

Practice Questions – Chemistry (Grade -12)

Physical Chemistry

Ionic Equilibrium

1. Which of the following represents the conjugate pair of NH_3 ?
a) NH_2^- b) NH_4^+
c) Both (a) and (b) d) N^{3-}

2. Conjugate base of H_2 is:
a) H_3^+ b) H_3^-
c) H^+ d) H^-

3. In the reaction $\text{I}_2 + \text{I}^- \rightarrow \text{I}_3^-$, which is the Lewis base?
a) I_2 b) I^-
c) I_3^- d) none of these

4. Which of the following is a Lewis acid?
a) H_2O b) SnCl_4
c) $\text{C}_2\text{H}_5\text{OH}$ d) Cl^-

5. Conjugate base of a strong acid is
a) a weak base b) a strong base
c) neutral d) a weak acid

6. The pH of an aqueous solution is:
a) $\log K_w$ b) pK_w
c) $\log[\text{H}^+]$ d) $\log \frac{1}{[\text{H}^+]}$

7. Purification of NaCl by passage of hydrogen chloride gas through brine is based on
a) Common ion effect b) Distribution Coefficient
c) Le Chatelier's principle d) Displacement law

8. The pH of a 0.1M solution of NH_4OH (having dissociation constant $K_b = 1.0 \times 10^{-5}$) is equal to:
a) 10 b) 6
c) 11 d) 12

9. Which of the following salt undergoes anionic hydrolysis?
a) CuSO_4 b) NH_4Cl
c) FeCl_3 d) Na_2CO_3

10. Out of the following, the compound whose water solution has the highest pH is:
a) NaCl b) Na_2CO_3
c) NH_4Cl d) NaHCO_3

11. 10^{-6} M NaOH is diluted by 100 times. The pH of diluted base is

23. Passing H_2S gas into a mixture of Mn^{2+} , Ni^{2+} , Cu^{2+} and Hg^{2+} ions in an acidified aqueous solution precipitates

 - a) CuS and HgS
 - b) MnS and CuS
 - c) MnS and NiS
 - d) NiS and HgS

24. Solubility of BaF_2 in solution of $\text{Ba}(\text{NO}_3)_2$ will be represented by the concentration term

 - a) $[\text{Ba}^{2+}]$
 - b) $[\text{F}^-]$
 - c) $\frac{1}{2} [\text{F}^-]$
 - d) $2[\text{NO}_3^-]$

25. When equal volumes of the following solutions are mixed, precipitation of AgCl ($K_{\text{sp}} = 1.8 \times 10^{-10}$) will occur only with

 - a) 10^{-4} M Ag^+ and 10^{-4} M Cl^-
 - b) 10^{-6} M Ag^+ and 10^{-5} M Cl^-
 - c) 10^{-8} M Ag^+ and 10^{-6} M Cl^-
 - d) 10^{-10} M Ag^+ and 10^{-10} M Cl^-

26. For preparing buffer solution of pH 6 by mixing sodium acetate and acetic acid, the ratio of the concentration of salt and acid should be ($K_a = 10^{-5}$)

 - a) 1:10
 - b) 10:1**
 - c) 100:1
 - d) 1:100

27. Which of the following statement is correct?

 - a) The pH of 10^{-8} M HCl is 8.
 - b) Aqueous solution of CuSO_4 is neutral.
 - c) BeCl_2 is a Lewis acid.
 - d) AgCl is more soluble in NH_3 than in water.

Short Answer Questions

- 1) 0.49 g of pure H_2SO_4 is dissolved in 500 mL of solution.

 - Calculate the molar concentrations of H_3O^+ and SO_4^{2-} in the solution. [2]
 - Calculate the pH of the solution. [Ans: 1.699] [1]
 - If the above solution is diluted to 5 litre, what would be the pH of the diluted solution? [Ans: 2.699] [2]

2. You are given two strong acids A and B with pH values 3 and 5 respectively.

 - If equal volumes of A and B are mixed together what will be the pH of the resulting solution. [Ans: 3.3] [2]
 - pH of a solution can be increased by adding a base. How many milligrams of NaOH must be added to 100 mL of acid A so that its pH becomes equal to that of B. [3.96 mg] [3]

3. pH of a solution depends upon a number of factors. Explain the following observations:

 - When 1 M hydrochloric acid is diluted, the pH rises. Eventually, the pH reaches a static value and does not change on further addition [1]
 - The pH of 10^{-8}M HCl solution is not 8. [2]
 - pH of pure water decreases with increase in temperature. [2]

4. Ionization of a weak acid HA is suppressed by the addition of a strong salt BA to its aqueous solution.

- a. What is this effect called? Write the principle behind it. [2]
- b. Does it have any effect on the pH of the acid? [1]
- c. How is this effect applied in salting out process during the manufacture of soap? [2]
5. Formation of NH_4^+ ion from NH_3 and H^+ is a neutralization process according to Lewis concept.
- a. Draw the Lewis structure of NH_4^+ [1]
- b. Which is Lewis acid and Lewis base? [1]
- c. Define Lewis acid and Lewis base. [1]
- d. Why this concept regards CO_2 as an acid though it does not contain hydrogen? [1]
- e. Do you agree with the statement "All Bronsted bases are also Lewis bases"? Justify your answer. [1]
6. Precipitation of an electrolyte takes place when its ionic product exceeds solubility product.
- a. What are ionic product and solubility product? [2]
- b. Should precipitation occur when 50 mL of $5.0 \times 10^{-4} M$ $\text{Ca}(\text{NO}_3)_2$ is mixed with 50 mL of $2.0 \times 10^{-4} M$ NaF to give 100 mL of solution? The K_{sp} of CaF_2 is 1.7×10^{-10} . [Ans: No] [3]
7. H_2S gas is passed through a solution containing equimolar amounts of Cu^{++} and Zn^{++} . (K_{sp} of $\text{CuS} = 8.0 \times 10^{-45}$ and K_{sp} of $\text{ZnS} = 3.0 \times 10^{-22}$)
- a. To which group Cu^{++} and Zn^{++} belong to in the group separation table of qualitative salt analysis? Also write their group reagents. [2]
- b. Which sulphide would be precipitated first and why? [1]
- c. If only one of the sulphide need to precipitate, would you add acid or alkali to the solution before bubbling H_2S ? Explain. [2]
8. The solubility product concept holds good only for sparingly soluble electrolytes.
- a. What is meant by sparingly soluble electrolytes? Give four examples [2]
- b. Point out any two differences between solubility and solubility product [2]
- c. How is solubility related to solubility product for $\text{Fe}(\text{OH})_3$? [1]
9. $\text{Mg}(\text{OH})_2$ has a solubility product value of 1.0×10^{-11} . What does it mean? [1]
- a. Calculate its solubility in g L^{-1} . [Ans: $7.87 \times 10^{-3} \text{ g L}^{-1}$] [2]
- b. Calculate the pH at which it begins to precipitate from a solution containing 0.1 M Mg^{2+} ions. [Ans: 9][2]
10. The relative value of ionic product and solubility product decides whether precipitation occurs or not.
- a. Point out the conditions under which precipitation occurs or not. Also state the solubility product principle. [2]
- b. The solubility product of BaSO_4 is 1.1×10^{-10} at 25°C . Will BaSO_4 precipitate if 1 millimole of H_2SO_4 is added to one litre of the saturated solution of BaSO_4 ? If yes, calculate the amount of BaSO_4 that will be precipitated. [3]

11. Weak electrolytes are partially ionized and there exists a dynamic equilibrium between ions present in solution and unionized molecules.

- What do you mean by degree of ionization? List the factors that affect degree of ionization.[2]
- Calculate the equilibrium concentration of various species present in 0.1 M solution of acetic acid. Given, $K_a = 1.7 \times 10^{-5}$ at $25^\circ C$. [Ans: 0.0987M, 0.0013M]{3}

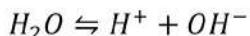
Long Answer Questions

1. pH is an important measure of hydrogen ion concentration of a solution. Approximate pH values of a few solutions are given below:

Solution	Vinegar	Milk	Blood	Urine
pH	3.0	6.6	7.4	6.0

- Define pH of a solution. How is it related to pOH at $25^\circ C$? [2]
- Calculate the H^+ ion concentration in each case. [1]
- If a person eliminates 1300 mL of urine per day, how many gram equivalents of the acid he/she eliminates per day? [Ans: 1.3×10^{-6}] [2]
- A sample of sour milk was found to be 0.1 M solution of lactic acid $CH_3CH(OH)COOH$. What is the pH of the sample of milk? K_a for lactic acid at $25^\circ C$ is 1.37×10^{-4} . [Ans: 2.43] [3]

2. Pure water ionizes by itself as follows:



- Obtain an expression for ionic product of water and write its value at $25^\circ C$. [2]
- How is ionic product of water affected by (i) increase in temperature and (ii) addition of an acid [2]
- Find the molarity of water if its density is 1000 gL^{-1} . [1]
- Use your knowledge of Ostwald's dilution law to find the value of degree of ionization of water at $25^\circ C$. [Ans: 1.8×10^{-9}] [3]

3. Bronsted and Lowry gave the protonic concept of acid and base.

- Define acid and base in terms of protonic concept. [1]
- Write suitable examples to show that water acts as Bronsted acid as well as Bronsted base. What are such substances called? [2]
- Define conjugate acid-base pair. Write conjugate acid and base of (i) NH_3 and (ii) HSO_4^- . [2]
- Conjugate acid of a weak base is always stronger. If so, what will be the order of strength of the following bases? [2]



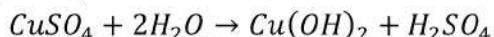
- Write a major drawback of this concept. [1]
- A typical basic buffer is obtained by mixing ammonia solution with ammonium chloride.
- Define a buffer solution and buffer action. [2]

b. How do you think this buffer solution resists the change in pH on adding a dilute solution of HCl? [2]

c. Calculate the pH of the buffer that contains 0.03 M NH₄OH and 0.04 M NH₄Cl. (K_b for ammonia is 1.8×10^{-5}) [Ans: 9.135] [2]

d. Explain the role of this buffer in selective precipitation of group IIIA metal ions. [2]

5. Copper sulphate when dissolved in water undergoes hydrolysis as follows:



a. Define hydrolysis of a salt. [1]

b. Write ionic reaction for the above hydrolysis and state whether cation or anion has undergone actual hydrolysis. [2]

b. What will be the result of blue and red litmus test on this solution. [1]

c. How can you detect the presence of SO₄²⁻ ion in the solution. Also write the reactions involved in the test. [2]

d. Borax (Na₂B₄O₇) is a sodium salt of boric acid (H₃BO₃) which is a weak acid. Do you think borax undergoes hydrolysis in water? Also predict whether its aqueous solution is acidic, basic or neutral. [2]

6. When AgNO₃ is added to solution containing Cl⁻ ions, white precipitate of AgCl is formed as a sparingly soluble salt.

a. What is the condition required for precipitation? [1]

b. At what condition precipitation may not form in above case? [1]

c. The solubility of AgCl in water at 25°C is 9.965×10^{-6} mol L⁻¹. Calculate its solubility in 0.5 M KCl solution. Also give the possible reason for the difference in solubility. [Ans: 1.986 × 10⁻¹⁰ mol L⁻¹] [3 +1]

d. Is AgCl more soluble than Ag₂CrO₄? (K_{sp} of Ag₂CrO₄ = 1.1×10^{-12}) [2]

7. Following table gives the ionization constant of different weak acids.

Acid	K _a
HCN	7.2×10^{-10}
HNO ₂	4.6×10^{-4}
CH ₃ COOH	1.8×10^{-5}

a. Arrange the above acids in increasing order of their strength. [1]

b. Write ionization constant expression for HNO₂. [1]

c. Compare the relative strength of CH₃COOH and HCN. [2]

d. Would there be any effect to the value of degree of ionization and ionization constant when CH₃COOH is added to the solution containing CH₃COONa? [1]

e. If 0.1 M binary electrolyte AB undergoes ionization by 3%, find the degree of ionization when it is diluted by 100 folds. [3]

8. Let us consider, you are given a weak electrolyte AB having initial concentration 'c' mol L⁻¹ and degree of ionization 'α'.

- f. How can you define weak electrolyte.[1]
- g. With the help of mathematical derivation show that 'the degree of ionization of weak electrolyte increases with dilution'.[3]
- h. Why Ostwald's law is not applicable in case of strong electrolyte?[1]
- i. Calculate the H⁺ ion concentration of CH₃COOH in (a) water (b) 0.2 M CH₃COONa (K_a for CH₃COOH is 1.76×10⁻⁵). [Ans: 1.33×10⁻³M, 8.8×10⁻⁶M] {1+2}

Chemical kinetics

Objective questions

1. The specific rate constant for a reaction depends on
 - a) Concentration of reactant
 - b) Concentration of product
 - c) Time
 - d) Temperature
2. The rate of the first order reaction depends on
 - a) Time
 - b) Concentration of reactant
 - c) Temperature
 - d) All of the above
3. When rate of the reaction is equal to rate constant the order of reaction will be
 - a) First
 - b) Second
 - c) Zero
 - d) Third
4. The hydrolysis of methyl acetate catalyzed by acid is the reaction of
 - a) Zero order
 - b) Pseudo First order
 - c) Second order
 - d) Third order
5. If the initial concentration of reactants is reduced to 1/4th in a zero order reaction, the time taken for half the reaction to complete
 - a) Remains same
 - b) Becomes 4 times
 - c) Becomes 1/4
 - d) Doubles
6. The half-life of reaction is halved as initial concentration of the reaction is doubled. The order of reaction will be
 - a) 1
 - b) 2
 - c) 3
 - d) 0
7. For a reaction N₂ + 3H₂ = 2NH₃, the rate of disappearance of H₂ is R, then rate of formation of NH₃ will be
 - a) 2R
 - b) 3R
 - c) 2R/3
 - d) R
8. The plot of lnK vs 1/T for a reaction gives the straight line. The slope of the line will be
 - a) -E_a/R
 - b) R/E_a

9. For a reaction the rate law is found to be, rate of reaction = $K [A]^{1/2} [B]^{3/2}$. The order of reaction will be

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

10. The unit of the rate constant is $\text{L}^2 \text{ mol}^{-2} \text{s}^{-1}$, the order of reaction will be

11. 75% of a first order reaction was completed in 32 minute, when was 50% of reaction completed?

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

12. The order of reaction is

- a) Sum of the stoichiometric coefficient of all reactants.
 - b) Sum of the stoichiometric coefficient of reactants on which rate depends.
 - c) Sum of power of concentration of reactants on which rate depends.**
 - d) Sum of power of concentration of all reactants.

13. Which of the following is not true for a chemical reaction?

- a) Order = 1, Molecularity = 0
 - b) Order = 1, Molecularity = 1
 - c) Order = 0, Molecularity = 1
 - d) Order = 2, Molecularity = 2

14. The average rate and instantaneous rate of a reaction are equal.....

- a) at start
 - b) at the end
 - c) in the middle
 - d) when two rates have time interval equal to zero

15. For a hypothetical reaction the unit of rate constant is atm s⁻¹. What is the order of reaction?

- a. First
 - b. Second
 - c. Third
 - d. zero

16. Lumps of coal burns slowly while the coal dust burns explosively. This is because of

- a. High mass of lumps of coal
 - b. Lower ignition temperature of coal dust

- c. Higher ignition temperature of coal dust
- d. Larger surface area of coal dust

17. What is the role of As_2O_3 during oxidation of SO_2 by using platinum?

- a. Promoter
- b. Inhibitor
- c. Poison
- d. Auto catalyst

18. The optimum pH for enzymatic reaction in human body is

- a) 4.7 b) 4.5 c) 7.4 d) 8.3

Short Answer Questions

1. For a reaction $2\text{N}_2\text{O}_5 \rightarrow 4\text{NO}_2 + \text{O}_2$, following data is obtained

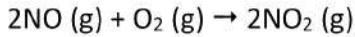
Time min	0	50	100	150	200	300	400	700	800
$[\text{N}_2\text{O}_5]$ mol L^{-1}	0.100	0.0905	0.0820	0.0741	0.0671	0.0549	0.0439	0.0210	0.017

- A. Calculate average rate of reaction a) between 0 and 50 min, b) between 200 and 300 min, c) between 700 and 800 min
- B. Make a plot of concentration vs time and find the rate of reaction at 600 min and 200 min graphically by drawing tangent.
2. Why is the concept of equivalence rate required? For the reaction:



The rate of formation of NO is $3.6 \times 10^{-3} \text{ mol L}^{-1}\text{s}^{-1}$. What are the rates of disappearance of NH_3 and O_2 ? Also calculate the rate of reaction. [Ans: $3.6 \times 10^{-3} \text{ mol L}^{-1}\text{s}^{-1}$, $4.5 \times 10^{-3} \text{ mol L}^{-1}\text{s}^{-1}$, $9 \times 10^{-4} \text{ mol L}^{-1}\text{s}^{-1}$]

3.. The following reaction takes place in one step:



Write the rate equation in terms of partial pressure. How many times the rate of reaction change if

(a) the partial pressure of NO is reduced to half but that of O₂ doubled. (b) the volume of the reacting vessel reduced to one-third. (c) an inert gas is added by keeping the volume constant (d) the temperature rises by 30°C.

4.. For the gaseous reaction



It is found that, Rate = $k[A][B]^2$. How many times does the rate of reaction increase or decrease if,

- (a) the partial pressures of both A and B are trebled.
- (b) the partial pressure of A is halved and of B is doubled.
- (c) the volume of the vessel is doubled.
- (d) the overall pressure is doubled by adding an inert gas at constant volume.
- (e) the temperature of the system is raised by 40°C.

5. Rate of the reaction: A + B → Product is given below as a function of different initial concentrations of A and B.

Expt. No.	[A] ₀ (mol L ⁻¹)	[B] ₀ (mol L ⁻¹)	Initial rate (mol L ⁻¹ min ⁻¹)
1	0.01	0.01	0.005
2	0.02	0.01	0.010
3	0.01	0.02	0.005

Determine the order of the reaction w.r.t A and B and overall order. What is the half-life of A in the reaction?

6. For the reaction $2NO + Cl_2 \longrightarrow 2NOCl$, the following data are obtained

[Cl ₂] ₀ mol L ⁻¹	[NO] ₀ mol L ⁻¹	initial rate, mol L ⁻¹ sec ⁻¹
0.02	0.01	2.4×10^{-4}
0.02	0.03	2.16×10^{-3}
0.04	0.03	4.32×10^{-3}

Determine the

- a) Order with respect to NO and Cl₂
- b) Overall order
- c) Rate law
- d) Rate of reaction when the concentration of NO and Cl₂ is 0.3 mol L⁻¹ and 0.2 mol L⁻¹ respectively.

7. According to collision theory of reaction rate there must be effective collision between reactant molecules in order to give product.

- a) What are the conditions for effective collision?
- b) What is energy barrier?
- c) Define activation energy.

- d) The rate of most reactions doubles when their temperature is raised from 25°C to 35°C. Calculate their activation energy.
8. The velocity of chemical reaction can be expressed in terms of rate of reaction and there the various factors affecting the rate of reaction.
- Powdered coal burns faster than a lump of coal why?
 - Explain the role of a catalyst on the reaction rate with the help of energy profile diagram.(1)
 - How temperature affect rate of reaction?
 - Define average rate and instantaneous rate of reaction. Why is the instantaneous rate preferred over the average rate?

Long Answer Questions

1. A reaction $A \rightarrow B$ follows the zero order kinetics. The differential rate equation for the reaction can be expressed as

$$-\frac{d[A]}{dt} = k [A]^0$$

Answer the following questions

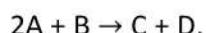
- Obtain the expression for 'k' by integrating above differential rate law. Also write its unit. (2)
- For above reaction how would you determine the value of 'k' graphically? (1)
- Define half-life and obtain the expression for half-life for the above reaction. (2)
- Show that for a first order reaction time required for completion of $\frac{3}{4}$ th of reaction is twice the half-life time. (3)

2. A reaction $A \rightarrow B$ follows the first order kinetics. The differential rate equation for the reaction can be expressed as

$$-\frac{d[A]}{dt} = k [A]$$

Answer the following questions

- Obtain the expression for 'k' by integrating above differential rate law. (2)
 - How would you determine the value of 'k' graphically? (1)
 - Define half-life and obtain the expression for half-life for the reaction. (2)
 - 50% completion of a first order reaction takes place in 16 minutes. What is the fraction that would react in 32 minutes? (3)
3. Differentiate between order and molecularity of a reaction. The following rate data were obtained at 300 K for the reaction:



Expt. No.	[A], mol L ⁻¹	[B], mol L ⁻¹	Rate of formation of D, mol L ⁻¹ min ⁻¹
1	0.1	0.1	7×10^{-3}
2	0.3	0.2	8.4×10^{-2}
3	0.3	0.4	3.36×10^{-1}
4	0.4	0.1	2.8×10^{-2}

- a. Find the order w.r.t. each reactant and overall order
 - b. Find out the rate constant with its units.
 - c. Find the rate of disappearance of A when [A] = [B] = 0.1 mol L⁻¹.
- [Ans: (a) orders w.r.t A and B = 1 and 2, overall order = 3, (b) $7 \text{ mol}^{-2} \text{ L}^2 \text{ min}^{-1}$, (c) $1.4 \times 10^{-2} \text{ mol L}^{-1} \text{ min}^{-1}$]

Thermodynamics

1. Which one of the following sets of units represents the smallest and the largest amount of energy respectively?
 (a) J and erg (b) erg and cal (c) erg and L atm (d) eV and L atm
2. Which of the following is an intensive property?
 (a) Mass (b) Volume (c) Density (d) Energy
3. Which of the following is not a state function?
 (a) q + w (b) q/w (c) H/T (d) E + PV
4. One mole of an ideal gas expands spontaneously into a vacuum. The work done is
 (a) 1J (b) 2J (c) Zero (d) Can not be predicted
5. During isothermal expansion of an ideal gas, its
 (a) enthalpy remains constant (b) enthalpy decreases
 (c) internal energy increases (d) internal energy decreases
6. The heat absorbed in a reaction at constant temperature and constant volume is
 (a) ΔH (b) ΔE (c) $-\Delta A$ (d) $-\Delta G$
7. The enthalpies of all elements in their standard states are
 (a) unity (b) zero (c) < 0 (d) > 0
8. The difference between ΔH and ΔE at constant volume is equal to
 (a) R (b) $P\Delta V$ (c) $V\Delta P$ (d) $\frac{3R}{2}$
9. ΔE is always positive when
 - (a) system absorbs heat and work is done on it.
 - (b) system emits heat and work is done on it.
 - (c) system emits heat and no work is done on it.
 - (d) system absorbs heat and work is done by it.
10. For the reaction: $\text{CO}_2(\text{g}) + \text{C}(\text{s}) \rightarrow 2\text{CO}(\text{g})$, which of the following statements is correct?
 (a) $\Delta H = \Delta E$ (b) $\Delta H > \Delta E$ (c) $\Delta H < \Delta E$ (d) $\Delta H = 0$

11. For an endothermic reaction where ΔH represents the enthalpy of the reaction, the minimum value for the energy of activation will be

- (a) less than ΔH (b) zero (c) more than ΔH (d) equal to ΔH

12. For the reaction $A \rightarrow B$, $\Delta H = +24$ KJ/mole

For the reaction $B \rightarrow C$, $\Delta H = -18$ KJ/mole

The decreasing order of enthalpy of A, B, C is

- (a) A, B, C (b) B, C, A (c) C, B, A (d) C, A, B

13. Enthalpy of formation of compound is

- (a) Always positive (b) Always negative (c) Either negative or zero (d) Either positive or negative

14. The reaction: $SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g)$ should be

- (a) Endothermic (b) Exothermic (c) $\Delta H = 0$ (d) Unpredictable

15. Heat of formation, ΔH°_f of an explosive compound like NCI_3 is

- (a) positive (b) negative (c) zero (d) positive or negative

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

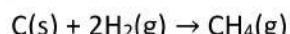
Short Answer Questions

1. A thermodynamic system is the part of universe which is under study, which consists of definite amount of matter and energy.

a) Consider you have a bottle of water, then how can you relate with system , surrounding and boundary ?

b) Define internal energy and enthalpy of system.

c) The enthalpy change (ΔH) for the reaction.



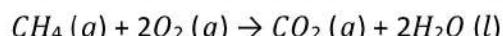
is -17.89 Kcal at 298K. What is ΔE at 298K?

2. Boundary is the real or imaginary line surface which separates system from surroundings.

a) Mention the types of system depending upon exchange of matter and energy between system and surrounding.

b) How do extensive properties differ from intensive properties?

c) The internal energy change (ΔE) for the reaction



is -885 KJ at 298 K. What is ΔH at 298 K?

3. a) What is meant by state functions of a system? Give examples.

b) What do you mean by a thermodynamic process? Name the different types of the processes.

c) What is the difference between an isothermal and an adiabatic process?

4. a) What is a cyclic process? Is there any enthalpy change in a cyclic process?
 b) What do you mean by thermodynamically reversible and irreversible processes?
 c) Define heat and work. Give their sign conventions.
5. The absolute entropies of $N_2(g)$, $H_2(g)$ and $NH_3(g)$ are 191.0, 130.6 and $193\text{ JK}^{-1}\text{mol}^{-1}$ respectively. Answer the following questions
- Calculate ΔS_{sys} for a reaction $N_2 + 3H_2 = 2 NH_3$ (2)
 - Calculate ΔS_{surr} for above reaction at $25^\circ C$ provided that enthalpy change for reaction is -92.6 kJ . (1)
 - Calculate ΔS_{uni} and predict the spontaneity of reaction at $25^\circ C$ (2) [-196.8, 310.7 and $+113.9\text{ JK}^{-1}$, spontaneous]
6. For a reaction $2NO + O_2 = 2 NO_2$, enthalpy change and entropy change are -113 kJ mol^{-1} and $-145\text{ JK}^{-1}\text{mol}^{-1}$ respectively. Answer the following questions
- Define standard enthalpy of formation of compound. (1)
 - Predict the spontaneity of the reaction at $25^\circ C$ (2)
 - Does this reaction attain equilibrium? If so at what temperature reaction is at equilibrium. (2) [-69.79 kJ mol^{-1} , spontaneous, rxn attains equilibrium at 779.3 K]
7. Gibb's Helmholtz equation gives a mathematical relation between enthalpy change, entropy change and free energy change as $\Delta G = \Delta H - T\Delta S$.
- Obtain the above relation. (2)
 - With the help of above equation explain the criteria of spontaneity of exothermic and endothermic reaction. (3)
8. Free energy is defined as $G = H - TS$, where H is enthalpy, S entropy and T temperature in kelvin. Answer the following questions.
- What is free energy change? Obtain the mathematical relation between free energy change, enthalpy change and entropy change. (2)
 - How the value of free energy change explains the criteria of spontaneity of reaction. (3)
 - Show that net useful work obtained from the process carried out at constant temperature and pressure is equal to decrease in free energy. (3)
9. Standard free energy of formation of some compounds are given in table

Substances	$\Delta G^\circ \text{ kJ mol}^{-1}$
$NO(g)$	87.7
$Cl_2(g)$	0
$NOCl(g)$	66.3

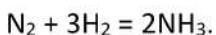
Answer the following questions

- a) Define standard free energy of formation. (1)
- b) Calculate standard free energy of reaction $2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) = 2\text{NOCl}(\text{g})$ using data from table. (2)
- c) Calculate equilibrium constant for above reaction at 298 K. (2) [-42.6 kJ, 3.16×10^7]

10. a) State first law of thermodynamics. (1)

- b) Obtain the mathematical formulation of first law of thermodynamics and give the sign convention used in that formulation. (2)
- c) State the second law of thermodynamics in terms of entropy. (2)

11. Ammonia can be manufactured by Haber's process according to following equation



- a) The table contains the mean bond energies

Bond	Bond energy, kJ mol^{-1}
$\text{N}\equiv\text{N}$	944
H-H	436
N-H	388

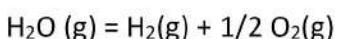
Calculate the value of enthalpy of formation of one mole of ammonia. (2)

- b) Following table contains some entropy data, use these data to calculate entropy of formation of one mole of ammonia. (2)

	entropy, $\text{J K}^{-1} \text{mol}^{-1}$
N_2	192
H_2	131
NH_3	193

- c) The synthesis of ammonia is usually carried out at 800 K. Use the results obtained from above calculation (a and b), calculate the value of ΔG for the reaction at this temperature and comment on feasibility of reaction at 800 K (1) [-38 kJ mol^{-1} , -99.5 $\text{J K}^{-1} \text{mol}^{-1}$, -41.6 kJ, spontaneous]

12. The following reaction becomes feasible at temperature above 5440 K



The entropies of the species are given in table

	entropy, $\text{J K}^{-1} \text{mol}^{-1}$
H_2O	189
H_2	131
O_2	205

- a) Define entropy of system. (1)
- b) Calculate entropy change for the reaction. (2)
- c) Calculate enthalpy change for reaction at 5440 K (2) [44.5 J K^{-1} , 242.08 kJ]

13. The first law of thermodynamics is simply the law of conservation of energy which states that 'energy can neither be created nor destroyed however it can be converted from one form to another form'.

- a) Obtain the mathematical formulation of first law of thermodynamics and give the sign convention used in that formulation. [2]
- d) How can you define internal energy of system? [1]
- e) At what condition there would be exchange of energy between systems and surrounding as work? [1]
- f) If 10 kJ work is done on a system and 3 kJ of heat is given out by the system. Calculate the change in internal energy of system. [1]
14. First law of thermodynamics is unable to explain extent and direction of convertibility of one form of energy to another form. Moreover, it can't explain unidirectional nature of spontaneous process.
- a) State the second law of thermodynamics in terms of entropy. [2]
- b) Show that the transfer of heat from system at higher temperature to surrounding at lower temperature is spontaneous. [2]
- c) How much work is done by the system, if internal energy of the system decreases by 100J when 200J of heat is supplied to the system? [1]

Long Answer Questions

1. The standard enthalpy of combustion of some element and compounds are given in table

Substances	$\Delta H^\circ_c \text{ kJ mol}^{-1}$
H ₂ (g)	-286
C (s)	-395
C ₂ H ₅ OH (l)	-1376
CH ₃ OH (l)	-736

Answer the following questions

- a) Define standard enthalpy of combustion of compounds. (1)
- b) Can enthalpy of combustion be positive value? If so why? (1)
- c) Calculate enthalpy of formation of C₂H₅OH (l) from the data given in table. (3)
- d) Calculate the amount of heat produced by burning 1 kg each of CH₃OH and C₂H₅OH.
Which alcohol acts as best fuel? (3) [- 272 kJ mol⁻¹, 29913 and 23000 kJ, ethanol is best]

2. For a reaction $2\text{NO} + \text{O}_2 \rightarrow 2 \text{NO}_2$, enthalpy change and entropy change are -113 kJ mol^{-1} and $-145 \text{ JK}^{-1}\text{mol}^{-1}$ respectively. Answer the following questions

- a) Define standard enthalpy of formation of compound. [1]
- b) Predict the spontaneity of the reaction at 25 °C. [2]
- c) Does this reaction attain equilibrium? If so at what temperature reaction is at equilibrium. [2]
- d) With the help of Gibbs- Helmholtz equation explain the criteria of spontaneity of exothermic and endothermic reaction. [3]

Volumetric Analysis

1) How many gram equivalents are present in 480 gram of oxygen?

- a) 15 b) **30** c) 60 d) 480

2) How many gram of magnesium would be there in its 4 equivalent?

- a) **48 g** b) 56 g c) 4 g d) 24 g

3) The equivalent mass of Al_2O_3 is

- a) **17** b) 71 c) 102 d) none

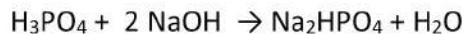
4) Equivalent mass of $\text{Al}_2(\text{SO}_4)_3$ is equal to

- a) $M/2$ b) $M/3$ c) $M/5$ d) **$M/6$**

5) Equivalent mass of KMnO_4 in acidic medium is equal to

- a) $M/2$ b) $M/3$ c) **$M/5$** d) $M/6$

6) The equivalent mass of H_3PO_4 in the following reaction is



- a) 98 b) **49** c) 32.6 d) 52.6

7) Which of the following is the eq. mass of $\text{K}_2\text{Cr}_2\text{O}_7$ in the following reaction.



- a) 98 b) **49** c) 94 d) 294

8) The unit of equivalent mass is

- a) amu b) gram c) kg d) **none**

9) 2.1 g of anhydrous barium chloride solution is completely converted into 2.36 g of barium sulphate on treating with excess sulphuric acid solution. The equivalent mass of barium is

- a) 25.45 b) **65.46** c) 72.6 d) 42.68

10) 1.8 g of acid when treated with excess magnesium metal produces 2.34 g of magnesium salt. The equivalent mass of acid is:

- a) 36.67 b) **73** c) 62 d) 23.25

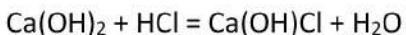
11) 2.8 g of metal is dissolved in nitric acid to give metal nitrate, which produces 4.66 g of oxide on strong heating. The equivalent mass of metal is

- a) **12** b) 22.4 c) 28 d) 36

12) The 0.257 g of a metal produces 120 mL of dry hydrogen gas at STP when treated with excess sulphuric acid solution. The equivalent mass of metal is

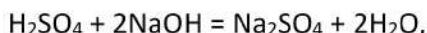
- a) **23.9** b) 22.9 c) 13.9 d) 49.3

13) The equivalent mass of $\text{Ca}(\text{OH})_2$ in following reaction is



- a) **74** b) 38 c) 36.5 d) 18

14) The equivalent mass of sulphuric acid in reaction:



- a) 49 b) 98 c) 40 d) 80

15) 0.04 % w/v solution of H_2SO_4 is equivalent to

- a) 4 ppm b) 40 ppm c) **400 ppm** d) 4000 ppm

16) The mass of anhydrous sodium carbonate required to prepare 250 mL decinormal solution is

- a) 2.650 g b) **1.325 g** c) 0.1325 g d) 0.2650 g

17) The normality of orthophosphoric acid having purity 70 % by weight and sp.gr 1.54

- a) 11 N b) 22 N, c) **33 N** d) 44 N

18) It is found that 500 mL of water sample collected from Tarai region contains 0.01 g of arsenic. The concentration of arsenic in ppm is

- a) 2 b) **20** c) 200 d) 2000

19) 200 mL of 0.2M HCl is neutralized with 0.1M NaOH. Then during half neutralization, what will be the molarity of HCl?

- a) 1M b) 0.1M c) 0.5M d) **0.05M**

20) What volume of N/2 & N/10 HCl must be mixed to give 4 litre of N/5 HCl

- a) 0.5L & 3.5L c) 2L & 2L
b) 1.5L & 2.5L d) 1L & 3L

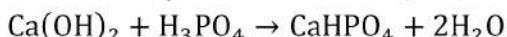
Short Answer Questions

1. Equivalent mass of certain metals can be determined by hydrogen displacement method.

a) Why this method is not applicable to determine equivalent mass of metals like Cu, Ag, Au?(1)

b) How can you determine the pressure of dry hydrogen gas collected in eudiometer tube? (1)

c) Calculate the equivalent mass of H_3PO_4 in the following reactions: (1)



d) A metal of equivalent mass 15 displaces 29 cc of H_2 at 660 mm pressure and 35°C. If aqueous tension at this temperature is 42 mm, find the mass of the metal reacted with the acid. (2)

2. Equivalent mass is the mass of given substance which will combine with or displaces a fixed quantity of another substance.

a) Can we determine equivalent mass of zinc metal by hydrogen displacement method?(1)

b) what is aqueous tension? (1)

c) A metal oxide having formula MO has equivalent mass of 20. Find the atomic mass of M. (1)

d) A chloride of an element contains 58.68 % of chlorine. Calculate the equivalent mass and valency of the element if the vapour density of the chloride is 91.

3. The strength of the solution can be expressed by using different concentration terms. Answer the following questions

- a) Define normality and molarity of the solution. (1)
- b) How are normality and molarity of acid related to each other? (1)
- c) How does molarity differ from molality? (1)
- d) Calculate the volume of commercial sulphuric acid solution containing 98 % by weight having specific gravity 1.84 required to prepare 250 mL decinormal solution.(2)

4. The solution which needs to be standardized with the help of suitable primary standard solution is called secondary standard solution.

- a) Define primary standard solution. (1)
- b) Give any two examples of each of primary standard and secondary standard substance.(1)
- c) Why is it necessary to calculate normality factor in volumetric analysis? (1)
- d) if 0.635 gram of oxalic acid crystals ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) was taken to prepare its 100 ml decinormal solution, find the normality factor and calculate its exact concentration.(2)

5. The strength of the solution can be expressed by using different concentration terms. Answer the following questions

- a) Define normality and molarity of the solution. (1)
- b) How are normality and molarity of acid related to each other? (1)
- c) How does molarity differ from molality? (1)
- d) Calculate the molality of 10% (w/w) H_2SO_4 solution. (2)

6. a) what is titration? [1]

- b) Differentiate between end point and equivalence point. [2]
- c) 20 mL of sulphuric acid neutralizes 10 mL of 0.5N solution of sodium carbonate. What volume of water must be added to 500 mL of the acid to make it exactly decinormal. [2]

7. a) Is solution of oxalic acid crystal primary standard? if so why? [1]

b) Differentiate between primary and secondary standard solution. [2]

- c) A sample of sulphuric acid having specific gravity 1.51 contains 60.65% of H_2SO_4 by mass. Find the molarity and normality of the acid. [2]

8. The solution which needs to be standardized with the help of suitable primary standard solution is called secondary standard solution.

- a) Define primary standard solution. (1)
- b) Give any two examples of each of primary standard and secondary standard substance.(1)
- c) Why is it necessary to calculate normality factor in volumetric analysis? (1)
- d) if 0.635 gram of oxalic acid crystals ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) was taken to prepare its 100 ml decinormal solution, find the normality factor and calculate its exact concentration.(2)

9. Titration is the experimental procedure of volumetric analysis, which involves determination of concentration of unknown solution by measuring its volume required to react completely with definite volume of another solution of known concentration. [1+1+3]

- a) How does end point of titration differ from equivalence point?
- b) What is titration error?

c) 7.8 g of dibasic acid is dissolved in water and the solution is made up to 250 mL. 25 mL of this solution required 32 mL of 0.5 N NaOH for neutralization, find the molar mass of acid.

10. Gastric juice contains hydrochloric acid. The quantitative estimation can be performed by titrating with standard Na_2CO_3 solution.

- Suggest the experimental design for estimation of HCl in gastric juice. [1]
- Which indicator is suitable for this titration? Justify your answer. [1]
- 2.014 g of sample of chalk was dissolved in 50 mL of 1N HCl. The remaining unchanged acid required 10.7 mL of 1N NaOH for neutralization. Find percentage of pure CaCO_3 in the chalk. [3]

11. The underlying principle of volumetric analysis is Law of chemical equivalence which states that the substances react in their equivalent proportion.

- Define decinormal solution.
- 3.12g of soda crystal ($\text{Na}_2\text{CO}_3 \cdot \text{XH}_2\text{O}$) were dissolved in 250 mL of water. 20 mL of resulting solution required 21.8 mL of N/10 H_2SO_4 for exact neutralization. Calculate the percentage of anhydrous Na_2CO_3 in the crustal and also the value of x. [Ans: 37.03%, 10]

12. The mathematical equation $V_1N_1 = V_2N_2$ is called normality equation which is based on law of chemical equivalence.

- Derive normality equation.
- A piece of Mg ribbon is completely dissolved in 40 ml of N/10 HCl. The excess of the acid requires 15 ml of N/5 NaOH for neutralization. Find the mass of Mg. [Ans: 0.012g]

13. The concentration of KMnO_4 solution can be determined by taking its definite volume and titrating against standard oxalic acid solution in acidic medium. Answer the following questions.

- Define redox titration.
- Find equivalent mass of KMnO_4 and oxalic acid. (Given, molecular mass of KMnO_4 and oxalic acid is 158 and 126 respectively). [Ans: 31.6, 63]
- How would you detect end point in this titration?
- Why KMnO_4 is called secondary standard solution?
- If 10 ml of KMnO_4 solution require 10.5 ml of 0.1 N ($f = 1.02$) oxalic acid solution, find the concentration of KMnO_4 in terms of gram per litre. [Ans; 3.38]

14. The auxiliary substances which are used during acid base titration to indicate the completion of titration are called acid – base indicators.

- Suggest two commonly used acid-base indicator with their pH range?
- What is titration curve?

- c. How would you select a suitable indicator for particular titration?
- d. Why titration of weak acid and weak base is not followed by using acid base indicator?

Long Answer Questions

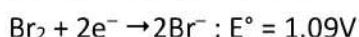
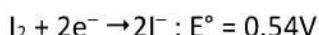
1. Primary standard solution can be prepared by direct weighing exact quantity of the substance and dissolving in water to make definite volume of solution. Answer the following questions

- a) What are pre-requisite of primary standard substances? (2)
 - b) Give two examples of primary standard substance. (1)
 - c) What are the differences between primary standard solution and secondary standard solution? (1)
 - d) How would you prepare 250 mL decimormal solution of anhydrous solution? (1)
 - e) What is the role of factor (f) during the preparation of primary standard solution? (1)
 - f) A student weighs 1.562 g of oxalic acid dehydrate crystal to make 250 mL of decimormal solution of it. Express the actual concentration using the term factor. (2)
2. The amount of substance present in definite volume of solution is concentration of solution and a solution of known concentration is called standard solution.
- a) What are molar and normal solutions? (1)
 - b) How can you relate normality of solution with molarity? (1)
 - c) What would be the effect of temperature on molarity and molality of solution? (1)
 - d) Solution of anhydrous sodium carbonate is primary standard but that of sodium hydroxide is secondary standard why? (1)
 - e) 26.5 g of sodium carbonate is dissolved in 250 mL of solution find the concentration of solution in terms of (2)
 - i) Normality
 - ii) Molarity
 - iii) gram per litre
 - iv) %w/v
 - f) The density of 3M solution of NaCl is 1.25 g mL^{-1} . Calculate the molality of the solution. (2)
3. Primary standard solution can be prepared by direct weighing exact quantity of the substance and dissolving in water to make definite volume of solution. Answer the following questions.
- a) What are pre-requisite of primary standard substances? (2)
 - b) Give two examples of primary standard substance. (1)
 - c) What are the differences between primary standard solution and secondary standard solution? (1)
 - d) How would you prepare 250 mL decimormal solution of sodium hydroxide? (1)
 - e) What is the role of factor (f) during the preparation of primary standard solution? (1)
 - f) A student weighs 0.55 g of anhydrous sodium carbonate to make 100 mL of decimormal solution of it. Express the actual concentration using the term factor. (2)
4. In a particular Acid - base titration a suitable indicator is selected such that, the pH range of indicator should coincide with pH change of resulting solution near equivalence point.
- a) What is acidimetry? [1]

- b) What indicator would you suggest for titration between oxalic acid and sodium hydroxide? [1]
- c) what is titration error? how can it be minimized? [1]
- d) Why do we observe pink colour while adding phenolphthalein to basic solution? [2]
- e) 0.4g of a metal was dissolved in 50 mL of 0.64N HCl and the solution was diluted to 100 mL. 25 mL of this solution then required 27.3 mL of 0.11N NaOH for neutralization. Find the equivalent mass of the metal. [3] [Ans: 20]

Electrochemistry

1. Given that



Predict which of the following is true?

- (a) I^- ions will be able to reduce bromine
- (b) Br^- ions will be able to reduce iodine
- (c) Iodine will be able to reduce bromine
- (d) Bromine will be able to reduce iodide ions

2. When $E^\circ_{Ag^+/Ag} = 0.8V$ and $E^\circ_{Zn^{2+}/Zn} = -0.76V$, which of the following is correct?

- (a) Ag can reduce Zn^{2+} ion
- (b) Ag^+ can be reduced by H_2
- (c) Ag can oxidize H_2 into H^+
- (d) Zn^{2+} can be reduced by H_2

3. The standard reduction potential values of A, B and C are 0.68V, -2.54V, -0.50V respectively.

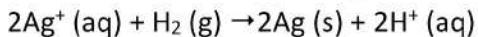
The order of their reducing power is

- (a) A > B > C (b) A > C > B (c) C > B > A (d) B > C > A

4. The standard reduction potentials of Li^+/Li , Ba^{2+}/Ba , Na^+/Na and Mg^{2+}/Mg are -3.05, -2.73, -2.71 and -2.37V respectively. Which one of the following is the strongest oxidizing agent?

- (a) Na^+ (b) Li^+ (c) Ba^{2+} (d) Mg^{2+}

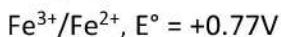
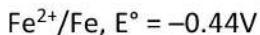
5. The emf of the cell involving the reaction



is 0.80V. The standard oxidation potential of silver electrode is

- (a) 0.80V (b) -0.80V (c) 0.40V (d) 0.20V

6. Standard electrode potentials are



If Fe^{2+} , Fe^{3+} and Fe block are kept together then

- (a) Fe^{3+} increases (b) Fe^{3+} decrease
- (c) Fe^{2+}/Fe^{3+} remains unchanged (d) Fe^{2+} decreases

7. Given that

- (i) $\text{Zn}^{2+} + 2\text{e}^- \rightarrow \text{Zn}$, $E^\circ = -0.763\text{V}$
- (ii) $\text{Mg}^{2+} + 2\text{e}^- \rightarrow \text{Mg}$, $E^\circ = -2.363\text{V}$

When Zn dust is added to MgCl_2 solution, then

- (a) Zn is dissolved (b) ZnCl_2 is formed
- (c) Mg crystallize out (d) No reaction

8. In a galvanic cell

- (a) Anode is +ve and cathode is -ve
- (b) Anode is -ve and cathode is +ve
- (c) Anode and cathode both +ve
- (d) Anode and cathode both -ve

9. The device which converts electrical energy into chemical energy is

- (a) Electrolytic cell (b) Dry cell
- (c) Daniel cell (d) Galvanic cell

10. Lead acid cell is the example of

- (a) Primary cell (b) Secondary cell
- (c) Fuel cell (d) Electrolytic cell

Answers

1.(a)	2.(b)	3.(d)	4.(d)	5.(b)	6.(b)	7.(d)	8.(b)	9.(a)	10.(b)
-------	-------	-------	-------	-------	-------	-------	-------	-------	--------

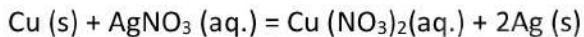
Short Answer Questions

1. The relative electrode potential of zinc electrode system is determined by coupling it with some reference electrode such as hydrogen electrode (SHE) or saturated calomel electrode (SCE).
 - a. What is standard electrode potential ? (1)
 - b. How electrode potential is originated? (1)
 - c. Zinc electrode is coupled with SCE as: $\text{SCE}/\text{Zn}^{2+}(\text{aq})/\text{Zn}$. The cell potential measured in standard condition is found to be -1.0 V . If standard electrode potential of SCE is $+0.24\text{ V}$, calculate electrode potential of zinc.(2)
 - d. IF SHE is coupled with zinc electrode in place of SCE (as mentioned in c), what will be the cell potential of cell: $\text{SHE}/\text{Zn}^{2+}(\text{aq})/\text{Zn}$ (1)
2. A galvanic cell is constructed using Cu and Ni electrode as $\text{Ni}/\text{Ni}^{2+}(\text{aq})/\text//\text{Cu}^{2+}(\text{aq})/\text{Cu}$.
Answer the following questions
 - a. Identify anode and cathode in this cell. (1)
 - b. Write the half reaction at each electrode and overall cell reaction.(2)
 - c. What will be the cell potential if standard potential of Ni and Cu electrode, $E^\circ_{\text{Ni}^{2+}/\text{Ni}} = -0.25\text{ V}$, $E^\circ_{\text{Cu}^{2+}/\text{Cu}} = +0.34\text{ V}$ (1)

- d. Can we replace the cathode of above cell using Zinc electrode. Suggest suitable explanation for you answer. $E^\circ_{Zn^{2+}/Zn} = -0.76$ V (1)
3. An electrochemical cell is a device that can convert either chemical energy to electrical energy or electrical energy to chemical energy. Answer the following questions.
- What is a galvanic cell? (1)
 - How does galvanic cell differ from electrolytic cell? (2)
 - What is salt bridge? Why salt bridge is used in galvanic cell? (1)
 - Write the cell notation for cell reaction $Fe + H_2SO_4 = FeSO_4 + H_2$ (1)
4. You are given standard potential, $E^\circ_{Zn^{2+}/Zn} = -0.76$ V, $E^\circ_{Mg^{2+}/Mg} = -2.38$ V. Answer the following questions.
- Construct the galvanic cell indicating anode and cathode. (1)
 - Write half-cell reaction and complete cell reaction. (2)
 - Calculate cell potential for the cell. (1)
 - Can we store the $MgSO_4$ solution in copper vessel? Given standard potential $E^\circ_{Zn^{2+}/Zn} = +0.34$ V (1)

Long Answer Questions

1. A student want to construct galvanic cell using the redox reaction



- Give diagrammatic sketch of a galvanic cell for above cell reaction. (2)
- Which is anode and which is cathode? (1)
- In which direction flow of electron takes place? (1)
- Write cell notation for above cell. (1)
- If standard potential of Cu and Ag electrode are +0.34 V and +0.80 V respectively, calculate cell emf for above cell. Also calculate net useful work obtained from that cell. (3)

2. A part of electrochemical series is given below. Answer the following questions.

Electrode reaction.	E° Volt.
$OX + ne \rightarrow R$	
$Zn^{2+} + 2e \rightarrow Zn$	-0.76
$Fe^{2+} + 2e \rightarrow Fe$	-0.44
$Ni^{2+} + 2e \rightarrow Ni$	-0.23
$Pb^{2+} + 2e \rightarrow Pb$	-0.13
$2H^+ + 2e \rightarrow H_2$	0.00
$Cu^{2+} + e \rightarrow Cu^{+}$	+0.16
$Cu^{2+} + 2e \rightarrow Cu$	+0.34

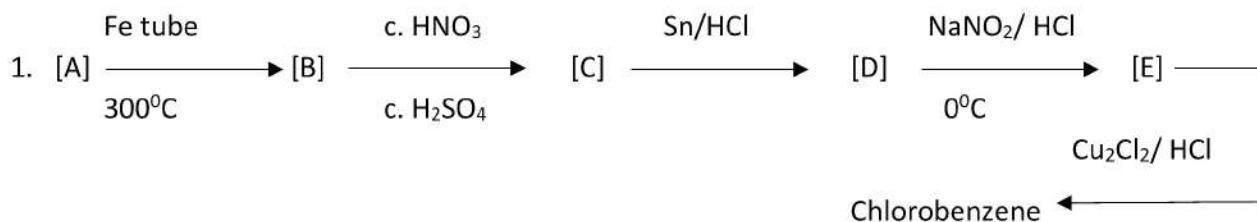
- Identify best oxidizing agent and best reducing agent from the species given in table. (1)
- Copper is found in two different oxidation state. Which of them (Cu^{2+} or Cu^+) has greater tendency to be reduced. (1)

- c. If we construct a galvanic cell using Zn and Pb electrode, what will be the cell potential? (1)
- d. Which two electrodes give maximum cell potential? (1)
- e. Can we stirred CuSO₄ solution by nickel rod? (1)
- f. Write the Nernst equation for Fe-electrode. Also calculate potential of Fe electrode, when dipped into the solution of 0.1 M FeSO₄ solution. (3)

Question collection for grade XII 2078

Topic: Haloalkane and Haloarene

[8]



Identify [A], [B], [C], [D] and [E].

- How would you prepare [A] from chloroform?
- What happens when [C] is reduced with Zn/ NH₄Cl?
- Give a reaction for preparation of DDT from chlorobenzene.

Bleaching powder/ Δ

(2+1+1+1)

- Ethanol \longrightarrow [A]
 - What happens when [A] is nitrated? And what is the use of the product?
 - Medically useful compound is formed when [A] is condensed with acetone in basic medium. Give the reaction.
 - Why is the use of chloroform discouraged as anesthetic agent nowadays?
- What happens when
 - 1-propanol is heated with conc sulphuric acid at 140°C.
 - benzene diazonium chloride is heated with Cu/HCl.
 - benzene reacts with Cl₂ in the presence of sun light.
 - Chloroform is reacted with aq. Alkali.
 - Chlorobenzene is reacted with chloromethane in the presence sodium/ dry ether.

4. Answer the following: (1+1+1+1+1+2+1)

- Write positional isomer formed when 2-bromobutane is boiled with alc KOH.
- Which of the isomer formed in question (i) show geometrical isomerism. Write their structure.
- What happens when 2-bromobutane is treated with aq. KOH?
- Write a chemical reaction to prepare 2-bromobutane from 1 –butene.
- Write the ozonolysis product [X] and [Y] of above unsymmetrical isomer from (i).
- Write the reduction product of [X] and [Y] separately.
- Does 2-bromobutane contain Chiral carbon?

5. Convert 2-Chloropropane to 1-bromopropane.
- What happens when 2-Chloropropane is treated with AgNO_2 and resulting product is reduced with $\text{Zn}/\text{NH}_4\text{Cl}$?
 - What happens when 1-bromopropane is treated with KNO_2 ?
 - Convert ethane to 2-butanamine.

KCN/alc

6. $2\text{-chloropropane} \xrightarrow{\text{KCN}/\text{alc}} [\text{A}]$. Identify [A].
- If AgCN is used instead of KCN , will the product be same or different?
 - What happens when [A] is hydrolysed with dil HCl ?
 - What happens when [A] is reduced with LiAlH_4 ?
 - Compare the boiling point of 2- chloropropane with 2- iodopropane and 2- bromopropane.

$\text{SOCl}_2/\text{pyridine}$

7. $\text{sec-butyl alcohol} \xrightarrow{\text{SOCl}_2/\text{pyridine}} [\text{A}]$.
- Identify [A].
- Does [A] exhibit optical isomerism? Why?
 - What happens when [A] is treated with excess of NH_3 in the presence of ethanol?
8. $\text{ter-butyl bromide} \xrightarrow{\text{KSH}/\text{alc}} [\text{A}]$.
- Identify [A].
 - What is the mechanism of the reaction?
 - What happens when ter-butyl bromide is treated with NaCN in ethanol and the product formed is reduced.

9. $[\text{A}] \xrightarrow{\text{red P/I}_2} [\text{B}] \xrightarrow{\text{AgCN}/\text{alc}} [\text{C}] \xrightarrow{\text{LiAlH}_4} \text{N-methyl ethanamine}$.
- Identify [A], [B] and [C].
 - What happens when [A] is treated with Lucas reagent?
 - What happens when [B] is treated with sodium acetylide?

10. Propene $\xrightarrow{\text{HBr}} [\text{A}] \xrightarrow{\text{aq KOH}} [\text{B}]$
- Identify [A] and [B].
 - What would be the product if HBr is used in the presence of R_2O_2 ?
 - What type of reaction is conversion of [A] to [B]?

Is compound [A] soluble in water? Explain

Topic: Alcohol

[4+1+1+2]



Molecular formula of [A] is $\text{C}_3\text{H}_8\text{O}$ and it is secondary alcohol.

Identify [A], [B], [C], [D] and [E].

- Give a reaction for preparation of ethanol from [D].
- What happens when [C] is treated with HBr in the presence of organic peroxide?
- Convert [B] to 2 – propanamine.

2. Give reasons:

(1+1+2+1+1+1)

- Methanol is more acidic than ethanol.
- Chlorobenzene is less reactive than benzene towards Electrophilic substitution reaction.
- $-\text{NO}_2$ group in Nitrobenzene is meta- directing group.
- Sodium metal can be used to remove traces of water from ethoxyethane but not from ethanol.
- Pure CHCl_3 does not give white ppt with AgNO_3 solution but if chloroform and AgNO_3 is placed in hot water bath and exposed to light, slight turbidity appears.
- Primary alcohol is easily oxidized in compared to secondary and tertiary alcohol.

3. Convert ethanol to propanoic acid.

(2+1+1+2+1+1+1)

- What happens when ethanol vapour is passed through Cu tube at 300°C ?
- What happens when ethanol is treated NaOH and I_2 ?
- Convert propanenitrile to 1- propanol.
- What happens when propanoic acid is treated with 1-propanol in the presence of $\text{c.H}_2\text{SO}_4$?
- Convert ethanol to nitroethane.

4. Convert 1-propanol to 2 – propanol.

(2+2+1)

- Which of the above compound gives blue color in Victor Mayer's test? Give reactions too.
- Which of the above compound gives nitriolic acid in Victor Mayer's test?

5. Which alcohol is commonly known as grain alcohol?

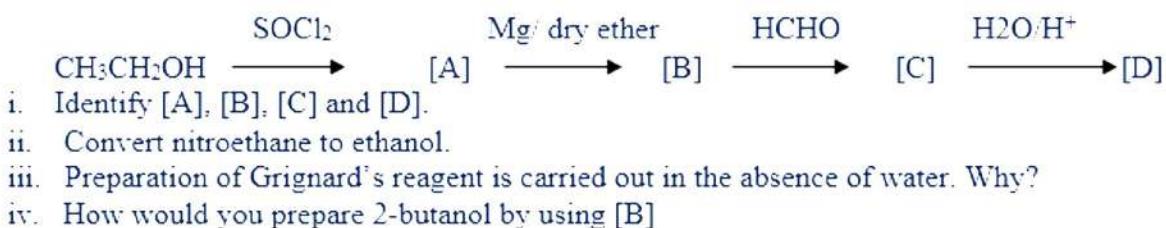
(1+2+1+1)

- How is this alcohol prepared from sugar molasses?
- Name the enzymes responsible for the fermentation of sucrose.
- What is methylated alcohol? Is it drinkable? Why?

6. Write the primary, secondary and tertiary alcohols of the compound having molecular formula C₄H₉OH
(2+2+1+1+1+1+1)

- i. Classify the above alcohol with their IUPAC name.
- ii. How would you distinguish above primary and secondary alcohols by Victor Meyer's methods?
- iii. Prepare 2-methyl – 2 propanol by using Grignard reagent.
- iv. Write the functional isomer of 1-butanol.
- v. Which of the above isomers is optically active and why?
- vi. Convert 2-butanol to 2-nitrobutane.

7.



Alcohols are hydroxyl derivative of alkane, very useful chemical widely used as solvent in industries.

8 .Answer the following:

- (a) Prepare 1-propanol from 1-aminopropane.
- (b) Make isomers of C₃H₇OH and write their IUPAC name.
- (c) Define oxo process with example.
- (d) Write the reaction involved in the fermentation of sucrose.
- (e) How do you distinguish 1-propanol and 2-propanol by Victor Meyer's method?
- (f) How is iodoform test used to distinguish ethanol from methanol?

9. Give reasons for the following

- (a) Anhydrous CaCl₂ cannot be used as a dehydrating agent for alcohol.
- (b) Boiling point of butan-1-ol is higher than 2-methylpropan-2-ol though they have same molecular mass
- (c) Ethanol and Propan-2-ol cannot be distinguished by iodoform test.
- (d) Methylated alcohol is not drinkable
- (e) Power alcohol can be used as an alternative source of energy

10. Convert following

- (a) Propan-1-ol to propan-2-ol

- (b) 2-aminopropane to 2- propanol
- (c) Ethanol to methanol and vice versa
- (d) Chloroethane to ethoxyethane

11. Alcohols react with sodium metal giving hydrogen gas which shows its acidic behavior

Compare the acidity of the following giving reasons

Ethanol, propan-2-ol, methanol, 2-methylpropan-2-ol

12. An organic compound (A) containing only one alpha – H atom reacts with PBr_3 to give (B). Compound 'B' produces C when heated with alcoholic KOH. The compound C undergoes ozonolysis to give ethanal as an only product.

If A responds iodoform test, identify A, B, C and D.

Is compound A chiral? Justify

Convert compound A to butanone

13 0.369 gram of a bromo derivative of hydrocarbon 'A' when vaporized, occupied 67.2 ml at STP. 'A' on reaction with aq. NaOH gives 'B'. B when passed over Al_2O_3 at 250 C gives a neutral compound 'C' while at 350 C, it gives a hydrocarbon (D). (D) When treated with HBr gives an isomer of (A). Identify (A) to (D) and explain the reaction. (atomic mass of Br = 80)

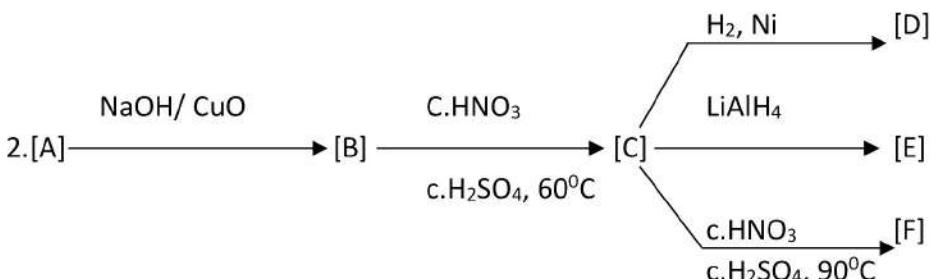
Topic: Nitro compounds and Amine

1. Write all possible isomers for molecular formula C₃H₉N. (1+1+3)

a. Classify them into 1°, 2° and 3°. Write their IUPAC name.

b. How do you separate the mixture of 1-propanamine and N-methylethanamine by Hoffmann's method

(5)



If [A] is sodium benzoate identify [B], [C], [D], [E], [F].

3. answer the following questions (8)

- Convert benzene to m-chloronitrobenzene.
- Convert benzene to o-nitrochlorobenzene.
- Convert ethane to n-butane.
- Convert propanoic acid to ethane.
- Convert methanamine to ethanamine.
- Convert ethene into 1-propanol.
- Convert bromoethane to propanamide.
- Convert benzene to benzoic acid.

4. Write a chemical reaction to convert propene to 1-nitropropane.

- Write positional isomer of 1-nitropropane.
- Write functional isomer of 1-nitropropane.
- What product is formed if 1-chloropropane is treated with NaNO₂?

5 A compound 'A' has molecular formula C₂H₇N:

- Identify the primary and secondary isomer of the above molecular formula with their IUPAC name.
- How would you prepare the above primary isomer from
 - propanamide
 - ethane nitrile
- How would you convert the same isomer into ethanol?
- Compare its boiling point with ethane.

6 Write down the suitable method for the conversion of:

- a. Chloroform to aniline
- b. Methylamine to acetamide
- c. Benzamide to aniline
- d. Ethanamide to methanamine

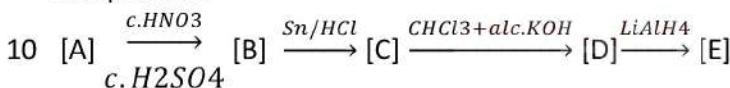
7 Write the products of:

- a. $\text{C}_6\text{H}_5\text{CONH}_2 + \text{KOH} + \text{Br}_2 \rightarrow$
- b. $\text{CH}_3\text{NC} + \text{H}_2 + \xrightarrow{\text{Pt}}$
- c. $\text{CH}_3\text{CONH}_2 + 4[\text{H}] \xrightarrow{\text{LiAlH}_4}$
- d. $\text{CH}_3\text{CH}_2\text{NO}_2 \xrightarrow{\text{LiAlH}_4}$

8 Answer the following questions with reason:

- a. Primary amines have higher boiling point than tertiary amines.
- b. Amines have lower boiling point than alcohol of same molecular mass.
- c. Compare the basicity of primary, secondary & tertiary amine.
- d. Compare the basicity of aliphatic amines with aniline.

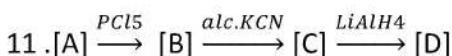
9 The compound 'A' on treating with Chlorine in presence of Sunlight gives 'B'. 'B' on treating with alc. KCN forms 'C' which on reduction forms 'D'. the compound 'A' is obtained by heating methyl Chloride with Sodium metal in presence of dry ether. Also find the product obtained by the reduction of compound formed by treating the compound 'B' with alc. AgCN. Write the chemical reactions involved identifying all the compounds.



[A] is also obtained by Zinc distillation of Phenol. Identify A, B, C, D & E with reactions

11 $\text{C}_6\text{H}_5\text{COOH}, \text{C}_6\text{H}_5\text{CH}_2\text{CH}_3, \text{C}_6\text{H}_6, \text{C}_6\text{H}_5\text{OH}, \text{C}_6\text{H}_5\text{SO}_3\text{Na}$

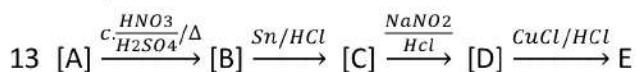
- a. From the above list of compounds, prepare a sequence of reaction chain with suitable condition and reactions. [3]
 - b. Suggest the reaction to convert benzene to phenol. [2]
- 12 Benzenediazonium chloride on hydrolysis gives [A]. identify [A]. [1]
- a. Starting from [A] how would you prepare salicylaldehyde. State the name of the reaction. [1]
 - b. How would you convert [A] to (i) picric acid (ii) p-nitrophenol ? [2]
 - c. Write a reaction to prepare phenolphthalein from [A]. [1]



A is primary alcohol that gives iodoform test. Identify A,B,C,D.[4+ 1+1+1+1]

- a. What happens when 'B' is treated with Alc AgCN ?
- b. Which product is formed when the product formed in qn. 'a' is reduced with LiAlH_4 ?
- c. How would you prepare 'D' from propanamide.

- d. How would you distinguish 'D' from the compound formed as a product in qn. no. b ?



Find A, B, C D & E with the reactions. A is obtained by decarboxylation of Sodium salt of benzoic acid . [5 +2 +1]

- a. Compare the basic nature of compound C with ethylamine.
b. What happens when D is coupled with aniline.

- 14 A chemical compound has molecular formula C_3H_9N . [1+ 4]

- c. Write its isomers with their IUPAC name.
d. How would you distinguish one of its primary isomer from its secondary & tertiary isomers by Hoffmann's method.
d.

Topic: ether

1. Give a chemical reaction to prepare methoxyethane by Williamson's etherification.
 - i. What is the expected mechanism of the reaction and why?
 - ii. What type of ether is methoxyethane?
- 2 Give a chemical reaction for preparation of ethoxyethane by Williamson reaction.
 - a. Convert ethoxyethane to methane.
 - b. What happens when diethyl ether is treated with cold/ conc. H_2SO_4 ?
 - c. Violent explosion may take place while distillating old sample of ether. Why?
 - d. Methoxymethane is more volatile than ethanol. Why?
- 3 $[\text{A}] + [\text{B}] \longrightarrow$ 2-methoxy-2-methylpropane. [B] is prepared by treating 2-methyl-2-propanol with sodium metal. Identify [A] and [B].
 - a. Convert 2-methylpropan-2-ol to 2-methylpropene.
 - b. What happens when 2-methoxy-2-methylpropane is treated with HI?
 - c. What happens when [A] is treated with AgCN followed by reduction?
- 4 Ethanol $\xrightarrow{\text{c. H}_2\text{SO}_4 / 140^\circ\text{C}}$ [A] $\xrightarrow{\text{O}_2 / \text{Light}}$ [B]. Identify [A] and [B].
 - a. What happens when [A] is treated with Cl_2 in presence of light?
 - b. Convert ethane to [A].
 - c. Convert [A] to methoxyethane.
- 5 [A] reacts with Sodium to give [B]. [A] reacts with PCl_5 to give [C]. [B] and [C] reacts to give diethyl ether. Identify [A], [B] and [C].
 - a. What is metamer of diethyl ether and its IUPAC name?
 - b. Convert Aniline to Anisole.
 - c. Methoxy group in anisole directs Nitronium ion towards ortho and para position during Nitration. Why?

Phenol

1. Sodium salicylate on heating with soda lime gives, compound A which is used for making disinfectants.

Answer the following:

- What happens when the compound A reacts with acetic anhydride? (1)
- How do you prepare (acid, base indicator) phenolphthalein from compound A? (1)
- How do you distinguish compound A from ethanol? (1)
- What is the effect of electron withdrawing group and electro releasing group on acidity of compound A? (2)

2. Give reasons for the following:

- Phenol has higher boiling point than toluene. (1)
- Mixture of ortho-nitrophenol and para nitrophenol can be separated by steam distillation. (1)
- Phenol is more acidic than alcohol. (2)
- Phenol and carboxylic acids can be distinguished by bicarbonate test. (1)

3. Sodium benzene sulphonate on fusion with solid NaOH at 350°C gives compound A. Compound A with aq. ammonia in presence of anhydrous zinc chloride gives B, on heating A with H₂ in presence of nickel gives C. The compound A also reacts with benzoyl chloride giving compound D.

- Identify A, B, C, and D with essential reactions. (4)
 - How to convert compound A to benzoic acid? (1)
- 4 A) What are phenols? Why benzyl alcohol is not a phenol?
b) make the possible isomer of phenol having molecular formula C₇H₇OH and write their IUPAC name.
c) how do you prepare phenol from i) benzene diazonium chloride ii) salicylic acid.

2. phenol is an acidic compound, as an acid it turns blue litmus to red and neutralizes alkalis. Answer the following.

- why is phenol more acidic than methanol?
- sodium carbonate test can be used to distinguish phenol from carboxylic acid. Give reason.
- name the major product, when sodium phenoxide is heated with CO₂ at 125 degree Celsius under 4 to 7 atmospheric pressure. What is the name of the reaction?
- show the formation of common acid-base indicator phenolphthalein from phenol.
- which organic compound is formed when diazotized solution of aniline is treated with phenol?

3. convert the following:

- phenol to phenyl benzoate
- aniline to 2-hydroxybenzaldehyde
- benzene to p- hydroxyazobenzene

- d) phenol to toluene
- e) benzene to m-bromophenol

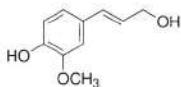
5 . an organic compound A, C_6H_6O gives parent hydrocarbon B. the compound A responds to ferric chloride test, the compound B can also be obtained by polymerization of acetylene.

- a) identify A and B with essential reactions.
- b) which compound is more acidic among compound A and o-nitrophenol and why?
- c) what happens when compound A reacts with aq bromine? Can we use this reaction for the test of compound A in lab?
- d) write the reaction which gives a common pain killer from compound A.

6 . large quantities of phenol are used for the preparation of plastic materials such as Bakelite and also used in making explosives like picric acid.

Answer the following:

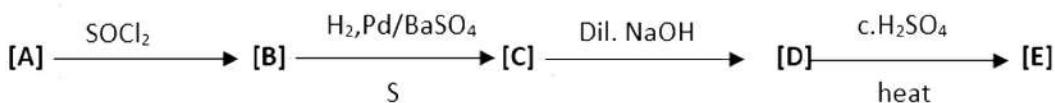
- a) Show the formation of bakelite from phenol.
 - b) Is formation of bakelite an example of condensation polymerization? Give an example of addition polymerization.
 - c) What do you mean by thermosetting polymer?
 - d) How is 2,4,6-trinitrophenol prepared from phenol?
 - e) Suggest Liebermann's test for phenol.
6. An organic compound A has 76.6% carbon and 6.38% hydrogen its vapour density is 47. It gives bromine water test positive. When compound A undergoes carboxylation reaction ($CO_2 + NaOH$) degree Celsius and 4-7 atm pressure gives compound B which on acetylation gives compound C.
- a) Identify A,B and C.
 - b) How do you convert compound A to o-hydroxybenzenesulphonic acid
 - c) Does compound B give ferric chloride test? Yes/no why?
7. Compound A reacts with nitrous acid at low temperature gives B. B on hydrolysis gives C and C reacts with acetyl chloride in the presence of pyridine giving D. Here A is obtained by reduction of nitrobenzene in acidic medium.
- a) Identify A,B,C and D with essential reactions.
 - b) Suggest a reaction to prepare methoxy benzene from compound C
8. About 20-30% by weight of dry wood is lignin. 'lignin' is a phenolic polymer formed by cross linking of different monomer. Coniferyl alcohol is one of the precursors. Based on the given molecular structure.



- I Name all the functional groups present in coniferyl alcohol.
- II What organic compound would you expect when it is treated with aqueous NaOH?
- III What product is obtained when product obtained in B reacts with methyl iodide?
- IV Research have shown that lignin protects wood from microbial attack. Based on structure of coniferyl alcohol, comment on this research findings.
- 9 An organic compound is used for making Dettol and for making analgesic like aspirin.
- Write the reaction when the compound reacts with phthalic anhydride. [1]
 - What happens when the compound is exposed to air? [1]
 - The compound can be distinguished from carboxylic acid by bicarbonate test. Give reason. [2]
 - How do you convert the compound to ortho and para cresol? [1]
 - Two isomeric aromatic compounds A and B have molecular formula C_7H_7OH . 'A' gives purple color with $FeCl_3$ solution while 'B' does not. What are 'A' and 'B'? [2]
 - Compound 'A' C_6H_6O is insoluble in water, dil. HCl and $NaHCO_3$ but dissolves in NaOH. When A is treated with Br_2/H_2O it is converted into a compound $C_6H_3OBr_3$, what is the structure of A? [1]
- 10 C_6H_5COOH , $C_6H_5CH_2CH_3$, C_6H_6 , C_6H_5OH , $C_6H_5SO_3Na$
- From the above list of compounds, prepare a sequence of reaction chain with suitable condition and reactions. [3]
 - Suggest the reaction to convert benzene to phenol. [2]
- 11 Benzenediazonium chloride on hydrolysis gives [A]. identify [A]. [1]
- Starting from [A] how would you prepare salicylaldehyde. State the name of the reaction. [1]
 - How would you convert [A] to (i) picric acid (ii) p-nitrophenol ? [2]
 - Write a reaction to prepare phenolphthalein from [A]. [1]

Topic aldehydes and ketones

1



If [A] is obtained by passing CO_2 gas through methyl magnesium bromide followed by hydrolysis. Identify A, B, C, D, E [4+1]

- I. Give a chemical test to distinguish [C] from acetone. [1]
 - II. Identify the reaction that converts [B] to [C] [1]
 - III. When [C] is treated with sodium bisulphite, a crystalline compound is formed. Write the reaction involved. [1]
2. 2 molecules of ethanal condenses in the presence of dil.NaOH to give 3-hydroxybutanal. This is an example of aldol condensation.
- ii. Formaldehyde does not give this reaction, why? [1]
 - iii. Convert formaldehyde to propanal [2]
 - iv. formaldehyde \longrightarrow [A] is a polymer. Identify [A] with reaction [2]
- 3 An alkene [A] undergoes ozonolysis to give aldehydes [B] and [C]. [1]
- Compound [B] gives Fehling's solution test and on Wolf Kishner reduction gives propane. [2]
- Compound [C] on treatment with HCN followed by complete hydrolysis with dil. HCl gives 2-hydroxy propanoic acid. Identify A, B, C. [2]
- 4 Tautomers are functional isomers that are interconvertible.
- i. What is the tautomer of ethanal? [1]
 - ii. Suggest the structure and IUPAC name of alkene which on ozonolysis gives only ethanal. Write the reaction involved. [1]
 - iii. Boiling point of ethanal is higher than that of propane and lower than that of propan-1-ol though they have almost same molecular mass. Give reason. [2]

iv. Give reaction to convert ethanal to gem-dichloroethane.[1]

5 Benzaldehyde does not give Fehling's test though it is an aldehyde.

i. Which one among benzaldehyde and acetaldehyde is more powerful reducing agent?[1]



Identify [A] and [B] [2]

iii. -CHO group in benzaldehyde is meta-directing, why?[2]

6 Compound [A] gives both Tollen's and Fehling's test. [A] on reduction with Zn-Hg and conc. HCl gives propane. Identify [A]. [3]

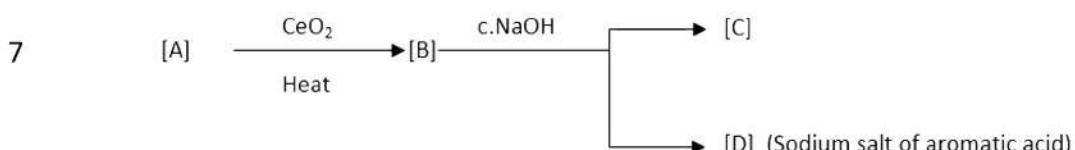
I. Does [A] give iodoform test? Why? [1]

II. What happens when [A] is oxidized with $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$? [1]

III. How would you prepare [A] by Rosenmund reduction? [1]

IV. [A] cannot be prepared by hydration of alkyne, why? [1]

Convert [A] to 1,1-dichloropropane. [1]



If [A] is obtained by Friedel Craft alkylation of benzene with CH_3Br . identify A, B, C, D. [1+3]

I. Convert [C] to [B] [1]

II. Convert [D] to benzene. [1]

III. Convert [B] to [A] [1]

IV. What happens when [B] is treated with acetic anhydride in the presence of sodium acetate. [1]

- 8 Molecular formula of [A] is C_3H_6O . [A] on warming with ammoniacal solution of $AgNO_3$ gives silver mirror. Identify [A] with its IUPAC name. [1]
- Write functional isomer of [A] and its IUPAC name which is compound [B]. [1]
 - [B] does not give Tollen's test why? [1]
 - Clemmensen reduction of both [A] and [B] give the same product. Give both reactions. [2]
- 9 How can 2,4-DNP be used to distinguish propanone and 2-propanol in lab? [2]
- What happens when propanone is treated with Tollen's reagent? [1]
 - Convert propanone to 2-methyl-2-propanol. [1]
 - Convert propanone to 2-propanol. [1]
- 10 $C_6H_5-CH=CH-CHO$
- Write structure of both cis and trans-isomer of the given structure. [1]
 - Write the reaction of the compound with Tollen's reagent. [1]
 - What happens when the compound is treated with $LiAlH_4$? [1]
 - Does the compound give iodoform test? Why? [1]
 - What happens when the compound is treated with hydrazine? [1]

Carboxylic acids and their derivatives:

1. The structural formula of carboxyl group is -COOH in carboxylic acid.
Answer the following questions:
 - a) Why carboxylic acid don not give properties of aldehyde and ketone?
 - b) Write down the IUPAC name of functional isomer of ethanoic acid.
 - c) How will you test the presence of carboxylic acid?
 - d) Why is boiling point of acetic acid higher than 1-propanol, though they have the same molecular mass.
 - e) How do you obtain methanoic acid from oxalic acid?
2. The acidic strength of carboxylic acid follows this order
$$\text{HCOOH} > \text{C}_6\text{H}_5\text{COOH} > \text{CH}_3\text{COOH} > \text{CH}_3\text{CH}_2\text{COOH}$$
 - a) Explain giving suitable reason for higher acidity of methanoic acid.
 - b) Discuss the effect of electron releasing group on acidity of carboxylic acid with reference of above given order.
 - c) Justify that chloroacetic acid is stronger acid than acetic acid.
 - d) Compare the acidity of 2-chlorobutanoic acid and 3-chlorobutanoic acid.
2. Methanoic acid not only act as an acid it also acts as a reducing agent. Answer the following:
 - a) Give reason for the reducing property of methanoic acid.
 - b) What happens when methanoic acid is warmed ammonical silver nitrate solution?
 - c) Formic acid doesn't undergo alpha-halogenation. explain.
 - d) Can we prepare formic anhydride from formic acid? If yes/no, why?
 - e) What happens when formic acid reacts with PCl_3 ?
3. Ethanoic acid commonly known as acetic acid is used as vinegar and also as a coagulant in the preparation casein from milk. Answer the following.
 - a) How do you prepare ethanoic acid from 1,1,1-trichloroethane and methyl magnesium bromide?
 - b) Which monocarboxylic acid is obtained when malonic acid undergoes decarboxylation?
 - c) You are given two test tubes containing acetic acid and formic acid, give two test reaction which can be used to distinguish them.
 - d) Can we use this test to distinguish ethanoic acid from propanoic acid? If not, why?
 - e) Ethanoic acid on heating with ammonia gives (A)
Is A an amphoteric compound? Justify your answer.
4. A) Starting from acetic acid how do you prepare the following.
 - i) Acetamide ii) acetyl chloride, iii) acetic anhydride, iv)ethylacetate.
 - b) arrange the above derivatives of acetic acid in increasing order of their reactivity. Giving reasons.

- c) compare boiling point of acetic acid with acetic anhydride.
- d) why is acetic anhydride considered as a better acylating agent than acetyl chloride?
5. Methanol on reacting with sodium gives compound (A). When CO is passed through compound (A) at high temperature and pressure gives compound (B) which on acidification gives (C) and the compound (C) reacts with ethanol in presence of conc. sulphuric acid gives compound (D) with fruity smell
- identify A, B,C,D with essential reactions.
 - Write the product when Compound D undergoes Claisen condensation?
 - What happens if compound B is heated with soda lime?
 - Convert compound C into ethanol and ethane.
7. An organic compound A C_7H_6O on oxidation with acidic sodium dichromate gives a compound B $C_7H_6O_2$. Which on heating with ammonia gives compound C C_7H_7NO . Treatment of C with P_2O_5 gives C_7H_5N . Compound D on hydrolysis gives compound B. identify A, B,C,D with essential reactions.
8. an ester A of molecular formula $C_4H_8O_2$ on reacting with CH_3MgCl followed by acidification gives two moles of an alcohol 'b' as the sole product. Alcohol B on oxidation with $NaOCl$ followed by acidification gives acetic acid and chloroform. Deduce structures of A and B and write reactions involved.
9. 30 gram of monocarboxylic acid (A) consumed 0.5 moles of NaOH for its neutralization and acid (A) gives the following sequences of reaction. Identify A,B and C
- $$A \xrightarrow{PCl_3} B \xrightarrow{C_6H_6, an. AlCl_3} C$$
10. Two isomeric compound X and Y with molecular formula C_3H_5N . Predict the structure of A and B on the basis of following information
- Hydrolysis of A with dil. HCl gives monocarboxylic acid
 - Reduction of A gives Primary Amine while B gives Secondary amine
 - Molecular mass of Secondary amine is 59
 - What happens if the acids obtained by hydrolysis reacts with the Cl_2 in presence of red P?
 - Does the acid give silver mirror test ?Why?

11. Give reason for the following

- (i) Why is benzamide less easily hydrolyzed than methyl benzoate?
- (ii) Why is P_2O_5 not used for the preparation of anhydrous formic acid?
- (iii) Why is the melting point of pentanoic acid less than butanoic acid?
- (iv) Ester of formic acid (formate) does not undergo Clasien condensation. Give reason
- (v) Why is pure acetic acid called glacial acetic acid?
- (vi) Why are carboxylic acid exists as dimer?

12. Convert following

- (i) Ethanol to benzoic acid
- (ii) Propanoic acid to 2- chloropropanoic acid
- (iii) Methanol to ethyl ethanoate
- (iv) Chloroethane to ethanoic anhydride
- (vi) Phenyl methanol to m-nitrobenzoic acid
- (vii) Methanoic acid to ethanoic acid and vice versa
- (viii) Benzene to benzoic acid

13. compound A reacts with chloroethane in presence of anhydrous aluminum chloride giving B. B on oxidation with alkaline potassium permanganate gives C. the compound C on reduction with HI in presence of red phosphorous gives D.

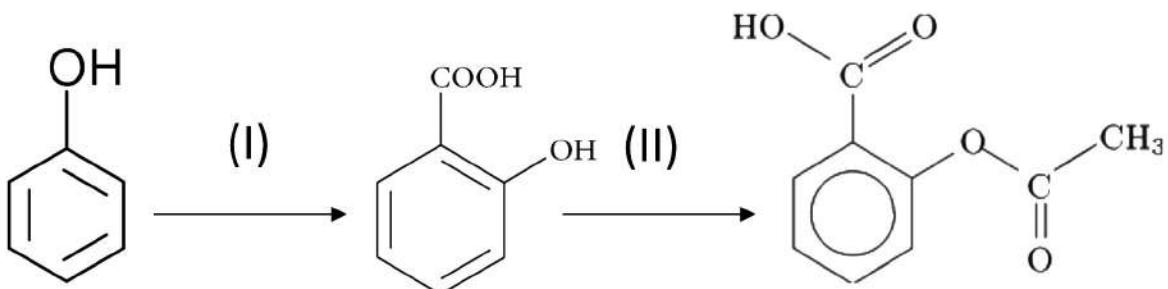
Compound A can be obtained by reduction of phenol with zinc dust. Then answer the following.

- a) Identify A,B,C and D.
 - b) Name the compound which is formed by oxidation of D.
 - c) What happens when C reacts with nitrating agent?
 - d) Compare the reactivity of the compound C with benzene towards electrophilic substitution reaction.
 - e) Suggest conversion of D to A.
- 14 A trihaloalkane derivative X on hydrolysis gives third member of homologous series of carboxylic acid Y. the acid Y on reacting with ethanol in the presence of conc. H_2SO_4 gives Z.
- a. Identify X,Y,Z with reactions involved [3]
 - b. Write IUPAC name of functional isomer of Y [1]

c. Why carboxyl group of Y does not give the test of carbonyl and hydroxyl group? [1]

Chemistry in service of mankind

1. What is the difference between antiseptic and antipyretic drug?
2. How do antiseptics differ from disinfectants?
3. Mention the difference between broad spectrum and narrow spectrum antibiotics.
4. Asprin is pharmacodynamic drug and used as antipyretic and analgesic. It's generic name is acetyl salicylic acid and can be prepared from phenol.



- a. What are antiseptics and analgesics?
 - b. Suggest reagent (I) with proper condition.
 - c. Suggest a reagent for preparation of aspirin from salicylic acid.
 - d. When aspirin is administered in the body it undergoes hydrolysis. Which bond do you predict to be broken?
5. Analgesics are drugs used in reducing pain without loss of consciousness. (1+1+2+1)
- (I) Both morphin and aspirin are analgesics but its safe to prescribe aspirin than morphin, why?
 - (II) Write the structure and chemical name of aspirin.
 - (III) Name any two drugs responsible for drug addiction.
 - (IV) What are the symptoms of psychological disorder.
6. Match the following:

A

Antiseptic

B

Metformin

Antibiotic

Cetirizine

Sulpha drugs	Amyl nitrite
Antipyretic	Methyl n-propyl ether
Analgesic	Equanil
Tranquilizer	Ranitidine
Anaesthetic	Tincture of I ₂
Antacid	Sulphanilamide
Antidiabetic	Penicillin
Antihistamine	Paracetamol
Drug for cardiovascular disease	heroin

7. Explain the term monomers, polymerization elastomer, fibres.

8. Write the Monomers and structures of following:

- | | |
|---------------|----------------|
| a. Polyethene | b. PVC |
| c. teflon | d. polystyrene |
| e. nylon-6,6 | f. bakelite |
| g. orlon | h. dacron |

9. give an example and use of:

- a. Homopolymer b. Co-polymer

10. Differentiate between thermosetting and thermoplastic polymer.

11. Define addition polymer and condensation polymer with example and structure.

12. Write reaction for preparation of the following:

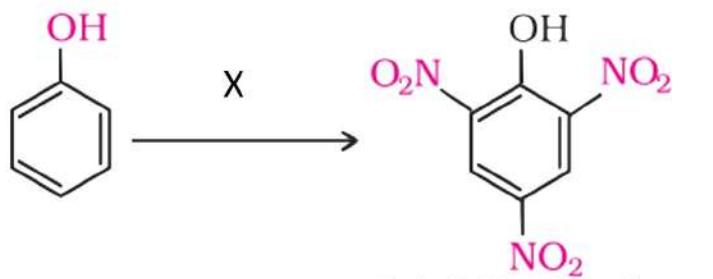
- | | |
|--------------|----------------|
| a. Nylon-6,6 | b. PVC |
| c. orlon | d. polystyrene |
| e. teflon | f. bakelite |

13. Why does nylon fibres have high tensile strength?

14. Condensation polymer or step growth polymer is made by addition of monomers with elimination of small molecules like H₂O, HCl, NH₃, etc. (2+1+1+1)

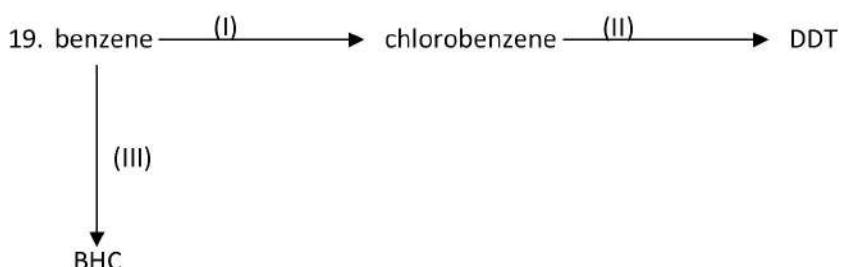
- (I) Write a chemical reaction involved in preparation of Nylon-6,6.
 (II) Classify the polymer on the basis of intermolecular force.

- (III) Why does this polymer have high tensile strength?
- (IV) Give an example of polymer made by condensation reaction.
15. Polyethene and bakelite are two different types of polymers on the basis of intermolecular force. (1+1+2+1)
- (I) Classify them on the basis of intermolecular force.
- (II) Write a difference between polyethene and bakelite.
- (III) Write the reactions involved in preparation of polyethylene and bakelite.
- (IV) Why does polyethylene melts on heating whereas bakelite does not?
16. Polymers that can be broken into smaller molecules or fragments by enzyme catalyzed reactions are called Biodegradable polymers. (1+1+1+2)
- (I) Give any two examples of biodegradable polymers.
- (II) What is the monomer of polysaccharide?
- (III) Polyglycolic acid is a biodegradable polymer used in sutures. What is its significance?
- (IV) Orlon is a polymer of vinyl cyanide. Write the structure of orlon and its use.
17. Phenol reacts with benzenediazonium chloride in basic medium to give a yellow coloured dye.
- (I) Write the reaction involved for the preparation of dye. Name the dye.
- (II) Phenol is colourless but the product is yellow, why?
- (III) Identify the auxochrome and chromophore in the compound.
- (IV) Classify the dye on the basis of chemical constituent.
18. Picric acid finds application as a yellow dye for silk fabric. It can be prepared by nitration of phenol.



2,4,6-Trinitrophenol
(Picric acid)

- a. Suggest the reagent 'X' in the given reaction.
- b. Picric acid is coloured whereas phenol is colourless, explain.



- a. How do pesticides differ from insecticides?
- b. Identify I,II,III with proper reaction conditions.
- c. Write the structure of DDT and BHC with their IUPAC name.

Cement

1. what is OPC cement? Write its main composition
2. what is PPC cement? Write its main composition
3. Differentiate between OPC and PPC Cement
4. Why gypsum is added to cement?
5. Nowadays, which method of cement manufacturing is used? Wet method or dry method and why?

Answer: Wet method was used from 1913 to 1960. The dry method is most adopted because it improves the quality of cement, utilizing less power.

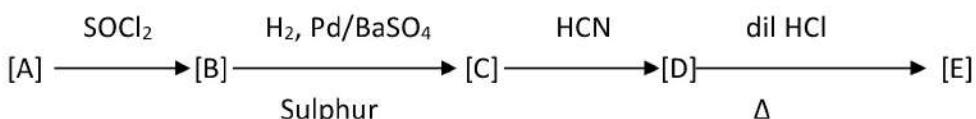
6. How many types of cement are there based on the ability to set in presence of water?

Answer: The 2 types are hydraulic and non-hydraulic cement. Hydraulic cement sets and becomes adhesive due to reaction with water. Non-hydraulic cement does not set under-water or in wet conditions.

GRADE XII

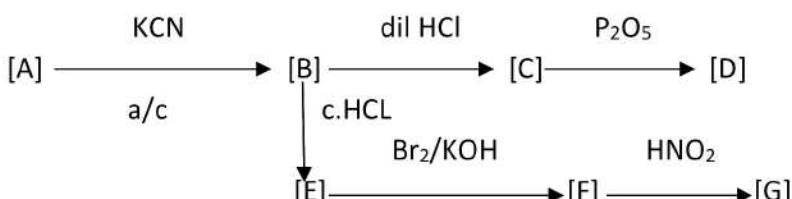
Identify A,B,C,D,E,F in the following equations

1.



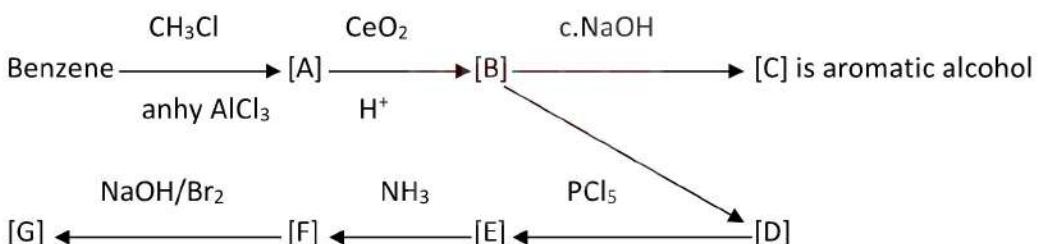
[A] is obtained by complete hydrolysis of ethanenitrile.

2.

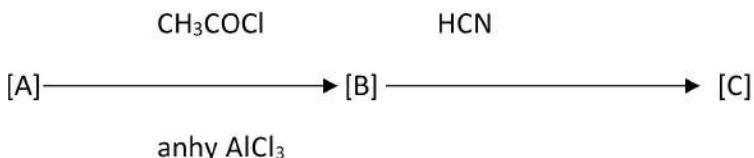


[A] on dehydrohalogenation gives ethene.

3.

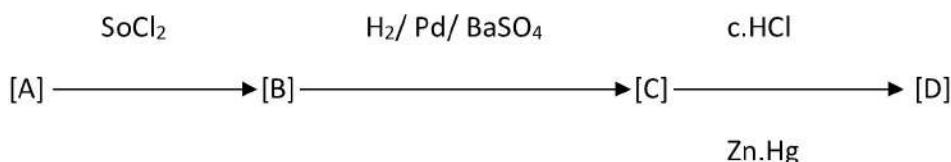


4.



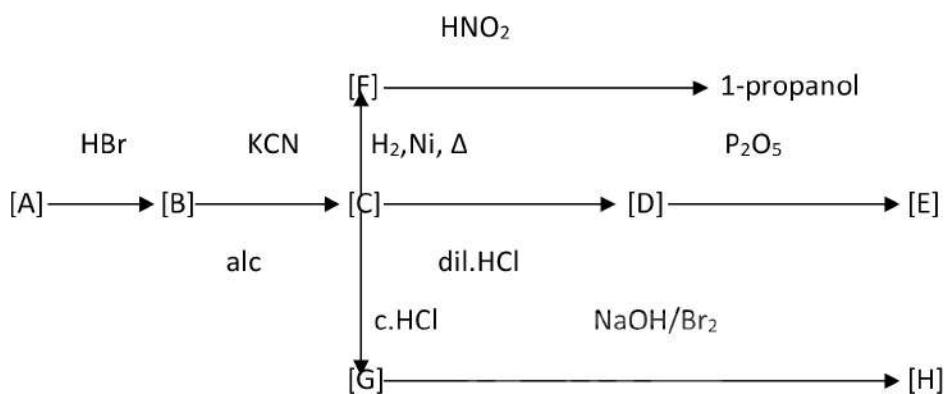
[A] is obtained by Sodalime decarboxylation of sodium benzoate.

5.

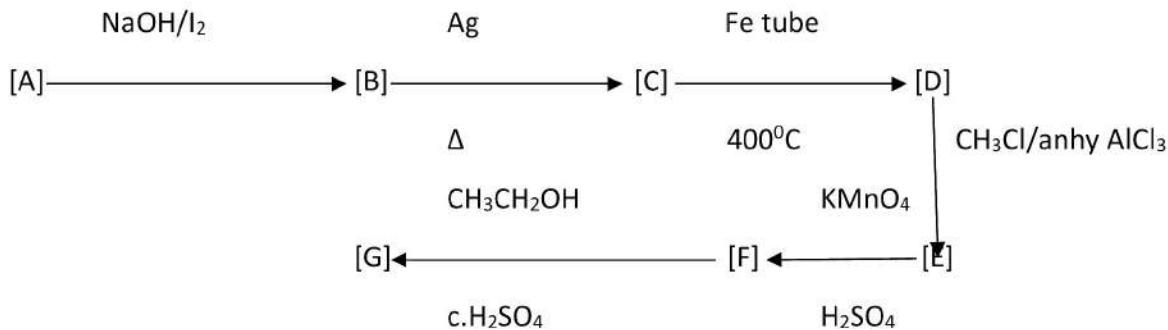


[A] is obtained by hydrolysis of 1,1,1 trichloroethane.

6.

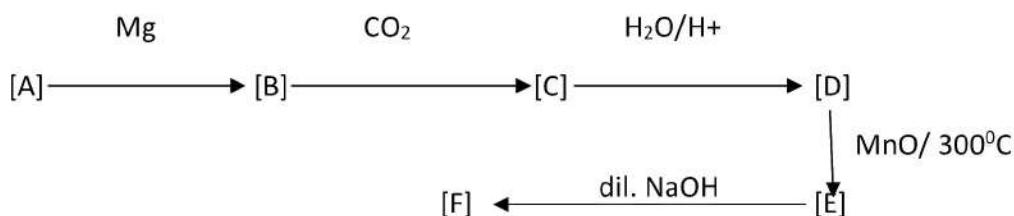


7.



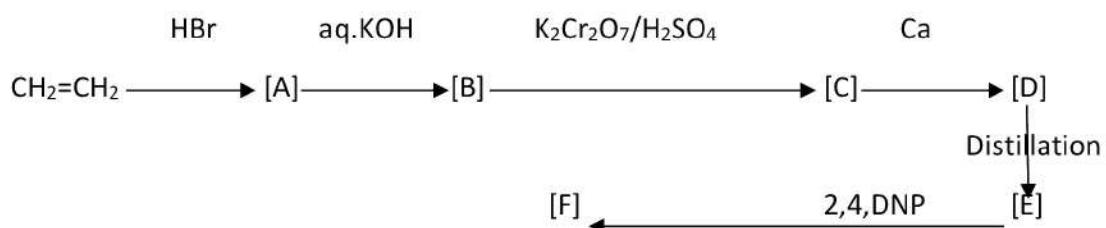
[A] is prepared by oxidation of 2-propanol.

8.



[A] on treatment with aq. KOH gives ethanol.

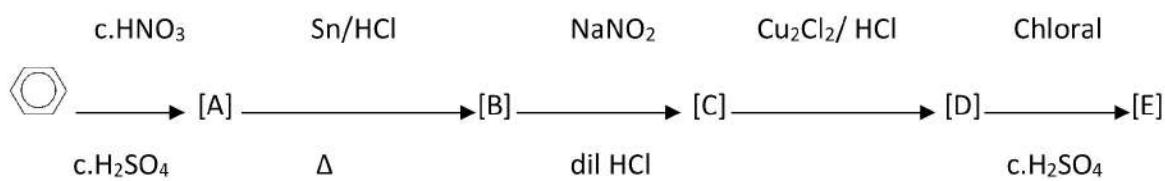
9.



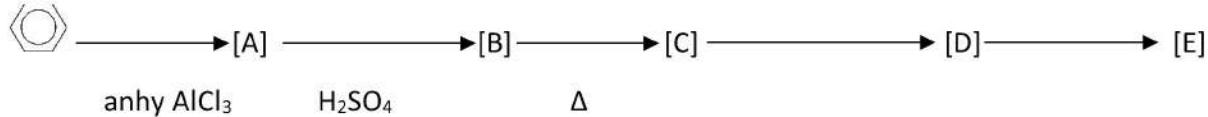
10.



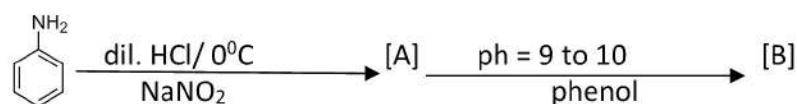
11.



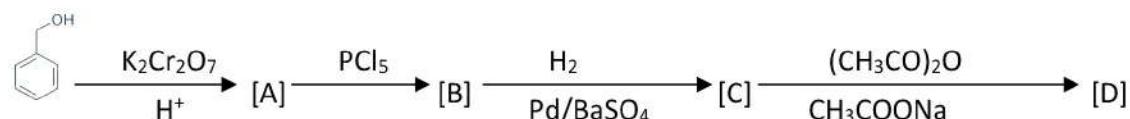
12.



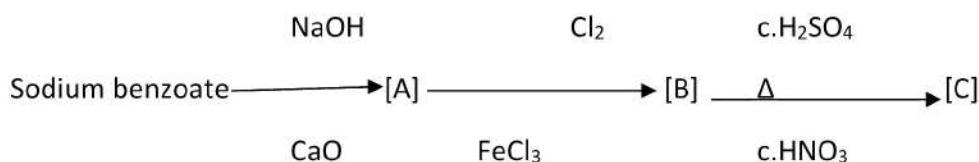
13.



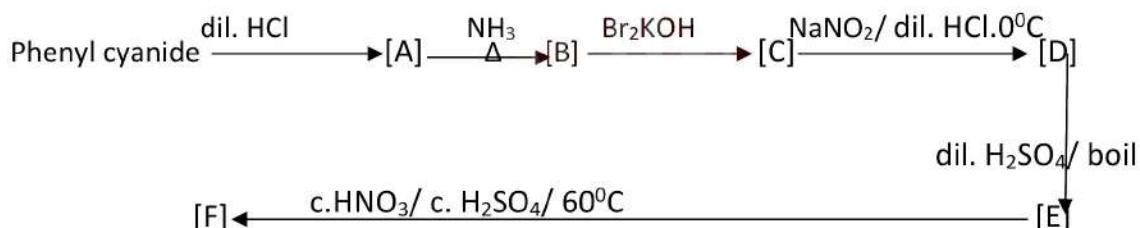
14.



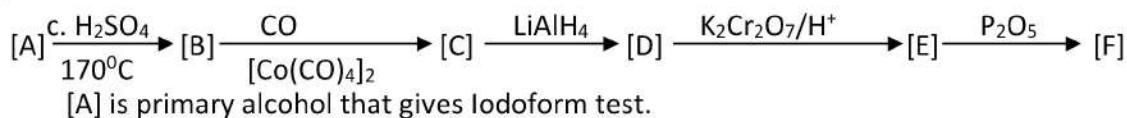
15.



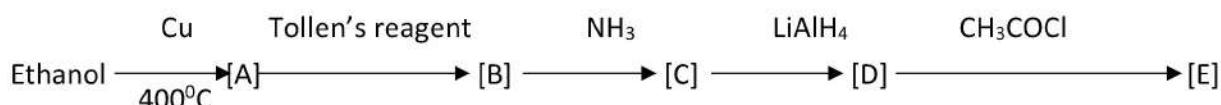
16.



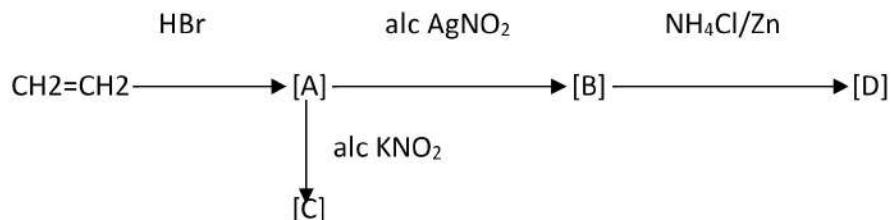
17.



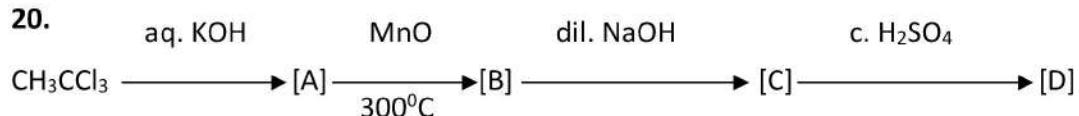
18.



19.



20.



Convert:

1. Ethanol to N-ethylhydroxylamine.
2. Benzene to Hydobenzene
3. Nitrobenzene to Acetanilide
4. Acetaldehyde to But-2 enal.

MCQs (HALOALKANE)

1. Which of the following is ambident group

- a. CN
- c. NO₂
- b. OH
- d. a & c**

2. 1-chlorobutane on treatment with alcoholic potash gives:

- a. 1-butene
- c. 1-butanol
- b. 2-butene**
- d. 2-butanol

3. Ethyl bromide on treatment with alcoholic KOH gives

- a. ethanol
- c. acetic acid
- b. ethylene**
- d. ethane

4. The order of reactivity of alkyl halides towards elimination reaction is

- a. 3 > 2 > 1**
- c. 3 > 1 > 2
- b. 2 > 1 > 3
- d. 1 > 2 > 3

5. Which reaction belongs to the elimination reaction

- a. hydrogenation
- c. halogenation
- b. dehydrohalogenation**
- d. dehydration

6. alkyl halide reacts with alcoholic AgCN to form:

- a. alkyl cyanide
- c. alkyl carbylamine**
- b. alkyl cyanate
- d. alkyl nitrile

7. The best reagent used for converting alcohols into alkyl halide is

- a. HCl
- c. PCl₅
- b. SOCl₂**
- d. PCl₃

8. An alkyl halide can be converted into alcohol by

- a. addition
- c. substitution**

b elimination d. dehydrohalogenation

9.ethyl bromide reacts with alcoholic silver nitrite to give

a. nitrolic acid **c. ethynitrite**

b. pseudonitrol d. nitroethane

10.when a compound reacts with KCN followed by hydrolysis gives acetic acid, the compound is

a. ethanol **c. methyl chloride**

b. methanol d. ethyl chloride

11.A sample of chloroform is tested with which of the following reagent before using as anesthetic purpose.

a. Aq. KOH **c. AgNO₃**

b. Conc. HNO₃ d. CH₃COCH₃

12.Most reactive alkyl halide towards SN¹ reaction is:

a. n-butyl chloride c. sec-butyl chloride

b. tert-butyl chloride d. none of the above

13.Which of the following cannot be synthesized by Wurtz reaction:

a. Ethane c. Butane

b. Hexane **d. Methane**

14.Tear gas is:

a. Chlorethane c. Ethyl carbonate

b. Chloropicrin d. Methylene dichloride

15.Which on reduction doesn't give primary amine:

a. CH₃CN **c. C₂H₅NC**

b. C₂H₅NO₂ d. All of these

16.Alkyl halide reacts with alc.AgCN to form

a. Alkyl Cyanide c. Alkyl cyanate

b. Alkyl carbylamine d. Alkyl nitrite.

17.Halogen atom in Haloarene is

a. Ortho-para director c. Meta- director

b. Ortho, meta & para director d. None of the above

MCQs (ALCOHOL)

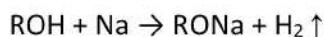
1.Which of the following has highest boiling point

- a. Butane c. **1-butanol**
- b. 1-chlorobutane d. Ethoxyethane

2.Which of the following alcohol is most reactive towards Lucas reagent?

- a. Primary alcohol c. Secondary alcohol
- b. Tertiary alcohol** d. None

3.In the reaction:



- a. **Acidic nature of alcohol** c. oxidizing property of Sodium
- b. Basic nature of Sodium d. Both a& b

4.Which of the following alcohol is least soluble in water:

- a. CH_3OH c. $\text{C}_3\text{H}_7\text{OH}$
- b. $\text{C}_6\text{H}_{13}\text{OH}$ **d. $\text{C}_{10}\text{H}_{21}\text{OH}$**

5.Compound A with formula $\text{C}_3\text{H}_8\text{O}$ on vigorous oxidation produces an acid $\text{C}_3\text{H}_6\text{O}_2$, A is :

- a. A tertiary alcohol c. A secondary alcohol
- b. A primary alcohol** d. Not an alcohol

6.Rectified spirit is

- a. 100% pure alcohol **c. 95% ethanol + 5% water**
 - b. Ethanol + water + petrol d. 95% ethanol + 55% methane
1. The primary amine is changed into corresponding alcohol by:
 - a) Acidified KMnO_4 b) HNO_2 c) Br_2/KOH d) HNO_3
 2. Which of the following is a trihydric alcohol?
 - a) Glycol b) glycerol c) glycine d) citric acid.
 3. Fermentation is an
 - a) Exothermic reaction b) endothermic reaction c) reversible reaction d) none of these
 4. n - butyl alcohol and tert-butyl alcohol can be chemically distinguished by
 - a) PCl_5 b) reduction c) oxidation d) substitution
 5. Which of the following is used as an anti-freeze
 - a) Methanol b) ethanol c) propane-2-ol **d) glycol**

6. which of the following alcohol contains chiral carbon?
a) Butane-1-ol b) butane-2-ol c) propane-1-ol d) 2-methylpropan-2-ol
7. An organic compound X on treatment with acidified $K_2Cr_2O_7$ gives a compound Y, which reacts with I_2 and Na_2CO_3 to form triiodomethane. The compound X is:
a) CH_3OH b) $CH_3-CO-CH_3$ c) CH_3-CHO d) $CH_3CHOH-CH_3$
8. Oxo-process is applicable for preparation of which alcohol?
a) Primary alcohol b) secondary alcohol c) tertiary alcohol d) all of the above
9. Hydroboration-oxidation of alkane gives product:
a) Markonikov's b) saytzeff's c)anti- markonikov's d) hoffmann's
10. When vapor of tertiary alcohol is passed over heated Cu at 300 degree Celsius it undergoes:
a) Dehydrogenation b) substitution c) dehydration d) dehydrohalogenation

MCQs (PHENOL):

1. Phenol is more acidic than:
a) p-cresol b) p-nitrophenol c) p-chlorophenol d) picric acid
2. phenol and ethanol cannot be distinguished by:
a) DNP test b) iodoform test c) ferric chloride test d) libermann's test
3. O- acetoxybenzoic acid is:
a) Paracetamol b) aspirin c) Dettol d) salicylaldehyde
4. Reamer- tiemann reaction yields
a) Benzaldehyde b) benzoic acid c) salicylaldehyde d) salicylic acid
5. Sodium phenoxide reacts with iodomethane to give anisole, this is a type of
a) Electrophilic substitution reaction b) nucleophilic addition reaction c) electrophilic addition reaction d) nucleophilic substitution reaction
6. From the following information, identify the compound
 - i) It is one of the derivative of carboxylic acid.
 - ii) It is formed by acetylation of phenol
 - a) Phenyl propanamide b) phenyl methanoate c) phenyl acetamide d) phenyl ethanoate
7. Phenol reacts with bromine in CS_2 at low temperature to give

- a) Ortho and para bromophenol b) 2,4,6-tribromophenol c) o-bromophenol d)p-bromophenol
8. Coupling reaction between phenol and benzene diazenium chloride gives:
a) p-hydroxyazobenzene b) p-aminoazobenzene c) azoxybenzene d) hyrazobenzene
9. compound A on fusion with NaOH followed by acidification gives phenol, A is:
a) sodium salicylate b) sodium carboxylate c) sodium phenoxide d) sodium benzene sulphonate
10. phenol develops reddish pink color when exposed in air. this is due to the formation of:
a) quinone b) p-benzoquinone c) phenoquinone d) none of these

MCQs (CARBOXYLIC ACID)

1.Which reaction is suitable for preparing alpha-chloroacetic acid?

- a. Hell- volhard zelinsky reaction c. perkin reaction
b. reamer-tiemann reaction d. none of these.

2.Formic acid and acetic acid can be distinguished by:

- a. Litmus test c. Tollen's test
b. NaHCO₃ test d. 2,4-DNP test

3.The high boiling point of carboxylic acid than alcohol having comparable molecular mass is due to:

- a. Hydrogen bonded dimeric structure of acid c. strong vandar waal's force
b. high polarity of oxygen-hydrogen bond d. both a and b.

4.Which one is the most reactive derivative of carboxylic acid?

- a. acid amide c. acid anhydride
b. ester d. acid chloride.

5. Claisen condensation not given by ester of

- a. propanoic acid c. formic acid
b. ethanoic acid d. butanoic acid

6. Amide acts as a

- a. Lewis's acid and Bronsted base c. Arrhenius base and Lewis's base
b. Lewis's base and Bronsted acid d. Lewis's acid and Lewis's base

7. Which of the following order of acidity is correct?

- a. $\text{HCOOH} > \text{CH}_3\text{COOH} > \text{C}_6\text{H}_5\text{COOH}$ c. $\text{C}_6\text{H}_5\text{COOH} > \text{HCOOH} > \text{CH}_3\text{COOH}$
b. $\text{CH}_3\text{COOH} > \text{HCOOH} > \text{C}_6\text{H}_5\text{COOH}$ d. $\text{HCOOH} > \text{C}_6\text{H}_5\text{COOH} > \text{CH}_3\text{COOH}$

8. Acetamide on treatment with P_2O_5 , Gives

- a. ethylamine c. ethane nitrile
b. ethyl methylamine d. none of the above

9. Which of the following is not fatty acid?

- a. oxalic acid c. acetic acid
b. formic acid d. pentanoic acid

10. Which reducing agent is used to convert carboxylic acid directly to alkane.

- a. LiAlH_4 c. H_2/Ni
b. NaBH_4 d. $\text{HI}/\text{red P}$

MCQs (Ether)

1. When ethyl halide reacts with sodium ethoxide, it gives diethyl ether. The reaction is:
 - a. Williamson's synthesis
 - b. Wurtz reaction
 - c. Kolbe's reaction
 - d. Hoffman's reaction
2. When vapours of ethanol is passed over heated alumina at 523K it gives
 - a. Ethoxyethane
 - b. ethanal
 - c. ethene
 - d. ethylhydrogen sulphate
3. Williamson's synthesis, RX reacts with RONa to give ROR, the reaction is
 - a. nucleophilic substitution
 - b. nucleophilic addition
 - c. electrophilic addition
 - d. electrophilic substitution
4. when tert-butyl bromide is reacted with sodium ethoxide, the major product is
 - a. tert-butyl methyl ether
 - b. diethyl ether
 - c. ethane
 - d. **2-methyl-1-propene**
5. The number of metamers that is represented by $C_4H_{10}O$ is
 - a. 2
 - b. 3
 - c. 4
 - d. 5
6. When anisole reacts with HI, it gives
 - a. Methanol
 - b. phenol
 - c. iodobenzene
 - d. iodophenol
7. when alcohol is treated with conc. H_2SO_4 at 443K it gives
 - a. ethoxyethane
 - b. ethanal
 - c. ethene
 - d. 1,2-ethandiol
8. Williamson's synthesis is suitable for
 - a. R-O-R and R-O-R'
 - b. R-O-R only
 - c. R-O-R' only
 - d. R-O-H
9. The reactivity order towards electrophilic substitution is
 - a. Phenol > anisole > benzene > chlorobenzene
 - b. Phenol > chlorobenzene > benzene > anisole
 - c. Anisole > phenol > benzene > chlorobenzene
 - d. Anisole > phenol > chlorobenzene > benzene
10. Diethyl ether and ethyl alcohol cannot be distinguished using
 - a. Iodoform test
 - b. Dichromate test
 - c. Permanganate test
 - d. **Bromine test**

MCQs(SERVICE TO MANKIND)

1. Which of the followings is a natural polymer?
 - a. Polystyrene
 - b. Neoprene
 - c.Nylon-6,6
 - d. **protein**
2. $F_2C=CF_2$ is monomer of
 - a. Buna-S
 - b. Nylon-6,6
 - c.Orlon
 - d.**Teflon**
3. The natural rubber is the polymer of
 - a. **Cis-isoprene**
 - b. Chloroprene
 - c.Trans-isoprene
 - d.Styrene
4. Phenolphthalein is
 - a. **Phthalein dye**
 - b. Azo dye
 - c.Nitro dye
 - d.Vat dye
5. Nonstick coating of cooking utensils is
 - a. Polypropylene
 - b. Bakelite
 - c.**PTFE**
 - d.Polystyrene
6. indigo is
 - a. nitro dye
 - b. mordant dye
 - c.**vat dye**
 - d.azoic dye
7. cellulose is the polymer of
 - a. maltose
 - b. fructose
 - c. **α -glucose**
 - d. β -glucose
8. Bakelite is the polymer of
 - a. methanal and alcohol
 - b. **phenol and methanal**
 - c.aniline and urea
 - d.phenol and chloroform
9. which of the following is rodenticide?
 - a. **Zinc phosphide**
 - b. 2,4-D
 - c.BHC
 - d.DDT
10. Out of the following which one is the step growth polymer?

11. Which is the correct statement about dye?

- a. Every coloured substance can act as dye
 - b. **Presence of chromophore and auxochrome are necessary**
 - c. Presence of chromophore is necessary
 - d. Presence of auxochrome is necessary

12. Which of the following is a copolymer?

13. Which of the following is an auxochrome?

- a. $\text{--N}=\text{N}\text{--}$ c. --N=O
 b. --OH d. --NO_2

14. An example of mordant dye is

- a. Picric acid
 - b. Alizarin
 - c. Indigo
 - d. Martius yellow

15. nylon-6,6 is chemically a

16. which of the following is an antibiotic drug?

17. natural rubber is a polymer of

18. which of the following is a Vat dye?

19. which of the following polymer contains nitrogen?

- a. Dacron
b. Teflon
c. Styrene
d. Nylon

20. pentachlorophenol is an example of:

- a. fungicide
b. herbicide
c. insecticide
d. none of these

21. which of the following is an analgesic drug?

- a. penicillin
b. anti-pyrene
c. novalgin
d. equanil

22. unsaturated group present in an organic compound is called

- a. chromophore
b. chromogene
c. auxochrome
d. none of these

23. drugs which helps to reduce anxiety and brings calmness is

- a. analgesic
b. diuretic
c. tranquilizer
d. antibiotic

24. which dye is used in blue jeans?

- a. Indigo
b. azo
c. nitro
d. phthalein

25. which of the following is not bio-degradable?

- a. Polyglycolic acid
b. Polyhydroxy butyrate
c. Polylactic acid
d. Polystyrene

MCQs (CEMENT)

1. Which chemical composition has highest content in OPC

- a. alumina
b. silica
c. lime
d. iron oxide

2. Which compound gives the color to the cement?

- a. lime
c. silica

- b. iron oxide d. alumina
3. What is released during the production of clinker?
a. CaCO₃ c. Ca(OH)₂
b. CO₂ d. CO
4. As the materials pass through the kiln their temperature is rised upto ____
a. 1350-1550 °C c. 1300-1700 °C

b. 1100-1500 °C d. 1100-1600 °C
5. What is the initial setting time of cement?
a. 1 hour c. 15 minutes
b. 30 minutes d. 30 hours
6. What is the final setting time of cement?
a. 1 hour c. 55 minutes
b. 10 hours d. 30 hours
7. Which one is a pozzolanic material?
a. Fly ash c. charcoal
b. Silica d. red mud
8. Silica in excess causes

a. the cement to set slowly c. the cement to expand
b. the cement to set slowly d. the cement to disintegrate
9. What is the average particle size of cement?
a. 15 microns c. 75 microns
b. 45 microns d. 100 microns

MCQs (NITRO COMPOUNDS)

1. Which of the following is ambident nucleophile.
a. CN c. OH
b. NO₂ **d. a & c**

2. The electrophile in Nitration is
- a. Nitrate ion c. nitrite ion
 - b. ***nitronium ion*** d. cyanide ion
3. Nitro group is isomeric with
- a. Cyano group c. ***nitrite group***
 - b. diazo group d. isocyanide group
4. Reduction of Nitro compounds in acidic medium
- a. amide c. Hydroxylamines
 - b. ***primary amines*** d. secondary amines
5. Nitrite group attaches itself to any alkyl or aryl group through
- a. ***Oxygen atom*** c. Nitrogen atom
 - b. Hydrogen atom d. Carbon atom
6. Reduction of Nitrobenzene in neutral medium gives
- a. azobenzene c. aniline
 - b. phenylcyanide d. ***phenylhydroxylamine***
7. Alkyl halide reacts with alcoholic AgCN to give
- a. alkyl cyanide c. alkyl cyanate
 - b. ***alkyl carbylamine*** d. alkyl nitrite
8. Nitration of Nitrobenzene above 60 °C gives
- a. o-dinitrobenzene c. p-dinitrobenzene
 - b. ***m-dinitrobenzene*** d. diazobenzene
9. ethyl bromide reacts with Silver Nitrite to give
- a. nitrolic acid c. pseudonitrol
 - b. ***ethylnitrite*** d. nitroethane
10. Compound that has a smell of bitter almond is
- a. aniline c. benzene
 - b. ***nitrobenzene*** d. phenol

11. Nitro group is an example of

- a. leaving group
- b. oxidizing agent
- c. reducing agent
- d. ***ambident group***

MCQs (AMINES)

1. What is obtained when benzoyl chloride reacts with aniline in presence of pyridine:

- a. Benzoic acid
- b. Acetanilide
- c. **Benzanilide**
- d. Azobenzene

2. Tertiary amines have lowest boiling point among isomeric amines:

- a. They have highest molecular mass
- b. They are more polar in nature
- c. **They do not form H-bonding**
- d. They are most basic in nature.

3. Which of the following amine gives carbylamine reaction:

- a. Triethylamine
- b. **Ethylamine**
- c. Diethylamine
- d. Ethyl methylamine

4. C₃H₉N cannot represent

- a. Primary amine
- b. Tertiary amine
- c. Secondary amine
- d. **Quaternary ammonium salt.**

5. Which of the following compound gives secondary amine on reduction:

- a. Nitrobenzene
- b. **Methylisocyanide**
- c. Nitromethane
- d. Methyl cyanide

6. Ethyl amine can be prepared by the action of Bromine & Caustic potash on which compound ?

- a. Acetamide
- b. Formamide
- c. **Propionamide**
- d. Methyl cyanide

7. Which of the following compound is formed in the reaction of an aldehyde & primary amine:

- a. Ketone c. Aromatic acid
b. Schiff's base d. Carboxylic acid.

8. An Aromatic compound A on treatment with ammonia and heating forms compound B which on heating with Br_2 & KOH forms a compound C Of molecular formula $\text{C}_6\text{H}_7\text{N}$. The substrate is :

- a. Aniline c. Benzoic acid
b. Benzamide d. Benzylamine

9. Chloroform & carbon tetra chloride are most commonly used solvent in the lab. They can be distinguished by

- a. Alc. KOH + Ethylamine** c. Alc. KOH + diethylamine
b. Aq. AgNO_3 d. Alc. KOH + triethylamine

10. The secondary amine on Excess alkylation gives:

- a. Primary amine c. **Tertiary amine**
b. Amide d. None of the above.

MCQs (PAPER AND PULP)

1. Pulp is
 - a. ***Commercial cellulose used for the production of paper***
 - b. Commercial lignin used for the psoduction of paper
 - c. Commercial cellulose used for the production of paper.
 - d. A kind of paper.

2. Paper is
 - a. ***Matted or pressed mass of Cellulose fiber sheet***
 - b. Conventional raw material for packaging
 - c. Bleached portion of pulp
 - d. Debarking portion of trees.

3. Which one of the following plants is commonly being used in the production of paper in Nepal
 - a. ***Sallo***
 - c. harro

- b. Allo d. barro
4. The objective of the pulping is
a. ***To break down the bulk structure of fiber sources***
b. To remove the sapwood portion of wood
c. To bleach the paper
d. To make the paper stretchable
5. Nowadays ecofriendly methods have been employed in preference to the other chemical methods. The science which can make wood based paper industry moreeconomically friendly is,
a. Biochemistry
b. Biotechnology
c. Botany
d. Economics
6. Which of the following is not fibrous raw material for paper
a. Pulp c. **asbestos**
b. Wastepaper d. **clay**
7. Quality of paper depends upon
a. Nature of raw material c. paper formation process
b. Nature of pulp **d. all of above**
8. Removal of which of the following leads to higher fiber-fiber bonding strength in paper
a. Softwood **c. lignin**
b. Hardwood d. pulp
9. Lignocellulosic fibrous material producesby mechanical or chemical removing of lignin
a. Cellulose c. pulpwood
b. Pulp d. bleachedpaper.

10. Bleaching of pulp may not be necessary for the production of
- a. Typing material c. newspaper
 - b. **Packaging material** d. tissue paper.

MCQs (RADIOACTIVITY)

1. The SI unit of radioactivity is

- Curie **c. Becquerel**
- Rutherford d. Einstein

2. 1 Curie is equal to

- a. 3.7×10^{10} dps c. 3.7×10^{10} bq
- b. 3.7×10^4 rd **d. all of the above**

3. Hydrogen bomb is built on the principle of

- Nuclear fission **c. nuclear fusion**
- Chemical reaction d. none

4. Atom bomb was made on the principle of

- Nuclear fission** c. Chemical reaction
- Nuclear fusion d. None of the above

5. The fat -man atom bomb dropped on Nagasaki was of

- a. ^{235}U c. Th
- b. ^{239}Pu** d. D

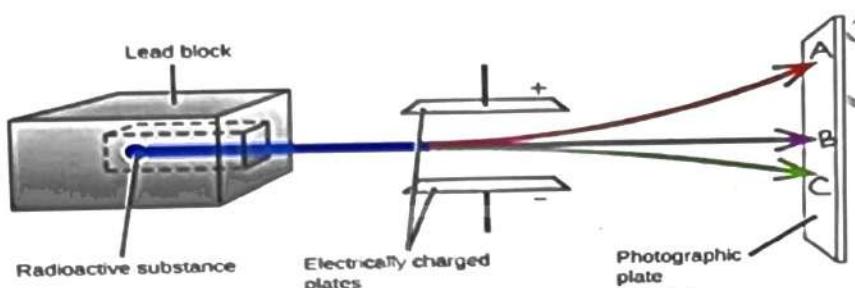
6. Radioactivity is due to

- a. Unstable nucleus** c. unstable electronic state
- b. Stable nucleus d. stable electronic state

7. The age of most ancient geological formation is estimated by,

- a. K- Ar method c. Ra-Si method

- b. **^{14}C dating method** d. U-Pb method
8. The radiation which has maximum penetrating power is
 a. Alpha -ray c. **Gamma -ray**
 b. Beta -ray d. Cathode - ray
9. Which of the following radioactive isotope is used in determining age of fossil
 a. **^{14}C** c. ^{3}H
 b. ^{18}O d. ^{24}Na
10. In the figure given below, which one is correct



- a. Alpha -ray deviate towards A, beta ray deviate towards C & gamma ray directtowards B
 b. Alpha ray directs towards B, beta rays deviate towards c & gamma rays towards A
 c. Alpha rays deviate towards C, beta rays directs towards B & gamma rays towards A
d. Alpha rays deviate towards C, beta rays deviate towards A & gamma rays directs towards B

MCQs (Organometallic compounds)

- 1.The pie - bonded organometallic compound which has ethene as one of its component is :
 a. **Zeise's salt** c. tetraethyl tin
 b. Ferrocene d. dibenzene Chromium
- 2.An example of sigma bonded organometallic compound is
 a. Ferrocene c. **Grignard's reagent**

d. Ruthenocene

3. Carbonation of Grignard reagent gives

4. Which of the following organometallic compound is known as antiknocking reagent

a. Trimethyl aluminium c. diethyl Zinc

5. Hydrolysis of alkyl magnesium bromide gives

a. Alkane *c. alkyne*

b. Alkene

6. Which of the following compound is formed when methanal is reacted with Grignard's reagent followed by hydrolysis

Transition metal

Questions

1. Concern the following metals from the first d-block series in the Periodic Table:

A Scandium (atomic number 21)

B Titanium (atomic number 22)

C Manganese (atomic number 25)

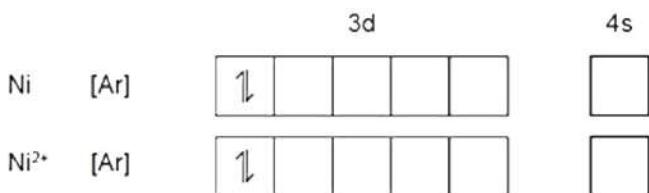
D Iron (atomic number 26)

E Copper (atomic number 29)

Select, from A to E, the metal which

- show general electronic configuration of transition element. (1)
- forms a colourless ion of oxidation state +4 (1)
- has the greatest number of unpaired electrons in its atom C (1)
- displays the highest oxidation number C (1)
- write two example of octahedral complex of atomic number 28.

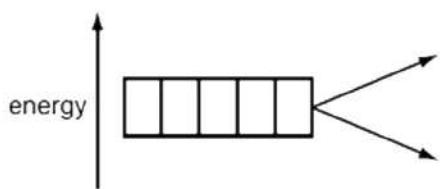
2. A. Complete the electronic configuration of Ni and Ni^{2+} .(2)



B. The presence of electron in d-orbitals is responsible for the colors of transition element compounds.

- The d orbital is an isolated transition metal atom or ion are all at the same energy level. What terms is used to describe orbital that are at the same energy level? (1)

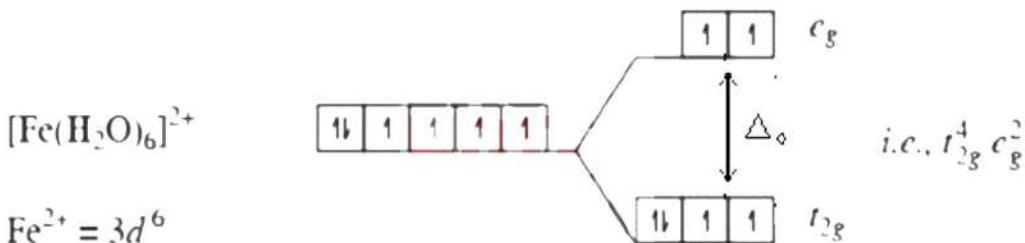
ii. Complete the diagram show splitting of d orbital energy levels in the octahedral complex ion. Write one example of octahedral complex. (2)



3. Iron is transition element and is an important catalyst in in Haber's process for the synthesis of ammonia.

- Does it shows a variable oxidation state? Which one is most stable and why? (1)
- What is meant by the complex ion? $K_4[Fe(CN)_6]$, potassium hexacyanoferroate(II) is a complex salt of iron, Show the ionization of the compound. (2)
- write the coordination number of the central metal atom. (1)
- In Fe^{2+} and Fe^{3+} , which one is more paramagnetic in nature and why? (1)

4. The figure shows the octahedral distortion of $[Fe(H_2O)_6]^{2+}$



- Why does octahedral distortion occur in presence of ligand? Explain on the basis of CFT.[2]
- On the basis of given distortion, how can you explain $[Fe(H_2O)_6]^{2+}$ is green colored complex. [1]
- Out of Fe^{++} and Fe^{+++} which one is more stable? Explain on the basis distortion seen the above figure. [1]
- Why do such elements which give such splitting show good catalytic properties? [1]

5. In aqueous solution, Iron can form complex ions which contain ligands.

- Name the type of bonding that occurs between ligand and transition element. (1)
- Which of the following species can act as ligand. (2)

species
NO_3^-
BF_3
$\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$
NH_4^+

c. Complete the following electronic configurations.(1)

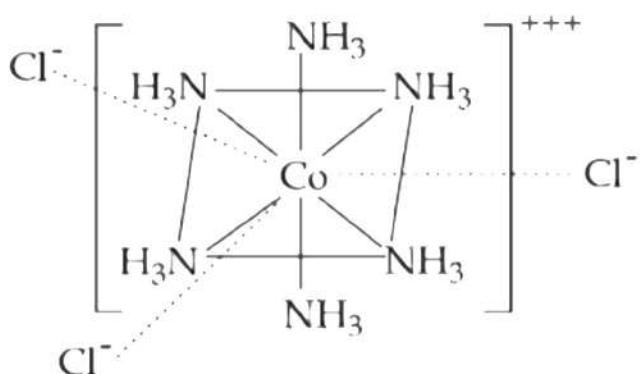
- the cobalt atom, Co $1s^22s^22p^6$
- the cobalt(II) ion, Co^{2+} $1s^22s^22p^6$

d. A cobalt complex has the general formula $\text{CoCl}_3 \cdot 6\text{NH}_3$. One mole of this compound is found to react completely with 3 mole of AgNO_3 to give precipitate of AgCl . This compound is found to possess high molar conductivity. Based on this information, Predict the ionic formulation and geometry of complex. (2)

6. The ions of transition elements can form complexes by reacting with ligands.

- a. State what is meant by complex and ligand. (2)
- b. You are supposed to given $[\text{Co}(\text{NH}_3)_5\text{Cl}] \text{Cl}_2$ compound, identify the following;
 - i. Primary valency ii. Secondary valency (1)
- c. What is term used where central metal atom or ion along with the ligand inside square bracket? (1)
- d. If the compound is $\text{CoCl}_3 \cdot 3\text{NH}_3$, and the doesnot give white precipitate of AgCl write the systematic formula of the compound.(1)

7. Study the structure of the following complex.



- Write the systematic structure of given compound. (1)
- Show the electronic configuration of central metal atom above. (1)
- This compound react to AgNO_3 form precipitate of AgCl . How many mole of AgNO_3 is consumed if 1 mole of complex is used? (1)
- Draw the three dimensional structure of CuCl_4^{2-} .

Heavy Metals (Zinc, Iron, Copper, Mercury, Silver)

Zinc

1. The electronic configuration of Zn is $[\text{Ar}] 4\text{S}^2 3\text{d}^{10}$, it is last element of 3d transition series.

- Group IIB elements are known as pseudo transition elements, why?
- Give an example of colliders solution which is used in concentration process of sulphide ores.
- Can you explain the importance of zinc in galvanization process?
- How can you prepare phillosopher's wool by using zinc?

2. A metal sulphate when heated gives yellow residue (X), Oxygen and Choking smell gas (Y). The gas Y turns lime water milky. The yellow residue becomes white when cooled.

- Identify X and Y.
- what is lithophone, write any one use of lithophone.
- Why does this metal acquire dull green colour on its surface after long exposure to moist air?

3. Spelter zinc can be purified by using fractional distillation process or electrolytic refining process.

- What do you mean by spelter zinc?

- ii. Explain electrorefining process.
- iii. what is the composition of brass and bronze?
- iv. What is the difference between fractional distillation and simple distillation?

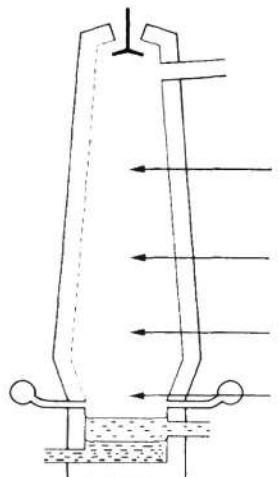
4. 'X' is an ore of metal 'M'. X on roasting gives white precipitation of metal oxide which on reduction gives metal 'M'.

- i. Identify 'X'.
- ii. Write the reaction involved during the roasting of 'X'.
- iii. Convert metal 'M' into its vitriol.
- iv. Why metal 'M' is not considered as true transition elements?
- v. Write two uses of metal 'M'.

Iron

5. Label a larger copy of Figure to answer the following:

- (a) the hopper feed and its composition, (1)
- (b) the parts of the furnace where the temperatures are approximately 250°C , 700°C , 1150°C and 1500°C . (2)
- (c) equations for the main chemical reactions opposite the appropriate parts of the furnace. (Assume that the iron ore is mainly Fe_2O_3)• (2)



Extraction of iron in a blast furnace.

6. Most of Steel manufacturing company in world applies Basic Oxygen Converter. This process is much faster than the Open-hearth process and produces less air pollution than methods using air.

- i. Write the raw materials required in this process.
- ii. Write principle behind the manufacture of steel by Basic Oxygen process.
- iii. In what ways does this process differ from Open Hearth process?
- iv. What is the role of acidic or basic lining in this process?

7. Steel is alloy of iron containing 0.2 to 2% carbon. Bessemerization process and open-hearth process can be used for manufacturing of steel.

- i. Which one of them is better and why?
- ii. What is use of spiegeleisen in manufacture of steel?
- iii. What is Thomas slag?

iv. Write reaction involved in acidic and basic bessemerization process?

8. Titanic ship accidentally sunk in the North Atlantic Ocean lies 3800m deep in the sea on 15th April 1912. The body of the ship is being significantly deteriorated mostly due to corrosion which is an electrochemical process.

- i. What are main causes of rusting? (1)
- ii. Write the electrochemical reaction that take place at anode and cathode during corrosion(rusting) of metal. (2)
- iii. What is the preventive measure of rusting? (2)

MERCURY

9. ‘A’ is the ore of metal ‘M’ which is concentrated by froth flotation process, on reduction and distillation gives impure metal ‘M’ which gives false impression of silver.

- i. Identify ‘A’ and ‘M’. (1)
- ii. What steps are involved in the purification of impure metal ‘M’.[1]
- iii. What happens when limited and excess of chlorine gas is passed over metal ‘M’. write the common name of compound formed. (2)
- iv. Write the use of each compound formed in above reaction. (1)

10. Calomel (Hg_2Cl_2) and corrosive sublimate ($HgCl_2$) are two important compounds of mercury,

- i. How would you prepare calomel from corrosive sublimate and vice versa? (2)
- ii. Hg_2Cl_2 gives white precipitate while $HgCl_2$ gives grey-black precipitate with NH_3 . Why? (1)
- iii. What is the use of calomel in electrochemistry? (1)
- iv. Write IUPAC name of Nessler’s reagent. (1)

COPPER

11. Copper is mainly extracted from copper pyrite ore

- i. Write the molecular formula of copper pyrite. (1)
- ii. Why complete removal of FeS is most important step in the extraction of copper? (1)
- iii. What is bessemerization? Describe the process in the reference of extraction of copper. (2)
- iv. Why the copper is used for making electrical wires and domestic cooking utensils? (1)

12. Copper sulphate pentahydrate is commonly known as blue vitriol.

- Write the action of heat on blue vitriol crystal? (1)
- The aqueous solution of copper sulphate is acidic. Why? (1)
- How can you prepare Schweitzer's reagent? (1)
- How are black and red oxides of copper obtained from cupric sulphate solution? (2)

13. Explain with suitable chemical reactions.

- A light blue colored precipitate 'A' obtained by the addition of caustic soda in the solution of cupric sulphate is converted to black precipitate B on heating. What are A and B with reaction? (2)
- A brown gas is obtained when copper is treated with conc. HNO_3 . (1)
- Copper becomes green when exposed to air for a long time? (1)
- Cuprous oxide is reduced back to copper by stirring the molten metal with green poles of wood. (1)

Silver

14. . Silver is found in free as well as in combined state. In our country it is found in Bandipur and Tanahu mainly.

- Write two ores of silver. (1)
- What are the steps of the extraction of silver(mention its steps only) (1)
- How silver is precipitated from sodium argento cyanide? (1)
- How silver chloride and silver nitrate is prepared? Show its chemical reaction. (2)

15. The impure silver is purified by electrolytic method.

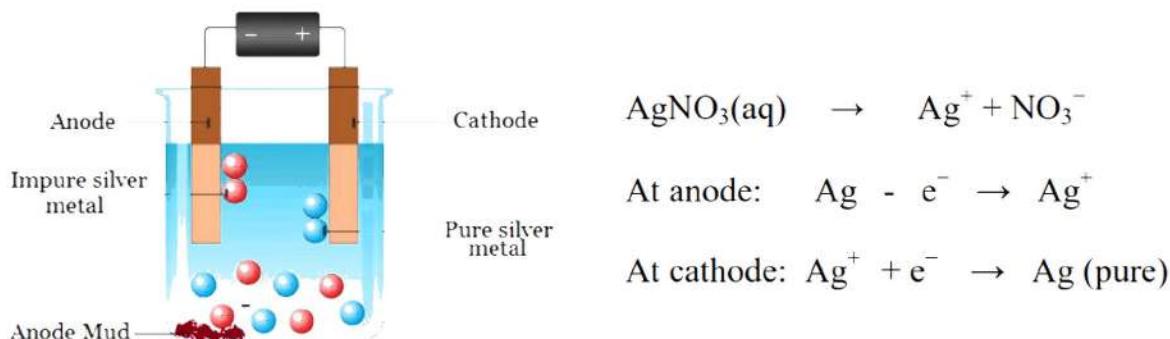


Fig: Electrolytic refining of silver

- What is the electrolyte used to purification of silver above? (1)

- ii. Which process is used to concentrate the argentite ore? (1)
- iii. For the extraction process, Concentrated ore of silver is treated with 0.4% to 0.7% solution of sodium cyanide? Write its reaction to form sodium argento cyanide complex. (2)
- iv. Write any one uses of AgNO_3 and AgCl . (1)

Multiple choice questions

1. The _____ sphere is enclosed in brackets in formulas for complex species, and it includes the central metal ion plus the coordinated groups.
a. Ligand b. Donor c. Oxidation **d. Coordination**
2. What is the oxidation number of the central metal atom in the coordination compound $[\text{Pt}(\text{NH}_3)_5\text{Cl}]\text{Cl}$?
a. -1 b. 0 c. +1 **d. +2**
3. The tetrahedral complex has coordination number
a. 3 b. 6 **c. 4** d. 8
4. $[\text{Fe}(\text{CN})_6]^{4-}$ is an example of complex ion.
a. Tetrahedral **b. Octahedral** c. Square planar d. linear
5. Name of the transition metal which does not exhibit variable oxidation state
a. **Zn** b. Ti c. V d. Fe
6. In coordination compound $[\text{Co}(\text{en})_3]\text{Cl}_3$, coordination number is 6. The ligand is
b. Monodentate **b. Bidentate** c. Tridentate d. Hexadentate
7. Which one of the following is an inner orbital complex as well as diamagnetic in behavior (Atomic number: Zn = 30, Cr = 24, Co = 27, Ni = 28)
a. $[\text{Cr}(\text{NH}_3)_6]^{3+}$ b. $[\text{Zn}(\text{NH}_3)_6]^{2+}$ **c. $[\text{Co}(\text{NH}_3)_6]^{3+}$** d. $[\text{Ni}(\text{NH}_3)_6]^{2+}$
8. Which of the following are pseudo transition elements?
a. Cu, Ag, Au **b. Zn, Cd, Hg** c. Fe, Co, Ni d. Ru, Rh, Pd
9. Electronic configuration of a transition element X in +3 oxidation state is $[\text{Ar}]3\text{d}^5$. What is its atomic number?
a. 25 **b. 26** c. 27 d. 2
10. The magnetic nature of elements depends on the presence of unpaired electrons. Identify the configuration of transition element, which shows highest magnetic moment.
a. 3d^7 **b. 3d^5** c. 3d^3 d. 3d^2
11. Which metal is not transition metal?
a. Gold b. Chromium c. Vanadium **d. Cesium**
12. Transition metals are colored because
a. They absorb electromagnetic radiation
b. Their penultimate d-sub shells are fully filled
c. **Of d-d transition**
d. None of the above
13. Co-ordination number in $[\text{Cu}(\text{NH}_3)_4]^{++}$ is
a. 2 b. 3 **c. 4** d. 5
14. Which of the following has a square planar shape?
a. $[\text{Ni}(\text{CN})_4]^{2-}$ b. $\text{Ni}(\text{Co})_4$ c. $[\text{Cu}(\text{NH}_3)_6]^{2+}$ d. $[\text{Fe}(\text{CN})_6]^{4-}$
15. Which of the following is bidentate ligand?
a. H_2O b. NH_3 c. SCN^- **d. $(\text{CH}_2)_2(\text{NH}_2)_2$**
16. The purest form of iron is
a. Steel b. Grey cast iron c. **Wrought iron** d. White cast iron
17. Stainless steel contains
a. $\text{Fe} + \text{C} + \text{Ni}$
b. $\text{Fe} + \text{Cu} + \text{Ni}$
c. $\text{Fe} + \text{Cr} + \text{Cu}$

- a. AgS b. AgBr c. **AgNO₃** d. Ag₂S
35. Photographic films and plates have essential ingredients of
a. AgNO₃ b. **AgBr** c. NaCl d. AgCl