane 1,2 diammine) Cobalt (III) ion

Q9. How many isomers are possible for the neutral complex $[Co(NH_3)_3Cl_3]$?

Ans. $[Co(NH_3)_3\ Cl_3]$ has two isomers, cis and trans.

Q10. What is meant by unidentate and ambidentate ligands ?

Ans. A molecule or an ion has only one donor atom to form one co-ordinate bond with the central metal atom is called unidentate ligand e.g. Cl^-, NH_3. A molecule or an ion has two donor atoms but only one of them can form a co-ordinate bond at a time with the central metal atom is called ambidentate ligand e.g. CN^- or NC^- and NO_2^- or ONO^-.

Q11. Calculate the oxidation numbers of the metals in the following co-ordination species.

(a) $[Pt\ Cl_4]^{2-}$ (b) $[Cr(NH_3)_3\ Cl_3]$ (c) $K_4[Fe(CN)_6]$

Ans. (a) $[Pt\ Cl_4]^{2-}$, the oxidation no: $x + 4\ (-1) = -2$ or $x = +2$

(b) $[Cr\ (NH_3)_3\ Cl_3]$, the oxidation No. : $x + 0 + 3\ (-1) = 0$ or $x = +3$

(c) $K_4[Fe(CN)_6]$, the oxidation No. : $x + 6\ (-1) = -4$ or $x = +2$

Q12. Write the formula of the following co-ordination compounds

(a) Dichloridoplatinum (IV) tetrachloridoplatinate (II)

(b) Sodium pentacyanonitrosylsulphido ferrate (III)

(c) Potassium amminetrichloridopalatinate (II)

Ans. (a) Dichloridoplatinum (IV) tetrachloridoplatinate (II) : $[Pt\ Cl_2]\ [Pt\ Cl_4]$

(b) Sodium pentacyanonitrosylsulphido ferrate (III) : $Na_4\ [Fe(CN)_5\ .\ NOS]$

(c) Potassium ammine trichloridoplatinate (II) : $K\ [Pt\ (NH_3)\ Cl_3]$

Q13. What is meant by chelate effect ? Give examples.

Ans. The complexes which are formed by chelating ligands like ethylene diamine (en), EDTA etc are more stable than those formed by monodentate ligands such as H_2O or NH_3. This enhanced stability of complexes containing chelating ligands is called chelate effect. Such as the complex of Ni with chelating ligand (en) is more stable than corresponding complex with ammonia ligand.

$$Ni^{2+}(aq) + 6NH_3(aq) \rightleftharpoons [Ni(NH_3)_6]^{2+}_{(aq)} : \log\beta = 8.61$$

$$Ni^{2+}(aq) + 3en(aq) \rightleftharpoons [Ni(en)_3]^{2+}_{(aq)} : \log\beta = 18.28$$

Q14. Explain the difference between weak field ligand and strong field ligand.

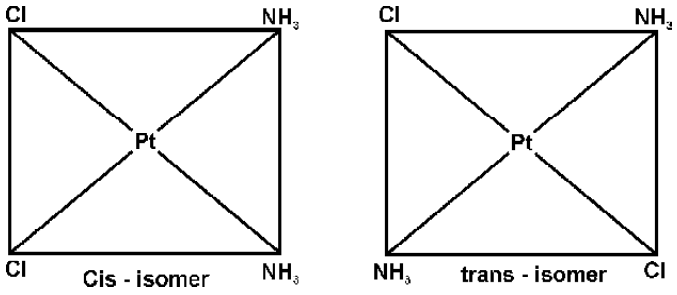
Ans. Ligands have different field strength and as a result the crystal field splitting Δ_0 or Δ_t, depends upon the field produced by the ligand and charge on metal ions. Some ligands are able to produce strong fields in which the splitting will be large whereas others produce weak fields and consequently result in small splitting of d-orbitals. The arrangement of ligands in order of increasing field strength is known as spectro chemical series.

$$I^- < Br^- < SCN^- < Ci^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < edta^{4-} < NH_3 < en < CN^- < CO$$

Q15. Define stereo isomerison. Give the geometrical isomers of $[Pt\ (NH_3)_2\ Cl_2]$.

15. In co-ordination compounds, the ligands are arranged in space in specific orientation around a given metal atom or ion which is known as stereo isomerism. This is two types (i) Geometrical (ii) Optical.

The geometrical isomers of [Pt $(NH_3)_2$ Cl_2] : diamminedichloridoplatinum (II) shows Cis and trans isomers.



Q16. A solution of [Ni $(H_2O)_6$]$^{2+}$ is green but a solution of [Ni$(CN)_4$]$^{2-}$ is colourless. Explain.

Ans. In [Ni$(H_2O)_6$]$^{2+}$ the metal ion Ni is in +2 state with $3d^8$ configuration that is two unpaired electrons do not pair up in the presence of the weak H_2O ligand. Hence it is coloured and shows green. But in [Ni$(CN)_6$]$^{2-}$, though Ni is in +2 state but due to presence of strong field ligand (CN), the two unpaired electrons in 3d orbitals pair up. Thus, it shows no unpaired electrons and is colourless.

Q17. What is the oxidation state of Ni in [Ni$(CO)_4$]?

Ans. [Ni $(CO)_4$] the oxidation state of Ni : x + 4 x 0 = 0 or x = 0

Q18. Give the geometry and magnetic character of [Ni Cl_4]$^{2-}$.

Ans. [Ni$(Cl_4]^{2-}$ gives sp^3 hybridization of tetrahedral structure. The electrons present in $3d^8$ orbitals do not pair up as Cl^- is weak ligand. So it shows paramagnetic.

Q19. What is bidentate ligand ? Give one example.

Ans. The molecule or ion which contain two donor atoms and hence forms two co-ordinate bonds with the central metal atom is called bidentate ligand

e.g.
$$\begin{array}{ll} CH_2NH_2 & COO^- \\ | & | \\ CH_2NH_2 & COO^- \end{array}$$

Q20. What are t_{2g} and e_g orbitals ?

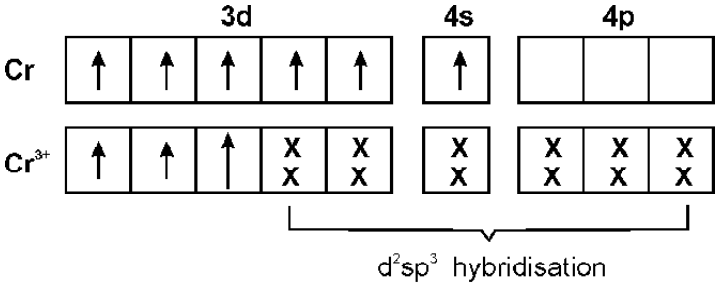
Ans. In a free transition metal ion, the five 'd' orbitals are degenerate. When complex is formed, the degeneracy is split. In octahedral field, the three 'd' orbitals having lower energy called t_{2g} and the remaining two 'd' orbitals of higher energy called e_g orbitals.

Q21. What are the basic postulates of Werner's theory of co-ordination ?

Ans. Werner's postulate : The co-ordination complex the metal possesses primary and secondary valencies. Primary valence satisfies the oxidation state and secondary valence satisfies the coordination number. Different co-ordination numbers have characteristic spatial arrangement of the ions or groups bound by secondary linkage.

Q22. Using valence bond theory of complexes, explain the geometry and paramagnetic nature of the ion $[Cr(NH_3)_6]^{3+}$, given the atomic number of Cr = 24.

Ans. In $[Cr(NH_3)_6]^{3+}$ ion the Cr is in +3 oxidation state. The electronic configuration $3d^5\ 4s^1$.



6 pairs of electrons from $6NH_3$ molecules

So $[Cr(NH_3)_6]^{3+}$ has d^2sp^3 hybridization of octahedral structure. But due to presence of unpaired electrons, it is paramagnetic.

Q23. How does the crystal field theory explain high spin and low spin states of complexes ?

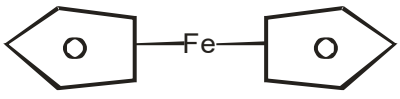
Ans. When ligand is approached the transition metal ion, the 'd' orbitals split into two sets. One set is to lower energy of triple generated and the other set is to higher energy of doubly generated. The energy difference between these two splitting is Δ_0 (for octahedral field).

If $\Delta_0 < P$ (pairing energy) the 4th electron enters one of the e_g orbital giving $t_{2g}^3\ e_g^1$ thus forming high spin compliexes. Such ligands for which $\Delta_0 < P$ are called weak field ligands.

If $\Delta_0 > P$, the 4th electron enters to t_{2g} orbitals to pair up giving $t_{2g}^4\ e_g^0$, there by forming low spin complexes. Such ligands for which $\Delta_0 > P$ are called strong field ligands.

Q24. Draw the structure of ferrocene.

Ans.



structure of ferrocene

Q25. What is the difference between inner and outer orbital complex ?

Ans. When the complex formed involves the inner (n-1) d orbital for hybridisation (e.g. d^2sp^3), the complex is called inner orbital complex. In this case, the electrons of the metal are made to pair up, so the complex will be either diamagnetic or will have lesser No. of unpaired electrons give low spin complex $[Co(NH_3)_6]^{3+}$.

When the complex formed involves the use of nd orbitals for hybridization (sp^3d^2) called outer orbital complex. The complex will have large number of unpaired electrons and remains unchanged. So it is called high spin complex e.g. $[Ni(H_2O)_6]^{2+}$.

Q26. Why the tetrahedral complex do not show geometrical isomerism ?

Ans. Because the relative position of the ligands attached to the central metal atom are the same with respect to each other.

Q27. Why chelated complexes are more stable than unchelated complexes ?

Ans. When a chelated ligand attached to the central metal atom the process is accompanied by increase in entropy resulting in the formation of a stable complex.

Q28. Copper sulphate solution on mixing with ammonia (ratio 1 : 4) does not give test for Cu^{2+} ions but gives test for sulphate ions. Why ?

Ans. When ammonia co-ordinates to copper it forms the complex $[Cu(NH_3)_4]SO_4$. Copper is present in co-ordination sphere and therefore is non-ionic where as sulphate ion is present in ionic sphere and hence ionic.

Q29. What happens when excess of KCN is added to aqueous $CuSO_4$ solution ? Why is it that no precipetate of copper sulphide is obtained when $H_2S_{(g)}$ is passed through the solution ?

Ans. $[Cu(H_2O)_4]^{2+} + 4CN^- \rightarrow [Cu(CN)_4]^{2-}$

As CN^- is a strong ligand it forms a highly stable complex with Cu^{2+} ions which on passing H_2S gas, the weak ligand S^{2-} can not replace CN^- ion.

Q30. Write the formulae of the following complexes.

(a) Pentamminechloridocobalt (III)

(b) Lithiumtetrahydroaluminate (III)

Ans. (a) $[Co(NH_3)_5Cl]^{2+}$

(b) $Li[AlH_4]$

Q31. Why the species $[CuCl_4]^{2-}$ exists while $[Cu\ I_4]^{2-}$ does not ?

Ans. Iodine atom is much larger size and copper atom is not able to accomodate four big atoms around it.

Q32. Write the chemical formula of sodiumtrioxalatoferrate (III). How many ions are formed by dissociation of one molecule of this compound ?

Ans. Cation : Na^+

Onion : $[Fe\ (C_2O_4)]^{3-}$

Formula of the complex : $Na_3\ [Fe\ (C_2O_4)_3]$

Four ions are formed by dissoication of one molecule of this compound (three Na^+ and one complexation).

$$Na_3[Fe(C_2O_4)_3] \rightarrow 3Na^+ + [Fe(C_2O_4)_3]^{3-}$$

Q33. What happens when potossium ferrocyanide solution is added to a ferric salt solution ?

Ans. A prussian blue colour complex (ferri-ferrocyanide) is formed

$$\underset{\text{Pol. ferrocyanide}}{4FeCl_3 + 3K_4[Fe(CN)_6]} \rightarrow \underset{\text{Ferri – ferrocyanide}}{Fe_4[Fe_3(CN)_6]_3} + 12KCl$$

Q34. Why only transition metals are known to form π complexes ?

Ans. Transition metal ions have empty 'd' orbitals, into which the electron pairs can be donated by ligands containing π electrons eg. $CH_2{=}CH_2$, C_5H_5, C_6H_6 etc.

Q35. Give names of two complexes which are used in medicines.

Ans. (i) EDTA used for the treatment of lead poisoning.

(ii) Cis platin : $[Pt\ (NH_3)_2\ Cl_2]$ used for treatment of cancer.

***

UNIT - VI

HALO ALKANES AND HALOARENES

I. Select the correct answer from the choices given under each bit :

1. The order of reactivity of following alcohols with halo acids is

(i) $CH_3CH_2CH_2-OH$

(ii) $CH_3CH_2\underset{\displaystyle CH_3}{\underset{|}{CH}}-OH$

(iii) $CH_3CH_2\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-OH$

(a) i > ii > iii (b) iii > ii > i

(c) ii > i > iii (d) i > iii > ii

2. Which of the following alcohols will yield the corresponding alkyl chloride on reaction with concentrated HCl at room temperature ?

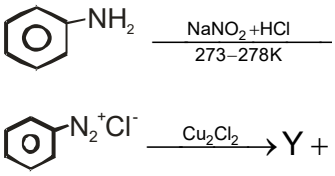
(a) CH_3-CH_2-OH

(b) $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-OH$

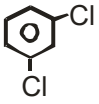
(c) $CH_3CH_2\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-OH$

(d) $CH_3CH_2\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle H}{\underset{|}{C}}}}-OH$

3. Identify the compound Y in the following reaction.



(a)  (b) 

(c)  (d) 

4. Toluene reacts with a halogen in presence of iron (III) chloride giving ortho and para halo compound. The reaction is

(a) Electrophilic elimination reaction

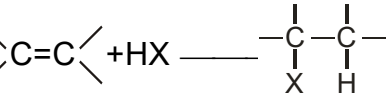
(b) Electrophilic substitution reaction

(c) Free radical addition reaction

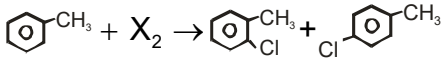
(d) Nucleophilic substitution reaction

5. Which of the following is halogen exchange reaction ?

(a) $RX + NaI \rightarrow R-I + NaX$

(b) 

(c) $R-OH + HX \xrightarrow{ZnCl_2} R-X + H_2O$

(d) 

6. Which reagent will you use for the following reaction ?

$CH_3 - CH_2 - CH_2 - CH_3 \rightarrow$

$CH_3 - CH_2 - CH_2 - CH_2 - Cl +$

$CH_3\text{-}CH_2\text{-}\underset{\displaystyle Cl}{CH}\text{-}CH_3$

(a) Cl_2 / uv light

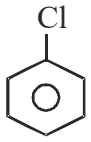
(b) $NaCl + H_2SO_4$

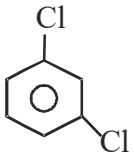
(c) Cl_2 gas in dark

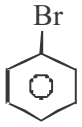
(d) Cl_2 gas in the presence of iron in dark

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

(i) 

(ii) 

(iii) 

(iv) 

(a) i < ii < iii < iv (b) i < iii < iv < ii

(c) iv < iii < ii < i (d) ii < iv < iii < i

8. Arrange the following compounds in increasing order of their boiling points.

(i) $\begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!\rangle CH - CH_2 - Br$

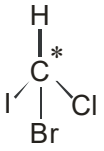
(ii) $CH_3 - CH_2 - CH_2 - CH_2 - Br$

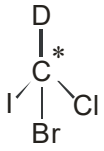
(iii) $CH_3\text{-}\underset{\displaystyle Br}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}}\text{-}CH_3$

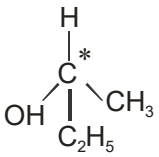
(a) ii < i < iii (b) i < ii < iii

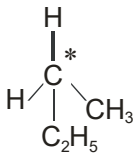
(c) iii < i < ii (d) iii < ii < i

9. In which of the following molecules carbon atom marked with asterisk (*) is assymatric ?

(i) 

(ii) 

(iii) 

(iv) 

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

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

10. Which of the following is an example of Vic-dihalide

(a) dichloro methane

(b) 1,2 dichloro ethane

(c) ethylidene chloride

(d) alkyl chloride

11. The position of -Br in the compound in CH_3 - CH = CHC(Br)$(CH_3)_2$ can _____.

(a) Alkyl (b) Aryl

(c) Vinyl (d) Secondary

12. Chlorobenzene is formed by reaction of chlorine with benzene in the presence of $AlCl_3$, which of the following species attacks the benzene ring in this reaction.

(a) Cl^- (b) Cl^+

(c) $AlCl_3$ (d) $[Al\ Cl_4]^-$

13. Ethylidene chloride is a/an _____

(a) vic-dihalide (b) gem-dihalide

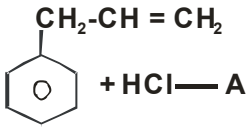
(c) allylic halide (d) vinylic halide

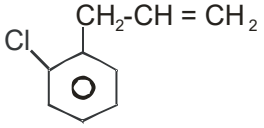
14. Which of the following alkyl halide will undergo S_N1 reaction most readily ?

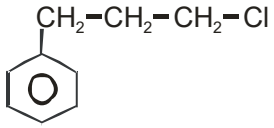
(a) $(CH_3)_3 C - F$ (b) $(CH_3)_3 C - Cl$

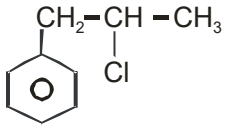
(c) $(CH_3)_3 C - Br$ (d) $(CH_3)_3 C - I$

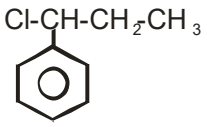
15. What is 'A' in the following reaction?



(a) 

(b) 

(c) 

(d) 

16. A primary alkyl halide would prefer to undergo _____

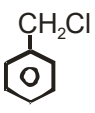
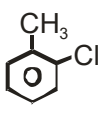
(a) S_N1 reaction

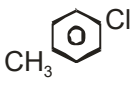
(b) S_N2 reaction

(c) α - Elimination

(d) Racemisation

17. The reaction of toluene with chlorine in the presence of iron and in the absence of light yields _____.

(a)  (b) 

(c)  (d) Mixture of b & c

18. Chloromethane on treatment with excess ammonia yields mainly :-

(a) N-N dimethyl methanamine ($CH_3 - N<^{CH_3}_{CH_3}$)

(b) N-methyl methanamine (CH_3-NH-CH_3)

(c) Methanamine (CH_3NH_2)

(d) Mixture containing all these in equal proportion

19. Which of the following are secondary bromides ?

(a) $(CH_3)_2$ CHBr

(b) $(CH_3)_3$ C CH_2 Br

(c) CH_3 CH (Br) CH_2 CH_3

(d) $(CH_3)_2$ C (Br) CH_2 - CH_3

20. Which of the following compounds can be classified as aryl halide ?

(a) p - Cl C_6H_4 CH_2CH $(CH_3)_2$

(b) p - CH_3 - CHCl (C_6H_4) CH_2 CH_3

(c) o - $BrCH_2$- $C_6H_4CH(CH_3)CH_2CH_3$

(d) C_6H_5 Cl

21. Ethylene dichloride and ethylidene chloride are isomers. Identify the correct statement.

(a) Both the compounds form same product with alcoholic KOH.

(b) Both the compounds form same product on treatment with aq. NaOH.

(c) Both the compounds form same products on reduction

(d) Both the compounds are optically active

22. In the addition of HBr to propene in the absence of peroxides, the first step involves the addition of

(a) H^+ (b) Br^-

(c) $\dot{H}$ (d) $\dot{Br}$

23. S_N2 reaction proceeds through the intervention of

(a) Carbonium ion

(b) Transition state

(c) Free radial

(d) Carbanion

24. Which of the following reactions is most suitable for the preparation of n-propylbenzene.

(a) Friedel - Craft reaction

(b) Wurtz reaction

(c) Wurtz - Fittig reaction

(d) Grignard reagent

25. The addition of HBr is easiest with

(a) $CH_2 = CHCl$

(b) $ClCH = CHCl$

(c) $CH_3 - CH = CH_2$

(d) $(CH_3)_2 C = CH_2$

26. The most reactive nucleophile among the following is

(a) CH_3O^-

(b) $C_6H_5O^-$

(c) $(CH_3)_2 CHO^-$

(d) $(CH_3)CO^-$

27. Which of the following can not be used in Friedel-Crafts reaction ?

(a) $FeCl_3$ (b) $FeBr_3$

(c) $AlCl_3$ (d) NaCl

28. Tertiary alkyl halides are practically inert to substitution by S_N2 mechanism, because

(a) insolubility

(b) instability

(c) inductive effect

(d) steric hinderance

29. Among the following the strongest nucleophile is

(a) C_2H_5SH (b) CH_3COO^-

(c) CH_3NH_2 (d) $NCCH_2^-$

30. The catalyst used in the preparation of alkyl chlorides by the action of dry HCl on an alcohol is

(a) anhydrous $AlCl_3$

(b) $FeCl_3$

(c) anhydrous $ZnCl_2$

(d) Cu

31. The halogen compound which most readily undergoes nucleophilic substitution is

(a) $CH_2 = CHCl$

(b) $CH_3CH=CHCl$

(c) $CH_2 = CHC(Cl) = CH_2$

(d) $CH_2 = CH\ CH_2Cl$

32. S_N1 reaction of optically active alkyl halides leads to

(a) retention of configuration

(b) racemisation

(c) inversion of configuration

(d) none of these

33. Aryl halides are less reactive towards nucleophilic substitution reactions as compared to alkyl halides due to

(a) the formation of less stable carbonium ion

(b) resonance stabilization

(c) longer carbon-chlorine bond

(d) the inductive effect

34. An S_N2 reaction at an asymmetric carbon of a compound always gives

(a) an enantiomer of the substrate

(b) a product with opposite optical rotation

(c) a mixture of diastereomers

(d) a single stereoisomer

35. Hydrolysis of benzyl chloride to form benzyl alcohol is an example of

(a) electrophilic addition

(b) elimination reaction

(c) substitution reaction

(d) hydrolysis reaction

36. Which of the following compounds is an allylic halide ?

(a) 1-chloro propoane

(b) 3-chloro propene

(c) 2-chloro propene

(d) 1-chloro propene

37. Which of the following compounds has the highest boiling point ?

(a) $CH_3 - CH_2 - CH_2 - CH_2 - Cl$

(b) $CH_3 - CHCl - CH_2 - CH_3$

(c) $CH_3 - CH_2 - \underset{\displaystyle CH_3}{\overset{\displaystyle |}{CH}} - Cl$

(d) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{\displaystyle |}{\underset{\displaystyle |}{C}}}} - Cl$

38. The conversion Cl - CH = CH - Cl to Cl_2CH-$CHCl_2$ can be carried out with :

(a) $Cl_2 / AlCl_3$

(b) Cl_2 / aq.NaOH

(c) Cl_2

(d) $Cl_2 / h\nu$

39. The conversion of 2, 3-dibromobutane to 2-butene with Zn and alcohol is :

(a) α-elimination

(b) redose reaction

(c) β-elimination

(d) both β-elimination and redox reaction

40. The addition of propene with HOCl proceeds via the addition of :

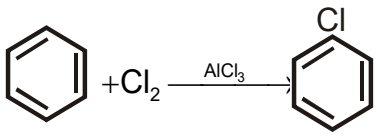
(a) Cl^+ in the first step

(b) OH^- in the first step

(c) Cl^+ and OH^- in a single step

(d) H^+ in the first step

41. In the following reaction



The species that attacks benzene is :

(a) Cl^- (b) Cl^+

(c) $AlCl_3$ (d) $AlCl_4^-$

42. Toluene reacts with Chlorine in the presence of iron (III) Chloride give Ortho ad para Chloro compounds. The reaction is :

(a) Electrophilic elimination reaction

(b) Free radical substitution reaction

(c) Electrophilic substitution reaction

(d) Nucleophilic substitution reaction

43. Which of the following represents a gem dihalide ?

(a) Ethylene dichloride

(b) 2, 2-dichlore propane

(c) 1, 3-dichloro propane

(d) 1, 2-dichloro propane

44. To prevent chloroform to form phosgene gas (poisonous gas) what is added ?

(a) C_2H_5OH (b) CH_3COOH

(c) CH_3OH (d) CH_3COCH_3

45. Which of the following sequence of reactions (reagents) can be uses for conversion of $C_6H_5CH_2CH_3$ into $C_5H_5CH = CH_2$?

(a) Cl_2 / hν;H_2O

(b) $SOCl_2$;alc KOH

(c) SO_2Cl_2;alc KOH

(d) $SOCl_2$; H_2O

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

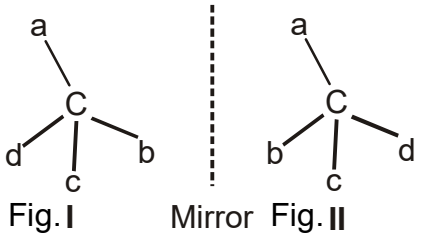
1.	(b)	16.	(b)	31.	(d)
2.	(d)	17.	(d)	32.	(b)
3.	(a)	18.	(a)	33.	(b)
4.	(b)	19.	(a) & (c)	34.	(d)
5.	(a)	20.	(b) & (d)	35.	(c)
6.	(a)	21.	(a) & (c)	36.	(b)
7.	(a)	22.	(a)	37.	(a)
8.	(c)	23.	(b)	38.	(c)
9.	(b)	24.	(c)	39.	(d)
10.	(b)	25.	(d)	40.	(a)
11.	(a)	26.	(a)	41.	(b)
12.	(b)	27.	(d)	42.	(c)
13.	(b)	28.	(d)	43.	(b)
14.	(d)	29.	(a)	44.	(a)
15.	(c)	30.	(c)	45.	(c)

II. Short Questions

Q1. What are enantiomers ?

Ans. Molecules which are non-superimposable mirror image of each other are called enantiomers.

Fig. I is not super imposable with Fig. II.



Q2. Differentiate between chiral and achiral molecules.

Ans. A chiral molecule has one asymmetric carbon atom. It gives none super imposable mirror image.

Achiral molecule gives superimposable mirror image.

Q3. Arrange the following halides in order of increasing S_N2 reactivity

CH_3Cl, CH_3Br, CH_3CH_2Cl, $(CH_3)_2CHCl$

Ans. $(CH_3)_2CHCl < CH_3CH_2Cl < CH_3Cl < CH_3Br$

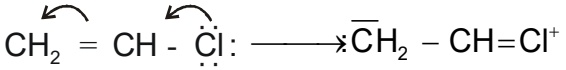
4. Arrange the following in decreasing order of S_N1 reactivity.

$CH_3CH_2CH_2Cl$, $CH_2 = CHCHClCH_3$, $CH_3CH_2CHClCH_3$

Ans. $CH_2 = CHCHClCH_3 > CH_3CH_2CHClCH_3 > CH_3CH_2CH_2Cl$.

5. Explain vinyl chloride is hydrolysed more slowly than ethyl chloride.

Ans. Vinyl chroride is represented as two resonance structures



Thus the C - Cl bond acquires some double bond character but in ethyl chloride ($CH_3 - CH_2 - Cl$), the C - Cl bond is purely single bond. So vinyl chloride hydrolyses more slowly than ethyl chloride.

6. Justify haloalkanes undergo nucleophilic substitution reactions where as haloarenes undergo electrophilic substitutions.

Ans. Haloalkanes having C - X bond forms carbocation having more +ve charge than haloarenes due to presence of benzene ring, as a result haloalkanes undergo nucleophilic substitution more readily and haloarenes undergo electrophilic substitution due to presence of benzene ring.

7. Write the IUPAC names of the following.

(a) $(CH_3)_2CH\ CH\ Cl\ CH_3$

(b) $CHF_2CBrClF$

(c) 

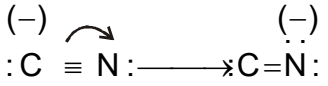
Ans. (a) $(CH_3)_2CHCHClCH_3$: 2 chloro 3 methyl butane

(b) CHF_2 CBr ClF : 1-Bromo 1-chloro 1, 2, 2- trifluoroethane

(c) : p - bromo chloro benzene

8. What are ambident nucleophiles ? Explain with example.

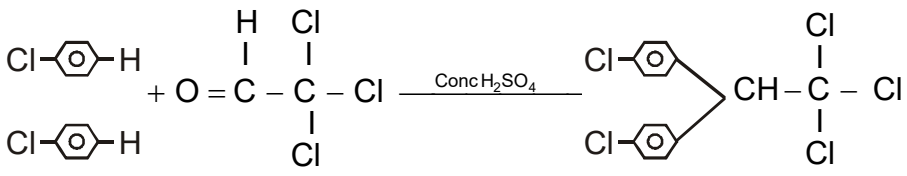
Ans. The nucleophiles which can attack through two different sites are called ambident nucleophiles e.g.



So it can act as cyanides when attack was done on C atom and can act as isocyanides when attack was done on N atom.

9. How DDT is prepared ?

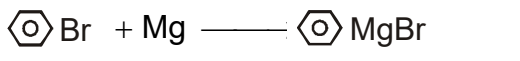
Ans. When chlorobenzene reacts with trichloro acetaldehyde (Chloral) in presence of Conc H_2SO_4 form DDT (pp′-dichloro diphenyl trichloro ethane)



D.D.T.

10. What happens when brombenzene is treated with Mg in the presence of dry ether ?

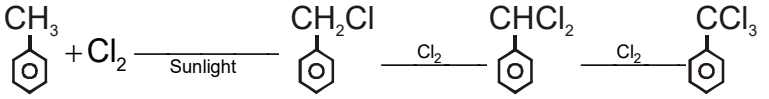
Ans. When bromo benzene is treated with Mg in the presence of dry ether forms Grignard reagent (phenyl magnesium bromide).



Bromo benzene Phenylmagnesium bromide

11. What happens when chlorine is passed through boiling toluene in the presence of sunlight ?

Ans. When chlorine is passed through boiling toluene in presence of sunlight benzyl chloride is formed, further form benzal dichloride, then benzotrichloride



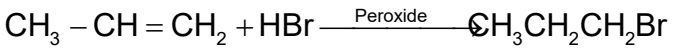
Toluene Benzylchloride Benzaldichloride Benzotrichloride

12. Give one test to distinguish C_2H_5Br and C_6H_5Br.

Ans. On hydrolysis C_2H_5 Br with aqueous KOH followed by acidification with dil HNO_3 and then on treatment with $AgNO_3$ gives light yellow precipitate of AgBr where as C_6H_5Br does not give this test.

13. How will you obtain 1-bromopropane from propene ?

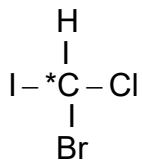
Ans. Propene reacts with HBr in presence of peroxide (anti Markovnikov's rule) forms 1- bromopropane



Propene l-bromopropane

14. What is an asymmetric carbon ?

Ans. A carbon which is attached to four different atoms or groups is called asymmetric carbon.



15. What is the condition to be satisfied for a compound to be chiral ?

Ans. The mirror image of the compound is not super imposable is said to be chiral.

16. What is a racemic modification ?

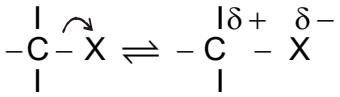
Ans. When equal proportions of two enentiomers of any optically active compound present together is called racemic mixture and the product is optically inactive.

17. What happens when iodoform is heated with silver powder ? Write the chemical equation.

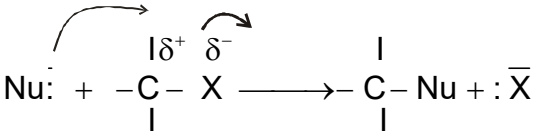
Ans. $2CH_3I + 6Ag \xrightarrow{heat} CH \equiv CH + 6AgI$

18. Why do alkyl halides show nucleophilic substitution reactions ?

Ans. The halogen atom in haloalkanes is more electronegative than the carbon atom attached to it. As a result, carbon atom acquires a partial positive charge and the halogen atom a partial negative charge



The presence of +ve charge on carbon atom makes it easy to attack by nucleophilic reagents. When the nucleophile stronger than the halide ion approaches to carbocation, the halogen atom is displaced and a new bond is formed by the nucleophile with the carbon.



Such reactions in which a strong nucleophile displaces a weaker nucleophile.

19. Explain why alkyl halides undergo hydrolysis more easily than aryl halides.

Ans. The aryl halides are stabilized by resonance but alkyl halides are not. The displacement of halogen from aryl halide is much less than alkyl halides towards nucleophilic substitution reaction. Hence alkyl halides undergo hydrolysis more easily than aryl halides..

20. Write the following name reactions.

(a) Friedel-Craft reaction

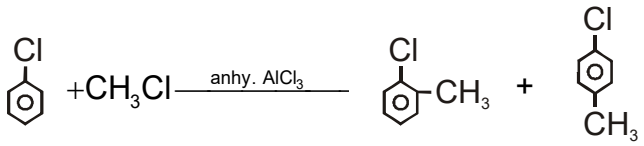
(b) Wurtz-Fittig reaction

(c) Markovnikov's rule

(d) Sandmeyer reaction

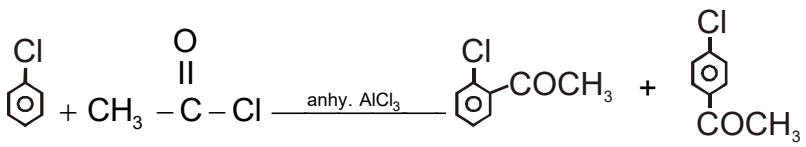
Ans. (a) Friedel Craft Reaction

Haloarenes undergo electrophilic substitution reaction such as alkylation and acylation. The alkylation is possible when chlorobenzene reacts with methyl chloride in presence of anhydrous $AlCl_3$ forms o and p chloro toluene.



o-Chlorobenzene (Minor) p-Chlorotoluene (Major)

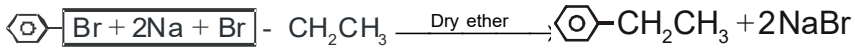
Friedel Craft Acylation : When chlorobenzene reacts with acetyl chloride in presence of anhy $AlCl_3$ forms. 2- chloroacetophenone and 4-chloroacetophenone.



2-Chloroacetophenone 4-Chloroacetophenone

(b) **Wurtz Fittig Reaction :**

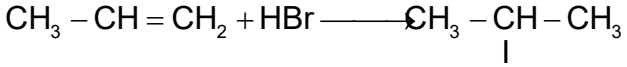
Halo arenes when treated with an ethereal solution of an alkyl halide in presence of sodium form alkyl derivatives of benzene.



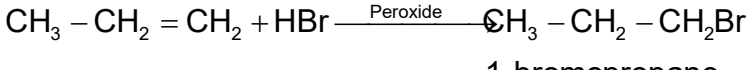
Bromo benzene Ethyl bromide Ethyl benzene

(c) **Markovnikov's Rule :**

Alkenes react with halogen acids form haloalkanes.



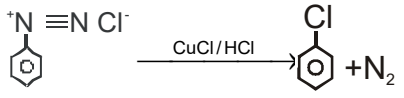
2 - bromopropane



1-bromopropane

(d) **Sandmeyer's Reaction :**

Haloarenes (chloro and bromo arenes) are prepared from diazonium salt on treatment with CuCl and HCl.



Chlorobenzene

21. Why alkyl halides are generally not prepared in laboratory by free radial halogenation of alkanes ?

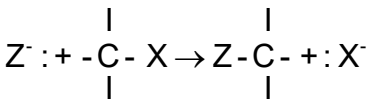
Ans. Free radical halogenation of alkanes not suitable method for laboratory synthesis of alkyl halides beause it results in the formation of many isomeric monosubstituted products through substitution of different kinds of H atoms. Moreover, polyhalogenation may also takes place.

22. Why is chloroform not soluble in water although it is polar?

Ans. The Chloroform molecules can not form hydrogen bonds with water. The energy required to break the bonds between haloalkanes and water molecules is much larger than the energy released during formation of new bonds between haloalkanes and wate rmolecules.

23. What do you undrestand by the term nucleophilicity? Arrange the following in the decreasing order of their nucleophiticity F^-, Br^-, Cl^-, I^-.

Ans. Nucleophilicity is defined in terms of the reaction of the nucleophile with in eletrophilic carbon.

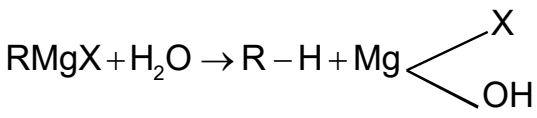


Greater the value of rate constant, K for the above reaction, greater is the nucleophilicity of the nucleophile.

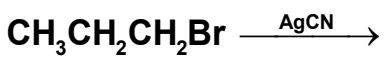
$$I^- > Br^- > Cl^- > F^-$$

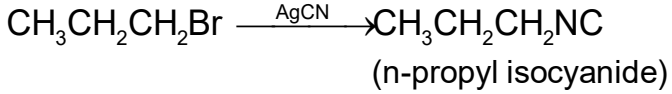
24. Why are Grignard reagents be prepared under anhydrous condition ?

Ans. Grignard reagents react with water and get decomposed (hydrolysed), hence they should be prepared under anhydrous conditions.



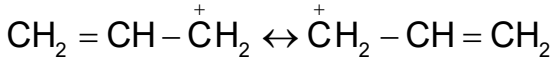
25. Write the major product of the reaction



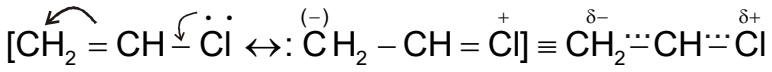
Ans. 
(n-propyl isocyanide)

26. Why is allyl chloride hydrolysed much more readily than vinyl chloride?

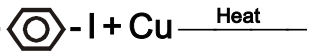
Ans. Hydrolysis of allyl chloride takes place via allyl carbocation. It is highly stabilised by resonance at fast rate, hence hydrolysed readily.

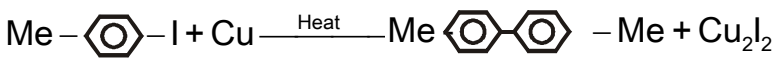


On the otherhand, C-Cl bond in vinyl chloride has partial double bond character due to resonance and hence is difficult to cleave.

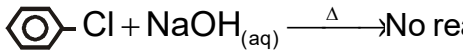


Therefore allyl chloride is hydrolysed much more readily than vinyl chloride.

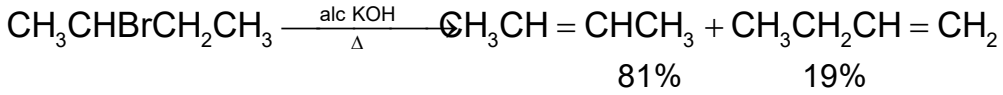
27. Complete the reaction 

Ans. 

28. What happens when Chlorobenzene is subjected to hydrodysis?

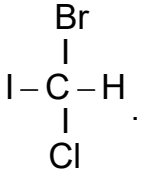
Ans. 

29. Write the Chemical reaction to illustrate Saytzeff's rule.

Ans. 

30. What is an asymmetric carbon?

Ans. A carbon which is attached to four different atoms or groups is called asymmetric carbon e.g.



UNIT - VII

ALCOHOLS, PHENOLS AND ETHERS

I. Select the correct answer from the choices given under each bit :

1. In allylic alcohol, the -OH group is attached to

(a) sp^3 hybridised carbon

(b) sp^2 hybridised carbon

(c) sp hybridised carbon

(d) None of these

2. In vinylic alcohol the -OH group is attached to

(a) sp^3 hybridised carbon

(b) sp^2 hybridised carbon

(c) sp hybridised carbon

(d) sp^3d hybridised carbon

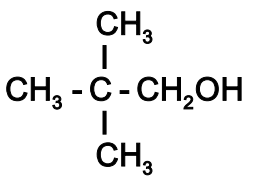
3. In phenol the -OH group is attached to

(a) sp^3 hybridized carbon

(b) sp^2 hybridized carbon

(c) sp hybridized carbon

(d) sp^3d hybridized carbon

4.  **is a**

(a) Primary alcohol

(b) Secondary alcohol

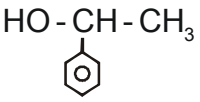
(c) Tertiary alcohol

(d) None of these

5. Identity which is allylic alcohol among the following

(a) $CH_2 = CHOH$

(b) $CH_2 = CH - CH_2OH$

(c) 

(d) CH_3CH_2OH

6. **IUPAC name of isobutyl alcohol is**

(a) 2-methyl prepan-1-ol

(b) butan-2-ol

(c) Butan-1-ol

(d) 2-methyl propan-2-ol

7. 2-methyl propan-1-ol is a____ alcohol.

(a) Primary (b) Secondary

(c) Tertiary (d) None of these

8. 2-methyl phenol is a

(a) o-cresol (b) p-cresol

(c) Resorcinol (d) Quinol

9. Catechol is

(a) Benzene - 1, 2 - diol

(b) Benzene - 1, 3 - diol

(c) Benzene - 1, 4 - diol

(d) None of these

10. Hydroquinone is

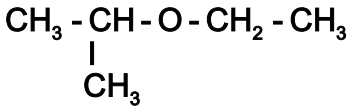
(a) Benzene - 1, 4 - diol

(b) 1-ethoxy propane

(c) Propoxy ethane

(d) 2-ethoxy butane

11. IUPAC name of



is

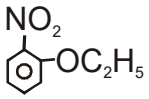
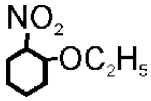
(a) 2- ethoxy propane

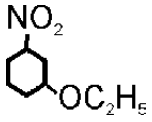
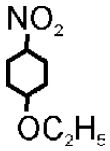
(b) 1- ethoxy propane

(c) propoxy ethane

(d) 2- ethoxy butane

12. The structure of 1-ethoxy-2-nitro cyclohexane is

(a)  (b) 

(c)  (d) 

13. 

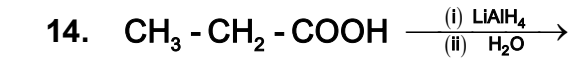
product. The product is

(a) Propan-2-ol

(b) Propan-1-ol

(c) Butan-1-ol

(d) Butan-2-ol

14. 

product. The product is

(a) Butan-1-ol

(b) Propan-1-ol

(c) Propan-2-ol

(d) Butan-2-ol

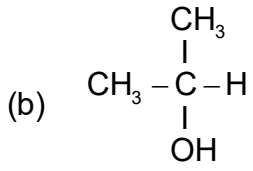
15. Catalytic reduction of butanal gives

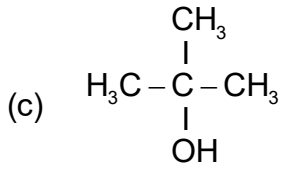
(a) Butan-2-ol (b) Butan-1-ol

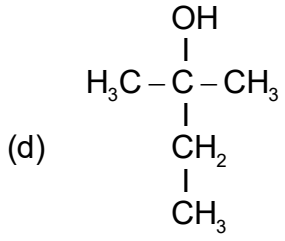
(c) Propan-2-ol (d) Propan-1-ol

16. The structure of the compound formed by the reaction of propanone with methyl magnesium bromide followed by hydrolysis is

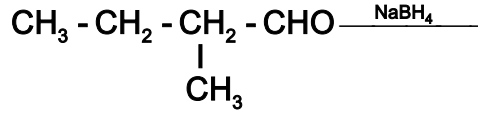
(a)

(b) 

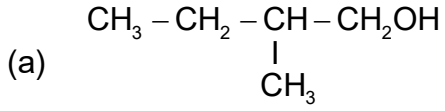
(c) 

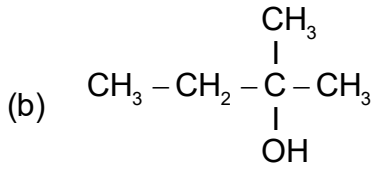
(d) 

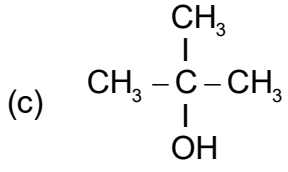
17. The structure of the product of the reaction



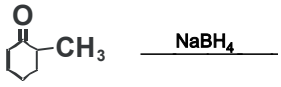
product is

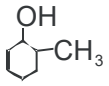
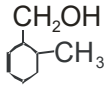
(a) 

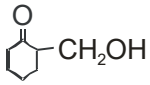
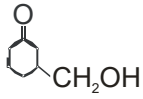
(b) 

(c) 

(d)

18.  product. The product is

(a)  (b) 

(c)  (d) 

19. the increasing order of the boiling points of

(i) Butan-1-ol (ii) Butan-2-ol

(iii) ethanal (iv) propan-1-ol

(a) iii < ii < i < iv (b) iii < iv < ii < i

(c) i < ii < iii < iv (d) iv < iii < ii < i

20. Which of the following alcohols, the least soluble alcohol in water is

(a) n-butyl alcohol

(b) Isobutyl alcohol

(c) Tertiary butyl alcohol

(d) Secondary butyl alcohol

21. The increasing order of boiling points

(i) pentan-1-ol (ii) n-butane

(iii) pentanal (iv) ethoxy ethane

(a) ii < iv < iii < i (b) i < ii < iii < iv

(c) iv < iii < ii < i (d) iv < ii < iii < i

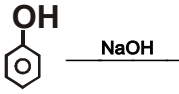
22. The compound which is most acidic :-

(a) phenol

(b) p-nitro phenol

(c) o-nitro phenol

(d) m-nitro phenol

23.  B. The end product B is

(a) Aspirin

(b) Phenyl Acetate

(c) Salicylic Acid

(d) Salicylaldehyde

24. The acid strength of alcohol decreases in the order

(a) T > S > P (b) P > S > T

(c) P > T > S (d) T > P > S

25. Ethyl Alcohol on heating with Conc H_2SO_4 at 443K gives

(a) Methyl Alcohol

(b) Methane

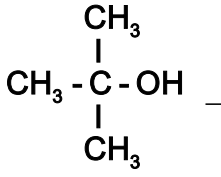
(c) Ethane

(d) Ethene

26. The relative ease of dehydration of alcohols follows the following order

(a) T > S > P (b) P > S > T

(c) T > P > S (d) S > P > T

27.  product. The product is

(a) 2-methyl propene

(b) propene

(c) but-2-ene

(d) but-1-ene

28. When phenol is treated with Br_2/H_2O, we get

(a) 2,4,6 - tribromo phenol
(b) 2,4 - dibromo phenol
(c) 2 - bromo phenol
(d) 3 - bromo phenol

29. On treatment with chloroform in presence of sodium hydroxide a - CHO group is introduced in ortho position of benzene ring of phenol. The reaction is known as

(a) Reimer - Tiemann reaction
(b) Kolbe's reaction
(c) Wurtz reaction
(d) Rosenmonds reaction

30. When phenol is treated with Zinc dust, we get

(a) n- hexane (b) cyclo hexane
(c) Benzene (d) Toluene

31. Oxidation of phenol with chromic acid gives

(a) Benzene (b) Toluene
(c) Benzo quinone (d) Benzoic acid

32. Williamson's synthesis method is used for the preparation of

(a) alcohol (b) ether
(c) ketone (d) aldehyde

33. $C_2H_5ONa + HC_3\text{-}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{-}Br \longrightarrow$

major product is

(a) 2- methyl prop-1-ene
(b) T- butyl ethyl ether
(c) ethyl - propyl ether
(d) methyl butyl ether

34. $HC_3\text{-}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{-}ONa + CH_3Br \longrightarrow A$ **. The major product A is**

(a) $CH_3-O-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$

(b) $CH_3-\underset{\underset{}{|}}{\overset{\overset{CH_3}{|}}{C}}=CH_2$

(c) $CH_3-CH_2-O-CH_3$

(d) $C_2H_5O-\underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$

35. $CH_3\text{-}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{-}OCH_3 + HI \longrightarrow A + B\cdot$

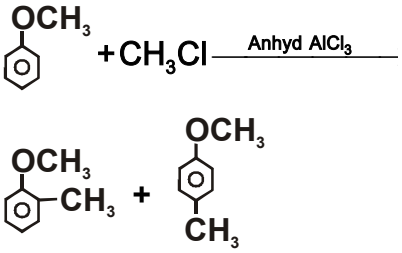
The product A and B are

(a) CH_3OH and $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-I$

(b) CH_3I and $H_3C-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-OH$

(c) C_2H_5OH and $CH_3-\underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}}-I$

(d) None of these

36. 

reaction is known as

(a) Friedel Craft's alkylation

(b) Friedel Craft's acylation

(c) Electrophilic substitution reaction

(d) Diels Alder addition reaction

37. **Phenol can be distinguished from ethyl alcohol by all reagents except**

(a) NaOH (b) $FeCl_3$

(c) Br_2/H_2O (d) Na

38. **Aspirin is an acetylation product of**

(a) p- Dihydroxy benzene

(b) o- Hydroxy benzoic acid

(c) o- Dihydroxy benzene

(d) m- Hydroxy benzoic acid

39. **The compound A when treated with methyl alcohol and few drops of H_2SO_4 gave smell of winter green. The compound A is**

(a) succinic acid (b) salicylic acid

(c) tartaric acid (d) oxalic acid

40. **Wood spirit is known as**

(a) methanol (b) ethanol

(c) acetone (d) benzene

41. **Haloform reaction does not takes place with :**

(a) Methanol

(b) Ethanol

(c) 2-Chloropropane

(d) Acetone

42. **Which of the following compounds will be most readily attacked by an electrophile?**

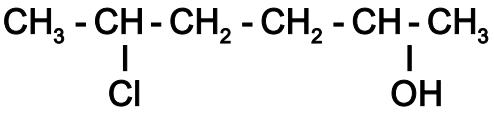
(a) Toluene

(b) Phenol

(c) Benzene

(d) Chlorobenzene

43. **Give IUPAC name of the compound**



(a) 2-chloro-5-hydroxy hexane

(b) 2-hydroxy-5-chloro hexane

(c) 2-chlorohexa-5-ol

(d) 5-chlorohexa-2-ol

44. **Arrange the following compounds in the decreasing order of acid strength.**

(i)  (ii)  (iii) 

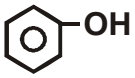
(a) (ii) > (i) > (iii)

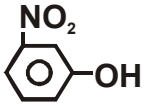
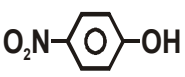
(b) (ii) > (iii) > (i)

(c) (iii) > (i) > (ii)

(d) (iii) > (ii) > (i)

45. **In the following compounds**

(I)  **(II)** 

(III)  **(IV)** 

The order of acidity is :

(a) IV > III > I > II (b) IV > III > II > I

(c) I > II > IV > III (d) II > IV > I > II

46. Which of the following will not soluble in sodium - bicarbonate ?

(a) 2, 4, 6 - trinitrophenol

(b) benzenesulphonic acid

(c) benzoic acid

(d) 0-nitrophenol

47. Phenol is heated with phthalic anhydride in presence of Conc. H_2SO_4. The product gives pink colour with alkali. The product is :

(a) Bakelite

(b) Salicylic acid

(c) Phenolphthalein

(d) Fluorescein

48. Benzylamine reacts with nitrous acid to form :

(a) azobenzene

(b) benzyl alcohol

(c) phenol

(d) benzene

49. When phenol is treated with $CHCl_3$ and NaOH, the product formed is :

(a) Benzoic acid

(b) Salicylic acid

(c) Benzaldehyde

(d) Salicylaldehyde

50. Williamson's synthesis is an example of :

(a) Nucleophilic substitution reaction

(b) Electrophilic substitution

(c) Electrophilic addition

(d) Nucleophilic addition

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

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

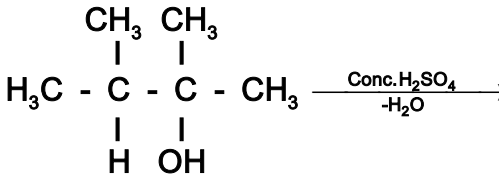
II. Short Questions

1. Arrange the following with their increasing order of basicity :

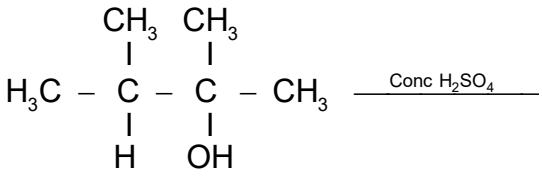
H_2O, OH^-, CH_3OH, CH_3O^-

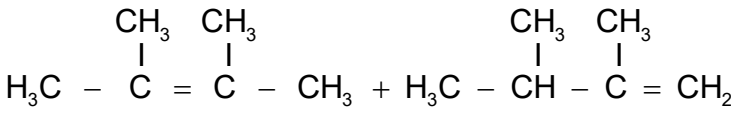
Ans. H_2O, CH_3OH, OH^-, CH_3O^-

2. Identify the organic product obtained in the following reaction



Ans.





2, 3-dimethyl but-2-ene (major) 2,3 dimethyl but-1-ene (minor)

3. How will you know whether a given-OH group is alcoholic or phenolic in nature?

Ans. Phenolic OH gives blue / violet colour with neutral $FeCl_3$ where as alcoholic OH does not.

4. Why boiling points of phenols are higher than those of corresponding aromatic hydrocarbons and alkyl halides ?

Ans. Because of H- bonding.

5. Alcohols react with halogen acids to form haloalkanes but phenols do not form halobenzenes. Explain.

Ans. The C-O bond of phenols has some double bond character due to resonance hence can not easily cleaved by X^- ion in presence of halogen acids but C-O bond in alcohols is a pure single bond and is cleaved easily with X^- ions in presence of halogen acids to form haloalkanes.

6. Explain why anisole is less reactive than phenol towards electrophilic substitution reactions ?

Ans. - OH and - OCH_3 are both +R effect. The electrophilic substitution reaction mainly occur at o and p positions, but the aromatic ethers are less reactive than phenols.

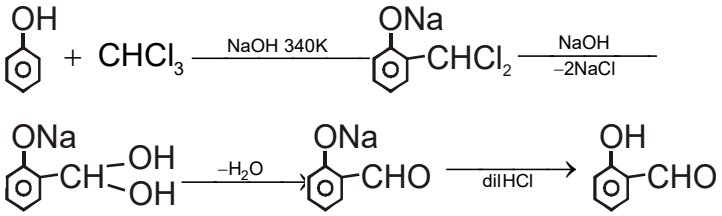
7. Why is phenol more acidic than ethanol ?

Ans. After the loss of proton, phenoxide ion is stabilized by resonance while ethoxide ion is not.

8. Write the equation involved in Reimer - Tiemann reaction.

Ans. Reimer - Tiemann Reaction:

When phenol is treated with chloroform in presence of aqueous NaOH (or KOH) at 340K followed by hydrolysis forms salicylaldehyde.

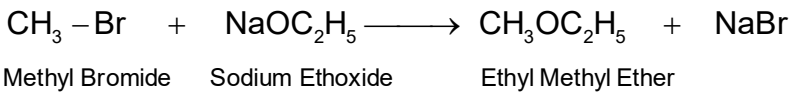


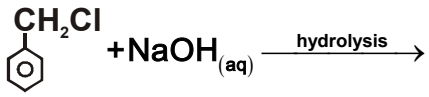
Salicylaldehyde

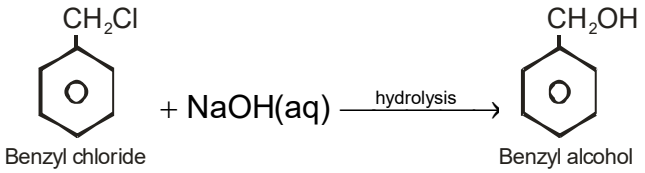
9. Write the reaction of Williamson synthesis.

Ans. Williamson's Systhesis :

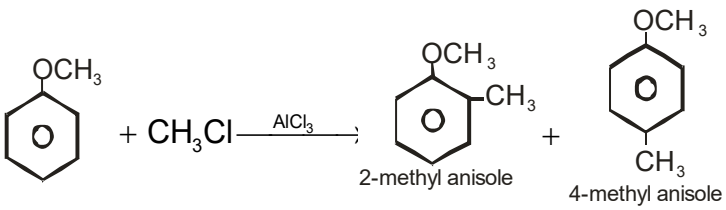
When alkyl halide is treated with sodium or potassium salt of alcohol or phenol forms ether.



10. Complete the reaction 

Ans. 

11. Write the equation of Friedel - Crafts reaction of alkylation in anisole.

Ans. 

12. Why phenols do not undergo substitution of - OH group like alcohols ?

Ans. See question No. 5.

13. Ortho-nitrophenol is more acidic than ortho-methoxy phenol. Give reason.

Ans. Due to strong - R and - I effect of the $-NO_2$ group, electron density in the O-H bond decreases and hence the loss of proton becomes easy. After loss of proton, the orthonitro phenoxide ion is stabilized by resonance.

But in case of ortho methoxy phenol, the electron density in O - H bond increases, thereby making the loss of proton difficult. Further, the ortho - methoxy phenoxide ion is destabilized by resonance, thereby making o- methoxy phenol a weaker acid.

14. Why are higher ethers insoluble in water ?

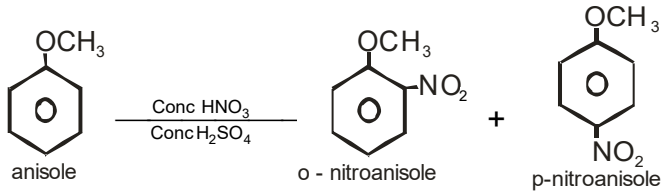
Ans. Higher ethers are of bigger size and the oxygen atom fails to form inter molecular H-bonds with water. Hence higher ethers are insoluble in water.

15. Explain - diethyl ether does not react with sodium.

Ans. Diethyl ether has no active hydrogen attached to oxygen like alcohol and phenols, so it does not react with sodium.

16. Write the reaction products obtained when anisole is treated with a mixture of Conc HNO_3 and H_2SO_4.

Ans.



anisole — o - nitroanisole — p-nitroanisole

17. Explain how does the - OH group attached to a carbon of benzene ring activates towards electrophilic substitution.

Ans. Phenol has +R effect of OH group. The electron density of benzene ring increases and facilitate the attack of a electrophile. So presence of - OH group activates the benzene ring towards electrophilic substitution mainly at o and p positions.

18. Write the chemical reaction when 1-propanol reacts with acidified $KMnO_4$ solution.

Ans. $CH_3 - CH_2 - CH_2OH + 2[O] \xrightarrow{\text{Acidic } KMnO_4} CH_3CH_2COOH + H_2O$

Propan - I - ol — Propanoic acid

19. Nitration of phenol gives ortho and para products only. Give reasons.

Ans. See question No. - 6

20. Describe the test to distinguish between primary, secondary and tertiary alcohols.

Ans. When alcohols are treated with equimolar mixture of conc HCl and anhy $ZnCl_2$ at room temp., if turbidy appears immediately, the alcohol is tertiary. If no trubidy, it is primary alcohol. If turbidity appears after sometime, it is secondary alcohol.

21. Write the structure of the product of the following reaction.

$$CH_3 - CH = CH_2 \xrightarrow{H_2O/H^+}$$

Ans.
$$CH_3 - CH = CH_2 \xrightarrow{H_2O/H^+} CH_3 - \underset{\displaystyle OH}{\overset{\displaystyle H}{\overset{|}{\underset{|}{C}}}} - CH_3$$

22. Why n-Hexanol is not soluble in water ?

Ans. In n-Hexanol, alkyl group is quite large. As a result it resembles the hydrocarbons more closely and is not soluble in water. The formation of H-bonding between n-Hexanol and water is very less.

23. Between ethanol and water which is stronger acid and why?

Ans. Water is stronger aid than ethanol.

$$C_2H_5OH \xrightarrow{H_2O} \underset{\text{ethoxide ion}}{C_2H_5 \rightarrow O^- + H_3O^+}$$

$$H_2O + H_2O \rightarrow \underset{\text{Hydroxids ion}}{H - O^- + H_3O^+}$$

Ethoxide ion is less stable than hydroxide ion due to concentration of negative charge on oxygen due to electron releasing inductive effect of ethyl group. Hence equilibrium in second equation is more in forward direction producing more H_3O^+ ions.

24. Name the reagents used for oxidation reaction of a primary alcohol to carboxylic acid.

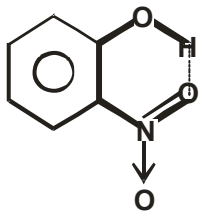
Ans. The reagent is acidfied $KMnO_4/K_2Cr_2O_7$ solution.

25. Why phenols do not give protonation reactions readily ?

Ans. In phenol, the lone pair of oxygen is shared with benzene ring through resonane. So, the electron density around oxygen is relatively less and therefore, phenols do not undergo protonation readily.

26. Why O-nitrophenol is less soluble is water than P-nitro phenol?

Ans. In O-nitrophenol, there is intramolecular hydrogen bonding. This inhibits its hydrogen bonding with water and reduces its solubility in water.



27. Why phenols do not undergo substitution of - OH group like alchols ?

Ans. C-OH bond in phenol has partial double bond character due to resonance. Hence, this bond is stronger and difficult to cleave. Also, phenols do not undergo substitution of -OH group like alcohols. In alcohols C-OH bond is pure single bond and therefore can be cleaved relatively easily.

28. Why phenol has smaller dipole moment than methanol ?

Ans. In phenol, the electron withdrawing inductive effect of oxygen is opposed by electron releasing resonance effect. So, phenol has smaler dipole moment. But in case of methanol only electron withdrawing inductive effect is operative. So, it has higher dipole moment.

29. Anhydrous $CaCl_2$ is not recommended as a drying agent for alcohols and amines why ?

Ans. Alcohols and amines cambine with anhydrous $CaCl_2$ to form complexes eg. with C_2H_5OH, it gives a complex of molecular formula $CaCl_2 . 3C_2H_5OH$.

30. Why are higher ethers insoluble in water ?

Ans. Becasue of bigger size of alkyl groups, the oxygen atom in ethers fails to form intermolecular H-bonds with water.

***

10. The starting material for Stephen's method for the formation of an aldehyde is

(a) Acid chloride

(b) Acid amide

(c) Alkyl halide

(d) Alkyl cyanide

11. When acetonitril is subjected to Stephen's reaction, the final product formed is

(a) CH_3CH_2OH (b) CH_3CHO

(c) HCHO (d) CH_3COCH_3

12. Which one of the compounds contain no α- Hydrogen atom ?

(a) Acetaldehyde

(b) Acetone

(c) Acetic Acid

(d) Formal dehyde

13. Which one of the compound does not contain α- carbon atom ?

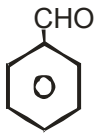
(a) CH_3CH_2CHO

(b) HCHO

(c) CH_3COCH_3

(d) $CH_3CH_2COCH_2CH_3$

14. Which one of the compounds contain α- C atom but no α- H atom?

(a) 

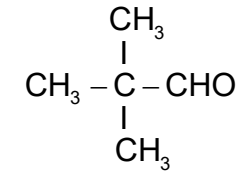
(b) $CH_3CH_2CH_2CHO$

(c) $CH_3COCH_2CH_3$

(d) HCHO

15. An example of the compound which has no α- H atom but contain α- carbon atom.

(a) CH_3CH_2CHO

(b) 

(c) HCHO

(d) $CH_3CH_2COCH_3$

16. Why aldehydes and ketones undergo nucleophilic addition reaction ?

(a) Due to greater electronegativity of oxygen, the carbon atom of carbonyl group developes positive charge and act a nucleophile

(b) Due to greater electronegativity of oxygen, the oxygen atom developes slight positive charge for nucleophilic reaction.

(c) There is a cleavage of C = O gr. to form a carbanion ion for the nucleophilic reaction.

(d) None of the above

17. Which of the compound reduces Fehling's solution ?

(a) CH_3COCH_3

(b) $CH_3COCH_2CH_3$

(c) CH_3CHO

(d) $CH_3CH_2COCH_2CH_3$

18. Which one of the followings is not the composition of Fehling-B solution?

(a) NaOH + Na, K- tartarate

(b) KOH + Na, K- tartarate

(c) NH_4OH + Na, K- tartarate

(d) $Ca(OH)_3$ + Na, K- tartarate

19. When ethanol and propanal mixture is subjected to Aldol condensation, the number of products formed are

(a) One (b) Two

(c) Three (d) Four

20. When formal dehyde is subjected to Cannizzaro's reaction using Conc NaOH, the products formed

(a) Methanol and formic acid

(b) Methanol and sodium formate

(c) Ethanol and formic acid

(d) Ethanol and sodium formate

21. When the mixture of HCHO and C_6H_5CHO is subjected to Cannizzaro's reaction, the products formed are

(a) Methanol and benzyl alcohol

(b) Sodium formate and benzyl alcohol

(c) Methanol and sodium benzoate

(d) Sodium methoxide and sodium benzoate

22. When benzaldehyde is treated with NH_3, the product formed is

(a) Urotropine

(b) Hydrobenzamide

(c) Hydrazone derivative of benzal dehyde

(d) Semicarbazone derivative of benzal dehyde

23. When formaldehyde is treated with NH_3, the product formed is

(a) Urotropine

(b) Hydrobenzamide

(c) Formamide

(d) Acetamide

24. Which of the following will respond iodoform test ?

(a) Butanone

(b) Formaldehyde

(c) Pentan-3-one

(d) Hexan-3-one

25. When benzal dehyde is treated with acetic anhydride and sodium acetate, the product formed is

(a) Benzoic acid

(b) Sodium benzoate

(c) Cinnamic acid

(d) Propanoic acid

26. When benzal dehyde is refluxed with KCN, the product is

(a) Benzoic acid

(b) Benzoin

(c) Phthalic acid

(d) Potassium benzoate

27. The starting material and final product of Etard's reaction are

(a) Benzene and benzal dehyde

(b) Benzene and benzoic acid

(c) Toluene and benzal dehyde

(d) Toluene and benzoic acid

28. The starting material and final product of Gattermann - Koch reaction are

(a) Toluene and benzal dehyde

(b) Toluene and benzoic acid

(c) Benzene and benzoic acid

(d) Benzene and benzal dehyde

29. The correct order of acid strength is

(a) $ClCH_2COOH > Cl_2CHCOOH > Cl_3CCOOH > CH_3COOH$

(b) $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH > CH_3COOH$

(c) $CH_3COOH > ClCH_2COOH > Cl_2CHCOOH > Cl_3CCOOH$

(d) $Cl_2CHCOOH > ClCH_2COOH > Cl_3CCOOH > CH_3COOH$

30. The correct order of acid strength is

(a) $FCH_2COOH > ClCH_2COOH > BrCH_2COOH > ICH_2COOH$

(b) $ClCH_2COOH > FCH_2COOH > BrCH_2COOH > ICH_2COOH$

(c) $ICH_2COOH > BrCH_2COOH > FCH_2COOH > ClCH_2COOH$

(d) $FCH_2COOH < ClCH_2COOH < BrCH_2COOH < ICH_2COOH$

31. The correct order of acid strength is

(a) $HCOOH > CH_3COOH > ClCH_2COOH$

(b) $CH_3COOH > HCOOH > ClCH_2COOH$

(c) $ClCH_2COOH > HCOOH > CH_3COOH$

(d) $ClCH_2COOH > CH_3COOH > HCOOH$

32. When ethyl benzene is oxidised by SeO_2, the product formed

(a) Benzoic acid

(b) Salicylic acid

(c) Phthalic acid

(d) Benzaldehyde

33. When ortho xylene is oxidised by SeO_2, the product formed is

(a) Benzoic acid

(b) Pthalic acid

(c) Tere phthalic acid

(d) Isophthalic acid

34. During essterification, the reagent used is

(a) Dil NaOH (b) Dil KoH

(c) Conc H_2SO_4 (d) Conc Alkali

35. Which of the following acid reduces Fehling's solution or Tollen's reagent ?

(a) CH_3COOH

(b) CH_3CH_2COOH

(c) $CH_3CH_2CH_2COOH$

(d) HCOOH

36. During Clemmenson's reduction process

(a) $>C=0$ group is converted to CH_2OH

(b) $>C=0$ group is converted to $>CH_2$ group

(c) $>C=0$ group is converted to $>CHOH$

(d) $>C=0$ group is converted to -COOH

37. Component 'A' of formula $C_5H_{10}O$ form oxime and give negative silver mirror test and iodoform test. Component 'A' is

(a) Pentan-2-one

(b) Pentanal

(c) Pentan-3-one

(d) 2- methyl butanal

38. Cyclohexanone is reduced by $NaBH_4$. The product formed is

(a) Cyclohexane

(b) Cyclohexanal

(c) Cyclohexadiene

(d) Oyclohexanol

39. From the following acids, the one which is optically active ?

(a) Benzoic acid

(b) $CH_3 - \underset{\underset{NH_2}{|}}{CH} - COOH$

(c) $CH_3CH_2CH_2CH_2COOH$

(d) $CH_3CH_2CH_2COOH$

40. Which one the following is not a derivative of carboxylic acid ?

(a) $RCOOR'$ (b) $RCONH_2$

(c) RCOCl (d) $R\text{-}NH_2$

41. Wolf-Kishner Reduction of acetaledehyde gives

(a) Propanone (b) Acetone

(c) Alkane (d) Butanaoe

42. Hell-Volhard-Zelinsky (HVZ) reaction of acetic acid gives

(a) Acetaldehyde

(b) Propanone

(c) Trichloro acetic acid

(d) Butanone

43. Which of the following reactions is responded by HCHO ?

(a) Cannizzaro's reaction

(b) Clemmenson's reaction

(c) Haloform reaction

(d) Aldol condensation

44. In aldehyde and ketone, the carbonylic carbon atom is

(a) sp^3 hybridized

(b) sp^2 hybridised

(c) sp-hybridized

(d) unhybirdsed

45. Schiff's reagent is

(a) Magneta solution decolorised by SO_2

(b) Magneta solution decolorised by Cl_2

(c) Ammoniacal cobalt chloride solution

(d) Ammoniacal manganese sulphate solution

46. Which of the following organic compounds are second oxidation product of alkanes ?

(a) 1^0 and 2^0 alcohols

(b) carboxylic acids and esters

(c) 2^0 and 3^0 alcohols

(d) aldehydes and ketones

47. Phenones are

(a) Aldehydes in which carbonyl group is attached to the benzene ring

(b) Ketones in which carbonyl group is attached to the benzene ring

(c) Aldehydes in which carbonyl group is attached to the alkyl group

(d) Acids in which carbonyl group is attached to the benzene ring

48. During the Claisen's condensation, ethyl ethanoate gives

(a) Ethanoic acid

(b) Propanoic acid

(c) Butanoic acid

(d) Ethyl-3-Keto butanoate

49. Kolbe's electrolysis of potassium propanoate gives

(a) Ethane (b) Propane

(c) Butane (d) Pentane

50. The reagent used during claisen condensation is

(a) Sodium ethoxide

(b) NaOH

(c) KOH

(d) Br_2 and alkali

51. **(i)** $CH_3COCH_3 \xrightarrow{'A'} CH_3 - \underset{\underset{OH}{|}}{CH} - CH_3$

(ii) $C_6H_5CH_2CH_3 \xrightarrow{B} C_6H_5COOH$

In the obove reactions A and B are

(a) $LiAlH_4$ and $NaBH_4$

(b) $LiAlH_4$ and SeO_2

(c) Acidified $KMnO_4$ and SeO_2

(d) Acidified $K_2Cr_2O_7$ and $LiAlH_4$

52. Aldehyde and Ketone can be distinguished by :

(a) Benedicts solution

(b) H_2SO_4 solution

(c) $KMnO_4^-/OH^-$

(d) NH_3

53. Aldehydes react with alcohols in the presence of dry HCl gas to form acetals. This reaction is an example of

(a) nucleophilic substitution

(b) nucleophilic addition

(c) electrophlic substitution

(d) electrophilic addition

54. Formaldehyde, on heating with potassium hydroxides, gives :

(a) Methyl alcohol

(b) Ethyl formate

(c) Methane

(d) Acetylene

55. The reaction of phenyl acetate O- and P-hydroxy acetophenone

(a) Beckmann's rearrangement

(b) Fries rearrangement

(c) Friedel's Craft reaction

(d) Reimer - Tiemann reaction

56. Which of the following gives aldol condensation ?

(a) Propionaldehyde

(b) Formaldehyde

(c) Benzaldehyde

(d) None of these

57. Acetaldehyde and acetone can be distinguished by :

(a) Bromoform test

(b) Solubility in water

(c) Tollen's reagent

(d) Molish test

58. Which of the following does not give brick red precipitate with Fehling's solution ?

(a) Acetaldehyde (b) Formalin

(c) D-glucose (d) Acetone

59. In Etard's reaction toluene is oxidised to benzaldehyde using

(a) H_2O_2

(b) Cl_2

(c) Chromyl Chloride (CrO_2Cl_2)

(d) $KMnO_4$

60. Which of the following can not reduce Fehling solution ?

(a) Formic acid

(b) Acetic acid

(c) Formaldehyde

(d) Acetaldehyde

61. Acid present in tomatoes is

(a) Lactice acid

(b) Citric acid

(c) Tantaric acid

(d) Oxalic acid

ANSWER KEYS

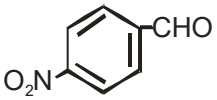
I. Select the correct answer from the choices given under each bit :

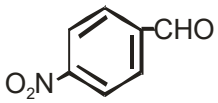
1.	(a)	17.	(c)	33.	(b)	49.	(c)
2.	(c)	18.	(c)	34.	(c)	50.	(a)
3.	(d)	19.	(d)	35.	(d)	51.	(b)
4.	(b)	20.	(b)	36.	(b)	52.	(a)
5.	(d)	21.	(b)	37.	(c)	53.	(b)
6.	(c)	22.	(b)	38.	(d)	54.	(a)
7.	(b)	23.	(a)	39.	(b)	55.	(c)
8.	(b)	24.	(a)	40.	(d)	56.	(a)
9.	(a)	25.	(c)	41.	(c)	57.	(c)
10.	(d)	26.	(b)	42.	(c)	58.	(d)
11.	(b)	27.	(c)	43.	(a)	59.	(c)
12.	(d)	28.	(d)	44.	(b)	60.	(b)
13.	(b)	29.	(b)	45.	(a)	61.	(d)
14.	(a)	30.	(a)	46.	(d)		
15.	(b)	31.	(c)	47.	(b)		
16.	(a)	32.	(a)	48.	(d)		

II. Short Questions

Q1. What is Carbonyl group ?

Ans: It is carbon-oxygen double bond, represented as $\rangle C = 0$

Q2. Write IUPAC names of  , $CH_3-\overset{\overset{O}{\|}}{C}-CH_2CH_3$ **and** $CH_3-\overset{\overset{Br}{|}}{\underset{\underset{H}{|}}{C}}-COOH$.

Ans.  , $CH_3-\overset{\overset{O}{\|}}{C}-CH_2CH_3$ **and** $CH_3-\overset{\overset{Br}{|}}{\underset{\underset{H}{|}}{C}}-COOH$

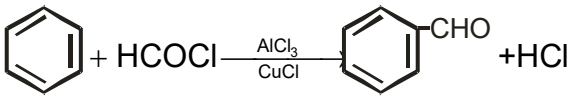
4-Nitrobenzene-carbaldehyde, **butan-2-one** **2-bromopropanoic acid**

Q3. What is Gattermann-Koch reaction ?

Ans: When a mixture of CO and HCl is passed through a solution of benzene or toluene in nitrobenzene at 323 K in presence of $AlCl_3$ and CuCl, benzaldehyde or p-tolualdehyde is formed.

$$CO + HCl \rightarrow [HCOCl]$$

formylchloride



Q4. Why are aldehydes more reactive than Ketones ?

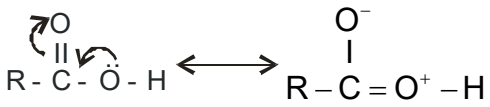
Ans: The +ve charge on carbon atom of aldehye is more due to smaller +I effect of one alkyl group than ketones of two alkyl groups. As a result nucleophilic addition reactions occur more readily. And due to presence of H atom on carbonyl group of aldehyde is readily oxidized, as a result aldehydes act as reducing agent and reduce Tollen's reagent, Fehling's solution etc.

Q5. What is Fehling's solution ?

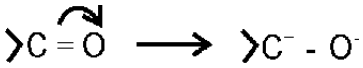
Ans: Alkaline solution of $CuSO_4$ and sodium potassium tartarate mixture solution.

Q6. Why carboxylic acids do not give the characteristic reactions of carbonyl group?

Ans: Due to lone pair of electrons on oxygen atom of OH group, exhibit resonance hybrid structures.



Similarly carbonyl group of aldehydes and ketones may be regarded as resonance hybrid structure



Thus Carbonyl group acts as electrophile. So carboxylic group is less electrophilic than aldehydes and ketonee. So nucleophilic addition reaction takes place.

7. Write Rosenmund's reaction.

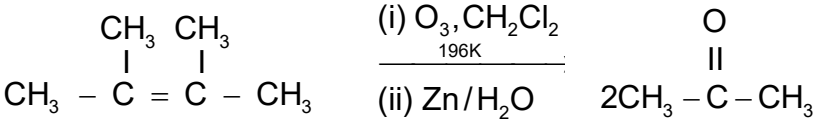
Ans: Acid chlorides are reduced to corresponding aldehydes by passing H_2 gas in presence of Pd and $BaSO_4$.

8. Which type of aldehydes undergo cannizzaro's reaction ?

Ans: The aromatic or aliphatic aldehydes which do not contain α-hydrogens undergo cannizzaro's reaction.

9. Which alkenes on reductive ozonolysis gives acetone as the only product ?

Ans:



2,3-dimethylbut-2-ene Acetone

10. How do you test aldehydes and ketones with

(a) Tollen's reagent

(b) Fehling's solution

Ans: (a) $RCHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow RCOO^- + 2Ag + 4NH_3 + 2H_2O$

(silver mirror)

(b) $RCHO + 2Cu^{2+} + 5OH^- \rightarrow RCOO^- + Cu_2O + 3H_2O$

red ppt

11. How will you convert acetone into ethanoic acid ?

Ans: $CH_3 - \overset{\overset{O}{\|}}{C} - CH_3 + 4[O] \xrightarrow[(ii)\ H^+/H_2O]{(i)\ \text{Alk. } KMnO_4,\ \Delta} CH_3COOH + CO_2 + H_2O$

12. How will you distinguish between ethanal and propanal ?

Ans: Ethanal (CH_3CHO) contain $CH_3 - \overset{\overset{O}{\|}}{C}$ gr which reacts with I_2/NaOH forming iodoform

$CH_3CHO + 3\ NaOI \xrightarrow{\Delta} CHI_3 + HCOONa + 2NaOH$

(Iodoform)

Where as proponal ($CH_3 - CH_2 - CHO$) does not contain CH_3CO group and does not give iodoform test.

13. Why does benzoic acid not undergo Friedel - Craft reaction ?

Ans: Due to presence of deactivated electron withdrawing - COOH gr and $AlCl_3$ gets bonded with - COOH group.

14. How methanoic acid differs from ethanoic acid ? Write the chemical reactions.

Ans: Methanoic acid acts as a reducing agent and decolorises acidified $KMnO_4$ soln, where as acetic acid does not.

$5HCOOH + KMnO_4 + 3H_2SO_4 \longrightarrow 5CO_2 + K_2SO_4 + 2MnSO_4 + 8H_2O$

(Pink) (Colourless)

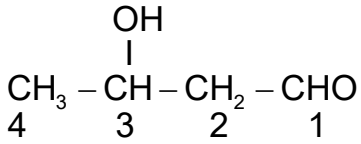
$CH_3COOH \xrightarrow{H_2SO_4/KMnO_4}$ No change in Pink colour

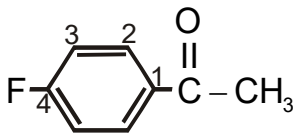
15. Why HCOOH does not give HVZ reaction but CH_3COOH does ?

Ans: CH_3COOH contains α - Hydrogen atom hence gives HVZ reaction but HCOOH does not contain any α - Hydrogen atom hence does not give HVZ reaction.

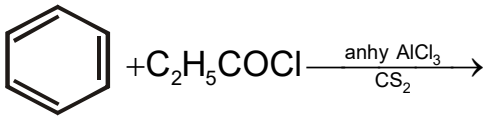
16. Write the structures of the following compounds ?

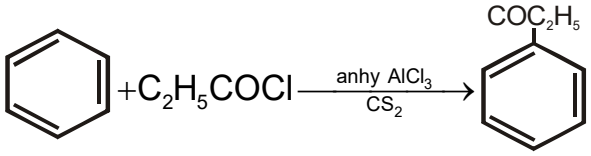
(i) 3-hydroxy butanal (ii) 4-Fluorocetophenone

Ans: (i) 3-hydroxy butanal : 

(ii) r-Fluoroacetophenone : 

17. Write the structure of the product of the following reaction :



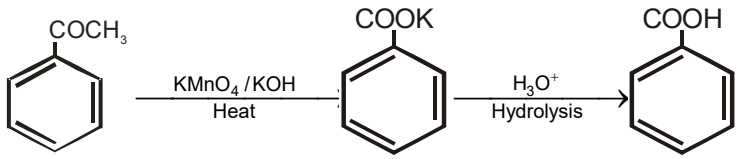
Ans: 

ethylphenyl ketone

18. Which reagent can be used to separate ethanol from the mixture of ethanal, carbon tetrachloride and ethanol?

Ans. $NaHSO_3$

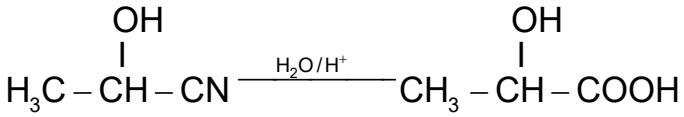
19. How will you prepare benzoic acid from acetophenone ?

Ans. 

Acetophenone Potassiumbenzoate Benzoic acid

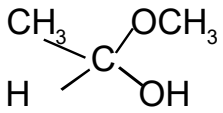
20. What is meant by Cyanohydrin and hemiacetal?

Ans. Cyanohydrin : It is a compound which contains both OH and CN group. On hydrolysis of it, lactic acid is obtained.



Cyanotrydria lactic acid

Hemiacetal : It is a compound which contains an ether and alcohol group. eg., methoxy ethanol.



21. How can alcohol and carboxylic acid be distinguished ?

Ans. By $NaHCO_3$ test, carboxylic acid gives effervescence of CO_2 gas where as alcohol does not give.

22. Why does benzoic acid not undergo Firedel Craft reaction ?

Ans. Due to deactivation of benzene ring by electron withdrawing effect of - COOH group and also -COOH gr is bonded with $AlCl_3$ which does not favour Friedel Craft reaction.

23. What is Tollen's reagent?

Ans. Tollen's reagent is ammoniacal silvernitrate solution.

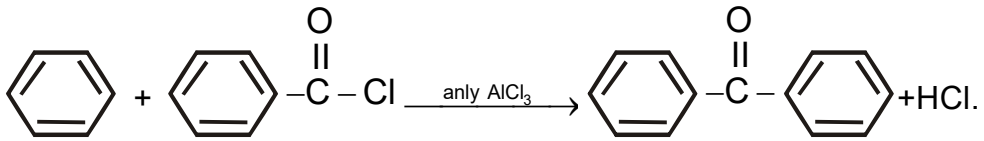
$[Ag(NH_3)_2]^+NO_3^-$

24. What is the Chemical name of Rochelle salt ?

Ans. Sodium potassium tartarate : NaOOCCH(OH)CH(OH)COOK.

25. How benzephenone is prepared from benzene ?

Ans. On Friedel Craft acylation reaction of benzene with benzoyl Chloride in presence of anhydrous $AlCl_3$.



Benzene benzoil chloride benzophenone

UNIT - IX

AMINIES AND DIAZONIUM SALTS

I. Select the correct answer from the choices given under each bit :

1. The IUPAC name of Isopropyl amine is :

(a) Propan-1-amine

(b) Propan-2-amine

(c) Ethanamine

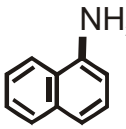
(d) N-methyl ehthanamine

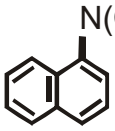
2. The common name of 2-methyl aniline is

(a) Toluene (b) o-toluidine

(c) m-toluidine (d) p-toluidine

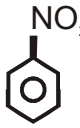
3. Among the following which is tertiary amine ?

(a) 

(b) 

(c) $C_2H_5NH_2$

(d) $(C_2H_5)_2NH$

4.  $\xrightarrow{Sn/HCl}$ **product. The product is**

(a) Aniline

(b) Toluene

(c) Benzene dichloride

(d) phenol

5. $CH_3CONH_2 \xrightarrow[H_2O]{LiAlH_4}$ **product**

(a) CH_3CN

(b) $CH_3COCH_2NH_2$

(c) $CH_3CH_2NH_2$

(d) CH_3NH_2

6. The correct decreasing order of basic character among the following NH_3, CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$ is

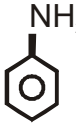
(a) $(CH_3)_2NH > CH_3NH_2 > (CH_3)_3N > NH_3$

(b) $(CH_3)_3N > (CH_3)_2NH > CH_3NH_2 > NH_3$

(c) $CH_3NH_2 > (CH_3)_2 NH > NH_3 > (CH_3)_3N$

(d) $NH_3 > (CH_3)_3N > CH_3NH_2 > (CH_3)_2NH$

7. What is the product of the reaction?

 $+Br_2 \xrightarrow{Br_2/H_2O}$

(a) 2-bromo aniline

(b) 3-bromo aniline

(c) 4-bromoaniline

(d) 2,4,6- tribromo aniline

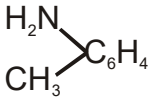
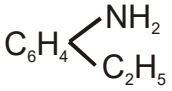
8. Which of the following will give N_2 gas on treatment with HNO_2 ($NaNO_2$ + HCl) ?

(a) $C_2H_5NH_2$ (b) CH_3NH_2

(c) $(CH_3)_2CH\text{-}NH_2$ (d) all of these

9. Which will not undergo diazotisation?

(a) $C_6H_5NH_2$ (b) $C_2H_5NH_2$

(c)  (d) 

10. A positive carbylamines test is given by

(a) N, N-dimethyl aniline

(b) 2,4- dimethyl aniline

(c) N-methyl benzylamine

(d) N-ethyl aniline

11. The correct decreasing order of base strength in gas phase :

(a) $(C_2H_5)_3N > (C_2H_5)_2NH > C_2H_5NH_2 > NH_3$

(b) $NH_3 > C_2H_5NH_2 > (C_2H_5)_2NH > (C_2H_5)_3N$

(c) $C_2H_5NH_2 > NH_3 > (C_2H_5)_2NH > (C_2H_5)_3N$

(d) $(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2 > NH_3$

12. A- mixture of 1^0, 2^0 and 3^0 amines can be separated by Hinsberg's reagent which is

(a) Benzoyl Chloride

(b) Acetyl Chloride

(c) Benzosulphonyl Chloride

(d) Benzyl Chloride

13. Reduction of benzene diazonium chloride with Zn/HCl gives

(a) Aniline

(b) Phenyl hydrazine

(c) Benzyl Alcohol

(d) Anisole

14. Gabriel Phthalimide reaction is used for the preparation of

(a) Primary aromatic amines

(b) Secondary amines

(c) Aliphatic primary amines

(d) Tertiary amines

15. Which of the following compounds gives dye test ?

(a) Aniline

(b) Methyl amine

(c) Diphenyl amine

(d) Ethylamine

16. The amine that does not react with acetyl chloride is

(a) CH_3NH_2

(b) $(CH_3)_2$ NH

(c) $(CH_3)_3N$

(d) None of these

17. Benzene diazonium chloride is reduced to benzene by

(a) Phosphorous Acid

(b) Hypo phosphorous Acid

(c) Hypo phosphoric Acid

(d) Phosphine

18. Which of the following is most basic ?

(a) aniline

(b) p-nitro aniline

(c) p-methyl aniline

(d) benzyl amine

19. Which of the following on reduction with $LiAlH_4$ yields a secondary amine ?

(a) Methyl cyanide

(b) Nitro ethane

(c) Methyl isocyanide

(d) Acetamide

20. Which of the following compound will dissolve in an alkali solution after it undergoes reaction with Hinsberg's reagent ?

(a) CH_3NH_2

(b) $(CH_3)_3N$

(c) $(C_2H_5)_2NH$

(d) $C_6H_5NH\ C_6H_5$

21. Which of the following gives yellow oily liquid with nitrous acid ?

(a) Methylamine

(b) Aniline

(c) Dimethyl amine

(d) Trimethyl amine

22. The amine which will not liberate nitrogen on reaction with nitrous acid is

(a) trimethyl amine

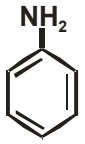
(b) ethyl amine

(c) t-butyl amine

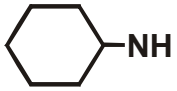
(d) isopropyl amine

23. Which of the following is the weakest Bronsted base ?

(a) 

(b) 

(c) CH_3NH_2

(d) 

24. Which of the following forms a stable diazonium salt at 273-278 K?

(a) Ethyl amine

(b) Dimethylanine

(c) Benzyl amine

(d) Aniline

25. Which of the following reagents can not be a good choice for reducing nitrobenzene to an amine ?

(a) Sn/HCl

(b) Fe/HCl

(c) $LiAlH_4$ in ether

(d) H_2/Ni

26. In order to prepare a $CH_3CH_2NH_2$ from CH_3Br, the reagnet used as source of nitrogen is :

(a) Sodamide ($NaNH_2$)

(b) Sodium azide (NaN_3)

(c) Potassium Cyanide (KCN)

(d) Potassium phthalimide

27. In Gabriel synthesis of amines which reagent becomes source of nitrogen :

(a) Sodium nitrite

(b) Sodium azide

(c) Potassium cyanide

(d) Potassium phthalimide

28. The gas evolved in the reaction of methyl amine with nitrous acid is :

(a) NH_3 (b) C_2H_6

(c) N_2 (d) H_2

29. Primary amine and acid anhydride react to form :

(a) amide

(b) imide

(c) secondary amine

(d) imine

30. Reduction of benzene diozonium chloride with Zn/HCl gives

(a) Aniline

(b) Phenyl hydrazine

(c) Azobenzene

(d) Hydrozobonzene

31. When benzene diazonium Chloride is warmed with methanol the product formed is :

(a) benzene (b) benzenol

(c) benzyl alcohol (d) anisole

32. Which of the following diazonium salt is most stable ?

(a) p-nitrobenzenediazonium chloride

(b) 2-4-dinitrobenzenediazonium chloride

(c) 2,4,6-trinitrobenzene diazonium chlorids

(d) p-methoxybenzenediazonium chloride

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

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

II. Short Questions

Q1. Give the distinction between methyl amine and dimethyl amine.

Ans. Methyl amine is a primary amine, gives carbylamine test i.e when methyl amine is heated with alcoholic solution of KOH and $CHCl_3$ gives methyl isocyanide where as dimethyl amine, a secondary amine does not give this test.

$$CH_3NH_2 + CHCl_3 + 3KOH \xrightarrow{\Delta} \underset{\text{alc}}{} \underset{\text{Methylisocyanide}}{CH_3NC} + 3KCl + 3H_2O$$

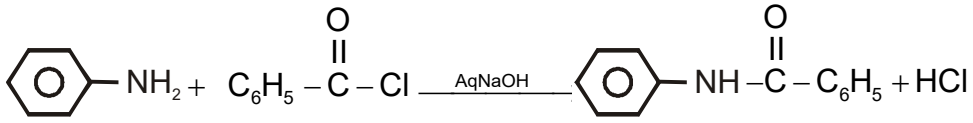
$$(CH_3)_2NH + CHCl_3 + KOH \xrightarrow{\Delta} \text{No reaction}$$

Q2. Why pK_b of aniline is more than that of methyl amine ?

Ans. Aniline is an aromatic amine and the lone pair of electrons on Nitrogen are delocalized. So the electron density on nitrogen decreases. But in CH_3NH_2, +I effect of CH_3 increases the electron density on N-atom, so a stronger base than aniline. Therefore, pK_b value of methyl amine is lower than aniline.

Q3. Write the chemical reaction of aniline with benzoyl chloride and write the name of the product.

Ans.



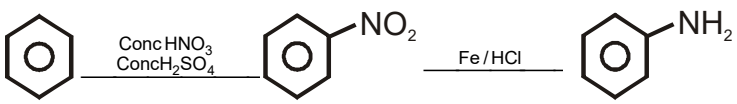
aniline benzoylchloride Benzanilide

Q4. How will you convert

(a) Benzene to aniline

(b) Acetic acid to methanamine

Ans. (a) Benzene to aniline



benzene nitrobenzene Reduction aniline

(b) Acetic acid to methanamine

$$CH_3COOH \xrightarrow[-SO_2, -HCl]{SOCl_2} CH_3COCl \xrightarrow{NH_3} CH_3CONH_2 \xrightarrow{Br_2/KOH} CH_3NH_2$$

Acetic acid Acetyl Chloride Ethanamide Methanamine

Q5. Write notes on carbylamine reactions giving examples.

Ans. Primary amine when heated with alcoholic solution of KOH and $CHCl_3$ (Chloroform) gives methyl isocyanide is known as carbylamine reaction.

$$CH_3NH_2 + KOH + CHCl_3 \xrightarrow{\Delta} CH_3NC + KCl + H_2O$$

Q6. Write the structures of different isomers corresponds to molecular formula C_3H_9N. Write IUPAC names of the isomers which will liberate N_2 gas on treatment with HNO_2.

Ans. The various isomers of C_3H_9N are

(i) $CH_3 - CH_2 - CH_2 - NH_2$

Propan - 1 - amine

(ii) $CH_3 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - CH_3$

Propan - 2 amine

(iii) $CH_3CH_2 - \underset{\displaystyle H}{\underset{|}{N}} - CH_3$

N-Methyl ethanamine

(iv) $H_3C - \ddot{N} - CH_3$ (with CH_3 below N)

N, N-dimethyl Methanamine

As primary amine can give N_2 gas on treatment with HNO_2.

$$CH_3 - CH_2 - CH_2\ NH_2 \xrightarrow{HNO_2} CH_3CH_2CH_2OH + N_2 + H_2O$$

Propan-1-ol

$$CH_3 - \underset{\displaystyle NH_2}{\underset{|}{CH}} - CH_3 \xrightarrow{HNO_2} CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - OH + N_2 + H_2O$$

Propan-2-ol

Q7. What is benzoylation ? Give one example.

Ans. See question no. - 3

Q8. How will you distinguish between primary amine, secondary amine and tertiary amine ?

Ans. When amine is shaken with benzene sulphonyl chloride in presence of aqueous KOH, a primary amine gives clear solution which on acidification gives an insoluble N-alkyl benzene sulphonamide which is soluble in alkali.

Secondary amine gives N.N dialkylbenzene sulphonamide which is insoluble in alkali.

Tertiary amines do not react with Hinsberg reagent at all.

Q9. Explain why do primary amines have higher boiling points than tertiary amines.

Primary > Secondary > Tertiary

Ans. Among amines, the primary amines have higher b.p. than corresponding secondary amines. This is due to extensive H-bonding in primary amines because of two N-H bonds in the molecule. Tertiary amines do not have N-H bond, consequently have lowest b.p. So the order is

Primary > Secondary > Tertiary

Q10. Write short notes on Hofmann's bromamide reaction.

Ans. Hoffmann's Bromamide Reaction : The primary acid amides on reaction with Br_2 in the presence of alkalies at about 343 K give primary amines. The amine formed in this method has one carbon atom less than the parent amide.

$$CH_3CONH_2 + Br_2 + 4KOH \longrightarrow CH_3NH_2 + 2KBr + K_2CO_3 + 2H_2O$$

Q11. Give the structures of A, B and C in the following reaction.

$$\mathbf{CH_3COOH \xrightarrow[\Delta]{NH_3} A \xrightarrow{NaOBr} B \xrightarrow[HCl]{NaNO_2} C}$$

Ans. $CH_3COOH \xrightarrow[\Delta]{NH_3} \underset{\text{Ethanamide}}{\underset{A}{CH_3CONH_2}} \xrightarrow{NaOBr} \underset{\text{Methanamine}}{\underset{B}{CH_3NH_2}} \xrightarrow{NaNO_2/HCl} \underset{\text{Methanol}}{\underset{C}{CH_3OH}}$

12. Give the structures of A, B and C in the following reaction.

$$\mathbf{C_6H_5N_2Cl \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow[\Delta]{NH_3} C}$$

Ans. $C_6H_5N_2Cl \xrightarrow{CuCN} \underset{\text{Benzene Carbonitril}}{\underset{(A)}{C_6H_5CN}} \xrightarrow{H_2O/H^+} \underset{\text{Benzoic acid}}{\underset{(B)}{C_6H_5COOH}} \xrightarrow[\Delta]{NH_3} \underset{\text{Benzamide}}{\underset{(C)}{C_6H_5CONH_2}}$

13. Why aromatic primary amines can not be prepared by Gabriel phthalimide synthesis.

Ans. Gabriel Phthalimide Synthesis shows that Phthalimide is first converted into potassium phthalimide by reaction with KOH which on further treatment with alkyl halide gives N-alkyl phalimide which on subsequent alkaline hydrolysis with NaOH gives primary amine.

But aromatic primary amines cannot be prepared because aryl halides do not undergo nucleophilic substitution reactions under ordinary conditions.

14. An aromatic compound 'A' on treatment with aqueous NH_3 and heating forms compound 'B' which on heating with Br_2 and KOH forms compound 'C' of molecular formula C_6H_7N. Write the structures and IUPAC names of compounds A, B, C.

Ans: Since compound C is of M.F. C_6H_7N, is formed from 'B' on treatment with Br_2/KOH i.e Hoffmann's bromamide reaction, therefore, the compound 'B' is an amide and 'C' must be an amine. The only amine of M.F. $C_6H_5NH_2$ (aniline). Since 'C' is an amine, the amide formed must be benzamide ($C_6H_5CONH_2$) i.e. B.

$$C_6H_5CONH_2 \xrightarrow{Br_2/KOH} C_6H_5NH_2$$

Benzamide Benzamine

Further 'B' is formed from compound 'A' with aq NH_3 and heating must be benzoic acid C_6H_5COOH.

$$C_6H_5COOH \xrightarrow[(ii)\ \Delta]{(i)\ Ag,\ NH_2} C_6H_5CONH_2$$

(A) (B)

15. Give the structures of A, B and C in the following reaction.

(i) $CH_3CH_2I \xrightarrow{NaCN} A \xrightarrow[\text{Partial hydrolysis}]{OH^-} B \xrightarrow{NaOH/Br_2} C$

(ii) $C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow{NaNO_2+HCl} B \xrightarrow[H^+]{H_2O} C$

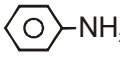
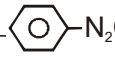
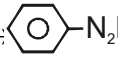
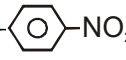
(iii)  $\xrightarrow{NaNO_2+HCl} A \xrightarrow{HBF_4} B \xrightarrow[Cu]{NaNO_2} C$

Ans: (i) $CH_3CH_2I \xrightarrow{NaCN} CH_3CH_2CN \xrightarrow{OH^-} CH_3-\overset{O}{\overset{\|}{C}}-NH_2 \xrightarrow{NaOH+Br_2} CH_3NH_2$

(A) Propane nitril (B) ethanamide (C) methanamine

(ii) $C_6H_5NO_2 \xrightarrow{Fe/HCl} C_6H_5NH_2 \xrightarrow{NaNO_2/HCl} C_6H_5N_2Cl \xrightarrow[H^+]{H_2O} C_6H_5OH$

aniline (A) Benzenediazonium Chloride (B) Phenol (C)

(iii)  $\xrightarrow{NaNO_2/HCl}$  $\xrightarrow{HBF_4}$  $\xrightarrow[Cu]{NaNO_2}$  $+BF_3+NaF$

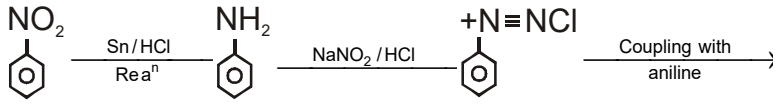
Benzenediazonium Chloride (A) Benzenediazo-niumfluoroborate (B) Nitro benzene (C)

16. How can you convert

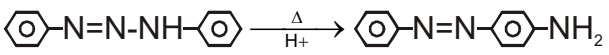
(a) Nitro-benzene to p-aminoazobenzene

(b) 4-nitrotoluene to 2-bromo benzoic acid

Ans.: (a) Nitrobenzene to P-aminoazobenzene

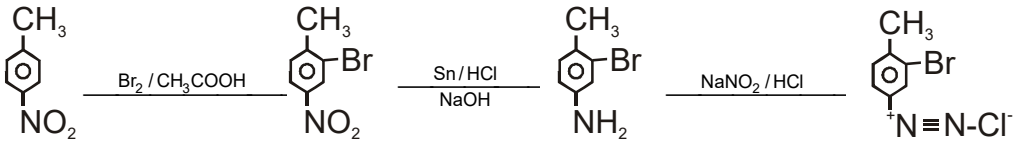


nitrobenzene aniline Benzenediazonium chloride

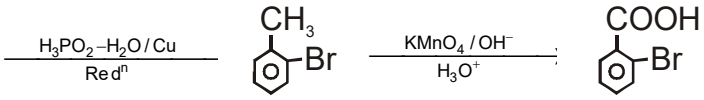


Diazoaminobenzene p-aminoazobenzene

(b) 4-nitrotoluene to 2-bromobenzoic acid



4-nitrotoluene 2-bromo-4-nitro toluene 3-bromo-4methyl aniline 3-bromo-4-methyl benzenediazonium chloride



2-bromotoluene 2-bromobenzoic acid

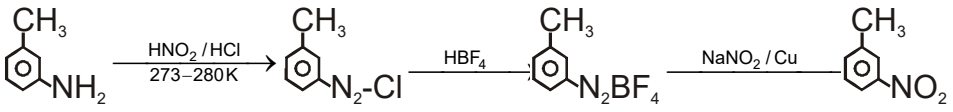
17. How can you convert

(a) 3- methyl aniline to 3-nitro toluene

(b) Aniline to 1,3,5- tribomo benzene

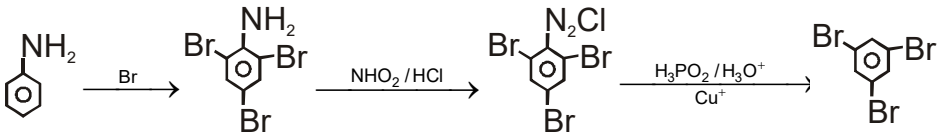
(c) Methanamine to ethanamine

Ans.: (a) 3-methylaniline to 3-nitrotoluene :-



3-methylaniline 3-nitrotoluene

(b) Aniline to 1, 3, 5 tribromobenzene :



1,3,5 - tribromobenzene

(c) Methanamine to Ethanamine

$$CH_3NH_2 \xrightarrow{HNO_2} CH_3OH \xrightarrow{P+I_2} CH_3I \xrightarrow{KCN} CH_3CN \xrightarrow{Na/C_2H_5OH} CH_3CH_2NH_2$$

Methanamine Methanol Methyl iodide Acetonitril ethanamine

18. Arrange the following in increasing order of basic character ?

(a) $C_6H_5NH_2$, NH_3, $C_6H_5CH_2^-$, NH_2, $C_2H_5NH_2$, $(C_2H_5)_2NH$

(b) $C_6H_5NH_2$, $C_2H_5NH_2$, $(C_2H_5)_3N$, $(C_2H_5)_2$ NH

(c) $C_6H_5NH_2$, $(CH_3)_3N$, $C_6H_5CH_2NH_2$, CH_3NH_2, $(CH_3)_2NH$

Ans.: (a) $C_6H_5NH_2 < NH_3 < C_6H_5CH_2NH_2 < C_2H_5NH_2 < (C_2H_5)_2$ NH

(b) $C_6H_5NH_2 < C_2H_5NH_2 < (C_2H_5)_3N < (C_2H_5)_2$ NH

(c) $C_6H_5NH_2 < C_6H_5CH_2NH_2 < (CH_3)_3N < CH_3NH_2 < (CH_3)_2$ NH

19. Write the structure and IUPAC names of

(i) The amide which give propanamine by Hoffmann's bromamide reaction.

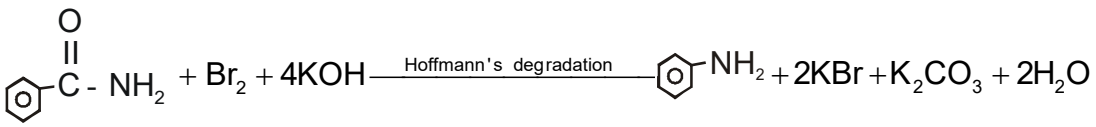
(ii) The amide produced by Hoffmann degradation of benzamide

Ans.: (i) Propanamine contains three carbon atoms which is formed after Hoffmann's bromamide reaction. So the amide should have 4 carbon atoms i.e.

$$CH_3CH_2-CH_2-\overset{\overset{O}{\|}}{C}-NH_2 + Br_2 + 4KOH \xrightarrow{\Delta} CH_3CH_2CH_2NH_2 + 2KBr + K_2CO_3 + 2H_2O$$

Butanamide Propanamine

(ii) Benzamide has 7 carbon atoms. The amine formed from benzamide is aromatic primary amine containing six carbon atoms i.e. aniline



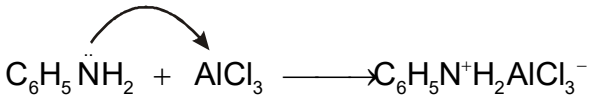
Benzamide Aniline or Benzamine

20. (a) Why aniline does not undergo Friedel-Craft reaction ? explain.

(b) Why do primary amines have higher b.p than tertiary amine ?

(c) Why aliphatic amines are stronger base than aromatic amines ?

Ans.: (a) Aniline is a Lewis base reacts with Lewis acid $AlCl_3$ to form a salt



Lewis base Lewis acid

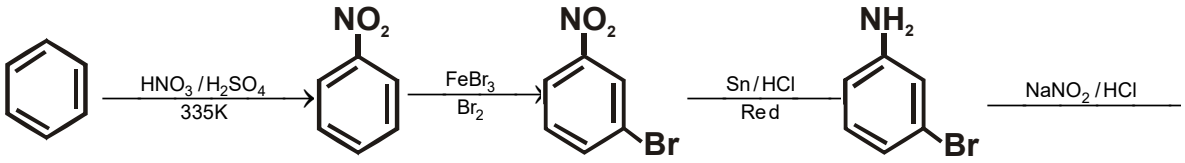
As a result aniline acquires a positive charge and acts as deactivating group for electrophilic substitution. Hence aniline does not undergo Friedel - Craft reaction.

(b) Due to presence of two H-atoms on N-atom of primary amines, they undergo H-bonding where as tert amines do not have H-atom on N-atom, do not possess H-bonding. So primary amines have highest b.p. than tert amines.

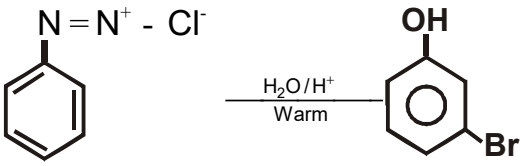
(c) Aromatic amines have resonance effect due to presence of benzene ring. As a result the lone pair of electrons on N-atom gets delocalized and less easily available for protonation. Hence aromatic amines are weaker base than aliphatic amines.

21. How will you convert benzene into 3-bromophenol?

Ans.



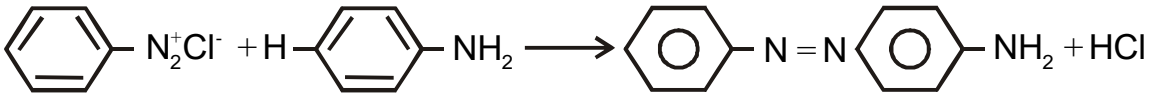
Benzene m-bromonitro benzene 3-bromoaniline



3-bromophenol

22. How will you distinguish between ethylamine and aniline ?

Ans. Aniline forms azodye with benzenediazoniumchloride but ethyl amine does not.



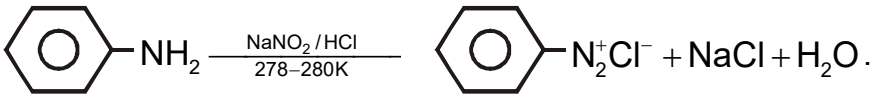
aniline azodye

23. Diazonium salts of aromatic amines are more stable than those of aliphatic amines. Why ?

Ans. Benzenediazonium ion is resonance stabilised whereas alkyldiazonium salt has no such reasonance stabilisation. So aromatic amines are more stable.

24. What is diazotisation ?

Ans. The reaction involves conversion of primary aromatic amine (aniline) into benzenediazonium salt by treatment with $NaNO_2$/HCl (nitrous acid) at low temperature.



25. Write the structures of A, B, C of the reaction :

$$C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow{HNO_2} B \xrightarrow[\Delta]{H_2O/H^+} C.$$

Ans. $C_6H_5NO_2 \xrightarrow{Fe/HCl} C_6H_5NH_2 \xrightarrow{HNO_2} C_6H_5N=N-Cl \xrightarrow[\Delta]{H_2O/H^+} C_6H_5OH$

aniline (A) — benzene diazonium chloride (B) — Phenol (C)

26. Complete the following reactions :

(i) $C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow$

(ii) $C_6H_5N_2Cl \xrightarrow[NaNO_2/Cu\Delta]{HBF_4}$

Ans. (i) $C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow C_6H_6 + N_2 + H_3PO_3 + HCl$

(ii) $C_6H_5N_2Cl \xrightarrow[NaNO_2/Cu\Delta]{HBF_4} C_6H_5NO_2$

nitro benzene

27. Why are benzene diozonium salts soluble in water ?

Ans. Being ionic, they are soluble in water.

28. What is Sandmeyer's reaction?

Ans. The reaction of diazonium salt with CuCl/HCl to give the corresponding chloroarene is called Sandmeyer's reaction.

29. How is phenyl hydrazine prepared from aniline ?

Ans. By reduction of benzenediazonium chloride with $SnCl_2$/HCl or Na_2SO_3.

30. What is a coupling reaction ?

Ans. The reaction of diazonium salts with phenols in basic medium and with amines in acid medium to give the corresponding azodyes is called the coupling reaction.

UNIT - X

BIOMOLECULES

I. Select the correct answer from the choices given under each bit :

1. A nano peptide contains how many peptide linkage ?

(a) 10 (b) 8

(c) 9 (d) 18

2. Which of the following exists in Zwitter ionic form ?

(a) alkaline (b) glucose

(c) fructose (d) ethanamide

3. Which of the following biomolecule will give blue colouration with Cu^{2+} and purple colour with nin-hydrin solution ?

(a) aldehyde (b) α-amino acid

(c) carbohydrate (d) DNA

4. Which among the following is the monomer of starch ?

(a) glucose (b) sucrose

(c) protein (d) lactose

5. Which of the following is/are reducing sugars ?

(a) sucrose (b) fructose

(c) starch (d) cellulose

6. The Carbon Atoms involved in osazone formation are

(a) 1 and 2 (b) 2 and 3

(c) 3 and 4 (d) 5 and 6

7. The bonds in protein structure that are not broken on denaturation

(a) hydrogen bond

(b) peptide bond

(c) ionic bond

(d) disulphide bond

8. The phenomenon of mutarotation is not exhibited by

(a) glucose (b) fructose

(c) sucrose (d) maltose

9. Which of these is not found in nucleotides ?

(a) guanine (b) cytosine

(c) adenine (d) tyrosine

10. Which of the following does not undergo hydrolysis ?

(a) glucose (b) cellulose

(c) cane sugar (d) maltose

11. Which of the following is a monosaccharide ?

(a) sucrose (b) galactose

(c) maltose (d) lactose

12. Which of the following carbohydrates is most abundant in nature ?

(a) glucose (b) fructose

(c) cellulose (d) starch

13. Which gives red colour with Fehling's Solution ?

(a) glucose

(b) cellulose

(c) benzaquinone

(d) cane sugar

14. On hydrolysis, proteins give

(a) nucleotides (b) nucleosides

(c) amides (d) amino acids

15. 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

16. Which of the following carbohydrates is used in silvering of mirror ?

(a) Sucrose (b) Cellulose

(c) Fructose (d) Glucose

17. Helical structure of proteins is stabilized by

(a) ionic bond

(b) covalent bond

(c) vanderwaal's forces

(d) hydrogen bond

18. Glucose and fructose are

(a) optical isomers

(b) functional isomers

(c) chain isomers

(d) position isomes

19. The number of chiral carbon atoms in β-D(+) glucose molecule is

(a) 3 (b) 5

(c) 4 (d) 6

20. Glucose with excess of phenyl hydrazine forms

(a) fructosazone

(b) glucose phenyl hydrazone

(c) glucosazone

(d) phenyl hydrazone of glucosazone

21. Protein is an important constituent of our diet. It functions mainly as

(a) source of energy

(b) a construction material

(c) shock absorber

(d) reserve food

22. The coagulation of protein is called

(a) dehydration (b) decay

(c) deamination (d) denaturation

23. Which one of the following is a disaccharide ?

(a) starch (b) lactose

(c) cellulose (d) fructose

24. A protein is best described as a

(a) poly amide (b) polyester

(c) poly peptide (d) poly urethane

25. α-D(+) - glucose and β-D(+) - glucose are called

(a) geometrical isomers

(b) anomers

(c) enantiomers

(d) epimers

26. The number of amino acids which form proteins in nature are about

(a) 6 (b) 10

(c) 15 (d) 20

27. The pH value of a solution in which a polar amino acid does not migrate under influence of electrical field is called

(a) iso electric point

(b) iso electronic point

(c) neutralization

(d) none of the above

28. The protein which transports oxygen is the blood stream is

(a) haemoglobin (b) insulin

(c) collagen (d) albumin

29. Which of the following base is found only in RNA and not in DNA ?

(a) thiamine (b) guanine

(c) uracil (d) adenine

30. At the iso electric point, amino acids are present as

(a) H_2N . CHR . COOH

(b) $H_3N^+CHRCOO^-$

(c) $H_3N^+CHRCOOH$

(d) $H_2NCHRCOO^-$

31. The most important energy carrier in the living cell is

(a) AMP (b) ADP

(c) UDP (d) ATP

32. Glucose and Fructose can also be distinguished by

(a) molisch test

(b) acetylation

(c) conc solution of NaOH

(d) phenyl hydrazine

33. Which of the following is a protein?

(a) Nylon (b) Natural silk

(c) Rayon (d) Teryline

34. Proteins give purple colour with

(a) Benedict's Solution

(b) Iodine Solution

(c) Ninhydrin Reagent

(d) Biuret

35. Bases common to RNA and DNA are

(a) adenine, guanine, cytosine

(b) adenine, uracil, cytosine

(c) adenine, guanine, thymine

(d) guanine, uracil, thymine

36. In nucleic acids, the sequence is

(a) base, phosphate, sugar

(b) base, sugar, phosphate

(c) sugar, base, phosphate

(d) phosphate, base, sugar

37. Which of the following contain a transition metal ?

(a) Chlorophyll (b) Haemoglobin

(c) Vitamin (d) DNA

38. The letter 'D' and 'L' in carbohydrates represent

(a) its optional rotation

(b) its mutarotation

(c) its direct synthesis

(d) its configuration

39. Carbohydrates are used by body mainly

(a) for obtaining vitamins

(b) as a source of energy

(c) for building muscles

(d) for all its developmental needs

40. The number of asymmetric carbon atoms in fructose are

(a) 2 (b) 3

(c) 4 (d) 5

41. Which one of the following is the reagent used to identify glucose ?

(a) Neutral $FeCl_3$

(b) $CHCl_3$ and alc. KOH

(c) Ammoniacal $AgNO_3$

(d) CH_5ONa

42. Charring of sugar is due to

(a) oxidation

(d) reduction

(c) dehydration

(d) reduction & hydration

43. On hydrolysis of starch, we finally get

(a) glucose

(b) fructose

(c) both glucose & fructose

(d) sucrose

44. The aqueous solution of carbohydrate gave a dark blue colour with iodine solution, the carbohydrate is

(a) glucose (b) fructose

(c) sucrose (d) starch

45. The glucose is an example of

(a) disaccharide

(b) aldohexose

(c) ketohexose

(d) none of these

46. Which carbohydrate is an essential constituent of plant cells ?

(a) Starch (b) Cellulose

(c) Sucrose (d) Vitamins

47. The reason for double helical structure of DNA is operation of

(a) hydrogen bonding

(b) electrostatic attraction

(c) Vander Waal's force

(d) dipole-dipole interaction

48. The conversion of maltose to glucose is possible by th enzyme

(a) Zymase (b) Lactase

(c) Maltase (d) Diastase

49. Which of the following amino acid is optically active

(a) phenyl alanine

(b) glycine

(c) glutamic acid

(d) asparagine

50. A compound gives negative test with ninhydrin and positive test with Benedict's solution. The compound is

(a) a lipid

(b) a protein

(c) an amino acid

(d) a mono saccharids

51. The essential amino acids are

(a) glycine (b) alanine

(c) valine (d) cysteine

52. Glucose does not react with

(a) NH_2OH (b) HCN

(c) $NaHSO_3$ (d) NH_3

53. Glucose is stored in our body as

(a) carbohydrates

(b) fats

(c) glycogen

(d) lipid

54. DNA multiplication is called

(a) translation (b) transduction

(c) transcription (d) replication

55. How can you say that glucose is a cyclic compound ?

(a) Glucose undergoes reaction with Tollen's reagent

(b) Glucose reacts with phenyl hydrazine

(c) Glucose fails to react with sodium bisulphite

(d) Glucose reacts with nitric acid

56. The sweetest carbohydrate is

(a) Sucrose (b) Glucose

(c) Fructose (d) Lactose

57. Which of the following is the first member of monosaccharides ?

(a) $CH_2OH - \overset{\overset{O}{\|}}{C} - CH_2OH$

(b) $HOCH_2 - CHOH - CHO$

(c) $OHCH_2 - CHOH - CHOH - CHO$

(d) $CH_2OH - CHOH - \overset{\overset{O}{\|}}{C} - CH_2OH$

58. A carbohydrate is treated with α-naphthol and conc. H_2SO_4. What colour will be formed at the junction of two liquids ?

(a) Blood red (b) Violet

(c) Brown (d) Orange

59. Milk changes into __ after digestion.

(a) Cellulose (b) Fructose

(c) Glucose (d) Lactose

60. In alkaline medium, glycine predominately exists as a/an

(a) cation (b) anion

(c) zwitter ion (d) covalent form

61. Denaturation of protein leads to loss of its biological activity by

(a) formation of amino acids

(b) loss of primary structure

(c) loss of both primary and secondary structures

(d) loss of both secondary and tertiary structures

62. At pH = 4, glycine exists as

(a) $H_3N^+ - CH_2 - COO^-$

(b) $H_3N^+ - CH_2 - COOH$

(c) $H_2N - CH_2 - COOH$

(d) $H_2N - CH_2 - COO^-$

63. The purine base present in RNA is

(a) guanine (b) cytosine

(c) uracil (d) thymine

64. Which one of the following statements about amino acids is not true ?

(a) They are constituents of all proteins

(b) They are all high melting solids

(c) Most naturally occurring amino acids have D-configuration

(d) They are characterized by iso electric point

65. The secondary structure of protein refers to

(a) α-helical backbone

(b) Hydrophobic interactions

(c) Sequence of α-amino acids

(d) Fixed configuration of the poly peptide backbone

66. Monomer of nucleic acid is

(a) Nucleotide (b) Nucleosides

(c) Amino Acids (d) Carboxylic Acid

67. Which one is not a constituent of nucleic acid ?

(a) Uracil

(b) Guanidene

(c) Phosphoric Acid

(d) Ribose Sugar

68. The function of DNA in an organism is

(a) to assist in the synthesis of RNA molecule

(b) to store information of heredity characteristics

(c) to assist in the synthesis of proteins and polypeptides

(d) All of the above

69. A sequence of how many nucleotides in messenger RNA make a codon for an amino acid ?

(a) Three (b) Four

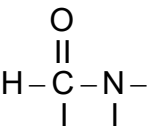
(c) One (d) Two

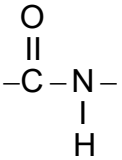
70. The presence and absence of hydroxy group on which carbon atom of sugar differentiates RNA and DNA ?

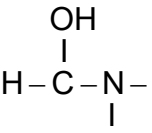
(a) First (b) Second

(c) Third (d) Fourth

71. Which one is correct representation of peptide bond ?

(a) 

(b) 

(c) 

(d) None of these

72. **α-D-glucose and β-D-glucose are _____.**

(a) Epimers

(b) Anomors

(c) Enantimomers

(d) Structural isomers

73. **Nucleic acids are polymers of _____**

(a) Nucleosides

(b) Peptides

(c) Nucleotides

(d) α-Amino acids

74. **Which of the following statements is not correct about glucose ?**

(a) It is an aldohexose

(b) It exists in pyranose form

(c) On heating with HI it forms I-iodohexane

(d) It is dextrorotatory

75. **On hydrolysis one molecule of sucrose gives _____.**

(a) 2 molecules of fructose

(b) 2 molecules of glucose

(c) one molecule each of glucose and ribose

(d) one molecule each of glucose and fructose

76. **Which of the following is Vitamin C?**

(a) Citric acid

(b) Aspartic acid

(c) Ascorbic acid

(d) Adipic acid

77. **Which of the following polysaccharides is stored in the liver of animals ?**

(a) Glycogen (b) Amylopectin

(c) Cellulose (d) Amylose

78. **Which of the following bases is not present in RNA?**

(a) Adenine (b) Uracil

(c) Cytosine (d) Thyamine

79. **Which of the following bases is not present in DNA?**

(a) Cytosine (b) Uracil

(c) Adenine (d) Thiamine

80. **Nucleotide units in a nucleic acid are linked through _____.**

(a) Glycoside linkage

(b) Phosphodiester linkage

(c) Peptide linkage

(d) Heterocyclic linkage

81. **The hormone that helps in the conversion of glucose into glycogen is :**

(a) insulin (b) adrenaline

(c) bile acids (d) cortisone

ANSWER KEYS

I. Select the correct answer from the choices given under each bit :

1.	(b)	17.	(d)	33.	(b)	49.	(b)	65.	(a)
2.	(d)	18.	(b)	34.	(c)	50.	(d)	66.	(a)
3.	(b)	19.	(c)	35.	(a)	51.	(c)	67.	(b)
4.	(a)	20.	(c)	36.	(b)	52.	(c)	68.	(d)
5.	(b)	21.	(b)	37.	(b)	53.	(c)	69.	(a)
6.	(a)	22.	(d)	38.	(d)	54.	(d)	70.	(b)
7.	(b)	23.	(b)	39.	(b)	55.	(c)	71.	(b)
8.	(c)	24.	(c)	40.	(b)	56.	(c)	72.	(b)
9.	(d)	25.	(b)	41.	(c)	57.	(b)	73.	(c)
10.	(a)	26.	(d)	42.	(c)	58.	(b)	74.	(c)
11.	(b)	27.	(a)	43.	(a)	59.	(c)	75.	(d)
12.	(c)	28.	(a)	44.	(d)	60.	(b)	76.	(c)
13.	(a)	29.	(c)	45.	(b)	61.	(d)	77.	(a)
14.	(d)	30.	(b)	46.	(b)	62.	(b)	78.	(d)
15.	(d)	31.	(d)	47.	(a)	63.	(a)	79.	(b)
16.	(d)	32.	(c)	48.	(c)	64.	(c)	80.	(b)
								81.	(a)

II. Short Questions

1. What is structural feature characterizing reducing sugar ?

Ans. The reducing sugars contain aldehyde group (- CHO) e.g Glucose, Mannose, Galactose etc. or α-Keto group (-CO-CH_2OH) like fructose.

2. Define mono saccharides. What is the main difference between the anomers of glucose ?

Ans. Monosaccharides are simple carbohydrates which cannot be hydrolysed to smaller molecules. The general formula is $(CH_2O)_n$ where n = 3 to 7 carbon atoms.

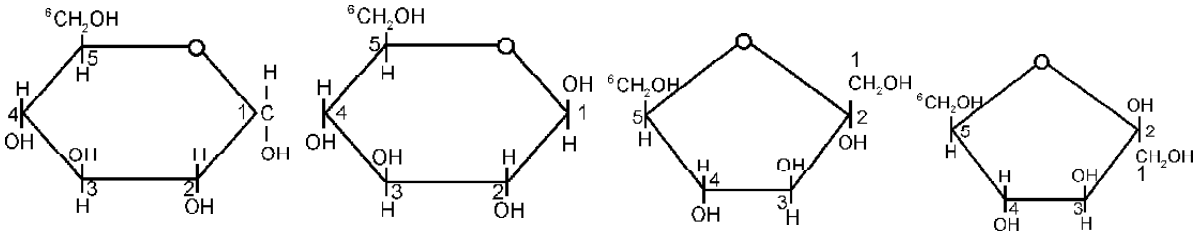
Glucose shows open chain structure as well as 5 or 6 numbered cyclic structures containing an oxygen atom. D-glucose exists as α and β forms which differ in configuration only around C_1 called anomers and C_1 carbon is called anomeric carbon.

3. Explain mutarotation taking place in D-glucose.

Ans. The α-D(+) glucose has specific rotation $+111^0$ and β-D(+) glucose has specific rotation 19.2^0. Both the forms are stable in aqueous sodium, but each form slowly changes into an equilibrium mixture of both. It is seen that the specific rotation of α-D(+) glucose falls gradually from $+111^0$ to $+ 52.5^0$ with time and β-D(+) glucose increases from 19.2^0 to 52.5^0. This spontaneous change in specific rotation of optically active compound with time to an equilibrium value is called 'muta rotation'.

4. How does glucose differ from fructose ?

Ans. Glucose has two isomers having $\alpha-D(+)$ and $\beta-D(+)$. Similarly fructose has two isomers $\alpha-D(-)$ & $\beta-D(-)$.



α-D(+) glucose β-D(+) glucose α-D(-) fructose $\beta-D(-)$fructose

Glucose is pyranose structure where as fructose is furanose structure.

5. Why glucose does not give 2-4 dinitrophenyl hydrazine test ?

Ans. Glucose does not give 2,4 dinitro phenyl hydrazine test, which shows that the -CHO gr is not free but combines with C_5-OH form hemiacetal. This cyclic structure of hemiacetal form cannot disturb the equilibrium to generate more open chain form from the cyclic form. Hence it does not react with 2,4 DNP.

6. What is the significance of 'D' and '+' for glucose ?

Ans. The letter 'D' in D(+) glucose indicates that C_5 - OH group is oriented towards right while the sign (+) indicates that glucose is dextrorotatory.

7. How is it explained the amphoteric nature of amino acid ?

Ans. Amino acids contain an acidic (-COOH gr) and a basic (-NH_2) gr. in the same molecule. In aqueous solution, they neutralise each other. -COOH gr. loses H^+ ion and - NH_2 accepts it, as a result they are dipolar or Zwitter ion. The $^+NH_3$ gr acts as acid and -COO^- gr acts as base. Therefore, amino acids are amphoteric.

8. What are enzymes ?

Ans. Enzymes are biological catalysts. Different biological system needs different enzyme. They are very specific and efficient in their action. They acts at optimum temperature and atmospheric pressure.

9. How are vitamins classified ?

Ans. Vitamins are classified as two groups (i) Water soluble vitamins and (ii) Fat soluble vitamins. Water vitamins include Vitamin B Complex, Vitamin C.. Fat soluble vitamins include Vitamin A, D, E and K. They are stored in liver and adipose tissues.

10. What is nuclcoside ?

Ans. A nucleoside consists of two components a nitrogenous base (purine and pyrimidine) and a five carbon sugar (ribose or deoxyribose). It is obtained when the nitrogenous base is attached to C_1 of sugar by a β-linkage. A nuclcoside is represented as base-sugar. They are adenosine, cytidine etc.

11. What are the constituents of starch ?

Ans. Amylose and amylopectin are constituents of starch.

12. What happens when protein is denatured ?

Ans. When protein is denatured, it loses its biological activity due to changes in the secondary and tertiary structures.

13. What are reducing sugars ?

Ans. Sugar which reduces Tollen's reagent and Fehling's solution are known as reducing Sugars. Glucose, Fructose, Galactose, Mannose, Maltose, Lactose are reducing sugars.

14. What is inversion of sugar ?

Ans. Sucrose (cane sugar) on hydrolysis gives D(+) glucose and D(-) fructose Surcose is dextrorotatory, D(+) glucose is dextrorotatory but D(-) fructose is laevorotatory. The change in specific rotation from dextrorotatory (from sucrose) to laevorotatory (glucose and fructose) is called inversion of sugar.

15. What are bio-molecules ?

Ans. The complex organic molecules such as carbohydrates, proteins, lipids, nucleic acids etc. which form the basis of life i.e. which build up living organisms and are also required for their growth and maintenance are called 'biomolecules'.

16. Discuss primary and secondary structures of nucleic acids.

Ans. Nucleic acids are polynucleotides and are formed by thousand molecules of nucleotides with the elimination of water molecules. During this polymerization the $^{5'}CH_2 - OH$ hydroxy group of the sugar residue of one nucleotide combines with one of the -OH groups of the phosphoric acid at C_3' of the other nucleotide to form a long poly nucleotide chain. The back bone consists of alternating sugar phosphate residue, each sugar on this backbone is further connected to one of the four nitrogenous bases. This chain is called the Primary Structure.

In secondary structure of nucleic acid, the base composition is DNA. It consists two right handed poly nucleotide strands, run in opposite directions giving a double helix structure.

The two strands are complementary and not identical. The base pairs of two strands are linked together through H-bonds. H-bonding is taking place between specific bases. A purin base of one strand is paired with a pyrimidine base of the other strand. The possible pairings of DNA are guanine (G) and cytosine (C) through three H-bonds and between adenine (A) and thiamine (T) through two H-bonds. On heating two strands of DNA separate from each other. On cooling they hybridise. Like DNA, RNA has single strand.

17. What are vitamins ? Which vitamin difficiencies cause night blindness ?

Ans. Vitamins are group of bio molecules (other than fats, carbohydrates and proteins) which are required in small amounts for normal metabolic processes and for the life, growth and health of human beings and animal organisms.

The deficiency of Vitamin A causes night blindness.

18. What are the functions of DNA ?

Ans. There are two important functions of DNA, these are (i) Replication and (ii) Protein synthesis.

The process by which a single DNA molecule produces two identical copies of itself is called Cell Division (mitosis) or replication.

Proteins are synthesized by RNA molecules in the cell, but the message for synthesis of a particular protein is coded in DNA. The three types of RNA molecules are (i) messenger RNA (m-RNA), ribosomal RNA (r-RNA) and transfer RNA (t-RNA).

19. What are complementary nature of two DNA strands ?

Ans. See question no. - 16

20. How are proteins related to amino acids ?

Ans. Proteins are polymers of α-amino acids. Like peptides the amino acid units in proteins are held up by peptide (-CONH-) linkage. The polymeric products of α-amino acids with molecular mass up to 10,000 are called poly peptides while those having molecular mass more than 10,000 are considered as proteins.

21. What are essential and non-essential amino acids ?

Ans. Amino acids which the body can not synthesize are called essential amino acid e.g phenylalanines, valine, leucine, isoleucine, methionine, tryptophan, threonine, lysine, orginine and histidine (10 amino acids) are essential amino acids.

The ten amino acids which the body can synthesize are called non-essential or dispensable amino acids. They are glycine, alanine, serine, cysteine, aspargine, glutamine, threonine, tyrosine, aspartic acid, glutamic acid.

22. Write the reaction of glucose converted to gluconic acid.

Ans. Glucose on oxidation with Br_2 water gives gluconic acid.

$$HOH_2C-(CHOH)_4-CHO+[O]\xrightarrow{Br_2\ Water}HOCH_2-(CHOH)_4-COOH$$

gluconic acid

This confirms the presence of -CHO gr. in glucose.

23. What are the main differences between α and β forms of glucose ?

Ans. See question No. 4.

24. What are reducing and non-reducing sugars ?

Ans. Carbohydrates which reduce Tallen's reagent and Fehling solution are called reducing sugars, while those which do not reduce these are called non-reducing sugars eg. Glucose, Fructose are reducing and sucrose is non-reducing sugar.

25. Give an example of aldohexose.

Ans. Glucose.

26. What is hydrolysis product of sucrose.

Ans. Sucrose $\xrightarrow{\text{hydrolysis}}$ Glucose + Fructose.

27. What type of linkages are responsible for the formation of primary structure of proteins ?

Ans. Primary structure of proteins arises due to peptide bonds (-CO-NH-bonds) between various constituents of amino acids.

28. Give the name and structure of optically inactive α -amino acid.

Ans. Glycine : $H_2N-\underset{\displaystyle H}{\overset{\displaystyle H}{\overset{|}{\underset{|}{C}}}}-COOH$.

29. Write the differences of DNA and RNA.

Ans. The differences of DNA and RNA are :

(i) In DNA, sugar is deoxyribose while in RNA it is ribose.

(ii) Thiamine base is present in DNA while Uracil is present in RNA.

(iii) DNA exist as double helix where as RNA exist as single strand.

30. What type of bonding helps in stabilising the α -helix structure of proteins ?

Ans. There is intramolecular H-bonding between - NH group of each amino acid residue with >C=0 of an adjacent turn of the helix.

31. The strands in DNA are not identical but are complementary. Explain.

Ans. DNA is a double helix in which the two strands of DNA are held by H-bonds between the bases on the two strands. Thymine (T) pairs with adenine through two H-bonds and Cytosine (C) pairs with guanine (G) through three H-bonds.

Therefore, opposite of each adenine (A) on one strand there is always a thymine on the otherhand and opposite guanine, there is cytosine, which means that the two strands of DNA are complimentary to each other.

32. What are different types of RNA in the cell ?

Ans. There are three types of RNA in the cell. These are messenger RNA (m-RNA), ribosonal RNA (r-RNA) and transfer RNA (t-RNA).

33. What are peptides ?

Peptides are the products formed by the condensation of two or more aminoacids through their amino and carboxylic groups involving elimination of water molecules. The linkage (-CO-NH-) which unites various amino acid units in a peptide molecule is called peptide linkage or peptide bond.

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CO
n+p
OH
O
HN
HO
CH2
SS
ON
CO2
HO
CHCO
OH