

GOVERNMENT OF KARNATAKA

DEPARTMENT OF SCHOOL EDUCATION (PRE-UNIVERSITY)

REVISED QUESTION BANK (2024-25)

SUBJECT-CHEMISTRY

SECOND YEAR PUC

ಕ್ರಮ ಸಂಖ್ಯೆ	ಉಪನ್ಯಾಸಕರ ಹೆಸರು	ಕಾಲೇಜಿನ ವಿಳಾಸ	
01	ಡಾ. ಈರೇಗೌಡ ಜಿ. ಬಿ	ಸರ್ಕಾರಿ ಪದವಿ ಪೂರ್ವ ಕಾಲೇಜು, ಯಲಹಂಕ, ಬೆಂಗಳೂರು	ಸಂಯೋಜಕರು
02	ಗಿರೀಶ್ ಸಿ.	ಸರ್ಕಾರಿ ಪದವಿ ಪೂರ್ವ ಕಾಲೇಜು, ಶಿರಾಳಕೊಪ್ಪ, ಶಿವಮೊಗ್ಗ ಜಿಲ್ಲೆ	ಸಮಿತಿ ಸದಸ್ಯರು
03	ಡಾ. ಶುಭಕರ ಕೆ.	ಸರ್ಕಾರಿ ಪದವಿ ಪೂರ್ವ ಕಾಲೇಜು, ರತ್ನಪುರಿ, ಹುಣಸೂರು ತಾ. ಮೈಸೂರು ಜಿಲ್ಲೆ	ಸಮಿತಿ ಸದಸ್ಯರು
04	ಡಾ. ಶ್ರೀನಿವಾಸ ವಿ.	ಬಾಲಕಿಯರ ಸರ್ಕಾರಿ ಪದವಿ ಪೂರ್ವ ಕಾಲೇಜು, ಚನ್ನಪಟ್ಟಣ, ರಾಮನಗರ ಜಿಲ್ಲೆ	ಸಮಿತಿ ಸದಸ್ಯರು
05	ತಿಪ್ಪೇಶ್ ಆರ್	ಸರ್ಕಾರಿ ಪದವಿ ಪೂರ್ವ ಕಾಲೇಜು, ಹೊಸದುರ್ಗ, ಚಿತ್ರದುರ್ಗ ಜಿಲ್ಲೆ	ಸಮಿತಿ ಸದಸ್ಯರು

UNIT 1 SOLUTIONS

Multiple Choice Questions (MCQs)

1. Which of the following is dependent on temperature?
   a) Molarity
   b) Mole fraction
   c) Weight percentage
   d) Molality

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

3. The dissolution of gas is in a liquid is governed
   a) Raoult's law
   b) Henry's law
   c) Dalton's law of pressure
   d) van't Hoff factor

4. The mole fraction of the solute in one molal aqueous solution is
   a) 0.009
   b) 0.018
   c) 0.027
   d) 0.036

5. Out of following which one is not an example of a solution.
   a) Air
   b) Brass
   c) amalgam
   d) benzene in water

6. If one mole of a substance is present in one kg of solvent, then
   a) It shows molar concentration
   b) It shows molal concentration
   c) It shows normality
   d) It shows strength g/g

7. **Statement I:** On adding NaCl to water its vapour pressure increases
   Statement II: Addition of non-volatile solute increases the vapour pressure.
   a) Both statement I and II are correct
   b) Both statement I and statement II are wrong
   c) Statement I is correct and statement II is incorrect
   d) Statement I is incorrect and statement II is correct

8. P_A and P_B are the vapour pressures of pure liquid components, A and B, respectively of an ideal binary solution. If X_A represents the mole fraction of component A, the total pressure of the solution will be
   a) $P_A + X_A(P_B - P_A)$
   b) $P_A + X_A(P_A - P_B)$
   c) $P_B + X_A(P_B - P_A)$
   d) $P_B + X_A(P_A - P_B)$

9. The vapour pressure of two liquids P and Q are 80 and 60 torr, respectively. The total vapour pressure of solution obtained by mixing 3 mole of P and 2 mol of Q would be
   a) 72 torr
   b) 140 torr
   c) 68 torr
   d) 20 torr

10. The mixture which shows positive deviation from Raoult's law is
    a) ethanol + acetone
    b) benzene + toluene
    c) acetone + chloroform
    d) chloroethane + bromoethane.

11. The mixture that forms maximum boiling azeotrope is
    a) heptane + octane
    b) water nitric acid
    c) ethanol + water
    d) acetone + carbon disulphide.
12. Which of the following statements is correct regarding a solution of two components A and B exhibiting positive deviation from ideal behaviour?
    a) Intermolecular attractive forces between A-A and B-B are stronger than those between A-B.
    b) $\Delta V_{mix}H = 0$ at constant T and P.
    c) $\Delta V_{mix}V = 0$ at constant T and P.
    d) Intermolecular attractive forces between A-A and B-B are equal to those between A-B.
13. Which of the following statements about the composition of the vapour over an ideal 1: 1 molar mixture of benzene and toluene is correct? Assume that the temperature is constant at 25°C. (Given, vapour pressure data at 25°C, benzene 12.8 kPa, toluene = 3.85 kP_a).
    a) The vapour will contain equal amounts of benzene and toluene.
    b) Not enough information is given to make a prediction.
    c) The vapour will contain a higher percentage of benzene.
    d) The vapour will contain a higher percentage of toluene.
14. A solution containing components A and B follows Raoult's law.
    a) A-B attraction force is greater than A - A and B-B
    b) A-B attraction force is less than A - A and B – B
    c) A-B attraction force remains same as A - A and B-B
    d) volume of solution is different from sum of volume of solute and solvent.
15. All form ideal solution except
    a) C_6H_6 and C_6H_5,CH_3
    b) C_2H_6 and C_2H_5I
    c) C_6H_5Cl and C_6H_5Br
    d) C_2H_5I and C_2H_5OH
16. An ideal solution is formed when its components
    a) have no volume change on mixing.
    b) have no enthalpy change on mixing.
    c) have both the above characteristics.
    d) have high solubility.
17. If molality of the dilute solution is doubled, the value of molal depression constant (K_f) will be
    a) halved
    b) tripled
    c) unchanged
    d) doubled.
18. During osmosis, flow of water through a semipermeable membrane is
    a) from solution having lower concentration only
    b) from solution having higher concentration only
    c) from both sides of semipermeable membrane with equal flow rates
    d) from both sides of semipermeable membrane with unequal flow rates.
19. Pure water can be obtained from sea water by
    a) centrifugation
    b) plasmolysis
    c) reverse osmosis
    d) sedimentation.

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

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

22. Blood cells retain their normal shape in solution which are
a) hypotonic to blood
b) isotonic to blood
c) hypertonic to blood
d) equinormal to blood.

23. Of the following 0.10 m aqueous solutions, which one will exhibit the largest freezing point depression?
a) KCl
b) $C_6H_{12}O_6$
c) $Al_2(SO_4)_3$
d) K_2SO_4

24. An aqueous solution is 1.00 molal in KI. Which change will cause the vapour pressure of the solution to increase?
a) Addition of NaCl
b) Addition of Na_2SO_4
c) Addition of 1.00 molal KI
d) Addition of water

25. Which of the following salts has the same value of Van't Hoff factor (i) as that of $K_3[Fe(CN)_6]$?
a) Na_2SO_4
b) $Al(NO_3)_3$
c) $Al_2(SO_4)_3$
d) NaCl

26 . At 25°C the highest osmotic pressure is exhibited by 0.1 M solution of
a) Glucose
b) urea
c) $CaCl_2$
d) KCl

27. Which of the following aqueous solution has minimum freezing point?
a) 0.01 NaCl
b) 0.005m C_2H_5OH
c) 0.005m MgI_2
d) 0.005m $MgSO_4$

28. For 0.1 M solution , the colligative property will follow the order
a) $NaCl > Na_2SO_4 > Na_3PO_4$
b) $NaCl < Na_2SO_4 < Na_3PO_4$
c) $NaCl > Na_2SO_4 \approx Na_3PO_4$
d) $NaCl < Na_2SO_4 = Na_3PO_4$

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

Statement II : The concentration of salt content in the cells increases.
a) Both statements I and II are correct
b) Both statements I and II are incorrect
c) Statement I is correct and statement II is incorrect
d) Statement I is incorrect and statement II is correct

30. During depression of freezing point in a solution the following are in equilibrium
a) Liquid solvent, solid solvent
b) Liquid solvent, solid solute
c) Liquid solute, solid solute
d) Liquid solute, solid solvent

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

Set-1

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

2 5 1 4 3

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

Set-2

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

2 1 3 5 4

1. Red blood cells are isotonic with_____ % NaCl solution
2. For non-electrolytes, the van't Hoff factor (i) is _____
3. Greater the value of Henry's constant of a gas_____ is its solubility at the same partial pressure and temperature.
4. An ionic compound dissolves in water if hydration energy is _____ than lattice energy.
5. A solution in which no more solute can be dissolved at the same temperature and pressure is called_____

Set-3

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

1 3 2 4 5

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

Set-4

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

5 2 3 1 4

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

Set-5

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

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

Set-6

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

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

Two marks questions:

1. What is saturated and unsaturated solution? What is the effect of temperature and pressure on the solubility?
2. Define the following terms i) Solution ii) Mole fraction iii) Molarity iv) Molality
3. Which of the two molarity or molality, does vary with temperature? and how?
4. State Henry's law. Write its mathematical statement. What is the significance of Henry's Constant?
5. Mention any two applications of Henry's law.
6. Why do gases always tend to be less soluble in liquids as the temperature increases ? Explain.
7. What is Vapour pressure of liquids? Name a law which helps us to determine partial vapor pressure of a volatile component in solution.
8. State Raoult's law as applied to a binary solution of Non-volatile solute in a volatile solvent.
9. What are ideal and non-ideal solutions?
10. Give an example of Ideal solution and non-ideal solutions.
11. What causes deviations from ideal behavior of solutions? Why do the vapour pressures of certain solutions show negative or positive deviations from the Raoult's law?
12. Derive the relation between molar mass of solute and relative lowering vapour pressure.
13. What is azeotropic mixture? Give example.
14. What are the different types of azeotropic mixtures? Explain with example.
15. What are colligative properties? Give examples.
16. Write the mathematical relation between molality and elevation in boiling point. What happens to boiling point of water when salt is dissolved in it? Which one will have greater boiling point: 0.1M NaCl, 0.1 M $BaCl_2$?
17. Write the mathematical relation between molality and depression in freezing point. Why is sodium chloride used to clear snow on roads?
18. Write a note on osmotic pressure.

19. Define osmosis and semi permeable membrane.
20. **Give reasons:**
    i) Cutting onions taken from the fridge is more comfortable than cutting onions lying at room temperature I would rather do that
    ii) When fruits and vegetables that have dried are placed in water they slowly swell and return to the original form

Three mark questions:

1. Define the following terms i) Mass percentage ii) volume percentage iii) Parts per million (ppm).
2. Give any three differences between ideal and non-ideal solutions.
3. Give any three differences between solutions showing positive and negative deviation from ideal behaviour.
4. Define the term molal elevation constant and Molal depression constant. Give their SI unit.
5. What is an isotonic, hypertonic and hypotonic solution?
6. What is abnormal molar mass? Define Van't- Hoff's factor. What would be the value of Van't Hoff factor for a dilute solution of K_2SO_4 in water if it undergoes complete dissociation.?
7. With the help of vapour pressure – temperature diagram, explain the depression of freezing point of a solution of a non-volatile solute in a volatile solvent. How would you determine the molar masses of solute using the above properties ?
8. What is reverse osmosis? Mention one of its practical uses and give an example for artificial semipermeable membrane.
9. Why do electrolytes show abnormal molecular masses? Name the factors responsible for abnormality.
10. Non-ideal solutions exhibit either positive or negative deviations from Raoult's law. What are these deviations and why they caused ? Explain with suitable example of each type.

Problems:

1. Calculate the molality and mole fraction of the solute containing 3g of urea (molar mass = 60 $gmol^{-1}$) per 250 g of water. [**Ans:** m = 0.2, X_2 = 0.0039]
2. If 22 g of benzene is dissolved in 122 g of carbon tetrachloride, determine the mass percentage of carbon tetrachloride (CCl_4) and benzene (C_6H_6). [**Ans:** mass% of benzene= 15.28, mass% of Chloroform = 84.72]
3. The mole fraction of He in a saturated solution at 20°C is 1.2 x10^{-6}. Find the pressure of helium above the solution. Given Henry's constant at 20°C = 144.97 Kbar.
4. The vapour pressure of a pure liquid A is 40 mm Hg at 310 K. The vapour pressure of this liquid in solution with liquid B is mm Hg. Calculate the mole fraction of A in the solution if the mixture obeys Raoult's law. [**Ans:** X_A = 0.8]
5. Calculate the mass of a non-volatile solute (molar mass 40 g mol^{-1}) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%. [**Ans:** w_2 = 8g]
6. The vapor pressure of 5% aqueous solution of a non-volatile organic substance at 373 Kelvin is 745 mm. Calculate the molar mass of the solute. [**Ans:** M_2 = 0.8 $gMol^{-1}$]
7. The vapor pressure of water is 92 mm at 323 K. 18.1g of urea are dissolved in 100 g of water the vapor pressure is reduced by 5 mm . Calculate the molar mass of urea.[**Ans:** 56.7 $gMol^{-1}$]
8. Calculate the boiling point of a solution containing 25 g of urea [NH_2CONH_2] and 25 g of thiourea [NH_2CSNH_2]in 500-gram chloroform [$CHCl_3$] the boiling point of pure chloroform is 61.2°C and K_b is equal to 3.63 Km^{-1}[**Ans:** 66.616°C]

9. Calculate the osmotic pressure in Pascals excreted by a solution prepared by dissolving 1.0g of polymer of molar mass 185,000 in 450 ml of water is 370 C. [**Ans:** 30.9 Pa]
10. Calculate the concentration of that solution of sugar which has osmotic pressure of 2.46 atmosphere at 300 K. [**Ans:** 34.42g/L].
11. Calculate the molar elevation constant of water, it being given that 0.1 molal aqueous solution of a substance boiled at 100.052°C. [**Ans:** $K_b = 0.52^0C$].
12. The boiling point of benzene is 353.23 K. When 1.80g of a non-volatile solute was dissolved in 90 gram of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is 2.53 KKg/mol. [**Ans:**58 $gMol^{-1}$]
13. A solution containing 34.2g of cane Sugar ($C_{12}H_{22}O_{11}$)dissolved in 500 $cm^3$of water froze at –0.374°C. Calculate the freezing point depression constant of water. [**Ans:** $K_f = 1.87Km^{-1}$]
14. The solution of urea in water has a boiling point of 100.128°C.Calculate the freezing point of the same solution. Molal constants for water K_f and K_b are 1.86°C and 0.512°C respectively. [$T_f = -0.465^0C$].
15. Two elements A and B form compounds having formulas AB_2 and AB_4. When dissolved in 20 g of benzene (C_6H_6), 1 g of AB_2 lowers the freezing point by 2.3 K, whereas 1.0 g of AB_4 lowers it by 1.3 K. The molar depression constant for benzene is 5.1 K kg mol^{-1}. Calculate the atomic masses of A and B. [**Ans:** Atomic masses of A and B are 25.59 u and 42.64]

UNIT 2 ELECTROCHEMISTRY

Multiple Choice Questions (MCQs)

1. Which of the following statements associated with electrochemical cells is incorrect?
   a) The function of a salt bridge in an electrochemical cell is to complete the circuit.
   b) Cell potential is the potential difference in a voltaic cell.
   c) A Bronsted-Lowry acid-base reaction can be the basis of the net reaction in a chemical cell.
   d) A half-reaction corresponds to one electrode in a voltaic cell.

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

3. A button cell used in watches function as following:
   $Zn_{(s)} + Ag_2O_{(s)} + H_2O \rightleftharpoons 2Ag_{(s)} + Zn^{2+} + 2OH^-_{(aq)}$ If half-cell potentials are
   $Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn_{(s)}$ E° = –0.76 V
   $Ag_2O_{(s)} + H_2O_{(l)} + 2e^- \rightarrow 2Ag_{(s)} + 2OH^-_{(aq)}$; E° = 0.34 V The cell potential will be
   a) 0.84 V
   c) 1.10 V
   b) 1.34 V
   d) 0.42 V

4. Standard reduction potentials of the half reactions given below:
   $F_{2(g)} + 2e^- \rightarrow 2F^-_{(aq)}$; E° = + 2.85 V
   $Cl_{2(g)} + 2e^- \rightarrow 2Cl^-_{(aq)}$; E° = + 1.36 V
   $Br_{2(g)} + 2e^- \rightarrow 2Br^-_{(aq)}$; E° = + 1.06 V
   $I_{2(g)} + 2e^- \rightarrow 2I^-_{(aq)}$; E° = + 0.53 V, the strongest oxidizing and reducing agents respectively are
   a) F_2 and I^-
   b) Br_2 and Cl^-
   c) Cl_2 and Br^-
   d) Cl_2 and I_2

5. Standard electrode potential for Sn^{4+}/Sn^{2+} is +0.15 V and that for the Cr/Cr is –0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be
   a) + 1.19 V
   b) + 0.18 V
   c) + 0.89 V
   d) +1.83 V

6. Consider the following relations for emf of an electrochemical cell.
   (i) EMF of cell = (Oxidation potential of anode) - (Reduction potential of cathode)
   (ii) EMF of cell = (Oxidation potential of anode) + (Reduction potential of cathode)
   (iii) EMF of cell = (Reductional potential of anode) + (Reduction potential of cathode)
   (iv) EMF of cell = (Oxidation potential of anode) - (Oxidation potential of cathode)
   Which of the above relations are correct?
   a) (iii) and (i)
   b) (i) and (ii)
   c) (iii) and (iv)
   d) (ii) and (iv)

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

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

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

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

c) $[Fe(CN)_6]^{4-}$ d) Fe^{2+}

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

i. the cathode carries a positive sign

ii. the anions migrate toward the cathode

iii. the electrons are released through the anode

iv. reduction occurs at the anode

a) i and iii b) i and ii

c) ii and iii d) ii and iv

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

a) Hydrogen iodide b) Sulphur dioxide

c) Chlorine d) Iodine

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

a) spontaneous b) non-spontaneous

c) exothermic d) endothermic

11. If the E°_{cell} for a given reaction has a negative value, which of the following gives the correct relationships for the values of $\Delta G°$ and K_{eq}?

a) $\Delta G° > 0$; $K_{eq} < 1$ b) $\Delta G° > 0$; $K_{eq} > 1$

c) $\Delta G° < 0$; $K_{eq} > 1$ d) $\Delta G° < 0$; $K_{eq} < 1$

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

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

c) Ohm's equation d) Faraday's equation.

13. What occurs when an atom is oxidized in a chemical reaction?

a) a loss of electrons and a decrease in oxidation number.

b) a loss of electrons and an increase in oxidation number.

c) a gain of electrons and a decrease in oxidation number.

d) a gain of electrons and an increase in oxidation number.

14. Standard cell potential is

a) measured at a temperature of 25°C.

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

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

d) All of the above.

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

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

b) Cathodic protection prevents corrosion by using a sacrificial anode

c) A corroding metal has both anodic and cathodic areas

d) Corrosion involves both oxidation and reduction

16. In the lead storage battery,

a) a reversible reaction can occur to recharge the battery

b) lead is oxidized to create a flow of electrons

c) lead forms the cathode when it is being reduced

d) all the above

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

a) is spontaneous b) has a positive $\Delta G°$

c) has a negative $\Delta G°$ d) has K = 1

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

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

b) maintains the electrical neutrality in each half cell

c) allows mixing of the two electrode solutions

d) is made of a medium through which ions can slowly pass

19. The advantages of fuel cells include :

a) they can be recharged by the addition of more material to be oxidized and/or reduced

b) they can be made to produce little or no harmful pollutants

c) they can be made to run very quietly

d) all of the above.

20. An aqueous solution of NaCl on electrolysis gives:

a) H_2 and Cl_2 b) H_2 and O_2

c) H_2, Cl_2 and NaCl d) H_2, Cl_2 and NaOH

21. Limiting molar conductivity NH_4OH is equal to

a) $\Lambda^0_m(NH_4Cl) + \Lambda^0_m(NaCl) - \Lambda^0_m(NaOH)$ b) $\Lambda^0_m(NaOH) + \Lambda^0_m(NaCl) - \Lambda^0_m(NH_4Cl)$

c) $\Lambda^0_m(NH_4OH) + \Lambda^0_m(NH_4Cl) - \Lambda^0_m(HCl)$ d) $\Lambda^0_m(NH_4Cl) + \Lambda^0_m(NaOH) - \Lambda^0_m(NaCl)$

22. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_2(SO_4)_3$? Given that $\lambda^0 Al^{3+}$ and $\lambda^0 SO_4^{2-}$ are the equivalent conductance at infinite dilution of the respective ions.

a) $2\lambda^0_{Al^{3+}} + 3\lambda^0_{SO4^{2-}}$ b) $\lambda^0_{Al^{3+}} + \lambda^0_{SO4^{2-}}$

c) $(\lambda^0_{Al^{3+}} + \lambda^0_{SO4^{2-}}) \times 6$ d) $1/3\,\lambda^0_{Al^{3+}} + 1/2\,\lambda^0_{SO4^{2-}}$

23. Kohlrausch's law states that at

a) infinite dilution, each ion makes definite contribution to conductance of an electrolyte whatever be the nature of the other ion of the electrolyte

b) infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

c) finite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

d) infinite dilution each ion makes definite contribution to equivalent conductance of an electrolyte depending on the nature of the other ion of the electrolyte.

24. On electrolysis of dil. sulphuric acid using platinum (Pt) electrode, the product obtained at anode will be.

a) hydrogen gas b) oxygen gas

c) H_2S gas d) SO_2 g

25. When 0.1 mol MnO_4^{-2} is oxidized, the quantity of electricity required to completely oxidize MnO_4^{-2} to MnO_4^{-1} is

a) 96500 C b) 2 × 96500 C

c) 9650 C d) 96.50 C

26. A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as

a) dynamo b) Ni-Cd cell

c) fuel cell d) electrolytic cell.

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

a) zinc is lighter than iron

b) zinc has lower melting point than iron

c) zinc has lower negative electrode potential than iron

d) zinc has higher negative electrode potential than iron.

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

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

c) connecting it with Mg block d) connecting it with Pb block.

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

a) copper plating b) zinc plating

c) nickel plating d) tin plating

30. In a dry cell,

a) the graphite rod is a negative terminal

b) the ammonia gas accumulates in the cell during its working

c) the zinc vessel is a negative terminal

d) the cellular reaction involves the complex formation of Zn with MnO_2

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

Set-1

4 1 5 2 3

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

1. In galvanic cell, the electrode which acts as anode is a _____ pole.
2. In lead storage battery, the cathode consists of_____
3. In Leclanche cell, MnO_2acts as a _____
4. Protection of iron by coating with zinc is called _____
5. The arrangements in which electrical energy supplied brings about a redox reaction is called_____

Set-2

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

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

Set-3

(Ohm^{-1} , non-electrolyte, electrochemical, weak electrolyte, automobiles, Cm^{-1})

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

Set-4

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

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

Set-5

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

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

Set-6

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

1. Conductivity always _____ with decrease in concentration.
2. Molar conductivity _____with decrease in concentration.

3. The SI unit of conductance is _____
4. The SI unit of conductivity is _____
5. The standard hydrogen electrode consists of a _____ electrode coated with platinum black.

Two marks questions:

1. What are electrochemical cells? Mention the types of electrochemical cells
2. Write a short note on Galvanic cells.
3. How do you represent a Daniel cell symbolically? Write the electrode reactions and the cell reaction?
4. What are the functions of salt bridge?
5. i) Define electrode potential?
   ii) Define standard hydrogen electrode potential? Mention the uses of standard hydrogen electrode?
6. i) Write the relation between E°_{cell} and equilibrium constant (K) of cell reaction.
   ii) Write down the Nernst equation for electrode potential.
7. What are the factors that electrode potential depends on?
8. Write the Nernst equation for the following cell $Zn/Zn^{2+}_{(aq)}//Cu^{2+}_{(aq)}/Cu$.
9. Name the factors on which emf of a cell depends.
10. What is conductivity? What are units of conductivity?
11. Write an expression for cell constant. What is SI unit of specific resistance?
12. Write the SI units for i) Specific conductance. (ii) Molar conductance.
13. Define molar conductivity ? How does it vary with increase in concentration of solution?
14. What is an electrolyte? Give an example for strong and weak electrolytes.
15. Define limiting molar conductivity and how it is related to molar conductivity of strong electrolyte?
16. Write Debye - Onsager equation and mention the various terms.
17. What is the effect of temperature on molar conductivity?
18. What is the effect of dilution on conductivity and molar conductivity?
19. How much electricity is required in coulomb for the oxidation of
    (i) 1mol of H_2O to O_2?
    (ii) 1 mol of FeO to Fe_2O_3?
20. Difference between electrochemical cell and electrolytic cell.
21. What are batteries? Mention the types of batteries with examples.
22. Write the overall reaction of Ni-Cd battery and mention the cathode and anode of Ni-Cd battery.
23. What is corrosion? Mention the Factors which affect corrosion.

Three Marks questions:

1. How much charge is required for the following reductions?
   (i) 1 mol of Al^{3+} to Al
   (ii) 1 mol of Cu^{2+} to Cu
   (iii) 1 mol of MnO_4^- to Mn^{2+}
2. Describe the construction and working of SHE or standard hydrogen electrode.
3. What is electrochemical series? What are the applications of electrochemical series?
4. Give reasons:

i) Zinc displaces copper from copper sulphate solution.

ii) Zinc displaces hydrogen from HCl, but copper does not.

iii) Iron displace copper from copper sulphate solution, but copper cannot displace iron from ferrous sulphate solution.

5. Write a neat diagram of H_2-O_2 Fuel cell and express its cathodic and anodic reactions.
6. Explain: corrosion is an electrochemical phenomenon.
7. Write a cathodic and anodic reaction of lead storage battery at both discharge and recharge process.
8. State Kohlrausch's law. What are its application?
9. Give the products obtained at each electrode respectively when molten NaCl, aqueous NaCl and acidulated H_2O undergoes electrolysis .
10. State Faraday's first and second law of electrolysis? Give its mathematical expression.
11. Write a note on dry cells and mercury cell?
12. Write the Nernst equation and emf of the following cells at 298 K.
    (i) $Mg(s)|Mg^{2+}(0.001M)||Cu^{2+}(0.0001M)|Cu(s)$
    (ii) $Fe(s)|Fe^{2+}(0.001M)||H^{+}(1M)|H_2(g)(1bar)|Pt(s)$
    (iii) $Sn(s)|Sn^{2+}(0.050M)||H^{+}(0.020M)|H_2(g)(1bar)|Pt(s)$

Problems

1. The resistance of a 0.01 N solution of an electrolyte is 100 ohms. Calculate its

   (a) conductance, (b) Conductivity and (c) resistivity. The cell constant of the cell is 1 cm. [**Ans:** a) 0.01 S b) 0.01 Scm^{-1} c) 100-ohm cm]
2. For the standard cell Cu (s) / $Cu^{2+}_{(aq)}$ || $Ag^{+}_{(aq)}$ / $Ag_{(s)}$ E^{0} Cu^{2+}/ Cu = +0.34 V E^{0} Ag^{+} / Ag = + 0.80 V
   i. identify the cathode and the anode as the current is drawn from the cell.
   ii. Write the reaction taking place at the electrodes.
   iii. Calculate the standard cell potential. [**Ans:** 0.46 V]
3. Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10.

   [**Ans:** –0.591 V]
4. Calculate the emf of the cell in which the following reaction takes place

   $Ni(s) + 2Ag^{+}$ (0.002M) $\rightarrow Ni^{2+}$ + (0.160M) + 2Ag(s) Given that E^{0} cell=1.05 V [**Ans:** 0.91V]
5. The cell in which of the following reaction occurs

   $2Fe^{3+}(aq)+2I^{-}$ (aq) $\rightarrow$ $2Fe^{2+}(aq)$ + $I_2(s)$ has E^{0} cell = 0.236V at 298K. Calculate the standard Gibbs energy change and the equilibrium constant of the cell reaction.[**Ans:** Gibbs energy: –45.55 KJ, equilibrium constant: 9.6×10^{7}]
6. The molar conductivity of 0.025 $molL^{-1}$ methanoic acid is 46.1 $Scm^{2}mol^{-1}$ Calculate its degree of dissociation and dissociation constant. Given λ^{0} (H^{+}) =349.6 $Scm^{2}mol^{-1}$ and λ^{0} $(HCOO^{-})$ = 54.6 $Scm^{2}mol^{-1}$. [**Ans:** $\alpha = 0.114$, $k = 3.67\times10^{-4}$]
7. If a current of 0.5 ampere flows through a metallic wire for 2hrs, then how many electrons flow through the wire? [**Ans:** no of electrons = 2.246×10^{22}].
8. The resistance of a conductivity cell containing 0.001M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001M KCl solution at 298 K is 0.146×10^{-3} S cm^{-1} [**Ans:** 0.219cm^{-1}]

9. How much electricity in terms of Faraday is required to produce
   (i) 20.0 g of Ca from molten $CaCl_2$? [**Ans:** 1F]
   (ii) 40.0 g of Al from molten Al_2O_3? [**Ans:** 4.44]
10. A solution of $Ni(NO_3)_2$ is electrolyzed between platinum electrodes using a current of 5 amperes for 20 minutes. What mass of Ni is deposited at the cathode? [**Ans:**1.825 g]
11. An electric current of 100 ampere is passed through a molten liquid of sodium chloride for 5 hours. Calculate the volume of chlorine gas liberated at the electrode at NTP. [**Ans:** 208.91L]
12. In an electrolysis experiment, a current was passed for 5 hours through two cells connected in series. The first cell contains a solution gold salt, and the second cell contains copper sulphate solution. 9.85 g of gold was deposited in the first cell. If the oxidation number of gold is +3, find the amount of copper deposited on the cathode in the second cell. [**Ans:** 4.76 g].
13. How long has a current of 3 amperes to be applied through a solution of silver nitrate to coat a metal surface of 80 cm^2 with 0.005 cm thick layer? Density of silver is 10.5 g/cm^3. [**Ans:**125.09 s]
14. A saturated solution of silver chloride at 20°C has a conductivity of 3.41×10^{-6} Scm^{-1}. The conductivity of water used was 1.60×10^{-6} Scm^{-1}. Determine the solubility of silver chloride moles per liter. [**Ans:** 1.31×10^{-5}mol/L]
15. Calculate the quantity of electricity that would be required to reduce 12.3g of nitrobenzene into Aniline if the current efficiency for the process is 50%. If the potential drop across the cell is 3 volts how much energy will be consumed? [Ans: Q = 5,79,000 C, Energy consumed = EMFX Qty of electricity = 347400J].
16. Two students use same stock solution of zinc sulphate and a solution of copper sulphate the EMF of one cell is 0.03 Volt higher than the other. The concentration of copper sulphate in the cell with higher EMF value is 0.5M. Find out the concentration of copper sulphate in the other cell (2.303 RT/F = 0.06) [**Ans:** 0.05M]
17. Show that 0.08 molar solution having conductivity equal to $2x10^{-2}$ $\Omega^{-1}cm^{-1}$has higher molar conductance than 0.10 molar solution having resistivity equal to 58 cm.
18. The molar conductivity of acetic acid solution at infinite dilution is 390.7 $\Omega^{-1}cm^{-2}mol^{-1}$Calculate the molar conductivity of 0.01 molar acetic acid solution given that the dissociation constant of acetic acid is 1.8×10^{-5}. [**Ans:** 16.57 $\Omega^{-1}cm^{-2}$]
19. How many grams of chlorine can be produced by the electrolysis of molten sodium chloride the current of 1 amp for 15 min? Also calculate the number of chlorine molecules liberated. [**Ans:** w = 0.331 g, $n_A= 2.80 \times 10^{21}$molecule]
20. The Λ^0_m values for NaCl and KCl are 126.5 and 149.9 $\Omega^{-1}cm^{-2}mol^{-1}$ respectively. The ionic conductance's of Na^+ at infinite dilution is 50.1 $\Omega^{-1}cm^{-2}mol^{-1}$. Calculate the ionic conductance at infinite dilution for k^+ ion. [**Ans:** 73.5 $\Omega^{-1}cm^{-2}mol^{-1}$]

UNIT 3 CHEMICAL KINETICS

Multiple Choice Questions (MCQs)

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

2. In the rate equation, when the conc. of reactants is unity then rate is equal to
   a) specific rate constant
   b) average rate constant
   c) instantaneous rate constant
   d) None of above

3. The rate of reaction between two specific time intervals is called
   a) instantaneous rate
   b) average rate
   c) specific rate
   d) ordinary rate

4. Which one of the following statements for the order of a reaction is incorrect ?
   a) Order can be determined only experimentally.
   b) Order is not influenced by stoichiometric coefficient of the reactants.
   c) Order of reaction is sum of power to the concentration terms of reactants to express the rate of reaction.
   d) Order of reaction is always whole number.

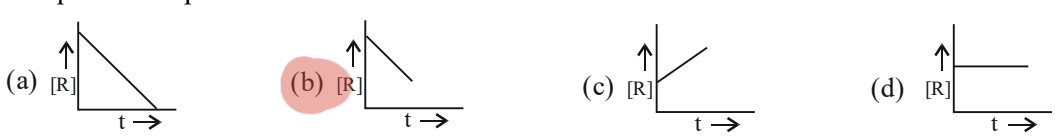
5. Units of rate constant of first and zero order reactions interms of molarity M unit are respectively
   a) sec^{-1}, M sec^{-1}
   b) sec^{-1}, M
   c) M sec^{-1}, sec^{-1}
   d) M, sec^{-1}.

6. In a 1st order reaction, reactant concentration C varies with time t as :
   a) $1/C$ increases linearly with t
   b) log C decreases linearly with t
   c) C decreases with $1/t$
   d) log C decreases with $1/t$

7. For a first order reaction, a plot of log (a – x) against time is a straight line with a slope equal to
   a) $\frac{-k}{2.303}$
   b) –2.303k
   c) $\frac{2.303}{k}$
   d) $-\frac{E_a}{2.303R}$

8. In a reaction, when the concentration of reactant is increased two times, the increase in rate of reaction was four times. Order of reaction is :
   a) zero
   b) 1
   c) 2
   d) 3

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



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

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

c) –1 d) $t_{1/2} \propto \alpha^2$

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

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

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

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

d) the unit of k is $mole^{-1}min^{-1}$

12. The slope for the plot of concentration of products Vs time will be equal to

a) Rate b) molecularity

c) order d) half life

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

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

c) atm s^{-1} d) atm L^{-1} s^{-1}

14. The representation of rate of reaction in terms of concentration of the reactants is known as

a) rate law b) law of kinetics

c) Arrhenius law d) Van't Hoff law

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

a) 1 b) 2

c) 4 d) 10

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

a) measures rate at given instant of time.

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

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

d) It involves differential rate equation.

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

a) –k b) log k

c) $[R_0]$ d) log $[R_0]$

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

a) –k b) log k

c) $[R_0]$ d) log $[R_0]$

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

a) –2. 303 k b) –k / 2.303

c) –2.303 / k d) k / 2.303

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

a) –2. 303 k b) –k / 2.303

c) $[R_0]$ d) log $[R_0]$

21. For a first order reaction, the plot of log {[R_0] / [R]} Vs time 't' will be
    a) straight line with negative slope and positive intercept
    b) straight line with positive slope and positive intercept
    c) straight line with positive slope and zero intercept
    d) straight line with zero slope and zero intercept
22. The thermal decomposition of HI in presence of gold is an example for a reaction of
    a) first order b) zero order
    c) half order d) second order
23. Decomposition of N_2O_5 and N_2O are some examples for reaction with
    a) first order kinetics b) zero order kinetics
    c) half order kinetics d) second order kinetics
24. Half life of zero order reaction is inversely proportional to
    a) initial concentration b) finial concentration
    c) rate constant c) rate of a reaction.
25. Select the incorrect statement with respect to pre exponential factor.
    a) It is also called frequency factor. b) It is constant for a particular reaction.
    c) Its value is specific for a particular reaction d) It is represented by E_a in Arrhenius equation.
26. Kinetic energy possessed by maximum fraction of molecules is called
    a) average kinetic energy b) most probable kinetic energy.
    c) maximum kinetic energy. d) root mean square kinetic energy.
27. The area under the Maxwell Boltzmann distribution curve is
    a) fraction of molecules reacting at time 't' and is constant.
    b) total energy of a reaction
    c) activation energy of a reaction.
    d) enthalpy of a reaction.
28. In the Arrhenius equation the factor $e^{-Ea/RT}$ corresponds to
    a) the fraction of molecules that have kinetic energy equal to or greater than E_a
    b) the fraction of molecules that have kinetic energy lesser than A
    c) the fraction of molecules that have kinetic energy equal to A
    d) the fraction of molecules that have kinetic energy greater than A
29. **Statement I:** Catalyst alters the Gibbs energy
    Statement II: Catalyst catalyses the forward as well as the backward reactions to the same extent
    Identify the correct statement
    a) Both Statement I and II are correct
    b) Both Statement I and II are incorrect
    c) Statement I is correct and Statement II is incorrect.
    d) Statement I is in correct and Statement II is correct.
30. When initial concentration of a reactant is doubled in a reaction, its half-life period is not affected. The order of the reaction is :
    a) First b) Second
    c) More than zero but less than first d) Zero

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

Set-1

(instantaneous, decreases, balanced equation, increases, rate expression, mol L^{-1})

1. Unit of rate is ____
2. The rate at a particular moment of time is _____rate.
3. With the passage of time rate of a reaction _____
4. The equation that relates rate of reaction and concentration of reactants is _____.
5. Rate law for any reaction cannot be predicted by _____

Set-2

(molecularity, order, zero, elementary, rate constant, complex)

1. Sum of powers of the concentration of the reactants in the rate law expression is called _____.
2. The order of reaction, if the rate of reaction is independent of the concentration of reactants is ____
3. The reactions taking place in one step are called _____reactions.
4. Oxidation of ethane to CO_2 and H_2O is an example of _____ reaction.
5. The S.I. units of _____for depends on order of reaction.

Set-3

(zero, three, order, slowest step, zero order, molecularity)

1. The number of species taking part in an elementary reaction, which collide to bring about a chemical reaction is called _____of a reaction.
2. Reactions with the molecularity _____are slow to proceed.
3. Molecularity of the _____ is same as the order of the overall reaction.
4. _____of a reaction is an experimental quantity.
5. Reactions which occur on metal surfaces are a few examples of _____reactions

Set-4

(pseudo first, sec^{-1}, half-life period, mol sec^{-1}, Joules mol^{-1}, first)

1. Hydrogenation of ethene is an example of _____order reaction.
2. For a first order reaction, _____is constant.
3. Inversion of cane sugar is a _____ order reaction.
4. S.I unit of rate constant of first order reaction is _____.
5. S.I unit of activation energy is _____.

Set-5

(increases, decreases, internal energy, Gibbs energy, activation energy, Pre-exponential factor)

1. _____ is constant specific to a particular reaction.
2. Rate of reaction _____ with raise in temperature.
3. As activation energy _____ rate of reaction increases.
4. Catalyst does not alter _____ .
5. Catalyst reduces _____

Set-6 :

(kinetic gas, steric, Arrhenius, collision frequency, effective collision, equilibrium constant)

1. Collision theory is based on _____ theory.
2. Catalyst does not change the _____ of a reaction.
3. The number of collisions per second per unit volume of the reaction mixture is known as _____.
4. The collisions in which molecules collide with sufficient kinetic energy and proper orientation is called _____.
5. _____ factor accounts for effective collision and proper orientation.

Two marks questions:

1. According to collision theory give any two criteria for effective collision.
2. Give any two drawbacks of collision theory.
3. Write Arrhenius equation. Explain the terms involved in it.
4. What is collision Frequency? Give equation that represent relation between collision frequency and steric factor.
5. Write any two properties of catalyst.
6. What is activation energy? How does its value effects rate of reaction?
7. What is catalyst? Whether catalyst catalyse non spontaneous reaction?
8. Graphically represent Arrhenius equation and how do you calculate activation energy from it?
9. Plot Maxwell Boltzmann distribution curve. Mark the position of E_a
10. What is most probable kinetic energy? How does it is affected by increase in temperature?
11. With the help of graph explain the effect of temperature on rate of reaction.
12. With the help of graph explain the effect of catalyst on rate of reaction.
13. What is first order reaction? Write the expression for the relation between partial pressure and rate constant of first order gas phase reaction.
14. Define a) Instantaneous rate b) half life period.
15. Define a) order b) Molecularity
16. State Rate Law. What is S.I unit of rate.
17. What are Elementary reaction and complex reaction?
18. For a first order reaction, plot a graph of log $\{[R_0] / [R]\}$ Vs time 't and write the value of slope for this graph.
19. What is Pseudo first order reaction? Give an example.
20. Give two example for first order reaction.

Three marks questions :

1. Derive integrated rate equation for zero order reaction.
2. Derive integrated rate equation for first order reaction.
3. Derive integrated rate equation for first order gas phase reaction $A(g) + B(g) \longrightarrow C(g)$
4. Show that half life of zero order reaction depends on initial concentration of reactant.
5. Show that half life of first order reaction is independent on initial concentration of reactant.

6. Show that in a first order reaction, time required for completion of 99.9% reaction is 10 times of half-life ($t_{1/2}$) of the reaction.
7. Differentiate between order and molecularity.
8. Write any three factors effecting rate of reaction.
9. Plot a graph of potential energy vs reaction coordinate. Indicate activation energy and enthalpy
10. Explain the effects of following on rate of reaction a) Temperature b) catalyst c) concentration.

Problems:

1. The decomposition of N_2O_5 in CCl_4 at 318K was studied. Initially the concentration of N_2O_5 is 2.33 mol L^{-1} and after 184 minutes, it was reduced to 2.08 mol L^{-1}. The reaction takes place according to the equation $2N_2O_5(g) \longrightarrow 4NO_2(g) + O_2(g)$, Calculate the average rate of this reaction in terms of seconds. What is the rate of production of NO_2 during this period?
2. For the reaction $R \longrightarrow P$, the concentration of a reactant changes from 0.03M to 0.02M in 25 minutes. Calculate the average rate of reaction using units of time both in seconds. What is the rate of production of P during this period?
3. In a reaction, $2A \longrightarrow R$, Products, the concentration of A decreases from 0.5 mol L^{-1} to 0.4 mol L^{-1} in 10 minutes. Calculate the rate during this interval?
4. The initial concentration of N_2O_5 in the following first order reaction $N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ was 1.24×10^{-2} mol L^{-1} at 318 K. The concentration of N_2O_5 after 60 minutes was 0.20×10^{-2} mol L^{-1}. Calculate the rate constant of the reaction at 318 K.
5. The following data were obtained during the first order thermal decomposition of $N_2O_{5(g)}$ at constant volume: $2N_2O_5(g) \longrightarrow 2N_2O_4(g) + O_2(g)$. Calculate the rate constant.

S.No.	Time/s	Total Pressure/(atm)
1	0	0.5
2	100	0.512

6. A first order reaction is found to have a rate constant, $k = 5.5 \times 10^{-14}$ s^{-1}. Find the half-life of the reaction.
7. A first order reaction has a rate constant 1.15×10^{-3} s^{-1}. How long will 5g of this reactant take to reduce to 3g?
8. Time required to decompose SO_2Cl_2 to half of its initial amount is 60 minutes. If the decomposition is a first order reaction, calculate the rate constant of the reaction.
9. The rate constants of a reaction at 500K and 700K are $0.02s^{-1}$ and $0.07s^{-1}$ respectively. Calculate the values of E_a and A.
10. The first order rate constant for the decomposition of ethyl iodide by the reaction $C_2H_5I(g) \longrightarrow C_2H_4(g) + HI(g)$ at 600K is 1.60×10^{-5} s^{-1}. Its energy of activation is 209 kJ/mol. Calculate the rate constant of the reaction at 700K.
11. The rate of the chemical reaction doubles for an increase of 10K in absolute temperature from 298K. Calculate E_a.

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

13. The rate constant for the first order decomposition of H_2O_2 is given by the following equation:
log k = 14.34 – 1.25 × $10^4 K/T$. Calculate E_a for this reaction and at what temperature will its half-period be 256 minutes?

14. Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law, with $t_{1/2}$ = 3.00 hours. What fraction of sample of sucrose remains after 8 hours?

15. The rate constant for the decomposition of N_2O_5 at various temperatures is given below:

$1/T^0C$	0	20	40	60	80
$10^5 \times k/s^{-1}$	0.0787	1.70	25.7	178	2140

Draw a graph between ln k and $1/T$ and calculate the values of A and E_a.

UNIT 4 d- and f- BLOCK ELEMENTS

Multiple Choice Questions (MCQs)

1. According to IUPAC transition metals are defined as
   a) Metals which have incomplete *d* subshell either in neutral atom or in their ions.
   b) Metals which have complete *d* subshell in neutral only atom.
   c) Metals with chemical properties were transitional between those of *s* and *p*-block elements.
   d) Metals with chemical properties were transitional between those of *p* and *f*- block elements

2. The d-block element not having general electronic configuration of (n-1)d^{1-10}ns^{1-2} is
   a) Pt
   b) Pd
   c) Zn
   d) Cr

3. The electronic configuration of Cr is $3d^5 4s^1$ instead of $3d^4 4s^2$ is due to
   a) The energy gap between the two sets (3*d* and 4*s*) of orbitals is big enough to prevent electron entering the 3*d* orbitals.
   b) The energy gap between the two sets (3*d* and 4*s*) of orbitals is small enough to prevent electron entering the 4sorbital.
   c) The energy gap between the two sets (3*d* and 4*s*) of orbitals is big enough to prevent electron entering the 4sorbital.
   d) The energy gap between the two sets (3*d* and 4*s*) of orbitals is small enough to prevent electron entering the 3*d* orbitals.

4. Among Cu, Hg, Cd and Cn which is/are not regarded as transition elements
   a) Cu only
   b) Hg and Cd only
   c) Hg, Cd and Cn only
   d) Hg, Cu and Cn only

5. The orbitals of the transition elements that protrude to the periphery of an atom more than the other orbitals is
   a) s- orbitals
   b) p- orbitals
   c) d- orbitals
   d) f-orbitals

6. The element having minimum volatility among the following is
   a) Cr
   b) W
   c) Os
   d) Zn

7. The correct statement among the following is
   a) Metals with very high enthalpy of atomisation tend to be noble in their reactions.
   b) Metals with very low enthalpy of atomisation tend to be noble in their reactions.
   c) Metals with very low enthalpy of ionisation tend to be noble in their reactions.
   d) Metals with very high enthalpy of atomisation tend to be highly reactive in their reactions.

8. **Statement 1:** Metals of the 4d and 5d series have greater enthalpies of atomisation than the corresponding elements of the 3d series
   Statement 2: More frequent metal – metal bonding are found in compounds of the heavy transition metals
   Identify the correct statement
   a) Statement I is correct and Statement II is incorrect
   b) Both Statement I and II are incorrect
   c) Both Statement I and II are correct
   d) Statement I is in correct and Statement II is correct

9. In transition elements, a regular decrease in atomic radii is a result of
   a) The filling of (n-1)*f* before n*d* orbital
   b) The filling of n*f* before (n-1)*d* orbital
   c) The filling of (n-1) *f* aftern *d* orbital
   d) The filling of n*f* after (n-1)*d* orbital
10. The element with least density is
   a) Cr
   b) Ni
   c) Zn
   d) Sc
11. Exchange energy is approximately proportional to the
   a) total number of possible pairs of parallel spins in the generate orbitals.
   b) total number of possible pairs of antiparallel spins in the degenerate orbitals.
   c) total number of possible pairs of parallel spins in the degenerate orbitals.
   d) total number of possible pairs of parallel spins in the generate orbitals
12. The element having stable minimum oxidation of state (+1) is
   a) Cr
   b) Cu
   c) Zn
   d) Sc
13. Which of the following transition metals cannot displace H_2 from acids?
   a) Sc
   b) Ti
   c) Zn
   d) Cu
14. The ability of fluorine to stabilise the highest oxidation state of transition elements is due to
   a) low lattice energy and high bond enthalpy.
   b) high lattice energy and high bond enthalpy
   c) high lattice energy and low bond enthalpy.
   d) low lattice energy and low bond enthalpy.
15. The stability of Cu^{2+} rather than Cu^{+} in aqueous solution is due to
   a) more positive $\Delta_{hyd} H^{o}$ of Cu^{1+} (aq) compensates 2nd ionisation enthalpy of Cu.
   b) more negative $\Delta_{hyd} H^{o}$ of Cu^{1+} (aq) compensates 2nd ionisation enthalpy of Cu
   c) more positive $\Delta_{hyd} H^{o}$ of Cu^{2+} (aq) compensates 2nd ionisation enthalpy of Cu.
   d) more negative $\Delta_{hyd} H^{o}$ of Cu^{2+} (aq) compensates 2nd ionisation enthalpy of Cu.
16. The correct increasing order of oxidising power is
   a) $VO_2^{+} < Cr_2O_7^{2-} < MnO_4^{-}$
   b) $VO_2^{+} > Cr_2O_7^{2-} > MnO_4^{-}$
   c) $Cr_2O_7^{2-} < VO_2^{+} < MnO_4^{-}$.
   d) $MnO_4^{-} < Cr_2O_7^{2-} < VO_2^{+}$
17. **Statement1:** Fe^{+3} ions show paramagnetic and magnetic moment of 5.92 BM
   Statement 2: Fe^{+3} ions have d^3 electronic configuration
   Identify the correct statement
   a) Statement I is incorrect and Statement II is correct
   b) Both Statement I and II are incorrect
   c) Both Statement I and II are correct
   d) Statement I is in correct and Statement II is incorrect
18. The element having maximum magnetic moment in its divalent ion form is/are
   a) Cr
   b) Mn
   c) Zn
   d) Fe

19. Transition metal **A** forms highest oxidation state only with oxygen, which is acidic and covalent and its divalent ion has a maximum magnetic moment. Its oxide oxidises iodide ion to Iodate ions in neutral medium, the metal is

a) Sc b) Mn

c) Ag d) Cr

20. The basic oxide among the following is

a) CrO_3 b) Cr_2O_3

c) CrO d) CrO_4

21. The composition of chromite ore is

a) $FeCr_2O_3$ b) $FeCrO_3$

c) $FeCrO_4$ d) $FeCr_2O_4$

22. Which of the following is not correctly matched?

	Compound of transition metal	**Use**
1)	TiO	Pigment industry
2)	MnO_2	Dry battery cell
3)	V_2O_5	Manufacture of H_2SO_4
4)	$PdCl_2$	Manufacture of polyethylene

23. The radius of La^{3+} (Z = 57) is 106 pm. Which one of the following given values will be closest to the radius of Lu^{3+} (Z = 71)?

a) 160 pm b) 140 pm

c) 106 pm d) 85 pm

24. Which of the following oxidation states is the most common among the lanthanoids?

a) 3 b) 4

c) 2 d) 5

25. What is the percentage of lanthanoid metal in mischmetall?

a) 90% b) 20%

c) 5% d) 95%

26. Although +3 is the characteristic oxidation state for lanthanoids but cerium also shows + 4 oxidation state because of

a) Cerium+ 4 has less stable half filled $4f^7$-orbital.

b) Cerium+ 4 has more stable half filled $4f^7$-orbital

c) Cerium + 4 has noble gas configuration $4f^0\ 5d^0\ 6s^0$.

d) Cerium + 4 has more stable completely filled $4f^{14}$-orbital.

27. In chemical behaviour, lower members of lanthanoids is similar to metal '**X**' and higher members resembles metal '**Y**'. Metal **X** and **Y** are

a) Ca and Al b) Al and Ca

c) Ca and Mg d) Mg and Al

28. Trivalent lanthanoid ions to be colourless is/are

a) Eu b) La

c) Er d) Ce

29. Lanthanoids on heating with carbon produces

a) mixtures of Ln_3C, Ln_2C_3 and LnC_2 b) mixtures of Ln_2C, LnC_3 and LnC

c) mixtures of LnC_4 and LnC d) only LnC

30. Actinoids to show maximum oxidation states is

a) Ac b) No

c) Np d) U

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

Set-1

(exchange energy, increase, chromium, oxidation number, scandium)

1. Ionization energies _____only slightly along the 3*d* series.
2. The loss of _____ increases the stability.
3. All the transition metals except _____form ionic metal oxides.
4. As the _____of a metal increases, ionic character decreases.
5. Element with more unpaired electron in 3d series is _____

Set-2

(chromate, $KClO_4$, $K_2Cr_2O_7$, Zr, Ln, melting point)

1. The high _____ of 6th group elements is due to more unpaired electrons.
2. The _____ ion is tetrahedral.
3. _____ is the primary standard in volumetric analysis.
4. Potassium permanganate crystals are isostructural with _____.
5. Hf and _____ have almost identical radii.

Set-3

(Carbon dioxide, sodium chromate, zinc, tin, Ln, +3)

1. Some_____ oxides are used as phosphors in television screens.
2. Actinoids generally show _____ oxidation state.
3. Acidified permanganate solution oxidises oxalates to _____.
4. Sodium chromate when acidified with sulphuric acid gives _____.
5. Brass is an alloy of copper and _____.

Set-4

(Cu, Zero, Interstitial, Cr^{2+}, catalytic, Mn^{+2})

1. Spin only magnetic moment of _____is 5.9 BM.
2. The element of 3d series to have positive standard electrode potential is _____.
3. The oxidation state of Fe in $Fe(CO)_5$ is _____.
4. The ion _____is strong reducing agents and will liberate hydrogen from a dilute acid.
5. _____ compounds are usually non stoichiometric.

Set-5

(zinc sulphate,Zn^{2+}, increases, Interstitial, unpaired electrons, decrease)

1. Lanthanoid contraction is a overall _____in atomic radii from La to Lu.

2. Manganous salt is oxidised to MnO_2in the presence of _____
3. _____ compounds chemically inert.
4. The magnetic moment _____ with the increasing number of unpaired electrons.
5. _____ forms colourless compounds.

Set-6

(Ag, high, Ti, low, +3, Hf)

1. Zr and _____ have similar atomic radii.
2. _____ salts show light sensitive properties.
3. Mn has _____ 3rd ionisation properties.
4. Oxide of _____ used in pigment industry
5. The common oxidation states of lanthanoids is _____

Two marks questions:

1. What is the common oxidation state shown by Lanthanoids? Mention any one consequence of Lanthanoid contraction.
2. Name the 3d series elements having
   a) maximum melting point
   b) Minimum melting point
3. Give any two examples for amphoteric oxides of 3d series.
4. Give any two examples for acidic oxides of 3d series.
5. Tungsten metal is used as a filament in bulb but zinc metal cannot be used in bulb. Why?
6. Why Manganese exhibit maximum oxidation of +7 only with oxide?
7. Give reasons:
   i) Cu^{+2} (aq) is more stable than Cu^{+}
   ii) Ionisation enthalpy increases along transition elements from left to right.
8. Why do the transition elements exhibit higher enthalpies of atomisation?
9. Why is Cr^{2+} reducing and Mn^{3+} oxidising when both have d^4 configuration?
10. The $E^{o}(M^{2+}/M)$ value for copper is positive (+0.34V). Give reason for this?
11. Why is the E^{o} value for the Mn^{3+}/Mn^{2+} couple much more positive than that for Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+}? Explain.
12. Which is a stronger reducing agent Cr^{2+} or Fe^{2+} and why?
13. Calculate the magnetic moment of Ti^{3+}?
14. Transition elements forms colour compounds, Give two reason?
15. The transition metals and their compounds are known for their catalytic activity. Give two reason.
16. What is lanthanoid contraction? How Lanthanoid contraction influence on covalent nature of d block elements.
17. Write any two difference between Lanthanoids and actinoids?
18. Draw the structure of dichromite ion ? what is the value of bond angle of Cr-O-Cr in it.
19. What are the compositions of alloy a) Brass b) Bronze
20. What is the composition of Mischmetall? Write one use of it.

Three marks questions:

1. Write the balanced chemical equations for the reactions involved in preparation of potassium permanganate from MnO_2. Write the structure of manganate ion
2. Write the balanced chemical equations for the reactions involved in preparation of potassium dichromite from chromite ore.
3. Write the balanced chemical reaction for the following
   a) Reaction between potassium dichromate and iodide ion in acidic medium.
   b) Reaction between potassium dichromate and sulphide ion in acidic medium.
   c) Reaction between potassium dichromate and stannous ion in acidic medium.
4. Write the balanced chemical reaction for the following
   a) Reaction between potassium permanganate and iodide ion in acidic medium.
   b) Reaction between potassium permanganate and iodide ion in neutral medium.
   c) Reaction between potassium permanganate and oxolate ion in acidic medium.
5. What are interstitial compounds? Write any two properties of it.
6. Write the composition for the following
   a) UK copper
   b) Silver Uk coins
   c) Ziegler catalyst.
7. Name the catalyst used in the following .
   a) Haber process
   b) Wacker process
   c) Hydrogenation of fats.
8. Write the products formed when lanthanoids reacts with
   a) Carbon
   b) Nitrogen
   c) acids
9. Give reasons for the following
   a) Actinoids show higher oxidation states.
   b) Actinoids contraction is greater from element to element than lanthanoid contraction.
   c) Chemical properties of actinoids is less known.
10. The transition metals form a large number of complex compounds. Give three reasons.

UNIT 5 COORDINATION COMPOUNDS

Multiple Choice Questions (MCQs):

1. A purple compound 'M' has a formula $Co(NH_3)_6Cl_3$, on adding excess $AgNO_3$ to one mole of 'M' produces 2 moles of AgCl. If secondary valence of Co is 6 then correct formula of the complex will be?

   a) $[CoCl_3(NH_3)_6]$ b) $[Co(NH_3)_6]Cl_3$

   c) $[Co(NH_3)_5Cl]Cl_2.NH_3$ d) $[Co(NH_3)_6Cl]Cl_2$

2. Which among the following is not a double salt

   a) Mohr's Salt b) Potash Alum

   c) Carnallite d) Potassium ferrocyanide.

3. The correct order of the stoichiometries of AgCl formed when $AgNO_3$in excess is treated with the complexes: $CoCl_3.6NH_3$, $CoCl_3.5NH_3$, $CoCl_3.4NH_3$respectively is (coordination valency is 6):

   a) 3 AgCl, 1 AgCl, 2 AgCl b) 3 AgCl, 2 AgCl, 1 AgCl

   c) 2 AgCl, 3 AgCl, 1 AgCl d) 1 AgCl, 3 AgCl, 2 AgCl

4. Which among the following has highest molar conductivity

   a) $K_4[Fe(CN)_6]$ b) $[Co(NH_3)_6]Cl_3$

   c) $[Cu(NH_3)_4]SO_4$ d) $[Ni(CO)_4]$

5. The primary and secondary valencies of $[Fe(C_2O_4)_3]^{3-}$ complexes are

   a) 3 and 3 b) 3 and 6

   c) 6 and 3 d) 0 and 3

6. Coordination number of the central atom/ion is determined by

   a) only by the number of pi bonds formed by the ligand with the central atom/ion.

   b) both by the number of sigma and pi bonds formed by the ligand with the central atom/ion.

   c) only by the number of sigma bonds formed by the ligand with the central atom/ion.

   d) by the total number of electrons present in ligand.

7. The correct IUPAC name of $K_3[Cr(C_2O_4)_3]$ is

   a) Potassiumtrioxalatochromium(III) b) Potassiumtrioxalatochromate(III)

   c) Potassiumtrisoxalatochromate(III) d) Potassium oxalatochromate(III)

8. $[Pt(NH_3)_4Cl_2]$ Br_2complex can show :

   a) Hydrated as well as ionization isomerism b) Ionization as well as geometrical isomerism

   c) Linkage as well as geometrical isomerism d) Ionization as well as optical isomerism

9. Possible isomerism in complexes$[Co(NH_3)_3(NO_2)_3]$ and $[Co(NH_3)_5(NO_2)]Cl_2$,respectively are:

   a) Linkage and optical b) Geometrical and linkage

   c) Optical and ionization d) Linkage and geometrical

10. In the reactions$[CoCl_2\ (NH_3)_4\ ]^+ + Cl^- \rightarrow [CoCl_3(NH_3)_3]$ +NH3 two isomers of the product are obtained. The initial complex is

    a) *cis* isomer b) *trans* isomer

    c) *cis* or *trans* isomers d) None of these

11. Which type of complexes shows geometrical isomerism

a) $[MX_4]$ Tetrahedral. b) $[MX_4]$ Square planar

c) $[MX_2L_2]$ Square planar d) $[MX_2L_2]$ Tetrahedral

12. Which type of complexes doesn't shows geometrical isomerism

a) $[MX_2L_2]$ Tetrahedral. b) [MABXL] Square planar

c) $[MX_2L_2]$ Square planar d) $[MX_4L_2]$ Octahedral

13. The optical active complex is

a) trans -$[PtCl_2(en)_2]^{2+}$ b) Cis -$[PtCl_2(en)_2]^{2+}$

c) trans- $[CrCl_2(ox)_2]^{3-}$ d) both a) and c)

14. Linkage isomerism arises in a coordination compound containing

a) ambidentate ligand b) neutral ligand

c) bidentate ligand d) Chelate ligand

15. The type of isomerism arises from the interchange of ligands between cationic and anionic entities of different metal ions present in a complex is

a) Linkage isomerism b) ionisation isomerism

c) Solvate isomerism d) co-ordination isomerism

16. The inner orbital complex is

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

c) $[Co(H_2O)_6]^{3+}$ d) $[CoCl_6]^{3+}$

17. The high spin complex is

a) $[Co(NH_3)_6]^{3+}$ b) $[Co(CN)_6]^{3+}$

c) $[Co(en)_3]^{3+}$ d) $[CoF_6]^{3+}$

18. The tetrahedral complex is

a) $[Ni(CN)_4]^{2-}$ b) $[Ni(NH_3)_4]^{2+}$

c) $[NiCl_4]^{2-}$ d) $[Ni(en)_2]^{2+}$

19. Square complex is

a) $[Ni(CN)_4]^{2-}$ b) $[NiF_4]^{2-}$

c) $[NiCl_4]^{2-}$ d) $[Ni(CO)_4]^{2+}$

20. Complex with maximum magnetic moment is

a) $K_4[Fe(CN)_6]$ b) $K_3[Fe(CN)_6]$

c) $[CoF_6]^{3-}$ d) $[Co(NH_3)_6]^{3+}$

21. The incorrect statement about Valence Bond theory

i. It involves a number of assumptions.

ii. It gives quantitative interpretation of magnetic data.

iii. It does not explain the colour exhibited by coordination compounds.

iv. It gives a quantitative interpretation of the thermodynamic or kinetic stabilities of coordination compounds.

a) i only b) i and iv

c) ii and iv d) iii and iv

22. **Statement 1:** The crystal field theory (CFT) is an electrostatic model which considers the metal-ligand bond to be ionic.

Statement 2: The crystal field theory (CFT) considers ligands as point dipoles in case of neutral molecules

Identify the correct statement

a) Both Statement I and II are correct

b) Both Statement I and II are incorrect

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

d) Statement I is in correct and Statement II is correct.

23. The degeneracy of d orbitals of isolated gaseous metal is maintained when

a) Negative charges of dipole molecules surround the central metal.

b) Spherically symmetrical field of negative charges surrounds the metal.

c) Spherically unsymmetrical field of negative charges surrounds the metal.

d) Non spherical unsymmetrical field of negative charges surrounds the metal.

24. In a complex with secondary valence six, the set of d-orbitals which experience more repulsion with electrons of ligands are

a) $d_{x^2-y^2}$ & d_{z^2} b) d_{xy} d_{yz} & d_{zx}

c) d_{xy} d_{yz} & $d_{x^2-y^2}$ d) $d_{yz}d_{zx}$ & d_{z^2}

25. According to spectral chemical series, the strongest field ligand is

a) CO b) NH_3

c) H_2O d) F^-

26. The correct electronic configuration of d^4coordination entities in a weak field ligand is

a) $t^3_{2g}\, e^1_g$ b) a) $t^4_{2g}\, e^0_g$

c) a) $t^2_{2g}\, e^2_g$ d) a) $e^3_{2g} t^1_g$

27. The relation between crystal field splitting energy of octahedral and tetrahedral complexes.

a) $\Delta_t = (4/9)\,\Delta_o$ b) $\Delta_o = (4/9)\,\Delta_t$

c) $4\Delta_t = 9\Delta_o$ d) $\Delta_t = (9/4)\Delta_o$

28. The shape of pentacarbonyl iron(0) is

a) square pyramidal b) tetrahedral

c) trigonal bipyramidal d) Octahedral

29. The number of bridged CO groups in Octacarbonyldicobalt (0) is

a) 2 b) 3

c) 4 d) 0

30. In black and white photography, the developed film is fixed by washing with hypo solution which dissolves the undecomposed AgBr to form a complex ion, the formed complex ion is:

a) $[Ag(S_2O_3)_2]^{3-}$ b) $[Ag(SO_4)_2]^{3-}$

c) $[Ag(S_2O_8)_2]^{3-}$ d) $[Ag(S_2O_4)_2]^{3-}$

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

Set-1

(Primary, potash alum, Lewis acids, *Ferricyanide, polyhedra,* secondary)

1. The number of groups bound directly to the metal ion is _____valence
2. The _____ valences are normally ionisable.
3. The spatial arrangements are called coordination_____.
4. _____dissociate into simple ions completely when dissolved in water.
5. In a coordination entitycentral atoms/ions are referred as _____

Set-2

(ambidentate, Octahedral, sigma bonds, Homoleptic, Square planar, chelate)

1. When a ligand uses its two or more donor atoms simultaneously to bind a single metal ion, then it is a _____ ligand
2. Ligand which has two different donor atoms and either of the two ligetes in the complex is called_____ ligand.
3. Coordination number of the central atom is determined by the number of _____ formed by the ligand with the central atom
4. _____ complexes do not show geometric isomerism.
5. Fac-Mer isomerism is shown by _____complexes of the form MX_3L_3

Set-3

(EDTA, ambidentate, trigonal bipyramidal, Werner, VBT, cis)

1. Example for polydentate ligand is _____
2. In a coordination entity $[PtCl_2(en)_2]^{2+}$ _____isomer shows optical activity.
3. Linkage isomerism arises in a coordination compound containing _____ligand.
4. _____ theory fails to explain the bonds in coordination compounds have directional properties.
5. Sp^3d hybrid orbitals have _____ shape.

Set-4

(high spin, diamagnetic, zero, Sp^3, dsp^2, $[Co(CN)_6]^{3-}$)

1. $[Co(NH_3)_6]^{3+}$forms _____ octahedral complex
2. $[NiCl_4]^{2+}$ is a _____ complex.
3. _____ is an inner orbital complex
4. The oxidation state of Ni in $[Ni(CO)_4]$ complex is _____
5. The hybridisation of $[Ni(CN)_4]^{2-}$ is _____

Set -5

(Weak, tetrahedral, paramagnetic, five, four, Ethylenediaminetetra acetate]

1. _____ion can bind through two nitrogen and four oxygen atoms to a central metal ion.
2. $[Ni(CO)_4]$ complex _____ and diamagnetic.
3. $[FeF_6]^{3-}$ has a paramagnetic moment of ____unpaired electrons.
4. $[MnCl_6]^{3-}$ is outer orbital _____ complex.
5. According to spectrochemical series Iodide ion is _____ ligand

Set -6

(tetrahedral, crystal field, colourless, valence bond, violet, $t^3_{2g}\ e^1_g$)

1. In high spin complexes d^4 has _____configuration
2. In crystal field splitting the subscript 'g' is not used for _____ complex.
3. If a complex having d^1 electron absorbs light with energy in blue-green region than complex appears to be _____ .
4. The _____theory attributes the colour of the coordination compounds to *d-d* transition of the electron.
5. Removal of water from $[Ti(H_2O)_6]Cl_3$ on heating gives _____compound.

Two marks questions:

1. Write any two differences between double salt and coordination complex.
2. What is meant by double salt? Give one example.
3. What is chelate ligand? Give one example.
4. Name the Metal present in a) haemoglobin b) vitamin B_{12}.
5. Write any two differences of primary and secondary valencies.
6. In a given complex $[MnCl_6]^{3-}$ indicate primary and secondary valencies.
7. If secondary valence of Co^{3+} is 6 then number of moles of AgCl formed when excess $AgNO_3$ is added to a) $CoCl_3.6NH_3$ b) $CoCl_3.5NH_3$is.
8. Indicate the type of valences having following properties
   a) Ionisable and satisfied by negative ions:
   b) Valences having characteristic spatial arrangements:
9. What is a) co-ordination polyhedra and b) counter ions.
10. What are primary and secondary valences if a complex with formula $PdCl_2.4NH_3$ precipitates 2 moles of AgCl per mole of compound with excess $AgNO_3$?
11. What are heteroleptic complex? Give an example.
12. Write the correct IUPAC name of the following compounds
    a) $[Cr(NH_3)_3(H_2O)_3]Cl_3$
    b) $[Co(SCN)_4]^-$
13. Draw structure of geometrical isomers of $[Co(NH_3)_4Cl_2]^+$
14. Write structures of geometrical isomers of $[Co(NH_3)_3(NO_2)_3]$
15. Among tetrahedral and square planar complex, which will not show geometrical isomerism? Why?
16. Draw structures of optical isomers of $[Co(en)_3]^{3+}$.
17. Draw structures of optical isomers of $[PtCl_2(en)_2]^{2+}$
18. Indicate the types of isomerism exhibited by the following complexes
    (i) $K[Cr(H_2O)_2(C_2O_4)_2]$
    (ii) $[Co(en)_3]Cl_3$
19. Write any two merits of crystal field theory.
20. What is crystal field splitting? Why subscript 'g' is not used for tetrahedral complexes.

Three marks questions:

1. Using Crystal field theory, explain the colour of $[Ti(H_2O)_6]^{3+}$complex.
2. Illustrate the influence of ligand on colour in $[Ni(H_2O)_6]^{2+}$ complex.
3. Write any 3 limitations of valence bond theory.
4. How many square pyramidal units are present in Decacarbonyldimanganese (0)? Write the formula and structure of Decacarbonyldimanganese (0).
5. Write the formula and structure of Octacarbonyldicobalt (0). How many bridged carbonyl ligands are present in it?
6. With the help of structure explain synergic effect in metal carbonyls? How it effects on M-CO bond strength in such compounds?
7. Write the structure of $(EDTA)^{2-}$ ion. Explain how Na_2EDTA is used to estimate hardness of water by simple titration method?
8. Using VBT explain hybridisation, magnetic property and shape of $[Ni(CN)_4]^{2-}$ complex.
9. Draw energy level diagram of crystal field splitting in octahedral complex. What is spectrochemical series?
10. a) Based on crystal field theory, write the configuration for metal with d^5 electron system, when
    i) $\Delta_o < P$ ii) $\Delta_o > P$.
    b) What is pairing energy?

UNIT 6 HALOALKANES AND HALOARENES

Multiple Choice Questions (MCQs):

1. Chlorine containing antibiotic, produced by microorganisms which is very effective for the treatment of typhoid fever is
   a) chloramphenicol b) thyroxine
   c) chloroquine d) halothane.
2. The halogen containing compound used as anaesthetic during surgery.
   a) chloramphenicol b) thyroxine
   c) chloroquine d) halothane.
3. 1,1 Dichloroethane is also called
   a) Ethylidene chloride b) ethane chloride
   c) ethylene dichloride d) pyrene.
4. The total number of structural isomers possible for compound having molecular formula $C_5H_{11}Br$ is
   a) 4 b) 5
   c) 8 d) 6
5. Which among the following has chiral carbon?
   a) 2-chloro propane b) 3-chloro-pentane
   c) 2-chloro butane d) 2-chloro-2-methyl-propane.
6. The alkyl compound having largest C-X bond length
   a) $CH_3 – Cl$ b) $CH_3 – Br$
   c) $CH_3 – I$ d) $CH_3 – F$
7. The alkyl compound having largest C-X bond enthalpy
   a) $CH_3 – Cl$ b) $CH_3 – Br$
   c) $CH_3 – I$ d) $CH_3 – F$
8. The alkyl compound having least dipole moment
   a) $CH_3 – Cl$ b) $CH_3 – Br$
   c) $CH_3 – I$ d) $CH_3 – F$
9. The best reagent used to produce pure alkyl halides from alcohols is
   a) Concentrated HCl b) Concentrated HBr
   c) $SOCl_2$ d) NaBr
10. Aryl halide cannot be prepared from phenol because
    a) phenol is more reactive than aryl halide.
    b) Aryl halide is more reactive than phenol.
    c) Carbon-oxygen bond in phenols has a partial doublebond character.
    d) Carbon-oxygen bond in phenols has a less bond energy.

11. The reaction that produces single haloalkane in low yield.
    a) Reaction between alcohol and Concentrated HCl in presence of $ZnCl_2$
    b) Reaction between alcohol and $SOCl_2$ in presence of pyridine.
    c) Reaction between alkene and HBr in presence of H_2O_2
    d) Free radical chlorination of alkanes.
12. Vicinal dihalides are obtained from reaction of
    a) Alkene and HBr
    b) Alkene and Br_2
    c) Alkanes and Br_2
    d) Alkanes and HCl
13. An example of vinyl halide is
    a) 1-chloro-cyclohex-1-ene
    b) 1-chloro-cyclohex-2-ene
    c) 1-chloro-cyclohexane
    d) 2-chlorocyclohexane
14. sym-Tribromobenzene is
    a) 1,2,3-Tribromobenzene
    b) 1,1,1-Tribromobenzene
    c) 2,4,6-Tribromobenzene
    d) 1,3,5-Tribromobenzene.
15. An example of allyl halide is
    a) Chloro ethene
    b) 2-chloropropene
    c) 3-chloropropene
    d) Isopropyl chloride
16. Dry acetone is used in Finkelstein reaction because.
    a) It is volatile solvent.
    b) It contains ketone group
    c) NaCl and NaBr formed is precipitated and favours forward reaction.
    d) R-I formed is precipitated and favours forward reaction.
17. Metallic fluoride not used in Swartz reaction is.
    a) AgF
    b) NaF
    c) SbF_3
    d) Hg_2F_2
18. **Statement I**: Iodination of benzene are reversible.
    Statement II: Iodination of benzene requires the presence of an oxidising agent to oxidise HI formed.
    Identify the correct statement
    a) Both Statement I and II are correct
    b) Both Statement I and II are incorrect
    c) Statement I is correct and Statement II is incorrect.
    d) Statement I is in correct and Statement II is correct.
19. Select the incorrect match
    i) Swartz reaction ----- CoF_2
    ii) Finkelstein reaction---NaI
    iii) Sandmeyer's reaction---$CuCl_2$
    iv) Wurtz reaction ----Na/dryether
    a) i only
    b) i and iii
    c) iii only
    iv) i and ii

20. A compound **X**with molecular formula C_2H_4 reacts with HBr to give compound **Y**, Which on further reacts with NaI in dry acetone to give compound **Z**. Identify compound **Z**

a) C_2H_5I b) C_2H_5F

c) C_2H_5Br d) C_2H_4IBr

21. The haloarene cannot be prepared from Sandmeyer's reaction is

a) C_6H_5-Cl b) C_6H_5-Br

c) C_6H_5-F d) both a and b

22. Gaseous halo compound at room temperature.

a) pyrene b) ethyl chloride

c) Chlorobenzene d) chloroform

23. The boiling points of alkyl halides decrease in the order:

a) RI>RBr>RCl> RF b) RI<RBr<RCl< RF

c) RBr>RCl> RI> RF d) RBr<RCl< RI < RF

24. para-isomers of dihalobenzenes have high melting compared to their ortho and meta-isomers. It is due to

a) Less dipole moment of para isomer.

b) Repulsion is less in para isomer.

c) symmetry of *para*-isomers that fits incrystal lattice better.

d) unsymmetry of *para*-isomers that fits incrystal lattice better.

25. The number of atoms bonded to carbon of transition state in S_N2 mechanism is/are

a) 4 b) 5

c) 3 d) 2

26. The haloalkane which reacts fast with SN^2 mechanism

a) Methyl chloride b) Methyl iodide

c) isopropyl chloride d) tertiary butyl bromide.

27. The haloalkane which reacts fast with SN^1 mechanism

a) Methyl chloride b) Methyl iodide

c) isopropyl chloride d) tertiary butyl bromide.

28. Select the incorrect statement among the following

a) Enantiomers possess identical physical properties.

b) Enantiomers only differ with respect to the rotation of plane polarised light.

c) Enantiomers are stereoisomers relating each other with non-superimposable mirror images.

d) Enantiomers are optically inactive.

29. The alkyl halide to produce racemic mixture in S_N1 reaction.

a) Isopropyl chloride b) tertiary butyl bromide

c) 2- chloro butane d) methyl iodide

30. The major product formed when 2-bromo pentane reacts with alcoholic KOH

a) Pent-1-ene b) Pent-2-ene

c) Pent-2-ol d) Pent-1-ol

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

Set-1

(hydrocarbon, carbocation, ionic, Grignard reagent, alkyl cyanides, covalent)

1. Alkyl halide reacts with magnesium in dry ether produces ____
2. Grignard reagent on hydrolysis with water yields _____.
3. S_N1 reaction involves _____intermediate
4. The carbon magnesium bond in Grignard reagent is _____ and polar
5. Haloalkanes react with KCN to form _____ as major product.

Set-2

(Increases, S_N1,density, Cu_2Cl_2, alkyl isocyanides, S_N2)

1. Haloalkanes react with AgCN to form _____ as cheif product
2. With the increase in size and mass of halogen atom boiling point_____
3. The_____ increases with increase in number of carbon atoms.
4. The catalyst used in Sandmeyer's reaction is _____.
5. The reaction involving in two step mechanism is _____.

Set-3

(Swartz, Dehydrohalogenation, Sandmeyer's, Finkelstein, Wurtz, Fitting)

1. _____ reaction produces hydrocarbon with double the carbon in haloalkanes.
2. The reaction that converts bromo ethane to fluro ethane is _____ reaction
3. Chlorobenzene is prepared from Benzenediazonium chloride in _____ reaction
4. In _____ reaction bromo ethane yields ethene
5. Alkyl iodides are prepared by the reaction of alkyl bromides with NaI in dry acetone. This reaction is known as _____reaction.

Set-4

(S_N^2, inversion, achiral, Zaitsev, retention, S_N1)

1. _____reactions are generally carried out in polar protic solvents.
2. _____ reaction follows single step reaction mechanism.
3. S_N2 reactions forms products with _____ in configuration.
4. Propan-2-ol is an _____molecule.
5. Dehydrohalogenation of halo alkanes follows_____ rule.

Set-5

(less, Grignard reagent, electron withdrawing,more, toluene, biphenyl)

1. Bromo benzene on reaction with Na in dry ether forms _____.
2. Methyl chloride and chlorobenzene on heating with sodium produces _____.
3. Haloarenes are _____ reactive for nucleophilic reactions.
4. An example for organometallic compounds is _____.
5. The presence of _____groups increase nucleophilic reaction of halo arenes.

Set -6

(Methylene chloride, iodoform, tetrachloromethane, freons,Chloroform, phosgene)

1. Chloroform on oxidation with air in presence of light forms _____ .
2. _____harms the human central nervous system.
3. _____was widely used as a cleaning fluid.
4. Freon refrigerant R-22 is produced from_____.
5. Earlier_____was used as antiseptic.

Two marks questions:

1. Give two differences between $S_N2$and S_N1.
2. Why free radical halogenation of alkanes method is not advised for preparation of haloalkanes?
3. Halo arenes cannot be prepared from phenols Why?
4. Classify following into geminal and vicinal dihalides
   a) Ethylene dichloride
   b) methylene chloride.
5. Classify following into allyl and vinyl halides
   a) 3-chloropropene
   b) 1-chloro ethene.
6. Explain Swartz reaction with an example.
7. Write the chemical reactions for the following synthesis
   a) Isopropyl chloride from propene
   b) 1-chloro propane from propene.
8. Write the product obtained when ethyl bromide reacts with i) alcholic KCN ii) $AgNO_2$
9. What is Grignard reagent? Write its general formula.
10. Complete the following reaction and name the reaction. $C_6H_5-Br+CH_3Br \xrightarrow{Na/dry\ ether} X+2NaBr$
11. Complete the following reaction
    i) $C_6H_5MgBr+C_2H_5ONa \longrightarrow$
    ii) $CH_3Br+KNO_2 \longrightarrow B$
12. Write the reactions involved in preparation of bromobenzene from Aniline.
13. Although chlorine is an electron withdrawing group, yet it is ortho-,para- directing in electrophilic aromatic substitution reactions. Why?
14. Which alkyl halide from the following pairs would you expect to react morerapidly by an S_N^2 mechanism?
    i) CH_3–Br or $(CH_3)_3C$–Br
    ii) $(CH_3)_3CCH_2Br$ or C_2H_5–Br
15. Identify the reactant
    i) $A+Na \xrightarrow{Dry\ ether} (CH_3)_3C-C(CH_3)_3+NaBr$
    ii) $B+O_2 \xrightarrow{h\nu} COCl_2+HCl$
16. Explain Sandmeyer's reaction with an example.

17. With the help of chemical reaction show that presence of electron withdrawing group fastens nucleophilic reactions of haloarenes.
18. Write the structure of DDT and mention one use of it.
19. Name the reaction involved in preparation of Freon-12 from tetrachloromethane. Mention one use
20. Write the IUPAC name of major product obtained when chlorobenzene reacts with acetyl chloride in presence of Anhydrous $AlCl_3$. Name this reaction.

Three Marks Questions

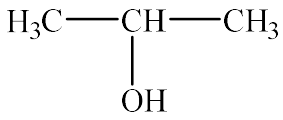
1. Write the steps involved in mechanism of conversion of 2-chloro-2-methyl butane in to 2-methyl-butan-2-ol. Which type of solvent favors such reaction?
2. Write the steps involved in mechanism of conversion of Ethyl chloride in to ethanol. What order of kinetics it follows?
3. Write any three reasons why Haloarenes are least reactive towards Nucleophilic reactions.
4. With the help of resonance structures show that presence of nitro group on meta positions does not effects reactivity of haloarenes for nucleophilic reactions.
5. With the help of resonating structures explain why chlorine directs electrophile towards ortho and para positions of haloarenes in spite of its electron withdrawing nature.
6. Illustrate Zaitsev rule with an example.
7. Primary alkyl halide C_4H_9Br (**A**) reacted with alcoholic KOH to give compound (**B**).Compound (**B**) is reacted with HBr to give (**C**) which is an isomer of (**A**). Write the structure of **A**, **B** and **C.**
8. Compound (**M)** with formula C_3H_6 on reaction with HBr forms a compound (**N),** compound **N** on heating with Na metal in dry ether produces hydrocarbon **X.** Write the IUPAC names of compound **M**, **N** and **X.**
9. Define the following a) Racemic mixtures b) Enantiomers c) optical isomers.
10. Complete the following reaction sequences.

$$C_6H_6 + Br_2 \xrightarrow{FeBr_3} Y \xrightarrow{Mg/dry\ ether} Z \xrightarrow{RNH_2}$$

UNIT 7 ALCOHOLS, PHENOLS AND ETHERS

Multiple Choice Questions (MCQs):

1. The C—O—H bond angle in alcohol is
   a) slightly greater than 109°.28'. b) slightly less than 109°.28'.
   c) slightly greater than 120° d) slightly less than 120°

2. Common name  of
   a) Isopropyl alcohol b) propan-2-ol
   c) 2-Methylpropan-2-ol d) n-propanol

3. Which of the following types of alcohol contain a bond between sp^2 hybridised carbon and -OH group?
   a) Primary allylic alcohols b) Secondary allylic alcohols
   c) Tertiary allylic alcohols d) Vinylic alcohols

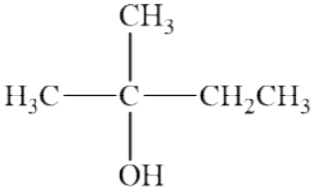
4. Which of the following terms does not describe CH_2=CH–CH_2OH?
   a) Vinylic b) Primary
   c) Allylic d) Monohydric

5. Which of the following compounds, -OH group is bonded to aryl carbon?
   a) Ethanol b) Phenol
   c) Vinyl alcohol d) Benzyl alcohol

6. R-O-R, where R represent an alkyl or aryl group is the general formula of which compound?
   a) Ethanol b) Phenol
   c) Vinyl alcohol d) Ether

7. Identify the simple ether from the following.
   a) $CH_3OC_2H_5$ b) $C_2H_5OC_6H_5$
   c) $C_6H_5OC_6H_5$ d) $C_6H_5OCH_3$

8. IUPAC name of m-cresol is.
   a) 3-methylphenol b) 3-chlorophenol
   c) 3-methoxyphenol d) benzene-1, 3-diol

9. The correct IUPAC name  of is
   a) tert-butyl alcohol (b) 2, 2-Dimethylpropanol
   c) 2-Methylbutan-2-ol d) 3-Methylbutan-3-ol

10. The C—O bond length in phenol is less than that in methanol due to
    a) partial double bond character of oxygen with aromatic ring
    b) sp^2 hybridised carbon to which oxygen attached
    c) sp^3 hybridised carbon to which oxygen attached
    d) both (a) and (b)

11. Which of the following are not used to convert RCHO into RCH_2OH?
    a) H_2/Pd b) $LiAlH_4$
    c) $NaBH_4$ d) Reaction with RMgX followed by hydrolysis

12. _____ on reaction with B_2H_6 give trialkyl boranes.
    a) Alkanes b) Alcohols
    c) Alkenes d) Phenols

13. Phenol is less acidic than _____ .
    a) ethanol b) *o*-nitrophenol
    c) *o*-methylphenol d) *o*-methoxyphenol

14. During dehydration of alcohol to alkenes by heating with conc.H_2SO_4, the initiation step is:
    a) protonation of alcohol molecule b) formation of carbocation
    c) elimination of water d) formation of an ester

15. The compound that reacts fastest with Lucas reagent at room temperature is
    a) butan-1-ol b) butan-2-ol
    c) 2-methylpropan-1-ol d) 2-methylpropan-2-ol

16. Cumene hydroperoxide on hydrolysis with dilute H_2SO_4 gives _____
    a) alcohol and phenol b) only phenol
    c) phenol and acetone d) ether and acetone

17. How is carbolic acid prepared from benzene diazonium chloride?
    a) Preparing an aqueous solution and warming it
    b) Freezing it with alcoholic NaCl
    c) Treating it with sodium hydroxide
    d) Treating it with nitrous acid at 275K

18. $\text{Benzene} \xrightarrow{X} \text{Benzene sulphonic acid} \xrightarrow{NaOH} \text{Sodium phenate} \xrightarrow{H^+} \text{Phenol}$. Identify the compound 'X'.
    a) Oleum b) Sulphuric acid
    c) Sodium sulphate d) Nitrous acid

19. Which of the following is necessary for the bromination of phenol?
    a) CS_2 b) $FeBr_3$
    c) $AlCl_3$ d) BF_3

20. Phenol is approximately how much times acidic than ethanol?
    a) 10 b) 1000
    c) 100000 d) 1000000

21. What is the correct order of boiling points of alcohols having the same number of carbon atoms?
a) 1°>2°>3° b) 3°>2°>1°
c) 3°>1°>2° d) 2°>1°>3°

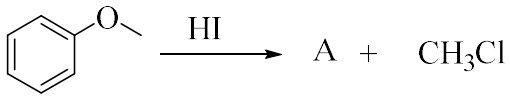
22. Four compounds A, B, C and D having similar molecular masses were tested for their boiling points. It was found that compound C has the highest boiling point of all four. What is the compound C most likely to be?
a) Hydrocarbon b) Ether
c) Haloalkane d) Alcohol

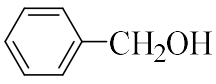
23. Reaction of aqueous sodium hydroxide on chlorobenzene at room temperature gives which of the following products?
a) *o*-chlorophenol b) Phenol
c) No reaction d) *p*-chlorophenol

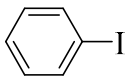
24. What is the correct order of reactivity of alcohols toward reactions involving cleavage of C-O bond?
a) 1°>2°>3° b) 3°>2°>1°
c) 1°>3°>2° d) 3°>1°>2°

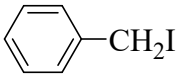
25. The oxidation of alcohol involves the cleavage of _____ bonds.
a) O–H b) C–H
c) O–H and C–H d) C–C

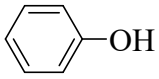
26. What will be the product 'a' for the given reaction?



a) 

b) 

c) 

d) 

27. Which of the following compound gives a ketone when its vapours are passes over heated copper at 573K?
a) Propan-1-ol b) Propan-2-ol
c) 2-Methylpropan-1-ol d) 2-Methylpropan-2-ol

28. Which of the following compound undergoes dehydration when its vapours are passes over heated copper at 573K?
a) Propan-1-ol b) Propan-2-ol
c) 2-Methylpropan-1-ol d) 2-Methylpropan-2-ol

29. What is the final major product of Reimer-Tiemann reaction?
a) Salicylic acid b) *o*-Salicylaldehyde
c) *m*-Salicylaldehyde d) *p*-Salicylaldehyde

30. Which of the following compound can covert phenol to benzene?
a) CrO_3 b) Zinc dust
c) Pyridine d) Strong acid

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

Set-1

(alcohols, sp^2, sp^3, carbolic acid, ol, mixed)

1. Phenol, also known as _____, was first isolated in the early nineteenth century from coal tar.
2. Hydroxyl (−OH) derivatives of alkane are called _____.
3. In Allylic alcohols−OH group is attached to a_____ hybridised carbon adjacent to the carbon-carbon double bond.
4. Unsymmetrical ethers are also called as _____ ethers.
5. _____ is the suffix used in the IUPAC nomenclature of the alcohols.

Set-2

(less, greater, cyclo, phenol, two, sigma)

1. Cyclic alcohols are named using the prefix _____.
2. The simplest hydroxy derivative of benzene is _____.
3. The number of −OH groups present in 1,4-benzenediol are _____.
4. In alcohols, the oxygen of the –OH group is attached to carbon by a _____ bond.
5. The bond angle in alcohols is slightly _____ than the tetrahedral angle.

Set-3

(alcohols, secondary, primary, benzene, *tert*-butyl alcohol, phenol)

1. Alkenes react with water in the presence of acid as catalyst to form _____.
2. Aldehydes reacts with H_2 in presence of finely divided palladium yield _____ alcohols.
3. Ketones reacts with sodium borohydride gives _____ alcohols.
4. _____ is the common name of 2-methylpropan-2-ol.
5. _____ is obtained by acidification of sodium phenoxide

Set-4

(nitrous acid, cumene hydroperoxide, acetone, oleum, ethene, Benzene diazonium chloride)

1. When benzene is sulphonated with _____ gives benzene sulphonic acid.
2. A diazonium salt is formed by treating an aromatic primary amine with _____.
3. _____ is produced when isopropyl benzene is oxidised in the presence of air.
4. _____ are hydrolysed to phenols by warming with water or by treating with dilute acids
5. In the manufacture of phenol from cumene _____ a by-product formed.

Set-5

(intermolecular, alkoxides, increase, decrease, nucleophiles, intramolecular)

1. The boiling points of alcohols and phenols _____ with increase in the number of carbon atoms
2. The bond between O–H is broken when alcohols react as _____.
3. The –OH group in alcohols and phenols is involved in _____ hydrogen bonding.
4. Alcohols and phenols react with active metals such as sodium, potassium and aluminium to yield corresponding _____.
5. In alcohols, the boiling points _____ with increase of branching in carbon chain.

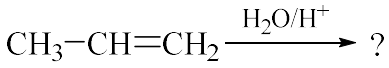
Set-6

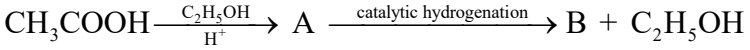
(esters, picric acid, weaker, stronger, Bronsted bases, acids)

1. Alcohols are, _____ acids than water.
2. The reaction of phenol with aqueous sodium hydroxide indicates that phenols are stronger _____ than alcohols and water.
3. Alcohols act as _____ due to the presence of unshared electron pairs on oxygen.
4. Alcohols and phenols react with carboxylic acids, acid chlorides and acid anhydrides to form _____.
5. 2,4,6-trinitrophenolis commonly known as _____ .

Two-mark questions

1. What are vinyl alcohols? Give an example.
2. What are allylic alcohols? Give an example.
3. What are Benzylic alcohols? Give an example.
4. What are symmetrical ethers? Give an example.
5. What are unsymmetrical ethers? Give an example.
6. Write a short note on bonding between C–OH in alcohols.
7. Write a short note on bonding between C–OH in phenol.
8. Identify the major product formed in the following reaction. Write its IUPC name.



9. Explain the preparation of alcohol from aldehyde by catalytic hydrogenation with suitable example.
10. Name the class of alcohol formed when ketones reacts with sodium borohydride. Write the chemical equation.
11. Identify 'A' and 'B' in this reaction: 
12. Write the general reaction for the conversion of ketone to alcohol by using Grignard reagent.
13. Give the structures and IUPAC names of the products expected from the following reactions:
    a) Catalytic reduction of butanal.
    b) Reaction of propanone with methyl magnesium bromide followed by hydrolysis.
14. How is phenol prepared from chlorobenzene? Write the chemical reaction.
15. Explain the preparation of phenol from benzene sulphonic acid. Write chemical equation.
16. How tert-butyl alcohol reacts with aluminium? Write chemical equation.
17. How butan-2-ene-1-ol reacts with PCC? Write chemical equation.
18. Explain Kolbe's reaction with an example.
19. Explain Reimer-Tiemann reaction with an example.
20. Explain Williamson's Ether synthesis.
21. How does Phenol reacts with conc. Nitric acid? Give equation.
22. Name the product formed when Phenol is treating with acidified solution of $Na_2Cr_2O_7$. Write chemical equation.
23. Among Alcohols and Phenols which one is more acidic? And why?

Three-mark questions

1. What are primary, secondary and tertiary alcohols?
2. Write the mechanism involved in the acid catalysed hydration of propene.
3. Explain the preparation of phenol from cumene. Write chemical equation.
4. Explain the preparation of phenol from aniline. Write chemical equation.
5. What is the effect of;
   (i) Electron withdrawing group on acidity of phenols.
   (ii) Electron donating group on acidity of phenols.
   (iii) Boiling point of alcohols on increasing number of carbon atoms.
6. Write the mechanism of acid catalysed dehydration of ethanol to ethene.
7. Mention the products obtained when the vapours of primary, secondary and tertiary alcohols are passed over heated copper at 573 K.
8. What happens when the vapours of primary, secondary and tertiary alcohols are passed over heated copper at 573 K. Write chemical equations for each class of alcohol.
9. Give details of two commercially important alcohols. What is denaturation of alcohol?
10. How do you prepare aspirin from salicylic acid? Write chemical equation and deduce its IUPAC name of aspirin.

UNIT 8 ALDEHYDES, KETONES & CARBOXYLIC ACIDS

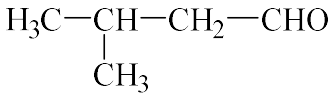
Multiple Choice Questions (MCQs)

1. Which of the following compounds do not contain a carbonyl group?
   a) Alcohol b) Aldehyde
   c) Ketone d) Carboxylic acid

2. How many carbon atoms does formaldehyde have?
   a) 0 b) 1
   c) 2 d) 3

3. What is the common name of the compound which has a CHO group attached to the sp^2 hybridised carbon of a benzene ring?
   a) Benzanal b) Benzaldehyde
   c) Benzenecarbaldehyde d) Phthaldehyde

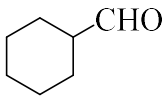
4. Which of the following is the incorrect name for the following compound?



   a) 3-Methylbutanal b) Isovaleraldehyde
   c) β-Methylbutyraldehyde d) γ-Methylbutyraldehyde

5. The prefix valer is generally used for naming aldehydes with how many carbon atoms in the structure?
   a) 3 b) 4
   c) 5 d) 6

6. What is the correct IUPAC naming of the compound shown?



   a) Benzenecarbaldehyde b) Cyclohexanal
   c) Cyclohexyl aldehyde d) Cyclohexanecarbaldehyde

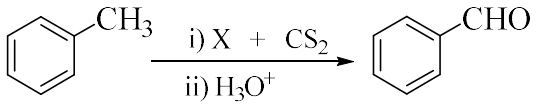
7. Which of the following methods cannot produce aldehydes?
   a) Oxidation of primary alcohols b) Dehydrogenation of secondary alcohols
   c) Ozonolysis of alkenes d) Hydration of ethyne with acid

8. Which of the following reactions can produce ketones?
   a) Oxidation of primary alcohols b) Dehydrogenation of primary alcohols
   c) Dehydrogenation of tertiary alcohols d) Oxidation of secondary alcohols

9. What is the catalyst used in the hydrogenation of acetyl chloride to produce ethanal?
   a) Pt over $BaSO_4$ b) Pt over $CuSO_4$
   c) Pd over $BaSO_4$ d) Pd over $CuSO_4$

10. Which of the following carbonyl compounds can be prepared from Rosenmund reaction?
    a) Methanal b) Acetone
    c) Butanone d) Benzaldehyde

11. Identify 'X' in the reaction given below.



    a) CrO_3 b) CrO_2Cl_2
    c) Alkaline $KMnO_4$ d) Anhydrous $AlCl_3$

12. If the boiling points of methoxyethane and propan-1-ol are 281 K and 370 K respectively, predict the boiling point of propanal.
    a) 273 K b) 281 K
    c) 322 K d) 370 K

13. Which of the following has the least pungent odour?
    a) Methanal b) Ethanal
    c) Propanal d) Butanal

14. Aldehydes and ketones undergo _____ reactions.
    a) electrophilic addition b) electrophilic substitution
    c) nucleophilic addition d) nucleophilic substitution

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

16. What is the correct order of reactivity towards nucleophilic addition?
    a) Benzaldehyde > Benzophenone > Acetophenone
    b) Benzophenone > Benzaldehyde > Acetophenone
    c) Acetophenone > Benzaldehyde > Benzophenone
    d) Benzaldehyde > Acetophenone > Benzophenone

17. Identify the catalyst in the nucleophilic addition of HCN to acetone.
    a) NaOH b) HCl
    c) NaCl d) NaCN

18. Acetone reacts with ethylene glycol in dry HCl gas to form _____
    a) hemiacetals b) acetals
    c) cyclic acetals d) cyclic ketals

19. Which of the following products is formed when an aldehyde reacts with an amine in acidic medium?
    a) Imine b) Schiff's base
    c) Oxime d) Hydrazone

20. What is the product of Clemmensen reduction on acetophenone?
    a) Benzaldehyde b) Methyl benzene
    c) Ethyl benzene d) Benzophenone

21. A compound on treatment with hydrazine followed by heating up to 473K with KOH in ethylene glycol gives propane. Identify the compound.
    a) Methanal
    b) Ethanal
    c) Propanal
    d) Acetone

22. Which of the following is Tollen's reagent?
    a) Ammoniacal silver nitrate solution
    b) Aqueous copper sulphate
    c) Alkaline sodium potassium tartaratel
    d) Mixture of sodium carbonate, sodium citrate and Cu^{2+} complex

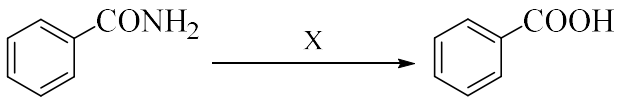
23. When an aldehyde is heated with Fehling's solution, a reddish-brown precipitate is formed due to which compound?
    a) CuS
    b) AgBr
    c) Cu_2O
    d) CdS

24. Which of the following compounds can be distinguished from iodoform test?
    a) Benzaldehyde and benzophenone
    b) Benzaldehyde and formaldehyde
    c) Acetophenone and acetaldehyde
    d) Acetophenone and benzophenone

25. Which of the following is used in the preservation of biological specimens?
    a) Methanal
    b) Ethanal
    c) Benzaldehyde
    d) Acetone

26. Which of the following is known as Jones reagent?
    a) $KMnO_4$ in alkaline medium
    b) CrO_3 in H_2SO_4
    c) $K_2Cr_2O_7$ in acidic medium
    d) $KMnO_4$ in H_2SO_4

27. Identify X in the following conversion.



$+ \ NH_3$

    a) Alkaline $KMnO_4$; H_3O^+
    b) KOH; heat
    c) H_3O^+; heat
    d) $KMnO_4$–KOH; heat

28. How can methyl magnesium bromide be converted to propanoic acid?
    a) Jones reagent
    b) $KMnO_4$-KOH; heat
    c) H_3O^+; heat
    d) CO_2-dry ether; H_3O^+

29. Which carboxylic acid is used in the manufacturing of nylon-6,6?
    a) Propanedioic acid
    b) Butanedioic acid
    c) Pentanedioic acid
    d) Hexanedioic acid

30. Benzoic acid reacts with _____ to give ammonium benzoate salt, which on further dehydration gives benzamide.
    a) N_2
    b) NH_3
    c) NH_4OH
    d) HNO_3

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

Set - 1

(sp^2, sp^3, polarised, fragrance, electrophilic, carbonyl group)

1. The organic compounds containing carbon-oxygen double bond (>C=O) called _____.
2. Aldehydes, ketones add _____ and flavour to nature.
3. The carbonyl carbon atom is _____ hybridised.
4. The carbon-oxygen double bond is _____ due to higher electronegativity of oxygen relative to carbon.
5. In a carbonyl group the carbonyl carbon is an _____ in nature.

Set - 2

(oxidation, reduction, Lewis base, acetaldehyde, ozonolysis, volatile)

1. In a carbonyl group the carbonyl oxygen acts as _____.
2. Aldehydes and ketones are generally prepared by _____ of primary and secondary alcohols, respectively.
3. In the preparation of Aldehydes and Ketones by oxidation of alcohols method is suitable for ____ alcohols.
4. By _____ of alkenes followed by reaction with zinc dust and water gives aldehydes, ketones or a mixture of both depending on the substitution pattern of the alkene.
5. Addition of water to ethyne in the presence of H_2SO_4 and $HgSO_4$ gives _____ .

Set - 3

(benzaldehyde, methyl group, imine, alcohol, ketone, anhydrous aluminium chloride)

1. Nitriles are reduced to corresponding _____ with stannous chloride in the presence of hydrochloric acid
2. Chromyl chloride oxidises _____of toluene to a chromium complex, which on hydrolysis gives corresponding benzaldehyde.
3. Side chain chlorination of toluene gives benzal chloride, which on hydrolysis gives _____ .
4. Treating a nitrile with Grignard reagent followed by hydrolysis yields a _____.
5. _____ is the catalyst used in Friedel-Crafts acylation reaction.

Set - 4

(higher, propiophenone, gas, increases, decreases, miscible)

1. When benzene is treated with propanoyl chloride in the presence of Anhyd. $AlCl_3$ and CS_2 gives _____.
2. Methanal is a _____ at room temperature.
3. The boiling points of aldehydes and ketones are _____ than hydrocarbons and ethers of comparable molecular masses.
4. The lower members of aldehydes and ketones such as methanal, ethanal and propanone are _____ with water in all proportions.
5. The solubility of aldehydes and ketones _____ rapidly on increasing the length of alkyl chain.

Set - 5

(planar, electronic, nucleophilic, electrophilic, addition, cyanohydrins)

1. The aldehydes and ketones undergo _____ addition reactions.

2. The structure of carbonyl group is _____.
3. Aldehydes are generally more reactive than ketones in nucleophilic addition reactions due to steric and _____ reasons.
4. Aldehydes and ketones react with hydrogen cyanide (HCN) to yield _____ .
5. Sodium hydrogensulphite adds to aldehydes and ketones to form the _____ products.

Set - 6

(Ketones, Aldehydes, copper sulphate, bright silver mirror, hemiacetals, dimer)

1. Aldehydes react with one equivalent of monohydric alcohol in the presence of dry hydrogen chloride to yield alkoxyalcohol intermediate, known as _____ .
2. _____ react with ethylene glycol under similar conditions to form cyclic products known as ethylene glycol ketals.
3. On warming an aldehyde with freshly prepared ammoniacal silver nitrate solution a _____ is produced.
4. Fehling solution A is aqueous _____ .
5. In fact, most carboxylic acids exist as _____ in the vapour phase or in the aprotic solvents.

Two-mark questions

1. Write the structures of the following compounds.
   (i) α – Methoxypropionaldehyde
   (ii) 3-Hydroxybutanal
2. Draw the structures of the following :
   (i) p-Methylbenzaldehyde
   (ii) 4-Methylpent-3-en-2-one
3. Explain Rosenmund reduction with an equation.
4. Explain Stephen reaction with suitable example.
5. Write the general reaction of conversion of alkyl nitrile to aldehyde by using DIBAL-H and expand DIBAL-H.
6. Explain Gatterman–Koch reaction with an example.
7. Write the IUPAC name and structure of the product obtained when benzene reacts with acetyl chloride in presence of anhyd. $AlCl_3$.
8. What is the composition Fehling reagent?
9. Aldehydes are more reactive than ketones in nucleophilic addition reactions. Give two reasons.
10. What is Tollens' reagent? Write one usefulness of this reagent.
11. Write the general equation involved in addition of ammonia and its derivatives to carbonyl group.
12. How does propanone reacts with hydrazine? Give equation.
13. Illustrate Clemmensen reduction with suitable reaction.
14. Explain haloform reaction with general equation.
15. What is aldol condensation reaction? Give the IUPAC name of the aldol condensation product obtained when propanone undergoes aldol condensation reaction.
16. How does benzaldehyde reacts with acetophenone in presence of a dilute alkali? Give equation.
17. Explain Cannizzaro's reaction with an example.

18. Explain the nitration of benzaldehyde with chemical equation.
19. Write the chemical equation for the conversion of toluene to benzoic acid.
20. Among methanoic acid and ethanoic acid, which is more acidic and why?
21. Explain esterification reaction with an example.
22. Explain HVZ (Hell-Volhard-Zelinsky) reaction with equation.
23. Explain the nitration of benzoic acid with chemical equation.

Three-mark questions

1. Explain the Structure of carbonyl Group.
2. Illustrate Etard reaction with equation.
3. How do you convert toluene to benzaldehyde by using chromic oxide? Write chemical equation.
4. How do you prepare benzaldehyde by side chain chlorination of toluene? Write chemical equation.
5. Explain the conversion of ethyl cyanide to propiophenone with equation.
6. Give names of the reagents to bring about the following transformations:
   (i) Hexan-1-ol to hexanal.
   (ii) Cyclohexanol to cyclohexanone.
   (iii) Allyl alcohol to propenal
7. Write the mechanism of addition of HCN to carbonyl group in presence of a base.
8. Explain preparation of propane by Wolff-Kishner reduction. Write chemical equation.
9. Explain the following conversion with equation: Ethanol to but-2-enal.
10. Explain the preparation of carboxylic acids from Grignard reagent. Give equation.

UNIT 9 AMINES

Multiple Choice Questions (MCQs):

1. Which of the following is not an amine?
   a) NH_3 b) CH_3NH_2
   c) $C_6H_5NH_2$ d) CH_3NHCH_3

2. How many lone pairs of electrons does the nitrogen atom of tertiary amines have?
   a) 0 b) 1
   c) 2 d) 3

3. What is the expected geometry of CH_3-NH-CH_3?
   a) Square planar b) Trigonal planar
   c) Trigonal pyramidal d) Trigonal bipyramidal

4. When two alkyl groups are attached to the nitrogen atom in an amine, it is known as a _____ amine.
   a) primary b) secondary
   c) tertiary d) aromatic

5. Which of the following is a 2° amine?
   a) $CH_3CH_2NHCH_3$ b) $(CH_3)_3N$
   c) $(CH_3CH_2CH_2)_2NCH_3$ d) $C_6H_5NH_2$

6. Which of the following is the IUPAC name of the compound in which one hydrogen of ammonia is replaced by an ethyl group?
   a) Ethylamine b) Aminoethane
   c) Ethanamine d) Ethane amine

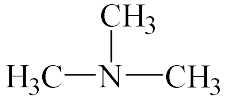
7. What is the correct common name of H_2N-CH_2-CH_2-NH_2?
   a) Ethylenediamine b) 1,2-Diaminoethane
   c) Ethyldiamine d) Aminoethylamine

8. Which of the following reagents cannot be used to convert nitrobenzene to aniline?
   a) $LiAlH_4$-dry ether b) Sn/HCl
   c) H_2/Pd-ethanol d) Fe in HCl

9. What compound is formed when hydrogen gas is passed through nitrobenzene in the presence of finely divided nickel?
   a) 2-Nitroaniline b) 3-Nitroaniline
   c) 4-Nitroaniline d) Aniline

10. Ammonolysis is a type of _____ reaction.
    a) electrophilic addition b) electrophilic substitution
    c) nucleophilic addition d) nucleophilic substitution

11. The product obtained when the following compound undergoes ammonolysis in a sealed tube at 373K with iodomethane?



    a) Dimethylamine b) N-Iodo-N-methylmethanamine
    c) Tetramethyl ammonium iodide d) No reaction

12. Ethyldimethylamine is obtained from the reduction of _____ with $LiAlH_4$.
    a) acetamide b) benzamide
    c) N-methylacetamide d) N,N-dimethylacetamide
13. Which of the following is not a byproduct of Hoffmann bromamide degradation of acetamide with alcoholic KOH?
    a) KBr b) KCN
    c) K_2CO_3 d) H_2O
14. Hoffmann bromamide degradation reaction is used for preparing _____ amines.
    a) primary b) secondary
    c) tertiary d) mixed
15. Which of the following steps is not present in Gabriel phthalimide synthesis?
    a) Treating phthalimide with alcoholic KOH b) Heating potassium phthalimide with alkyl halide
    c) Alkaline hydrolysis of N-alkylphthalimide d) Heating phthalic acid with NaOH
16. Which of the following amines is not a gas?
    a) Methylamine b) Dimethylamine
    c) Ethylamine d) Trimethylamine
17. What is the characteristic odour of relatively lower aliphatic amines?
    a) Fruity odour b) Fishy odour
    c) Rotten egg smell d) Odourless
18. The intermolecular hydrogen bonds, if any, in amines is formed between _____
    a) N-H and N-H b) N and N-H
    c) Alkyl carbon and N-H d) Alkyl H and N-H
19. If A is the boiling point of propanamine and B is the boiling point of butanamine, what is the correct relation between the two?
    a) A > B b) B > A
    c) A = B d) A >> B
20. Amines are generally _____ in nature.
    a) electrophilic b) acidic
    c) basic d) neutral
21. Which of the following is associated with decrease in pK_b value of amines?
    a) Increase in acidic strength b) Increase in basic strength
    c) Better proton donation d) Better electron acceptor
22. What is the product formed when ethanamine reacts with HBr?
    a) NH_4Br b) CH_3NH_3Br
    c) CH_3CH_2NHBr d) $CH_3CH_2NH_3Br$
23. Which of the following is not produced on the reaction of methylammonium chloride with sodium hydroxide?
    a) HCl b) CH_3NH_2
    c) H_2O d) NaCl

24. Consider three gaseous alkylamines A, B and C or 1°, 2° and 3° respectively. What will be the correct order of their basicity?
    a) A > B > C b) C > B > A
    c) B > A > C d) B > C > A
25. Which of the following groups when present at para position increases the basic strength of aniline?
    a) $-NO_2$ b) –Br
    c) $-NH_2$ d) –COOH
26. During the acylation of an aliphatic primary amine, which of the following is replaced by an acyl group?
    a) $-NH_2$ group b) One H atom of $-NH_2$
    c) Both H atoms of $-NH_2$ d) Alkyl group of the amine
27. What is the most suitable temperature for the diazotisation reaction to take place?
    a) 0 to 8°C b) 12°C
    c) 22°C d) 32°C
28. Aromatic diazonium salts are stable at _____ temperatures.
    a) cold b) room
    c) warm d) high
29. In reactions of diazonium salts involving the displacement of diazonium group, the nitrogen escapes as _____ .
    a) precipitate b) liquid
    c) gas d) crystals
30. The coupling reaction is a type of _____ reaction.
    a) electrophilic addition b) electrophilic substitution
    c) nucleophilic addition d) nucleophilic substitution

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

Set -1

(sp^2, sp^3, unshared pair, trivalent, RNH_2, ammonia)

1. Amines are derivatives of _____.
2. Nitrogen atom of amines is _____ and carries an unshared pair of electrons.
3. Nitrogen atom of methyl amine is _____ hybridised.
4. The fourth orbital of nitrogen in all amines contains an _____ of electrons.
5. If one hydrogen atom of ammonia is replaced by R we get _____.

Set -2

(ammonolysis, amines, nucleophile, primary, secondary, alkyl group)

1. In common system, an aliphatic amine is named by prefixing _____ to amine
2. The process of cleavage of the C–X bond by ammonia molecule is known as _____.
3. In the process of ammonolysis the primary amine thus obtained behaves as a _____.
4. The amides on reduction with lithium aluminium hydride yield _____.
5. Gabriel synthesis is used for the preparation of _____ amines.

Set -3

(primary amines, Hoffmann, Gabriel phthalimide synthesis, gases, advantage, disadvantage)

1. Ammonolysis has the _____ of yielding a mixture of primary, secondary and tertiary amines and also a quaternary ammonium salt.
2. Reduction of alkyl cyanides with lithium aluminium hydride or catalytic hydrogenation produce_____.
3. _____ developed a method for preparation of primary amines by treating an amide with bromine in an aqueous or ethanolic solution of sodium hydroxide.
4. Aromatic primary amines cannot be prepared by _____ method.
5. The lower aliphatic amines are _____ with fishy odour.

Set -4

(acids, bases, Tertiary amines, ammonia, stronger, Lewis base)

1. _____ do not have intermolecular association due to the absence of hydrogen atom available for hydrogen bond formation.
2. Amines are reacts with _____ to form salts.
3. Amines have an unshared pair of electrons on nitrogen atom due to which they behave as _____.
4. Smaller the value of pK_b, _____ is the base.
5. Alkylamines are stronger bases than _____.

Set -5

(isocyanides, nitrous acid, unstable, stable, Benzenesulphonyl chloride, acylation)

1. Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. This reaction is known as _____.
2. Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form _____.
3. Primary aliphatic amines react with _____ to form aliphatic diazonium salts.
4. _____ is also known as Hinsberg's reagent.
5. Primary aliphatic amines form highly _____ alkyldiazonium salts.

Set -6

(aniline, amides, primary, secondary, Isocyanide, benzoylation)

1. The products obtained by acylation reaction are known as _____.
2. Amines also react with benzoyl chloride. This reaction is known as _____.
3. _____ test and is used as a test for primary amines.
4. The conversion of _____ aromatic amines into diazonium salts is known as diazotisation.
5. Diazonium salt reacts with _____ yields p-aminoazobenzene.

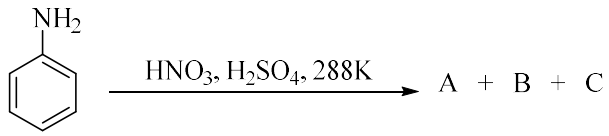
Two-mark questions

1. Write the structures of the following compounds.
   (i) 2-Methylaniline (ii) N, N-Dimethylmethanamine
2. Give the common names for the following compounds.
   (i) Propan-1-amine (ii) Propan-2-amine

3. How do you convert nitrobenzene to aniline? Write the equation.
4. How nitriles are reduced to amines. Write general equation.
5. How amides are reduced to amines. Write general equation.
6. Explain Hoffmann bromamide degradation reaction with an example.
7. How do you prepare methanamine from Hoffmann's bromamide degradation reaction. Give equation
8. Between $CH_3CH_2CH_2NH_2$ and $(CH_3)_3N$, which has higher boiling point and why?
9. Which is more basic among aqueous solutions of aniline and ammonia? Give one reason.
10. (i) The pk_b values of ammonia, methanamine and benzeneamine (aniline) are 4.75, 3.38 & 9.38 respectively. Arrange them in the increasing order of their basic strength.
    (ii) Why aromatic primary amines cannot be prepared by Gabriel synthesis?
11. Explain Carbylamine reaction with equation.
12. How aromatic amine reacts with nitrous acid? Write the chemical equation.
13. What is Hinsberg's reagent? Write its structure.
14. How do you convert aniline to 2,4,6-tribromoaniline? Write the chemical equation.
15. Among alkyldiazonium salts and arenediazonium salts which is more stable? Give reason.
16. How do you convert aniline to benzenediazonium chloride? Write the chemical equation.
17. What is diazotization? Write the general formula of diazonium salts.
18. Explain Sandmeyer reaction with an example.
19. Explain Gatterman reaction with an example.
20. What is coupling reaction? Write the structure of *p*-hydroxyazobenzene.

Three-mark questions

1. Write a note about structure of Amines.
2. What is an ammonolysis? Write the chemical equation involved in it and mention its disadvantage.
3. Write the general equations involved in Gabriel phthalimide synthesis for preparation of primary amine.
4. Explain acylation reaction with an example.
5. How do you convert primary aliphatic amine to alcohol? Write the chemical equation.
6. How do you distinguish between primary and secondary and tertiary amines by using benzene sulphonyl chloride?
7. How do you convert aniline to 4-bromoaniline? Write the chemical equation.
8. Write the structures of 'A', 'B' and 'C' in the following reaction.



9. How do you convert acetanilide to *p*-nitroaniline? Write the chemical equation.
10. How do you convert benzene diazonium chloride to nitrobenzene? Write the chemical equation.

UNIT 10 BIOMOLECULES

Multiple Choice Questions (MCQs)

1. Which of the following carbohydrates does not satisfy the formula $C_x(H_2O)_y$?
   a) Fructose b) Deoxyribose
   c) Glucose d) Lactose

2. Which of the following carbohydrates does not have the formula $C_{12}H_{22}O_{11}$?
   a) Galactose b) Sucrose
   c) Allolactose d) Maltose

3. What of the following carbohydrates is not a sugar?
   a) Glucose b) Fructose
   c) Lactose d) Cellulose

4. Which of the following is not a polysaccharide?
   a) Cellulose b) Sucrose
   c) Starch d) Glycogen

5. Identify the monosaccharide from the following.
   a) Deoxyribose b) Sucrose
   c) Maltose d) Fructose

6. Which of the following disaccharides gives two same monosaccharide units on hydrolysis?
   a) Maltose b) Sucrose
   c) Lactose d) Lactulose

7. Sucrose consists of which of the following monosaccharide units?
   a) Fructose, galactose b) Fructose, glucose
   c) Galactose, glucose d) Glucose, glucose

8. Which of the following is a non-reducing sugar?
   a) Galactose b) Glucose
   c) Fructose d) Sucrose

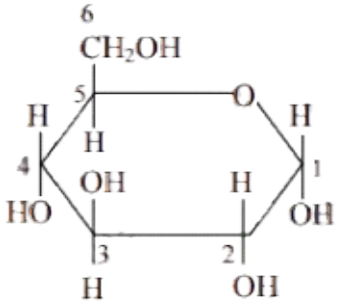
9. Which of the following monosaccharides is a ketohexose?
   a) Glucose b) Galactose
   c) Fructose d) Mannose

10. The reaction of glucose with which of the following proves the presence of an aldehydic group?
    a) Potassium iodide b) Hydroxylamine
    c) Bromine water d) Acetic anhydride

11. The reaction of glucose with acetic anhydride confirms the presence of how many hydroxy groups in glucose?
    a) 3 b) 4
    c) 5 d) 6

12. The α-D-glucose and β-D-glucose isomers of glucose are known as _____
    a) enantiomers b) stereoisomers
    c) anomers (d) glycomers

13. Identify the compound from the Haworth projection shown;



a) α-D-(+)-glucopyranose
b) β-D-(+)-glucopyranose
c) α-D-(+)-glucofuranose
d) β-D-(+)-glucofuranose

14. Disaccharides on _____ with dilute HCl yield two same or different monosaccharides.
a) hydration
b) hydrolysis
c) oxidation
d) carbonation

15. Two monosaccharides are joined through a _____ bond to form a disaccharide.
a) ionic
b) peptide
c) glycosidic
d) phosphodiester

16. Sucrose is made of which of the following monosaccharides?
a) α-D-glucose, α-D-fructose
b) α-D-glucose, β-D-fructose
c) β-D-glucose, α-D-fructose
d) β-D-glucose, β-D-fructose

17. Which of the following statements is incorrect with respect to starch?
a) It is a reducing carbohydrate
b) It is a polymer of α-D-glucose
c) It gives blue colour with iodine
d) It consists of branched chains

18. Cellulose is a _____ saccharide.
a) reducing
b) branched chain
c) β-glucose straight chain
d) oligo

19. Proteins are polymers of _____
a) α-amino acids
b) β-amino acids
c) γ-amino acids
d) δ-amino acids

20. Which of the following amino acids is optically inactive?
a) Glycine
b) Alanine
c) Lysine
d) Valine

21. Which of the following amino acids are aromatic in nature?
a) Methionine
b) Isoleucine
c) Proline
d) Histidine

22. Which of the following is a non-essential amino acid?
a) Threonine
b) Glutamine
c) Phenylalanine
d) Valine

23. Which of the following is a neutral amino acid?
a) Glycine
b) Lysine
c) Arginine
d) Histidine

24. Cysteine is a/an _____ amino acid.
a) acidic
b) essential
c) aromatic
d) sulphur containing

25. Identify the correct statement.
    a) Peptide bond is formed by the loss of water molecule
    b) A protein is made of only one type of amino acid
    c) Dipeptides consists of different amino acids
    d) Glycylalanine is a tripeptide

26. Which of the following is not a fibrous protein?
    a) Keratin b) Myosin
    c) Collagen d) Albumin

27. Enzymes are regarded as _____
    a) biocatalysts b) messengers
    c) inhibitors d) antibodies

28. Which of the following compounds is usually not produced by the human body?
    a) Hormones b) Nucleic acids
    c) Vitamins d) Enzymes

29. Which of the following vitamins are soluble in water?
    a) A b) C
    c) D d) E

30. Which of the following bases is not present in DNA?
    a) Adenine b) Guanine
    c) Thymine d) Uracil

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

Set-1

(lactose, oligosaccharides, monosaccharide, polysaccharides, sugars, Glucose)

1. Carbohydrates, which are sweet in taste, are also called _____.
2. The sugar present in milk is known as _____.
3. A carbohydrate that cannot be hydrolysed further to give simpler unit of polyhydroxy aldehyde or ketone is called a _____.
4. Carbohydrates that yield two to ten monosaccharide units, on hydrolysis, are called _____.
5. _____ is the example of monosaccharide.

Set-2

(reducing sugars, polysaccharides, Sucrose, glucose, ketose, aldose)

1. Carbohydrates which yield a large number of monosaccharide units on hydrolysis are called _____.
2. All monosaccharides whether aldose or ketose are _____.
3. If a monosaccharide contains an aldehyde group, it is known as an _____.
4. Ripe grapes also contain _____ in large amounts.
5. _____ is boiled with dilute HCl or H_2SO_4 in alcoholic solution, glucose and fructose are obtained in equal amounts.

Set-3

(hydrolysis, ketone, aldehyde, oxime, glucose, dextrose)

1. If a monosaccharide contains a _____ group, it is known as a ketose.
2. Commercially glucose is obtained by _____ of starch by boiling it with dilute H_2SO_4 at 393 K under pressure.
3. Glucose is an aldohexose and is also known as _____.
4. On prolonged heating with HI, _____ forms n-hexane.
5. Glucose reacts with hydroxylamine to form an _____.

Set-4

(saccharic acid, Acetylation, ketohexose, aldohexose, bromine water, dextrorotatory)

1. Glucose gets oxidised to gluconic acid on reaction with a mild oxidising agent like _____.
2. _____ of glucose with acetic anhydride gives glucose penta acetate.
3. On oxidation with nitric acid, glucose yield _____ .
4. Fructose is an important _____.
5. Sucrose is _____.

Set-5

(monosaccharide, insoluble, milk sugar, plants, α-glucose, soluble)

1. Lactose is more commonly known as _____.
2. Polysaccharides contain a large number of _____ units.
3. Starch is the main storage polysaccharide of _____.
4. Starch is a polymer of _____.
5. Amylose is water _____ component.

Set-6

(insoluble, soluble, zwitter ion, non-essential, α-amino acids, Carbohydrates)

1. Amylopectin is _____ in water.
2. _____ are essential for life in both plants and animals.
3. All proteins are polymers of _____.
4. The amino acids, which can be synthesised in the body, are known as _____ amino acids.
5. _____ is neutral but contains both positive and negative charges.

Two-mark questions

1. What are monosaccharides? Give an example.
2. What are oligosaccharides? Give an example.
3. What are polysaccharides? Give an example.
4. What are reducing sugars? Give an example.
5. What are aldose and ketose?
6. Explain the preparation of glucose from sucrose with equation.

7. Explain the preparation of glucose from starch with equation.
8. Give an example for aldohexose and ketohexose.
9. How do you show that glucose contains a linear chain of six carbon atoms? Write equation for it.
10. How do you show that glucose contains five hydroxyl groups? Write equation for it.
11. How do you show that glucose contains aldehyde group? Write equation for it.
12. Write the Haworth structure of sucrose.
13. Write the Haworth structure of maltose.
14. Write the Haworth structure of lactose.
15. Mention the two components present in starch.
16. What are the expected products of hydrolysis of lactose?
17. What are essential amino acids? Give an example.
18. What are non-essential amino acids? Give an example.
19. What is denaturation of proteins? Mention the structure of protein remains intact during this process.
20. What are enzymes? Name the enzyme which responsible for conversion of maltose to glucose.
21. What are fat soluble vitamins? Give an example.
22. What are water soluble vitamins? Give an example

Three-mark questions

1. What are anomers? Give the structures of two anomers of glucose.
2. Give the classification of carbohydrates on the basis of their behaviour on hydrolysis.
3. Write any three importance of carbohydrates.
4. Name the functional groups present in amino acids and write the general structure of α – amino acid.
5. (a) What is zwitter ion? Write the structure.
   (b) What is peptide linkage?
6. Explain the preparation Glycylalanine with equation.
7. Write a short note for the following;
   (a) Primary structure of proteins
   (b) Secondary structure of proteins
   (c) Tertiary structure of proteins
8. Write the products of oxidation of glucose with:
   (a) Bromine water
   (b) Nitric acid
   (c) Acetic anhydride
9. (a) What are vitamins? Deficiency of which vitamin causes scurvy?
   (b) What type of linkage is responsible for the formation of proteins?
10. Mention the three types of RNA.
11. (a) Describe two important functions of nucleic acids.
    (b) What is meant by glycosidic linkage?