ANNEXURE -1
SAMPLE PAPER

SAMPLE PAPER 1 (2022-23)

XII CHEMISTRY (043)

MM:70 **Time: 3 hours**

General Instructions:

Read the following instructions carefully.

a) There are **35** questions in this question paper with internal choice.
b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.
c) SECTION B consists of 7 very short answer questions carrying 2 marks each.
d) SECTION C consists of 5 short answer questions carrying 3 marks each.
e) SECTION D consists of 2 case- based questions carrying 4 marks each.
f) SECTION E consists of 3 long answer questions carrying 5 marks each.
g) All questions are compulsory.
h) Use of log tables and calculators is not allowed

SECTION A

1. Phenol can be distinguished from ethanol by the following reagents except:

(a) Sodium (b) NaOH/I_2 (c) Neutral $FeCl_3$ (d) Br_2/H_2O

2. Predict the stereochemistry of the product formed if an optically active alkyl halideundergoes substitution reaction by S ^{1} mechanism.
a) the product will have the structure with retained and inverted geometry in equalproportion, which is racemic mixture.
b) the product will have the structure with retained configuration with same opticallyactivity.
c) the product will have the structure with inverted configuration with inversion ofoptical activity.
d) all of these.

3. IUPAC name of $[Co(NH_3)_4(H_2O)Cl]Cl_2$ is
a) Tetraammineaquachloridocobalt (II) chloride
b) Tetraammineaquachloridocobalt (III) chloride
c) Tetraammineaquachloridocobaltate (III) chloride
d) Tetraamineaquachloridocobalt (III) chloride

4. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would ittake for 100% completion?
(a) 1.26×10^{15} s (b) 2.52×10^{14} s (c) 2.52×10^{28} s (d) infinite

5. The standard reduction potentials of X, Y, Z metals are 0.52V, -3.03V, -1.18V respectively. The order of reducing power of the corresponding metals is:

a) $Y > Z > X$ b) $X > Y > Z$ c) $Z > Y > X$ d) $Z > X > Y$

6. For a chemical reaction $A \rightarrow B$, it is found that the rate of reaction doubles when the concentration of A is increased four times. Rate law for the reaction is doubled, keeping the concentration of 'A' constant, the value of rate constant will be-

(a) the same (b) doubled (c) quadrupled (d) halved

7. Product of reaction of propenamide with aq KOH and bromine water will be-

a) Propan-1-amine b) Ethanamine
c) Propan-2-amine d) Diethylamine

8. If limiting molar conductivity of Ca^{2+} and Cl^{-} are 119.0 and 76.3 Scm^2mol^{-1}, then the value of limiting molar conductivity of $CaCl_2$ will be-

a) 195.3 Scm^2mol^{-1} b) 271.6 Scm^2mol^{-1}
c) 43.3 Scm^2mol^{-1} d) 314.3 Scm^2mol^{-1}

9. Which of the following is a secondary allylic alcohol?

a) But-3-en-2-ol b) But-2-en-2-ol
c) Prop-2-enol d) Butan-2-ol

10. Arrange the following in order of boiling points:

$(CH_3)_3N$, C_2H_5OH, $C_2H_5NH_2$

a) $(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH$ b) $(CH_3)_3N > C_2H_5NH_2 > C_2H_5OH$
c) $(CH_3)_3N < C_2H_5OH < C_2H_5NH_2$ d) $(CH_3)_3N > C_2H_5OH > C_2H_5NH_2$

11. To differentiate between pentan-2-one and pentan-3-one, a test is carried out. Which of the following is the correct answer?

(a) pentan-2-one will give silver mirror test
(b) pentan-2-one will give iodoform test
(c) pentan-3-one will give iodoform test
(d) None of these

12. A catalyst increases the rate of reaction because it-

a) Increases the activation energy
b) Decreases the energy barrier for reaction
c) Decreases the collision diameter
d) Increases the temperature coefficient

13. Primary and secondary valency of Cr in $[Cr(ox)_2(H_2O)Cl]^{2-}$ are-
a) 3,6 b) 3,4 c) 2,4 d) 2,6

14. Which transition element can show only one oxidation state-
a) Sc b) Zn c) Ag d) all of these

Note- Given below from question no. 15 to 18 are two statements labelled as Assertion (A) and Reason (R). Select the most appropriate answer from theoptions given below:

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

15. **Assertion (A)**: $(CH_3)_3C–O–CH_3$ gives $(CH_3)_3C–I$ and CH_3OH on treatment with HI.

Reason (R): The reaction occurs by SN1 mechanism.

16. **Assertion:** Vitamin D can be stored in our body
Reason: Vitamin D is fat soluble vitamin and is excreted from the body in urine

17. **Assertion:** Transition metals are good catalysts.
Reason: V_2O_5 or Pt is used in the preparation of H_2SO_4 by contact process.

18. **Assertion**: Aromatic 1° amines cannot be prepared by Gabriel Phthalimide Synthesis.
Reason: Aryl halides do not undergo nucleophilic substitution easily with anionformed by phthalimide.

SECTION B

19. The initial rate of a reaction, $A + B \longrightarrow$ Products is doubled when the initial concentration of A is doubled and increases eight-fold when the initial concentration of both A and B were doubled. Find the order of the reaction with respect to A and with respect to B and write the rate equation. (2)

20. i) What happens when glucose reacts with Bromine water? (1+1)
ii) What is invert sugar? Why is it called so?

OR

Enumerate the reactions of D-Glucose which cannot be explained by its open structure. (2)

21. Give reason for the following: (1+1)
   a. Alkyl halides are immiscible with water although they are polar.
   b. Grignard reagent should be prepared under anhydrous conditions.

OR

Write the structure and IUPAC name of major product formed by (1+1)

dehydrohalogenation of 1-bromo-1-methylcyclohexane with alcoholic KOH.

22. What type of isomers are $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$? Give a chemical test to distinguish between them. (2)

23. Write the electrode equations involved during discharging of Lead Storage Battery. (2)

24. With the help of a diagram, explain the physical significance of energy of activation (Ea) in chemical reactions. (2)

25. The pK_a value for benzoic acid, 4-nitrobenzoic acid, 4-methoxybenzoic acid are 4.19, 3.41, 4.46 respectively. What do you suggest about the effect of substituents on the acidic character of these compounds? (2)

SECTION C

26. Carry out the following conversions: (1 X 3)
   (i) Phenol to Salicylaldehyde
   (ii) t-butylchloride to t-butylethylether
   (iii) Propene to Propanol

27. Using Valence bond theory, for the complex ion of $[Fe(CN)_6]^{3-}$ (1 X 3)
   (i) Show hybridization diagrammatically.
   (ii) Is it an inner orbital complex or an outer orbital complex?
   (iii) State its magnetic property.

28. A solution of glucose (Molar mass = 180 g mol^{-1}) in water has a boiling point of 100.20°C. Calculate the freezing point of the same solution. Molal constants for water K_f and K_b are 1.86 $Kkgmol^{-1}$ and 0.512 $Kkgmol^{-1}$ respectively. (3)

29. (i) Write a distinguishing test between primary, secondary and tertiary amine with reaction.

(ii) Convert Nitrobenzene into 2,4,6-Tribromoaniline. (2+1)

30. i) Account for the following: (1 X 3)

a) p-isomers are higher boiling point than o-isomer and m-isomers.

b) Vinyl chloride is unreactive in nucleophilic substitution reactions.

ii) Which of the following compound undergo nucleophilic substitution faster by SN_2 mechanism and why? $(CH_3)_3Br$ and $CH_3CH_2CH_2CH_2Br$.

OR

i) Complete the following equations: (1 X 3)

a. $CH_3CH_2CH(Cl)CH_3 + KOH\ (Ethanol) \longrightarrow$

b. $C_6H_5Br + CH_3Br + Na\ (in\ Dry\ ether) \longrightarrow$

ii) Thionyl chloride is more preferable for the preparation of haloalkanes from alcohols, why?

SECTION D

The following questions are case-based questions. Each question has an internalchoice and carries 4 marks each. (1+1+2)

Read the passage carefully and answer the questions that follow.

31.Proteins are the most abundant biomolecules of the living system. The chief sources of proteins are milk, cheese, pulses, fish, meat, peanuts, etc. They are found in every part of the body and form a fundamental basis of the structure and functions of life. These are also required for the growth and maintenance of the body. The word protein is derived from the Greek word, 'proteios' meaning 'primary' or of 'prime importance'. Chemically, proteins are the polymers in which the monomeric units are the α-amino acids. Amino acids contain an amino ($-NH_2$) and carboxylic ($-COOH$) functional groups. Depending upon the relative position of the amino group with respect to the carboxylic group, the amino acids can be classified as α, β, and γ-amino acids.

Proteins are complex nitrogenous polymers of amino acids connected through peptide bonds. The sequence in which amino acids are linked is called Primary structure. Secondary structures are of 2 types α -helix in globular proteins and β

-pleated structure in fibrous proteins. The tertiary and quaternary structure refer to the further folding of polypeptide chain. These structures have H-bonds, disulphide linkage, ionic bonding, and van der Waals' forces. Insulin is a hormone for the metabolism of glucose, has a quaternary structure. Enzymes are highly specific, work at specific pH, moderate temperature, and catalyze biochemical reactions. Hormones perform specific functions and are secreted byendocrine glands. Physical and chemical changes destroy secondary and tertiarystructure, loss of biological activity but primary structure remaining the same.

a. α-Helix is a secondary structure of proteins formed by twisting of polypeptide chain into right handed screw like structures. Which type of interactions are responsible for making the a-helix structure stable?

b. Protein found in a biological system with a unique three-dimensional structure and biological activity is called a native protein. When a protein in its native form, is subjected to a physical change like change in temperature or a chemical change like, change in pH, denaturation of protein takes place. Explain the cause

c. Amino acids behave like salts rather than simple amines or carboxylic acids. Explain.

OR

What do you understand by Peptide linkage? Structures of glycine andalanine are given below. Show the peptide linkage in glycylalanine.

$H_2N—CH_2—COOH$: $H_2N—\underset{CH_3}{\underset{|}{CH}}—COOH$

(Glycine) (Alanine)

32. A solution which obeys Raoult's law strictly is called an ideal solution, while a solution which shows deviation from Raoult's law is called a non-ideal solution or real solution. Suppose the molecules of the solvent and solute are represented by A and B respectively, and let ©AB, ©AA and ©BB are the attractive forces between A—B, A—A and B—B respectively. An ideal solution of the components A and B is defined as the solution in which the intermolecular interactions between the components A—B are of the same magnitude as the intermolecular interactions found in the pure components A—A and B—B. Similarly, a non- ideal solution of the components A and B is defined as the solution in which the intermolecular interactions between the components A—B are of the different magnitude as the intermolecular interactions found in the pure components A—A and B—B.

i. What type of liquids form the ideal solution? Give one example of an ideal solution. (1)

ii. Write two characteristics of non-ideal solution. (1)

iii. On mixing liquid A and liquid B, volume of the resulting solution decreases, what type of deviation from Raoult's law is shown By and why? (2)

OR

In non-ideal solution, what type of deviation shows the formation of maximumboiling azeotropes? Give one example also. (2)

SECTION E

33. a. Why does the cell voltage of a mercury cell remain constant during its lifetime?
(1+1+3)

b. Predict the product of electrolysis of dil H_2SO_4 on cathode?

c. Write the Nernst equation and find the e.m.f. of the given cell at 298 K.

$Mg(s)/Mg^{2+}(0.001M)//Cu^{2+}(0.0001M)/Cu(s)$

(E^0 Mg^{2+}/Mg = -2.37V and E^0 Cu^{2+}/Cu = + 0.34 V)

OR

(2+1+2)

a. Determine Molar conductivity of 0.15 M solution of KCl at 298 K, if its conductivity of 0.0152 Scm^{-1}.

b. In an aqueous solution, how does specific conductivity of electrolytes change with addition of water?

c. Why on dilution the Λ_m of CH_3COOH increases drastically, while that of CH_3COONa increases gradually?

34. An organic compound A (C_3H_4) on hydration in presence of $H_2SO_4/HgSO_4$ gives compound B(C_3H_6O). Compound B gives white crystalline product D with sodiumhydrogensulphite. It gives negative Tollen's test and positive iodoform test. On drastic oxidation B gives compound C along with formic acid.

a). Identify compounds A and B and (2 + 3)

b). explain all the reactions involved

OR

(i) Describe the following (2+3)

(a) Aldol condensation (b) Decarboxylation

(ii) Carry out the following conversions: -

(a) Ethanal to 3-hydroxybutanal (b) Benzaldehyde to benzophenone.

(c) Acetone to propene

35. Answer the following: (2+3)

(i) Complete the following equations:

(a) $Cr_2O_7^{2-} + 2OH^- \rightarrow$

(b) $MnO_4^- + 4H^+ + 3e^- \rightarrow$

(ii) Following are the transition metal ions of 3d series:

Ti^{4+}, V^{2+}, Mn^{3+}, Cr^{3+} (At. No.: Ti=22, V=23, Mn=25, Cr=24)

Answer the following:

(a) Which ion is most stable in an aqueous solution and why?
(b) Which ion is a strong oxidizing agent and why?
(c) Which ion is colorless and why?

Sample paper 1

ANSWER KEY

SECTION A

1. a. Sodium
2. d. All of these
3. b. Tetraamminеaquachloridocobalt (III)chloride
4. d. infinite
5. a. Y > Z > X
6. a. the same
7. b. Ethanamine
8. b. 271.6 $\text{Scm}^2\text{mol}^{-1}$
9. a. But-3-en-2-ol
10. a. $(CH_3)_3N < C_2H_5NH_2 < C_2H_5OH$
11. b. pentan-2-one will give iodoform test
12. b. Decreases the energy barrier for reaction
13. a. 3,6
14. a. Sc
15. a
16. c
17. b
18. a

SECTION B

19. When conc of A is doubled, the rate is doubled. So, Order wrt [A] is 1. The rate increases by a factor of 8 when conc of [A] and [B] are doubled. So Orderwrt [B] is 2.
Rate is $=k[A][B]^2$ 2 marks

20.a. When glucose reacts with bromine water, the main product is gluconicacid.
correct equation 1 mark

b. The product mixture i.e. mixture of Glucose and Fructose on hydrolysis ofsucrose is called INVERT SUGAR. ½ mark Since the laevorotation of fructose (−92.4°) is more than dextrorotation of glucose (+52.5°), the mixture is laevorotatory. Thus, the hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (−), and the product is named as invert sugar. ½ mark

OR

The following reactions of D-glucose cannot be explained on the basis of its open chain structure : 2 marks

(i) D-Glucose does not react with sodium bisulphite '($NaHSO_3$)'

(ii) It does not give 2, 4-DNP test and Schiff's test.

(iii) The pentaacetate of D-glucose does not react with hydroxylamine.

(iv) existence of Anomers.

21.a. The molecules of water are held together by hydrogen bonds. As the new force of attraction between water and alkyl halides molecules are weaker than the forces of attraction already existing between alkyl halide- alkyl halide molecules and water - water molecules, they cannot form hydrogen bonds with water. 1 mark

b. Grignard reagents are very reactive. In the presence of moisture, they react to give alkanes. Therefore, Grignard reagents should be prepared under anhydrous conditions. 1 mark

OR

Correct structure 1 mark

1-Methylcyclohex-1-ene 1 mark

22. $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)SO_4]$ Br exhibit Ionisation isomers. 1mark

These can be distinguished by chemical test such that $[Co(NH_3)_5(SO_4)]Br$ react with silver ion to precipitate silver bromide, AgBr .

whereas $[Co(NH_3)_5Br]SO_4$ does not react with silver ion as a bromide is bonded to cobalt and hence not free to react. 1 mark

23. Correct equations (1+1 mark)

24. Correct expalnation 1mark

Correct diagram 1mark

25. Lower pk_a value, greater acidic character. So, the order of acidic character is

4-nitrobenzoic acid > benzoic acid > 4-methoxy benzoic acid 2 marks

As 4-nitrobenzoic acid contains $-NO_2$ group which is an electron withdrawing group; resulting in higher acidity than benzoic acid.

Methoxy is electron releasing group so lower acidity than benzoic acid.

SECTION C

26. Correct conversion 1mark each

27. i. d^2sp^3 with orbital diagram 1 mark

ii. Inner orbital complex 1 mark

iii. Paramagnetic with one unpaired electron 1 mark

28.Given, boiling point of solution, $T_b = 100.20°C = 373.35\ K$

K_f and $K_b = 1.86\ K\ kg\ mol^{-1}$ and $0.512\ K\ kg\ mol^{-1}$ respectively.We know, boiling point of pure water, $T_b^{\circ} = 100°C = 373.15\ K$ And freezing point of pure water, $T_f^{\circ} = 0°C = 273.15\ K$

$\Delta T_b = K_b \times m$

$T_b - T_b^{\circ} = 0.512 \times m$

$0.20 = 0.5120 \times m$ 1mark

$m = 0.390\ mol/kg$

Now, putting the above value in $\Delta T_f = K_f \times m$

$\Delta T_f = 1.86 \times 0.390 = 0.725\ K$ 1 mark

And, $\Delta T_f = T_f^{\circ} - T_f$

$T_f = 273.15 - 0.725 = 272.425\ K$ 1 mark

Therefore, the freezing point of the same solution is 272.425K.

29. i. Hinsberg test with equations 2 marks

ii. Correct conversion 1 mark

30. i) Correct reasons 1 mark each

ii) $CH_3CH_2CH_2CH_2Br$ because it is a primary alkyl halide, so less sterichindrance.
1 mark

OR

i) Correct answer 1 mark each.

ii) Correct reason 1 mark

SECTION D

31. a. H bonding 1 mark

b. Physical and chemical changes destroy secondary and tertiary structure,loss of biological activity. 1 mark

c. Correct explanation with equations 2marks

OR

Correct definition 1 mark

$NH_2CH_2CONHCH(CH_3)COOH$ 1 mark

32.i. The solution in which the intermolecular interactions between the components A—B are of the same magnitude as the intermolecular interactions found in the pure components A—A and B—B.

Any one example 1 mark

ii . Any two characteristics 1 mark

iii. Negative deviation 1mark

intermolecular interactions between the components A—B are stronger than the intermolecular interactions found in the pure components A—Aand B—B. 1 mark

OR

Negative deviation 1 mark

Any one example 1 mark

SECTION E

33.a. Because the overall cell reaction does not include any ion in the solution whose concentration changes during its lifetime. 1 mark.

b. Hydrogen gas 1 mark

c.

$$E_{cell} = E^0_{cell} - \frac{0.0591}{n} \log \frac{[Mg^{2+}]}{[Cu^{2+}]}$$ 1 mark

$E^0_{cell} = E^0\ Cu^{2+}/Cu - E^0 Mg^{2+}/Mg$

$= 0.34\ V - (-2.37V) = 2.71\ V$ 1mark

$E_{cell} = 2.71 - 0.0591/2\ (\log .001/.0001)$

$= 2.71 - 0.0295 = 2.6805\ V$ 1mark

OR

a. Given,

$M = 0.15M,\ \kappa = 0.0152\ Scm^{-1}$

We know the relation,

$\Lambda_m = \kappa \times 1000/M$ 1 mark

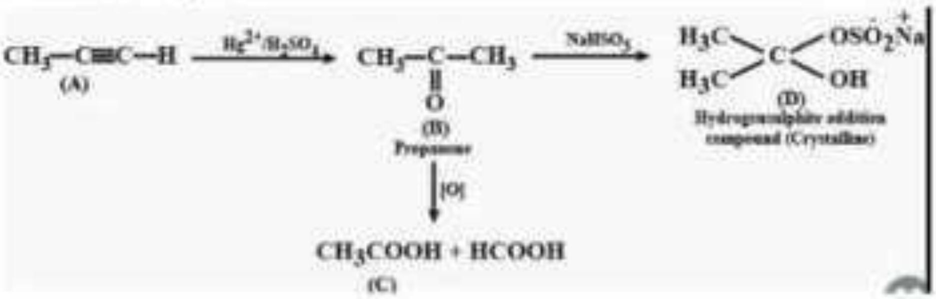
$\Lambda_m = \frac{1.52 \times 10^{-2} \times 1000}{0.15} = 101\ \Omega^{-1} cm^2 mol^{-1}$ 1 mark

b. correct explanation 1mark

c. correct explanation for both 1 mark each

34. a. A- propene , B- acetone 1 mark each

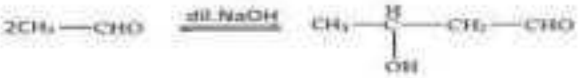
b. 3 mark each equation



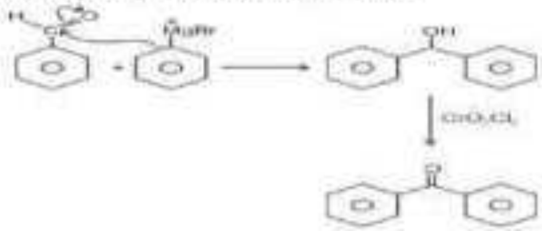
OR

i. (a) Each reaction with correct example 1 mark each

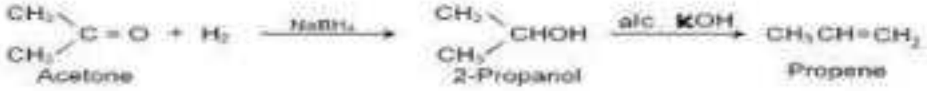
ii. (a) Ethanal to 3-hydroxybutanal 1 mark



(b) Benzaldehyde to benzophenone 1 mark



(c) Acetone to propene



35 (i) (a) $Cr_2O_7^{2-} + 2OH^- \rightarrow CrO_4^{2-} + H_2O$ 1 mark

(b) $MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$ 1 mark

(ii) (a) Ti^{4+} is most stable in an aqueous solution and because of noble gas configuration $3s^23p^6$. 1 mark

(b) Mn^{3+} strong oxidizing agent and because can gain an electron easily to attain half-filled 3d configuration. 1 mark

(c) Ti^{4+} colorless and because 3d subshell is empty. 1 mark

SAMPLE PAPER NO -2 (2022-23)

MM:70 **CHEMISTRY THEORY (043)** **Time: 3 hours**

General Instructions:

Read the following instructions carefully.

a) There are 35 questions in this question paper with internal choice.

b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.

c) SECTION B consists of 7 very short answer questions carrying 2 marks each.

d) SECTION C consists of 5 short answer questions carrying 3 marks each.

e) SECTION D consists of 2 case- based questions carrying 4 marks each.

f) SECTION E consists of 3 long answer questions carrying 5 marks each.

g) All questions are compulsory.

h) Use of log tables and calculators is not allowed

SECTION A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1. The alcohol which does not react with Lucas reagent is

a. isobutyl alcohol
b. n-butanol
c. tert-butyl alcohol
d. sec-butyl alcohol

2. Which of the following compounds has the highest boiling point?

a. $CH_3CH_2CH_2Cl$
b. $CH_3CH_2CH_2CH_2Cl$
c. $CH_3CH(CH_3)CH_2Cl$
d. $(CH_3)_3CCl$

3. Which group contains coloured ions out of the following?
1. Cu^+ . 2. Ti^{4+} 3. Co^{2+} 4. Fe^{2+}

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

4. The unit of rate constant for the reaction
$2H_2 + 2NO \rightarrow 2H_2O + N_2$ which has rate = $K[H_2][NO]^2$, is

a. mol L^{-1} s^{-1}
b. s^{-1}
c. mol^{-2} L^2 s^{-1}
d. mol L^{-1}

5. What is pH of the half cell Pt|H2(g)|H^+ if E∘H+|H2 =-0.0295 V

a. 1
b. 2

c. 0.5
d. 3

6. Half life period of a first order reaction is 10 min. What percentage of the reaction will be completed in 100 min?

a. 25%
b. 50%
c. 99.9%
d. 75%

7. Benzoic acid is treated with $SOCl_2$ and the product (X) formed is reacted with ammonia to give (Y). (Y) on reaction with Br_2 and KOH gives (Z). (Z) in the reaction is

a. Aniline
b. Chlorobenzene
c. Benzamide
d. benzoyl chloride

8. The CFSE of $[CoCl_6]^{3-}$ is 18000 cm^{-1} the CFSE for $[CoCl_4]^{-}$ will be:

a. 18000 cm^{-1}
b. 8000cm^{-1}
c. 2000 cm^{-1}
d. 16000 cm^{-1}

9. Phenol is less acidic than

a. ethanol
b. o-nitrophenol
c. o-methylphenol
d. o-methoxyphenol

10. Arrange the following compounds in increasing order of basicity:
CH_3NH_2, $(CH_3)_2$ NH, NH_3, $C_6H_5NH_2$

a. $C_6H_5NH_2 < NH_3 < (CH_3)_2NH < CH_3NH_2$
b. $CH_3NH_2 < (CH_3)_2NH < NH_3 < C_6H_5NH_2$
c. $C_6H_5NH_2 < NH_3 < CH_3NH_2 < (CH_3)_2NH$
d. $(CH_3)_2NH < CH_3NH_2 < NH_3 < C_6H_5NH_2$

11. A plot of log (a – x) against time t is a straight line. This indicates that the reaction is of

a. zero order
b. first order
c. second order
d. third order

12. Which of the following compounds will undergo Cannizzaro reaction?

   a. CH_3CHO
   b. CH_3COCH_3
   c. C_6H_5CHO
   d. $C_6H_5CH_2CHO$

13. Which of the following ligands form a chelate?

a. Acetate
b. Oxalate
c. Cyanide
d. Ammonia

14. Hydrocarbons are formed when aldehydes and ketones are reacted with amalgamated zinc and conc. HCl. The reaction is called

a. Cannizzaro reaction

b. Clemmensen reduction
c. Rosenmund reduction
d. Wolff-Kishner reduction

15. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): Phenol is more reactive than benzene towards electrophilic substitution reaction
Reason (R): In case of phenol, the intermediate carbocation is more resonance stabilised.
Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

16. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): The two strands in double helix structure of DNA are complementary to each other.
Reason (R): Disulphide bond are formed between specific pairs of bases.
Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

17. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): Ce^{4+} is used as an oxidising agent in volumetric analysis.
Reason (R): Ce^{4+} has the tendency of attaining +3 oxidation state.
Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

18. Given below are two statements labelled as Assertion (A) and Reason (R)
Assertion (A): Aromatic primary amines cannot be prepared by Gabriel phthalimide synthesis.
Reason (R): Aryl halides do not undergo nucleophilic substitution with the anion formed by phthalimide.
Select the most appropriate answer from the options given below:
a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

SECTION B

This section contains 7 questions with internal choice in two questions. The following questions are very short answer type and carry 2 marks each.

19. The rate law for the reaction : Ester + H+ ------ → Acid + Alcohol is:
$dx/dt = k\,[\text{Ester}][H^+]0$
What would be the effect on the rate if i) concentration of the ester is doubled?
ii) concentration of H^+ is reduced to half?

20. If one strand of DNA has the sequence –ATGCTTCA-, what is the sequence of the bases in the complementary strand? Give reason.

OR

- i) Name the species formed when an aqueous solution of amino acid is dissolved in water.
- ii) Which reaction shows that all the carbon atoms in glucose are linked in a straight chain.

21. Give reason for the following:
- i) Racemic mixture is optically inactive.
- ii) C-Cl bond length in chlorobenzene is shorter than C-Cl bond length in CH_3-Cl

OR

- i) Write equation for the preparation of 1-Iodobutane from 1-Chlorobutane.
- ii) Out of 2-Bromopentane, 2-Bromo-2-methylbutane and 1-Bromopentane, which compound is most reactive towards elimination reaction and why?

22. Write the IUPAC name of the complex $[Co(en)2(NO2)(Cl)]^+$. What type of structural isomerism is shown by this complex?

23. i) Write the reactions taking place at the anode and cathode of the cell used in hearing aids.

ii) Why mercury cell has a constant potential throughout its useful life?

24. The decomposition of hydrocarbon follows the equation: $k = (4.5 \times 10^{11}\ s^{-1})e^{-(28000\ K)/T}$ Calculate Ea.

25. What happens when
- i) Salicylic acid is treated with $(CH_3CO)_2O/H^+$?
- ii) Phenol is oxidised with $Na_2Cr_2O_7/H^+$?

Write chemical equation in support of your answer.

SECTION C

This section contains 5 questions with internal choice in two questions. The following questions are short answer type and carry 3 marks each.

26. i) Arrange the following in increasing order of their boiling point: Propanol, propane, propanal, Methoxy ethane

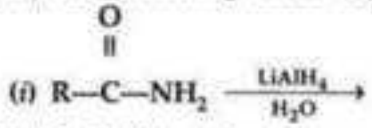
ii) Write the formula of reagents used in the following reactions:
- a) Bromination of phenol to 2,4,6-Tribromophenol.
- b) Hydroboration of propene and then oxidation to propanol.

27. A metal ion M^{n+} having d^4 valence electronic configuration combines with three bidentate ligands to form a complex compound. Assuming $\Delta > P$:
- i) Write the electronic configuration of the valence electrons of the metal M^{n+} ion in terms of t2g and eg.
- ii) What type of hybridisation will ion M^{n+} have?
- iii) Name the type of isomerism exhibited by this complex.

28. i) Predict the state of the solute in the solution when 'i' is found to be 0.3.

ii) What type of azetrope is formed by negative deviation from Raoult's law? Give an example.

29. Complete the following reaction equations:



(*i*) $R-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow[H_2O]{LiAlH_4}$ (*ii*) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$

(*iii*) $C_6H_5NH_2 + Br_2\ (aq) \longrightarrow$

OR

a) Give a chemical test to distinguish between each of the following pairs of compounds :
   (i) Ethylamine and Aniline
   (ii) Aniline and Benzylamine

b) Write the structure of 2-aminotoluene

30. Among all the isomers of molecular formula C4H9Br, identify

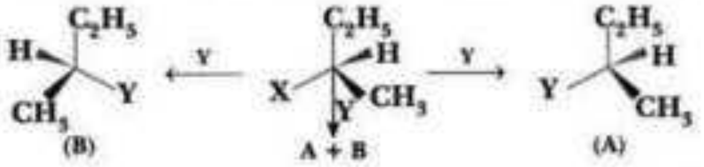
i) the one isomer which is optically active.

ii) the one isomer which is highly reactive towards SN2.

iii) the two isomers which give the same product on dehydrohalogenation with alcoholic KOH.

OR

Consider the three types of replacement of group X by group Y as shown here.



This can result in giving compound (A) or (B) or both. What is the process called if
i) (A) is the only compound obtained?
ii) (B) is the only compound obtained?
iii) (A) and (B) are formed in equal proportions?

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

31. Proteins are high molecular mass complex biomolecules of amino acids. The important proteins required for our body are enzymes, hormones, antibodies, transport proteins, structural proteins, contractile proteins etc. Extept for glycine, all α-amino acids have chiral carbon atom and most of them have L-configuration. The amino acids exists as dipolar ion called zwitter ion, in which a proton goes from the carboxyl group to the amino group. A large number of α-amino acids are joined by peptide bonds forming polypeptides. The pep tides having very large molecular mass (more than 10,000) are called proteins. The structure of proteins is described as primary structure giving sequence of linking of amino acids; secondary structure giving manner in which polypeptide chains are arranged and folded; tertiary structure giving folding, coiling or bonding polypeptide chains producing three dimensional structures and quaternary structure giving arrangement of sub-units in an aggregate protein molecule.

Answer the following questions:

i) α-Amino acids have relatively higher melting points than the corresponding halo acids. Explain.

ii) Name the protein and its shape present in oxygen carrier in human body.

iii) Give two differences between globular protein and fibrous protein.

OR

Give two differences between α-helix and β-pleated structure of protein.

32. Boiling point or freezing point of liquid solution would be affected by the dissolved solids in the liquid phase. A soluble solid in solution has the effect of raising its boiling point and depressing its freezing point. The addition of non-volatile substances to solvent decreases the vapour pressure and the added solute particles affect the formation of pure solvent crystals. According to many researches the decrease in freezing point directly correlated to the concentration of solutes dissolved in the solvent. This phenomenon is expressed as freezing point depression and it is useful for several applications such as freeze concentration of liquid food and to find the molar mass of an unknown solute in the solution. Freeze concentration is a high quality liquid food concentration method where water is removed by forming ice crystals. This is done by cooling the liquid food below the freezing point of the solution. The freezing point is referred as a colligative property along with vapour pressure lowering, boiling point elevation and osmotic pressure. These are physical characteristics of solutions that depend only on the identity of the solvent and concentration of the solute. The characters are not depending on the solute's identity.

Answer the following questions:

i) Why is glycol and water mixture used in car radiators in cold countries?

ii) What do you understand by the term that K_f for water is 1.86 Kkg/mol?

iii) Calculate the freezing point of a solution containing 60 g of glucose (Molar mass = 180g/mol) in 250 g of water (K_f for water is 1.86 Kkg/mol)

OR

iv) Calculate the mass of NaCl (molar mass = 58.5 g/mol) to be dissolved in 37.2 g of water to lower the freezing point by 2°C, assuming that NaCl undergoes complete dissociation. (K_f for water is 1.86 Kkg/mol)

SECTION E

The following questions are long answer type and carry 5 marks each. Two questions have an internal choice.

33. a) Represent the cell in which the following reaction takes place:

$2Al (s) + 3Ni^{2+} (0.1\ M) \dashrightarrow 2Al^{3+} (0.01M) + 3Ni (s)$

Calculate the emf if $E^\circ_{cell} = 1.41$ V

b) How does molar conductivity vary with increase in concentration for strong electrolyte and weak electrolyte? How can you obtain the limiting molar conductivity of weak electrolyte?

OR

i) Represent the cell in which the following reaction takes place:

$2Al (s) + 3Cu^{2+} (0.01\ M) \dashrightarrow 2Al^{3+} (0.01M) + 3Cu (s)$

Calculate the emf if $E^\circ_{cell} = 1.98$ V

ii) Using the E° values of A and B, predict which is better for coating the surface of iron [$E^\circ_{Fe2+/Fe} = -0.44$ V] to prevent corrosion and why?

(Given: $E^\circ_{A2+/A} = -2.37$ V, $E^\circ_{B2+/B} = -0.14$ V)

34. i) Write the products formed when CH_3CHO reacts with the following reagents:

(a) HCN

(b) $H_2N - OH$

(c) CH_3CHO in the presence of dilute NaOH

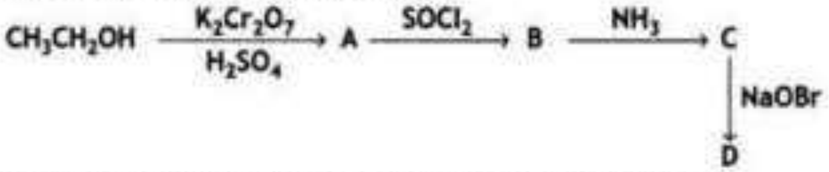
(ii) Give simple chemical tests to distinguish between the following pairs of compounds:

(a) Benzoic acid and Phenol

(b) Propanal and Propanone

OR

i) Predict the products of the following:



ii) Arrange the following in increasing order of acidic character:

HCOOH, CF_3COOH, $ClCH_2COOH$, CCl_3COOH

35. Assign reasons for the following:

- i) The enthalpies of atomisation of transition elements are high.
- ii) From element to element, the actinoid contraction is greater than the lanthanoid contraction.
- iii) The Eo value for the Mn3+/Mn2+ couple is much more positive than that of Cr3+/Cr2+.
- iv) Scandium does not exhibit variable oxidation states and yet it is regarded as a transition element.
- v) Transition elements and many of their compounds act as a good catalyst.

Answer Key

1. b
2. b
3. b
4. c
5. c
6. c
7. a
8. b
9. b
10. c
11. b
12. c
13. b
14. b
15. a
16. c
17. a
18. a
19. i) The rate of reaction will be doubled ii) No effect on rate
20. Sequence of bases in the complementary strand : TACGAAGT as Adenine (A) always pairs with Thymine(T) and Cytosine(C) always pairs with Guanine(G)

    OR

    i) Zwitter ion

    ii) On prolonged heating with HI, glucose gives n-hexane.
21. i) Racemic mixture contains bothe d and l enantiomers in equal proportions. As the rotation due to one enantiomer is cancelled by equal and opposite rotation of another enantiomer, therefore it is optically inactive.

    ii) In chlorobenzene, C-Cl bond acquires partial double bond due to resonance whilein methyl chloride, C-Cl bond has pure single bond character.

    OR

    i) $CH_3CH_2CH_2CH_2Cl + NaI \xrightarrow{\text{dry acetone}} CH_3CH_2CH_2CH_2I + NaCl$

    ii) 2-Bromo-2-methylbutane is more reactive as it gives more substituted alkene on elimination.
22. Chloridobis-(ethane-1,2-diamine)nitrito-N cobalt (III) ion.

    Linkage isomerism
23. i)

    Anode: $Zn(Hg) + 2OH^- \rightarrow ZnO(s) + H_2O + 2e^-$

    Cathode: $HgO + H_2O + 2e^- \rightarrow Hg(l) + 2OH^-$

    ii) Ions are not involved in the overall cell reaction of mercury cell.

24.

Arrhenius equation, $k = Ae^{-E_a/RT}$

Given equation is $k = (4.5 \times 10^{11}\ s^{-1})e^{-28000K/T}$

Comparing both the equations, we get

$$-\frac{E_a}{RT} = -\frac{28000\ K}{T}$$

or, $E_a = 28000\ K \times R = 28000 \times 8.314$

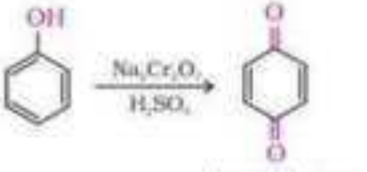
$= 232.79\ kJ\ mol^{-1}$

25.i)

Salicylic acid

Acetylsalicylic acid
(Aspirin)

ii)



benzoquinone

26.i) Propane, Methoxy methane, propanal, propanol

ii) Br_2 (aq) iii)B_2H_6,

H_2O_2/OH^-

27.i) $t_{2g}^{4} e_{g}^{0}$

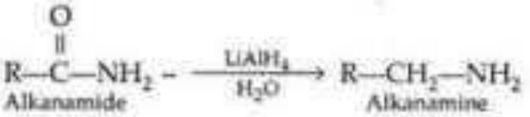
ii) d^2sp^3

iii) optical isomerism

28.i) Solute particles associate in solution.

ii) Maximum boiling azetrope. Example: A mixture of 68% nitric acid and 32% water by mass.

29.i)

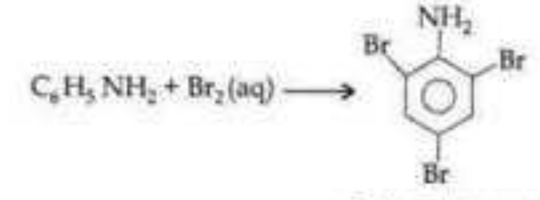


$$\underset{\text{Alkanamide}}{R-\overset{\overset{\displaystyle O}{\|}}{C}-NH_2} - \xrightarrow[H_2O]{LiAlH_4} \underset{\text{Alkanamine}}{R-CH_2-NH_2}$$

(*ii*) **Deamination**

$$\underset{\substack{\text{Benzene diazonium}\\\text{chloride}}}{C_6H_5N_2Cl} + H_3PO_2 + H_2O \longrightarrow \underset{\text{Benzene}}{C_6H_6} + N_2 + H_3PO_3 + HCl$$

(*iii*) **Bromination**

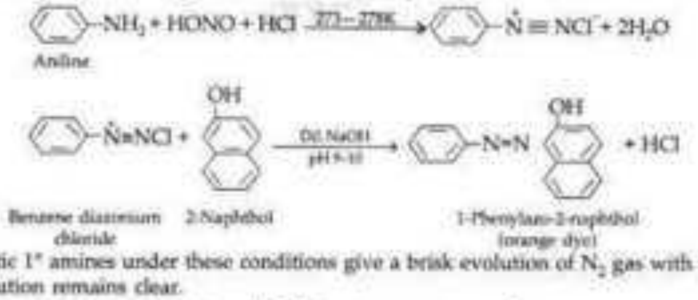


2, 4, 6-Tribromo aniline

OR

(i) Ethylamine and aniline :

By Azo dye test: It involves the reaction of any aromatic primary amine with $HNO_2(NaNO_2$ + dil. HCl) at 273-278 K followed by treatment with an alkalinesolution of 2-naphthol when a brilliant yellow, orange or red coloured dye is obtained.



Aliphatic 1° amines under these conditions give a brisk evolution of N_2 gas with the formation of 1° alcohol *i.e.*, solution remains clear.

$$\underset{\text{Ethylamine}}{CH_3CH_2} + \underset{\text{Nitrous acid}}{HONO} \xrightarrow{273\text{-}278\,K} \underset{\text{Ethyl alcohol}}{C_2H_5OH} + N_2\uparrow + H_2O$$

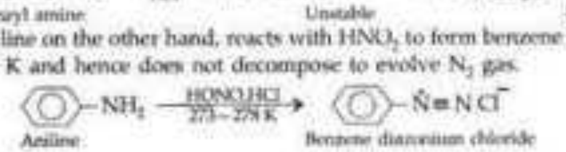
(ii) Aniline and Benzylamine :

By Nitrous acid test : Benzylamine reacts with HNO_2 to form a diazonium saltwhich being unstable even at low temperature, decomposes with evolution of N_2 gas

b) correct structure.

$$\underset{\text{Benzyl amine}}{C_6H_5CH_2NH_2} \xrightarrow[HCl]{HONO} \underset{\text{Unstable}}{[C_6H_5CH_2-\overset{+}{N} \equiv NCl^-]} \xrightarrow[\text{Decompose}]{H_2O} \underset{\text{Benzyl alcohol}}{C_6H_5CH_2OH} + N_2\uparrow + HCl$$

Aniline on the other hand, reacts with HNO_2 to form benzene diazonium chloride which is stable at 273-278 K and hence does not decompose to evolve N_2 gas.



30.i)2-Bromobutane

ii)1-Bromobutane

iii) 1-Bromo-2-methylpropane and 2-Bromo-2-methylpropane

OR

i) Retention ii) Inversion iii) Racemisation

31.i) α-Amino acids act as zwitter ion or dipolar ion. Due to this dipolar structure, theyhave strong dipole-dipole interactions resulting in their higher melting point.

ii) Globular protein and spherical shape.

iii) Any two correct differences

OR

iii) Any two correct differences

32.i)Ethylene glycol lowers the freezing point of water. Due to this, coolant in radiatorswill not freeze.

ii) It means that the freezing point of water is lowered by 1.86 K when 1 mole of non-volatile solute is dissolved in 1 kg of water.

iii)

Given,

$W_2 = 60$ g

$M_2 = 180$ g mol^{-1}

$W_1 = 250$ g

$K_f = 1.86$ K kg mol^{-1}

$\Delta T_f = k_f m$

$$T_f^0 - T_f = \frac{K_f \times w_2 \times 1000}{M_2} \times w_1$$

$$2.73 - T_f = \frac{1.86 \times 60 \times 1000}{180 \times 250}$$

$$2.73 - T_f = \frac{1.86 \times 60 \times 1000}{180 \times 250}$$

$273.15 - T_f = 2.48$

$T_f = 273.15 - 2.48 = 270.67$ K

Hence, the freezing point of water is 270.67 K or -2.48°C

OR

$NaCl \rightarrow Na^+ + Cl^-$

The Van't Hoff factor, i is given as:

$$i = \frac{Numberofparticlesafterdissociation}{Numberofparticlesbeforedissociation}$$

$$\Rightarrow i = \frac{2}{1} = 2$$

The depression in freezing point of a solution is given by

$$\Delta T_f = iK_f \frac{w_s \times 1000}{M_s \times W} \ldots\ldots (i)$$

Given :

K_f for water $= 1.86 K kg mol^{-1}$

Molar mass of solute, $M_s = 58.5 g mol^{-1}$

Mass of water, $W = 37.2 g$

$\Delta T_f = 2^\circ C = 2K$

Mass of solute, $w_s = ?$

Substituting the above values in (i), we get

$$2 = 2 \times 1.86 \times \frac{w_s \times 1000}{58.5 \times 37.2}$$

$w_s = 1.17 g$

Hence, the required mass of NaCl is $1.17 g$.

33.

(a) $2Al(s) + 3Ni^{2+}(0.1M) \rightarrow 2Al^{3+}(0.001M) + 3Ni(s)$

Cell Repn: $Al(s) \mid Al^{3+}(0.01M) \parallel Ni^{2+}(0.1M) \mid Ni(s)$

Nernst Eqn : $E_{cell} = E^0 cell - \frac{0.0591}{n} \log \frac{[Al^{3+}]^2}{[Ni^{2+}]^3}$

$$= 1.41 - \frac{0.0591}{6} \log \frac{[10^{-2}]^2}{[10^{-1}]^3} = 1.41 - 0.00985 \log 10^{-1}$$

$= 1.41985V = 1.42V$

(b) With increase in temperature, the greater inter-ionic attraction retard the motion of the ions and therefore the molar conductivity falls in case of both strong and weak electrolytes.

The limiting molar conductivity ($\wedge_m^0$) for weak electrolyte can be calculated by using Kohlrausch's Law.

OR

i) Cell

$Al_{(s)} | Al^{3+}(0.01M) \parallel Cu^{2+}(0.01M) \mid Cu$

$$E_{cell} = E^{\circ}_{cell} - \frac{0.0591}{n} \log \frac{[Al^{3+}]^2}{[Cu^{2+}]^3}$$

$$E^{\circ}_{cell} = E_{cell} + \frac{0.0591}{n} \log \frac{[Al^{3+}]^2}{[Cu^{2+}]^3}$$

$$= 1.98 + \frac{0.0591}{6} \log \frac{(0.01)^2}{(0.01)^3}$$

$$= 1.98 + \frac{0.0591}{6} \log 10^2$$

$$= 1.98 + \frac{0.0591}{6} 2 \log 10$$

$$= 1.98 + \frac{0.0591}{6} \times 2 [\because \log 10 = 1]$$

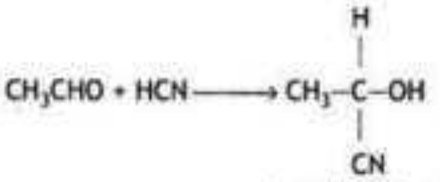
$$= 1.98 + 0.0197$$

$$E^{\circ}_{cell} = 1.9997 \text{ V}$$

ii) A, as its standard reduction potential is less than B, therefore, it will undergo oxidation more easily than B.

34.

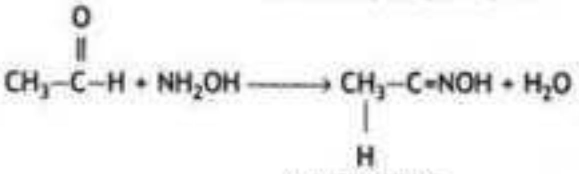
(*i*) (*a*)



$$CH_3CHO + HCN \longrightarrow CH_3-\underset{CN}{\overset{H}{C}}-OH$$

Acetaldehyde cyanohydrin

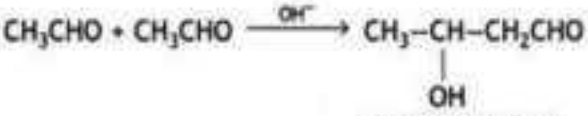
(*b*)



$$CH_3-\overset{O}{\overset{\|}{C}}-H + NH_2OH \longrightarrow CH_3-\underset{H}{C}=NOH + H_2O$$

Acetaldoxime

(c)



$$CH_3CHO + CH_3CHO \xrightarrow{OH^-} CH_3-\underset{OH}{CH}-CH_2CHO$$

3-Hydroxybutanal

(ii) (a) Add neutral $FeCl_3$ in both the solutions, phenol gives violet color with $FeCl_3$ solution,but benzoic acid does not give such color.

(b) Add an ammoniacal solution of silver nitrate (Tollen's reagent) in both the solutions,propanal gives silver mirror whereas propanone does not.

$$\underset{\text{Propanal}}{CH_3CH_2CHO} + \underset{\text{Tollen's reagent}}{2[Ag(NH_3)_2]OH} \longrightarrow CH_3CH_2COONH_4 + \underset{\text{Silver mirror}}{2Ag} + H_2O + 3NH_3$$

OR

i) A =
CH_3C
OOHB
=
CH_3C
OCl
C =
CH_3C
ONH_2
D =
CH_3N
H_2

ii) $HCOOH < ClCH_2COOH < CCl_3COOH < CF_3COOH$

35.i) Transition metals have strong metallic bonds as they have a large number of unpaired electrons.
ii) This is because of poor shielding effect of 5f electrons in actinoids than that of 4felectrons in lanthanoids.
iii) This is due to much larger third ionisation energy of Mn as Mn2+ is very stableon account of d5 configuration.
iv) This is because Scandium has partially filled d orbitals in the ground state.
v) They show variable oxidation state due to which they form unstable intermediate compounds and provide a new path with lower activation energyfor the reaction.

SAMPLE PAPER No 3
CHEMISTRY THEORY (043)

MM:70 **Time: 3 hours**

General Instructions:

Read the following instructions carefully.

a) There are 35 questions in this question paper with internal choice.
b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.

c) SECTION B consists of 7 very short answer questions carrying 2 marks each.

d) SECTION C consists of 5 short answer questions carrying 3 marks each.

e) SECTION D consists of 2 case- based questions carrying 4 marks each.

f) SECTION E consists of 3 long answer questions carrying 5 marks each.

g) All questions are compulsory.

h) Use of log tables and calculators is not allowed

SECTION –A

The following questions are multiple-choice questions with one correct answer.Eachquestion carries 1 mark. There is no internal choice in this section

1. Conversion of Alcohols to Aldehyde involves_______________as reagent.

(a) Alkaline $KMnO_4$

(b) O_2

(c) PCC

(d) H_2

2. $ROH + PCl_5 \rightarrow RCl + A$, here A is

(a) $POCl_3 + HCl$

(b) H_3PO_3 + No other product

(c) $H_3PO_3 + HCl$

(d) $Cl_2 + HCl$

3. Out of Mn^{+2}, Ni^{+2}, $Fe^{+2}$and Zn^{+2}, which one is colourless

a) Mn^{+2} c) Fe^{+2}

b) Ni^{+2} d)Zn^{+2}

4. For a hypothetical reaction, R→Products;

Rate = - k [R]

The negative sign used in the rate expression indicates.

(a) decrease in concentration of reactants with time

(b) decrease in rate with time

(c) reaction is reversible

(d) None of the above

5.Out of the following which one is an example of primary cell

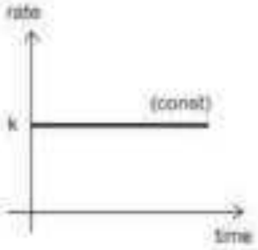
a) Fuel cell

b) Lead storage cell

c) Dry cell

d) All of the above

6. Identify order of the reaction from the given graph



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

7. Amongst the following which is the strongest base in aqueous medium
(a) CH_3NH_2
(b) $(CH_3)_2NH$
(c) $C_6H_5NHCH_3$

(d) $NCCH_2NH_2$

8. What is the oxidation number of cobalt in the following complex: $[Co(H_2O)(CN)(en)_2]^{2+}$

(a) +4
(b) +6
(c) +3
(d) +2

9.Alcohols have______________boiling point as compared to ethers

(a) low
(b) high
(c) same
(d) none of these

10. The reagent used in Clemmenson's reduction is

(a) $AlCl_3$
(b) $H_2\ O_2$
(c) $NH_2 = NH_2$
(d) Zn-Hg/HCl

11.Which of the alkyl halide is best suited through SN_1 mechanism

$C_6H_5\ CH_2\ NH_2 + RX \rightarrow C_6H_5\ CH_2\ NH\ R$

(a) CH_3Br
(b) $C_6H_5\ Br$
(c) $C_6H_5\ CH_2\ Br$
(d) $CH_3\ CH_2\ Br$

12. Order of the reaction can be

(a) 0
(b) fractional
(c) positive
(d) All of the above

13. According to the CFT, the configuration of d^4 in an octahedral complex with astrong ligand is

(a) $t_{2g}{}^4\ e_g{}^0$

(b) $t_{2g}{}^3\ e_g{}^1$

(c) $t_{2g}{}^2\ e_g{}^2$

(d) $e_g{}^4\ t_{2g}{}^0$

14. IUPAC name of the compound is $CH_3\ CH_2\ NH\ CH_3$

(a) N-methylmethanamine

(b) N-ethylmethanamine

(c) N-methylethanamine

(d) N-methyl–N-ethanamine

15. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): Alcohols are having more boiling point than corresponding etherof similar molecular masses.

Reason (R): Intermolecular Hydrogen bonding in compounds is responsible for highB.pt .

Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true but R is not the correct explanation of A.

c. A is true but R is false.

d. A is false but R is true

16. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): Carbohydrates are polyhydroxy aldehyde or ketone.

Reason (R): Deoxyribose is not a carbohydrate.

Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true but R is not the correct explanation of A.

c. A is true but R is false.

d. A is false but R is true

17. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): Zn, Cd and Hg are not considered as Transition elements.

Reason (R): Presence of paired d electrons are responsible for properties of transition elements.

Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true but R is not the correct explanation of A.

c. A is true but R is false.

d. A is false but R is true

18. Given below are two statements labelled as Assertion (A) and Reason (R)

Assertion (A): Amino acids except Lysine contain at least one asymmetriccarbon atom.
Reason (R): Zwitter ion of amino acids contains both positive and negativecharge.

Select the most appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A

b. Both A and R are true but R is not the correct explanation of A.

c. A is true but R is false.

d. A is false but R is true

SECTION –B

This section contains 7 questions with internal choice in two questions. Thefollowing questions are very short answer type and carry 2 marks each.

19. A first order reaction has a specific reaction rate of 10^{-3} sec^{-1}.

How much time will it take for 10g of the reactant to reduce to 2.5g ?Given log 2 = 0.301, log 4 = 0.6021, log 6 = 0.778.

20. What are the hydrolysis products of
(i)sucrose (ii) lactose

OR

What happens when D – glucose is treated with the following reagents
a) HI b) HNO_3

21. Explain i) Williamson's synthesis ii) Sandmeyer's reaction

OR

a) Reimer Tiemann reaction b)Kolbe's reaction

22.a) The spin only magnetic moment of $[MnBr_4]$ is 5.9 BM. Predict the geometryof the complex ion ?

b) Out of the following two coordination entities which is chiral (optically active)?

(a) cis-$[CrCl_2(ox)_2]^{3-}$ (b) trans-$[CrCl_2(ox)_2]^{3-}$

23.a)State Kohlrausch's law

b) How does molar conductivity depends on dilution ?

24. A reaction is first order with respect to A and second order with respect to B.

(i) How is rate affected on increasing the concentration of B three times?

(ii) How is rate affected when the concentration of both A and B are doubled?

25. What happens when i) Acetadehyde reacts with methyl magnesium bromide

ii) Propan-1-ol reacts with alk.$KMnO_4$

SECTION –C

This section contains 5 questions with internal choice in two questions. Thefollowingquestions are short answer type and carry 3 marks each.

26. Convert a) Toluene to benzyl alcohol

b) Ethanol to propane nitrile

c) 2-bromoprapane to 1-bromopropane

27 i) $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both aretetrahedral. Why? (2)

ii) Give formula of the compound – (1)

tris(ethane-1,2-diamine)chromium (III) chloride

28. On a certain hill station, pure water is found to boil at 95° C. How many grams of NaCl must be added to 2 kg of water so that it boils at 100°C?

29. Give plausible explanation for :

(i) Why are amines less acidic than alcohols of comparable molecular masses?

(ii) Why do primary amines have higher boiling points than tertiary amines?

(iii) Why are aliphatic amines stronger bases than aromatic amines?

30. Write reactions for—

i) Nitration of Anisole

ii) Phenol with Bromine in CS_2

iii) Methoxy benzene with HI

SECTION –D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer the questions that follow.

31. Nucleic acids are polynucleotides—that is, long chain like molecules composed of a series of nearly identical building blocks called nucleotides.

Each nucleotide consists of a nitrogen-containing aromatic base attached to apentose (five-carbon) sugar, which is in turn attached to a phosphate group.

Each nucleic acid contains four of five possible nitrogen-containing bases: adenine (A), guanine (G), cytosine (C), thymine (T), and uracil (U). A and G are categorized as purines, and C, T, and U are collectivelycalled pyrimidines.

Thymine is present only in DNA, while U is found only in RNA.

The pentose sugar in DNA (2'-deoxyribose) differs from the sugar in RNA (ribose) by the absence of a hydroxyl group (—OH) on the 2′ carbon of the sugar ring. Without an attached phosphate group, the sugar attached to one of the bases is known as a nucleoside. These nucleoside linkages are called phosphodiester bondsand are the same in RNA and DNA.

DNA is the master blueprint for life and constitutes the genetic material in all free- living organisms and most viruses. RNA plays an important role in certain processes such as the making of proteins

Answer the following questions:-

a) Two strands of DNA are not identical but are complementary. (1)

b) What is the complementary base sequence on DNA for the given strand
C A G A C (1)

c)Write one structural and one functional difference between DNA and RNA. (2)

OR

Which bases are common in DNA and RNA?

How is Guanine and cytosine linked with each other?

32. Colligative properties depends on the number of solute particles relative to the total number of particles present in the solution. These properties are independent of the solute particles. The examples of colligative properties include relative lowering of vapour pressure, elevation of boiling point, depression of freezing point and osmotic pressure.

These properties change when non volatile solute particles are added to it. Application of colligative properties are used in day to day life as use of ethyleneglycol and water mixture as anti-freezing mixture in the radiator of automobiles. Answer the following questions:-

a) Why does vapour pressure of a liquid decrease on addition of a solute into it?

b) Arrange the following in increasing order of their Van't Hoff's factor.

0.1M $CaCl_2$, 0.1M KCl ,, 0.1M $Al_2(SO_4)_3$

c) A peeled egg (whose outer shell is removed in dil HCl), swells when dipped in water while shrinks in saturated brine solution. Why?

OR

What will happen to Raisins kept in water after some time?

SECTION -E

The following questions are long answer type and carry 5 marks each. Twoquestionshave an internal choice

33. a) How much charge is required for the following reductions: (2)

i) 1 mol of Mg^{+2} to Mg. (ii)1 mol of MnO_4^- to Mn^{2+}

b) Calculate the emf of the following cells at 298 K:

$Mg(s)|Mg^{2+}(0.001M)||Cu^{2+}(0.0001\ M)|Cu(s)$

$E^0\ Mg^{2+}/Mg = -2.37\ V$,, $E^0\ Cu+/Cu =$ 0.34 V (3)

OR

How much electricity is required in Faraday to produce

i) a) 27.0 g of Al from molten $AlCl_3$. (b) 48.0 g of Mg from molten $MgCl_2$ (2)

ii) Calculate emf of the following cells at 298 K using the given data. (3)

$[Sn^{2+}]$=0.08 M and $[Ag^+]$=(0.20 M)

$E^0\ Sn^{2+}/Sn = -0.14\ V$,, $E^0\ Ag+/Ag =$ 0.80 V

(log 2 =0.3010)

34.a)Distinguish between i) Propanal and Propanol

ii) Benzaldehyde and acetophenone (2)

b)Identify A , B and C with reactions involved. (3)

An organic compound (A) has a characteristic odour, on treatment with NaOHforms two compound (B) and (C) .Compound (B) has molecular formula C_7H_8O , which on oxidation gives back compound (A). Compound (C) is sodium salt ofan acid.

OR

a)Distinguish between i) Ethanal and ethanoic acid

ii) ethanal and benzaldehyde

b)Complete the reaction

i) $C_2H_5COCl + Pd/BaSO_4 \rightarrow A + LiAlH_4 \rightarrow B$

ii) $CH_3CHO + NaOH \rightarrow X + heat \rightarrow Y$

35.a) Complete the reaction

i) $CrO_4^{-2} + H^+ \rightarrow$

ii) $MnO_4^{-1} + Fe^{+2} + H^+ \rightarrow$

b) Give any one difference between Lanthanoids and Actinoids.

c) "Transition elements shows catalytic properties" .Explain

d) Which is Paramagnetic ' Fe^{+3} or Cu^{+1} '?

OR

i) Complete the reaction

a) $Cr_2O_7^{-2}$ + OH----- →

b) MnO_4^{-1} + $C_2O_4^{-2}$ + H^+----------- →

ii) What is Lanthanoid contraction?

iii) "Transition elements forms alloy" explain

iv) Which has more magnetic moment—Ti^{+3} or Cu^{+2} ?

SAMPLE PAPER

CHEMISTRY-THEORY (043)

MARKING SCHEME

SECTION A

Q1 to 18 each correct answer 1 mark each

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

SECTION B

19. t = 1386.6 s. 2 marks

20. i) glucose and fructose 1 mark
ii) glucose and galactose 1 mark

OR

a) Forms n-hexane 1 mark

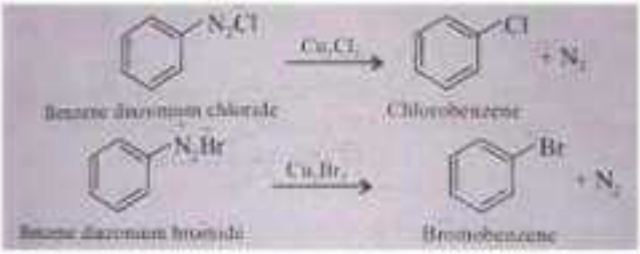
b) Forms saccharic acid 1 mark

21..Correct reaction

i) Williamson's synthesis 1 mark

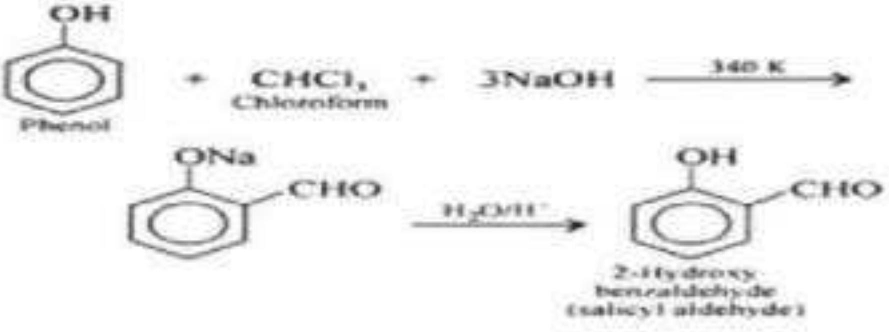
R-O-Na + R'-X → R-O-R' + NaX

ii)Sandmeyer's reaction 1 mark

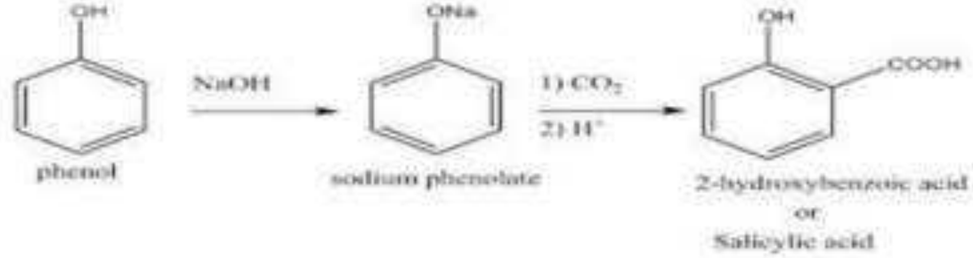


OR

a) Reimer Tiemann reaction 1 mark



b) Kolbe's reaction 1 mark



22.a) Tetrahedral 1 mark

b) cis isomer 1 mark

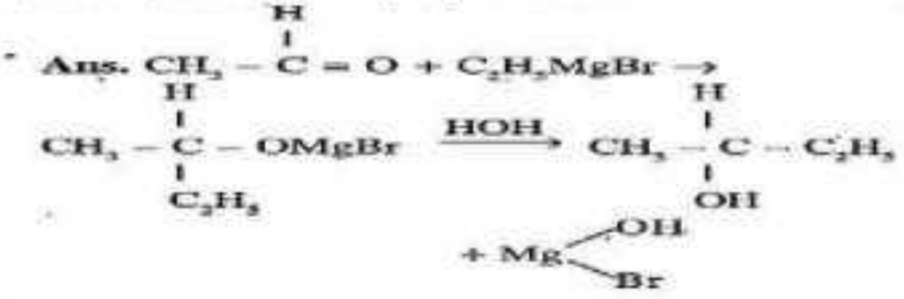
23. a) The law states that limiting molar conductivity of an electrolyte can be represented as the sum of the individual contributions of the anion and cation of the electrolyte 1 mark

b) Increases 1 mark

24. (i) Rate = K$[A]^1$ $[B]^2$ ---→ On increasing concentration of B three times rate becomes 9 times 1 mark

(ii) when the concentration of both A and B are doubled rate becomes 8 times. 1 mark

25i) Acetadehyde reacts with methyl magnesium bromide- 1 mark


$$\text{Ans. } CH_3-\overset{H}{\overset{|}{C}}=O + C_2H_5MgBr \rightarrow CH_3-\underset{C_2H_5}{\underset{|}{\overset{H}{\overset{|}{C}}}}-OMgBr \xrightarrow{HOH} CH_3-\underset{OH}{\underset{|}{\overset{H}{\overset{|}{C}}}}-C_2H_5 + Mg\begin{smallmatrix}OH\\Br\end{smallmatrix}$$

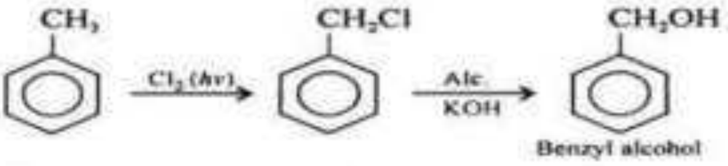
ii) propan-1-ol reacts with alk.$KMnO_4$ 1 mark

$CH_3CH_2CH_2OH$---[O]--→ CH_3CH_2CHO-----[O]→ CH_3CH_2COOH

SECTION C

26. Conversion (1mk +1 mk+1mk)

i) Toluene to benzyl alcohol



ii) Ethanol to propane nitrile

Conversion of ethanol to propanenitrile

STEP 1:

$CH_3CH_2OH + HCl \longrightarrow CH_3CH_2Cl + H_2O$

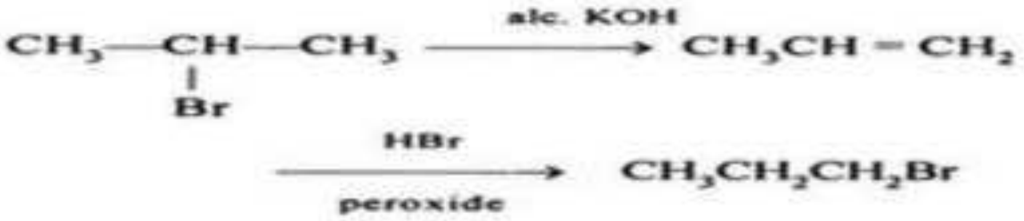
Ethanol chloroethane

STEP 2:

$CH_3CH_2Cl + KCN \longrightarrow CH_3CH_2CN + KCl$

chloroethane propanenitrile

c)2-bromoprapane to 1-bromopropane



$$CH_3-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{\text{alc. KOH}} CH_3CH=CH_2 \xrightarrow[\text{peroxide}]{\text{HBr}} CH_3CH_2CH_2Br$$

27. i)$[NiCl_4]^{2-}$ is paramagnetic---Ni exists as Ni^{+2} ,number of unpaired electron=2 ,while $[Ni(CO)_4]$ is diamagnetic- Ni exists as Ni(0), no unpaired electron during complex formation (1+1mk)

ii) $[Cr(en)_3]Cl_3$ 1 mark

28. $\Delta T_b = i \times K_b \times m$ (formula + substitution ½ + ½)

$m=4.807$ (Calculaion = 1)

$w_B = 562.42$ g (correct answer + unit = ½ +½)

29. explanation- (1+1+1mk)

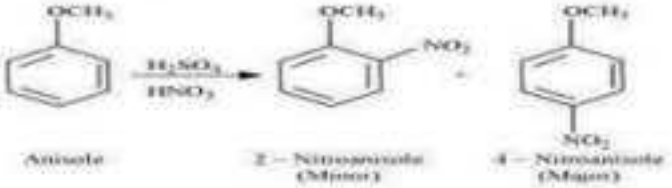
i) Phenyl group is electron withdrawing, increases electron density on nitrogen whereas methyl group is electron donating group.

ii) intermolecular H-bonding in primary amines.

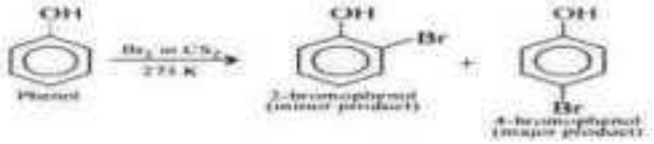
iii) lone pair of electrons of N-atom in aromatic amines are involved in resonance with the benzene ring, so they are not available for donation. While N-atom in aliphatic amines can easily donate its lone pair of electrons

30.correct reactions—(1+1+1 mk)

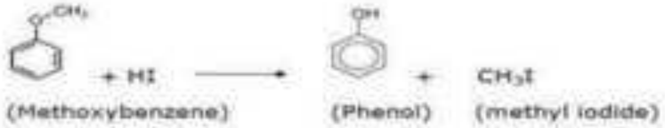
i) Nitration of Anisole



ii) Phenol with Bromine in CS_2



iii) Methoxy benzene with HI



SECTION D

31. a) A pairs with T and G pairs with C. If sequence of one strand is known other strand can be predicted. (1)

b) G T C T G (1)

c) Structural difference:- difference in sugar or bases

Functional difference:- DNA constitutes the genetic material and RNA plays an important role in making of proteins.

(1+1)

OR

Adenine(A), Guanine(G) and Cytosine(C) (1)

They are linked through three hydrogen bonds. (1)

32. a) Presence of non volatile compound on surface decreases the effective surface area decreasing vapour pressure of the solution.

b) 0.1M KCl < 0.1 M $CaCl_2$ < 0.1 M $Al_2(SO_4)_3$

c) due to osmosis

or

They will swell because of endosmosis

Q.33 a) i) Mg --→ Mg^{+2} +2 e^-

2 x 96500 C = 193000 C

ii) MnO_4^- --→ Mn^{2+} +5 e^-

5 x 96500 C = 482500 C

c) $E^0 = [E^0\ (cathode) - E^0\ (anode)] - 0.0591/n \quad \log [AE]^x / \log [CE]^y$

(formula1/2 mk)

=[0.34 - (- 2.37)] -0.0591 /2 log 0.001/0.0001 (1/2mk)

= 2.71 - 0.0295________________________________1mk
= 2.68 V (½ (ans) +1/2 (unit) mk)

OR

i) a) $AlCl_3 \dashrightarrow Al^{+3} + 3e^-$
27 g requires 3F 1mk
b) $MgCl_2 \dashrightarrow 1Mg^{+2} + 2e^-$
24g------- 2F
:- 48 g --→ 4F 1mk

b) E^0 = [E^0 (cathode)- E^0 (anode)] – 0.0591/n log $[AE]^{x}$ / log $[CE]^{y}$
(formula1/2 mk)
=[0.80- (- 0.14)]-0.0591 /2 x log $0.08/(0.2)^2$ (1/2mk)

= 0.94 - 0.0295 x log 2 -1mk
E^0 = 0.93 V (½(ans) +1/2(unit) mk)

34.a) i) Propanal gives Tollen's test (silver mirror) or any distinction ------------------- 1mk
ii) Acetophenone gives iodoform test (yellow ppt with NaOI)

a) $2C_6H_5CHO + NaOH \rightarrow C_6H_5CH_2OH + C_6H_5COONa$
(A) --→ (B) (C_7H_8O) + (C) sodium salt of acid$C_6H_5CH_2$
OH------[O]→ C_6H_5CHO
A—Benzaldehyde B Benzyl
Alcohol
C- Sodium benzoate

OR

a) i) Ethanal gives yellow ppt with NaOI (iodoform test) / methanoic acid gives effervescence with sodium bicarbonate ---1 mk
ii) Ethanal gives Tollens test (silver mirror) or any other test 1mk
b) i)A=C_2H_5CHO B= $C_2H_5CH_2OH$ (1mk)
ii) X=$CH_3CH(OH)CH_2CHO$ B= $CH_3CH{=}CHCHO$ (1mk)

35.a) (i)$2CrO_4^{-2} + 2H^+ \dashrightarrow Cr_2O_7^{-2} + H_2O$ (1mk)ii) MnO_4^{-1}+
$5Fe^{+2} + 8H^+ \dashrightarrow Mn^{+2} + 5Fe^{+3} + 4H_2O$ (1mk)
b) Electron enters in 4f in Lanthanoids and in 5f in Actinoids or any otherdifference (1mk)

c) Good adsorbent, ability show variable oxidation states, and ability to formcomplexes (1mk)

d) Fe^{+3} ,as it has 5 unpaired electron(1mk)

OR

i) a)$Cr_2O_7^{-2}$ + OH^- ---→ CrO_4^{-2} (1mk) b)$2MnO_4^{-1}$+
$5C_2O_4^{-2}$+16 H^+-------→ $2Mn^{+2}$+$10CO_2$ + $8H_2O$ (1mk)

ii)The steady decrease in atomic and ionic radii from La to Luiii)Due to similar atomic sizes one atom can replace other

iv) Ti^{+2} ($3d^2 4s^0$) as it has 2 unpaired electrons whereas Cu^{+2} ($3d^9 4s^0$) has 1 unpaired electron.

1mk

Sample paper-4 (2022-23)

MM:70
Time: 3 hours

General Instructions:

Read the following instructions carefully.

(a) There are 35 questions in this question paper with internal choice.

(b) SECTION A consists of 18 multiple-choice questions carrying 1 mark each.

(c) SECTION B consists of 7 very short answer questions carrying 2 marks each.

(d) SECTION C consists of 5 short answer questions carrying 3 marks each.

(e) SECTION D consists of 2 case-based questions carrying 4 marks each.

(f) SECTION E consists of 3 long answer questions carrying 5 marks each.

(g) All questions are compulsory

(h) Use of log tables and calculators has not allowed

SECTION A

The following questions are multiple-choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1	On dissolving sugar in water at room temperature, the solution feels cool to the touch. Underwhich of the following cases dissolution of sugar will be more rapid? (a) Sugar crystals in cold water (b) Sugar crystals in hot water (c) Powdered sugar in cold water (d)Powdered sugar in hot water
2	An unripe mango placed in a concentrated salt solution to prepare pickle, shrivels because (a) It gains water due to osmosis (b) It loses water due to reverse osmosis (c) It gains water due to reverse osmosis (d) It loses water due to osmosis
3	The difference between the electrode potentials of two electrodes when no current is drawnthrough the cell is called (a) Cell potential (b) Cell emf (c) Potential difference (d) Cell voltage
4	$\Lambda_m^0(NH_4OH)$ is equal to- (a) $\Lambda_m^0(NH_4OH) + \Lambda_m^0(NH_4Cl) - \Lambda_m^0(HCl)$ (b) $\Lambda_m^0(NH_4Cl) + \Lambda_m^0(NaOH) - \Lambda_m^0(NaCl)$ (c) $\Lambda_m^0(NH_4Cl) + \Lambda_m^0(NaCl) - \Lambda_m^0(NaOH)$ (d) $\Lambda_m^0(NaOH) + \Lambda_m^0(NaCl) - \Lambda_m^0(NH_4Cl)$
5	In the presence of a catalyst, the heat evolved or is absorbed during the reaction (a) Increases (b) Decreases (c) Remain unchanged (d) May increase or decrease
6	The magnetic moment is associated with its spin angular momentum and orbital angular momentum. Spin only magnetic moment value of Cr^{+3} ion is (a) 2.87 B.M. (b) 3.87 B.M. (c) 3.47 B.M (d) 3.57 B.M
7	The compounds $[Co(SO_4)(NH_3)_5]Br$ and $[Co(SO_4)(NH_3)_5]Cl$ represents (a) Linkage isomerism (b) no isomerism (c) Ionisation isomerism (d) Coordination isomerism
8	Chlorobenzene is formed by the reaction of chlorine with benzene in the presence of $AlCl_3$. Which of the following species attacks the benzene ring in this reaction? (a) Cl^- (b) Cl^+ (c) $AlCl_3$ (d) $[AlCl_4]^-$
9	Which reagent will you use for the following reaction? $CH_3CH_2CH_2CH_3 \rightarrow CH_3CH_2CH_2CH_2Cl + CH_3CH_2CHClCH_3$ (a) Cl_2/UV light (b) $NaCl + H_2SO4$ (c) Cl_2 gas in presence of Fe in dark (d) Cl_2 gas in dark
10	Which of the following compounds will react with NaOH solution in water (a) C_6H_5OH (b) $C_6H_5CH_2OH$ (c) $(CH_3)_3COH$ (d) C_2H_5OH
11	The correct order of increasing acidic strength is Phenol < Ethanol < Chloroacetic acid < Acetic acid (b) Ethanol < Phenol< Chloroacetic acid < Acetic acid (c) Ethanol < Phenol < Acetic acid < Chloroacetic acid (d) Chloroacetic acid < Acetic acid < Phenol < Ethanol
12	Hoffmann Bromamide Degradation reaction is shown by (a) $ArNH_2$ (b) $ArCONH_2$ (c) $ArNO_2$ (d) $ArCH_2NH_2$

13	Hydrolysis products of Sucrose are (a) 2 molecules of glucose (b) 2 molecules of glucose + 1 molecule of fructose (c) 1 molecule of glucose + 1 molecule of fructose (d) 2 molecules of fructose

14	Which of the following statements are not true about glucose? (a) It is an aldohexose (b) On heating with HI, it forms n-hexane (c) It is present in furanose form (d) It does not give 2,4-DNP test

Given below are two statements labeled as Assertion (A) and Reason (R). Select themost appropriate answer from the options given below:

a. Both A and R are true and R is the correct explanation of A
b. Both A and R are true but R is not the correct explanation of A.
c. A is true but R is false.
d. A is false but R is true.

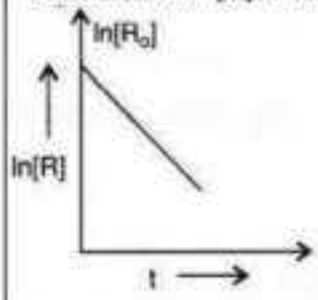
15	**Assertion (A):** The rate of reaction doubles when the concentration of reactant is doubled ifit is a first-order reaction. **Reason (R):** Rate constant also doubles with twice an increase in the concentration ofreactant.
16	**Assertion (A):** Separation of Zr and Hf is difficult. **Reason (R):** Zr and Hf are in the same group of the periodic table, and they have the samesize.
17	**Assertion (A):** Boiling points of alcohols and ethers are high **Reason (R):** They can form intermolecular hydrogen bonding.
18	**Assertion (A):** D(+) Glucose is dextrorotatory in nature **Reason (R):** D represents its configuration.

Section B

This section contains 7 questions with internal choices in two questions. Thefollowing questions are very short answer types and carry 2 marks each

19	Calculate the emf of the cell in which the following reaction takesplace: $Ni(s) + 2Ag^{+}$ (0.002 M) Ni^{2+} (0.160 M) + 2Ag(s) [Given that E° cell = 1.05 V, log 2 = 0.301]
20	Write the reactions taking place in lead storage cell? How it can be recharged? **O** **R** Predict the products of electrolysis in each of the following (i) An aqueous solution of $AgNO_3$ with silver electrodes. (ii) A dilute solution of H_2SO_4 with Pt electrodes.

21 For a certain chemical reaction variation in the concentrationln [R] vs. time plot is given along side.



For this reaction:
(i) what is the order of the reaction?
(ii) what are the units of rate constant k?
(iii)give the relationship between k and $t_{1/2}$ (half-life period).
(iv) what is the slope of the curve?

22 i)Define Crystal field splitting energy.

ii)A metal ion having d^4 electronic configuration combines with three bidentate ligands toform a complex compound. Assuming $\Delta_0 > P$,write the electronic configuration of the valence electrons of the metal ion(d^4) in terms of t_2g and eg.

23 An aromatic compound 'A' on treatment with conc NaOH gives two compounds, 'B' and

'C' with molecular formula $C_7H_5O_2Na$. 'C' on heating with soda lime gives 'D' Identify 'A', 'B','C', and 'D'.

OR

Write the equations involved in the following reactions:
(i) Wolff-Kishner reduction (ii) Etard reaction

24 (i) Write IUPAC Name for $C_6H_5CH_2CHO$
(ii) What is composition of Fehling's Reagent

25 Give one chemical test to distinguish between the following pairs of compounds:
(i) Methylamine and dimethylamine (ii) Secondary and tertiary amines

SECTION – C

This section contains 5 questions with internal choices in two questions. Thefollowing questions are short answer types and carry 3 marks each.

26	The chemistry of corrosion of iron is essentially an electrochemical phenomenon. Explainthe reactions occurring during the corrosion of iron in the atmosphere.
27	$A + 2B \rightarrow 3C + 2D$. The rate of disappearance of B is 1×10^{-2} mol L^{-1} s^{-1}. What will be (i) Rate of the reaction (ii) Rate of change in concentration of A and C?
28	(i) Give a reason: (a) Benzoic acid is a stronger acid than acetic acid. (b) Methanal is more reactive towards nucleophilic addition reaction than ethanal. (ii) Give a simple chemical test to distinguish between propanal and propanone.
29	(i) Arrange the following compounds in increasing order of dipole moment. $CH_3CH_2CH_3$, $CH_3CH_2NH_2$, CH_3CH_2OH (ii) Give a possible explanation for each of the following: (a) The presence of a base is needed in the ammonolysis of alkyl halides. (b) Amides are more acidic than amines.
30	(i) Give one structural difference between amylose and amylopectin (ii) Name the protein and its shape present in the oxygen carrier in the human body. (iii) Name two fat-storing tissues in the human body.

SECTION D

The following questions are case-based questions. Each question has an internal choice and carries 4 (1+1+2) marks each. Read the passage carefully and answer thequestions that follow.

31	Coordination compounds are the compounds in which the central metal atom is linked to a number of ions or neutral molecules by coordinate bonds and the donor atoms, molecules, or anions donate a pair of electrons to the metal atom or ion and form a coordinate bond with it are called ligands. The coordination number is the number of atoms or ions immediately surrounding a central atom in a complex or a crystal. The coordination numberof Ni^{2+} is 4 and it forms two complexes A and B as given below: $NiCl_2 + KCN \rightarrow$ A (Cyano complex)

$NiCl_2$ + conc. HCl → B (Chloro complex)

a. Write the IUPAC name of complex A.

b. Write the formula of the complex B.

c. Predict the magnetic nature and geometry of A.

O
R

Write the state of hybridization and shape of the complex B.

Williamson synthesis is one of the best methods for the preparation of ethers. It involves the treatment of an alkyl halide with a suitable sodium alkoxide. Williamson's synthesis involves the nucleophilic substitution of the halogen atom of an alkyl halide by an alkoxide group as shown below:

$R—O^- Na^+ + R'X \rightarrow R—O—R' + NaX$

When the alkyl halide is used in the reaction is the primary, Williamson's synthesis proceeds via

S_N2 mechanism leading to the formation of an ether. This method is a versatile method for the

synthesis of both symmetrical and unsymmetrical ethers.

a. Why is Williamson's synthesis not applicable when the alkyl halide used is tertiary?

b. How would you obtain allyl phenyl ether?

c. $(CH_3)_3C\text{-}O\text{-}CH_3$ on reaction with HI gives $(CH_3)_3C\text{-}I$ and $CH_3\text{-}OH$ as the main products andnot $(CH_3)_3C\text{-}OH$ and $CH_3\text{-}I$. Give reason.

OR

How is 1-propoxypropane synthesized from propan-1-ol? Write the mechanism of thisreaction.

SECTION E

The following questions are long answer types and carry 5 marks each. Twoquestions have an internal choice.

33 (i) Define the following terms:

(a) Azeotrope (b) Osmotic pressure (c) Colligative properties

(ii) Calculate the molarity of 9.8% (w/w) solution of H_2SO_4 if the density of the solution is 1.02 g mL^{-1}. (Molar mass of H_2SO_4 = 98 g mol^{-1})

O
R

(i) On mixing liquid X and liquid Y, the volume of the resulting solution decreases. What typeof deviation from Raoult's law is shown by the resulting solution? What change in temperature would you observe after mixing liquids X and Y?

(ii) What happens when we place the blood cell in water (hypotonic solution)? Givereason.

(iii) At 25°C the saturated vapor pressure of water is 3.165 kPa (23.75 mm Hg). Find the saturated vapor pressure of a 5% aqueous solution of urea (carbamide) at the same temperature. (Molar mass of urea = 60.05 g mol^{-1})

34 (i) Describe the preparation of potassium permanganate from pyrolusite ore. Write the balanced chemical equation for one reaction to show the oxidizing nature of potassium permanganate.

(ii) Draw the structures of chromate and dichromate ions.

O
R

When an oxide of manganese (A) is fused with KOH in the presence of an oxidizing agent and dissolved in water, it gives a dark solution of compound (B). Compound (B) disproportionate in a neutral or acidic solution to give purple compound (C). An alkaline solution of compound

(C) oxidizes potassium iodide solution to a compound (D) and compound (A) is also formed. Identify compounds A to D and also explain the reactions involved.

35 (i) Among all the isomers of molecular formula C 4 H 9 Br, identify-

(a) the one isomer which is optically active. 1

(b) the one isomer which is highly reactive towards S N 2.

(c) the two isomers which give the same product ondehydrohalogenation with alcoholic KOH.

I) Give IUPAC the name of the following organic compounds:

a) C6H5COOH

b) (CH3)3CCH2Br

SAMPLE PAPER 4

Marking Scheme

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

<table>
<tr><td>19</td><td>

$E^0 = 0.91$ Volts

</td><td>2</td></tr>
<tr><td>20</td><td>

At cathode: $PbSO_4\,(s) + 2e^- \rightarrow Pb(s) + SO_4^{2-}(aq)$
At anode: $PbSO_4\,(s) + 2H_2O \rightarrow PbO_2\,(s) + 4H^+(aq) + SO_4^{2-}(aq) + 2e^-$
Overall reaction: $PbSO_4\,(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2\,(s) + 2H_2SO_4\,(aq)$

During recharging, electrical energy is supplied to the cell from an external source. The reactions are reverse of those that takes place during discharge.

OR

(i) At Cathode : $Ag^+(aq) + e^- \rightarrow Ag(s)$,
At Anode : $Ag(s) \rightarrow Ag^+(aq) + e^-$

(iii) At cathode :
$4H^+ + 4e^- \rightarrow 2H_2$
At anode
$2H_2O \rightarrow O_2(g) + 4H^+(aq) + 4e^-$

</td><td>2
1
1</td></tr>
<tr><td>21</td><td>(i) First order, (ii) time $^{-1}$ or s^{-1}, (iii) $k = 0.693/t_{1/2}$ (iv) slope = -k (rate constant)</td><td>2</td></tr>
<tr><td>22</td><td>

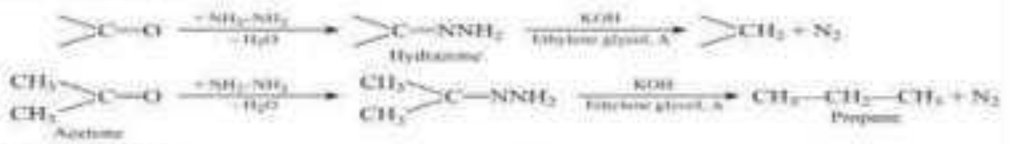
(i) The energy associated with splitting of the degenerate levels due to the presence of ligands in a definite geometry is termed as crystal field splitting energy.
(ii) t_{2g} eg

</td><td>1
1</td></tr>
<tr><td>23</td><td>

A = Benzaldehyde C_6H_5CHO
B=Benzyl Alcohol $C_6H_5CH_2OH$
C = Sodium salt of Benzoic acid C_6H_5COONa
D = Benzene C_6H_6

OR

(i) Wolff-Kishner reduction:



(ii) Etard reaction:

</td><td>2
1
1</td></tr>
</table>

24	(i) Phenylethanal (ii) Alkaline solution of $CuSO_4$ and Sodium potassium tartrate	1 1
25	(i) Methylamine is 1° amine,therefore, it gives offensive smell of carbylamine on treatment with KOH and $CHCl_3$	1 1
	(ii) By Hinsberg's reagent (benzene sulphonyl chloride) - 2° amines form dialkyl benzenesulfonamide which does not react with alkali and hence it remains insoluble. 3°amines do not react with benzene sulphonyl chloride at all.	
26	**At anode:** $Fe \longrightarrow Fe^{2+} + 2e^-;\ E^{\circ}_{Fe^{2+}/Fe} = -0.44\ V$ **At cathode:** $2H^+ + \frac{1}{2}O_2 + 2e^- \longrightarrow H_2O;\ E^{\circ}_{H^+/O_2/H_2O} = 1.23\ V$ **Overall reaction:** $Fe + 2H^+ + \frac{1}{2}O_2 \longrightarrow Fe^{2+} + H_2O;\ E^{\circ}_{cell} = 1.67\ V$ The Fe^{2+} ions are further oxidised by atmospheric oxygen to Fe^{3+} ions, which comes out in the form of hydrated ferric oxide (rust). $2Fe^{2+} + \frac{1}{2}O_2 + 2H_2O \longrightarrow Fe_2O_3 + 4H^+$ $Fe_2O_3 + xH_2O \longrightarrow Fe_2O_3.xH_2O$ (Rust)	3
27	(i) As $\frac{-d[B]}{dt} = 1 \times 10^{-2}\ mol\ L^{-1}\ s^{-1}$ $\therefore$ Rate $= -\frac{1}{2}\frac{d[B]}{dt} = \frac{1}{2} \times 1 \times 10^{-2} = \mathbf{0.5 \times 10^{-2}\ mol\ L^{-1}\ s^{-1}}$ (ii) Rate $= -\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt} = +\frac{1}{3}\frac{d[C]}{dt}$ Rate of change in concentration of A $= -\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt}$ $= \mathbf{0.5 \times 10^{-2}\ mol\ L^{-1}\ s^{-1}}$ Rate of change in concentration of C $= +\frac{d[C]}{dt} = -\frac{3}{2}\frac{d[B]}{dt} = \frac{3}{2} \times 1 \times 10^{-2}$ $= \mathbf{1.5 \times 10^{-2}\ mol\ L^{-1}\ s^{-1}}$	3
28	(i) (a) This is because of greater electronegativity of sp^2 hybridised carbonyl to which carboxyl carbon is attached in benzoic acid $\overset{sp^2}{C_6H_5}-COOH$ (Benzoic acid) $\overset{sp^3}{CH_3}-COOH$ (Acetic acid) (b) The methyl group due to its +ve I effect reduces the positive charge on carbonyl carbon atom. Moreover it also hinders the approach of the nucleophile. Since in ethanal there is one methyl group while in methanal there is no methyl group on carbonyl carbon atom therefore methanal is more reactive towards nucleophilic addition reaction than ethanal. (ii) Propanal being an aldehyde gives silver mirror with Tollens' reagent while propanone being a ketone does not give this test. $\underset{Propanal}{CH_3CH_2CHO} + \underset{Tollens' reagent}{2[Ag(NH_3)_2]^+} + 3OH^- \longrightarrow CH_3CH_2COO^- + \underset{Silver mirror}{2Ag\downarrow} + 4NH_3 + 2H_2O$	3
29	(i) $CH_3CH_2CH_3 < CH_3CH_2NH_2 < CH_3CH_2OH$ (ii) (a) To remove HX formed so that the reaction shifts in the forward direction. (b)  Due to +R effect, availability of lone pair of electron on N of —NH_2 group decreases. As a result, acid amide is much weaker base than amines. Because of the positive charge on N, as a result of resonance, N can easily lose a proton and behaves, as a weak acid.	1 1 1

30	(i) Amylose is a long unbranched chain polymer of α-D(+) glucose. Amylopectin is a branched chain polymer of α-D(+) glucose. (ii) Globular protein and its shape are spherical. (iii) Liver and adipose tissue.	1 1 1
31	a. Potassium tetracyanonickelate(II). b. K2[NiCl4] c. Diamagnetic and octahedral OR sp3 and Square planar	1 1 2
32	a. This is because 3° alkyl halides are highly susceptible to dehydrohalogenation in the presence of sodium alkoxides and an elimination reaction occurs. b. Allyl phenyl ether can be obtained by heating $CH_2=CHCH_2Br$ and C_6H_5ONa c. The reaction between $(CH_3)_3COCH_3$ and HI follow S_N1 mechanism. For an S_N1 reaction, the formation of the product is controlled by the stability of the carbocation formed in the slowest step. Since tert.butyl carbonium ion (CH) C$^{\oplus}$ formed after the cleavage of C—O 3 3 bond in the slowest step is more stable than methyl carbonium ion therefore $(CH_3)_3C$-I and CH_3OH are the main products. **OR** 	1 1 1
33	(i) (a) The binary mixtures of liquids having same composition in liquid and vapour phase and boil at a constant temperature are called azeotropes. (b) The excess of pressure which must be applied to the solution side to prevent the passage of solvent into it through a semipermeable membrane is called osmotic pressure. (c) The properties of solutions which depend only on the number of soluteparticles in the	1 1 1

solution but independent of their nature are called colligative properties. 2

(ii) Let the mass of solution = 100 g

∴ Mass of H_2SO_4 = 9.8 g

$$\text{Number of mole of } H_2SO_4 = \frac{\text{Mass of } H_2SO_4}{\text{Molar Mass}} = \frac{9.8\text{ g}}{98\text{ g mol}^{-1}} = 0.1\text{ mol}$$

$$\text{Volume of solution} = \frac{\text{Mass of solution}}{\text{Density of solution}} = \frac{100\text{ g}}{1.02\text{ g mL}^{-1}} = \frac{100}{1.02}\text{mL}$$

$$= \frac{100}{1.02}\text{mL} \times \frac{1}{1000\text{ mL L}^{-1}} = \frac{1}{10.2}\text{L}$$

$$\text{Molarity} = \frac{\text{Moles of solute}}{\text{Volume of solution (in L)}}$$

$$= \frac{0.1\text{ mol}}{\frac{1\text{L}}{10.2}} = \mathbf{1.02\ mol\ L^{-1}\ or\ 1.02\ M}$$

2

OR

(i) The solution will show negative deviation from Raoult's law. Temperature will rise. 1

(ii) Due to osmosis water enters into the cell and blood cell will swell. 2

(iii)(iii)

$W_B = 5$ g, $W_A = 95$ g, $M_B = 60.05$ g mol^{-1}, $M_A = 18$ g mol^{-1}, $p^0_A = 3.165$ kPa

Substituting the values in the expression

$$\frac{p^0_A - p}{p^0_A} = \frac{W_B \times M_A}{M_B \times W_A}, \text{ we get}$$

$$\frac{3.165\text{ kPa} - p}{3.165\text{ kPa}} = \frac{5\text{ g} \times 18\text{ g mol}^{-1}}{60.05\text{ g mol}^{-1} \times 95\text{ g}} = 0.015$$

$$p = 3.165\text{ kPa} - 0.015 \times 3.165\text{ kPa}$$

$$p = \mathbf{3.118\ kPa}$$

34 (i) Conversion of pyrolusite (MnO_2) into potassium manganate (K_2MnO_4). 3

$$2MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$$

Electrolytic oxidation:

$$K_2MnO_4 \rightleftharpoons 2K^+ + MnO_4^{2-}$$

At anode $\quad MnO_4^{2-} \longrightarrow MnO_4^- + e^-$

At cathode $\quad H^+ + e^- \longrightarrow H \qquad 2H \longrightarrow H_2$

It oxidises oxalate ($C_2O_4^{2-}$) to carbon dioxide (CO_2) in acidic medium.

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O] \times 2$$

$$C_2O_4^{2-} \longrightarrow 2CO_2 + 2e^-] \times 5$$

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

(ii)

Chromate ion

Dichromate ion

2

O
R

A = MnO_2 (Manganese (IV) oxide), B = K_2MnO_4 (Potassium manganate), C = $KMnO_4$ (Potassium permanganate), D = KIO_3 (Potassium iodate)

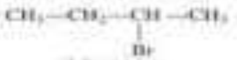
$$\underset{(A)}{2MnO_2} + 4KOH + O_2 \longrightarrow \underset{(B)}{2K_2MnO_4} + 2H_2O$$

5

$$3K_2MnO_4 + 4H^+ \longrightarrow \underset{(C)}{2KMnO_4} + MnO_2 + 2H_2O + 4K^+$$

$$2MnO_4^- + H_2O + KI \longrightarrow \underset{(A)}{2MnO_2} + 2OH^- + \underset{(D)}{KIO_3}$$

35 (i) (a)



$$CH_3-CH_2-\underset{\underset{Br}{|}}{CH}-CH_3$$

2-Bromobutane

(b) $CH_3-CH_2-CH_2-CH_2-Br$ 1

1-Bromobutane

1

(c)

$$CH_3-\overset{\overset{CH_3}{|}}{CH}-CH_2-Br$$

1-Bromo-2-methyl propane

and

$$CH_3-\overset{\overset{CH_3}{|}}{\underset{\underset{Br}{|}}{C}}-CH_3$$

2-Bromo-2-methyl propane

1

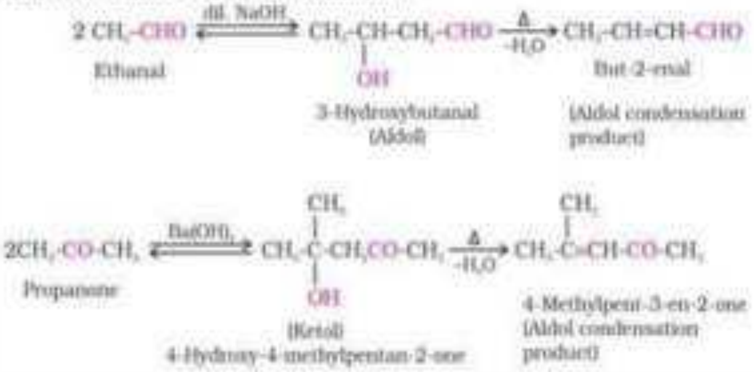
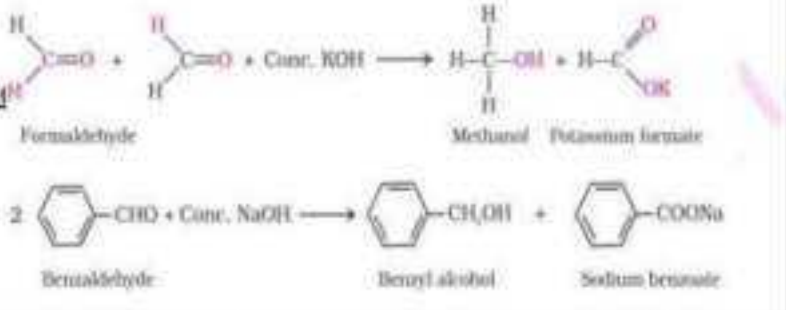
(ii) (a) 2-chloro cyclopent-1-ene-1-carboxylic acid

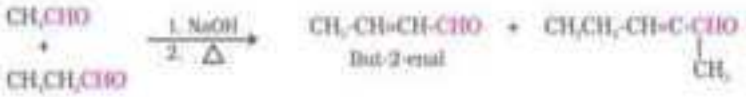
(b) 1-bromo-2, 2-dimethyl propane

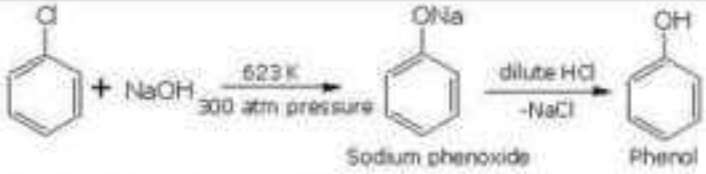
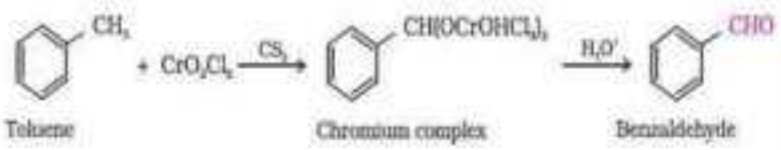
2

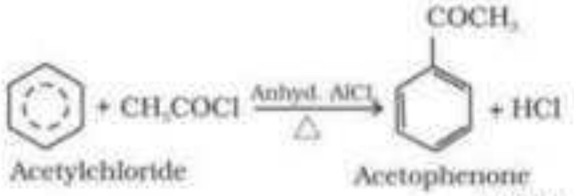
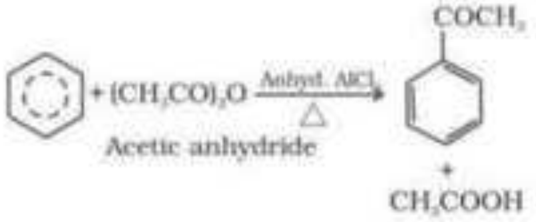
ANNEXURE -2

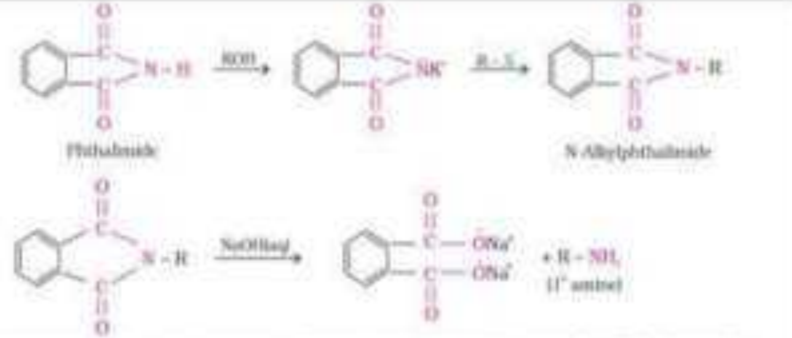
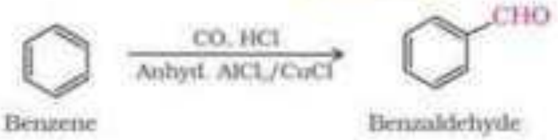
NAME REACTION

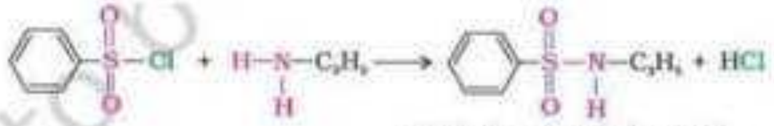
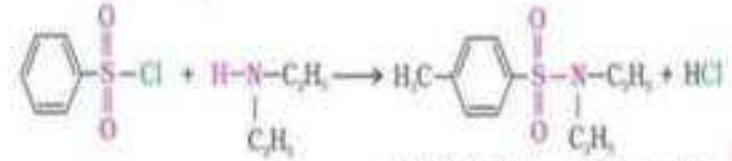
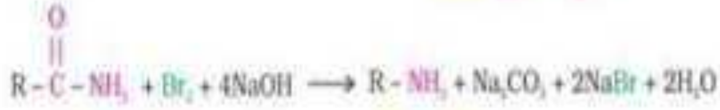
SL NO	NAME REACTION	EQUATION OF REACTION
1	**Aldol condensation.**	The aldol and ketol readily lose water to give α,β-unsaturated carbonylcompounds which are aldol condensation products and the reaction is called Aldol condensation 
2	**Balz-Schiemann Reaction**	When arenediazonium chloride is treated with fluoroboric acid,arenediazoniumfluoroborate is precipitated which on heating decomposes to yield aryl fluoride. $Ar\overset{+}{N}_2\overset{-}{Cl} + HBF_4 \longrightarrow Ar-\overset{+}{N}_2\overset{-}{BF}_4 \xrightarrow{\Delta} Ar-F + BF_3 + N_2$
	Cannizzaro reaction: ANNUXURE-2 NAME REACTIONS IN ORGANIC	Aldehydes which do not have an α-hydrogen atom, undergo self oxidation and reduction (disproportionation) reaction on treatment withconcentrated alkali. In this reaction, one molecule of the aldehyde is reduced to alcohol while another is oxidised to carboxylic acid salt. 
4	**Carbylamine reaction**	Aliphatic and aromatic primary amines on heating with chloroform

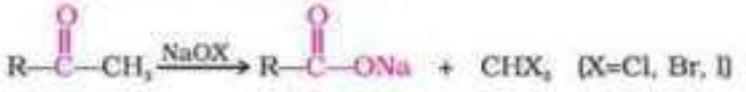
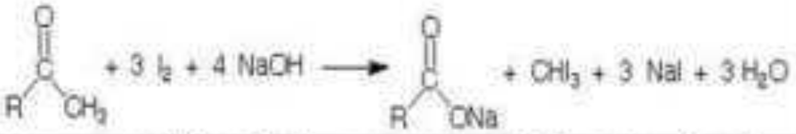
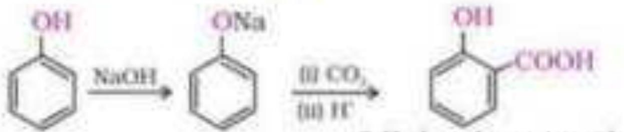
		are foul smelling substances. This reaction is known as carbylamines reaction or isocyanide test. $R-NH_2 + CHCl_3 + 3KOH \xrightarrow{Heat} R-NC + 3KCl + 3H_2O$ Note: Secondary and tertiary amines do not show this reaction and is used as a test for primary amines
5	**Clemmensen Reduction**	The carbonyl group of aldehydes and ketones is reduced to CH2 group on treatment with zincamalgam and concentrated hydrochloric acid. This is known as Clemmensen reduction.  (Clemmensen reduction)
6	**Coupling Reactions:**	Benzene diazonium chloride reacts with phenol in which the phenol molecule at its para position is coupled with the diazonium salt to form p-hydroxyazobenzene. This type of reaction is known as coupling reaction.  p-Hydroxyazobenzene (orange dye) Similarly the reaction of diazonium salt with aniline yields p-aminoazobenzene.  p-Aminoazobenzene (yellow dye)
7	**Cross aldol condensation:**	When aldol condensation is carried out between two different aldehydes and / or ketones, it is called cross aldol condensation. If both of them contain α-hydrogen atoms, it gives a mixture of four products.  $CH_3CHO + CH_3CH_2CHO \xrightarrow[2.\ \Delta]{1.\ NaOH} \underset{\text{But-2-enal}}{CH_3-CH=CH-CHO} + CH_3CH_2-CH=\underset{\displaystyle CH_3}{\underset{\vert}{C}}-CHO$
8	**Dow's process**	In this process, chlorobenzene is heated with aqueous sodium hydroxide under pressure. Sodium phenoxide so produced on acidification gives phenol.

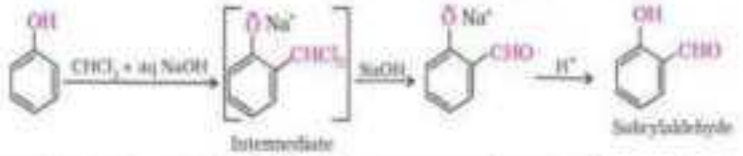
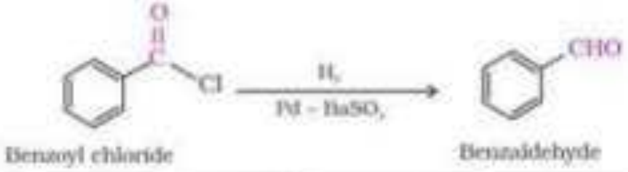
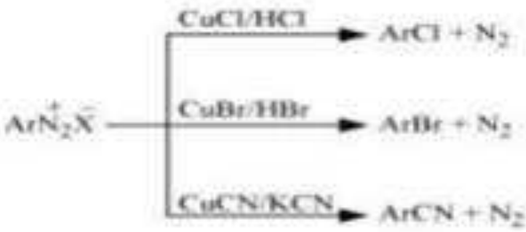
		
9	**Diazotisation**	The nitrosation of primary aromatic amines with nitrous acid (generated in situ from sodium nitrite and a strong acid, such as hydrochloric acid, sulfuric acid, or HBF_4) leads to diazonium salts. $C_6H_5NH_2 + NaNO_2 + 2HCl \xrightarrow{273\text{-}278K} C_6H_5\overset{+}{N}_2\overset{-}{Cl} + NaCl + 2H_2O$
10	**Etard reaction**	Chromyl chloride oxidizes methyl group to a chromium complex, which on hydrolysis gives corresponding benzaldehyde. This reaction is called Etard reaction 
11	**Fehling's test**	Fehling reagent comprises of two solutions, Fehling solution A and Fehling solution B. Fehling solution A is aqueous copper sulphate and Fehling solution B is alkaline sodium potassium tartarate (Rochelle salt). These two solutions are mixed in equal amounts before test. On heating an aldehyde with Fehling's reagent, a reddish brown precipitate is obtained. Aldehydes are oxidised to corresponding carboxylate anion. Aromatic aldehydes do not respond to this test. $R\text{-}CHO + 2Cu^{2+} + 5\bar{O}H \longrightarrow RCO\bar{O} + \underset{\text{Red-brown ppt}}{Cu_2O} + 3H_2O$
12	**Finkelstein Reaction**	Alkyl iodides are often prepared by the reaction of alkyl chlorides/ bromides with NaI in dry acetone. This reaction is known as Finkelstein reaction. $R-X + NaI \longrightarrow R-I + NaX$ $(X = Cl, Br)$ Note: This reaction in forward direction can be favoured by precipitating NaX formed in dry acetone (according to Le Chatelier's principle).

13	**Fittig Reaction**	Aryl halides also give analogous compounds when treated with sodium in dry ether, in which two aryl groups are joined together. It is called Fittig reaction. 
14	**Friedel-Crafts acylation reaction**	The reaction of benzene with an acyl halide or acid anhydride in the presence of Lewis acids (AlCl3) yields acyl benzene  (13.77) 
15	**Friedel-Crafts alkylation Reaction**	When benzene is treated with an alkyl halide in the presence of anhydrous aluminium chloride, alkylbenene is formed.  (13.75)
16	**Gabriel phthalimide synthesis**	Gabriel synthesis is used for the preparation of pure primary amines. Phthalimide on treatment with ethanolic potassium hydroxide forms potassium salt of phthalimide which on heating with alkyl halide followed by alkaline hydrolysis produces the corresponding primary amine.

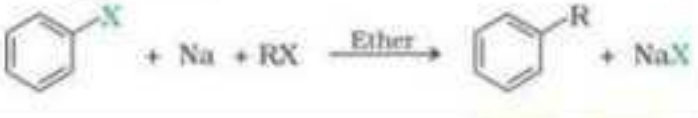
		 **Note:** Aromatic primary amines cannot be prepared by this method because aryl halides do not undergo nucleophilic substitution with the anion formed by phthalimide.
17	**Gatterman – Koch reaction**	When benzene or its derivative is treated with carbon monoxide and hydrogen chloride in the presence of anhydrous aluminium chloride or cuprous chloride, it gives benzaldehyde or substituted benzaldehyde. This reaction is known as Gatterman-Koch reaction. 
18	**Gatterman Reaction**	Chlorine or bromine can be introduced in the benzene ring by treating the benzene diazonium salt solution with corresponding halogen acid in the presence of copper powder. This is referred as Gatterman reaction. 
19	**Hell-Volhard-Zelinsky (HVZ)reaction**	Carboxylic acids having an α-hydrogen are halogenated at the α-position on treatment with chlorine or bromine in the presence of small amount of red phosphorus to give α-halocarboxylic acids. The reaction is known as Hell-Volhard-Zelinsky reaction $R\text{-}CH_2\text{-}COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } X_2\text{/Red phosphorus}} R\text{-}\underset{\underset{X}{\mid}}{C}H\text{-}COOH$ $X = Cl, Br$ α – Halocarboxylic acid
20	**Hinsberg's Test**	Benzenesulphonyl chloride ($C_6H_5SO_2Cl$), which is also known as Hinsberg's reagent, reacts with primary and secondary amines to form sulphonamides. (a) The reaction of benzenesulphonyl chloride with

		primary amine yields N-ethylbenzenesulphonyl amide. The hydrogen attached to nitrogen in sulphonamide is strongly acidic due to the presence of strong electron withdrawing sulphonyl group. Hence, it is soluble in alkali.  *N*-Ethylbenzenesulphonamide (soluble in alkali) (b) In the reaction with secondary amine, N,N-diethyl-benzenesulphonamide is formed. Since N, Ndiethylbenzene sulphonamide does not contain any hydrogen atom attached to nitrogen atom, it is not acidic and hence insoluble in alkali.  *N,N*-Diethylbenzenesulphonamide (c) Tertiary amines do not react with benzenesulphonyl chloride. Note: This test is used for the distinction of primary, secondary and tertiary amines and also for the separation of a mixture of amines. However, these days benzenesulphonyl chloride is replaced by p-toluenesulphonyl chloride.
21	**Hoffmann bromamide degradation reaction**	An amide with bromine in an aqueous or ethanolic solution of sodium hydroxide gives primary amines. In this degradation reaction, migration of an alkyl or aryl group takes place from carbonyl carbon of the amide to the nitrogen atom. The amine so formed contains one carbon less than that present in the amide.  $R-\overset{O}{\overset{\|}{C}}-NH_2 + Br_2 + 4NaOH \longrightarrow R-NH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

22	**Iodoform test**	Aldehydes and ketones having at least one methyl group linked to the carbonyl carbon atom (methyl ketones) are oxidised by NaOH and I_2 to sodium salts of corresponding carboxylic acids having one carbon atom less than that of carbonyl compound. The methyl group is converted to Iodoform. **Shows positive test for:** acetaldehyde and methyl ketones **Reactions:** the methyl group of the ketone is removed from the molecule and produces iodoform (CHI_3)  $R-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{NaOX} R-\overset{O}{\overset{\|}{C}}-ONa + CHX_3$ (X=Cl, Br, I) 
23	**Kolbe electrolysis**	An aqueous solution of sodium or potassium salt of a carboxylic acid on electrolysis gives alkane containing even number of carbon atoms.It is decarboxylation reaction. The reaction is known as Kolbe electrolysis. $2CH_3COO^-Na^+ + 2H_2O$ Sodium acetate $\downarrow$ Electrolysis $CH_3-CH_3+2CO_2+H_2+2NaOH$
24	**Kolbe's Reaction**	Phenol with sodium hydroxide gives sodium phenoxide ion which with carbon dioxide in acidic medium results hydroxybenzoic acid (salicylic acid). This is known as Kolbe's reaction.  2-Hydroxybenzoic acid (Salicylic acid)
25	**Liebermanns test**	Libermann'snitroso test is is used as a test for secondary amines.Secondaryamines(aliphatic as well as aromatic) reacts with nitrous acid to form N-nitrosoamines.

		$(CH_3)_2NH + HONO$ -----------------> $(CH_3)_2N\text{-}N{=}O + H_2O$ Where $(CH_3)_2$ N-N=O is N-Nitrosodimethylamine.Nitrosoamines are water soluble yellow oils and when warmed with phenol and few dropos of conc.H_2SO_4 produce a green colour solution which turns blue on adding alkali.This reaction is called Libermann'snitroso reaction .Tertiary amine do not react with nitrous acid.
26	**Reimer-Tiemann Reaction**	On treating phenol with chloroform in the presence of sodium hydroxide, a -CHO group is introduced at ortho position of benzene ring resulting salicylaldehyde. This reaction is known as Reimer - Tiemann reaction. 
27	**Rosenmund Reduction**	Acyl chloride (acid chloride) is hydrogenated over catalyst, palladium on barium sulphate. This reaction is called Rosenmund reduction. 
28	**Sandmeyer Reaction**	The Cl , Br and CN nucleophiles can easily be introduced in the benzene ring of benzene diazonium salt in the presence of Cu(I) ion. This reaction is called Sandmeyer reaction. 
29	**Stephen reaction**	Nitriles are reduced to corresponding imine with stannous chloride in the presence of hydrochloric acid, which on hydrolysis give corresponding aldehyde. This reaction is called Stephen reaction.

		$RCN + SnCl_2 + HCl \longrightarrow RCH = NH \xrightarrow{H_3\dot{O}} RCHO$
30	**Swarts Reaction**	Heating an alkyl chloride/bromide in the presence of a metallic fluoride such as AgF, Hg_2F_2, CoF_2 or SbF_3 gives alkyl fluorides. The reaction is termed as Swarts reaction. $H_3C{-}X + AgF \longrightarrow H_3C - F + AgX$ $(X = Cl, Br)$ **Note:** Finkelstein Reaction and Swarts Reaction are known as halogen exchange reaction.
31	**Tollens' test**	On warming an aldehyde with freshly prepared ammoniacal silver nitrate solution (Tollens' reagent), a bright silver mirror is produced due to the formation of silver metal. The aldehydes are oxidised to corresponding carboxylate anion. The reaction occurs in alkaline medium. $RCHO + 2[Ag(NH_3)_2]^+ + 3\bar{O}H \longrightarrow RCO\bar{O} + 2Ag + 2H_2O + 4NH_3$
32	**Wolff Kishner Reduction**	The carbonyl group of aldehydes and ketones is reduced to CH_2 group on treatment with hydrazine followed by heating with sodium or potassium hydroxide in high boiling solvent such as ethylene glycol. This is known Wolff Kishner reduction. 
33	**Williamsons reaction**	The Williamson ether synthesis is a reaction that converts alcohols (R-OH) into ethers (R-O-R). The first step in this reaction is forming the conjugate base of the alcohol (called an alcoxide) by reacting the alcohol with sodium metal. This reaction forms hydrogen gas (H_2) as a biproduct, so if you perform this reaction take caution to keep all flame sources away during sodium addition. 
34	**Wurtz Reaction**	Alkyl halides react with sodium in dry ether to give hydrocarbons Containing double the number of carbon atoms present in the halide.

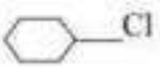
		This reaction is known as Wurtz reaction. $CH_3Br + 2Na + BrCH_3 \xrightarrow{\text{dry ether}} CH_3-CH_3 + 2NaBr$ Bromomethane Ethane $C_2H_5Br + 2Na + BrC_2H_5 \xrightarrow{\text{dry ether}} C_2H_5-C_2H_5$ Bromoethane n-Butane
35	**Wurtz-Fittig Reaction**	A mixture of an alkyl halide and aryl halide gives an alkylarene whentreated with sodium in dry ether and is called Wurtz-Fittig reaction. 

ANNEXURE -3

REASON BASED QUESTIONS

HALOALKANES AND HALOARENES

Q1. Which of the following undergo SN^2 faster?

(i) 

(ii) 

Ans:  CH_2Cl is more faster under go SN^2 because it is Primary alkyl halide

ii)  I is more faster to under go SN^2 mechanism because I is better leaving group due to its large size.

Q2. Out of o-and p-dibromobenzene which one has a higher melting point and why?

Ans: The melting point of p-dibromobenzene is higher than that of the other two compounds. This is due to the symmetry of p-dibromobenzene, which allows the molecule to fit into the crystal lattice more easily. As a result, breaking the bonds between the molecules demands a higher temperature, resulting in a higher melting point.

Q3. Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for this.

Ans: The reasons are:

(i) Due to resonance C – Cl bond acquires a partial double bond character. As a result, the C – Cl bond in chlorobenzene is shorter and hence stronger. Thus, cleavage of C – Cl bond in benzene becomes difficult which makes it less reactive towards nucleophilic substition.

(ii) Due to repulsion between nucleophile and electron rich arenes.

Q4. What are ambident nucleophiles? Explain with an example.

Ans: Ambident nucleophile : A nucleophile that can form new bonds at two or more spots in its structure, usually due to resonance contributors. Example: $S = C = N^-$ can act as a nucleophile with either the S or N attacking.

Q5. Out of $C_6H_5CH_2Cl$ & $C_6H_5CHCl\ C_6H_5$ Which is more easily hydrolyzed by KOH?

Ans; The second comound is more resonance stabilized hence easily forms carbo cation and react faster by SN^1 mechanism.

Q6. Haloalkanes easily dissolve in organic solvents, why?

Ans: Because the new forces of attraction set up between haloalkanes and solvent molecules are of the same strength as the forces of attraction being broken.

Q7. What is known as a racemic mixture? Give an example.

Answer: A mixture which contains the equal proportions of two enantiomers of a compound in equal proportions is called racemic mixture

Example : (±) butan-2-ol

Q8. Chloroform contains chlorine but it does not give white precipitate with silver nitrate solution,why?

Ans: Chloroform is a covalent compound therefore, it does not ionize to give chloride ion. Hence it does not give white precipitate with silver nitrate solution.

$CHCl_3 + AgNO_3 \longrightarrow$ No precipitate.

Q9.Why preparation of Alkyl halides from alcohols by using $SOCl_2$ is preferable.?

Ans.When $SOCl_2$ is used,side products are gases and forms pure alkyl halides.

$$R\text{-}OH + SOCl_2 \longrightarrow R\text{-}Cl + SO_2 + HCl$$

Q10. . Arrange each set of compounds in order of increasing boiling poings.

(i) Bromo Ethane , Bromoform, Chloro methane, Dibromo methane

(ii) 1-Chloro Propane, Isopropyl chloride, 1-chloro butane

Ans: i)Chloro Methane(CH_3Cl) < Bromo Ethane($CH_3\text{-}CH_2\text{-}Br$) < Dibromo Mehane($CH_2Br_2$) < Bromoform ($CHBr_3$)

ii)$CH_3CHCl\text{-}CH_3 < CH_3\text{-}CH_2\text{-}CH_2Cl < CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}Cl$

As atomic mass increases boiling point increases. And branching compounds has less spherical contact as compare with straight chain compounds. Hence boiling point less for branching chain alkyl halides.

Q11.Halo alkanes react with KCN to form alkyl cyanides as main product while AgCN forms isocyanides as the chief product. Explain.

Ans: KCN is predominantly ionic and provides cyanide ions in solution. Although both carbon and nitrogen atoms are in a position to donate electron pairs. The attack takes place mainly through carbon atom not through nitrogen atom since C—C is more stable than C—N bond. However, AgCN is mainly covalent in nature and nitrogen is free to donate electron pair forming isocyanide as the main product.

Q12. Chloroform stored in dark colored bottles by completely filling it it. Explain.

Ans: Chloroform react with air in presence of sun light it forms poisonous phosogene.

$2\,CHCl_3 + O_2 \rightarrow 2\,COCl_2 + 2\,HCl$

Q13. The presence of nitro group ($-N0_2$) at o/p positions increases the reactivity of haloarenes towards nucleophilic substitution reactions, why?

Answer: The $-N0_2$ group, being an electron – withdrawing group decreses the electron density over the benzene ring hence reactivity of haloarenes towards nucleophilic substitution reaction increases.

Q14. Which alkyl halide from the following pairs would you expect to react more rapidly by an SN^2 mechanism? Explain your answer?

1. CH_3-CH_2-CH_2-CH_2-Br & CH_3-CH_2-CHBr –CH_3
2. CH_3-CH_2-CHBr –CH_3 & $C(CH_3)_3Br$
3. CH_3- $CHCH_3$- CH_2- CH_2- Br & CH_3- CH_2- $CHCH_3$- CH_2- Br

Ans: 1. CH_3-CH_2-CH_2-CH_2-Br primary alkyl halide is more reactive than secondary alkyl halide

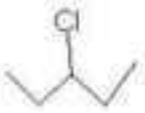
2. CH_3-CH_2-CHBr –CH_3 Secondary alkyl halide is more reactive than Tertiary alkyl halide

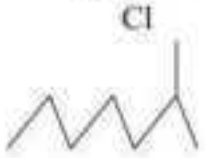
3. CH_3- $CHCH_3$- CH_2- CH_2- Br As methyl group is far from Br it will less stabilize the carbo cations and facilitate the SN^2 mechanism.

Q15. Which of the following compound go faster SN^1 reaction:

1. 

&



2. 

&

Ans: 1. first compound ismore stable because tertiary is more reactive than secondary alkyl halide for SN^1 mechanism.

2. first compound is more stable because Secondary is more reactive than primary for SN^1 mechanism.

ALCOHOLS, PHENOLS AND ETHERS

Q1. Phenol is stronger acid than alcohol. Give reason.

Ans. Acidity of the substance depends on stability of anion after loosing H+ ion. Since phenoxide ion undergoes resonance stabilization compare to alkoxide hence phenol is more acidic than alcohol.

Q2. Boiling point of p-nitro phenol is more than the o- nitro phenol. Explain?

Ans:- O-nitro phenol is a stream volatile due to intra molecular Hydrogen bond where as p-nitro phenol is having inter molecular Hydrogen bond which results in association of molecules and hence have large molecular mass. Intra molecular hydrogen bond decreases Boiling point and Inter molecular hydrogen bond increases Boiling point.

Q3. Why the commercial ethanol is mixed with copper sulphate & pyridine?. Explain.

Ans: Commercial ethanol is mixed with $CuSO_4$ & pyridine to make it unfit for drinking. It is known as denaturation of alcohol.

Q4. Alcohols are comparatively more soluble in water than hydrocarbons of comparable molecular masses. Why?.

Ans: Due to hydrogen bond with water molecules.

Q5. The C-O bond is much shorter in phenol than in ethanol. Give reason.

Ans: Carbon of C-O bond of phenol is Sp^2 hybridised, so it acquires a partial double bond character but in ethanol it is Sp^3 hybridised and a single bond. Double bond is shorter than a single bond.

Q6. o- and p-nitrophenols are more acidic than phenol , why?

Ans: Both o- and p-nitrophenols contain the NO_2 group which is an electron withdrawing group. Due to this electron density in the OH bond of substituted phenol decreases and hence the loss of proton becomes easy and therefore more acidic.

Q7. Arrange the following sets of compounds in order of their increasing boiling points:

(a) Pentan-1-ol, butan-1-ol, butan-2-ol, ethanol, propan-1-ol, methanol.

(b) Pentan-1-ol, n-butane, pentanal, ethoxyethane.

Ans: (a) Methanol, ethanol, propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol.

(b) n-Butane, ethoxyethane, pentanal and pentan-1-ol.

Q8. Preparation of ethers by dehydration of alcohols is not suitable for the use of secondary and tertiary alcohols give reason.

Ans: dehydration of secondary and tertiary alcohols to give corresponding ethers is not successful as elimination competes over substitution and as a consequence alkenes are easily formed.

Q9. Anisole react with HI to gives phenol & methyl iodide but not iodo benzene and methanol. Explain.

Ans. Nucleophilic substitution on aromatic ring is difficult due to partial double Bond character between oxygen and carbon of benzene ring. As a result, nucleophilic attack by iodide ion occurs on CH_3 group forming methyl iodide and phenol.

$$C_6H_5-O-CH_3 + HI \longrightarrow C_6H_5OH + CH_3I$$

Q10. The C—O—H bond angle in alcohol is slightly less than the tetrahedral angle ($109^0\ 28'$) why?

Ans: The C—O—H bond angle in alcohol is slightly less (108.9^0) than the tetrahedral angle ($109^0\ 28'$) due to greater lone pair-lone pair repulsion than lone pair-bond pair repulsions.

Q11. Methyl phenyl ether cannot be prepared from bromobenzene. Give reason.
Ans: . Methyl phenyl ether(Anisole) cannot be prepared from bromobenzene because bromobenzene do not undergo nucleophilic substitution reactions easily.
12. Which of the following is appropriate for the preparation of anisole and why?
a) Bromo Benzene & Sodium Methoxide b) Phenoxide & CH_3Br
Ans: Set (b) is appropriate because in set a nucleaophilic substitution on aromatic ring is difficult due to partial double bond character.
Q13. . The relative dehydration of alcohols is in the order of
Tertiary>Secondar>Primary , why?.
Ans: Dehydration carryout by carbocation mechanism, and stability of carbocation is teriary>Secondary>Primary

Q14. Out of o-nitrophenol and o-cresol which is more acidic?

Ans: The presence of an electron-withdrawing group ($-NO_2$) in an ortho position relative to the –OH group increases the acidic strength of the chemical by stabilising the phenoxide ion, allowing o-nitrophenol to easily release a proton. Because of the presence of an electron releasing group, o-cresol is less acidic (alkyl group). They prevent the production of the phenoxide ion. As a result, the compound's acidic strength is reduced.

Q15. Arrange the following compounds in increasing order of acidity and give a suitable explanation. Phenol, o-nitrophenol, o-cresol.

Ans: Increasing order of acidity : o-cresol < phenol < o-nitrophenol

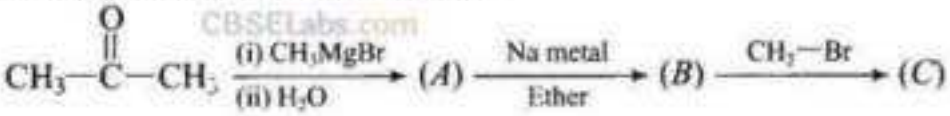
O-nitrophenol is a stronger acid than phenol due to the -I and -R effects of the NO_2 group, but o-cresol is a weaker acid due to the +I effect of the CH_3 group.

ANNEXURE-4

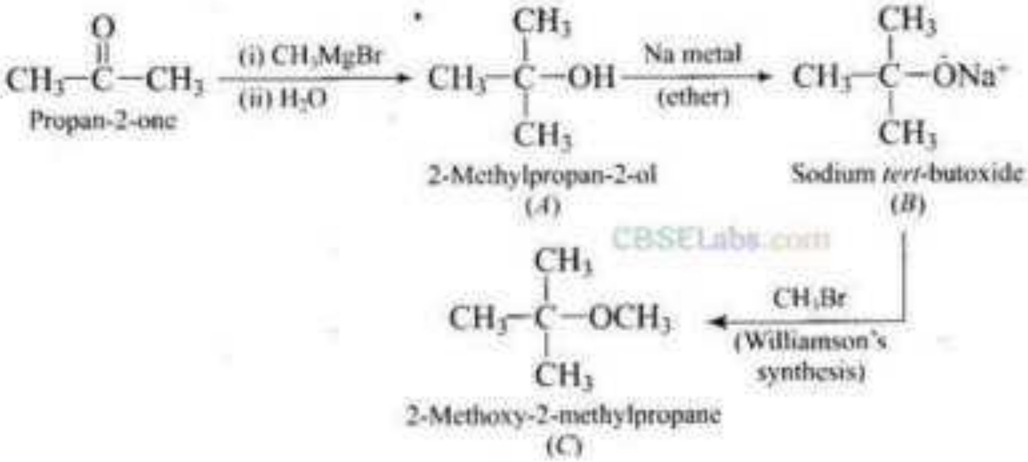
WORD PROBLEMS

ALDEHYDES KETONES AND ACIDS WORD PROBLEMS

Q1 Complete the following reaction sequence.



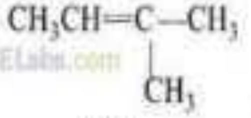
$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[\text{(ii) } H_2O]{\text{(i) } CH_3MgBr} (A) \xrightarrow[\text{Ether}]{\text{Na metal}} (B) \xrightarrow{CH_3-Br} (C)$$



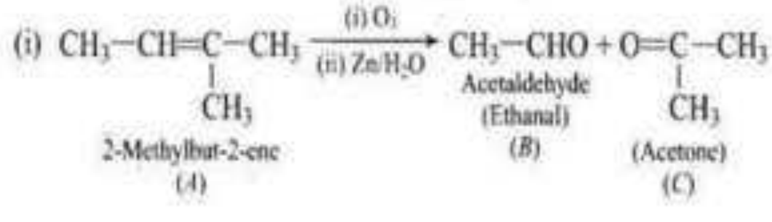
2. An alkene 'A' (Molecular formula C_5H_{10}) on ozonolysis gives a mixture of two compounds 'B' and 'C'. Compound 'B' gives positive Fehling's test and also forms iodoform on treatment with I2 and NaOH. Compound 'C' does not give Fehling's test but forms iodoform. Identify the compounds A, B and C. Write the reaction for ozonolysis and formation of iodoform from B and C.

Compound B gives positive Fehling's test. It shows that it is an aldehyde and gives iodoform test which shows it has -COCH₃ group. Compounds C is a ketone because it does not give Fehling's test but gives iodoform test which shows it also has -COCH₃ groups.

Hence compound A is



$$CH_3CH{=}\underset{CH_3}{\underset{|}{C}}-CH_3$$



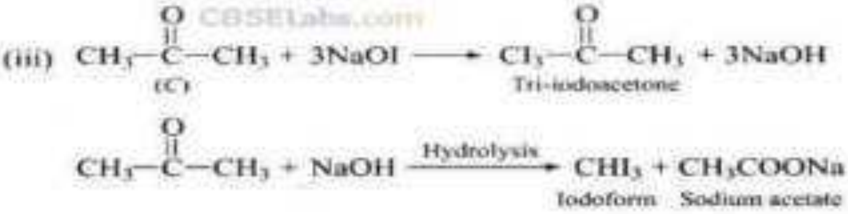
$$CH_3-CH{=}\underset{CH_3}{\underset{|}{C}}-CH_3 \xrightarrow[\text{(ii) } Zn/H_2O]{\text{(i) } O_3} CH_3-CHO + O{=}\underset{CH_3}{\underset{|}{C}}-CH_3$$

Other isomer of (A) will not give products corresponding to the given test.

$(2NaOH + I_2 \rightarrow NaOI + NaI + H_2O)$

(ii) $\underset{(B)}{CH_3CHO} + \underset{\text{Sodium hypoiodite}}{3NaOI} \longrightarrow \underset{\text{Tri-iodo acetaldehyde}}{CI_3CHO} + 3NaOH$

$\underset{\text{Iodal}}{CH_3CHO} + NaOH \xrightarrow{\text{Hydrolysis}} \underset{\text{Iodoform}}{CHI_3} + HCOONa$



(iii) $\underset{(C)}{CH_3-\overset{\overset{O}{\|}}{C}-CH_3} + 3NaOI \longrightarrow \underset{\text{Tri-iodoacetone}}{CI_3-\overset{\overset{O}{\|}}{C}-CH_3} + 3NaOH$

$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 + NaOH \xrightarrow{\text{Hydrolysis}} \underset{\text{Iodoform}}{CHI_3} + \underset{\text{Sodium acetate}}{CH_3COONa}$

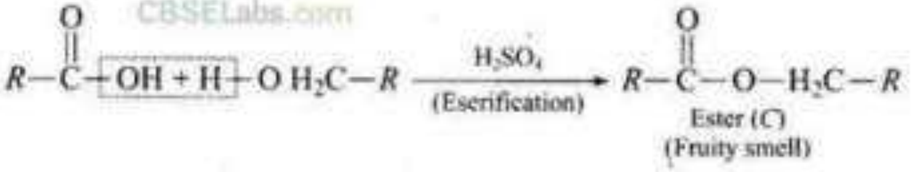
QUESTIONN 3

Compound 'A' was prepared by oxidation of compound 'B' with alkaline $KMnO_4$. Compound 'A' on reduction with lithium aluminium hydride gets converted back to compound 'B'. When compound 'A' is heated with compound 'B' in the presence of H_2SO_4 it produces fruity smell of compound 'C' to which family the compounds 'A', 'B' and 'C' belong to?

'A' is carboxylic acid (R – COOH), 'B' is an alcohol ($R - CH_2OH$) and 'C' is an ester ($RCH_2 - COOR$)

$$\underset{(B)}{R-CH_2OH} \xrightarrow{\text{Oxidation }(KMnO_4)} \underset{(A)}{R-COOH}$$

$$\text{Alcohol }(B) \xleftarrow{LiAlH_4\text{, reduction}} \text{Carboxylic acid }(A)$$



$$R-\overset{\overset{O}{\|}}{C}-\boxed{OH + H}-O\,H_2C-R \xrightarrow[\text{(Eserification)}]{H_2SO_4} \underset{\substack{\text{Ester }(C)\\\text{(Fruity smell)}}}{R-\overset{\overset{O}{\|}}{C}-O-H_2C-R}$$

QUESTION 4

$$CH_3-Br \xrightarrow{\text{Mg/ether}} (A) \xrightarrow[\text{(ii) Water}]{\text{(i) }CO_2} (B) \xrightarrow[\Delta]{CH_3OH/H^+} (C)$$

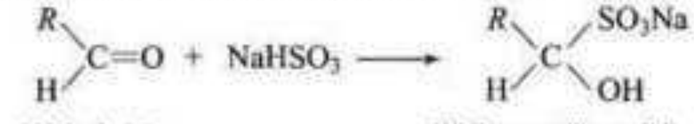
$$\underset{\text{Methyl bromide}}{CH_3-Br} \xrightarrow{\text{Mg/ether}} \underset{\text{Methyl magnesium bromide }(A)}{CH_3-MgBr} \xrightarrow[\text{(ii) }H_2O]{\text{(i) }CO_2} \underset{\text{Ethanoic acid }(B)}{CH_3-\overset{\overset{O}{\|}}{C}-OH}$$

$$\underset{\substack{\text{Methyl ethanoate}\\\text{(ester) }(C)}}{CH_3-\overset{\overset{O}{\|}}{C}-OCH_3} \xleftarrow[\text{(Esterification)}]{CH_3OH/H^+,\ \Delta}$$

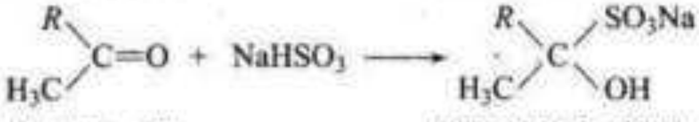
QUESTION 5

When liquid 'A' is treated with a freshly prepared ammoniacal silver nitrate solution, it gives bright silver mirror. The liquid forms a white crystalline solid on treatment with sodium hydrogen sulphite. Liquid 'B' also forms a white crystalline solid with sodium hydrogen sulphite but it does not give test with ammoniacal silver nitrate. Which of the two liquids is aldehyde? Write the chemical equations of these reactions also.

Chemical equations for these reactions are:



Aldehyde (*A*) (While crystalline solid)



Methyl ketone (*B*) (White $NaHSO_3$ adduct)

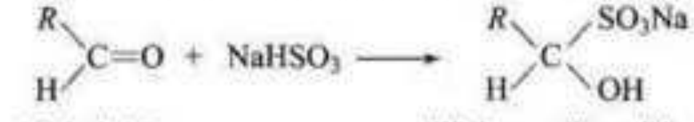
$$R{-}CHO + 2[Ag(NH_3)_2]^+ OH^- \xrightarrow{Warm} RCOONH_4 + 2Ag + 3NH_3 + H_2O$$

Aldehyde (*A*) Tollens reagent (Silver mirror)

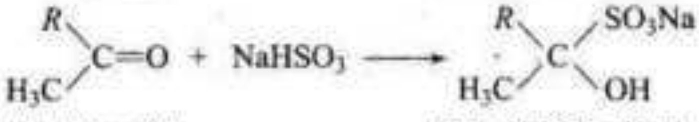
$$R{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}CH_3 \xrightarrow{\text{Tollens reagent}} \text{No silver mirror}$$

Methyl ketone (*B*)

Chemical equations for these reactions are:



Aldehyde (*A*) (While crystalline solid)

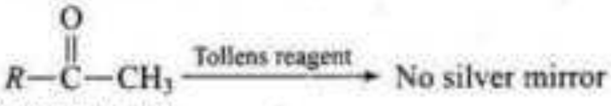


Methyl ketone (*B*) (White $NaHSO_3$ adduct)

CBSELabs.com

$$R{-}CHO + 2[Ag(NH_3)_2]^+ OH^- \xrightarrow{Warm} RCOONH_4 + 2Ag + 3NH_3 + H_2O$$

Aldehyde (*A*) Tollens reagent (Silver mirror)

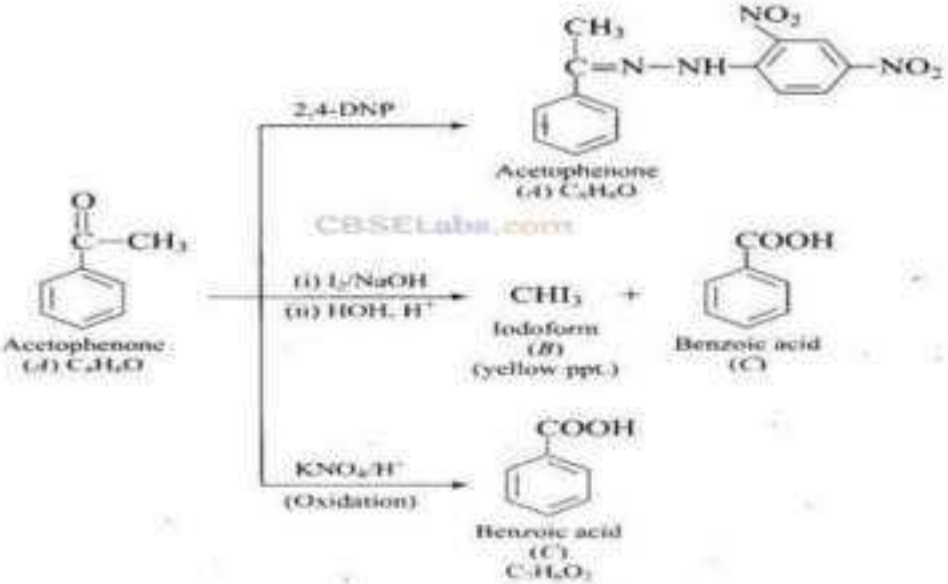


$$R{-}\overset{\overset{\displaystyle O}{\|}}{C}{-}CH_3 \xrightarrow{\text{Tollens reagent}} \text{No silver mirror}$$

Methyl ketone (*B*)

QUESTION 6

An aromatic compound 'A' (Molecular formula C8H8O) gives positive 2, 4-DNP test. It gives a yellow precipitate of compound 'B' on treatment with iodine and sodium hydroxide solution. Compound 'A' does not give Tollen's or Fehling's test. On drastic oxidation with potassium permanganate it forms a carboxylic acid 'C' (Molecular formula C7H6O2), which is also formed along with the yellow compound in the above reaction. Identify A, B and C and write all the reactions involved.



ANNEXURE-5

IMPORTANT CONVERSIONS IN ORGANIC CHEMISTRY

IMPORTANT CONVRSIONS:

Students memorize all organic reactions but unable to rearrange all these reactions and solve problems based on organic conversions. This is an effort to systematize and rearrange the organic reactions to solve problems based on organic conversions.

METHOD:- Organic conversions are classified as:-

A. *Aliphatic conversions.*

B. *Aromatic conversions*

(A) ALIPHATIC CONVERSIONS: Aliphatic conversions further classified as

Step-up conversions

(i) By Wurtz reaction:

$$RX \xrightarrow{Na} R - R$$

(ii) Through cyanide:

$$RX \xrightarrow{KCN} R - CN$$

(iii) Through Grignard reagent:

$$RX \xrightarrow{Mg} RMgX \xrightarrow{} -\underset{R}{\overset{|}{C}} - OH$$

(iv) Through Alkyne:

$$RX \xrightarrow{HC \equiv C - Na} H - C \equiv C - R$$

(b) Step-down conversions

(i) Through carboxylic acid:

$$RCOOH \xrightarrow{NaOH + CaO} RH$$

(ii) By Hofmann bromamide reaction:

$$RCONH_2 \xrightarrow{Br_2 + KOH} R - NH$$

KEY FOR CONVERSIONS

Sl No	Reagent	Group Out	Group In	Remark
1	$KMnO_4$ / H+	$-CH_2OH$	-COOH	Strong Oxidation (2^0 alc→ ketone)
2	$LiAlH_4$	-COOH	$-CH_2OH$	Strong Reduction (ketone → 2^0 alc)
3	Cu / 573 K or CrO_3	$-CH_2OH$	-CHO	Dehydrogenation
4	PCl_5 or $SOCl_2$	-OH	-Cl	
5	Cl_2 / Δ or Cl_2 / UV	-H	-Cl	Free radical substitution
6	Aq NaOH / KOH	-X	-OH	Nucleophilic substitution
7	KCN	-X	-CN	Step Up
8	AgCN	-X	-NC	
9	Alcoholic KOH	-HX	=	Dehydrohalogenation (Stzf)
10	Mg / dry ether		Mg	R-X → R-MgX
11	HBr	>=<	H, Br	Merkovnikov
12	H_2 / Pd-$BaSO_4$	-COCl	-CHO	Rosenmund Reduction
13	Zn-Hg / HCl	>C=O	$-CH_2-$	Clemmension Reduction
14	NH_3 / Δ	-COOH	$-CONH_2$	-COOH + NH_3 → -$COONH_4$
15	Br_2 / NaOH or NaOBr	$-CONH_2$	$-NH_2$	Step Down (Hoffmann)
16	HNO_2 or $NaNO_2$/HCl	$-NH_2$	-OH	HONO
17	$CHCl_3$ / alc KOH	$-NH_2$	-NC	Carbyl amine
18	P_2O_5	$-CONH_2$	-CN	Dehydration
19	H_3O^+	-CN	-COOH	Hydrolysis
20	OH^-	-CN	$-CONH_2$	
21	$LiAlH_4$	-CN	$-CH_2NH_2$	Reduction
22	Red P / Cl_2	α-H of acid	-Cl	HVZ Reaction
	In benzene ring			
23	Fe / X_2 /dark	-H	-X	Halogination
24	CH_3Cl / $AlCl_3$(anhyd)	-H	$-CH_3$	Friedel Craft alkylation
25	CH_3COCl / $AlCl_3$(anhyd)	-H	$-COCH_3$	Friedel Craft acylation
26	Conc.HNO_3/con.H_2SO_4	-H	$-NO_2$	Nitration
27	Conc H_2SO_4	-H	$-SO_3H$	Sulphonation
28	$KMnO_4$ / H+	-R	-COOH	Oxidation
29	CrO_2Cl_2 / H+	$-CH_3$	-CHO	Mild oxidation(Etard Reaction)
30	Sn / HCl or Fe/HCl	$-NO_2$	$-NH_2$	Reduction
31	NaOH / 623K / 300 atm	-Cl	-OH	

32	Zn dust / Δ	-OH	-H	
33	$NaNO_2$ / dil HCl / 273-278 K	$-NH_2$	$-N_2^+Cl^-$	Diazo reaction
34	CuCl / HCl or Cu/HCl	$-N_2^+Cl^-$	-Cl	Sandmeyer or Gattermann
35	CuBr / HBr or Cu/HBr	$-N_2^+Cl^-$	-Br	Sandmeyer or Gattermann
36	CuCN / KCN	$-N_2^+Cl^-$	-CN	Sandmeyer
37	KI	$-N_2^+Cl^-$	-I	
38	HBF_4 / Δ	$-N_2^+Cl^-$	-F	
39	H_3PO_2 or CH_3CH_2OH	$-N_2^+Cl^-$	-H	
40	H_2O / 283 K	$-N_2^+Cl^-$	-OH	
41	HBF_4/ $NaNO_2$, Cu / Δ	$-N_2^+Cl^-$	$-NO_2$	
42	C_6H_5-OH	$-N_2^+Cl^-$	$-N=N-C_6H_5-OH$	Coupling (p-hydroxy)
43	$C_6H_5-NH_2$	$-N_2^+Cl^-$	$-N=N-C_6H_5-NH_2$	Coupling (p-amino)

Reactions of Grignard Reagent

Grignard reagent +	Any one below + H_2O →	Product
R-MgX	H_2O or ROH or RNH_2	R-H
	H-CHO	$R-CH_2-OH$ (1^0 alc)
	R-CHO	R-CH(OH)-R (2^0 alc)
	R-CO-R	$R_2C(OH)-R$ (3^0 alc)
	CO_2	R-COOH
	R-CN	R-CO-R
	HCOOR	Aldehyde
	RCOOR	Ketone

NB: i) During reaction generally changes take place in the functional group only so see the functional group very carefully.

ii) Remember structural formula of all the common organic compounds (with their IUPAC and common names)

iii) Wurtz Reaction and Aldol Condensation are not included in the table although they are very important for conversions so study them .

iv) By taking examples practice all the above cases (from 1 to 43 and Grignard)

v) Practice only from NCERT book.

vi) Start practicing NOW !

How to use the table? See below.

Example : See no 7 in the table

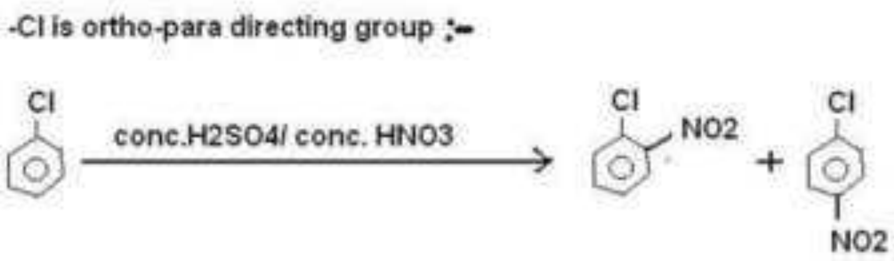
$$R\text{-}X \xrightarrow{KCN} R\text{-}CN$$

Directional Properties of groups in benzene ring for electrophilic substitution

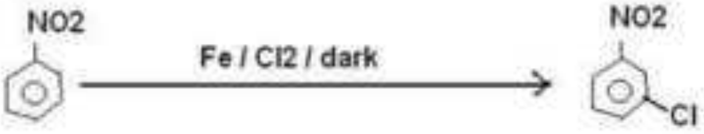
Ortho-para directing group: -R , -OH, $-NH_2$, -X, -OR, -NHR, $-NR_2$, $-NHCOCH_3$, $-CH_2Cl$, -SH, - Ph

Meta-directing group: $-NO_2$, -CHO , -COOH , COOR , -CN , $-SO_3H$, $-COCH_3$, $-CCl_3$, $-NH_3^+$,

-Cl is ortho-para directing group :-

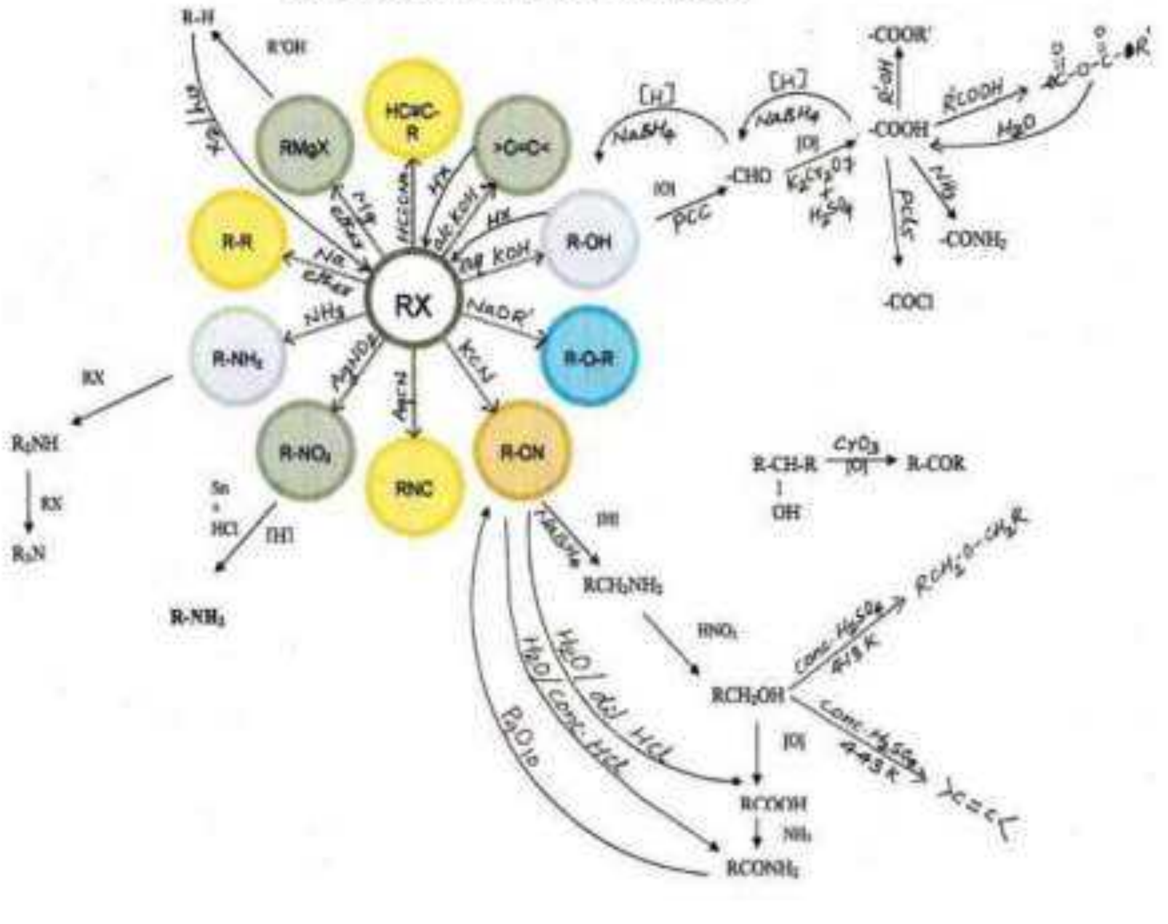


-NO2 is meta directing group :-



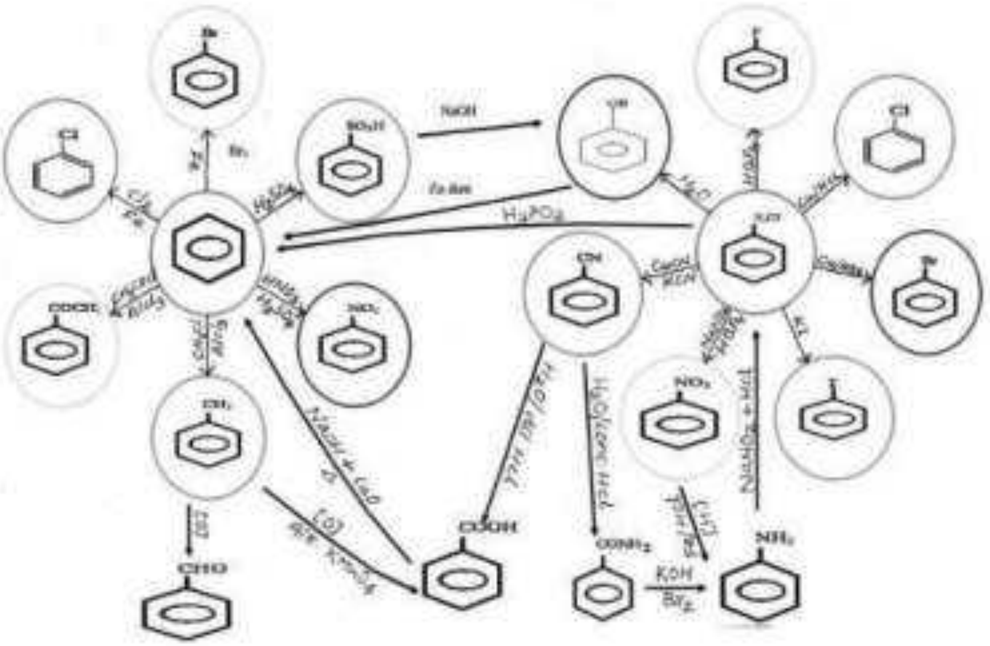
(C) Conversions of same no. of carbon atoms

ALIPHATIC CONVERSION CHART



(B) Aromatic Conversions

AROMATIC CONVERSION CHART



CONCLUSION:-

Now students are able to solve the problems based on organic conversions by using this method in shortest possible time. They can also solve the problems of what happens when? Complete the reactions etc, which cover the major aspect of organic chemistry. These conversion charts make organic chemistry interesting for the students. Teacher can also use it as a teaching aid.

--****************-------

ASSIGNMENT FOR CLASS -XII Sc (CHEMISTRY) ORGANIC CONVERSION---(2 to 3 marks)

CONVERT THE FOLLOWING:-

Q.I# Aniline to

(a) benzoic acid	(b) benzonitrile	(c) iodobenzene
(d)phenol	(e) acetanilide	(f) p-nitroaniline
(g) sulphanilic acid		

Q.II# Benzonitrile to

(a)actophenone (b) benzoic acid (c) benzamide (d) 1-phenyl methanamine

(e) aniline

Q.III# Phenol to

(a) salicylic acid (b) salicylaldehyde (c) toluene (d) acetophenone
(e) aspirin

Q.IV# Acetylene to
(a) Lactic acid (b) Acetaldehyde (c) Acetic acid

Q.V# Benzaldehyde to
(a) α-hydroxy phenyl acetic acid (b) Benzophenone (c) 3-phenylpropan-1-ol
(d) Benzyl alcohol

Q.VI# Hept-1-ene to (a) Heptanal (b) Hexanal (c) Hexanoic acid (d) Heptanoic acid.

Q.VII # Acetaldehyde to
(a) butan-2-one (b) but-1,3-diol (c) but-2-enal (d) butan-1-ol (e) butanoic acid (f) but-2-enoic acid (g) Lactic acid (h) nitropropene -1

Q.VIII # Benzene to
(a) m-nitrobenzoic acid (b) phenyl acetic acid (c) p-nitro benzaldehyde
(d) p-nitro benzoic acid (e) methyl benzoate (f) meta-nitroacetophenone

Q.IX #
(a) Benzoic acid from chlorobenzene (b) t-butyl alcohol from acetone (c) ethanol to propan-2-ol (d) Methyl cyanide to propanone-2 (e) Acetophenone to 2-phenyl-2-butanol (f) Methanal to propan-1-ol (g) bromobenzene to 1-phenyl ethanol (h) Propanal to Butanone

Q.X # (1) Ethyl amine from acetaldehyde (2) Ethanoyl chloride to methyl nitrile
(3) 2-nitropropane to acetone (4) Hexanamide to hexanitrile
(5) Propene to acetone and *vice versa* (6) Toluene to benzaldehyde
(7) Ethylbromide to ethylamine (8) Anisole to p-methoxy acetophenone
(9) Benzoyl chloride to benzonitrile (10) n-propyl alcohol to hexane.
(11) Hexanoic acid to hexanenitrile (12) p-nitrobenzoic acid to p-nitroaniline
(13) benzoic acid to benzyl amine (14) Benzyl alcohol to phenylethanoic acid
(15) m-nitroaniline from nitrobenzene (16) p-toludine to 2-bromo-4-methyl aniline
(17) Ethanol to 1,2-ethanediol (18) Acetic acid to acetaldehyde
(19) Acetic acid to ethylamine (20) acetic acid to acetone
(21) Benzyl alcohol to Benzoic acid (22) Propanoic acid to Propenoic acid
(23) Cyclohexene to Hexane-1,6-dioic acid (24) p-methyl acetophenone to benzene-1,4-dicarboxylic acid
(25) Propanoyl chloride to Dipropyl amine (26) Benzoic acid to Benzaldehyde
(27) Acetophenone to ethyl benzene

Q.XI# (a) Methyl amine to Ethyl amine and *vice versa* *(b) propanoic acid to ethyl ammine*
(c) ethyl bromide to propanamine (d) Acetyl chloride to methyl chloride.

IDENTIFY THE COMPOUNDS A,B,C etc.

1# An organic compound "A" which has characteristic odour, on treatment with NaOH forms two compounds "B" and "C" .Compound "B" has a molecular formula C_7H_8O which on oxidation gives back compound "A'.
Compound "C" is the sodium salt of an acid ."C" when heated with sodalime yields an aromatic hydrocarbon"D".Deduce the structure A,B,C,D .

2# An organic compound "A" has a molecular formula $C_5H_{10}O$.It does not reduce Fehling's Solution but forms a bisulphite compound .It also positive iodoform test.What is the possible structure of "A"? Explain your reasoning which helped to arrive at the structure.

3# A compound "A" has a molecular formula $C_5H_{10}O$ gave a positive 2,4-DNP testbut a negative Tollen's test.
It was oxidized to carboxylic acid "B" with molecular formula $C_3H_6O_2$ when treated with alkaline KMnO4 under vigorous condition .Sodium salt of 'B" gave a hydrocarbon "C" on Kolbe's electrolytic reduction Identify A,B and C and write chemical equations for the reaction.

4# An organic compound "A" has a molecular formula $C_3H_7O_2N$ on reaction with Fe and Conc.HCl give a compound "B" of molecular formula C_3H_9N . Compound "B" on treatment with $NaNO_2$ and HCl give another compound "C" of molecular formula C_3H_8O.The compound "C" gives effervescence with Na.On oxidation with CrO_3, the compound "C" gives a saturated aldehyde containing three carbon atoms .Deduce the structures of "A", "B" and "C" and write the chemical equations for the reactions involved.

IMPORTANT FORMULAE

SOLUTIONS

1. Mass percentage (w/w) $= \frac{W_B}{W_A + W_B} \times 100$

W_B = Mass of solute
W_A = Mass of solvent

2A Mole fraction of A, $x_A = \frac{n_A}{n_A + n_B}$

n_A = no. of moles of solute
n_B = no. of moles of solvent.

2B. Mole fraction of B, $x_B = \frac{n_B}{n_A + n_B}$

$$\boxed{x_A + x_B = 1}$$

3. Molarity (M) $= \frac{\text{Moles of solute}}{\text{Volume of solution in Litres}}$

$$= \frac{W_B}{M_B \times V\,(\text{in L})}$$

4. Molality (m) $= \frac{\text{Moles of solute}}{\text{Mass of solvent (in kg)}}$

$$m = \frac{W_B \times 1000}{M_B \times W_A\,(\text{in g})}$$

M_B = Molar mass of solute

$$\text{Normality (N)} = \frac{\text{Gram equivalents of solute}}{\text{Volume of solution in Litres}}$$

$$= \frac{W_B}{\text{GEM of solute} \times V(\text{in L})}$$

GEM = Gram equivalent mass

6. Raoult's law for volatile solute

$$P_A = P_A^o x_A \quad \text{and} \quad P_B = P_B^o x_B^{+}$$

P_A and P_B are the partial vapour pressure of Component A and B

P_A^o and P_B^o are vapour pressure of pure component of A and B.

$$\text{Total vapour pressure } P = P_A + P_B$$

$$= P_A^o x_A + P_B^o x_B$$

7. Elevation in Boiling point:

$$M_B = \frac{K_b \times W_B \times 1000}{\Delta T_b \times W_A}$$

K_b = Molal elevation Constant

ΔT_b = Elevation of boiling Point

Depression in freezing point.

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

K_f = Molal depression constant.

ΔT_f = Depression in freezing point

9. Osmotic pressure (π)

$\pi = CRT$ — C = Molarity

$\pi = \frac{n_2}{V} RT$ — R = gas constant

$M_2 = \frac{W_2 RT}{\pi V}$ — W_2 = grams of solute

T = Temperature

10. Van't Hoff factor

$$i = \frac{\text{Total no. of moles of particles after association/Dissociation}}{\text{Number of moles of particle before association/Dissociation}}$$

WORK SHEET NUMERICALS

CHAPTER :- Solution

Q- Calculate the mass percentage of benzene (C_6H_6) and carbon tetrachloride (CCl_4) if 22 g of benzene is dissolved in 122 g of carbon tetrachloride.

Solution :- Mass of solution = Mass of C_6H_6 + Mass of CCl_4

= 22 g + 122 g = 144 g

Mass % of benzene = $\frac{\text{Mass of benzene}}{\text{Total mass}} \times 100$

$= \frac{22}{144} \times 100 = 15.28\%$

Mass % of CCl_4 = $\frac{\text{Mass of } CCl_4}{\text{Total mass}} \times 100$

$= \frac{122}{144} \times 100 = 84.72\%$

Q- Calculate the mass percentage of benzene (C_6H_6) and carbontetrachloride (CCl_4) if 42 g of benzene is dissolved in 132 g of carbon tetrachloride.

Solution :-

Q- Calculate the mole fraction of benzene in solution containing 30% by mass in carbon-tetrachloride?

Solution -

30% by mass of C_6H_6 in CCl_4 => 30 g C_6H_6 in 100 g of solution

∴ no. of moles of C_6H_6 ($n_{C_6H_6}$) $= \frac{30}{78} = 0.385$

molar mass of C_6H_6 = 78 g

no. of moles of CCl_4 (n_{CCl_4}) $= \frac{70}{154} = 0.455$

$$x_{C_6H_6} = \frac{n_{C_6H_6}}{n_{C_6H_6} + n_{CCl_4}} = \frac{0.385}{0.385 + 0.455}$$

$$= \frac{0.385}{0.84} = 0.458$$

$$x_{CCl_4} = 1 - 0.458 = 0.542$$

Q- Calculate the mole fraction of benzene in solution containing 50% by mass in carbontetrachloride?

Q- Calculate the molarity of each of the following solutions —

(a) 30 g of $Co(NO_3)_2 \cdot 26H_2O$ in 4.3 L of solution

Molarity

Q- calculate the amount of benzoic acid (C_6H_5COOH) required for preparing 250 ml of 0.15 M solution in methanol?

Solution-

0.15 M solution means 0.15 mole of benzoic acid are present in 1L or 1000 mL of solution.

Molar mass of benzoic acid (C_6H_5COOH)

$= (6 \times 12) + (5 \times 1) + (1 \times 12) + (2 \times 16) + 1$

$= 122\ g\ mol^{-1}$

$\because$ 1 mole of benzoic acid = 122 g

$\therefore$ 0.15 mole of benzoic acid = 0.15×122 = 18.3 g

$\because$ 0.15 mole are present in 1000 mL of sol^n

so, 1000 mL of solution contains benzoic acid = 18.3 g.

$\therefore$ 250 ml of solution contains benzoic acid

$$= \frac{18.3 \times 250}{1000} = 4.575\ g$$

Q- calculate the amount of benzoic acid (C_6H_5COOH) required for preparing 250 ml of 0.25 M solution in methanol?

Solution :-

Q- calculate the mass of urea (NH_2CONH_2) required in making 2.5 kg of 0.25 molal aqueous solution.

Solution - Since, the molal aqueous solution of urea is 0.25 m.

$\therefore$ Moles of urea = 0.25 mol.

Mass of solvent (water) = 1 kg = 1000 g

Mass (molar mass) of urea (NH_2CONH_2)

$= 14 + 2 + 12 + 16 + 14 + 2 = \boxed{60\ g\ mol^{-1}}$

$\therefore$ 0.25 mole of urea = $\boxed{0.25\ mol \times 60\ g\ mol^{-1}}$

$= 15\ g$

Total mass of solution = 1000 g + 15 g

= 1015 g

= 1.015 kg

Thus, 1.015 kg of solution contains urea = 15 g

$\therefore$ 2.5 kg of solution will require

$$\text{urea} = \frac{15\ g}{1.015\ kg} \times 2.5\ kg = 37\ g$$

Q- calculate the mass of urea (NH_2CONH_2) required in making 3.5 kg of 0.45 molal aqueous solution.

Solution :-

Q- H_2S, a toxic gas with rotten egg like smell, is used for quantitative analysis. If the solubility of H_2S in water at STP is 0.195 m, calculate Henry's law constant?

Solution :- solubility of H_2S gas = 0.195 m
i.e., 0.195 moles
in 1 kg of the solvent (water)

∵ Number of moles of H_2O in 1kg of the solvent (water) $= \frac{1000\ g}{18\ g\ mol^{-1}} = 55.55$ mol

∴ Mole fraction of H_2S gas in the solution

$$x = \frac{0.195}{0.195 + 55.55} = \frac{0.195}{55.745} = 0.0035$$

Pressure at STP = 0.987 bar

According to Henry's law,

$$P_{H_2S} = K_H \times x_{H_2S}$$

or $K_H = \frac{P_{H_2S}}{x_{H_2S}} = \frac{0.987\ bar}{0.0035} = 282$ bar

Q- H_2S, a toxic gas with rotten egg like smell, is used for quantitative analysis. If the solubility of H_2S in water at STP is 0.185 m, calculate Henry's law constant?

Solution -

Q- Henry's law constant for the molality of methane in benzene at 298 K is 4.27 ×105 mm of Hg calculate the solubility of methane in benzene at 298 K under 760 mm of Hg.

Solution:-

According to Henry's Law, $p = K_H \cdot x$

So, $x = \frac{p}{K_H} = \frac{760}{4.27 \times 10^5} = 1.78 \times 10^{-3}$

or the mole fraction of methane in benzene is 1.78×10^{-3}.

Q- Henry's law constant for the molality of methane in benzene at 298 K is 5.13×10^5 mm of Hg. calculate the solubility of methane in benzene at 298 K under 760 mm of Hg.

Solution :-

Q- Vapour pressure of pure A is 70 mm of Hg at 25°C. It forms an ideal solution with 'B' in which mole fraction of A is 0.8. If the vapour pressure of the solution is 84 mm of Hg at 25°C, the vapour pressure of pure B at 25°C is?

Solution- Given, $P_A^0 = 70$ mm of Hg

$x_A = 0.8$

$x_B = (1-0.8) = 0.2$

$P = 84$ mm Hg

Acc. to Raoult's law,

$P = P_A^0 x_A + P_B^0 x_B$

$84 = (0.8 \times 70) + (0.2 \times P_B^0)$

$84 = 56 + 0.2 P_B^0$

$84 - 56 = 0.2 P_B^0$

$28 = 0.2 P_B^0$

$140 = \frac{28}{0.2} = P_B^0$

$\therefore P_B^0 = 140$ mm Hg

Q- At some temperature, the vapour pressure of pure C_6H_6 is 0.256 bar and that of pure $C_6H_5CH_3$ (toluene) is 0.0925 bar. If the mole fraction of toluene in solution is 0.6, then-

(i) what will be the total pressure of the solution?

(ii) what will be the mole fraction of each component in vapour phase?

Solution:-

(i) According to Raoult's law,

For toluene, $P_1 = P_1^0 x_1$

$\therefore P_1^0 = 0.0925$ bar & $x_1 = 0.6$

Then $P_1 = 0.0925 \times 0.6 = 0.0555$ bar

For benzene, $P_2 = P_2^0 \times x_2$

Mole fraction of benzene,

$x_2 = 1 - x_1 = 1 - 0.6 = 0.4$

& $P_2^0 = 0.256$ bar

Then $P_2 = 0.256 \times 0.4 = 0.1024$ bar

Total vapour pressure of soln $P_{Total} = P_1 + P_2$

$P_{Total} = 0.0555 + 0.1024 = 0.158$ bar.

(ii) Mole fraction of toluene in vapour phase $y_1 = \frac{P_1}{P_{Total}} = \frac{0.0555}{0.158} = 0.351$

& Mole fraction of Benzene $y_2 = \frac{P_2}{P_{Total}} = \frac{0.1024}{0.158} = 0.648$

Q- Vapour pressure of pure A is 80 mm of Hg at 25°C. It forms an ideal solution with 'B' in which mole fraction of A is 0.7. If the vapour pressure of the solution is 74 mm of Hg at 25°C, the vapour pressure of pure B at 25°C is-?

solution-

Q - At some temperature, the vapour pressure of pure C_6H_6 is 0.365 bar and that of pure $C_6H_5CH_3$ (toluene) is 0.0750 bar. If the mole fraction of toluene in solution is 0.6, then-

(i) what will be the total pressure of the solution?

(ii) what will be the mole fraction of each component in vapour phase?

solution-

7/8/23 **Group-2**

Q1. Calculate the mass of a non-volatile solute [molar mass 40g/mol] which should be dissolved in 114g of octane to reduce its vapour pressure to 70%.

solu Given:- molar mass of solute = 40g. P=70 $P_1^\circ = 0.70P_1^\circ$

w_1 (weight of solvent) = 114g

To find:- wt of solute (g).

no. of moles of solute $n_2 = \frac{W_2}{40}$

no. of moles of solvent

$n_1 = \frac{114}{114} = 1$ [molar mass of octane = 114g]

Now,

$$\frac{P_1^\circ - P}{P_1^\circ} = x_2 = \frac{n_2}{n_1+n_2}$$

$$\frac{P_1^\circ - 0.70P_1^\circ}{P_1^\circ} = \frac{(W_2/40)}{(W_2/40 + 1)}$$

$$\frac{0.3P_1^\circ}{P_1^\circ} = \frac{W_2/40}{(W_2/40 + \frac{40}{40})}$$

$$0.3\left(\frac{W_2+40}{40}\right) = \frac{W_2}{40}$$

$$0.3W_2 + 12 = \frac{W_2 \times 40}{40}$$

$$12 = W_2 - 0.3W_2$$

$$12/.7 = W_2$$

$$\boxed{W_2 = 17.14\,g}$$

Colligative Properties

Q2. Calculate the mass of a non-volatile solute [molar mass 40g/mol] which should be dissolved in 114g of octane to reduce its vapour pressure to 50%?

Q3. Boiling point of water at 750° mm Hg is 96.63°c. How much sucrose is to be added to 400g of water such that it boils at 100°c? $k_b = 0.52\ \text{Km}^{-1}$

<u>solu</u> Given $\Delta T_b = 100 - 96.63$
$= 3.37°c.$

Mass of water $= 400g = \omega_1$

Molar mass M_1 of water
$= 18 g/mol.$

Molar mass M_2 of sucrose
$= 342 g/mol.$

<u>To find</u> :- $\omega_2 = ?$

Now $\underline{\Delta T_b = k_b \times m}$

$$\Delta T_b = k_b \times \frac{\omega_2}{M_2} \times \frac{1000}{\omega_1}$$

$$\omega_2 = \frac{M_2 \times \omega_1 \times \Delta T_b}{k_b \times 1000}$$

$$= \frac{342 \times 400 \times 3.37}{1000 \times 0.52}$$

$$\omega_2 = \frac{461,016}{520} = \underline{886.56} g$$

$$\omega_2 = \underline{\underline{0.886}}56 kg.$$

Q4. Boiling point of water at 750° mm Hg is 99.63°C. How much sucrose is to be added to 500g of water such that it boils at 100°C.
$[k_b = 0.52\ \text{Km}^{-1}.]$

Q5. Calculate the mass of Ascorbic acid (Vit C $C_6H_8O_6$) to be dissolved in 75g of acetic acid to lower its melting point by 1.5°c. ③

[k_f for CH_3COOH = 3.9 k kg/mol]

Soln Given:-

Mass of acetic acid $w_A = 75g$.

$= 0.075 kg$.

Molar mass of Ascorbic acid

$M_B = 176 g/mol$

Depression in melting point

$$\Delta T_f = k_f \times m$$

$$= \frac{k_f \times w_B \times 1000}{M_B \times w_A}$$

$$w_B = \frac{\Delta T_f \times M_B \times w_A}{k_f \times 1000}$$

$$= \frac{1.5 \times 176 \times 75}{3.9 \times 1000}$$

$$w_B = \underline{5.08g}$$

Q6. Calculate the mass of Ascorbic acid [$C_6H_8O_6$] to be dissolved in 70g of acetic acid to lower its melting point by 2°c.

k_f for CH_3COOH = 3.9 k kg/mol

Q7 Calculate the osmotic pressure of a solution in pascal exerted by a solution prepared by dissolving 1.0g of polymer of molar mass 1,85000 g/mol in 450ml of water at 37°C.

Solu Given :- R = 0.082 L atm/k/mol

Mass of polymer $w_B = 1.0g$.

Molar mass (M_B) of polymer $= 1,85000 g/mol$

$T = 37 + 273.15 = \underline{310.15} k$

Osmotic pressure $\pi = ?$

$$\pi = \frac{w_B \times R \times T}{M_B \times V}$$

$$\pi = \frac{1 \times 0.082 \times 310.15}{185000 \times 450 \times 10^{-3} L}$$

$= 3.05 \times 10^{-4}$ atm

$= 3.05 \times 10^{-4} \times 1.01 \times 10^{5} Pa$

$=$ $\underline{30.8 \text{ Pascal}}$

Q8 Calculate the osmotic pressure of a solution in pascal exerted by a solution prepared by dissolving 1.2g of polymer of molar mass 1,85000g/mol in 500ml of water at 37°C.

Q9. Determine the osmotic pressure of a solution prepared by dissolving 25 mg of K_2SO_4 in 2 Litres of water at 25°C, assuming that it is completely dissociated.

solu

Given:- K_2SO_4 is completely dissociated as -

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$

$i = 3.$

Volume of solution = 2L

Mass of K_2SO_4 (W_B) = 25 mg

$= 25 \times 10^{-3}\,g = \underline{\underline{0.025\,g}}$

Molar mass of K_2SO_4 M_B

$= 174\,g/mol.$

$\pi = i \times C \times R \times T$

$= i \times \frac{W_B \times R \times T}{M_B \times V(L)}$

$= \frac{3 \times 0.025 \times 0.0821 \times 298.15}{174 \times 2}$

$= \underline{\underline{5.27}} \times 10^{-3}\,atm$

Q10 Determine the osmotic pressure of a solution prepared by dissolving 20 mg of K_2SO_4 in 2.5 Litres of water at 25°C, assuming that it is completely dissociated.

Q- 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. calculate the van't Hoff factor and predict the nature of solute (associated or dissociated)

Given :- Molar mass of benzoic acid $= 122\ g\ mol^{-1}$, K_f for benzene $= \boxed{4.9\ K\ kg\ Mol^{-1}}$

<u>solution</u> - The given quantities are-

$w_2 = 3.9\ g$, $w_1 = 49\ g$

$\Delta T_f = 1.62\ K$, $K_f = 4.9\ K\ kg\ mol^{-1}$

Apply van't Hoff equation,

$\Delta T_f = i\ k_f\ m$ where i = no. of ions

$$\Delta T_f = i \cdot K_f \times \frac{w_2}{w_1} \times \frac{1000}{M_2}$$

$$1.62\ K = i \cdot 4.9 \times \frac{3.9}{49} \times \frac{1000}{122}$$

$$\therefore i = \frac{1.62 \times 49 \times 122}{4.9 \times 3.9 \times 1000} = 0.51$$

As the value of $i < 1$ thus benzoic acid is an associated solute.

Q- 3.6 g of benzoic acid dissolved in 63 g of benzene shows a depression in freezing point of 2.34 K. calculate the van't Hoff factor and predict the nature of solute (association or dissociated)

<u>solution</u> :-

Q- Calculate the boiling point of solution when 4g of $MgSO_4$ ($M = 120\ g\ mol^{-1}$) was dissolved in 100g of water assuming $MgSO_4$ undergoes complete ionisation. (K_b for water $= 0.52\ K\ kg\ mol^{-1}$)

<u>solution</u> - Given,

weight of solute, $w_2 = 4g$

weight of solvent, $w_1 = 100g$

$i = 2$ (as $MgSO_4$ dissociates completely into 2 ions)

$$MgSO_4 \rightleftharpoons Mg^{2+} + SO_4^{2-}$$

$K_b = 0.52\ K\ kg\ mol^{-1}$, $M_2 = 120\ g\ mol^{-1}$

$\therefore$ Elevation in boiling point of soln

$$\Delta T_b = i \times K_b \times \frac{w_2}{w_1} \times \frac{1000}{M_2}$$

ΔT_b^0 = boiling point of pure solvent

$$\Delta T_b^0 = 2 \times 0.52 \times \frac{4}{100} \times \frac{1000}{120}$$

$= 0.346\ K$

At boiling point of pure water is 100°C or 373 K

$T_b = \Delta T_b + T_b^0$

$\therefore T_b = 373 + 0.346 = 373.346\ K$

Q- Calculate the boiling point of solution when 5 g of ~~At~~ $BaCl_2$ ($M = 208.233\ g\ mol^{-1}$) was dissolved in 100 g of water assuming $BaCl_2$ undergoes complete ionisation (K_b for water $= 0.52\ K\ kg\ mol^{-1}$)

<u>solution</u> -

Q- calculate the van't Hoff factor for NH₄OH if degree of dissociation is 10% ?

solution- $\alpha = \frac{i-1}{n-1}$

where,

α = degree of dissociation = 10%

or $\frac{10}{100} = 0.1$

$n = 2$ (as $NH_4OH \longrightarrow NH_4^+ + OH^-$ 2 ions are formed)

$\therefore \alpha = \frac{i-1}{2-1}$

$0.1 = \frac{i-1}{2-1} = \frac{i-1}{1}$

$0.1 = i-1$

$i = 0.1 + 1 = \underline{1.1}$

Q- calculate the van't Hoff factor of CH_3COOH if degree of association is 10%.

Solution

$\alpha = 10\% = \frac{10}{100}$ or 0.1

$i = 2$

$CH_3COOH \rightarrow CH_3COO^- + H^+$

$\alpha = \frac{i-1}{\frac{1}{n}-1}$

$0.1 = \frac{i-1}{\frac{1}{2}-1}$

$0.1 = \frac{i-1}{-\frac{1}{2}}$

$0.1 \times (-\frac{1}{2}) = i-1$

$i = 0.1 \times (-\frac{1}{2}) + 1$

or $i = 0.1 \times (-0.5) + 1$

$i = 1 - 0.05$

$i = 0.9500$

or $i = 95\%$

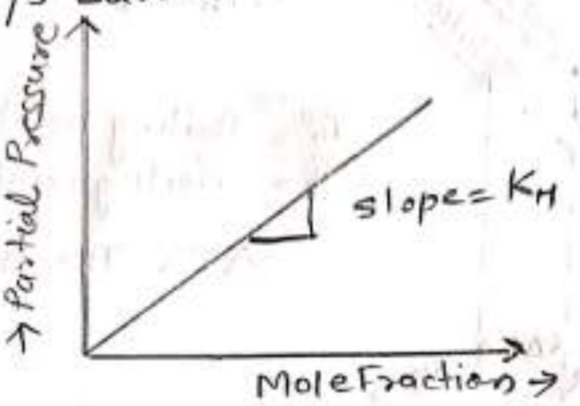
Q- Calculate the van't Hoff factor for NH₄OH if degree of dissociation is 25% ?

Q- calculate the van't Hoff factor of CH_3COOH if degree of association is 20%.

solution-

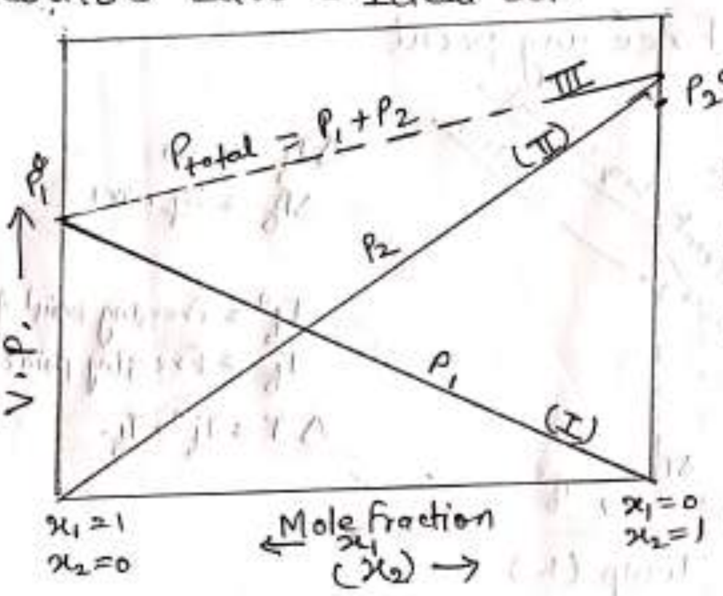
GRAPHS — SOLUTIONS

① Henry's Law.



$P = K_H \cdot x$

② Raoult's Law - Ideal Sol^n



$P \propto x$

Ex → n hexane + n heptane

Line I - Partial Press of componet I

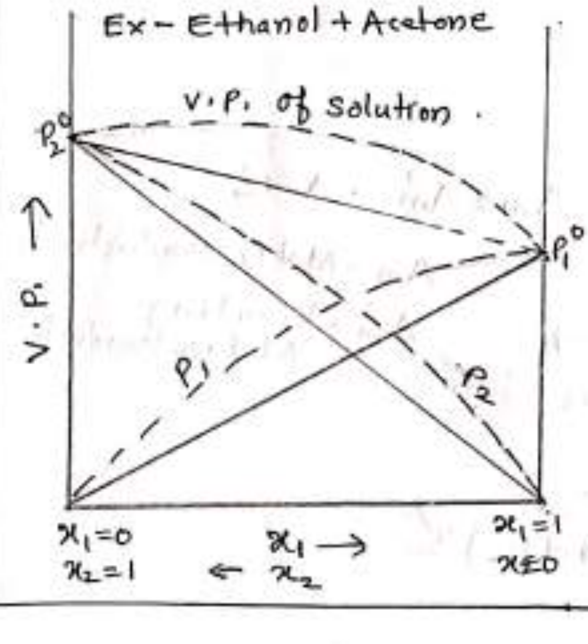
Line II - Partial Press of Componet II

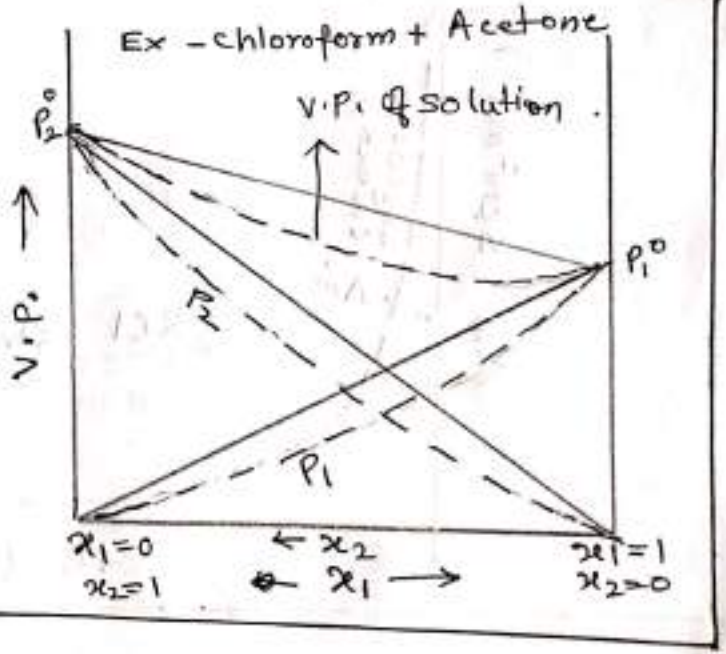
Line III - Total V.P. of solution.

P_1° → V.P. of Pure Comp (I)

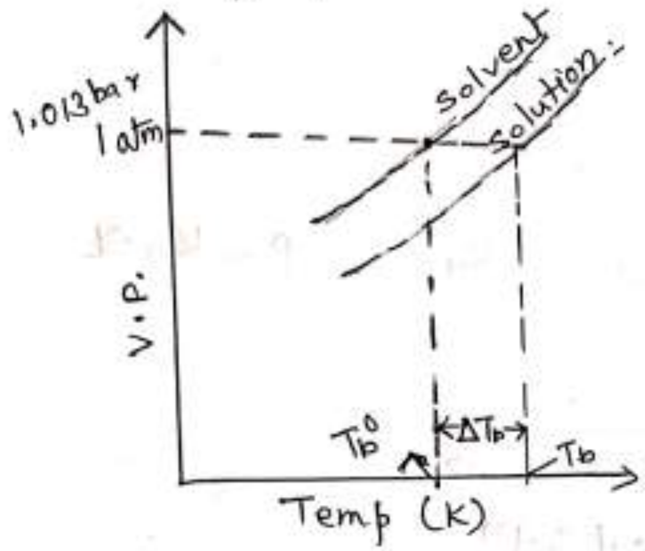
P_2° → V.P. of Pure Component II

③ Roults Law for Solution showing
(a) Positive Deviation (b) Negative Deviation.





④ Elevation of b.p



$\Delta T_b \propto m$

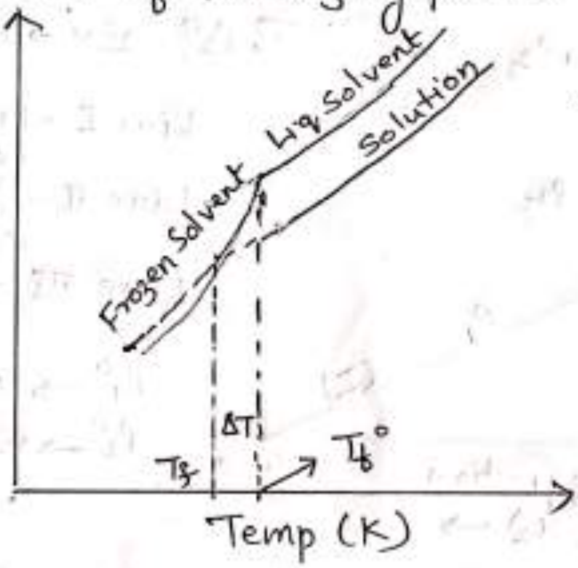
$\Delta T_b = K_b \cdot m$

T_b^0 = Boiling point of solvent

T_b = Boiling point of solution

$\Delta T = T_b - T_b^0$

⑤ Depression of freezing point



$\Delta T_f \propto m$

$\Delta T_f = K_f \cdot m$

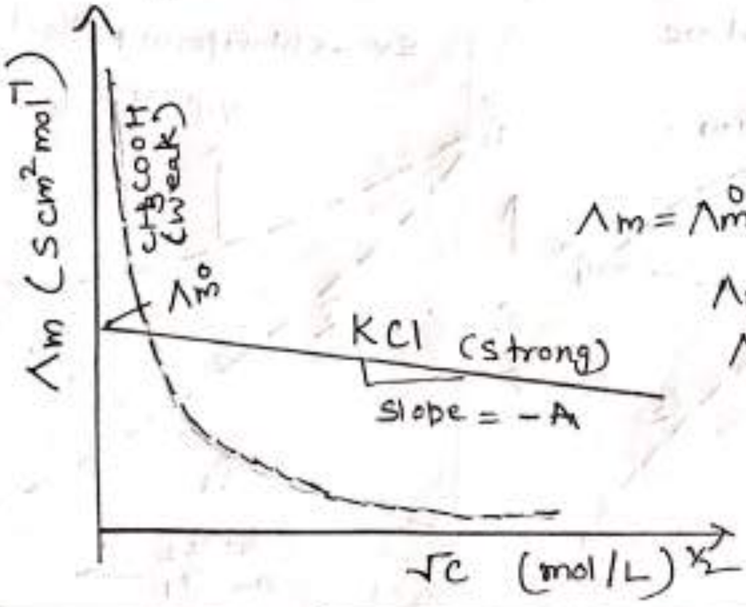
T_f^0 = freezing point of solvent

T_f = Freezing point of solution.

$\Delta T = T_f^0 - T_f$

⑥ ELECTROCHEMISTRY

Variation of Λ_m with $\sqrt{c}$

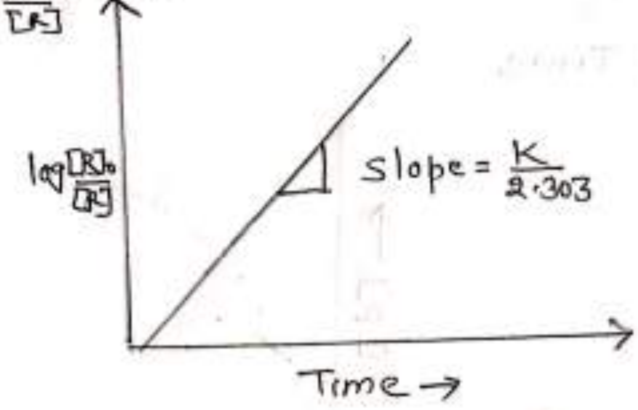


$\Lambda_m = \Lambda_m^0 - A\sqrt{c}$

Λ_m - Molar conductivity

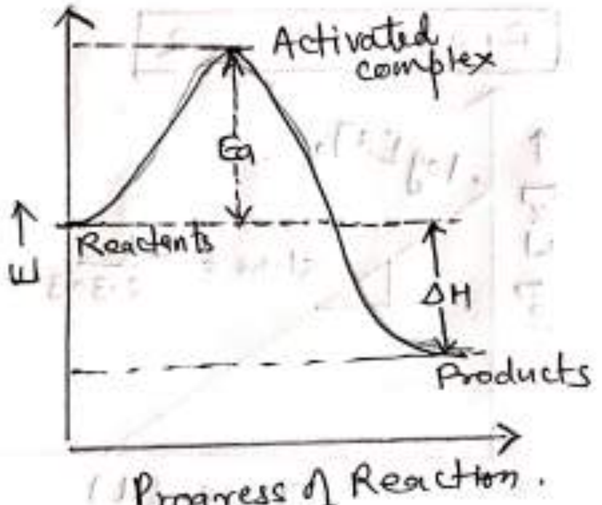
Λ_m^0 - Limiting Molar conductivity

⑨ $\log\frac{[R]_0}{[R]}$ vs t



$$\log\frac{[R]_0}{[R]} = \frac{kt}{2.303}$$

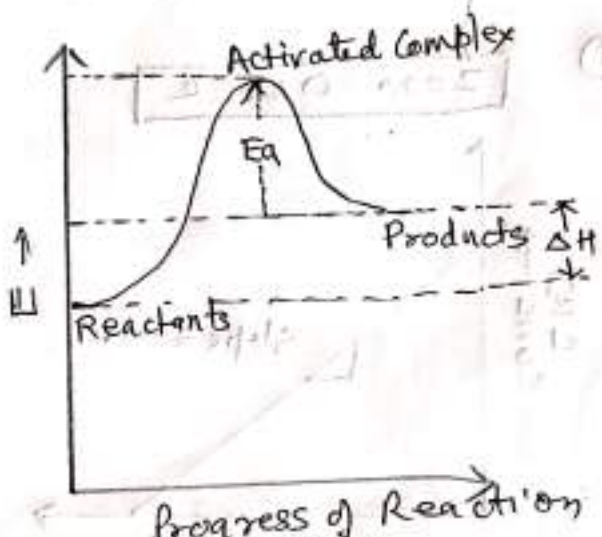
⑩ Exothermic Reaction



$\Delta H = -ve$

$\Delta H = E_P - E_R$

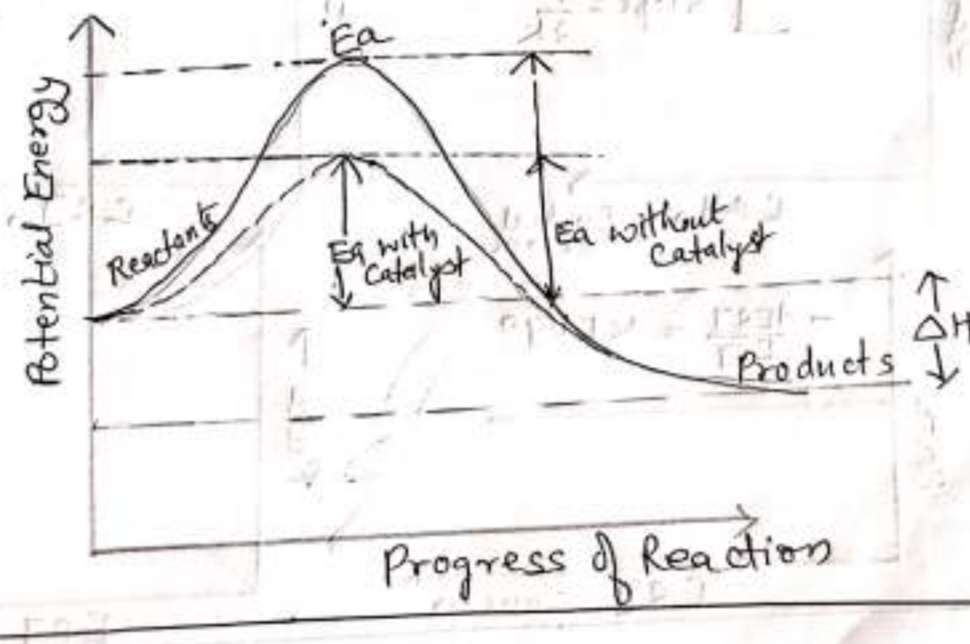
Endothermic Reaction.



$\Delta H = +ve$

$E_a = E_T - E_R$

⑪ Catalysed & Uncatalysed Reaction.



ELECTROCHEMISTRY

1. $R = \rho\left(\frac{l}{A}\right) = \rho \times \text{cell constant}$

R = Resistance
A = Area of cross-section of electrodes
ρ = Resistivity

2. $K = \frac{1}{R} \times \text{cell constant}$

K = Conductivity of Specific conductance

3. $\Lambda_m = \frac{K \times 1000}{M}$

Λ_m = Molar conductivity
M = Molarity of the solution.

4. Degree of dissociation. $\alpha = \frac{\Lambda_m^c}{\Lambda_m^0}$

Λ_m^c = Molar conductivity at a given concentration.

5. For a weak binary electrolyte AB.

$$K = \frac{C\alpha^2}{1-\alpha} = \frac{C(\Lambda_m^c)^2}{\Lambda_m^0(\Lambda_m^0 - \Lambda_m^c)}$$

K = Dissociation Constant

$$E^0_{cell} = E^0_{cathode} - E^0_{anode}$$
$$= E^0_{right} - E^0_{left}$$

6. $\log K_c = \frac{n}{0.0591} E^0_{cell}$

K_c = Equilibrium constant.

7. $\Delta G^0 = -nFE^0_{cell}$

$\Delta_r G^0 = -2.303\,RT \log K_c$

$\Delta_r G^0$ = Standard Gibbs energy of Reaction.

8. Nernst equation for a general electrochemical reaction

$$aA + bB \xrightarrow{ne^-} cC + dD$$

$$E_{cell} = E^0_{cell} - \frac{RT}{nF} \ln \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

ELECTROCHEMISTRY

1. The conductivity of 0.2 M solution of KCl at 298 K is 0.025 S cm⁻¹. Calculate its molar conductivity.

Sol^n: Given:

Conductivity, $\kappa = 0.025\ S\,cm^{-1}$

Molarity, $M = 0.2\ mol\ L^{-1}$

Molar conductivity, $\Lambda = ?$

$$\Lambda = \frac{\kappa \times 1000}{M} = \frac{0.025 \times 1000}{0.2}$$

$$\therefore \boxed{\Lambda = 125\ S\,cm^2\,mol^{-1}}$$

2. The conductivity of 0.4 M solution of KCl at 25°C is 0.05 S cm⁻¹. Calculate the molar conductivity.

Sol^n:

3. The conductivity of 0.00241 M acetic acid is 7.896×10^{-5} S cm⁻¹. Calculate its molar conductivity. What is its dissociation constant, if the limiting molar conductivity of acetic acid is 390.5 S cm² mol⁻¹?

Sol^n: $\Lambda = \dfrac{\kappa \times 1000}{M} = \dfrac{7.896 \times 10^{-5} \times 10^{3}}{0.00241}$

$$\therefore \boxed{\Lambda = 32.76\ S\,cm^2\,mol^{-1}}$$

$$\alpha = \frac{\Lambda}{\Lambda^\circ} = \frac{32.76}{390.5} = 8.4 \times 10^{-2}$$

Now, $K_a = \dfrac{C\alpha^2}{1-\alpha} = \dfrac{0.00241 \times (8.4 \times 10^{-2})^2}{1 - 0.084}$

$$\therefore \boxed{K_a = 1.86 \times 10^{-5}}$$

4. The conductivity of 0.004 M acetic acid is 15.8×10^{-5} S cm⁻¹. Calculate the molar conductivity. If the limiting molar conductivity of acetic acid is 390.5 S cm² mol⁻¹, find its degree of dissociation (α) and dissociation constant (K_a).

Sol^n:

5. Calculate the standard cell potentials of the galvanic cells in which the following reactions take place.

(a) $2Cr_{(s)} + 3Cd^{2+}_{(aq)} \longrightarrow 2Cr^{3+}_{(aq)} + 3Cd_{(s)}$

$E^\circ_{Cr} = -0.74\,V$; $E^\circ_{Cd} = -0.4\,V$

(b) $Fe^{2+}_{(aq)} + Ag^{+}_{(aq)} \longrightarrow Fe^{3+}_{(aq)} + Ag_{(s)}$

$E^\circ_{Ag} = 0.8\,V$; $E^\circ_{Fe} = 0.77\,V$

Solⁿ: (A) $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= -0.4 - (-0.74)$

$\therefore \boxed{E^\circ_{cell} = 0.34\,V}$

$\Delta G^\circ = -nFE^\circ_{cell}$

$= -6 \times 96500 \times 0.34$

$\therefore \boxed{\Delta G^\circ = -19686\,J \quad \underline{OR} \quad \Delta G^\circ = -196.86\,\underline{kJ}}$

$\Delta G^\circ = -2.303\,RT \log K_c$

$\therefore \log K_c = \frac{-\Delta G^\circ}{2.303\,RT} = -\frac{-19686}{2.303 \times 8.314 \times 298}$

$= 34.501$

$\therefore K_c = \text{Antilog}\,(34.501)$

$\therefore \boxed{K_c = 3.17 \times 10^{34}}$

(B) $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.8 - 0.77$

$\therefore \boxed{E^\circ_{cell} = 0.03\,V}$

$\Delta G^\circ = -nFE^\circ_{cell} = -1 \times 96500 \times 0.03$

$\therefore \boxed{\Delta G^\circ = -2895\,J \quad \underline{OR} \quad \Delta G^\circ = -289.5\,kJ}$

$\Delta G^\circ = -2.303\,RT \log K_c$

$\therefore \log K_c = \frac{-\Delta G^\circ}{2.303\,RT} = -\frac{-2895}{2.303 \times 8.314 \times 298}$

$= 0.5073$

$\therefore K_c = \text{Antilog}\,(0.5073)$

$\therefore \boxed{K_c = 3.2 \text{ (approx)}}$

6. Calculate the E°_{cell} of the galvanic cells in which the following reactions take place.

(a) $Mg_{(s)} + Zn^{2+}_{(aq)} \longrightarrow Mg^{2+}_{(aq)} + Zn_{(s)}$

$E^\circ_{Mg} = -2.36\,V$; $E^\circ_{Zn} = -0.76\,V$

(b) $2Al_{(s)} + 3Pb^{2+}_{(aq)} \longrightarrow 2Al^{3+}_{(aq)} + 3Pb_{(s)}$

$E^\circ_{Al} = -1.66\,V$; $E^\circ_{Pb} = -0.13\,V$.

Solⁿ: (A)

(B)

6. Using the standard electrode potentials given below, predict of the reaction between the following is feasible or not.

(a) Fe^{3+} and I^-

$E^\circ_{Fe} = 0.77$; $E^\circ_{I^-} = 0.54V.$

(b) Ag^+ and Cu

$E^\circ_{Ag} = 0.8V$; $E^\circ_{Cu} = 0.34V$

(c) Fe^{3+} and Br^-

$E^\circ_{Fe} = 0.77$; $E^\circ_{Br^-} = 1.08V$

Solⁿ: (a) $I^- + Fe^{3+} \longrightarrow \frac{1}{2}I_2 + Fe^{2+}$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.77 - 0.54$

$\therefore E^\circ_{cell} = 0.23V$ (Feasible $\because E^\circ_{cell} = +ve$)

(b) $Cu + 2Ag^+ \longrightarrow Cu^{2+} + 2Ag$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.8 - 0.34$

$\therefore E^\circ_{cell} = 0.46V$ (Feasible $\because E^\circ_{cell} = +ve$)

(c) $Br^- + Fe^{3+} \longrightarrow \frac{1}{2}Br_2 + Fe^{2+}$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode} = 0.77 - 1.08$

$\therefore E^\circ_{cell} = -0.31V$ (Not feasible $\because E^\circ_{cell} = -ve$)

7. Using E° values given below, predict of the following reactions between the species is feasible or not.

(a) Ag and Fe^{3+} ; $E^\circ_{Ag} = 0.8V$, $E^\circ_{Fe} = 0.77V$

(b) Br_2 and Fe^{2+} ; $E^\circ_{Br_2} = 1.8V$, $E^\circ_{Fe} = 0.77V$

(c) Pb^{2+} and F^- ; $E^\circ_{Pb} = -0.13V$, $E^\circ_{F^-} = 2.87V$

Solⁿ:

8. Calculate the emf of the cell in which the following reaction occurs:

$Ni_{(s)} + 2Ag^+(0.002M) \longrightarrow Ni^{2+}(0.16M) + 2Ag_{(s)}$

(Given: $E^\circ_{cell} = 1.05V$)

Solⁿ: $E_{cell} = E^\circ_{cell} - \frac{0.059}{n} \log \frac{[Ni^{2+}][Ag]^2}{[Ni][Ag^+]^2}$

$\therefore E_{cell} = E^\circ_{cell} - \frac{0.059}{2} \log \frac{[Ni^{2+}]}{[Ag^+]^2}$ $\because [Ni] = [Ag] = \text{solid} = 1$

$= 1.05 - \frac{0.059}{2} \log \frac{0.16}{(0.002)^2}$

$= 1.05 - \frac{0.059}{2} \log(4 \times 10^4)$

$= 1.05 - \frac{0.059}{2} \times 4.6021$

$= 1.05 - 0.14$

$\therefore \boxed{E_{cell} = 0.91V}$

9. Calculate the emf of the cell in which the following reaction occurs:

$3Mg_{(s)} + 2Al^{3+}(0.02M) \longrightarrow 3Mg^{2+}(0.01) + 2Al_{(s)}$

(Given: $E^\circ_{Mg} = -2.36V$, $E^\circ_{Al} = -1.66V$)

Solⁿ:

10. Represent the cell in which the following reaction occurs. The value of E° for the cell is 1.26 V. What is the value of E_{cell}?

$2Al_{(s)} + 3Cd^{2+}(0.1M) \longrightarrow 2Al^{3+}(0.01M) + 3Cd_{(s)}$

Solⁿ:

11. Calculate the emf of the following cell at 298 K.

$2Cr_{(s)} + 3Fe^{2+}(0.1M) \rightarrow 2Cr^{3+}(0.01M) + 3Fe$

$E^\circ_{Cr} = -0.74\ V$, $E^\circ_{Fe} = -0.44\ V$

Solⁿ:

12. Calculate the emf of the following cell:

$Zn/Zn\ (0.1M)\ ||\ Ag^+(0.01\ M)/Ag$

$E^\circ_{Zn} = -0.76V$, $E^\circ_{Ag} = +0.8\ V$

Solⁿ:

13. Write the cell reaction and calculate the emf of the following cell at 298 K.

$Sn/Sn^{2+}(0.004\ M)\ ||\ H^+(0.02M)/H_2(1bar), Pt_{(s)}$

$(E^\circ_{Sn} = -0.14\ V)$

Solⁿ:

14. What is the standard free energy change for the following reaction at room temperature? Is the reaction spontaneous?

$Sn_{(s)} + 2Cu^{2+}_{(aq)} \longrightarrow Sn^{2+}_{(aq)} + 2Cu_{(s)}$

Sol^n: Given : $E^\circ_{cell} = 0.29\,V$

$$\Delta G^\circ = -nFE^\circ_{cell}$$
$$= -2 \times 96500 \times 0.29$$
$$= -55970\ J\,mol^{-1}$$

$\therefore \boxed{\Delta G^\circ = -55.97\ kJ\,mol^{-1}}$

$\because$ The ΔG° is ~~positive~~ negative, the reaction is ~~non~~-spontaneous.

15. What is the standard free energy change for the following reaction at 298K? Is the reaction spontaneous.

$Cu_{(s)} + Zn^{2+}_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + Zn_{(s)}$; $E^\circ_{cell} = -1.1V$

Sol^n:

16. The values of Λ°_m for NH_4Cl, NaOH, and NaCl at infinite dilution are 129.8 $\Omega^{-1} cm^2 mol^{-1}$, 248.1 $\Omega^{-1} cm^2 mol^{-1}$ and 126.4 $\Omega^{-1} cm^2 mol^{-1}$ respectively. Calculate the Λ°_m of NH_4OH.

Sol^n: According to Kohlrausch's law:

$$\Lambda^\circ_m(NH_4OH) = \lambda^\circ_{NH_4^+} + \lambda^\circ_{OH^-}$$
$$= \lambda^\circ_{NH_4^+} + \lambda^\circ_{OH^-} + \lambda^\circ_{Na^+} - \lambda^\circ_{Na^+} + \lambda^\circ_{Cl^-} - \lambda^\circ_{Cl^-}$$
$$= \left[\lambda^\circ_{NH_4^+} + \lambda^\circ_{Cl^-}\right] + \left[\lambda^\circ_{Na^+} + \lambda^\circ_{OH^-}\right] - \left[\lambda^\circ_{Na^+} + \lambda^\circ_{Cl^-}\right]$$
$$= (129.8) + (248.1) - (126.4)$$

$\therefore \boxed{\Lambda^\circ_m(NH_4OH) = 251.5\ \Omega^{-1} cm^2 mol^{-1}}$

17. The values of Λ°_m for HCl, NaCl and NaAc are 425.9, 126.4 and 91 $S cm^2 mol^{-1}$ respectively. Calculate the value of Λ°_m for HAc.

Sol^n:

18. The value of Λ°_m of $Al_2(SO_4)_3$ is 858 $S cm^2 mol^{-1}$, while $\lambda^\circ_{SO_4^{2-}}$ is 160 $S cm^2 mol^{-1}$. Calculate the limiting ionic conductivity of Al^{3+}.

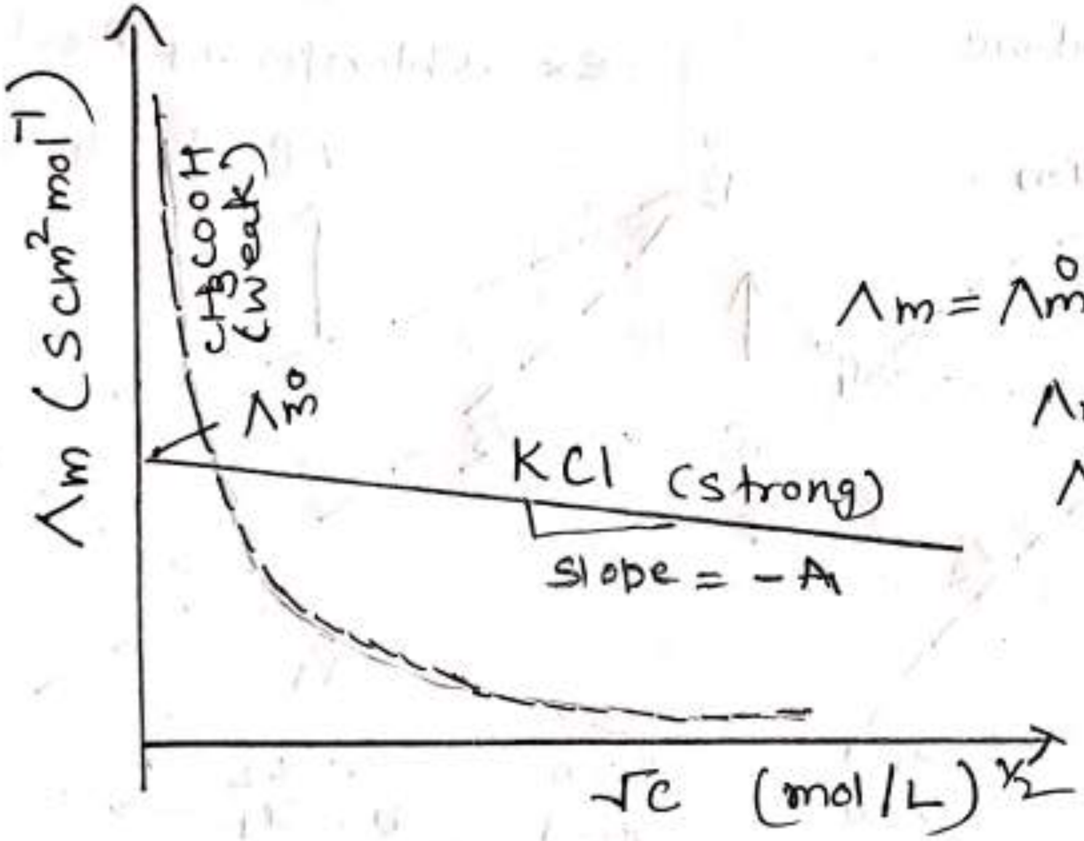
Sol^n: According to Kohlrausch's law:

$$\Lambda^\circ_m(Al_2(SO_4)_3) = 2\lambda^\circ_{Al^{3+}} + 3\lambda^\circ_{SO_4^{2-}}$$
$$\therefore 858 = 2\lambda^\circ_{Al^{3+}} + 3 \times 160$$
$$\therefore 2\lambda^\circ_{Al^{3+}} = 858 - 3 \times 160$$
$$= 378\ S\,cm^2 mol^{-1}$$

$\therefore \boxed{\lambda^\circ_{Al^{3+}} = \frac{378}{2} = 189\ S cm^2 mol^{-1}}$

⑥ ELECTROCHEMISTRY

Variation of Λ_m with $\sqrt{c}$



$\Lambda_m = \Lambda_m^0 - A\sqrt{c}$

Λ_m - Molar conductivity

Λ_m^0 - Limiting Molar Conductivity

CHEMICAL KINETICS

1. Rate of Reaction $= \frac{-\Delta[R]}{\Delta t} = \frac{\Delta[P]}{\Delta t}$

2. Integrated Rate Equations

(1) For a zero order reaction:

$$t = \frac{[R]_0 - [R]}{k} \quad \text{and} \quad t_{1/2} = \frac{[R]_0}{2k}$$

(II) For a first order reaction:

$$t = \frac{2.303}{k} \log \frac{[R]_0}{[R]} \quad \text{and} \quad t_{1/2} = \frac{0.693}{k}$$

Amount of the substance left after n half lives of I^{st} Order reaction $= \frac{[R]_0}{2}$

2. Arrhenius Equation:–

(1) $k = Ae^{-Ea/RT}$

(II) $\log \frac{k_2}{k_1} = \frac{Ea}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$

(III) $Ea = -2.303 \times R \times \text{slop}$ (in a plot of $\log k$ vs $\frac{1}{T}$)

k = Rate constant
A = Arrhenius factor or frequency factor
Ea = Activation energy
R = Gas constant
T = Temperature in Kelvin
k_1 = Rate constant at T_1
K_2 = Rate constant at T_2

Average rate:–

$$= -\frac{\Delta[R]}{\Delta t} = \frac{[R_2] - [R_1]}{t_2 - t_1}$$

3 Chemical kinetics (Group 2)

1. A reaction is of second order with respect to a reactant. How is the rate affected if the concentration of the reactant is reduced to its $\frac{1}{3}$rd. ?

Solution:-

Rate $= k[A]^2 =$

If $[A] = \frac{1}{3}[A]$

then Rate $= k\left[\frac{1}{3}A\right]^2$

$= k \times \frac{1}{9}[A]^2$

OR

$\frac{1}{9} k[A]^2$

∴ Rate = $1/9$th (one ninth of original rate

2. A reaction is of third order with respect to a reactant. How is the rate affected if the concentration of the reactant is doubled. ?

Q-3. A first order reaction is found to have a rate constant $k = 5.5 \times 10^{14} s^{-1}$ Find the half life of the reaction

Given $k = 5.5 \times 10^{14} s^{-1}$

$t_{1/2} = ?$

Solution $t_{1/2} = \frac{0.693}{k}$

$t_{1/2} = \frac{0.693}{5.5 \times 10^{14} s^{-1}}$

Hence $\boxed{t_{1/2} = 1.26 \times 10 13\ s}$

Q.4 A first order reaction is found to have a rate Constant $k = 6.6 \times 10^{15} s^{-1}$ Find the half life of the reaction.

Chemical kinetics

5 The initial Concentration of N_2O_5 in the following first order reaction

$N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$

was 1.24×10^{-2} mol L^{-1} at 318 K. The Concentration of N_2O_5 after 60 minutes was 0.20×10^{-2} mol L^{-1}. Calculate the rate constant of the reaction at 318 K.

Solution

$$N_2O_5(g) \longrightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$$

$t_1 = 0$ 1.24×10^{-2} mol L^{-1} $[R_1]$

$t_2 = 60$ min 0.20×10^{-2} mol L^{-1} $[R_2]$

$k = ?$

Solution

For 1st order reaction

$$\log \frac{[R]_1}{[R]_2} = \frac{k(t_2 - t_1)}{2.303}$$

$$k = \frac{2.303}{(t_2 - t_1)} \log \frac{[R_1]}{[R_2]}$$

$$= \frac{2.303}{(60\,\text{min} - 0\,\text{min})} \log \frac{1.24 \times 10^{-2}\,\text{mol L}^{-1}}{0.20 \times 10^{-2}\,\text{mol L}^{-1}}$$

$$= \frac{2.303}{60} \log 6.2\ \text{min}^{-1}$$

$$= \frac{2.303}{60} \times 0.7924 \quad (\log 6.2 = 0.7924)$$

$$k = 0.0304\ \text{min}^{-1}$$

Q.6 The initial Concentration of N_2O_5 in the following first order reaction

$N_2O_5(g) \longrightarrow 2NO(g) + \frac{1}{2}O_2(g)$

was 2.13×10^{-3} mol L^{-1}. at 418 K. The Concentration of N_2O_5 after 40 minutes was 0.30×10^{-3} mol L^{-1}. Calculate the rate constant of the reaction at 418 K.

(log 7.1 = 0.8512)

Chemical kinetics

Q.7 Show that in a first order reaction, time required for completion of 99.9% is 10 times of the half life ($t_{1/2}$) of the reaction

Solution

When reaction is completed 99.9%., $[R] = 100 - 99.9$

$[R] = 0.1$

$$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

$$k = \frac{2.303}{t} \log \frac{100}{0.1}$$

$$= \frac{2.303}{t} \log 1000$$

$$= \frac{2.303}{t} \log 10^3$$

$$K = \frac{2.303}{t} 3 \log 10 \quad (\log 10 = 1)$$

$$t = \frac{2.303 \times 3}{k} = \frac{6.909}{K}$$

$$\frac{t}{t_{1/2}} = \frac{6.909}{K} \times \frac{K}{0.693}$$

$$\frac{t}{t_{1/2}} = 10$$

Q.8 For first order reaction, show that the time required for 99% completion of a first order reaction is twice the time required for completion of 90%.

The rate of the chemical reaction doubles for and increase of 10k in absolute temperature from 298k. Calculate E_a

Ans

$T_1 = 298$

$T_2 = 298 + 10 = 308\ k$

$k_1 = k \quad k_2 = 2k$

$\cancel{\log \frac{k_2}{k_1}}$ $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$

$\log \frac{2k}{k} = \frac{Ea}{2.303 \times 8.314}\left(\frac{308 - 298}{308 \times 298}\right)$

$\log 2 = \frac{Ea}{2.303 \times 8.314} \times \frac{10}{308 \times 298}$

$0.3010 = \frac{Ea}{2.303 \times 8.314} \times \frac{10}{308 \times 298}$

$Ea = \frac{0.3010 \times 2.303 \times 8.314 \times 308 \times 298}{10}$

$Ea = 52897.7\ J\ mol^{-1}$

$= 52.8\ kJ\ mol^{-1}$

Q.16 The rate of the chemical reaction quadruples when temperature changes from 293k to 313k. Calculate the energy of activation of the reaction

Chemical kinetics

For the first order nermal decomposition reaction, the following data were obtained

$C_2H_5Cl(g) \rightarrow C_2H_4(g) + HCl(g)$

Time/sec	Total pressure/atm
0	0.30
300	0.50

Calculate the rate constant
(Given log 2 = 0.3010,
log 3 = 0.4771, log 4 = 0.6021)

Given

$P_0 = 0.30$ atm, $P_t = 0.50$ atm,
$t = 300$ s

Solution

Rate constant, $k = \frac{2.303}{t} \log \frac{P_0}{2P_0 - P_t}$

$$k = \frac{2.303}{300} \log \frac{0.30}{2 \times 0.30 - 50}$$

$$k = \frac{2.303}{300} \log \frac{0.30}{0.10}$$

$$k = \frac{2.303}{300} \log 3$$

$$= \frac{2.303}{300} \times 0.4771$$

$$= \frac{1.099}{300}$$

$$= 0.0036 s^{-1}$$

Q.12 For the first order thermal decomposition reactions the following data were obtained

$C_2H_5Cl(g) \rightarrow C_2H_5(g) + HCl(g)$

Time/sec	Total pressure/atm
0	0.40
500	0.70

Calculate the rate constant
(Given log 2 = 0.3010)

The rate constant for first order reaction is $60 s^{-1}$. How much time will it take to reduce the Initial Concentration of the reactant to $1/10$th value.?

Ans:-

$$k = \frac{2.303}{t} \log \frac{[R]_0}{[R]}$$

$$60 s^{-1} = \frac{2.303}{t} \log \frac{[R]_0}{\frac{[R]_0}{10}}$$

$$\boxed{\because R = \frac{1}{10}[R]_0}$$

$$t = \frac{2.303}{60 s^{-1}} \log 10$$

$$t = \frac{2.303}{60}$$

$$t = 0.0384 s$$

Q.15 A 1st order reaction takes 30 min. fo 50% completion. Calculate the time required for 90% Completion of this reaction

Sol^n: As Conc reduced to 50%.

$$t = t_{1/2} = 30 \text{ min} = 1800 \text{ sec}$$

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{1800 s} = \boxed{0.000385 = k}$$

$$t = \frac{2.303}{k} \log \frac{[R]_0}{[R]} \text{ or } t = \frac{2.303}{k} \log \frac{100}{100-90}$$

$$t = \frac{2.303}{0.000385} \log \frac{100}{10} = \frac{2.303}{0.000385} \log 10$$

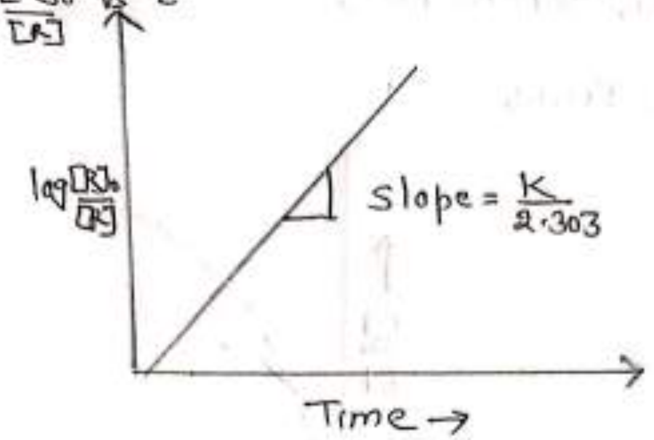
$$t = \frac{2.303}{\quad} = \boxed{15.98 \times 10^3 sec = t}$$

Q.14 The rate Constant for a first order reaction is $40 s^{-1}$. How much time will it take to reduce the initial concentration of the reactant to $1/4$th value.

Q.16 A 1st order reaction takes 40 min for 50%. Completion Calculate the time required for 99%. Completion of this reaction

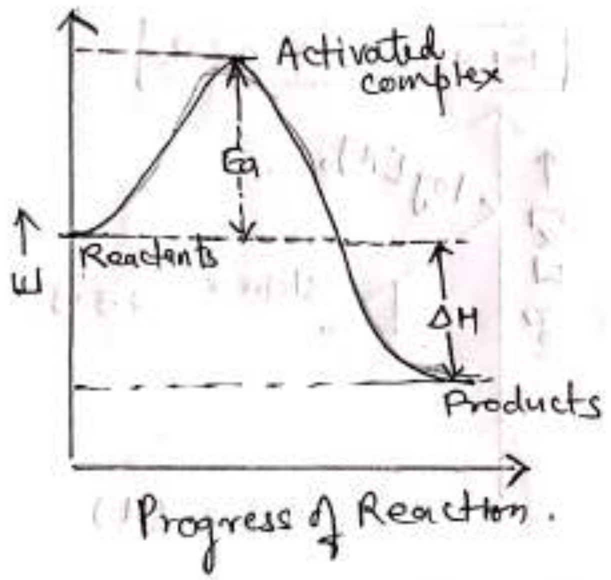
chemical kinetics

⑨ $\log \frac{[A]_0}{[A]}$ vs t

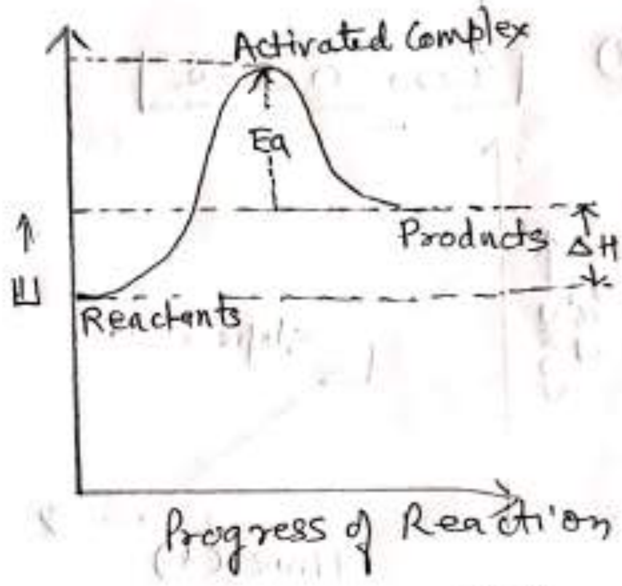


$$\log \frac{[R]_0}{[R]} = \frac{Kt}{2.303}$$

⑩ Exothermic Reaction



Endothermic Reaction.



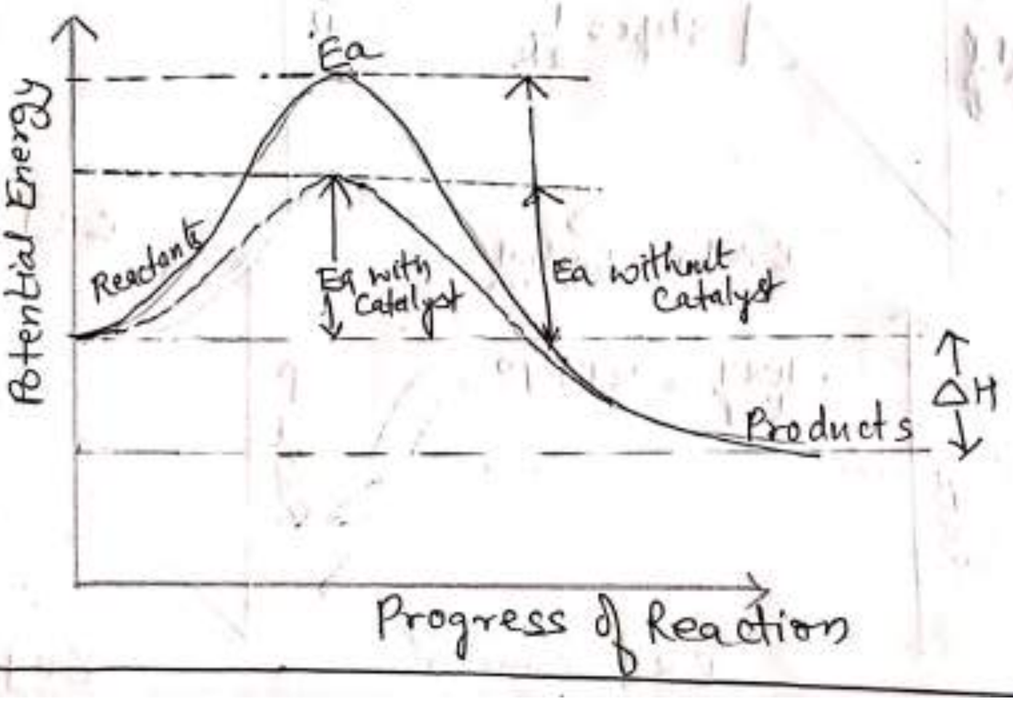
$\Delta H = -ve$

$\Delta H = +ve$

$\Delta H = E_P - E_R$

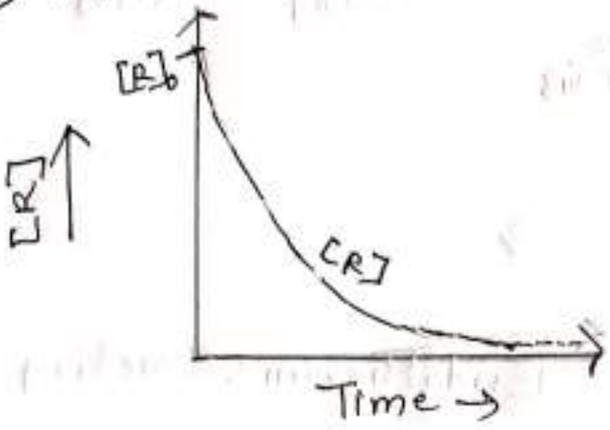
$E_a = E_T - E_R$

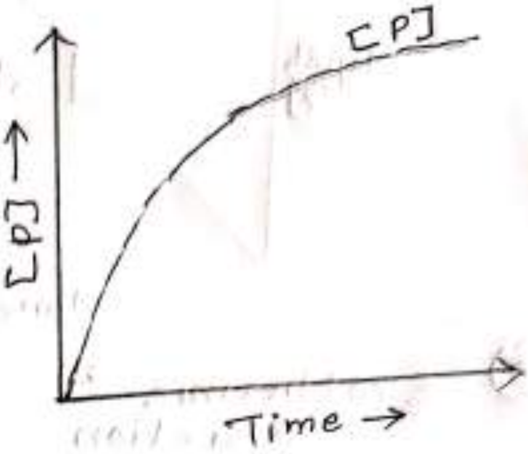
⑪ Catalysed & Uncatalysed Reaction.



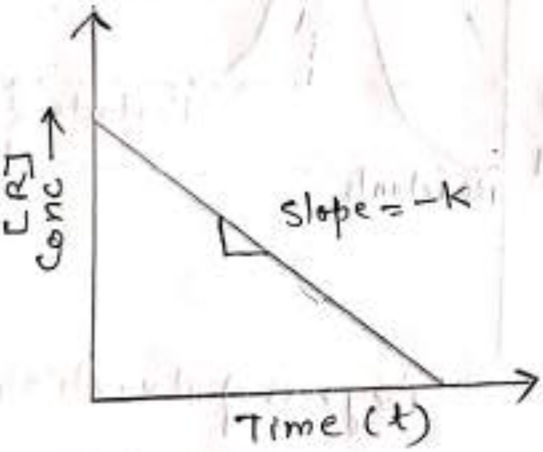
CHEMICAL KINETICS

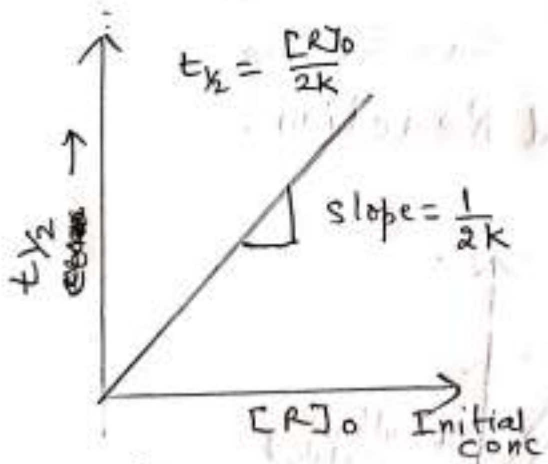
⑦ Concentration Vs Time

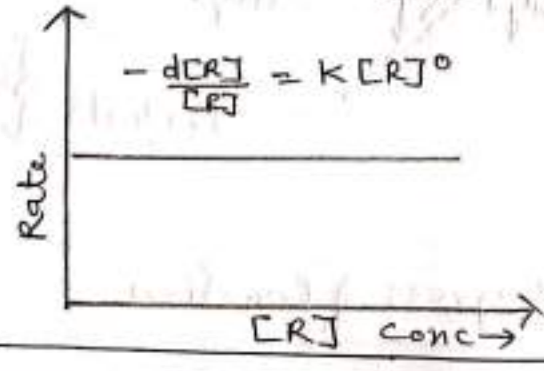




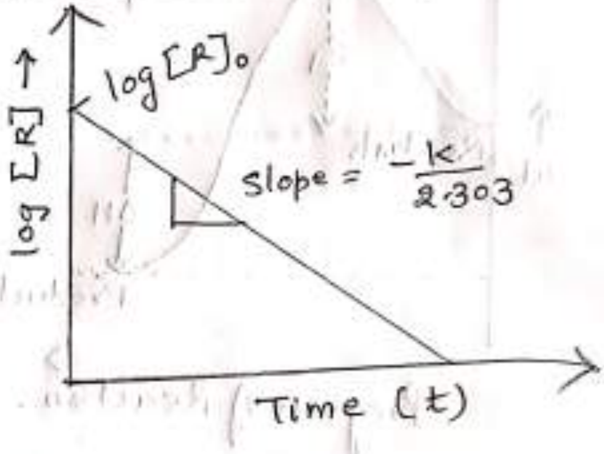
⑧ Zero ORDER

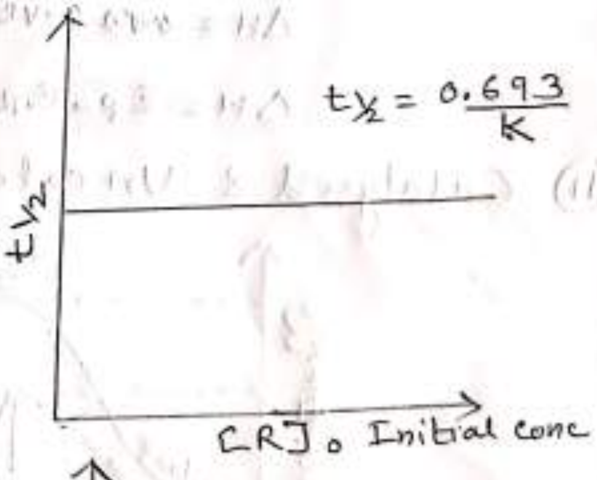


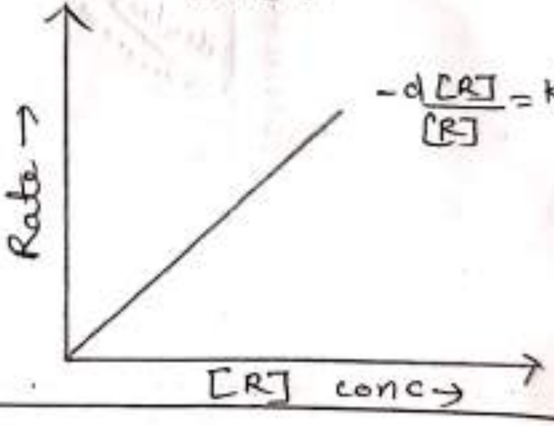




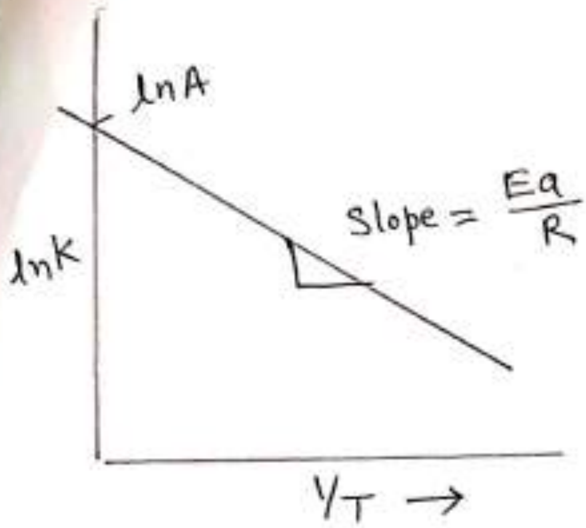
FIRST ORDER

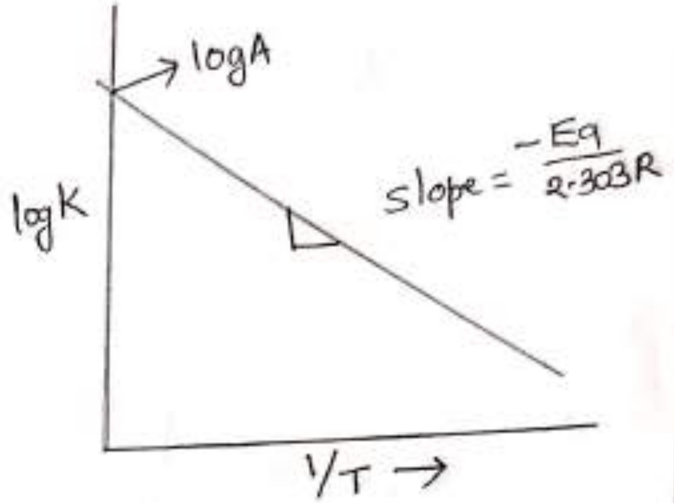




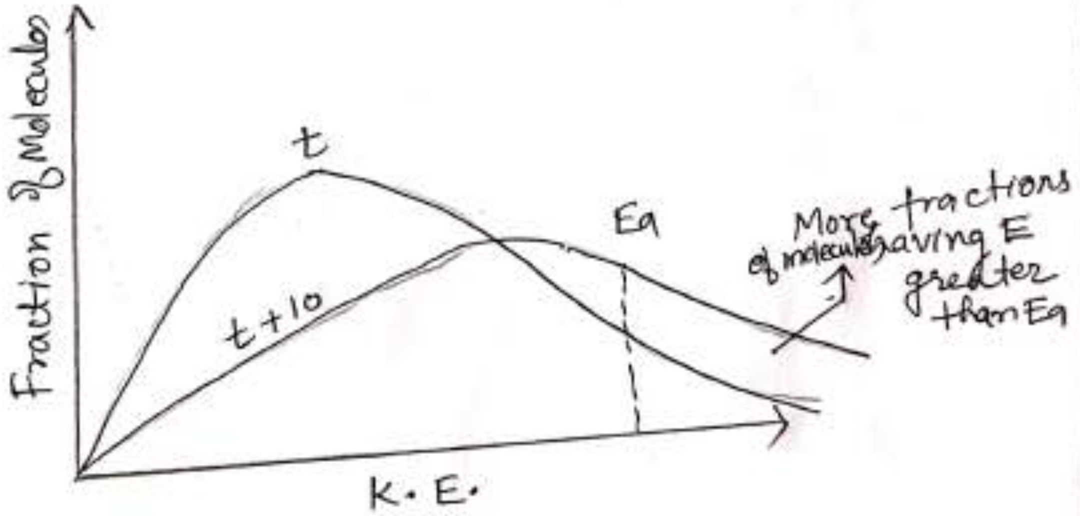


Arrhenius Equation. $\log K = \log A - \frac{Ea}{2.303\,RT}$





⑬ Effect of temperature on rate of reaction.



REASONING QUESTIONS (d & f block)

Q1 Transition elements form coloured Compounds
- Presence of unpaired / partially filled 'd' orbitals
- Ability to undergo transition within 'd' orbitals ie d-d transition

Q2 Most of transition metals are paramagnetic
- Partially filled 'd' orbitals containing unpaired electrons

Q3 Zn, Cd and Hg do not show typical properties of transition elements
- All of them have $(n-1)d^{10} ns^2$ configuration
- Absence of unpaired e^-s in d orbitals

Q4 Sc^{3+} is colourless where as Cr^{3+} is coloured.
Configuration of Sc^{3+} is $[Ar] 3d^0 4s^0$, Unpaired e^- are absent ∴ colourless
Configuration of Cr^{3+} is $[Ar] 3d^3 4s^0$, 3 unpaired are present in 3d orbital which can undergo d-d transition hence coloured

Q5 Transition metals have high m-pt & boiling pt
- Transition metals contain one or more unpaired e^-, so strong metallic bonding.

Q6 Zn, Cd, Hg are soft metals / Low m.pt
- Zn, cd, Hg have completely filled (d^{10}) configuration
- Absence of unpaired e^- ∴ weak metallic bonding

Q7 Transition elements exihibit variable oxidation states
- Presence of partially filled 'd' orbitals
- participation of (n-1)d & ns in bond formation

Q8 Transition metals readily form alloys.
- Transition metals have comparable / similar sizes.
- One atom can replace other in lattice arrangement

Q9 Fe^{3+} is more stable than Fe^{2+} where as Mn^{2+} is more stable than Mn^{3+}
- Fe^{3+} & Mn^{2+} have stable $3d^5$ configuration
- They have stable half filled where as Fe^{2+} & Mn^{3+} are $3d^6$ & unstable

Q10 Transition metals form complexes
- Small size
- High Charge
- Partially filled 'd' orbitals which can accept lone pair of e⁻ from Ligands.

Q11 Transition metals form interstial Compounds
- Small atoms like H, C, B, N can occupy empty space (Interstitial site) in their lattices.

Q13 Transition metals are used as catalyst in many reactions.
- Presence of partially filled 'd' orbitals
- Good adsorbate - provide large surface area
- variable oxidation states
- ability to form complexes

Q14 Generally there is increase in density of elements from titanium (z=22) to copper (z=29) in the first series of transition elements.
- Atomic mass increases from Ti to Cu but no significant change in atomic size so density decreases

Q.15 First ionisation energy of 5d series of transition elements are higher than that of 3d and 4d series elements.
- The transition elements of 5d series have intervening 4f orbitals
- Greater effective nuclear charge acting on outer valence electron due to weak sheilding by 4f electron

Q16 Cr^{2+} is reducing agent but Mn^{3+} is strong oxidising agent though both have 3d4 configuration.
- Cr^{2+} (d^4) changes to Cr^{3+} (d^3) stable t_{2g}^3 losing e⁻
- whereas Mn^{3+} is strong oxidising agent because it forms Mn^{2+} stable half filled (d^5)

$$\underset{(d^4)}{Cr^{2+}} \longrightarrow \underset{t_{2g}^3\ \text{(stable)}}{Cr^{3+}} \qquad \underset{d^4}{Mn^{3+}} \longrightarrow \underset{\substack{d^5 \\ \text{stable} \\ \text{Half fille}}}{Mn^{2+}}$$

Q.17 $La(OH)_3$ is stronger base than $Lu(OH)_3$

La—$(OH)_3$
Lu—$(OH)_3$

Size of Lanthanum bigger than Lu. (Lanthanide contraction)
Bond Length decreases from $La(OH)_3$ to $Lu(OH)_3$
So easy to give -OH from $La(OH)_3$ due to less

Q.18 The second and third rows of transition elements resemble each other much more than they resemble the first row. Explain why?

Ans:- Due to lanthanoid contraction, the atomic radii of the second and third-row transition elements are almost identical. So they resemble each other much more than first row elements

Q.19 Reactivity of transition elements decreases almost regularly from Sc to Cu Explain.

Ans. Reactivity of transition elements decreases almost regularly from Sc to Cu due to the regular increase increase in - ionisation enthalpy.

Q.20 When Cu^{2+} ion is treated with KI a white precipitate is formed Explain the reaction with the help of a chemical equation.

Ans:- When Cu^{2+} ion is treated with KI it produces Cu_2I_2 white precipitate In the final product.

$$2Cu^{2+} + 4I^- \longrightarrow Cu_2I_2 \text{ (white ppt)} + I_2$$

(In this reaction CuI_2 is formed, which, being unstable dissociates into Cu_2I_2 and I_2

Q. 21 Out of Cu_2Cl_2 and $CuCl_2$. which is more stable and why?

Ans. $CuCl_2$ is more stable than Cu_2I_2. The stability of $Cu^{2+}_{(aq)}$ is more negative $\Delta_{hyd}H^\circ$ of $Cu^{2+}_{(aq)}$ than $Cu^{+}_{(aq.)}$

Q.22 Although fluorine is more electronegative than Oxygen, but the ability of oxygen to stabilise higher oxidation state exceeds that of fluorine. why?

Ans. Oxygen can form multiple bond with metals. while fluorine can't form multiple bonds. Hence oxygen has more ability to stabilise a higher oxidation state rather than fluorine.

Q. 23. The halides of transition elements become more covalent with increasing oxidation state of the metal. Why?

Ans. As the oxidation state increases. the size of the ion of the transition element decreases As per Fajan's rule, as the size of metal ions decreases the covalent character of the bond formed Increases. Therefore the halides of transition elements become more covalent with the increasing oxidation state of the metal.

Coordination Compounds

Valence Bond Theory

Coordination Compounds	**Coordination number**	**Type of hybridisation**	**Shape**
$[NiCl_4]^{2-}$, $[Ni(CO)_4]$	4	sp^3	Tetrahedral
$[Ni(CN)_4]^{2-}$	4	dsp^2	Square planar
	5	sp^3d	Trigonal bipyramidal
$[MnCl_6]^{3-}$, $[FeF_6]^{3-}$ and $[CoF_6-]^{3-}$	6	sp^3d^2	Octahedral
$[Co(NH_3)_6]^{3+}$, $[Mn(CN)_6]^{3-}$ $[Fe(CN)_6]^{3-}$, $[Co(C_2O_4)_3]^{3-}$	6	d^2sp^3	Octahedral

Examples:

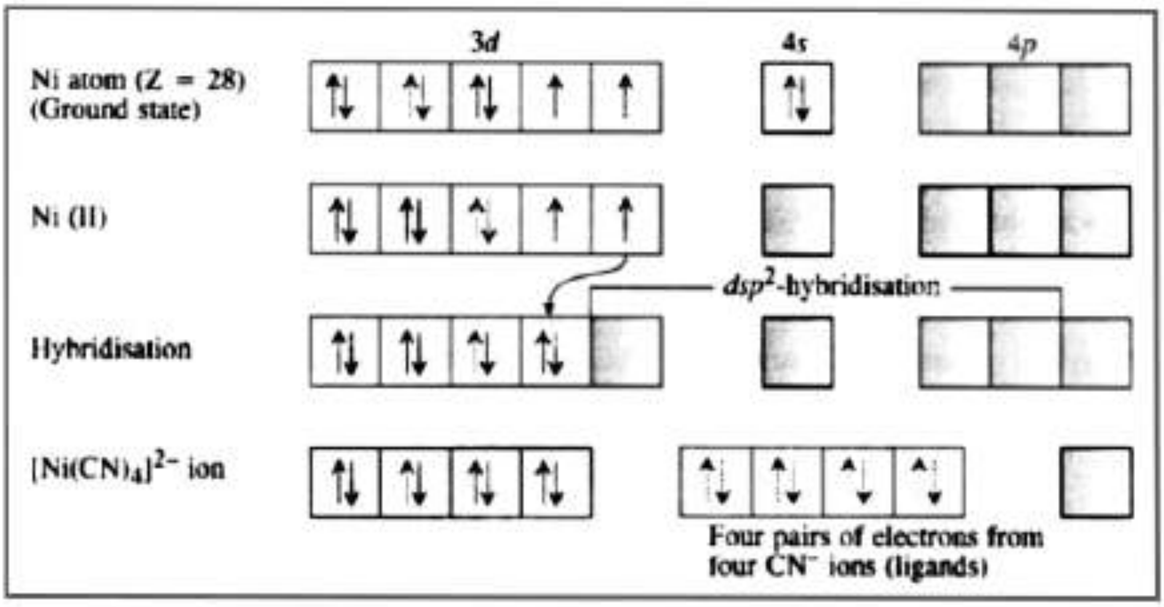
1. $[Ni(CN)_4]^{2-}$ - Tetracyanido nickelate (II) ion

Electronic configuration of nickel (Z = 28) in ground state is $_{18}[Ar]3d^8 4s^2$.

Nickel is in + 2 oxidation state after the loss of the two 4s-electrons.

Ni^{2+} ion has outer electronic configuration - $_{18}[Ar]3d^8$.

Since CN^- ion is a strong field, two unpaired electrons in the 3d orbitals pair up.



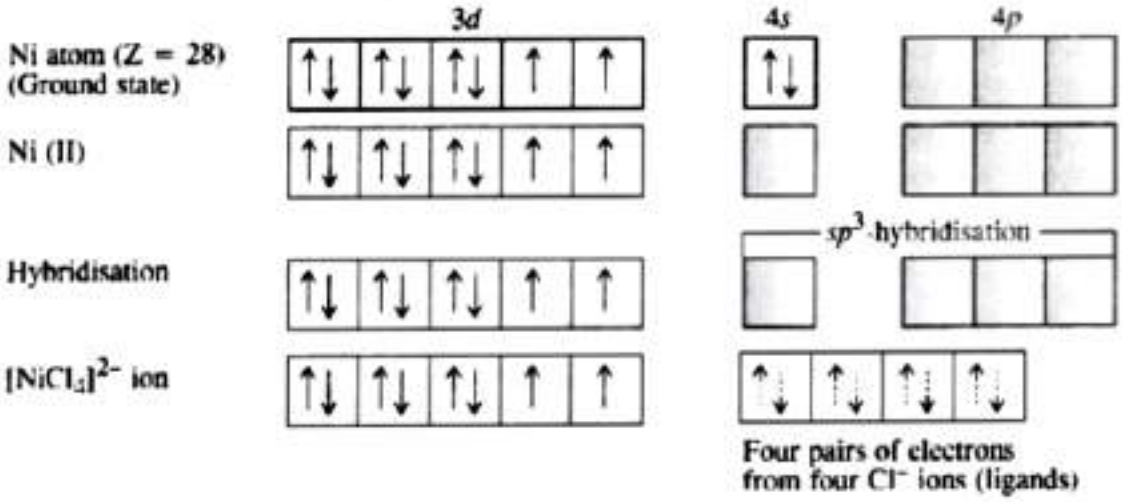
2. $[NiCl_4]^{2-}$ - Tetrachloridonickelate (II) ion

Electronic configuration of nickel (Z = 28) in ground state is $_{18}[Ar]3d^8 4s^2$.

Nickel is in + 2 oxidation state after the loss of the two 4s-electrons.

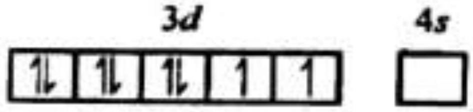
Ni^{2+} ion has outer electronic configuration - $_{18}[Ar]3d^8$.

Since Cl- ion is a weak field ligand, it does not cause electron pairing.

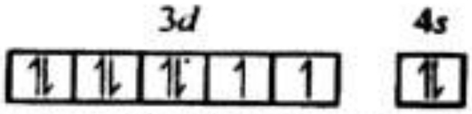


Q. $[NiCl_4]^{2-}$ is paramagnetic while $[Ni(CO)_4]$ is diamagnetic though both are tetrahedral. Why?

In $[NiCl_4]^{2-}$, Ni is in +2 oxidation state
Ni (28) : $3d^8 4s^2$
Ni^{2+} : $3d^8 4s^0$



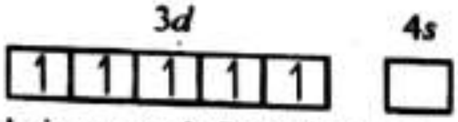
Cl^- is weak field ligand. It does not pair up e^{-1}s.
Hence, it is paramagnetic
In $[Ni(CO)_4]$, Ni is in 0 O.S.
Ni (28) : $3d^8 4s^2$



CO is strong field ligand, as it pairs the 4s e^{-1}s with 3d e^{-1}s to give $3d^{10} 4s^0$. So, no unpaired e^- and hence, the complex is diamagnetic.

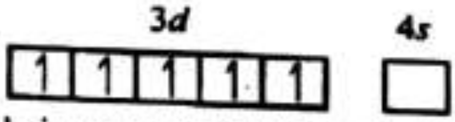
Q. $[Fe(H_2O)_6]^{3+}$is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$is weakly paramagnetic. Explain.

$[Fe(H_2O)_6]^{3+}$
Fe (26) : $3d^6 4s^2$
Here, Fe is in +3 state. Thus,
Fe^{3+} : $3d^5 4s^0$

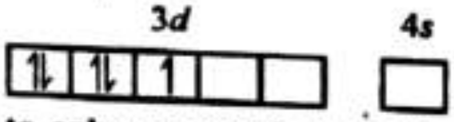


H_2O being a weak field ligand does not pair up the e^{-1}s and hence the complex is strongly paramagnetic.

$[Fe(CN)_6]^{3-}$
Fe (26) : $3d^6 4s^2$
Here, Fe is in +3 state, So
Fe^{3+} : $3d^5 4s^0$



CN^- being a strong field ligand pairs up the e^{-1}s so that we have



Due to only one unpaired e^-, the complex is weakly paramagnetic

Crystal Field Theory

1. The crystal field theory (CFT) considers the metal-ligand bond to be ionic due to electrostatic interactions between the metal ion and the ligand.
2. Ligands are treated as point charges in case of anions or point dipoles in case of neutral molecules.
3. The five d orbitals in an isolated gaseous metal atom/ion have same energy, i.e., they are degenerate. This degeneracy is maintained if a spherically symmetrical field of negative charges surrounds the metal atom/ion.
4. When the negative field is due to ligands (either anions or the negative ends of dipolar molecules like NH3 and H2O) in a complex, it becomes asymmetrical and the degeneracy of the d orbitals is lost. It results in splitting of the d orbitals.

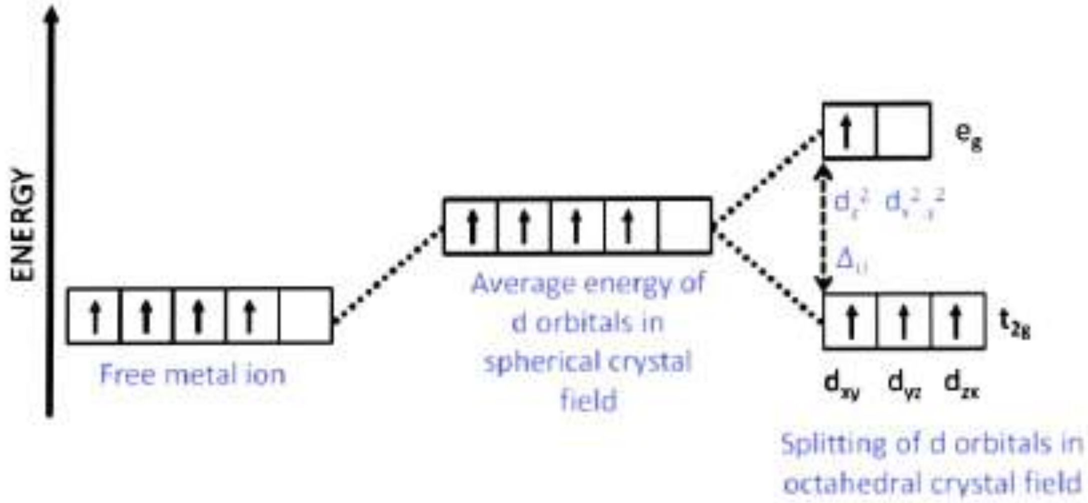
(a) Crystal field splitting in octahedral coordination entities

1. In an octahedral coordination entity with six ligands surrounding the metal atom/ion, there is repulsion between the electrons in metal d orbitals and the electrons (or negative charges) of the ligands.

2. The d $x^2 - y^2$ and dz^2 orbitals which point towards the axes along the direction of the ligand will experience more repulsion and will be raised in energy. This yields three orbitals of lower energy, t_2g set and two orbitals of higher energy, eg set.
3. The dxy, dyz and dxz orbitals which are directed between the axes will be lowered in energy relative to the average energy in the spherical crystal field. This yields two orbitals of higher energy, eg set.

The splitting of the degenerate levels due to the presence of ligands in a definite geometry is termed as **crystal field splitting**.

CRYSTAL FIELD SPLITTING DIAGRAM



The energy separation is denoted by Δo (the subscript o is for octahedral).
The energy of the two eg orbitals will increase by (3/5) Δo and that of the three t_2g will decrease by (2/5) Δo.

The crystal field splitting, Δo, depends upon the field strength of the ligand and charge on the metal ion.
order of increasing field strength of ligands:
$I^- < Br^- < SCN^- < Cl^- < S^{2-} < F^- < OH^- < C_2O_4^{2-} < H_2O < NCS^- < edta^{4-} < NH_3 < en < CN^- < CO$
The series is termed as **spectrochemical series.**

The single d electron occupies one of the lower energyt_2g orbitals.
In d^2 and d^3 coordination entities, the d electrons occupy the t_2g orbitals singly in accordance with the Hund's rule.
For d^4 ions, there are two possible ways of electron distribution:
(i) the fourth electron could either enter the t_2g level and pair with an existing electron, or

(ii) it could occupy the eg level.

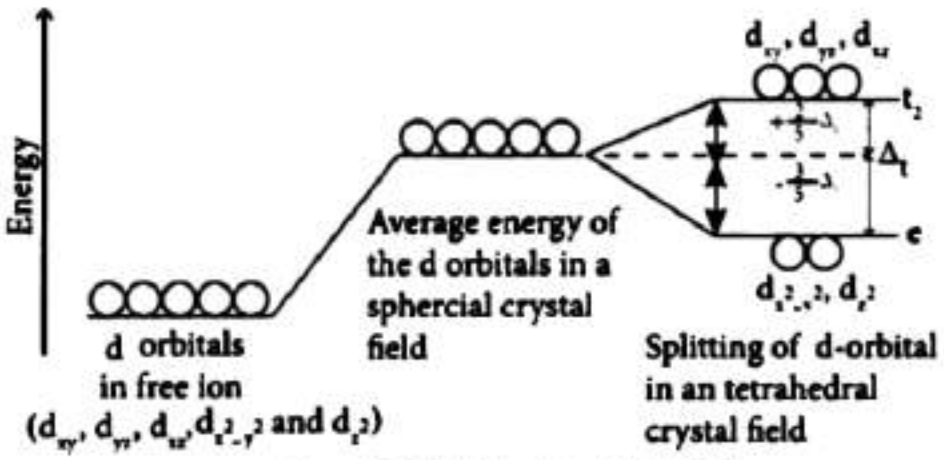
Pairing energy, P is the energy required for electron pairing in a single orbital.

(i) If $\Delta o < P$, the fourth electron enters one of the eg orbitals giving the configuration $t_2g\,^3e\,g^1$. Ligands for which $\Delta o < P$ are known as weak field ligands and form high spin complexes.

(ii) If $\Delta o > P$, it becomes more energetically favourable for the fourth electron to occupy a t_2g orbital with configuration $t_2g\,^4\,eg\,^0$.
Ligands which produce this effect are known as strong field ligands and form low spin complexes.

(b) Crystal field splitting in tetrahedral coordination entities

In tetrahedral coordination entity formation, the d orbital splitting is inverted and is smaller as compared to the octahedral field splitting.

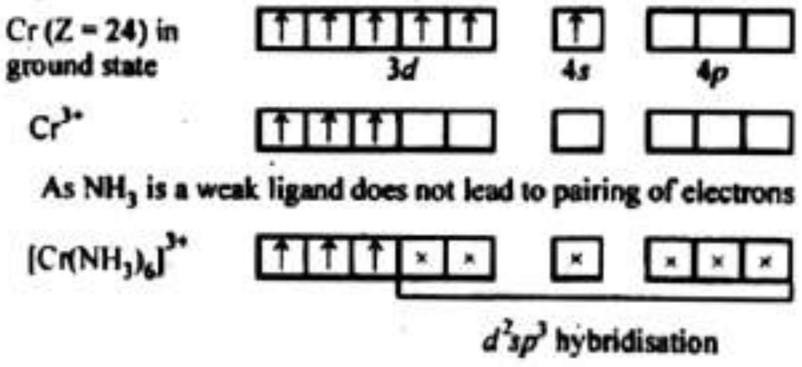


Crystal field splitting in tetrahedral field

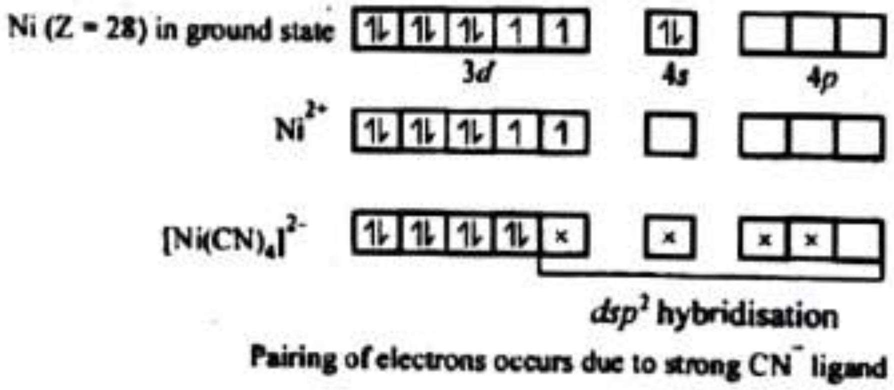
For the same metal, the same ligands and metal-ligand distances, $\Delta t = (4/9)\,\Delta_O$.
The orbital splitting energies are not sufficiently large for forcing pairing and, therefore, low spin configurations are rarely observed.
The 'g' subscript is used for the octahedral and square planar complexes which have centre of symmetry.
Since tetrahedral complexes lack symmetry, 'g' subscript is not used with energy levels.

Q. $[Cr(NH_3)_6]^{3+}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain why?

The presence of three unpaired electrons in $[Cr(NH_3)_6]^{3+}$ explains its paramagnetic character.



$[Ni(CN)_4]^{2-}$ is diamagnetic, since there is no unpaired electrons.



Q.A solution of $[Ni(H_20)_6]^{2+}$ is green but a solution of $[Ni\ (CN)_4]^{2-}$is colourless. Explain.

Ans: In $[Ni(H_20)_6]^{2+}$, Ni is in + 2 oxidation state and having $3d^8$ electronic configuration, in which there are two unpaired electrons which do not pair in the presence of the weak H_20 ligand. Hence, it is coloured. The d-d transition absorbs red light and the complementary light emitted is green.

In $[Ni\ (CN)_4]^{2-}$ Ni is also in + 2 oxidation state and having $3d^8$ electronic configuration. But in presence of strong ligand CN^- the two unpaired electrons in the 3d orbitals pair up. There is no unpaired electron present. So, it is colourless.

List of Ligands

I> Monodentate ligands:-

a> Neutral monodentate ligands:-

Ligand	Formula	Name in complexes
→ Ammonia	NH_3	ammine
→ Water	H_2O	aqua
→ Carbonmonoxide	CO	carbonyl
→ Pyridine	pyr (C_5H_5N)	pyridine

b) Negatively charged monodentate ligands:-

Ligand	Formula	Name in complexes
→ Chloride	Cl^-	chlorido
→ Bromide	Br^-	bromido
→ Cyanide	CN^-	cyanido
→ Fluoride	F^-	Fluorido
→ Hydroxide	OH^-	hydroxido
→ Nitrite	NO_2^-	nitrito-N
	or ONO^-	nitrito-O
→ Thiocyanate	SCN^-	thiocyanato
	or NCS^-	isothiocyanato

II> Didentate ligands:-

a) Neutral didentate ligands:-

Ligand	Formula	Name in complexes
→ Ethylenediamine	$H_2NCH_2CH_2NH_2$ (en)	ethane-1,2-diamine
→ Dipyridine	$C_{10}H_8N_2$ (dipy)	dipyridine

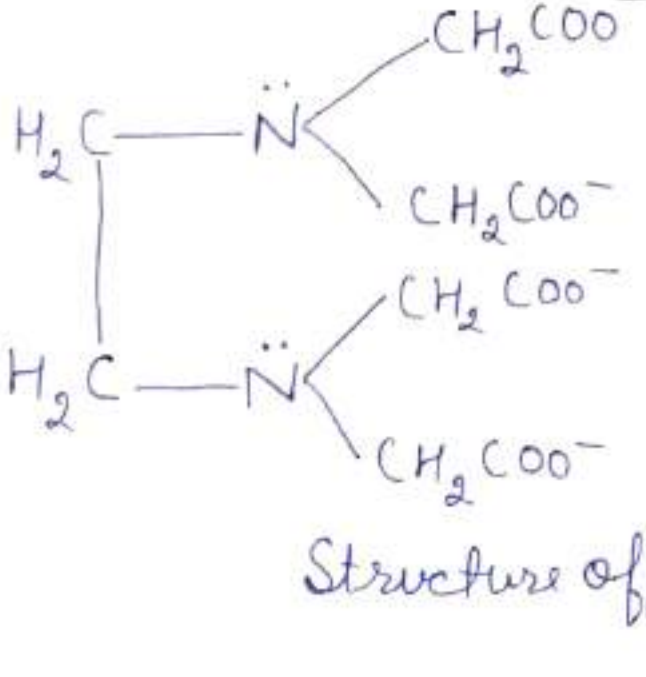
b) Negatively charged didentate ligands

Ligand	Formula	Name in complexes
→ Oxalate	$C_2O_4^{2-}$	Oxalato
→ Carbonate	CO_3^{2-}	carbonato
→ oxide	O^{2-}	oxo
→ Sulphate	SO_4^{2-}	sulphato

III Hexadentate ligand

→ $(EDTA)^{4-}$ – Ethylenediaminetetraacetate ion

Formula:- $C_{10}H_{16}N_2O_8$ or $[C_{10}H_{12}N_2O_8]^{4-}$



Structure of $[EDTA]^{4-}$

GANIC CONVERSIONS INVOLVING INCREASE
NUMBER OF C ATOMS (ASCENTING IN SERIES)

① Methanol to Ethanol

$$\begin{tikzcd}
CH_3OH \arrow[rr] \arrow[d, "\substack{PCl_5\\PCl_3\\SOCl_2\\ZnCl_2|HCl}"] & & C_2H_5OH \\
CH_3Cl \arrow[d, "KCN"] & & \\
CH_3CN \arrow[r, "H_3O^+"] \arrow[dr, "H_2/Pt"'] & CH_3COOH \arrow[uur, "LiAlH_4"] & \\
& CH_3CH_2-NH_2 \arrow[uuur, "\substack{NaNO_2\\+\\HCl}"'] &
\end{tikzcd}$$

OR

$$\begin{tikzcd}
CH_3OH \arrow[r] \arrow[d, "PCC"] & C_2H_5OH \\
HCHO \arrow[ur, "\substack{i) CH_3MgBr\\ii) H_3O^+}"'] &
\end{tikzcd}$$

② Methanoic Acid to Ethanoic Acid

$$\begin{tikzcd}
HCOOH \arrow[rr] \arrow[d, "LiAlH_4"] & & CH_3COOH \\
CH_3OH \arrow[r, "P_4+I_2"] & CH_3I \arrow[r, "KCN"] & CH_3CN \arrow[u, "H_3O^+"']
\end{tikzcd}$$

③ Methanamine to Ethanamine

$$\begin{tikzcd}
CH_3NH_2 \arrow[rr] \arrow[d, "HNO_2"] & & CH_3CH_2NH_2 \\
CH_3OH \arrow[r, "P_4/I_2"] & CH_3I \arrow[r, "KCN"] & CH_3CN \arrow[u, "Na|C_2H_5OH"']
\end{tikzcd}$$

④ Chloroethane to Chloropropane

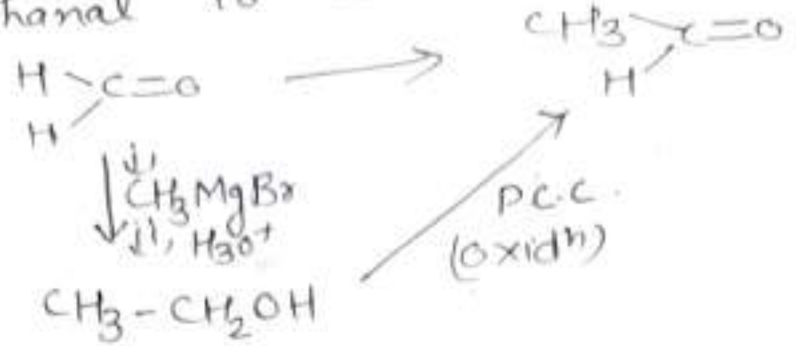
$$\begin{tikzcd}
CH_3-CH_2-Cl \arrow[rr] \arrow[dd, "KCN"] & & CH_3CH_2CH_2Cl \\
& CH_3CH_2CH_2NH_2 \arrow[dr, "HNO_2"] & \\
CH_3CH_2CN \arrow[ur, "Ni|H_2", "Na|C_2H_5OH"'] & & CH_3CH_2CH_2OH \arrow[uu, "\substack{PCl_5\\PCl_3\\SOCl_2\\ZnCl_2|HCl}"']
\end{tikzcd}$$

⑤ Methanal to Ethanal

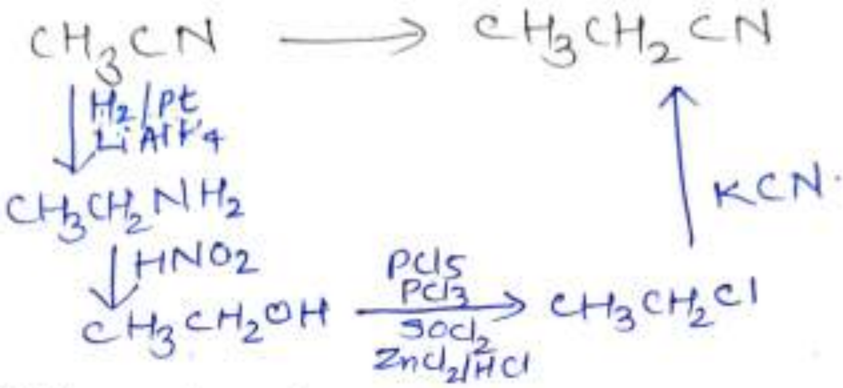
$$\begin{tikzcd}
HCHO \arrow[rrr] \arrow[ddd, "\substack{NaBH_4\\LiAlH_4}", "\substack{H_2|Pt\\Pd\\Ni}"'] & & & CH_3CHO \\
& & & CH_3COCl \arrow[u, "Pd|BaSO_4"'] \\
& & & CH_3COOH \arrow[u, "\substack{PCl_5, PCl_3\\SOCl_2}"'] \\
CH_3OH \arrow[r, "PCl_5|PCl_3", "\substack{SOCl_2\\ZnCl_2|HCl}"'] & CH_3Cl \arrow[r, "KCN"] & CH_3CN \arrow[ur] &
\end{tikzcd}$$

OR

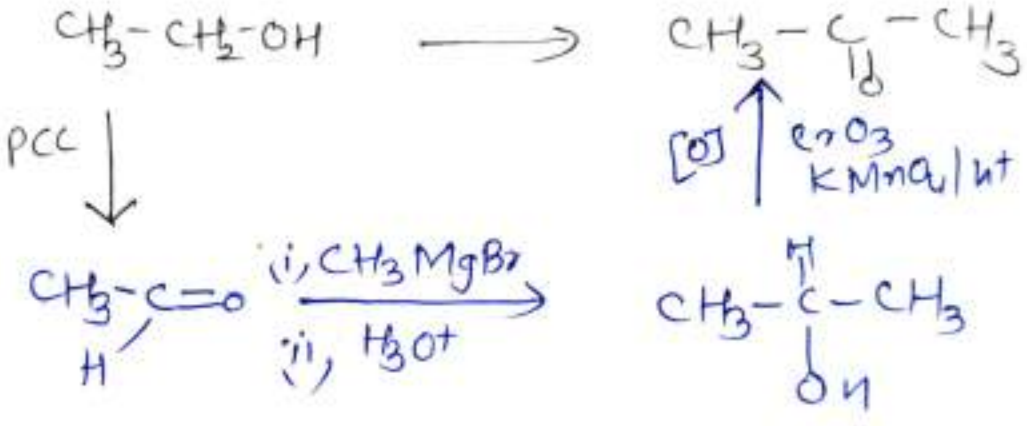
Methanal to Ethanal *



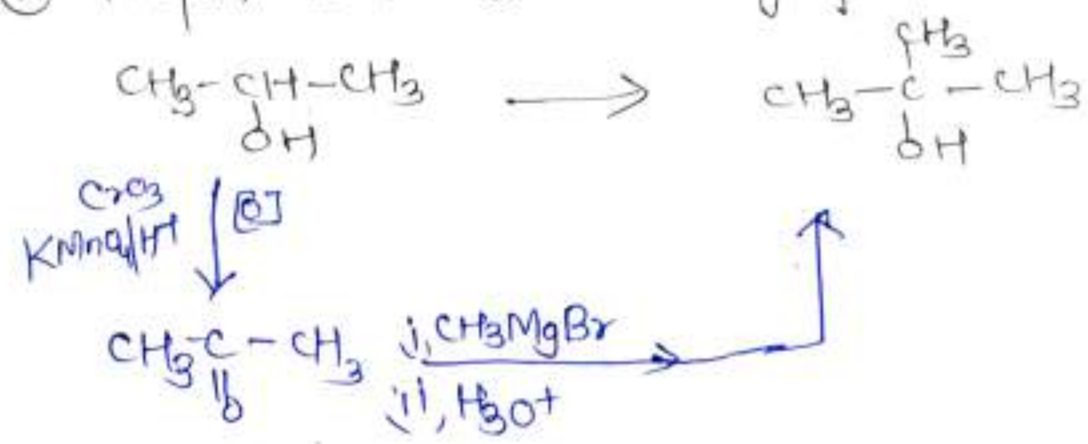
⑥ Ethanenitrile to propanenitrile



⑦ Ethanol to Acetone



⑧ Propan-2-ol to 2-methyl propan-2-ol

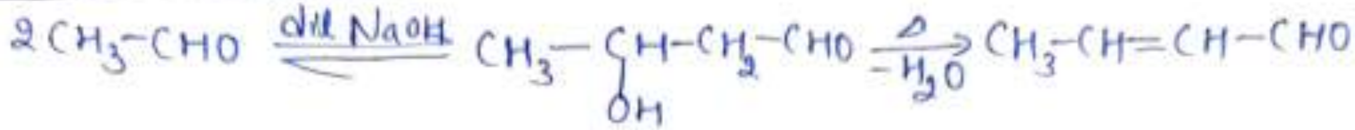


Wurtz Reaction:-

$2R-X + 2Na \xrightarrow{\text{dry ether}} R-R + NaX$

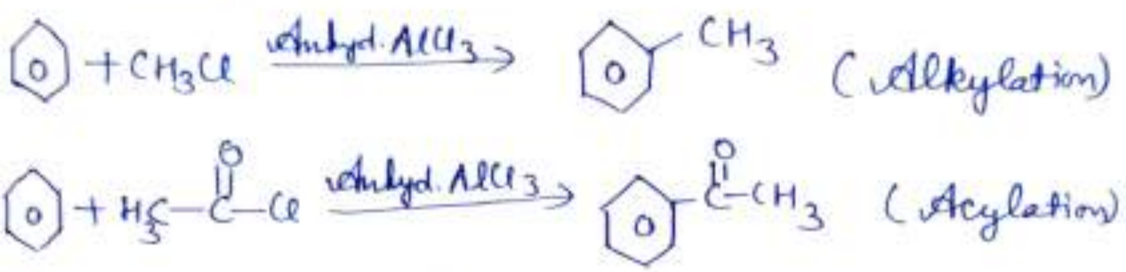
$2CH_3-Cl + 2Na \xrightarrow{\text{dry ether}} CH_3-CH_3 + 2NaCl$

⑩ Aldol condensation:-

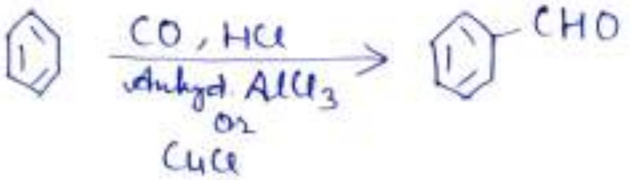


$2CH_3-CHO \underset{\longleftarrow}{\xrightarrow{\text{dil NaOH}}} CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-CHO \xrightarrow[-H_2O]{\Delta} CH_3-CH=CH-CHO$

⑪ Friedel-Crafts reaction:-

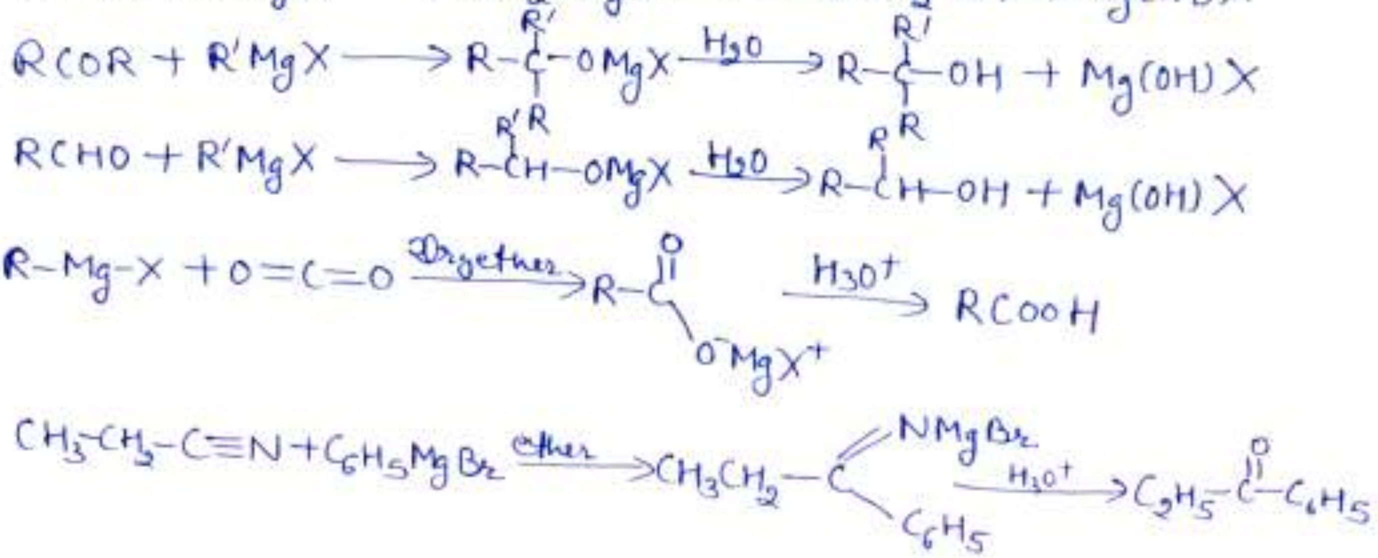


⑫ Gatterman-Koch reaction:-



⑬ Reactions with Grignard's reagent

$HCHO + RMgX \longrightarrow RCH_2OMgX \xrightarrow{H_2O} R-CH_2-OH + Mg(OH)X$



$RCOR + R'MgX \longrightarrow R-\overset{R'}{\underset{R}{C}}-OMgX \xrightarrow{H_2O} R-\overset{R'}{\underset{R}{C}}-OH + Mg(OH)X$

$RCHO + R'MgX \longrightarrow R-\overset{R'}{CH}-OMgX \xrightarrow{H_2O} R-\overset{R}{CH}-OH + Mg(OH)X$

$R-Mg-X + O=C=O \xrightarrow{\text{Dry ether}} R-\overset{O}{\overset{\|}{C}}-O^-MgX^+ \xrightarrow{H_3O^+} RCOOH$

$CH_3-CH_2-C\equiv N + C_6H_5MgBr \xrightarrow{\text{ether}} CH_3CH_2-C(=NMgBr)-C_6H_5 \xrightarrow{H_3O^+} C_2H_5-\overset{O}{\overset{\|}{C}}-C_6H_5$

Group-2

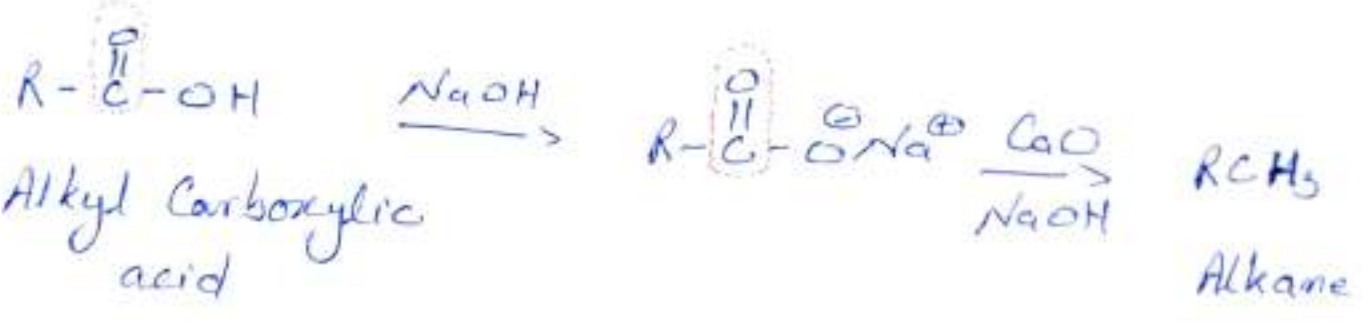
Descending Reactions [Carbon number]

1. Hoffmann Bromamide reaction :-

$$\underset{\text{Alkyl amide}}{R-\overset{O}{\overset{\|}{C}}-NH_2} \xrightarrow[KOH]{Br_2} \underset{\text{alkyl amine}}{R-NH_2}$$

No. of carbons in the chain is reduced in the final product (amine).

2. Decarboxylation reaction :-

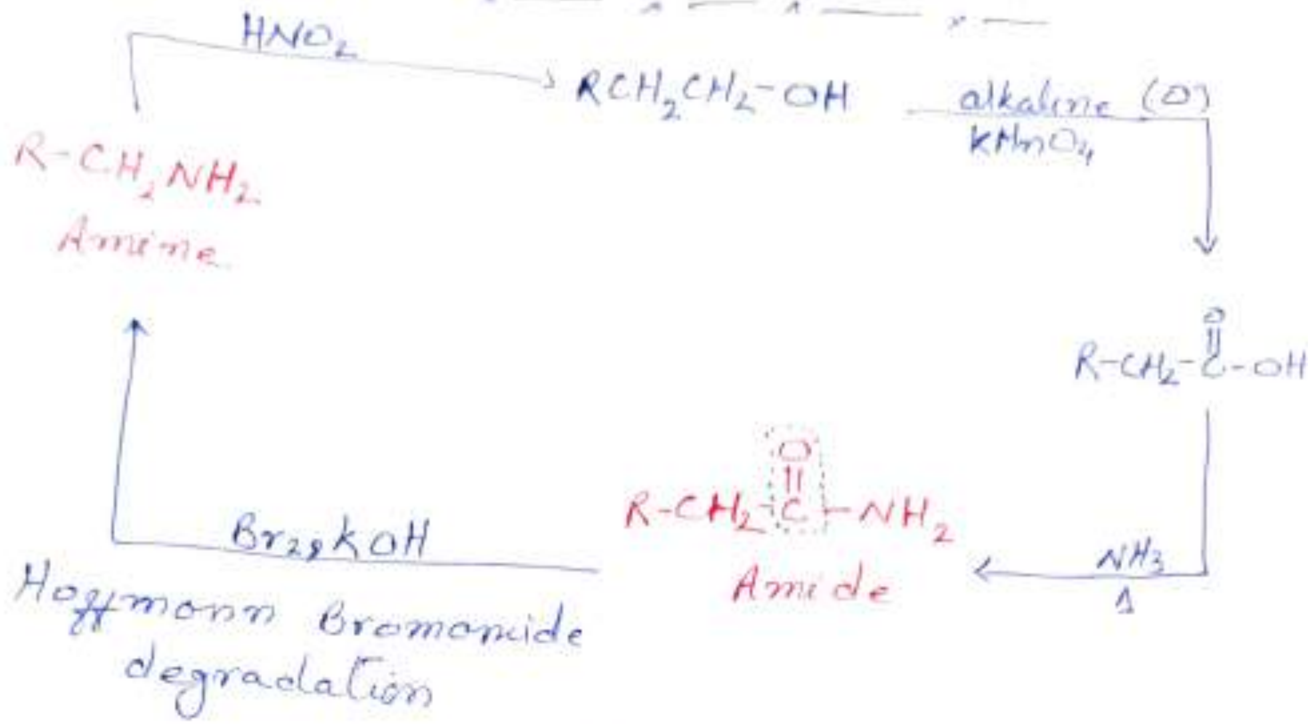


$$\underset{\text{Alkyl Carboxylic acid}}{R-\overset{O}{\overset{\|}{C}}-OH} \xrightarrow{NaOH} R-\overset{O}{\overset{\|}{C}}-\overset{\ominus}{O}Na^{\oplus} \xrightarrow[NaOH]{CaO} \underset{\text{Alkane}}{RCH_3}$$

Carbonyl carbon $(\overset{O}{\overset{\|}{C}})OH$ group of carboxylic acid is removed which results in one carbon atom less in the final product.

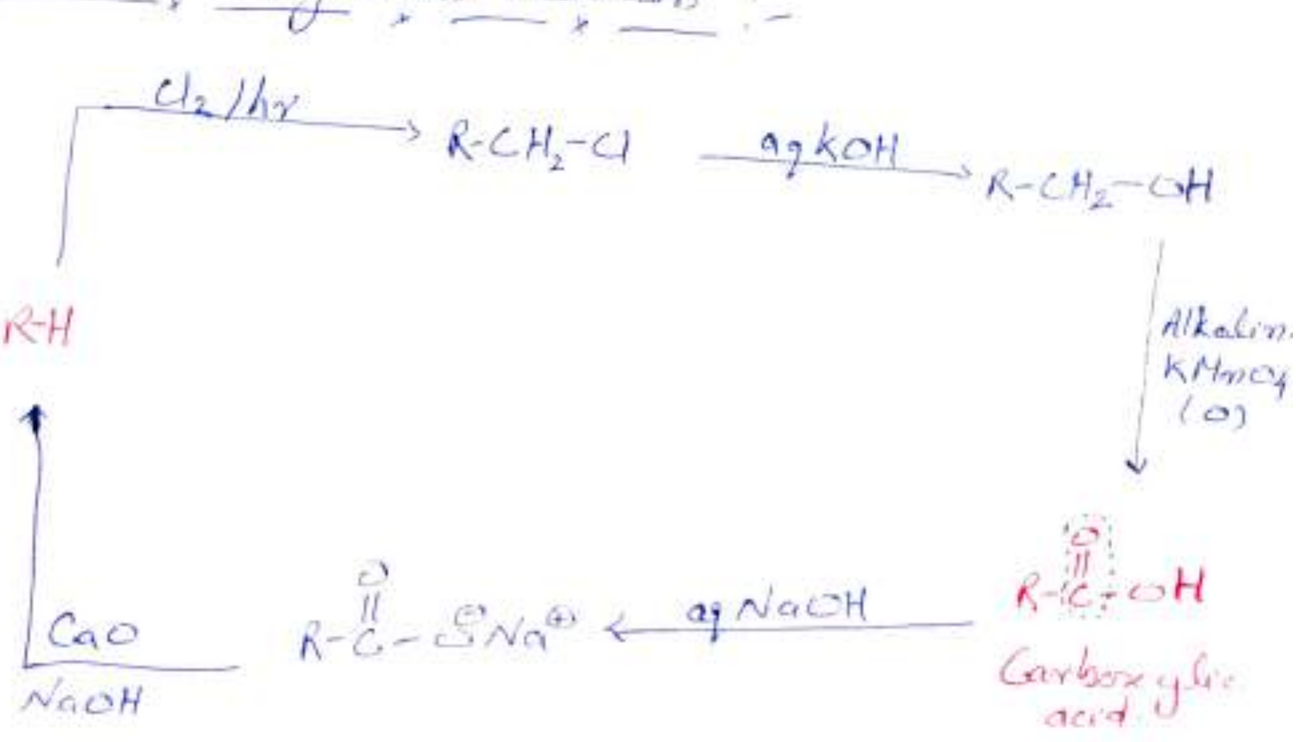
Descent of Series

1. Hoffmann Bromamide reaction :-



→ Marked Carbonyl $(-\overset{O}{\overset{\|}{C}}-)$ group is not present in the product amine. Hence this reaction reduces the member of carbon in the chai

2. Decarboxylation reaction :-



Descending the Series

Ethyl Alcohol to Methyl Alcohol

$$\begin{tikzcd}
CH_3CH_2OH \arrow[rrr] \arrow[d, "\begin{matrix}KMnO_4/H^+\\CrO_3\end{matrix}"', "{[O]}"] & & & CH_3OH \\
CH_3COOH \arrow[r, "NH_3", "\Delta"'] & CH_3CONH_2 \arrow[r, "KOH", "Br_2"'] & CH_3NH_2 \arrow[ur, "HNO_2"'] &
\end{tikzcd}$$

② Propanoic Acid to Ethanoic Acid

$$\begin{tikzcd}
CH_3CH_2COOH \arrow[rrr] \arrow[d, "\Delta"', "NH_3"] & & & CH_3COOH \\
CH_3CH_2CONH_2 \arrow[r, "KOH", "Br_2"'] & CH_3CH_2NH_2 \arrow[r, "HNO_2"] & CH_3CH_2OH \arrow[ur, "\begin{matrix}KMnO_4/H^+\\CrO_3\end{matrix}"'] &
\end{tikzcd}$$

③ Ethyl Amine to Methyl Amine

$$\begin{tikzcd}
C_2H_5NH_2 \arrow[rrr] \arrow[d, "HNO_2"] & & & CH_3NH_2 \\
C_2H_5OH \arrow[r, "{[O]}", "KMnO_4/H^+"'] & CH_3COOH \arrow[r, "NH_3", "\Delta"'] & CH_3CONH_2 \arrow[ur, "\begin{matrix}KOH\\+Br_2\end{matrix}"'] &
\end{tikzcd}$$

④ Ethyl Chloride to Methyl Chloride

$$\begin{tikzcd}
CH_3CH_2Cl \arrow[rrrr] \arrow[d, "NaOH"] & & & & CH_3Cl \\
CH_3CH_2OH \arrow[d, "KMnO_4/H^+"', "{[O]}"] & & & & CH_3OH \arrow[u, "\begin{matrix}PCl_3\\PCl_5\\SOCl_2\end{matrix}"', "\begin{matrix}ZnCl_2\\+\\HCl\end{matrix}"] \\
CH_3COOH \arrow[r, "NH_3", "\Delta"'] & CH_3CONH_2 \arrow[r, "KOH", "Br_2"'] & CH_3NH_2 \arrow[urr, "HNO_2"'] & &
\end{tikzcd}$$

⑤ Ethanamide to Methanamine

$$CH_3CONH_2 \xrightarrow[Br_2]{NaOH/KOH} CH_3NH_2$$

Group 3 REASONING QUESTIONS ORGANIC 07/8/2023.

Reasoning Questions of Organic Chemistry

Account for the following observations.

Q1 Alkyl halides though polar, are immiscible with water.

Ans:- Because alkyl halides are unable to form hydrogen bonds with water molecules.

Q2. Grignard reagents should be prepared under anhydrous conditions.

Ans: Grignard reagents react with moisture to give hydrocarbons

$$R{-}MgX + H{-}OH \rightarrow R{-}H + Mg(OH)X$$

Q3. Sulphuric acid is not used during the reaction of alcohols with KI.

Ans: Because sulphuric acid converts KI to HI and then oxidises it to I_2.

Q4. p-dichlorobenzene has higher melting point than those of o- and m- isomers.

Ans: Due to greater symmetry of para-isomer.

Q5. C-Cl bond length in chlorobenzene is shorter than C-Cl bond length in $CH_3{-}Cl$.

Ans: Due to partial double bond character acquired by C-Cl bond in chlorobenzene.

ALCOHOLS PHENOL and ETHERS :-

Q6: ortho-nitrophenol is more acidic than ortho-methoxy phenol.

Ans: Because NO_2 group is electron withdrawing and $-OCH_3$ group is electron releasing.

Q7 Propanol has higher boiling point than that of the hydrocarbon, butane.

Ans Due to hydrogen bonding in propanol.

Q8. Alcohols are comparatively more soluble in water than hydrocarbons of comparable molecular masses.

Ans Due to hydrogen bonding between alcohol and water molecules.

Q9 The C-O-H bond angle in alcohols is slightly less than the tetrahedral angle.

Ans: Due to lone pair - lone pair repulsion on oxygen atoms.

Q10 o-nitrophenol is more steam volatile than p-nitrophenol.

Ans: Due to intramolecular hydrogen bonding in o-nitrophenol.

Worksheet on Reasoning questions of Aldehydes, ketones and carboxylic acids

Group-3

Q1 Aldehydes are more reactive than ketones, why?

→ 1) Steric effect - In ketones two bulky alkyl group hinders the ~~effect~~ approach of nucleophile

2) Electron releasing effect - In ketones, presence of two alkyl group, decrease the +ve charge on carbonyl carbon and make it less reactive towards nucleophile.

Q2 Aromatic carboxylic acid do not undergo Fridal craft reaction why?

→ Because $-COOH$ group is deactivating group and the catalyst $AlCl_3$ also bonded to carboxylic group.

Q3 Pka value of 4-nitrobenzoic acid is lower than that of benzoic acid, give reason.

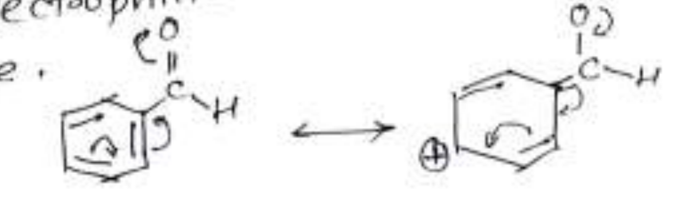
→ Because $-NO_2$ group is EWG (electron withdrawing group) and stabilises the carboxylate anion and strengthen carboxylic acid.

Q4 Why carboxylic acid is stronger than phenol?

→ Because resonating structure of carboxylate ion are more stable than phenoxide ion and negative charge dispersing on two oxygens in carboxylate ion where as it is on one oxygen in phenoxide ion.

Q5. Why benzaldehyde is less reactive than propanal towards nucleophilic addition reaction?

→ The carbon atom of carbonyl group of benzaldehyde is less electrophilic than in propanal due to resonance.



Q6 HCHO is more reactive than CH_3-CHO towards addition of HCN

→ Due to +I effect of CH_3 gp. in CH_3CHO

Q7. α-Hydrogen of aldehydes and ketones is acidic in nature

→ Due to strong electron withdrawing effect of carbonyl gp and resonance stabilisation of conjugate base.

Q8. Propanal is more reactive than propanone in nucleophilic addition reactions.

→ Due to steric hindrance and +I effect of two methyl groups in propanone.

Q9 Electrophilic substitution in benzoic acid takes place at meta position

→ Due to electron withdrawing group (EWG) - COOH, decrease e- density at ortho & para position.

Q10. Carboxylic acids are highest boiling point than aldehydes ketones and alcohols of comparable molecular masses

→ Due to extensive association of carboxylic acid molecules through intermolecular hydrogen bonding.

Q11. Carboxylic acid do not give characteristic reaction of carbonyl group.

→ Due to resonance, electroplicity of carbonyl carbon is reduced.

Q12. Oxidation of propanal is easier than propanone.

→ Because aldehyde have one-H-atom attached to carbonyl group while ketones have two H-atom attached to carbonyl group

Reasoning questions on Amines

Group-3

Q1. Aniline does not undergo Friedel craft reaction why?

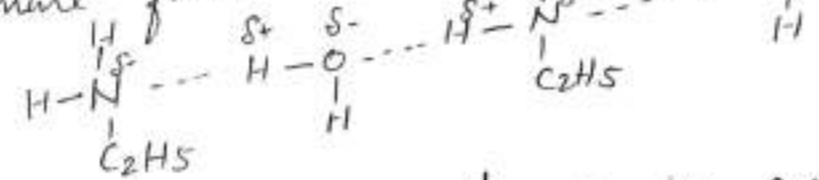
→ Aniline is a Lewis base. It reacts with Lewis acid $AlCl_3$ to form a salt. As a result, N acquires a positive charg and hence it acts as a strong deactivating group for electrophilic substitution reaction.

Q.2. pKa of aniline is more than that of methylamine.

→ In aniline due to resonance, the lone pair of electrons on N atom are delocalised over the benzene ring. In CH_3NH_2, +I effect of CH_3 increases the electron density on the N atom.

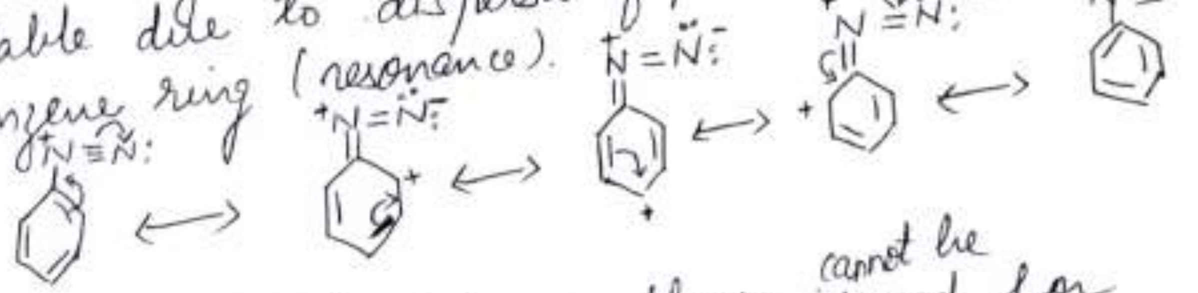
Q3. Ethylamine in soluble in water, whereas aniline is not.

→ Ethylamine forms H bonds with water molecules as shown.



Q4. Diazonium salts of aromatic amines are more stable than those of aliphatic amines.

→ The diazonium salts of aromatic amines are more stable due to dispersal of positive charge on the benzene ring (resonance).



Q5. Gabriel phthalamide synthesis ~~is~~ cannot be used for synthesising primary ~~amines~~ aromatic amines.

→ Aromatic primary amines cannot be prepared as aryl halides do not undergo nucleophilic substitution because of partial double bond character of aryl halides.

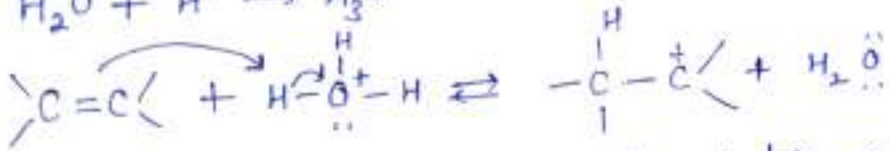
Group 3 08/08/2023

Mechanisms of Organic Chemistry

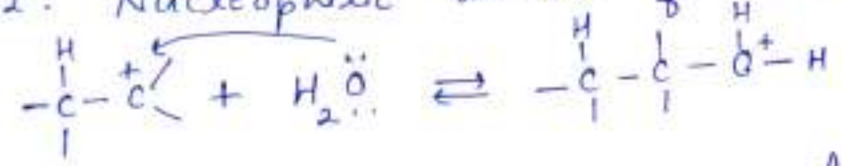
① Hydration of Alkenes

Step 1: Protonation of Alkene to form carbocation by electrophilic attack of H_3O^+

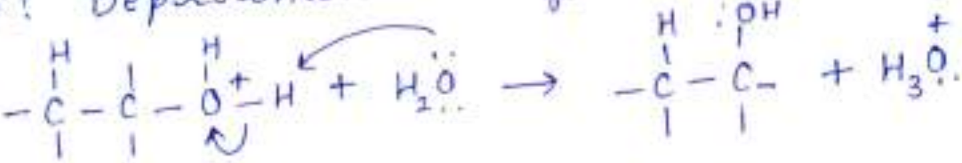
$H_2O + H^+ \rightarrow H_3O^+$



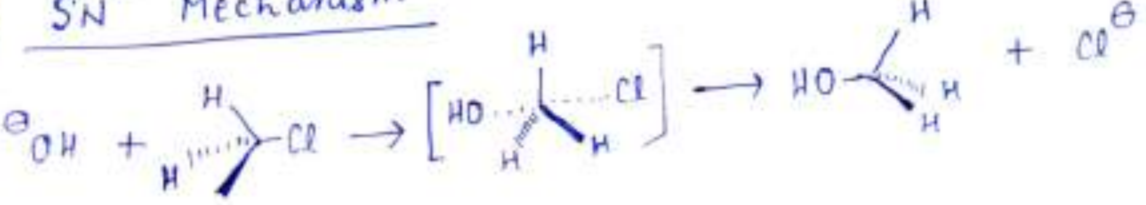
Step 2: Nucleophilic attack of water on carbocation



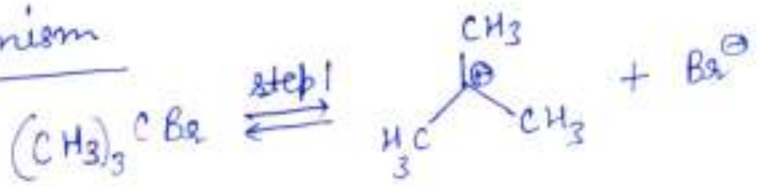
Step 3: Deprotonation to form an alcohol.

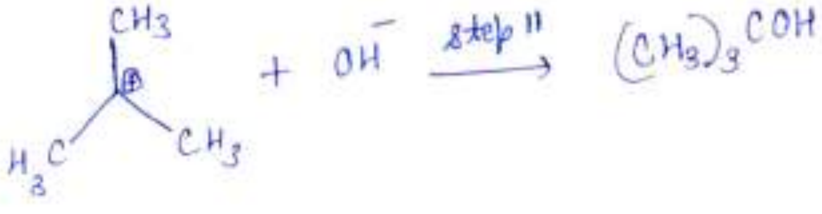


② S_N^2 Mechanism



③ S_N^1 Mechanism



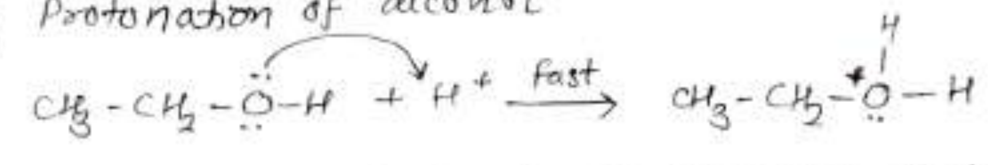


④ Reaction mechanism of alcohol to ~~ether~~ ethoxye

$$2C_2H_5OH \xrightarrow[413K]{Con. H_2SO_4} C_2H_5-O-C_2H_5 + H_2O$$

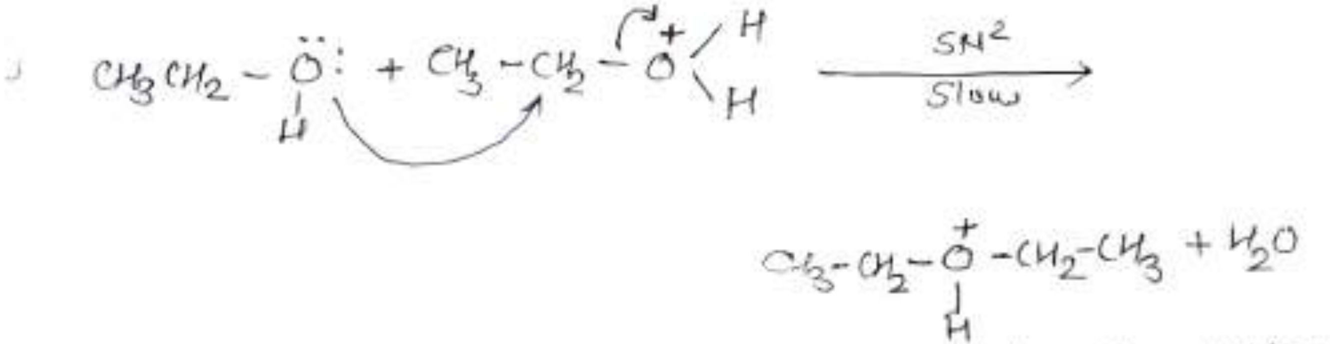
The formation of ether is a nucleophilic bimolecular reaction S_N2. It involves the attack of alcohol on a protonated alcohol.

Step 1: Protonation of alcohol



$$CH_3-CH_2-\ddot{O}-H + H^+ \xrightarrow{fast} CH_3-CH_2-\overset{H}{\overset{|}{\overset{+}{O}}}-H$$

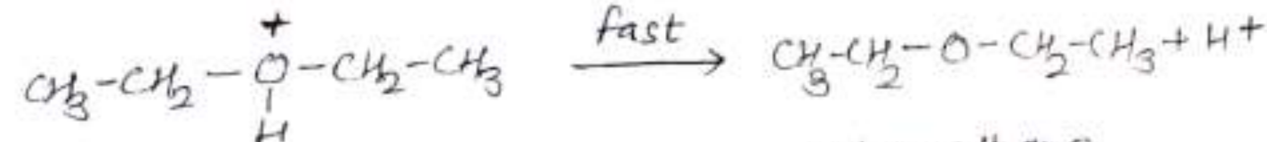
Step 2: Nucleophilic attack by unprotonated alcohol molecule on protonated alcohol molecule.



$$CH_3CH_2-\underset{H}{\underset{|}{\ddot{O}}}: + CH_3-CH_2-\overset{+}{O}\langle^{H}_{H} \xrightarrow[Slow]{S_N2} CH_3-CH_2-\underset{H}{\underset{|}{\overset{+}{O}}}-CH_2-CH_3 + H_2O$$

protonated ethoxyethane

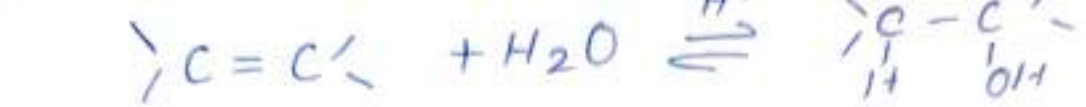
Step 3: Loss of proton from protonated ethoxy ethane



$$CH_3-CH_2-\underset{H}{\underset{|}{\overset{+}{O}}}-CH_2-CH_3 \xrightarrow{fast} CH_3-CH_2-O-CH_2-CH_3 + H^+$$

Ethoxy ethane

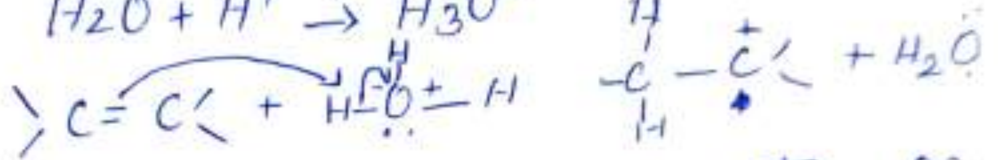
⑤ Mechanism of preparation of alcohol from alkenes.



$$>C=C< + H_2O \overset{H^+}{\rightleftharpoons} >\underset{H}{C}-\underset{OH}{C}<$$

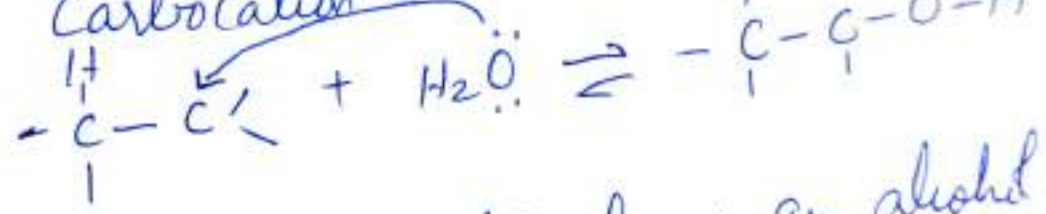
Step I : Protonation of alkene to form carbocation by electrophilic attack of H_3O^+

$$H_2O + H^+ \rightarrow H_3O^+$$



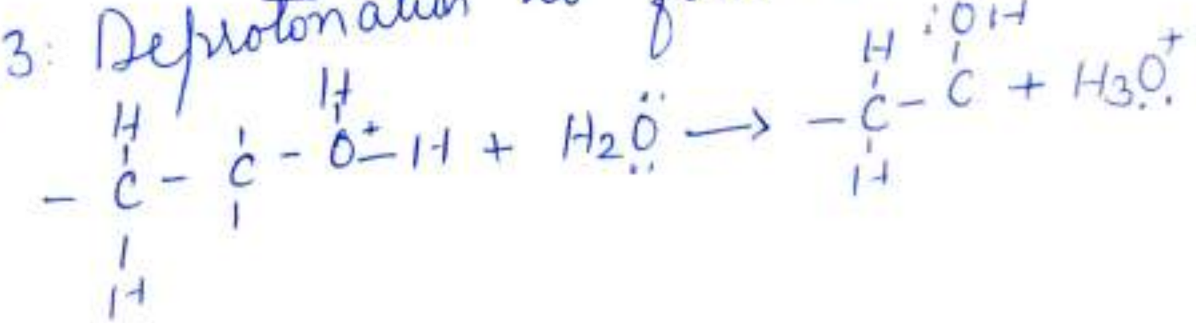
$$>C=C< + H-\overset{H}{\ddot{O}^+}-H \quad -\underset{H}{\overset{H}{C}}-\overset{+}{C}< + H_2\ddot{O}$$

Step 2: Nucleophilic attack of water on carbocation



$$-\underset{|}{\overset{H}{C}}-C< + H_2\ddot{O} \rightleftharpoons -\underset{|}{\overset{H}{C}}-\underset{|}{C}-\overset{H}{O^+}-H$$

Step 3: Deprotonation to form an alcohol.



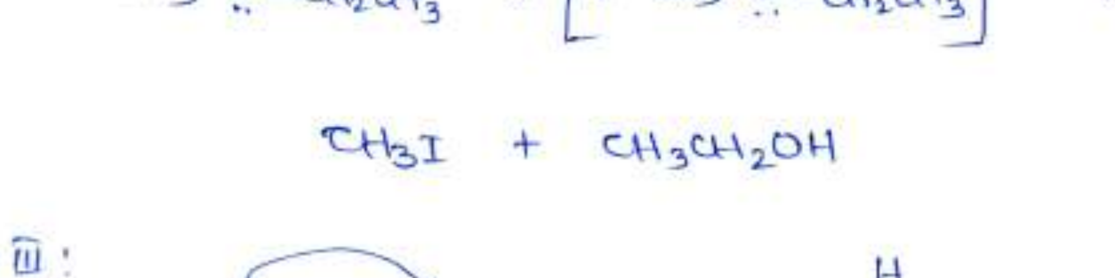
$$-\underset{H}{\overset{H}{C}}-\underset{|}{C}-\overset{H}{O^+}-H + H_2\ddot{O} \rightarrow -\underset{H}{\overset{H}{C}}-\overset{:\ddot{O}H}{C} + H_3\ddot{O}^+$$

⑥ Mechanism involved in reaction of ether with HI -

Step I :

$$CH_3-\ddot{O}-CH_2CH_3 + H-I \rightleftharpoons CH_3-\overset{H}{\overset{|}{O^{+}}}-CH_2CH_3 + I^-$$

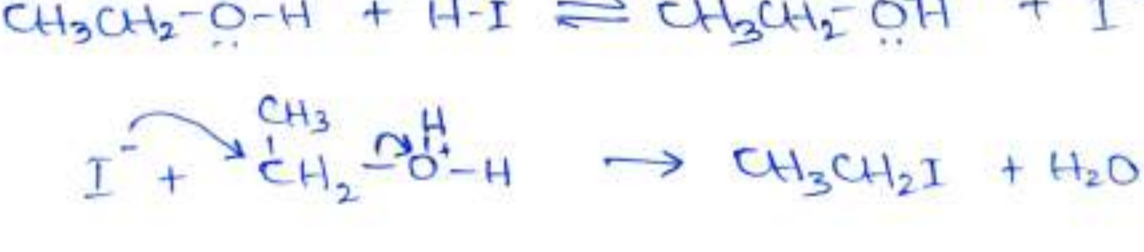
Step II :



$$I^- + CH_3-\overset{H}{\overset{|}{O^{\oplus}}}-CH_2CH_3 \longrightarrow \left[I\cdots CH_3-\overset{H}{\overset{|}{O^{\oplus}}}-CH_2CH_3 \right]^{-} \longrightarrow$$

$$CH_3I + CH_3CH_2OH$$

Step III :



$$CH_3CH_2-\ddot{O}-H + H-I \rightleftharpoons CH_3CH_2-\overset{H}{\overset{|}{O^{\oplus}}}H + I^-$$

$$I^- + \overset{CH_3}{\overset{|}{C}}H_2-\overset{H}{\overset{|}{O^{+}}}-H \longrightarrow CH_3CH_2I + H_2O$$

Group-4 IUPAC ~~Name~~ Nomenclature ~~part-2~~

2°	1°		1°	2°
Substituent	cyclo	WORD ROOT	Double or Triple bond	functional group.

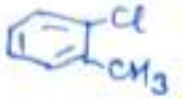
Group-4 Vineeta Vidyarthi

WORKSHEET ON IUPAC NOMENCLATURE
HALOALKANES & HALOARENES

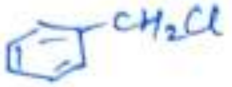
1. Write IUPAC names of the following compounds:

a. $CH_2=CHCl$ Chloroethene

b. $CH_2=CHCH_2Br$ 3-Bromopropene

c. 

1-Chloro-2-methylbenzene
or
2-Chlorotoluene

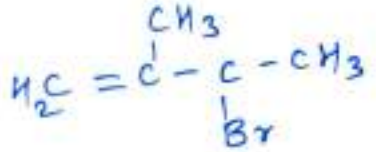
d. 

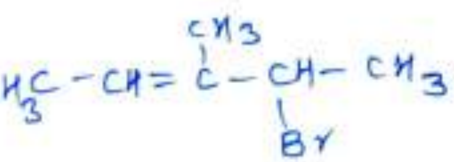
Chlorophenylmethane (Benzylchloride)

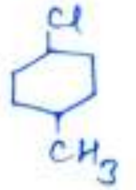
e. $CHCl_3$ Trichloromethane (Chloroform)

f. CCl_4 Tetrachloromethane (Carbon tetrachloride)

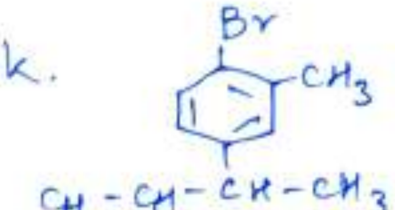
g. $(CH_3)_3CCH_2Br$ 1-Bromo-2,2-dimethylpropane

h. 
$H_2C=\overset{CH_3}{C}-\underset{Br}{C}-CH_3$ 3-Bromo-2-methylbut-1-ene

i. 
$H_3C-CH=\overset{CH_3}{C}-\underset{Br}{CH}-CH_3$ 4-Bromo-3-methylpent-2-ene

j. 

1-Chloro-4-methylcyclohexane

k. 

1-Bromo-4-sec.butyl-2-methylbenzen

Q.1. Write the structure of the following compounds.

(i) 1,4 - Dibromobut-2-ene

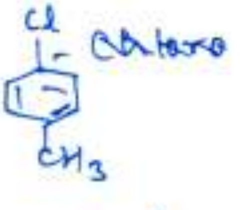
(ii). 1-Chloro-4-ethylcyclohexane

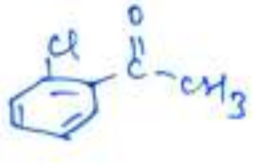
(iii) 2-Bromo-2-methylpropane

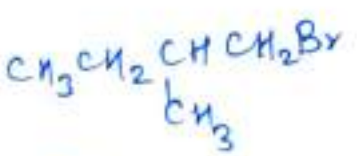
(iv) 1-Chloro-4-nitrobenzene

(v) 4-Chlorobenzenesulfonic acid

Q.2. Write the IUPAC names of the following compounds.

(i)


(ii)


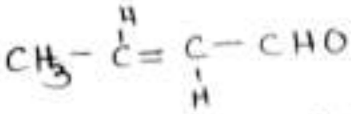
(iii)

$CH_3CH_2\underset{CH_3}{CH}CH_2Br$

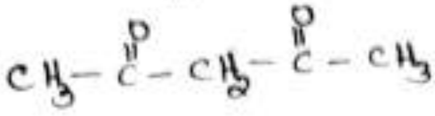
(iv)

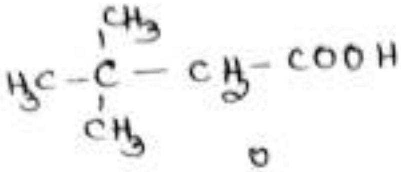

(V) $CH_3CH(Cl)CH(Br)CH_3$

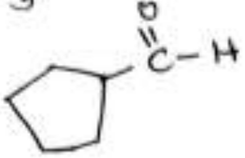
LET ME SOLVE:

1) IUPAC NAMES

i)

$CH_3-\overset{H}{C}=\underset{H}{C}-CHO$

ii)

$CH_3-\overset{O}{\overset{\|}{C}}-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

iii)

$H_3C-\overset{CH_3}{\underset{CH_3}{C}}-CH_2-COOH$

iv)


2) Draw structures of the following Compounds :-

i) 3 - Methyl Butanal

ii) 4 - Methyl pent - 3 - en - 2 - one

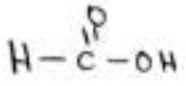
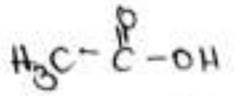
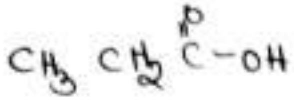
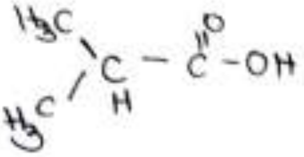
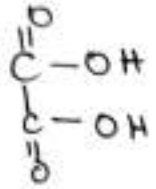
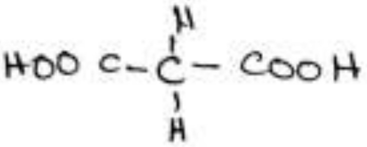
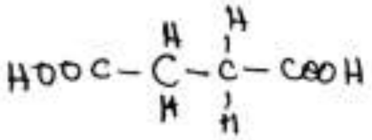
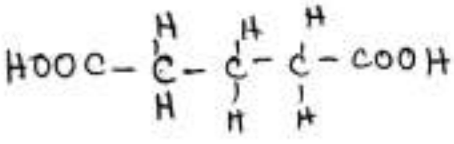
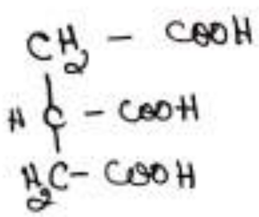
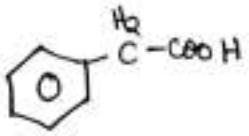
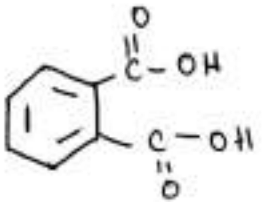
iii) Hex - 2 - en - 4 - ynoic acid

iv) 4 - chloropentan - 2 - one

v) 3 - Bromo - 4 - Phenyl pentanoic Acid.

vi) P - Methyl benzaldehyde.

CARBOXYLIC ACIDS – NOMENCLATURE

 $H-\overset{O}{\overset{\parallel}{C}}-OH$	Methanoic Acid
 $H_3C-\overset{O}{\overset{\parallel}{C}}-OH$	Ethanoic Acid
 $CH_3\ CH_2\ \overset{O}{\overset{\parallel}{C}}-OH$	Propanoic Acid
	2- Methyl Propanoic Acid
	Ethane dioic Acid
 $HOOC-\overset{H}{\underset{H}{C}}-COOH$	Propanedioic Acid
 $HOOC-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-COOH$	Butane dioic Acid
 $HOOC-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-COOH$	Pentane dioic Acid
$HOOC\ CH_2\ CH_2\ CH_2\ CH_2\ COOH$	Hexane dioic Acid
	Propane -1, 2, 3- Tri Carboxylic A
	Benzoic Acid
	2-Phenyl Ethanoic Acid
	Benzene -1, 2 -Di Carboxylic Aci

Group-4 Premdas K. Meshram

AMINES IUPAC Nomenclature

1) Alkane $\xrightarrow[\text{amine}]{-e}$ Alkanamine For 1° amine

2) If more than one amino group present Prefix di, tri etc & letter e of suffix is retained

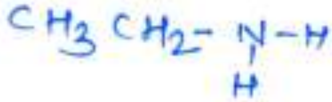
3) For 2° and 3° amine we use Locant N to designate substituent attached to a nitrogen atom.

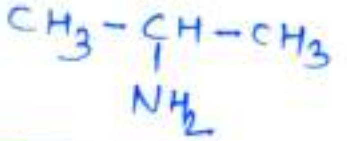
Primary amine $(-NH_2)$

Structure

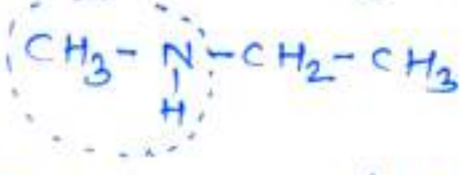
IUPAC Name

1) 
$CH_3\underset{H}{\underset{|}{N}}-H$
Methanamine

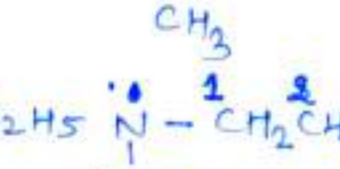
2) 
$CH_3CH_2-\underset{H}{\underset{|}{N}}-H$
Ethanamine

3) 
$CH_3-\underset{NH_2}{\underset{|}{C}}H-CH_3$
Propan-2-amine

2° Amine $(-\overset{|}{N}H)$

4) 
$CH_3-\underset{H}{\underset{|}{N}}-CH_2-CH_3$
N-Methylethanamine

3° Amine $(-\overset{|}{N}-)$

5) 
$CH_3-\underset{CH_3}{\underset{|}{N}}-CH_3$
N, N-Dimethylmethanamine

6) 
$C_2H_5\underset{C_2H_5}{\underset{|}{\ddot{N}}}-\overset{1}{C}H_2\overset{2}{C}H_2-\overset{3}{C}H_2-\overset{4}{C}H_3$ → N,N-Diethylbutan-1-amine

Group-4 Premdas K. Meshram P.N. 2

Amines IUPAC Nomenclature

S.N. Structure IUPAC Name.

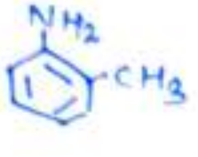
7) $NH_2-\overset{1}{C}H_2-\overset{2}{C}H=\overset{3}{C}H_2$ Prop-2-en-1-amine

8) $NH_2-(CH_2)_6-NH_2$ Hexane-1,6-diamine

9)

Aniline or Benzenamine

10)

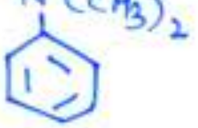


2-Methylaniline

11

4-Bromobenzenamine or 4-Bromoaniline

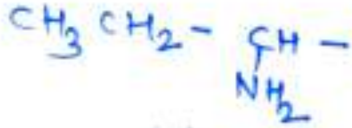
12.



N,N-Dimethylbenzenamine

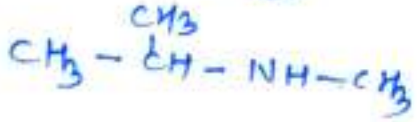
13. $CH_3-CH_2-CH_2-CH_2NH_2$ - Butanamine (1°)

14.



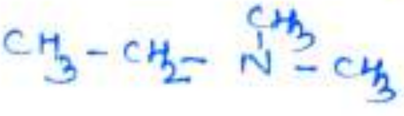
$CH_3CH_2-\underset{NH_2}{CH}-CH_3$ — Butan-2-amine (1°)

13



$CH_3-\overset{CH_3}{C}H-NH-CH_3$ N-methylpropan-2-amine (2°)

14.

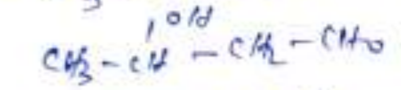
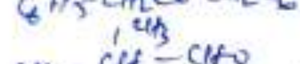
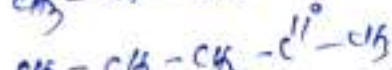
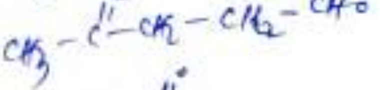
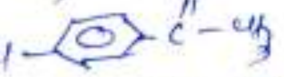
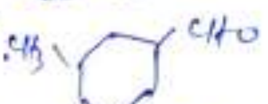
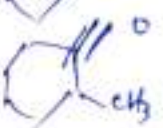
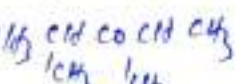
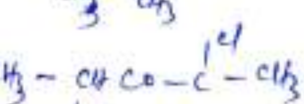
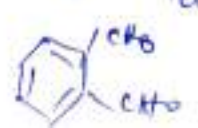


$CH_3-CH_2-\overset{CH_3}{N}-CH_3$ N,N-Dimethylethanamine

ALDEHYDES, KETONES (9B-4)

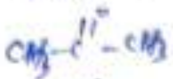
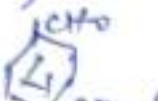
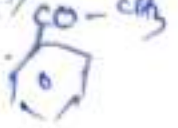
7/8/23 ①

Name the following according to IPUAC system of nomenclature

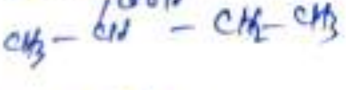
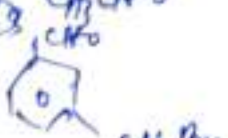
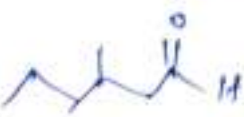
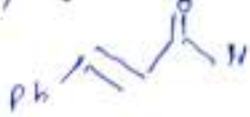
	ANSWER
1. CH_3COCH_3	1. Propanone
2. $CH_3COCH_2CH_3$	2. Butan-2-one.
3 $CH_3CH_2COCH_2CH_3$	3. Pentan-3-one
4. $C_3H_7COC_2H_5$	4 Hexan-3-one.
5 $HCHO$	5. Methanal
6. CH_3CHO	6. Ethanal
7 ~~$(CH_3)_2$ CHO~~ C_4H_9CHO	7. Butanal
8. $CH_3CH(CH_3)CH_2CH_2CHO$	8. 4-methyl Pentanal
9 $OHC\,C_6H_4CHO$	9. Benzene-1,4-dicarbaldehyde
10 $CH_3CH=CHCHO$	10. But-2-enal.
11  $CH_3-\overset{OH}{\overset{\vert}{CH}}-CH_2-CHO$	11 3-Hydroxy butanal.
12 $C_6H_5-CH_2COCH_2C_6H_5$	12. 1,3-Diphenyl-2-Propanone
13  $CH_3-\overset{CH_3}{\overset{\vert}{CH}}-CHO$	13. 2-methyl Propanal
14  $CH_3-CH_2-CH_2-\overset{O}{\overset{\Vert}{C}}-CH_3$	14 Pentan-2-one
15 $CH_3-CH=CH-CHO$	15 2-Butenal.
6. $C_6H_5-CH_2CHO$	16 phenyl ethanal
7- $CH_3COCH_2CH(Cl)CH_3$	17. 4-chloropentan-2-one.
8  $CH_3-\overset{O}{\overset{\Vert}{C}}-CH_2-CH_2-CHO$	18. 4-oxopentanal.
	19 4-chloroacetophenone
$CH_3CH_2=CH-CH_2OH$	20 Prop-2-en-1-ol
	21. 3-Methylcyclohexane
	22. 2-Methyl cyclohexanone.
 $CH_3\underset{\vert\,CH_3}{CH}CO\underset{\vert\,CH_3}{CH}CH_3$	23. 2,4-Dimethyl Pentan-3-one
 $CH_3-\underset{\vert\,Cl}{CH}CO-\overset{Cl}{\underset{\vert\,Cl}{\overset{\vert}{C}}}-CH_3$	24 2,2,4-Trichloropentan-3-one
	25. Benzene-1,2-dicarbaldehyde

①

EXERCISE FOR PRACTICE

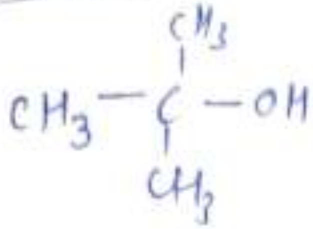
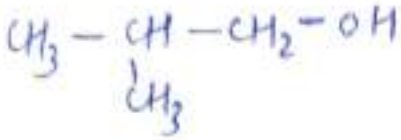
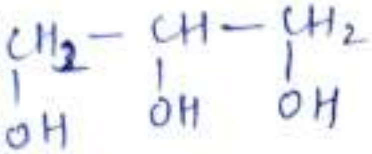
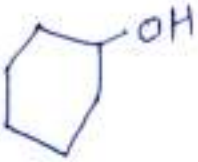
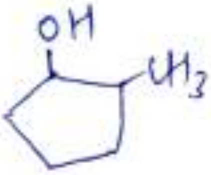
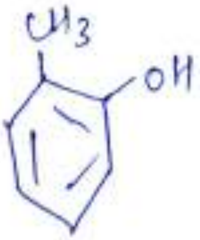
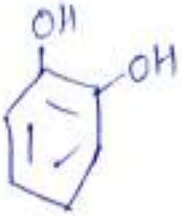
1. $CH_3CH_2CH_2COCH_3$
2. C_3H_7CHO
3. $C_5H_{11}COC_2H_5$
4. C_2H_5CHO
5. $CH_3CH_2CH_2CHO$
6. $CH_3-CO-CH_2-CO-CH_3$
7. 
$CH_3CH_2CH_2CH_2-\overset{O}{\overset{\|}{C}}-CH_3$
8. C_2H_5CHO
9. 
$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$
10. 
11. 
12. CHO
$|CHO$
13. $COOH$
$|COOH$
14. $COOH$
$|$
$COOH$

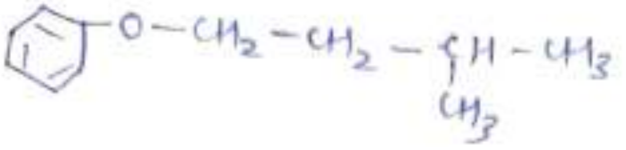
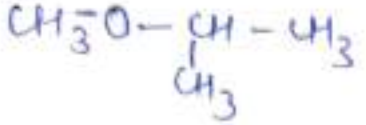
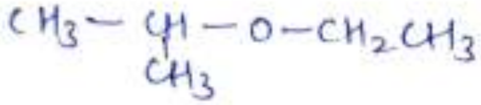
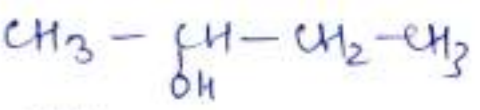
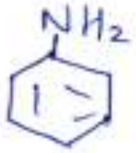
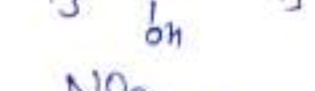
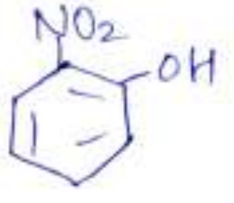
$|COOH$

15. 
$CH_3-\overset{COOH}{CH}-CH_2-CH_3$
16. Cl_3CH_2CHO
17. 
18. 
19. 
20. 

Asif Equbal
K.V. Ganeshkhind

ALCOHOLS, PHENOLS AND ETHERS

	Structures	IUPAC Name
1.	 $CH_3-\overset{\displaystyle CH_3}{\overset{\vert}{\underset{\underset{\displaystyle CH_3}{\vert}}{C}}}-OH$	2-Methylpropan-2-ol
2	 $CH_3-\underset{\underset{\displaystyle CH_3}{\vert}}{CH}-CH_2-OH$	2-Methylpropan-1-ol
3.	 $\underset{\underset{\displaystyle OH}{\vert}}{CH_2}-\underset{\underset{\displaystyle OH}{\vert}}{CH}-\underset{\underset{\displaystyle OH}{\vert}}{CH_2}$	Propane-1,2,3-triol
4.	 	cyclohexanol
5.	 	2-Methylcyclopentanol
6.	 	2-Methylphenol (o-Cresol)
7	 	Benzene-1,2-diol
8.	CH_3OCH_3	Methoxymethane

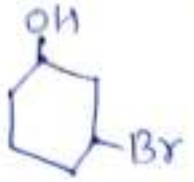
structure	IUPAC name
9. 	3-Methylbutoxybenzene
10. $CH_3-O-CH_2-CH_2-OCH_3$	1,2-Dimethoxyethane
11.  $CH_3-O-\underset{CH_3}{CH}-CH_3$	2-Methoxypropane
12 $C_2H_5-O-C_2H_5$	Ethoxyethane
13  $CH_3-\underset{CH_3}{CH}-O-CH_2CH_3$	2-Ethoxypropane
14. $CH_3-CH_2-CH_2-OH$	Propan-1-ol
15.  $CH_3-\underset{OH}{CH}-CH_2-CH_3$	Butan-2-ol
16. 	Aniline
17. $HO-H_2C-CH_2-OH$	Ethane-1,2-diol
18. 	Benzene-1,4-diol
19.  $CH_3-\underset{OH}{CH}-CH_3$	Propan-2-ol
20. 	O-Nitrophenol

ALCOHOLS AND PHENOLS

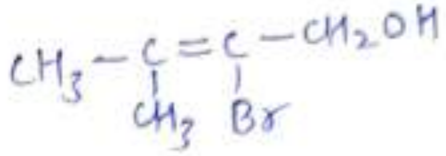
LET ME SOLVE

Q1) Name the following compounds according to IUPAC system.

(a)

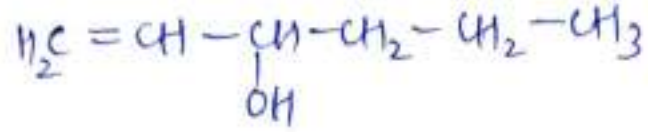


(b)



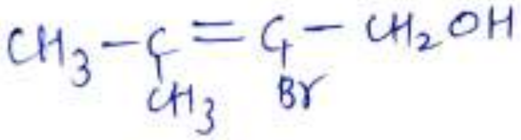
$CH_3-\underset{CH_3}{\underset{|}{C}}=\underset{Br}{\underset{|}{C}}-CH_2OH$

(c)



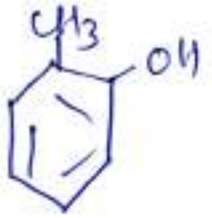
$H_2C=CH-\underset{OH}{\underset{|}{CH}}-CH_2-CH_2-CH_3$

(d)

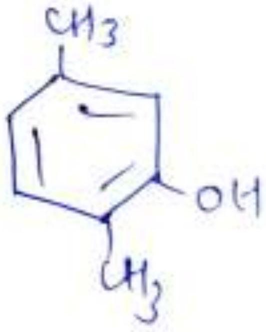


$CH_3-\underset{CH_3}{\underset{|}{C}}=\underset{Br}{\underset{|}{C}}-CH_2OH$

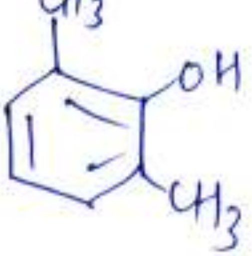
(e)



(f)



(g)



structures

Q2) Write structures of compounds whose IUPAC names are as follows:-

(a) 2-Methylbutan-2-ol

(b) 4-chloro-3-ethylbutan-1-ol

(c) Cyclohexylmethanol

(d) 3,5-Dimethylhexanane-1,3,5 triol

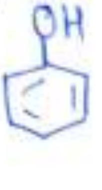
(e) 1-Phenylpropan-2-ol

(f) 2,3-Diethylphenol

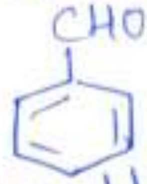
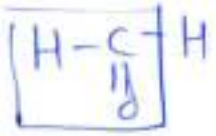
(g) 3-Cyclohexylpentan-3-ol

(h) 2-Ethoxy-3-methylpentane

Chemical distinguishing tests of functional groups

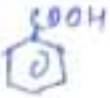
Name of the functional group	Name of the reagent	Test
① 1° Alcohol	Lucas Reagent (Anhydrous $ZnCl_2$ + Conc HCl)	→ No turbidity is obtained at room temperature
2° Alcohol		→ turbidity obtained after 5 minutes
3° Alcohol		→ turbidity is obtained immediately.
② Phenol 	1) Neutral ferric chloride solution	→ violet colouration is obtained.
	2) Bromine water	→ White ppt is obtained of 2,4,6-tribromophenol is obtained
③ Ethanol CH_3-CH_2-OH	1) Iodoform test $NaOH + I_2$	→ Yellow ppt of iodoform is obtained.
④ Aldehyde	① Mixture of Fehling solution A & B (Equimolar)	→ On heating for 5 minutes reddish brown ppt of Cu_2O is obtained.
	② Tollen's reagent (Ammonical silver nitrate solution)	→ A silver mirror inside the bottom of test tube is obtained after heating in waterbath for 5 minutes
⑤ Aldehydes & ketones with  $CH_3-\underset{O}{\underset{\|}{C}}-$ gr.	① Iodoform test $NaOH + I_2$	→ Yellow ppt of iodoform is obtained.

Chemical distinguishing tests of functional group.

ame of the functional- group	Name of the reagent	Test
⑥ Aromatic aldehyde CHO  Benzaldehyde	Equimolar mixture of Fehling solution A & B	On heating for 5 minutes in waterbath reddish brown PPT of Cu_2O is obtained (in w
⑦ Carboxylic acids —COOH	$NaHCO_3$ (Baking Soda)	→ Brisk effervescence of CO_2 gus are observed
Exception H-COOH OR  $H-\underset{\|\|}{\overset{}{C}}-H$	Tollen's reagent	→ On heating in waterbath for 5 minutes silver mirror is obtained inside the bottom of test tube.
⑧ Amines 1° amines R-NH_2	Hinsberg reagent (Benzene sulphonyl chloride)	→ 1° amines react with benzene sulphonyl chloride gives adduct which is soluble in alkali
2° amines R-NH | R	—11—	→ 2° amines react with Hinsberg reagent to give adduct which is insoluble in alkali
30 amines R-N-R | R	—11—	→ 30 amines do not react with Hinsberg reagent

Pair Distinguishing Test

① Phenol & Benzoic acid

Name of Reaction	Phenol	Benzoic acid
① $FeCl_3$ Test	C_6H_5OH  $\big\downarrow FeCl_3$ Violet complex of $[Fe(OC_6H_5)_6]^{3-}$ is formed	C_6H_5COOH  $\big\downarrow FeCl_3$ Buff coloured ppt is formed due to formation of $(C_6H_5COO)_3Fe$
② $NaHCO_3$ Test	C_6H_5OH $\big\downarrow NaHCO_3$ No effervescence of CO_2 is observed	C_6H_5COOH $\big\downarrow NaHCO_3$ $CO_2\uparrow + C_6H_5COONa + H_2O$ Effervescence due to CO_2 gas is evolved.

② Propanal and Propanone

Name of Reaction	Propanal	Propanone
(i) Iodoform Test	$CH_3CH_2\overset{O}{\overset{\|}{C}}-H$ $\big\downarrow NaOH + I_2$ No Yellow ppt	$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ $\big\downarrow NaOH + I_2$ $CH_3\overset{O}{\overset{\|}{C}}-ONa + CHI_3$ Yellow ppt due to formation of Iodoform
(ii) Fehling's Test	CH_3CH_2CHO $\big\downarrow$ Fehling soln $CH_3CH_2COO^{\ominus} + Cu_2O\downarrow + H_2O$ Red ppt of Cu_2O is obtained	$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ $\big\downarrow$ Fehling soln Red ppt of Cu_2O is not obtained.
(iii) Tollen's Test	CH_3CH_2CHO $\big\downarrow AgNO_3 + NH_4OH$ $CH_3CH_2COO^- + 2Ag + H_2O + NH_3$ Silver Mirror is obtained	CH_3COCH_3 $\big\downarrow AgNO_3 + NH_4OH$ No Silver mirror is obtained.

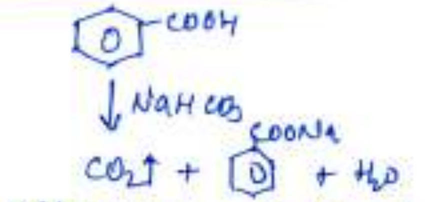
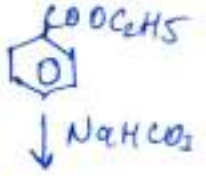
Butanal & Butan-2-one

me. of React.n /Test	Butanal	Butan-2-one
Iodoform Test	$CH_3CH_2CH_2CHO \xrightarrow{NaOH + I_2}$ X No yellow crystalline product obtained	$CH_3-CH_2-\overset{O}{C}-CH_3 \xrightarrow{NaOH + I_2} CH_3CH_2\overset{O}{C}-O^{\ominus}Na^{\oplus} + CHI_3$ Yellow ppt of Iodoform is obtained

④ Acetophenone and Benzophenone

Name of Test	Acetophenone	Benzophenone
Iodoform Test	$C_6H_5COCH_3 \xrightarrow{NaOH + I_2} C_6H_5COONa + CHI_3$ Yellow ppt of Iodoform is obtained	$C_6H_5COC_6H_5 \xrightarrow{NaOH + I_2}$ No yellow ppt of Iodoform is obtained

⑤ Benzoic acid and Ethyl Benzoate.

Name of Test	Benzoic acid	Ethyl Benzoate
$NaHCO_3$ Test	 Effervescence of CO_2 is obtained	 Effervescence of CO_2 is not obtained

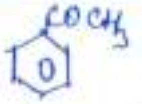
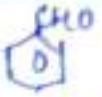
⑥ Pentan-2-one and Pentan-3-one

Name of Test	Pentan-2-one	Pentan-3-one
Iodoform Test	$CH_3CH_2CH_2\overset{O}{C}CH_3 \xrightarrow{NaOH + I_2} CH_3CH_2CH_2COONa + CHI_3$ ↓ Yellow ppt of (CHI_3) Iodoform is obtained	$CH_3CH_2\overset{O}{C}CH_2CH_3 \xrightarrow{NaOH + I_2}$ No yellow ppt of (CHI_3) Iodoform is obtained.

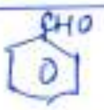
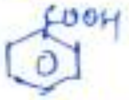
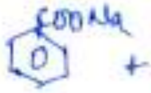
thanal and Propanal

me of Test	Ethanal	Propanal
odoform Test	CH_3CHO $\downarrow NaOH + I_2$ $CHI_3 \downarrow$ Yellow ppt of Iodoform is obtained	CH_3CH_2CHO $\downarrow NaOH + I_2$ No yellow ppt of CHI_3 (Iodoform) is obtained

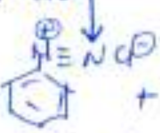
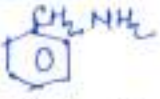
⑧ Acetophenone and Benzaldehyde

Name of Test	Acetophenone	Benzaldehyde
Iodoform Test	 $\downarrow I_2 + NaOH$ $\boxed{CHI_3} + C_6H_5COONa$ Yellow ppt of Iodoform is obtained	 $\downarrow I_2 + NaOH$ No Yellow ppt of Iodoform CHI_3 is Observed

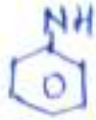
⑨ Benzaldehyde and Benzoic acid

Name of Test	Benzaldehyde	Benzoic acid
$NaHCO_3$ Test	 $\downarrow NaHCO_3$ No effervescence due to evolution of CO_2 gas is Observed	 $\downarrow NaHCO_3$  $+ CO_2\uparrow + H_2O$ $\downarrow$ Evolution of CO_2 gas is observed.

⑩ Aniline and Benzylamine

Name of Test	Aniline	Benzyl amine
Nitrous acid test	 $273-278K \downarrow NaNO_2 + HCl$  $+ NaCl + H_2O$ stable diazonium salt is obtained	 $273-278K \downarrow NaNO_2 + HCl$ unstable diazonium salt is obtained which is decomposed and gives N_2 gas $C_6H_5CH_2OH + N_2\uparrow + HCl$

iline and N-methyl aniline

me. of Test	Aniline	N- methyl aniline
Carbylamine test	 $\Delta \downarrow CHCl_3 + KOH$ $C_6H_5NC + KCl + H_2O$ phenyl isocyanide having foul smell Is obtained.	 $\Delta \downarrow CHCl_3 + KOH$ No isocyanide is obtained

⑫ Methanamine and N-Methylmethanamine

Name of Test	Methanamine	N-Methylmethanamine
Carbylamine Test	CH_3NH_2 $\Delta \downarrow CHCl_3 + KOH$ $CH_3NC + KCl + H_2O$ Methyl isocyanide with foul smell is obtained.	$(CH_3)_2NH$ $\Delta \downarrow CHCl_3 + KOH$ No isocyanide is obtained.

⑬ Methanamine and N,N-Dimethylmethanamine

Name of Test	Methanamine	N,N-Dimethylmethanamine
Carbylamine Test	CH_3NH_2 $\Delta \downarrow CHCl_3 + KOH$ $CH_3NC + KCl + H_2O$ Methyl isocyanide with foul smell is obtained	$(CH_3)_3N$ $\Delta \downarrow CHCl_3 + KOH$ No isocyanide is obtained

Solutions

Question 1.
The osmotic pressure of a solution is directly proportional to
(a) the molecular concentration of the solute
(b) the absolute temperature at a given concentration
(c) the lowering of vapour pressure
(d) all the above.

Answer: (d) all the above.

Question 2.
Isotonic solution are the solutions having the same.
(a) surface tension
(b) concentration
(c) osmotic pressure
(d) viscosity

Answer: (c) osmotic pressure

Question 3.
Which of the following is a colligative property?
(a) osmotic pressure
(b) boiling point
(c) vapour pressure
(d) electrical conductivity

Answer: (a) osmotic pressure

Question 4.
Which of the following solutions have highest freezing point?
(a) 0.1 M NaCl
(b) 0.1 M BaCl2
(c) 0.1 M Al2 (SO4)3
(d) 0.1 M urea.

Answer: (d) 0.1 M urea.

Question 5.
Which of the following 0.1 M aqueous solutions will have the lowest freezing point?
(a) potassium sulphate
(b) sodium chloride
(c) urea
(d) glucose

Answer: (a) potassium sulphate

Question 6.
The mass of $(COOH)_2 \cdot 2H_2O$ needed to prepare 500 ml of 0.1 molar solution is
(a) 12.6 gm
(b) 6.3 gm
(c) 4.5 gm
(d) 9.0 gm

Answer: (b) 6.3 gm

Question 7.
Which of the following solutions has highest osmotic pressure?
(a) 1 M NaCl
(b) 1 M $MgCl_2$
(c) 1 M urea
(d) 1M glucose.

Answer: (a) 1 M NaCl

Question 8.
Which of the following solutions (in water) has highest boiling point?
(a) 1 M NaCl
(b) 1 M $MgCl_2$
(c) 1M Urea
(d) 1 M glucose.

Answer: (b) 1 M $MgCl_2$

Question 9.
Which of the following aqueous solutions containing 10 g of solute in each case, has highest m.pt?
(a) NaCl solution
(b) KC1 solution
(c) sugar solution
(d) glucose solution.

Answer: (c) sugar solution

Question 10.
Equal volumes of 0.1 M $AgNO_3$ and 0.2 M NaCl solutions are mixed. The concentration of NO_3^- ions in mixture solution will be
(a) 0.1 M
(b) 0.05 M

(c) 0.2 M
(d) 0.15 M

Answer: (b) 0.05 M

Electrochemistry

Question 1.
Standard solution of KNO3 is used to make a salt bridge because
(a) Velocity of K+ is greater than that of NO−3.
(b) Velocity of NO−3 is greater than that of K+.
(c) Velocity of both K+ and NO−3 are nearly same
(d) KNO3 is highly soluble in water.

Answer: (c) Velocity of both K+ and NO−3 are nearly same

Question 2.
For the electro-chemical cell:
M| M+|| X–| X, E0M+,M = 0.44 V and E0x,x− = 0.33 V
From the data one can deduce that
(a) M+ X → M+ + X– is the spontaneous change
(b) M+ + X– → M + X is the spontaneous reaction
(c) Ecell = 0.77 V
(d) Ecell = -0.77 V

Answer: (b) M+ + X– → M + X is the spontaneous reaction

Question 3.
Galvanised iron sheets are coated with
(a) Carbon
(b) Copper
(c) Zinc
(d) Nickel

Answer: (c) Zinc

Question 4.
How many coulombs are required for the oxidation of 1 mole of H2O to O2?
(a) 1.93 × 105 C
(b) 9.65 × 104 C
(c) 3.86 × 105 C
(d) 4.825 × 105 C

Answer: (a) 1.93 × 105/sup> C

Question 5.
Rust is a mixture of
(a) FeO and Fe (OH)3
(b) FeO and Fe (OH)2
(c) Fe2O3 and Fe (OH)3
(d) Fe3O4 and Fe (OH)3

Answer: (c) Fe2O3 and Fe (OH)3

Question 6.
The Standard electrode potentials for the half cell reactions are as follows
Zn ? Zn2+ + 2e– [E° = 0.41 V]
Fe ? Fe2+ + 2e– [E° = 0.76 V]
(a) -0.35 V
(b) 0.35 V
(c) + 1.17 V
(d) -1.17 V

Answer: (b) 0.35 V

Question 7.
Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox titration. Some half cell reactions and their standard potentials are given below:
MNO–4 (aq) + 8H+ (aq) + 5e– → Mn2+ (aq) + 4H2O (1) E° = 1.51 V
Cr2O72- (aq) + 14H+ (aq) + 6e– → 2 Cr3+ (aq) + 7H2O (1) E° = 1.38 V
Fe3+- (aq) + e– ? Fe2+ (aq) E° = 0.77 V
Cl2 (g) + 2e– ? 2Cl– (aq) E° = 1.40 V
Identify the only incorrect statement regarding the quantitative estimation of aqueous Fe (NO3)2.
(a) MnO−4 can be used in aqueous HCl.
(b) Cr2O2−7 can be used in aqueous HCl.
(c) MnO−4 can be used in aqueous H2SO4.
(d) Cr2O2−7 can be used in aqueous H2SO4.

Answer: (a) MnO−4 can be used in aqueous HCl.

Question 8.
The standard reduction potentials of Cu2+/Cu and Cu2+/Cu+ are 0.337 and 0.153 respectively. The standard electrode potential of Cu+/Cu half cell is
(a) 0.184 V
(b) 0.827 V
(c) 0.521V
(d) 0.490 V

Answer: (c) 0.521V

Question 9.
The standard reduction potentials of X, Y, Z metals are 0.52, -3.03, -1.18 respectively. The order of reducing power of the corresponding metals is:
(a) Y > Z > X
(b) X > Y > Z
(c) Z > Y > X
(d) Z > X > Y

Answer: (a) Y > Z > X

Question 10.
Which of the following is not a good conductor?
(a) Cu
(b) NaCl (aq)
(c) NaCl (molten)
(d) NaCl(s)

Answer: (d) NaCl(s)

Chemical Kinetics

Question 1.
For a chemical reaction, X + 2Y → Z, if the rate of appearance of Z is 0.50 moles per litre per hour, then the rate of disappearance of Y is
(a) 0.5 mol L-1 hr-1
(b) 1.0 mol L-1 hr-1
(c) 0.25 mol L-1 hr-1
(d) cannot be predicted

Answer: (b) 1.0 mol L-1 hr-1

Question 2.
For the reaction, NO2 (g) + CO (g) → NO (g), the correct expression for the rate of the reaction is
(a) rate = −d[NO2]dt
(b) rate = −d[CO2]dt
(c) rate = d[NO2]−d[CO]dt
(d) rate = d[CO2]dt

Answer: (a) rate = −d[NO2]dt

Question 3.
The rate of a reaction is primarily determined by the slowest step. This step is called
(a) rate determining step
(b) activation step

(c) reaction rate step
(d) none of these.

Answer: (a) rate determining step

Question 4.
The reaction of high molecularity are rare because
(a) Many body collisions have a low probability.
(b) Many body collisions are not favoured energetically.
(c) Activation energy of many body collisions is very large
(d) Very high concentration is required for such reactions.

Answer: (a) Many body collisions have a low probability.

Question 5.
For a chemical reaction A → B, it is found that the rate of the reaction quardruples when the concentration of A is doubled. The rate expression for the reaction is, rate = k [A]n where the value of n is
(a) 1
(b) 2
(c) 0
(d) 3

Answer: (b) 2

Question 6.
On increasing the temperature of the reacting system by 10° the rate of reaction almost becomes double. The most appropriate reason for this is that
(a) Activation energy decreases by increases of temperature
(b) The fraction of molecules having threshold energy increases
(c) Collision frequency increases
(d) The value of threshold energy decreases.

Answer: (b) The fraction of molecules having threshold energy increases

Question 7.
The half-life period of any first order reaction
(a) is half the specific rate constant
(b) is always the same irrespective of the reaction
(c) is independent of initial concentration
(d) in directly proportional to initial concentration of reactants.

Answer: (c) is independent of initial concentratio

Question 8.
The dimensions of rate constant of 2nd order reaction involves
(a) concentration
(b) concentration and time
(c) time only
(d) neither time nor concentration.

Answer: (b) concentration and time

Question 9.
A zero order reaction A → Products, has rate constant 10-2 mole L-1 s-1. If a process is started with 10 moles of A in a one litre vessel, the number of moles of reactant after 10 minutes will be
(a) 10
(b) 5
(c) 6
(d) 4.

Answer: (d) 4.

Question 10.
For which of the following reactions, the temperature coefficient is maximum?
(a) A → B : Ea = 50 kJ
(b) P → Q : Ea = 40 kj
(c) X → Y : Ea = 60kJ
(d) W → Z : Ea = 80kJ

Answer: (d) W → Z : Ea = 80kJ

d-and f-Block Elements

Question 1.
Which one of. the following metals is used as a catalyst in the Haber's process?
(a) Tungsten
(b) Molybdenum
(c) Chromium
(d) iron containing Mo.

Answer: (d) iron containing Mo.

Question 2.
When manganese dioxide is fused with KOH in air. It gives
(a) potassium permanganate
(b) potassium manganate

(c) manganese hydroxide
(d) Mn3O4.

Answer: (b) potassium manganate

Question 3.
Whith metal has highest melting point?
(a) Pt
(b) W
(c) Pd
(d) Au.

Answer: (b) W

Question 4
In KMnO4 oxidation number of Mn is
(a) +2
(b) + 4
(c) + 6
(d) + 7

Answer: (d) + 7

Question 5

When KMn04 acts as oxidising agent in alkaline medium, the oxidation number of Mn decreases by
(a) 1
(b) 2
(c) 3
(d) 5.

Answer: (c) 3

Question 6

The transition element with lowest atomic number is
(a) Scandium
(b) Titanium
(c) Zinc
(d) Lanthanum.

Answer: (a) Scandium

Question 7

Which of the following oxides is amphoteric in nature?
(a) NiO
(b) ZnO
(c) CoO
(d) FeO

Answer: (b) ZnO

Question 8
Which of the following oxides in acidic in nature?
(a) CrO
(b) Cr2O3
(c) CrO3
(d) CrO2

Answer: (c) CrO3

Question 9

If two compounds have the same crystal structure and analogous formula, they are called
(a) Isomers
(b) Isotopes
(c) Isobars
(d) Isomorphous.

Answer: (d) Isomorphous.

Question 10
Which of the following would be diamagnetic?
(a) Cu2+
(b) Ni2+
(c) Cd2+
(d) Ti3+.

Answer: (c) Cd2+

Coordination Compounds

Question 1.
The oxidation number of Cr in a [Cr(NH3)2F4]– complex is
(a) II
(b) III

(c) IV
(d) VI.

Answer: (b) III

Question 2.
The formula of potassium dicyanobis (oxalato) nickelate (II) is
(a) K4[Ni(CN)(Ox)2]
(b) K3[Ni2 (CN)2 (Ox)2]
(c) K4[Ni(CN)2(Ox)2]
(d) K2[Ni(CN)2(Ox)2]

Answer: (c) K4[Ni(CN)2(Ox)2]

Question 3.
The name of [Co(NH2)3 (NO2)3] is
(a) T.initrotriamminecobalt(III)
(b) Trinjtrotriamminecobalt(II)
(c) Trirtitrotriamjninecobalt (III) ion
(d) TrinitrotnamminecobaHate (III).

Answer: (a) T.initrotriamminecobalt(III)

Question 4.
The co-ordination number of cobalt in the complex [Co(en)2Br2]Cl2 is
(a) 4
(b) 6
(c) 5
(d) 2.

Answer: (b) 6

Question 5.
The number of halide ions in [Pt(NH3)3Cl3Br]Cl will be
(a) 4
(b) 3
(c) 2
(d 1.

Answer: (d) 1.

Question 6.
K3[Al(C2O4)3] is called
(a) Potassium alumino oxalate
(b) Potassium aluminium (III) trioxalate
(c) Potassium trioxalato aluminate (III)
(d) Potassium tris (oxalato) aluminium.

Answer: (c) Potassium trioxalato aluminate (III)

Question 7.
The cation that does not form an ammine complex with excess of ammonia is
(a) Ag+
(b) Al3+
(c) Cu2+
(d) Cd2+

Answer: (b) Al3+

Question 8.
EDTA combines with cations to form
(a) chelates
(b) clathrates
(c) non-stoichiometric compounds
(d) polymers.

Answer: (a) chelates

Question 9.
One among the following is an example of hexadentate ligands
(a) 2,2-bipyridyl
(b) ethylenediammine tetra acetate ion
(c) dimethyl glyoxime
(d) Tetracarbonyl nickel.

Answer: (b) ethylenediammine tetra acetate ion

Question 10.
One among the following is not an organometallic compound
(a) Trimethylboron
(b) Trimethyl aluminium
(c) Trimethoxy titanium chloride
(d) Tetracarbonyl nickel.

Answer: (c) Trimethoxy titanium chloride

Haloalkanes and Haloarenes

Question 1.
The most reactive nucleophile among the following is
(a) CH3O–
(b) C6H5O–

(c) (CH3)2CHO–
(d) (CH3)3 CO–

Answer: (a) CH3O–

Question 2.
CH3CH2CHCl CH3 obtained by chlorination of n-butane, will be
(a) meso-form
(b) racemic mixture
(c) d-form
(d) 1-form

Answer: (b) racemic mixture

Question 3.
In Friedel-Crafts synthesis of toluene, reactants in addition to anhydrous AlCl3 are:
(a) C6H6 + CH4
(b) C6H6 + CH3Cl
(c) C5H5Cl + CH3Cl
(d) C6H5/sub>Cl + CH4

Answer: (b) C6H6 + CH3Cl

Question 4.
SN1 reaction of alkyl halides leads to
(a) retention of configuration
(b) racemisation
(c) inversion of configuration
(d) none of these.

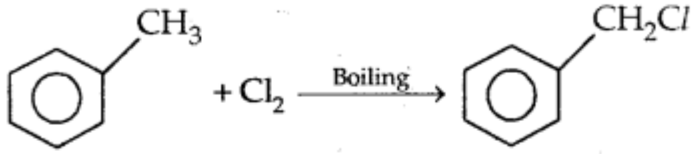
Question 5.
Nucleophilieity order is correctly represented by
(a) $CH_3^- < \overline{N}H_2 < H\overline{O} < F^-$
(b) $CH_3^- \simeq N\overline{H}_2 > OH^- \simeq \overline{F}$
(c) $CH_3^- > \overline{N}H_2 > H\overline{O} > F^-$
(d) $NH_2^- > \overline{F} > HO^- > CH_3^-$

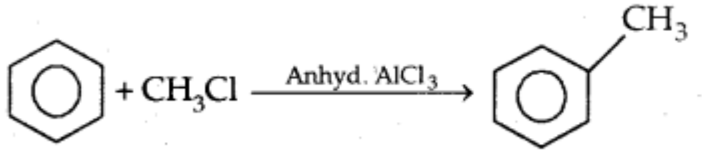
Answer: (c)

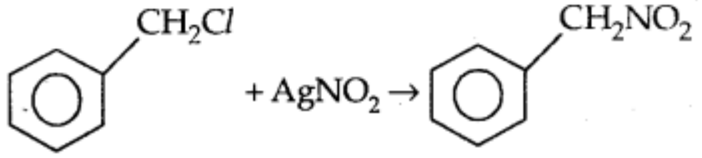
Question 6.
Which of the following are arranged in the decreasing order of dipole moment?
(a) CH3Cl, CH3Br, CH2F
(b) CH3Cl, CH3F, CH3Br
(c) CH3Br, CH3Cl, CH3F
(d) CH3Br, CH3F, CH3Cl

Answer: (b) CH3Cl, CH3F, CH3Br

Question 7.
Which of the following is a free radical substitution reaction?

(a)


(b)


(c)


(d) CH3CHO + HCN → CH3CH (OH) CN

Answer: (a)

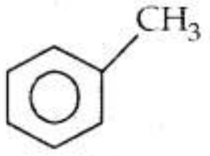
Question 8.
The reactivity order of halides for dehydrogenation is
(a) RF > RCl > RBr > RI
(b) RI > RBr > RCl > RF
(c) RI > RCl > RBr > RF
(d) RF > RI > RBr > RCl

Answer: (b) RI > RBr > RCl > RF

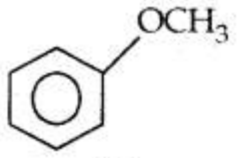
Question 9.
The addition of HBr is easiest with
(a) CH2 = CHCl
(b) ClCH = CHCl
(c) CH3-CH = CH2
(d) (CH3)2C = CH2

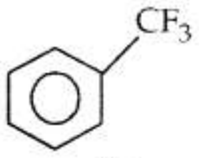
Answer: (d) (CH3)2C = CH2

Question 10.
Among the following compounds, the decreasing order of reactivity towards electrophilic substitution is


I


II


III


IV

(a) III > I > II > IV
(b) IV > I > II > III
(c) I > II > III > IV
(d) II > I > III > IV

Answer: (a) III > I > II > IV

Alcohols, Phenols and Ethers

Question 1.
Among the following compounds, strongest acid is
(a) H-C = C-H
(b) C6H6
(c) C2H6
(d) CH3OH

Answer: (d) CH3OH

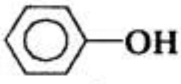
Question 2.
1-Propanol and 2-propanol can be best distinguished by
(a) Oxidation with KMnO4 followed by reaction with Fehling solution?
(b) Oxidation with acidic dichromate followed by reaction with Fehling solution.
(c) Oxidation by heating with copper followed by reaction with Fehling solution.
(d) Oxidation with cone. H2SO4 followed by reaction with Fehling solution.

Answer: (c) Oxidation by heating with copper followed by reaction with Fehling solution.

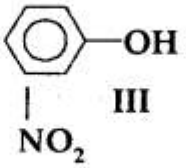
Question 3.
The compound which gives the most stable carbonium ion on dehydration is
(a) (CH3)2CHCH2OH
(b) (CH3)3COH
(c) CH3CH2CH2CH2OH
(d) CH3CH OH CH2 CH3

Answer: (b) (CH3)3COH

Question 4.
In the following compounds:


I


II


III


IV

The order of acidity is
(a) III > IV > I > II
(b) I > IV > III > II
(c) II > I > III > IV
(d) IV > III > I > II

Answer: (d) IV > III > I > I

Question 5.
In CH_3 CH_2 OH, the bond that undergoes heterolytical change most readily is
(a) C-C
(b) C-O
(c) C-H
(d) O-H

Answer: (d) O-H

Question 6.
Phenol reacts with Br_2 in CS_2 at low temperature to give
(a) o-Bromophenol
(b) o-and p-promophenols
(c) p-Bromophenol
(d) 2, 4, 6Tribromophenol

Answer: (b) o-and p-promophenols

Question 7.
In the reaction of phenol with $CHCl_3$ and aqueous NaOH at 343 K, the electrophile attacking the ring is:
(a) $CHCl_3$
(b) $CHCl_2$
(c) CCl_2
(d) $COCl_2$

Answer: (c) CC

Question 8.
Which of the following is most acidic?
(a) Phenol

(b) Benzyl alcohol
(c) m-chlorophenol
(d) cyclohexanol

Answer: (c) m-chlorophenol

Question 9.
The correct order of boiling points for primary (1°), Secondary (2°) and Tertiery (3°) alcohols is
(a) 1° > 2° > 3°
(b) 3° > 2° > 1°
(c) 2° > 1° > 3°
(d) 2° > 3° > 1°

Answer: (a) 1° > 2° > 3°

Question 10.
When Phenol is distilled with zinc dust, it gives
(a) Benzene
(b) Toluene
(c) Benzaldehyde
(d) Benzoic acid

Answer: (a) Benzene

-

Aldehydes, Ketones, and Carboxylic Acids

Question 1.
Which of the following cannot reduce Fehling's solution?
(a) Formic acid
(b) Acetic acid
(c) Formaldehyde
(d) Acetaldehyde

Answer: (b) Acetic acid

Question 2.
Which of the following acids does not form anhydride?
(a) Formic add
(b) Acetic acid
(c) Propionic add
(d) n-butyric acid

Answer: (a) Formic add

Question 3.
The acid which does not contain-COOH group is
(a) Ethanoic acid
(b) Lactic acid
(c) Picric add
(d) Palmitic acid

Answer: (c) Picric add

Question 4.
Trans-esterification is a reaction between
(a) two ester molecules
(b) alcohol and carboxylic acid
(c) alcohol and ether
(d) alcohol and ester.

Answer: (d) alcohol and ester.

Question 5.
Acetone on heating with ammonia produces
(a) Acetaldehyde
(b) Diacetone alcohol
(c) Diacetoneamine
(d) Hydrobenzamide

Answer: (c) Diacetoneamine

Question 6.
Methyl ketones are usually characterised through
(a) Tollen's reagent
(b) Iodoform test
(c) Schiff'stest
(d) Benedict solution test.

Answer: (b) Iodoform test

Question 7.
Which of the following reagents can be used to prepare ketone from acid chloride?
(a) Grignard's reagent
(b) LiAlH4
(c) Dimethyl cadmium
(d) Cadmium chloride

Answer: (c) Dimethyl cadmium

Question 8.
HVZ reaction is used to prepare
(a) ß-haloacid
(b) α-haloacid
(c) α, ß-unsaturated add
(d) None of these

Answer: (b) α-haloacid

Question 9.
An alkene C7H14 on reductive ozonolysis gives an aldehyde with formula C3H6O and and a ketone. The ketone is
(a) 2-butanone
(b) 2-pentanone
(c) 3-pentanone
(d) propanone

Answer: (a) 2-butanone

Question 10.
Acetaldol is a condensation product of
(a) two molecules of ethanal
(b) two molecules of propanone
(c) ethanal and methanal
(d) ethanal and propanone.

Answer: (a) two molecules of ethanal

Amines

Question 1.
Which of the following does not react with Hinsberg reagent?
(a) Ethylamine
(b) (CH3)2NH
(c) (CH3)3N
(d) Propan-2-amine

Answer: (c) (CH3)3N

Question 2.

$$C_2H_5NH_2 \xrightarrow{NaNO_2/HCl} X \xrightarrow{P/Br_2} Y \xrightarrow[(excess)]{NH_3} Z.$$

above sequence, Z is
(a) Cyanoethane

(b) Ethanamide
(c) Methanamine
(d) Ethanamine

Answer: (d) Ethanamine

Question 3.
Oxidation of aniline with K2Cr2O7/H2SO4 gives
(a) phenylhydroxylamine
(b) p-benzoquinone
(c) nitrosobenzene
(d) nitrobenzene

Answer: (b) p-benzoquinone

Question 4.
Which of the following amines can exhibit enantiomerism?
(a) Benzeamine
(b) 2-Butanamine
(c) 2-Propanamine
(d) 2-Methyl-propanamine.

Answer: (b) 2-Butanamine

Question 5.
Which of the following: when heated with a mixture of ethanmine and alcoholic potash gives ethyl isocyanide?
(a) 2-chloropropane
(b) 2,2-dichloropropane
(c) trichloromethane
(d) tetrachloromethane

Answer: (c) trichloromethane

Question 6.
Which of the following pair of species will yield carbylamine?
(a) CH3CH2Br and KCN
(b) CH3CH2Br and NH3 (excess)
(c) CH3CH2Br and AgCN
(d) CH3CH2NH2 and HCHO

Answer: (c) CH3CH2Br and AgCN

Question 7.
Which one of the following methods is neither meant for the synthesis nor for

separation of amines?
(a) Hinsberg method
(b) Hoffmann method
(c) Wurtz reaction
(d) Curticus reaction

Answer: (c) Wurtz reaction

Question 8.
$C_6H_5CONHCH_3$ can be converted into $C_6H_5CH_2NHCH_3$ by
(a) $NaBH_4$
(b) H_2-Pd/C
(c) $LiAlH_4$
(d) Zn-Hg/HCl

Answer: (c) $LiAlH_4$

Question 9.
$C_6H_5N^+_2 Cl^- + CuCN \rightarrow C_6H_5CN + N_2 + CuCl$. The above chemical reaction is associated with which of the following name:
(a) Balz Schiemen
(b) Gattermann
(c) Shimonini
(d) Sandmeyer.

Answer: (d) Sandmeyer.

Question 10.
The reaction of aniline with benzoyl chloride gives
(a) Benzoin
(b) Benzanilide
(c) Benzalaniline
(d) Benzamide

Answer: (b) Benzanilide

Biomolecules

Question 1.
The number of tripeptide formed by 3 different amino acids.
(a) Three
(b) Four
(c) Five
(d) Six.

Answer: (d) Six.

Question 2.
The functional group which is found in amino acids is
(a) COOH
(b) -NH2
(c) -CH3
(d) both (a) and (b).

Answer: (d) both (a) and (b).

Question 3.
The vitamins absorbed from intestine along with fats are
(a) A and D
(b) A, B
(c) A, C
(d) D, B

Answer: (a) A and D

Question 4.
Which amino acids is a chiral?
(a) Alanine
(b) Valine
(c) Proline
(d) Histidine
(e) none of these.

Answer: (e) none of these.

Question 5.
Which of the following biomolecules is insoluble in water?
(a) a-Keratin
(b) haemoglobin
(c) ribonuclease
(d) adenime

Answer: (a) a-Keratin

Question 6.
The protein responsible for blood clotting is
(a) Albumins
(b) Globulins
(c) Fibroin
(d) Fibrinogen

Answer: (d) Fibrinogen

Question 7.
Which one of them is not a protein?
(a) Wool
(b) Nail
(c) Hair
(d) DNA

Answer: (d) DNA

Question 8.
The helical structure of protein is stabilized by:
(a) Peptide band
(b) Dipeptide band
(c) Hydrogen bands
(d) vander Waal's forces

Answer: (c) Hydrogen bands

Question 9.
Which of the following has a branched chain structure
(a) Amylopectin
(b) Anylose
(c) Cellulose
(d) Nylon

Answer: (a) Amylopectin

Question 10.
Glucose reacts with acetic anhydride to form
(a) Monoacetate
(b) Tetraacetate
(c) Penta-acetate
(d) Hexa-acetate

Answer: (c) Penta-acetate

MINIMUM LEVEL LEARNING (MLL) MATERIAL

CHAPTER - SOLUTIONS

Q.1 Differentiate between molarity and molality of a solution. (All India 2010)

Ans:

Molarity	Molality
1. Molarity of solution is defined as the total number of moles of solute present per litre of solution.	1. Molality is defined as the total moles of a solute present per kilogram of solvent.
2. Mathematical expression is: M = No. of moles of solute /Vol of solution in L	2. The mathematical expression is: m = No. of moles of solute/Mass of solvent in Kg.
3. Molarity has a unit of mol L^{-1}.	3. Molality has a unit of mol Kg^{-1}.
4. It depends on the volume of the solution.	4. It depends on the mass of the solvent.
5. Molarity is affected by the change in temperature because volume of solution is affected by temperature.	5. Molality has no effect on temperature because mass is not affected by temperature.

Q.2 What is meant by 'reverse osmosis'? (All India 2011)

Ans: If a pressure higher than the osmotic pressure is applied on the solution, the solvent will flow from the solution into the pure solvent through a semipermeable membrane. This process is called reverse osmosis (R.O.).It is used for desalination of seawater and in RO- filters.

Q.3 What are isotonic solutions? Give example. (Delhi 2014).

Ans: Any two solutions are said to be isotonic if they have the same osmotic pressure under similar conditions. If these solutions are separated by a semipermeable membrane, there will be no net movement of solvent through the membrane.

For example 0.9% (mass/volume)NaCl solution is isotonic with human blood. When blood cells reside in such a medium, the intracellular and extracellular fluids are in osmotic equilibrium across the cell membrane, and there is no net influx or efflux of water.

Q.4 Some liquids on mixing form 'azeotropes'. What are 'azeotropes'? (Delhi 2014)

Ans: An azeotrope is a mixture of two or more liquids which displays the same level of concentration in the liquid and vapour phase. Simple distillation cannot alter their proportions and hence they cannot be separated by simple distillation. These mixtures can either have a lower boiling point or a higher boiling point than the boiling points of the components.

For example, 95% ethanol + 5% water.

Q.5 Define the terms, 'osmosis' and 'osmotic pressure'. What is the advantage of using osmotic pressure as compared to other colligative properties for the determination of molar masses of solutes in solutions? (All India 2010)

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

Osmotic pressure : The minimum pressure that has to be applied on the solution to prevent the entry of the solvent into the solution through the semipermeable membrane is called the osmotic pressure.

The osmotic pressure method has the following advantages over other colligative properties:

(i) Osmotic pressure is much larger and therefore more precisely measurable property than other colligative properties. Therefore, it is useful to determine molar masses of very expensive substances and of the substances that can be prepared in small quantities.

(ii) It uses more convenient concentration term molarity instead of molality.

(iii) It can be measured at room temperature hence it is particularly useful for biomolecules as they are generally not stable at higher temperatures and also for polymers as they have poor solubility at higher temperatures.

Q.6 A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C. Determine the van't Hoff factor for trichloroacetic acid. (K_b for water = 0.512 K kg mol^{-1}) (Delhi 2012)

Ans:

As $\Delta T_b = iK_b m$

$(100.18 - 100)\ ^\circ C = i \times 0.512\ K\ kg\ mol^{-1} \times 1\ m$

$0.18\ K = i \times 0.512\ K\ kg\ mol^{-1} \times 1\ m$

$\therefore i = 0.3$

Q.7 Define the following terms : (Delhi 2012)

(i) Mole fraction

(ii) van't Hoff factor

(iii) Ideal solution

Ans: **(i) Mole fraction :** Mole fraction is the ratio of number of moles of one component to the total number of moles in a mixture.

(ii) van't Hoff factor : The Van't Hoff factor is the ratio of the concentration of particles formed when a substance is dissolved to the concentration of the substance by mass.

van't Hoff factor is expressed as :

i = normal molar mass / abnormal molar mass

It is one for no association or no dissociation but its value is more than one if there is dissociation and less than one for association.

(iii) Ideal solution : The solution which obeys Raoult's law under all conditions is known as an ideal solution. The enthalpy of mixing of the pure components to form the solution is zero and the change in volume of mixing is also zero, example benzene and toluene.

Q.8 Explain why aquatic species are more comfortable in cold water rather than in warm water. (Comptt. Delhi 2012)

Ans: Aquatic species need dissolved oxygen for breathing. As solubility of gases decreases with increase of temperature, less oxygen is available in summer in the lake. Hence the aquatic species feel more comfortable in winter (low temperature) when the solubility of oxygen is higher.

Q.9 State Raoult's law. How is it formulated for solutions of volatile liquids ? (Comptt. Delhi 2012)

Ans: Raoult's Law states that "for a solution of volatile liquids, the partial vapour of each component in the solution is directly proportional to its mole fraction".

Thus for component 1 $\Rightarrow p_1 = p_1^0 X_1$

where [p_1^0 is vapour pressure of pure component 1]

For component 2. $\Rightarrow p_2 = P_2^0 X_2$

According to Dalton's law of partial pressure

$$P_{Total} = P_1 + P_2 \Rightarrow P_T = p_1^0 X_1 + p_2^0 X_2$$
$$\Rightarrow P_T = p_1^0(1 - X_2) + p_2^0 X_2$$
$$\Rightarrow P_T = p_1^0 + (p_2^0 - p_1^0)X_2$$

Q.10 State Henry's law and mention two of its important applications. (Comptt. All India 2012)

Ans: Henry's law states that "The partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution",

$P = K_H X$, Where, K_H = Henry's constant

X = Mole fraction of the gas in solution.

Applications of Henry's law :

- To increase the solubility of CO_2 in soft drinks and soda water, the bottle is sealed under high pressure.
- To avoid a dangerous medical condition called bends, scuba divers use oxygen diluted with less soluble helium gas..

Q.11 Why do gases nearly always tend to be less soluble in liquids as the temperature is raised? (Comptt. All India 2012)

Ans: This is because the dissolution of gas in liquid is an exothermic process. The solubility should decrease with increase in temperature.

Q.12 18 g of glucose, $C_6H_{12}O_6$ (Molar mass – 180 g mol^{-1}) is dissolved in 1 kg of water in a sauce pan. At what temperature will this solution boil? (K_b for water = 0.52 K kg mol^{-1}, boiling point of water =

373 K) (Delhi 2013)

Ans:

$$\triangle T = K_b \times \frac{w_B \times 1000}{m_B \times w_A}$$

$$\triangle T = 0.52 \times \frac{18 \times 1000}{180 \times 1000}$$

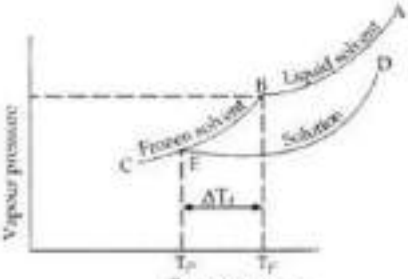
$$T - T_0 = 0.052$$

$$T - 373 = 0.052$$

$$T = 373.052\text{K}$$

Q.13 An aqueous solution of sodium chloride freezes below 273 K. Explain the lowering in freezing points of water with the help of a suitable diagram. (Comptt. Delhi 2013)

Ans: An aqueous solution of sodium chloride freezes below 273 K because vapour pressure of the solution is less than that of the pure solvent.



Q.14 Calculate the mass of compound (molar mass = 256 g mol^{-1}) to be dissolved in 75 g of benzene to lower its freezing point by 0.48 K (K_f = 5.12 K kg mol^{-1}). (Delhi 2014)

Ans:

Let W g of compound is to be dissolved.

Number of moles of compound, $n = \frac{\text{mass}}{\text{molar mass}} = \frac{W}{256}$

Mass of benzene = 75 g = $\frac{75}{1000}$ kg = 0.075kg

Molality of solution, $m = \frac{\text{number of moles of solute}}{\text{mass of solvent in kg}}$

$$m = \frac{W}{256 \times 0.075} = \frac{W}{19.2}\text{m}$$

The depression in the freezing point, ΔT_f = 0.48K

The molal depression in freezing point constant = K_f = 5.12K kg/mol

$$\Delta T_f = K_f m$$

$$0.48 = 5.12 \times \frac{W}{19.2}$$

$$W = \frac{0.48 \times 19.2}{5.12} = 1.8$$

Hence, 1.8 g of solute is to be dissolved.

Q.15 What happens when blood cells are placed in water ?

Ans: Blood cell will swell due to osmosis as water enters the cell.

Q.16 Gas (A) is more soluble in water than Gas (B) at the same temperature. Which one of the two gases will have the higher value of K_H (Henry's constant) and why?

Ans: Gas (B) will have higher value of K_H(Henry's constant) than Gas (A) at the same temperature because lesser the solubility of a gas in a given solvent, higher will be the value of K_H for a gas.

K_H = Partial pressure of gas/ Mole fraction of gas in the solution = P/x

Q.17 Define the term Colligative properties (Delhi 2017)

Ans: All those properties which depend on the number of solute particles irrespective of the nature of solute are called as colligative properties.

Example: Elevation in boiling point, Depression in freezing point, Osmotic pressure, Relative lowering of vapour pressure

Q.18.Define the term "Abnormal molar mass"(Delhi 2017)

Ans: Abnormal molar mass. If the molar mass calculated by using any of colligative properties tends to be different than theoretically expected molar mass, it is called abnormal molar mass.

Q.19 Explain why on addition of 1 mol of glucose to 1 litre of water, the boiling point of water increases. (Comptt. Delhi 2017)

Ans: Glucose is a non-volatile solute, therefore, addition of glucose to water lowers the vapour pressure of water as a result of which boiling point of water increases.

Q.20. A solution of glycerol ($C_3H_8O_3$; molar mass = 92 g mol^{-1}) in water was prepared by dissolving some glycerol in 500 g of water. This solution has a boiling point of 100.42 °C. What mass of glycerol was dissolved to make this solution? Kb for water = 0.512 K kg mol^{-1}. (Delhi 2010)

Ans:

Given : $M_2 = 92\ g\ mol^{-1}$ $w_1 = 500g$

$\Delta T_b = 100.42°C - 100°C = 0.42°C$

$K_b = 0.512\ K\ kg\ mol^{-1}$

Substituting above values in the formula

$$\Delta T_b = \frac{1000\, K_b\, w_2}{w_1 \times M_2}$$

$$\therefore \quad w_2 = \frac{w_1\, M_2\, \Delta T_b}{1000\, K_b} = \frac{500 \times 92 \times 0.42}{1000 \times 0.512}$$

$$= \frac{19320}{512} = \mathbf{37.73\ g}$$

MINIMUM LEVEL LEARNING (MLL) MATERIAL
CHAPTER - ELECTROCHEMISTRY

Q.1 Define Molar conductivity(Λ_m).

Ans: Molar conductivity of a solution at a given concentration is the conductance of a solution containing one mole of electrolyte kept between two electrodes with area of cross section 'A' and distance of unit length.

Q.2.State Faraday's first law.

Ans: When an electric current is passed through an electrolyte, the amount of substance deposited is proportional to the quantity of electric charge passed through the electrolyte.

Q.3 What is the effect of catalyst on activation energy of a reaction?

Ans: The catalyst provides an alternative pathway by decreasing the activation energy of a reaction.

Q.4 What is the effect of catalyst on Gibbs energy (ΔG)?

Ans: There will be no effect of catalyst on Gibbs energy.

Q.5 Determine the values of ΔG° for the following reaction:(Given: E° = 1.05 V, 1F = 96500 C mol^{-1})

$Ni(s) + 2Ag^+ (aq) \rightarrow Ni^{2+} (aq) + 2Ag(s)$ (Delhi

2011)
Ans: According to the formula $\Delta G^\circ = -nFE^\circ = -2 \times 96500 \times 1.05 = -202650\ J\ mol^{-1} = -202.65\ KJ\ mol^{-1}$

Q.6 State Kohlraush's law.
Ans: The limiting molar conductivity of an electrolyte (i.e. molar conductivity at infinite dilution) is the
sum of the limiting ionic conductivities of the cation and the anion.

Q.7 Can $CuSO_4$ be kept in Zn container? why?
Ans: No, Zinc being more reactive will displace copper from copper container.

Q.8 State Faraday's second law.
Ans: The amounts of different substances liberated by the same quantity of electricity passing through the electrolytic solution are proportional to their chemical equivalent weights.

Q.9 Under what conditions is $E^0_{cell} = 0$ and $\Delta_rG^0 = 0$?
Ans: At the condition of equilibrium, $E^0_{cell} = 0$ and $\Delta_rG^0 = 0$.

Q.10 How much charge in terms of Faraday is required for reduction of 1 mole of Cu^{2+} ions to Cu?

Ans: The electrode reaction is $Cu^{2+} + 2e^- \rightarrow Cu$
$\therefore$ quantity of charge required for reduction of 1 mole of $Cu^{2+} = 2F = 2 \times 96500 = 193000C$

Q.11 Calculate Λ°_m of acetic acid if $\lambda^\circ(H^+) = 349.6\ S\ cm^2\ mol^{-1}$ and $\lambda^\circ(CH3COO^-) = 40.9\ S\ cm^2\ mol^{-1}$
Ans: $\Lambda^\circ_m(HAc) = \lambda^\circ_{H^+} + \lambda^\circ_{AC^-} = \lambda^\circ_{CH3}COOH = \lambda^\circ_{H^+} + \lambda^\circ_{CH3}COO^-$
$= 349.6\ S\ cm^2\ mol^{-1} + 40.9\ S\ cm^2\ mol^{-1} = 390.5\ S\ cm^2\ mol^{-1}$

Q.12 Write the name of the cell which is generally used in transistors.
Ans: Leclanche cells (Dry cell) is used in transistors.

Q.13 Write **the name of the cell which is generally used in inverters.**
Ans: Lead storage battery is used in inverters.

Q.14 What is corrosion?
Ans:- Corrosion is defined as the destruction of a substance because of its reaction with water and air.

Q.15 What are fuel cells?
Ans:- These cells are the devices which convert the energy produced during combustion of fuels like H_2, CH_4, etc. directly into electrical energy.

Q.16 Calculate the mass of Ag deposited at cathode when a current of 2 amperes was passed through a solution of $AgNO_3$ for 15 minutes. (Given: Molar mass of Ag = 108 g mol^{-1} 1F = 96,500 C mol^{-1})

Ans: $Q = I \times t$ …(Charge = Current a Time)
$= 2 \times 15 \times 60 = 1800\ C$
$\because$ 96500 C deposit Ag = 108 g
$\therefore$ 1800 C deposit Ag = $108/96500 \times 1800 = 2.0145$ g

Q.17 How does molar conductivity changes with concentration of Solute for weak and strong electrolytes?

Ans: 1. In case of strong electrolytes there is a small increase in conductance with dilution because a strong electrolyte is completely dissociated in solution and the number of ions remains constant.

2. In case of weak electrolytes there is increase in conductance with decrease in concentration due to the increase in the number of ions in the solution.

Q.18 How can lead storage battery be recharged?

Ans:-By reversing the terminals the battery it can be recharged.

Q.19 Calculate the emf of the following cell at 298 K: (Given $E^\circ_{cell} = +0.44V$)

$Fe(s) \mid Fe^{2+} (0.001\ M) \parallel H^+ (1M) \mid H_2(g)\ (1\ bar), Pt(s)$

Ans: As $Fe + 2H^+ \rightarrow Fe^{2+} + H_2$ (n = 2)

According to Nernst equation

$$E_{cell} = E^0_{cell} - \frac{0.0591}{2} \log \frac{[Fe^{2+}]}{[H^{+2}]^2}$$

$$\Rightarrow \quad E_{cell} = 0.44 - \frac{0.0591}{2} \log \frac{10^{-3}}{1^2}$$

$$\therefore \quad E_{cell} = 0.44 - \frac{0.0591}{2} \times (-3)$$

$$= 0.44 + 0.0887 = \mathbf{0.529\ V}$$

Q.20 A current was passed for 5 hours through two electrolytic cells connected in series. The first cell contains $AuCl_3$ and second cell $CuSO_4$ solution. If 9.85 g of gold was deposited in the first cell, what amount of copper gets deposited in the second cell? Also calculate the magnitude of current in ampere. (Given: Atomic mass of Au = 197 amu and Cu = 63.5 amu.)

Ans: :--Weight of Au deposited / Weight of Cu deposited = eq wt of Au/eq wt of Cu

:--eq wt of Au=197/3 =65.66 ($Au^{+3} + 3e^- \rightarrow Au$)

:- eq wt of Cu=63.5/2 =31.75 ($Cu^{+2} + 2e^- \rightarrow Cu$)

--9.85 g / x = 65.66/31.75

=4.76 g (amount of Cu deposited)

MINIMUM LEVEL LEARNING (MLL) MATERIAL
CHAPTER - CHEMICAL KINETICS

Q.1 Define rate of a reaction.

Ans: It is the change of concentration with respect to time.

Q.2 What is meant by order of the reaction.

Ans: The sum of powers of the concentration of the reactants in the rate law expression is called the order of that chemical reaction.

Q.3 Define the term Activation energy .

Ans: The minimum extra amount of energy absorbed by the reactant molecules to form the activated complex is called activation energy.

Q.4 What is the order of the reaction if the $K=1.02 \times 10^{-2}\ s^{-1}$.

Ans: First order.

Q.5 For a reaction, A+B---> Product; the rate law is given by, $r = k[A]^{1/2}[B]^2$. What is the order of the reaction?

Ans: 2 + ½ = 2.5

Q.6 A first order reaction has a rate constant $1.15 \times 10^{-3} s^{-1}$. How long will 5g of this reactant take to reduce to 3g?

Ans: From the question, we can write down the following information:

Initial amount = 5 g, Final amount = 3 g, Rate constant = $1.15 \times 10^{-3}\ s^{-1}$

We know that for a first order reaction,

$$t = \frac{2.303}{k} \log \frac{[R_0]}{[R]} = \frac{2.303}{1.15 \times 10^{-3}} \log \left(\frac{5}{3}\right)$$

$$= 2.00 \times 10^3 \log(1.667)$$

$$= 2 \times 10^3 \times 0.2219$$

$$= 444\ s.$$

Q.7 What will be the effect of temperature on rate constant?

Ans: The rate constant of a reaction is nearly doubled with a 10° rise in temperature.

Q.8 Mention the factors that affect the rate of a chemical reaction.

Ans: The factors that affect the rate of a reaction are as follows:

(i) Concentration of reactants (pressure in case of gases). (ii) Temperature. (iii) Presence of a catalyst

Q.9 A reaction is second order with respect to a reactant. How is the rate of reaction affected if the concentration of the reactant is (i) doubled (ii) reduced to half?

Ans: Let the concentration of the reactant be [A] = a

Rate of reaction, $R = k[A]^2 = ka^2$

(i) If the concentration of the reactant is doubled, i.e. [A] = 2a, then the rate of the reaction would be

$R' = k(2a)^2 = 4ka^2 = 4R$, Therefore, the rate of the reaction would increase by 4 times.

(ii) If the concentration of the reactant is reduced to half, i.e. [A] = 1/2a then the rate of the reaction would be

$R' = k(1/2a)^2 = 1/4ka^2 = 1/4R$. Therefore, the rate of the reaction would be reduced by ¼ times.

Q.10 A reaction is first order in A and second order in B. Write the differential rate equation. How is the rate affected on increasing the concentration of B three times? How is the rate affected when the concentrations of both A and B are doubled?

Ans: It is given that a reaction is first order in A and second order in B.

(i) The differential rate equation is as follows: Rate = $R = k[A][B]^2$

(ii) On increasing the concentration of B three times, rate becomes 9 times.

$R' = k[A][3B]^2 = 9k[A][B]^2 = 9R$

(iii) When the concentrations of both A and B are doubled, rate becomes 8 times.

$R'' = k[2A][2B]^2 = 2x2x2\ k[A][B]^2 = 8R$

Q.11 Calculate the half-life of a first order reaction from their rate constants given below: (i) 200 s^{-1} (ii) 2 min^{-1} (iii) 4 $years^{-1}$

Ans: The relationship between the half-life period and the rate constant is, $t_{1/2}=0.693/k$

(i) $t_{1/2}=0.693/k = 0.693/200 = 3.465 \times 10^{-3}$ s

(ii) $t_{1/2}=0.693/k = 0.693/2 = 0.3465$ mins

(iii) $t_{1/2}=0.693/k = 0.693/4 = 0.1732$ years

Q.12 The half-life for radioactive decay of ^{14}C is 5730 years. An archaeological artefact containing wood had only 80% of the ^{14}C found in a living tree. Estimate the age of the

sample.

Ans: Decay constant $k = 0.693/t_{1/2} = 0.693/5730$ years $= 1.209\times10^{-4}$/years

The rate of counts is proportional to the number of C^{14} atoms in the sample i.e. $N_0=100$, $N=80$

The age of the sample is $t = (2.303/k)\log(N_0/N)$

$$t = (2.303/1.209\times10^{-4}) \times \log(100/80) = 1846 \text{ years}$$

Q.13 Differentiate between Order and Molecularity of a reaction.

Ans: Molecularity is the total number of reacting species in elementary reaction whereas order isthe sum of powers of the concentration of the reactants in the rate law expression i

Q.14 Define half life time of a reactant.

Ans: It is the time required for the reactant species to reduce to half of its initial quantity.

Q.15 What are pseudo first order reactions?

Ans:- the reactions which have some other order but behaves as first order reaction. Such reactions are called pseudo first order reactions. Inversion of cane sugar is an example of pseudo first order reaction.

$$\underset{\text{Cane sugar}}{C_{12}H_{22}O_{11}} + H_2O \rightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

Rate = $k\,[C_{12}H_{22}O_{11}]$

Q.16 For which type of reactions, order and molecularity have the same value?

Ans: If the reaction is an elementary reaction, order is same as molecularity.

Q.17 A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion?

Ans: Reaction would be 100% complete only after infinite time which cannot be calculated.

Q.18 Write the rate equation for the reaction $2A + B \rightarrow C$ if the order of the reaction is zero.

Ans: Rate = $k\,[A]^0[B]^0$ or Rate = k

Q.19 State a condition under which a bimolecular reaction is kinetically first order reaction.

Ans: Bimolecular reaction becomes kinetically first order when one of the reactants is in excess.

Q.20 Oxygen is available in plenty in air yet fuels do not burn by themselves at room temperature. Explain.

Ans: The activation energy for combustion reactions of fuels is very high at room temperature therefore they do not burn by themselves.

MINIMUM LEVEL LEARNING (MLL) MATERIAL
CHAPTER - D AND F BLOCK ELEMENTS

Q.1 What is meant by 'lanthanoid contraction'?

Ans: The steady decrease in the ionic radius from La^{3+} to Lu^{3+} is termed as lanthanoid contraction.

Q.2 Write general electronic configuration of d block elements.

Ans: $(n\text{-}1)d^{1\text{-}10}ns^{1\text{-}2}$

Q.3 Why Zn, Cd, Hg are not considered as transition elements?

Ans: Because they have completely filled d orbitals in their ground state as well as in their most common oxidation state(+2)

Q.4 Transition elements form coloured compounds, why?

Ans: Due to unpaired electron

Q.5 Calculate spin only magnetic moment of M^{2+} ion if Atomic number of the metal is 27

Ans: Given ion is M^{2+} with the atomic no. 27. So, electronic configuration of M^{2+} is $[Ar]3d^74s^0$

[Ar] ↿⇂ ↿⇂ ↿ ↿ ↿

No. of unpaired e^- = 3 So, the spin only magnetic moment is given by,

$\mu = \sqrt{n(n+2)} = \sqrt{3(3+2)} = \sqrt{3x5} = \sqrt{15}$ BM = 3.87 BM

Q.6 Why transition elements have high enthalpy of atomisation?

Ans . Transition metals have high effective nuclear charge, greater number of valence electrons and some unpaired electrons. They thus have strong metal–metal bonding. Hence, transition metals have high enthalpies of atomisation.

Q.7 Zn^{+2} salts are white but Cu^{+2} salts are blue. Give reason.

Ans. Zn^{2+} has completely filled d-orbitals ($3d^{10}$) while Cu^{2+} has incompletely filled d-orbitals ($3d^9$). Due to this d-d transition takes place and impart colour.

Q.8 Why Zirconium resembles Hafnium in its chemical properties?

Ans. Size of Hf and Zr becomes almost equal due to lanthanide contraction and hence both have similar properties.

Q.9 Which transition metal exhibits maximum oxidation state and why?

Ans: Manganese(atomic no. 25 and ele. Configuration = $[Ar]3d^5 4s^2$) exhibit the largest number of oxidation states viz. +2,+3,+4,+5,+6 and +7 due to the presence of maximum number of unpaired electrons in the d-subshell (5 electrons)

Q10.Why transition metals have high melting and boiling point

Ans: Transition metals have high effective nuclear charge, greater number of valence electrons and some unpaired electrons. They thus have strong metal–metal bonding. Hence, transition metals have high melting and boiling point.

Q12. Name the two 3d series elements, that do not show variable oxidation states. Give reason.

Ans . Sc and Zn are the two elements that do not show variable oxidation states because scandium has the electronic configuration $[Ar]3d^1 4s^2$. When it forms ions, it always loses the 3 outer electrons and ends up with an argon structure so it is always found in Sc^{3+} ion whereas Zn has $[Ar]3d^{10}4s^2$ electronic configuration so it always loses only two electrons to show only +2 oxidation state so that it can have fully filled d-orbital.

Q.13 Why transition metals and their compounds show paramagnetic behaviour ?

Ans: The transition metal ions are generally containing one or more unpaired electrons in them & hence their compounds are generally paramagnetic.

Q.14 Complete the following chemical equations : (All India 2011)

(i) MnO_4 (aq) + $S_2O_3^{2-}$ (aq) + H_2O (1) →

(ii) $Cr_2O_7^{2-}$ (aq) + Fe_{3+} (aq) + H_+ (aq) →

Ans:

$$(i)\ 8MnO_4^- \text{ (aq)} + 3S_2O_3^{2-} \text{ (aq)} + H_2O \text{ (l)} \rightarrow$$
$$8MnO_2 \text{ (s)} + 6SO_4^{2-} \text{ (aq)} + 2OH^- \text{ (aq)}$$

$$(ii)\ Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow$$
$$2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

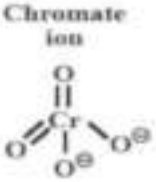
Q.15 Write one similarity and one difference between the chemistry of lanthanoids and that of actinoids.

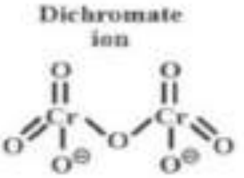
Ans: Similarity : Both lanthanoids and actinoids show contraction in size and irregularity in their electronic configuration.

Difference: Actinoids show wide range of oxidation states but lanthanoids do not.

Q.16 Draw structure of Dichromate ion and permanganate ion.

Ans:


Chromate ion


Dichromate ion

Q.15 Compare the chemistry of the actinoids with that of lanthanoids with reference to
(i) Electronic configuration (ii) oxidation state

Ans. The electrical configuration of lanthanoids is $[Xe]4f^{1-14}5d^{0-1}6s^2$ whereas of actinoids is $[Rn]5f^{1-14}6d^{0-1}7s^2$
Oxidation state of Lanthanoids is +2 to +4 whereas actinoids is +2 to +6

Q.16 What is Mischmetal? Give one use of Mischmetal.

Ans. Misch metal is alloy of any metal with inner transition metal.

Uses: In vacuum tube manufacturing mischmetals are used to remove oxygen

- Batteries that work upon metal hydride technology use mischmetals
- Mischmetals can easily produce sparks when struck with and therefore they are used in cigarette lighters and similar devices
- They are used in other alloys to improve the physical properties as well as cast ability.
- Used in movies to add special effects

Q.17 What is the cause and consequences of lanthanoid contraction.

Ans. Cause of Lanthanoid contraction- Poor shielding effect of d and f orbitals.

Consequences of lanthanoid contractions are:

(i) The radii of the members of the third transition series to be very similar to those of the corresponding members of the second series.

(ii) The almost identical radii of Zr (160 pm) and Hf (159 pm) & Nb (146pm) & Ta (146pm)

(iii) Difficulty in separation of lanthanoids due to similarity in chemical properties.

(iv) As the size of the lanthanides decreases from the elements La to Lu, the covalent character of the hydroxides increases, and thus, their basic strength decreases. Therefore, $Lu(OH)_3$ is said to be least basic, and $La(OH)_3$ is said to be more basic.

(v) Due to the smaller size and higher nuclear charge, the tendency to produce coordinate. Complexity increases from the element La^{3+} to Lu^{3+}.

(vi) Electronegativity: It increases from the elements La to Lu.

(vii) Ionization Energy: Electron's attraction by the nuclear charge is higher, and thus the Ionization energy of the 5d elements is much larger compared to 4d and 3d. In the 5d series, the total elements except Pt and Au contain a filled s-shell. Elements from Hafnium to rhenium contain similar Ionization energy, and after that, the Ionization energy increases with the number of shared d-electrons such that Gold and Iridium hold the maximum Ionization Energy.

Q.18 Why the transition elements and their compounds are generally found to act as good catalyst?

Ans-. The catalytic properties of the transition elements are due to the presence of unpaired electrons in d-orbitals and variable oxidation states.

Q.19 Why Actinoids exhibit greater range of oxidation states than lanthanoids

Ans: Actinides exhibit larger oxidation states than lanthanides, because of the very small energy gap between 5f, 6d and 7s subshells. Thus, the outermost electrons get easily excited to the higher energy levels, giving variable oxidation states.

Q.20 Why do transition elements form alloys?

Ans: The atomic sizes of transition metals are relatively very similar to each other, which attributes to their nature of forming the alloys.

MINIMUM LEVEL LEARNING (MLL) MATERIAL

CHAPTER -COORDINATION COMPOUNDS

Q.1 Give examples of two neutral ligands.
Ans: NH_3 and H_2O

Q.2 Calculate the oxidation number of metal atom or ion in the following:
$[Fe(CN)_6]^{3-}$, $[Cu(NH_3)_4]^{2+}$, $[Ni(CO)_4]$, $[Co(NH_3)_4Cl_2]^{+}$
Ans: Fe(+3) , Cu(+2) , Ni(0) , Co(+3).

Q.3 What are ambidentate ligands? Give two examples.
Ans: Ligand which has two different doner atoms and either of the two ligates in the complex is called ambidentate ligands. Examples NO^{2-}, SCN^-

Q.4 What type of isomerism is shown by following compound: $[Co(NH_3)_6][Cr(CN)_6]$
Ans: Coordination isomerism.

Q.5 What is a chelate ligand? Give one example.
Ans: When a di or polydentate ligand uses its two or more donor atoms simultaneously to bind a single metal ion it is said to be a chelate ligand. Example: ethane1,2-diammine.

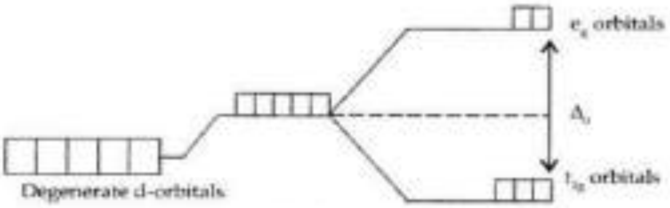
Q.6 Give an example of polydentate ligand.
Ans: EDTA (ethylene diamine tetra acetate)

Q.7 For the complex $[Fe(en)_2Cl_2]$, Cl, (en = ethylene diamine), identify the oxidation number of iron.
Ans: $[Fe(en)_2Cl_2]$ Cl or $x + 0 + 2(-1) + (-1) = 0$
$x + (-3) = 0$ or $x = +3$

Q.8 What are the factors affecting stability of coordination compounds
Ans: Factors affecting the stability of a complex ion are as follows:
- **(i)** Nature of metal ion: Greater the charge and smaller the size of the ion, more is its charge density and greater will be stability of the complex.
- **(ii)** Nature of ligand: More the basicity of ligand, more is its tendency to donate electron pair and therefore, more is the stability of the complex.

Q.9 $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain.
Ans: In the presence of CN^-, the 3d electrons pair up leaving only one unpaired electron. The hybridisation involved is d^2sp^3 forming inner orbital complex which is weakly paramagnetic. In the presence of H_2O (a weak ligand), 3d electrons do not pair up. As it contains five unpaired electrons so it is strongly paramagnetic.

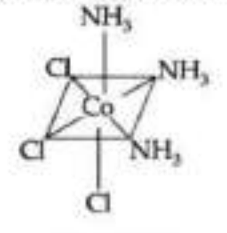
Q.10 Draw diagram of crystal field splitting in octahedral complexes.



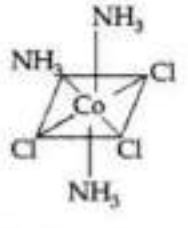
Splitting of d-orbitals in an octahedral complex

Q.11 Draw geometrical isomers of the complex $[Co(NH_3)_3Cl_3]$

Ans: $[Co(NH_3)_3Cl_3]$ has 2 geometrical isomers:



Facial isomer



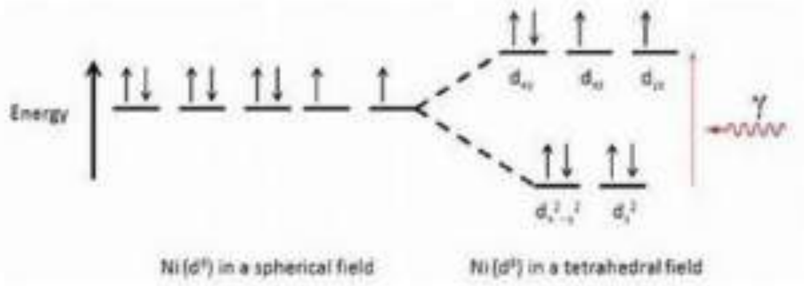
Meridional isomer

Q.12 How is a double salt different from a complex?

Ans: Double salt dissociates completely into its constituent ions in their aqueous solution whereas coordination compounds give only those ions which are out of coordination sphere.

Q.13 Draw diagram to show crystal field splitting in tetrahedral complexes.

Ans.



Q.14 Why are low spin tetrahedral complexes not formed? (Comptt. Delhi 2017)

Ans: Low spin tetrahedral complexes are rarely observed because orbital splitting energies for tetrahedral complexes are sufficiently large for forcing pairing.

Q.15 When a co-ordination compound $CrCl_3.6H_2O$ is mixed with $AgNO_3$, 2 moles of AgCl are precipitated per mole of the compound. Write:

(i) Structural formula of the complex.

(ii) IUPAC name of the complex. (Delhi 2016)

Ans: (i) The complex formed on mixing a coordination compound $CrCl_3.6H_2O$ with $AgNO_3$ is as follows

$CrCl_3.6H_2O + AgNO_3 \rightarrow [Cr(H_2O)_5Cl]Cl_2.H_2O$

(ii) Pentaaquachloridochromium(III)chloride monohydrate

Q.16 Give names of two complexes which are used in medicines.

Ans: (i) Cis – platin$[Pt(NH_3)_2Cl_2]$ is used in the treatment of cancer.

(ii) EDTA is used in the treatment of lead poisoning.

Q.17 What is meant by crystal field splitting energy? On the basis of crystal field theory, write the electronic configuration of d^4 in terms of t_2g and eg in an octahedral field when

(i) $\Delta_o > P$

(ii) $\Delta_o < P$ (All India 2013)

Ans: Crystal field splitting energy : When ligands approach the central metal ion, the degenerate d-orbitals split into two sets, one with lower energy (t_2g) and the other with higher energy (eg). The difference of energy between these two sets of orbitals is called crystal field splitting energy. (Δ_o for octahedral complexes).

The magnitude of Δ_o decides the actual configuration of d-orbitals by the help of mean pairing energy.

- If $P > \Delta_o$ then pairing of electrons does not occur and electrons enter in the higher energy e orbitals and thus form high spin complexes due to weak field ligands. The electronic configuration in this case would be: t_2g^3, eg^1
- If $P < \Delta_o$ then pairing of electrons occurs within the same set and form low spin complexes due to strong field ligands. The electronic configuration in this case would be: t_2g^4, eg^0

Q.18 Why do compounds having similar geometry have different magnetic moment?

Ans: It is due to the presence of weak and strong ligands in complexes, if CFSE is high, the complex will show low value of magnetic moment and vice versa, e.g. $[CoF_6]^{3-}$ and $[Co(NH_3)_6]^{3+}$, the former is paramagnetic and the latter is diamagnetic.

Q.19 $CuSO_4.5H_2O$ is blue in colour while $CuSO_4$ is colourless. Why?

Ans: In $CuSO_4.5H_2O$, water acts as ligand as a result it causes crystal field splitting. Hence d—d transition is possible in $CuSO_4.5H_2O$ and hence it shows colour. In the anhydrous $CuSO_4$ due to the absence of water (ligand), crystal field splitting is not possible and hence no colour.

Q.20 Name the type of isomerism when ambidentate ligands are attached to central metal ion.

Ans: Linkage isomerism.

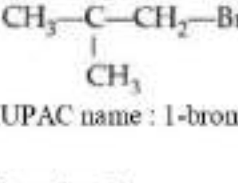
MINIMUM LEARNING MATERIAL
CHAPTER- HALOALKANES AND HALOARENES QUESTIONS

1 MARK QUESTIONS

Question 1.

Write the IUPAC name of the following compound: $(CH_3)_3 CCH_2Br$ (Delhi 2010)

Answer:



$$\overset{3}{CH_3}—\overset{2}{C}(CH_3)_2—\overset{1}{CH_2}—Br$$

IUPAC name : 1-bromo-2, 2-dimethyl propane

Question 2.

Write the IUPAC name of the following compound: $CH_2 = CHCH_2Br$ (All India 2010)

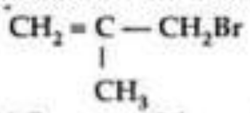
Answer:

$\overset{3}{CH_2} = \overset{2}{CH}\, \overset{1}{CH_2}\, Br$

IUPAC name : 3-Bromo-prop-1-ene

Question 3.

Give the IUPAC name of the following compound. (Delhi 2012)



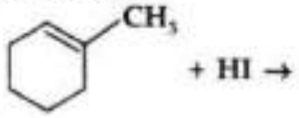
$$CH_2=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_2Br$$

Answer:

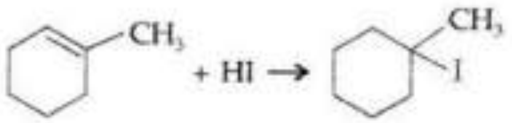
IUPAC name : 3-bromo-2-methyl propene

Question 4

Draw the structure of major monohalogen product formed in the following reaction: (Comptt. Delhi 2012)



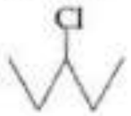
Answer:



Question 5.

In the following pair of compounds, which will react faster by S_N1 mechanism and why? (Comptt. Delhi 2012)

and

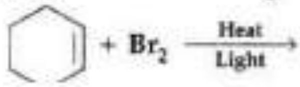


Answer:

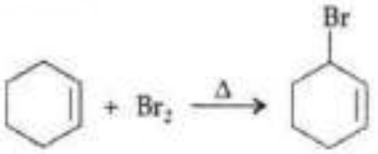
reacts faster by S_N1 mechanism as it is a tertiary halide and it produces a stable tertiary carbocation.

Question 06.

Draw the structure of major monohalogen product in the following reaction : (Comptt. Delhi 2012)



Answer:



Question 07.

Predict the order of reactivity of the following compounds in S_N1 reaction :

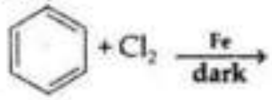
$C_6H_5CH_2Br$, $C_6H_5C(CH_3)(C_6H_5)Br$, $C_6H_5CH(C_6H_5)Br$, $C_6H_5CH(CH_3)Br$ (Comptt. Delhi 2012)

Answer:

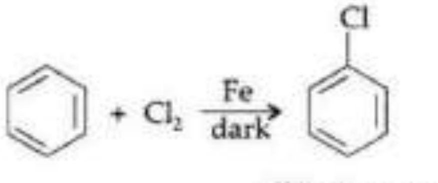
$C_6H_5C(CH_3)(C_6H_5)Br > C_6H_5CH(C_6H_5)Br > C_6H_5CH(CH_3)Br > C_6H_5CH_2Br$

Question 08

Draw the structure of major monohalogen product in the following reaction : (Comptt. Delhi 2012)



Answer:



Chlorobenzene

Question 09

Give a chemical test to distinguish between C_2H_5Br and C_6H_5Br. (Comptt. All India 2012)

Answer:

Both are heated with aqueous NaOH. C_2H_5Br gives ethanol and NaBr, which on reacting with $AgNO_3$, gives yellow precipitate of AgBr.

C_6H_5Br does not respond to this test.

Question 10

Arrange the following in increasing order of boiling point:

(i) $CH_3CH_2CH_2CH_2Br$

(ii) $(CH_3)_3.Br$

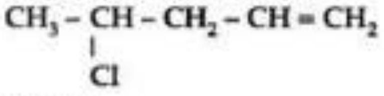
(iii) $(CH_3)_2C.Br$ (Comptt. All India 2012)

Answer:

$(CH_3)_3C.Br < (CH_3)_2.CHCH_2.Br < CH_3CH_2CH_2CH_2Br$

Question 11.

Write the IUPAC name of



$$CH_3-\underset{\displaystyle Cl}{\underset{|}{CH}}-CH_2-CH=CH_2$$

(Delhi 2013)

Answer:

IUPAC name : 4-chloropent-l-ene

Question 12

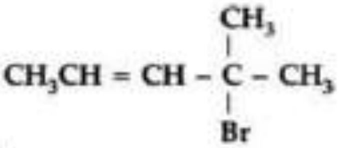
What happens when CH_3— Br is treated with KCN? (Delhi 2013)

Answer:

$$\underset{\text{Methyl bromide}}{CH_3-Br} + \underset{\text{Potassium cyanide}}{KCN} \longrightarrow \underset{\text{Methyl cyanide}}{CH_3CN} + \underset{\text{Potassium bromide}}{KBr}$$

Question 13

Write the IUPAC name of (Delhi 2013)



$$CH_3CH=CH-\underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$$

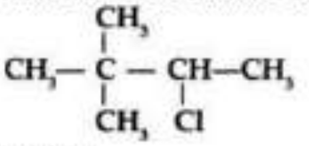
Answer:
IUPAC name : 4-bromo-4-methylpent-2-ene

Question 14
What happens when ethyl chloride is treated with aqueous KOH? (Delhi 2013)
Answer:

$$\underset{\text{Chloroethane}}{C_2H_5Cl} + \text{aq. KOH} \xrightarrow{\Delta} \underset{\text{Ethanol}}{C_2H_5OH} + KCl$$

Question 15.
Write the IUPAC name of $(CH_3)_2CH.CH(Cl)CH_3$. (Delhi 2013)
Answer:
IUPAC name : 2-chloro-3-methylbutane

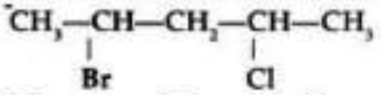
Question 16
Write the IUPAC name of the following compound: (All India 2013)



$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-\underset{\underset{Cl}{|}}{CH}-CH_3$$

Answer:
IUPAC name : 2-Chloro-3, 3-dimethylbutane.

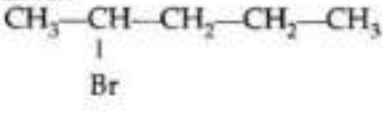
Question 17
Write the IUPAC name of the following compound : (All India 2013)



$$CH_3-\underset{\underset{Br}{|}}{CH}-CH_2-\underset{\underset{Cl}{|}}{CH}-CH_3$$

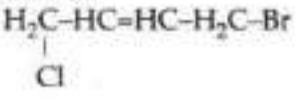
Answer:
IUPAC name : 2-Bromo-4-chloropentane

Question 18. Draw the structure of 2-bromopentane. (Comptt. Delhi 2014)
Answer:



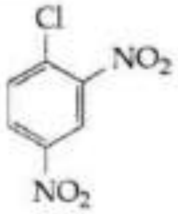
$$CH_3-\underset{\underset{Br}{|}}{CH}-CH_2-CH_2-CH_3$$

Question 19
Write the structure of 1-Bromo-4-chlorobut-2-ene. (Delhi 2017)
Answer:

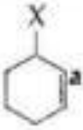


$$\underset{\underset{Cl}{|}}{H_2C}-HC=HC-H_2C-Br$$

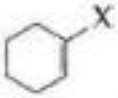
Question 20.
Write the structure of 2, 4-dinitrochlorobenzene. (Delhi 2017)
Answer:



Question 21.
Out of



and

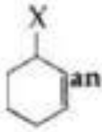


which is an example of allylic halide? (All India 2017)

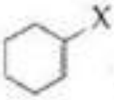
Answer:

is an allylic halide.

Question 22.
Out of

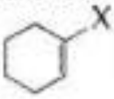


and



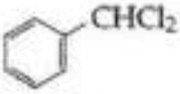
which is an example of vinylic halide? (All India 2017)

Answer:

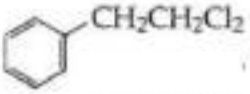


is vinylic halide.

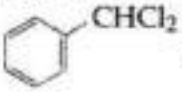
Question 23.
Out of



and



which is an example of a benzylic halide? (All India 2017)
Answer:

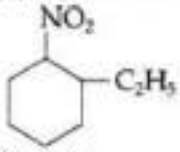


is a benzylic halide.

2 MARK QUESTIONS

Question 24
(i) o-nitrophenol has lower b.p. than p-nitro-phenol. Explain.

(ii) Write IUPAC name of the following: (Comptt. Delhi 2013)



Answer:

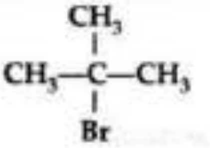
(i) Ortho-nitrophenol has lower boiling point due to formation of intramolecular H-bonding whereas p-nitrophenol forms intermolecular H-bonding.

(ii) IUPAC name : 2-ethyl-1-nitrocyclohexane.

Question 25.

Which would undergo SN2 reaction faster in the following pair and why? (Delhi 2015)

CH_3-CH_2-Br and



$CH_3-\underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$

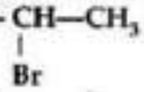
Answer:

CH_3CH_2Br reacts faster because it is a primary halide (1° halide).

Question 26.

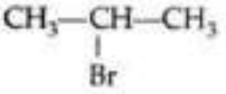
Which would undergo SN1 reaction faster in the following pair and why? : (All India 2015)

$CH_3-CH_2-CH_2-Br$ and



$CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$

Answer:

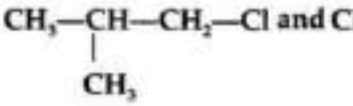


$CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$

because the secondary carbocation formed is more stable than primary carbocation.

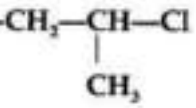
Question 27.

Out of



$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-Cl$

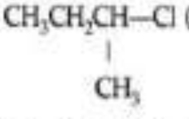
and



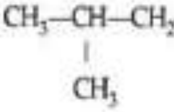
$CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-Cl$

which is more reactive towards S_N1 reaction and why? (Delhi 2016)

Answer:



$CH_3CH_2\underset{\underset{CH_3}{|}}{CH}-Cl$ (2-Chlorobutane) is more reactive than

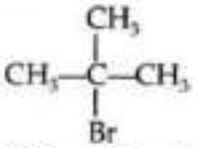


$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH_2-Cl$ (1-Chloro-2-methylpropane) because 2-Chlorobutane forms a more stable 2° carbocation.

Question 28

Write the structure of an isomer of compound C_4H_9Br which is most reactive towards S_N1 reaction and why? (All India 2016)

Answer:



$CH_3-\underset{Br}{\overset{CH_3}{C}}-CH_3$

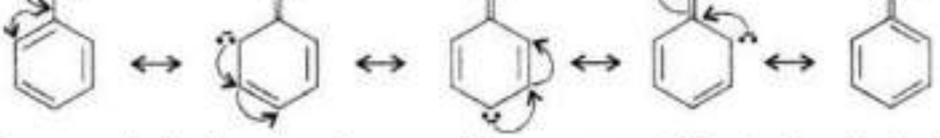
(2-Bromo-2-methyl propane) or tert-butyl bromide is most reactive towards S_N1 reaction as it Br can form 3° carbocation.

Question 29

Haloalkanes undergo nucleophilic substitution whereas haloarenes undergo electrophilic substitution. Explain. (Comptt. Delhi 2012)

Answer:

Haloarenes (say chlorobenzene) is a resonance hybrid of the following five structures :



Resonance leads to lowering of energy and hence greater stability. On the other hand, no such resonance is possible in haloalkanes. Halogens directly attached to benzene ring are o, p-directing in electrophilic substitution reactions. This is due to greater electron density at these positions in resonance.

Question 30.

Chlorobenzene is extremely less reactive towards a nucleophilic substitution reaction. Give two reasons for the same. (Delhi 2013)

Answer:

The reasons are:

(i) Due to resonance C – Cl bond acquires a partial double bond character. As a result, the C – Cl bond in chlorobenzene is shorter and hence stronger. Thus, cleavage of C – Cl bond in benzene becomes difficult which makes it less reactive towards nucleophilic substition.

(ii) Due to repulsion between nucleophile and electron rich arenes.

Question 31.

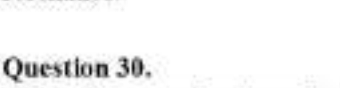
(a) Why does p-dichlorobenzene have a higher m.p. than its o- and m-isomers?

(b) Why is (±)-Butan-2-ol optically inactive? (Delhi 2013)

Answer:

(a) p-isomers are comparatively more symmetrical and fit closely in the crystal lattice, thus require more heat to break these strong forces of attraction. Therefore p–isomers have higher melting point than o- and m-isomers.

(b) (±)-Butan-2-ol is optically inactive because in racemic mix one type of rotation is cancelled by other.



$H_3C-\underset{OH}{CH}-H_2C-CH_3$

Question 32

Account for the following:

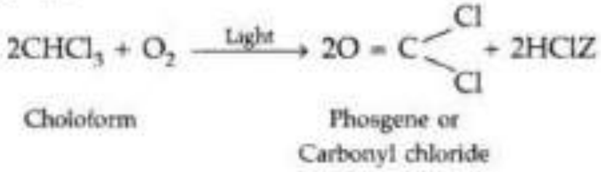
(i) The C – Cl bond length in chlorobenzene is shorter than that in CH_3-Cl.

(ii) Chloroform is stored in closed dark brown bottles. (Delhi 2013)

Answer:

(i) In haloalkanes, the halogen atom is attached to sp^3-hybridized carbon while in haloarenes it is attached to sp^2 -hybridized carbon whose size is smaller than sp^3 orbital carbon . Therefore C – Cl bond in chloro-benzene is shorter than alkyl chloride.

(ii) $CHCl_3$ is stored in dark coloured bottles to cut off light because $CHCl_3$ is slowly oxidised by air in presence of light to form an extremely poisonous gas, carbonyl chloride, popularly known as phosgene.

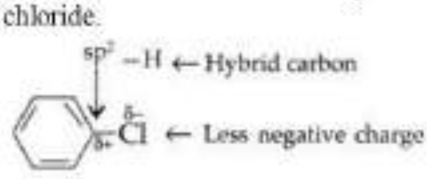


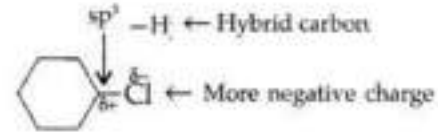
$$2CHCl_3 + O_2 \xrightarrow{\text{Light}} 2O = C\begin{matrix} Cl \\ Cl \end{matrix} + 2HClZ$$

Question 33.
Explain why :
(a) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
(b) Alkyl halides, though polar, are immiscible with water. (Comptt. All India 2013)

Answer:

(a) Chlorobenzene has lower dipole moment than cyclohexyl chloride due to lower magnitude of -ve charge on the Cl atom and shorter C – Cl distance. Due to greater S-character, a sp^2-hybrid carbon is more electronegative than a sp3-hybrid carbon. Therefore, the sp^2-hybrid carbon of C – Cl bond in chlorobenzene has less tendency to release electrons to Cl than a sp^3 hybrid carbon of cyclohexyl chloride.





(b) Alkyl halides and polar molecules are held together by dipole-dipole interaction. The molecules of H_2O are held together by H- bonds. Since the new forces of attraction between water and alkyl halide molecules are weaker than the forces of attraction already existing between alkyl halide-alkyl halide molecules and water-water molecules, therefore alkyl halides are immiscible (not soluble) with water.

Question 34.
What are ambident nucleophiles? Explain with an example. (Comptt. All India 2014)

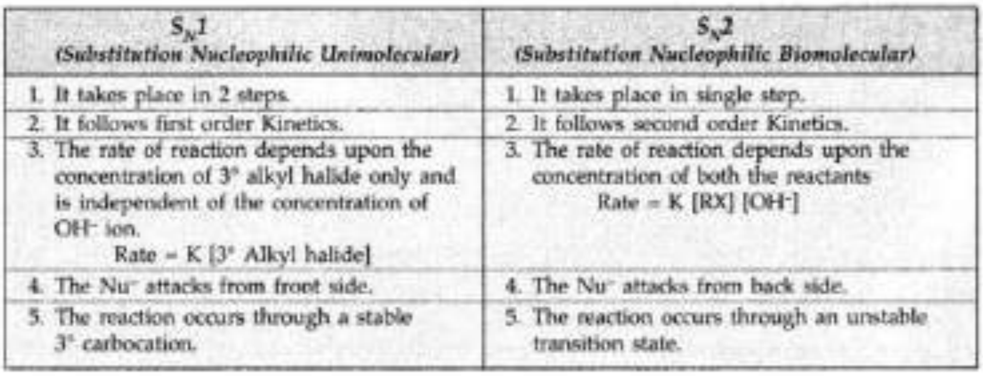
Answer:

Ambident nucleophile : Nucleophiles which can attack through 2 different sites are known as ambident nucleophiles.

Example : Cyanide ion is an example of a ambident nucleophile. Nucleophillic attack by AgCN leads to formation of cyanides whereas attack of KCN leads to formation of isocyanides

3 MARKS QUESTIONS-

Question35 Write three difference between SNI and SN2 mechanism



S_N1 (*Substitution Nucleophilic Unimolecular*)	S_N2 (*Substitution Nucleophilic Biomolecular*)
1. It takes place in 2 steps.	1. It takes place in single step.
2. It follows first order Kinetics.	2. It follows second order Kinetics.
3. The rate of reaction depends upon the concentration of 3° alkyl halide only and is independent of the concentration of OH^- ion. Rate = K [3° Alkyl halide]	3. The rate of reaction depends upon the concentration of both the reactants Rate = K [RX] [OH^-]
4. The Nu^- attacks from front side.	4. The Nu^- attacks from back side.
5. The reaction occurs through a stable 3° carbocation.	5. The reaction occurs through an unstable transition state.

Question36

Answer the following:

(i) Haloalkanes easily dissolve in organic solvents, why?

(ii) What is known as a racemic mixture? Give an example.

(iii) Of the two bromoderivatives, $C_6H_5CH(CH_3)Br$ and $C_6H_5CH(C_6H_5)Br$, which one is more reactive in S_N1 substitution reaction and why? (Delhi 2011)

Answer:

(i) Because the new forces of attraction set up between haloalkanes and solvent molecules are of the same strength as the forces of attraction being broken.

(ii) A mixture which contains the equal proportions of two enantiomers of a compound in equal proportions is called racemic mixture

Example : (±) butan-2-ol

(iii) Since the reactivity of S_N1 reactions increases as the stability of intermediate carbocation increases. Of the two 2° bromides, the carbocation intermediate derived from C_6H-$CH(C_6H_5)Br$ i.e. $C_6H_5CHC_6H_5$ is more stable as compared to the carbocation C6H+5CHCH3 obtained from $C_6H_5CH(CH_3)Br$ because it is stabilized by two phenyl groups due to resonance.

Question 37

(a) Account for the following:

(i) Electrophilic substitution reactions in haloarenes occur slowly.

(ii) Haloalkanes, though polar, are insoluble in water.

(b) Arrange the following compounds in increasing order of reactivity towards S_N2 displacement:

2-Bromo-2-Methylbutane, 1-Bromopentane, 2-Bromopentane (Comptt. All India 2017)

Answer:

(a) (i) Due to -I effect of halogen atom, it withdraws electrons from the benzene ring and thus ring gets deactivated.

(ii) They fail to form hydrogen bonds with water. More energy is required to break hydrogen bonds in water and less energy is released when new attractions are set up.

(b) 2-Bromo-2-Methylbutane < 2-Bromopentane < 1-Bromopentane

MINIMUM LEARNING MATERIAL

Chapter- ALCOHOLS PHENOLS AND ETHERS

Multiple Choice Questions

1. Reaction between acetone and methyl magnesium chloride followed by hydrolysis will give :

a) Isobutylalcohol b) Isopropyl alcohol c) sec-butyl alcohol d) tert-butyl alcohol

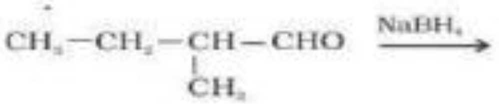
2. Which of the following cannot be made by using Williamson's synthesis ?

a) Methoxy benzene b) tert-butyl ethyl ether c) allyl methyl ether
d) Di tert-butyl ether

3 .Which of the following reagents may be used to distinguish between phenol and benzoic acid ?

a) Neutral $FeCl_3$ b) Aqueous NaOH c) Tollen's reagent d) Molisch reagent

4. Identify the product of the following reaction :



$$CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CHO \xrightarrow{NaBH_4}$$

a) 2-methylbutan-1-ol b) 2- methylbutanoic acid c) 2- methylbutane
d) 2-methylbutan-2-ol

5. Dehydration of alcohol is an example of

a. addition reaction
b. elimination reaction
c. substitution reaction
d. redox reaction

6. The alcohol which does not react with Lucas reagent is

a. isobutyl alcohol
b. n-butanol
c. tert-butyl alcohol
d. sec-butyl alcohol

7. The substance used to distinguish between ethanol and methanol

a. Lucas reagent b. Sodium metal c. Iodoform test d. Ferric chloride

8. The correct order of reactivity of primary secondary and tertiary alcohols towards sodium metal

a. Primary > Sec> Tert b. Primary > tert . Sec c. Sec > Primary > Tert

d. Tert > Sec > Primary

9. Which will react fastest with conc HCl and anhydrous ZnCl2 is

a. 2-Methylpropanol b. Butanol c. 2 Butanol d. 2-Methylpropan-2-ol

10. The molecular formula of ethers is

a. $C_nH_{2n}O$ b. $C_nH_{2n-1}O$ c. $C_nH_{2n+2}O$ d. $C_nH_{2n}OC_nH_{2n}$

1	2	3	4	5	6	7	8	9	10
	a	a		b	b	b	a	d	c

ASSERTION REASONING QUESTIONS

For questions given below two statements are given - one labelled Assertion (A) and the other labelled as Reason (R). Select the correct answer from the codes (A) , (B) , (C) and (D) as given below :

(A) Bothe assertion and reason are correct statements , and reason is the correct explanation of the assertion.

(B) Both assertion and reason are correct statements , but reason is not the correct explanation of the assertion

(C) Assertion is correct , but reason is wrong statement

(D) Assertion is wrong , but reason is correct statement

1. **Assertion** (A) : Aldehydes are reduced to primary alcohols by using $LiAlH_4$

Reason (R) : $LiAlH_4$ is a strong reducing agent

2. **Assertion** (A) : The acid strength of primary alcohol is more than secondary alcohol

Reason (R) : + I effect decreases the acid character

3. **Assertion** (A) : o- nitrophenol has lower boiling point than p-nitrophenol

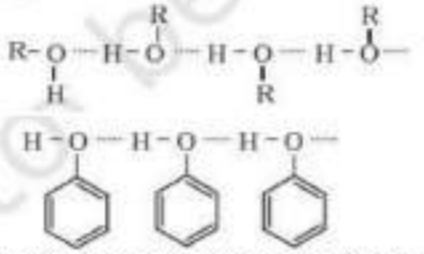
Reason (R) : o-nitrophenol possess intramolecular hydrogen bonding while p-nitrophenol has intermolecular hydrogen bonding

1	2	3
a	a	a

SHORT ANSWER QUESTIONS 2 MARK EACH

Q1. Why the boiling points of alcohols and phenols are higher in comparison to other classes of compounds, namely hydrocarbons, ethers, haloalkanes and haloarenes of comparable molecular masses?

Boiling points of alcohols and phenols are higher in comparison to other classes of compounds, namely hydrocarbons, ethers, haloalkanes and haloarenes of comparable molecular masses. The high boiling points of alcohols and phenols are mainly due to the presence of intermolecular hydrogen bonding in them which is lacking in ethers and hydrocarbons.



Q2. How primary, secondary and tertiary alcohols are distinguished by Lucas reagent test?

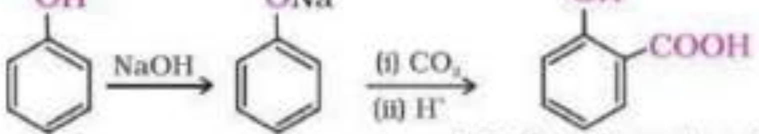
Alcohols react with hydrogen halides to form alkyl halides.

$ROH + HX \rightarrow R\text{–}X + H_2O$ The difference in reactivity of three classes of alcohols with HCl distinguishes them from one another (Lucas test). Alcohols are soluble in Lucas reagent (conc. HCl and $ZnCl_2$) while their halides are immiscible and produce turbidity in solution. In case of tertiary alcohols, turbidity is produced immediately as they form the halides easily. Primary alcohols do not produce turbidity at room temperature.

Q3.Give a chemical test to distinguish between the following pairs of compounds:
Methanol and phenol
Phenol gives a violet colouration with $FeCl_3$ solution while methane does not.

Q3. How will you convert phenol into ortho hydroxybenzoic acid?

Phenoxide ion generated by treating phenol with sodium hydroxide is even more reactive



2-Hydroxybenzoic acid
(Salicylic acid)

than phenol towards electrophilic aromatic substitution. Hence, it undergoes electrophilic substitution with carbon dioxide, a weak electrophile. Ortho hydroxybenzoic acid is formed as the main reaction product

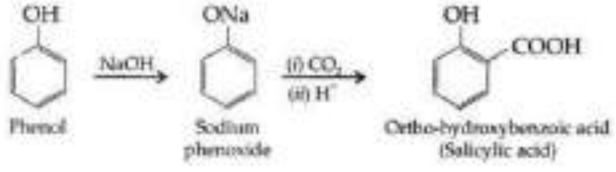
Q4. Give a chemical test to distinguish between 2-Pentanol and 3-Pentanol.

Answer:

2-pentanol gives Iodoform test with yellow ppt. of Iodoform while 3-pentanol does not give this test.

Q5. Write the chemical reaction to explain Kolbe's reaction

Kolbe's reaction: Phenol reacts with CO_2 in presence of sodium hydroxide (NaOH) produces sodium phenoxide which on treatment with CO_2 followed by acidification produces salicylic acid



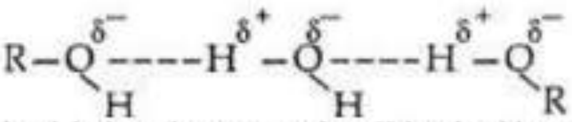
Q6. Explain the following behaviours:

(I) Alcohols are more soluble in water than the hydrocarbons of comparable molecular masses.

(II) Ortho-nitrophenol is more acidic than ortho-methoxyphenol. (All India 2012)

Answer:

(i) Alcohols can form H-bonds with water and break the H-bonds already existing between water molecules. So they are soluble in water.



On the other hand, hydrocarbons cannot form H-bonds with water and hence are insoluble in water.

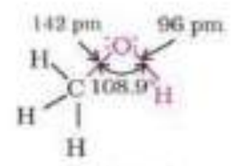
(ii) Due to strong – R and -I effect of the – NO_2 group, electron density in the – OH bond decreases and hence the loss of a proton becomes easier. Moreover O-nitrophenoxide ion is stabilized by resonance, 1 thereby making O-nitrophenol a stronger acid.

In O-methoxyphenol, due to + R effect of the – OCH_3 group the electron density in the

O – H bond increases thereby making the loss of proton difficult. Furthermore, the O-methoxyphenoxide ion left after the loss of a proton is destabilized by resonance because the two negative charges repel each other. So O-methoxyphenol is a weaker acid.

Q7. The bond angle  **in alcohol is slightly less than the tetrahedral bond angle. Give reason?**

The bond angle in alcohols is slightly less than the tetrahedral angle (109°-28′). It is due to the repulsion between the unshared electron pairs of oxygen.



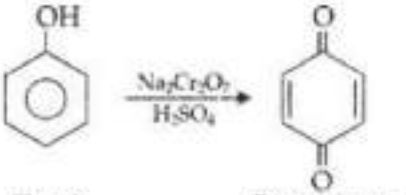
Methanol

Q8. How would you obtain phenol from benzene? (Comptt. All India 2013)

An. By Dows Process

Q9. What happens when phenol is oxidized by $Na_2Cr_2O_7/H_2SO_4$?

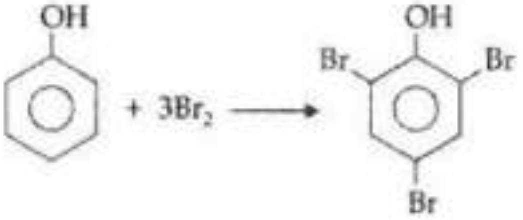
Phenol forms benzoquinone on oxidation with $Na_2Cr_2O_7$ / H_2SO_4,



Phenol Benzoquinone

Q10. What happens when phenol is treated with bromine water? (Comptt. All India 2017).

Ans. 2, 4, 6-tribromophenol is formed when phenol is treated with bromine water.



Q11. Illustrate Williamsons synthesis for production of ether by giving chemical equation (Delhi 2010)

Answer:

Williamson's ether synthesis : The reaction involves the nucleophilic substitution of the halide ion from the alkyl halide by the alkoxide ion by S_N2 mechanism.

Example :

$$\underset{\text{Sod. ethoxide}}{CH_3CH_2{-}O{-}Na^+} + \underset{\text{Ethyl bromide}}{CH_3\overset{\delta+}{C}H_2{-}\overset{\delta-}{Br}} \xrightarrow[S_N2]{330\,K} \underset{\text{Diethyl ether}}{CH_3CH_2{-}O{-}CH_2{-}CH_3} + NaBr$$

SHORT ANSWER 3 MARK QUESTIONS

Q12. Explain the following observations :

(i) The boiling point of ethanol is higher than that of methoxymethane.

(ii) Phenol is more acidic than ethanol.

(iii) o- and p-nitrophenols are more acidic than phenol. (All India 2009)Ans .

(i) Due to presence of intermolecular H-bonding, associated molecules are formed, hence ethanol has high boiling point while methoxymethane does not have intermolecular H-bonding.
(ii) Phenol on losing H^+ ion forms phenoxide ion, and ethanol on losing H^+ ion forms ethoxide ion. Phenoxide ion is more stable than ethoxide ion as phenoxide ion exists in resonance structure. Due to this phenol is more acidic than ethanol.
(iii) Both o- and p-nitrophenols contain the NO_2 group which is an electron withdrawing group. Due to -R and -I effect of the $-NO_2$ group, electron density in the OH bond of substituted phenol decreases and hence the loss of proton becomes easy and therefore more acidic.

Q13. a) Give a seperate chemical test to distinguish between the following pairs of compounds:
i) Ethanol and Phenol
(ii) 2-Pentanol and 3-Pentanol

Answer:
(a) (i) Ethanol on reacting with I_2 in NaOH gives yellow ppt of iodoform whereas phenol does not respond to this test.
(ii) 2-Pentanol on reacting with I_2 in NaOH gives yellow ppt of iodoform whereas 3-pentanol does not respond to this test.

Q14. Give reasons for the following :
(i) Phenol is more acidic than methanol.
(ii) The C—O—H bond angle in alcohols is slightly less than the tetrahedral angle (190°28').
(iii) $(CH_3)_3C—O—CH_3$ on reaction with HI gives $(CH_3)_3C—I$ and $CH_3—OH$ as the main products and not $(CH_3)_3C—OH$ and $CH_3—I$. (All India 2015)

Answer:
(i) Phenol is more acidic than methanol because in phenol, phenoxide ion formed is more stabilized by resonance than phenol. There is no resonance in methanol.
(ii) The C—O—H bond angle in alcohols is slightly less than tetrahedral angle due to repulsion between the lone pairs of electrons of oxygen.

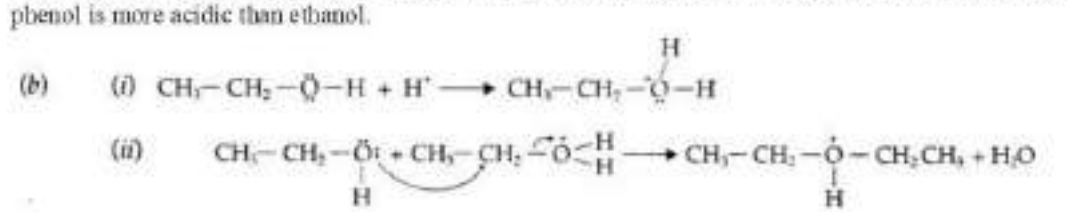
(iii) $(CH_3)_3C+$ is 3° carbo-cation which is more stable than CH+3 for S_N1 reaction.

Q15. a) Why phenol is more acidic than ethanol?

(b) Write the mechanism of acid dehydration of ethanol to yield ether: (All India 2017)

$$2CH_3CH_2OH \xrightarrow[413K]{H^+} CH_3CH_2OCH_2CH_3$$

Ans. a) Phenol on losing H+ ion forms phenoxide ion, and ethanol on losing H+ ion forms ethoxide ion. Phenoxide ion is more stable than ethoxide ion as phenoxide ion exists in resonance structure. Due to this phenol is more acidic than ethanol.



(b) (i) $CH_3-CH_2-\ddot{O}-H + H^+ \longrightarrow CH_3-CH_2-\overset{+}{\underset{|}{O}}{}-H$ (with H above O)

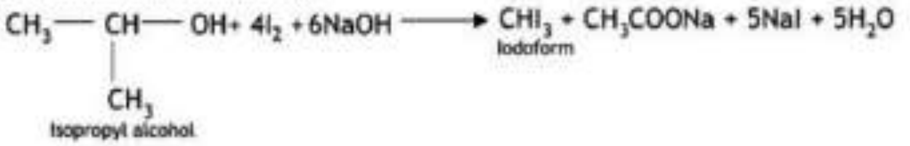
(ii) $CH_3-CH_2-\underset{H}{\underset{|}{\ddot{O}}} + CH_3-CH_2-\overset{+}{O}{<}^{H}_{H} \longrightarrow CH_3-CH_2-\underset{H}{\underset{|}{\overset{+}{O}}}-CH_2CH_3 + H_2O$

Q16. Give chemical tests to distinguish between (CBSE Sample Paper 2011)
Answer:

(i) Isopropyl alcohol and n-propyl alcohol

Answer:

Isopropyl alcohol gives the iodoform test. On heating with NaOH/I_2 or NaOI, isopropyl alcohol forms a yellow precipitate of iodoform (CHI_3).



$$\underset{\text{Isopropyl alcohol}}{CH_3-\underset{\underset{CH_3}{|}}{CH}-OH} + 4I_2 + 6NaOH \longrightarrow \underset{\text{Iodoform}}{CHI_3} + CH_3COONa + 5NaI + 5H_2O$$

LONG ANSWER QUESTION -5 mark

Q17.. Write the formula of reagents used in the following reactions:

(i) Bromination of phenol to 2,4,6-tribromophenol

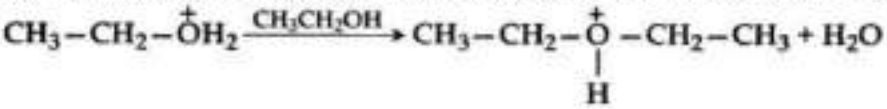
(ii) Hydroboration of propene and then oxidation to propanol.

(b) Arrange the following compound groups in the increasing order of their property indicated:

(i) p-nitrophenol, ethanol, phenol (acidic character)

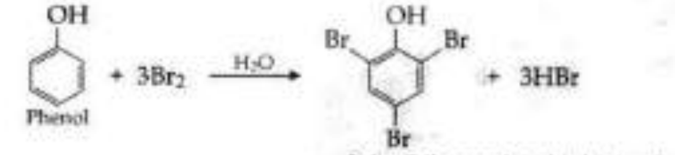
(ii) Propanol, Propane, Propanal (boiling point)

(iii) Write the mechanism (using curved arrow notation) of the following reaction: (Delhi 2017)



$$CH_3-CH_2-\overset{+}{O}H_2 \xrightarrow{CH_3CH_2OH} CH_3-CH_2-\underset{\underset{H}{|}}{\overset{+}{O}}-CH_2-CH_3 + H_2O$$

(*a*) (*i*) Br_2/H_2O



2, 4, 6-Tribromophenol (white ppt.)

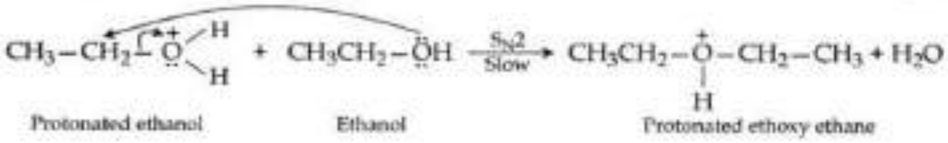
(*ii*) B_2H_6, H_2O_2 and OH^-

$$\underset{\text{Propene}}{CH_3-CH=CH_2} \xrightarrow[(ii)\ H_2O_2/OH^-]{(i)\ BH_3/THF} \underset{\text{Propanol}}{CH_3CH_2CH_2OH}$$

(*b*) (*i*) p-nitrophenol > Phenol > Ethanol (*Acidic character*)

(*ii*) Propanol > Propanal > Propane (*Boiling point*)

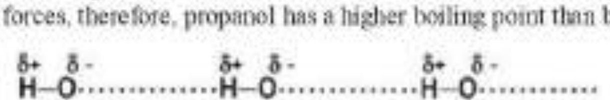
(*c*)



$$\underset{\text{Protonated ethanol}}{CH_3-CH_2-\overset{+}{O}\begin{smallmatrix}H\\H\end{smallmatrix}} + \underset{\text{Ethanol}}{CH_3CH_2-\ddot{O}H} \xrightarrow[\text{Slow}]{S_N2} \underset{\text{Protonated ethoxy ethane}}{CH_3CH_2-\underset{\underset{H}{|}}{\overset{+}{O}}-CH_2-CH_3} + H_2O$$

Q18.a. Why does propanol have a higher boiling point than that butane? (CBSE 2019C)

The molecules of propanol are held together by intermolecular hydrogen bonding while butane molecules have only weak van der Waals forces of attraction. Since hydrogen bonds are stronger than van der Waals forces, therefore, propanol has a higher boiling point than butane.



b. Give reasons for the following: (CBSE 2015, Outside Delhi)

(i) o-nitrophenol is more acidic than o-methoxyphenyl.

Answer:

This is because —NO_2 (nitro group) is an electron-withdrawing group and will increase the +ve charge on oxygen to make it more acidic. On the other hand, the -OCH_3 group is an electron-releasing group and will decrease +ve charge on oxygen making it less acidic as O-H bond will not break easily.

(ii) Butan-1-ol has a higher boiling point than diethyl ether.

Answer:

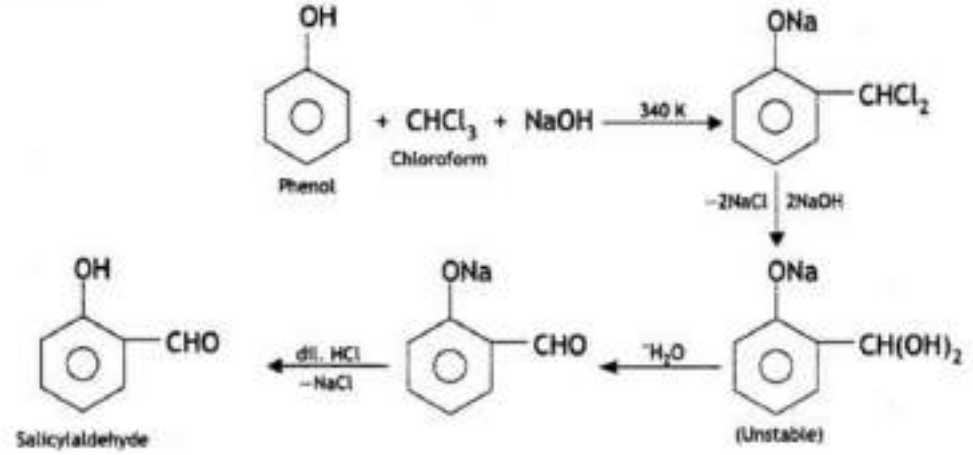
Butan-1 -ol has intermolecular hydrogen bonding between their molecules. Therefore, it exists as associated molecules and large amount of energy is required to break these bonds and hence, its boiling point is high. But diethyl ether does not show any association by intermolecular hydrogen bonding. Hence, its boiling point is low.

Q19. Write the equations involved in the following reactions: (CBSE 2013, 2014)

(i) Reimer-Tiemann reaction

Answer:

Reimer-Tiemann reaction: When phenol is refluxed with chloroform in the presence of aqueous caustic alkali at 340 K, an aldehydic group (CHO) gets introduced in the ring at a position ortho to the phenolic group. Ortho hydroxy benzaldehyde or salicylaldehyde is formed as the product of the reaction.



ii) Williamson's ether synthesis

Answer:

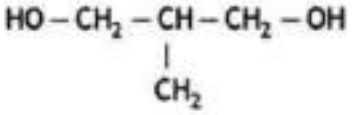
Williamson's ether synthesis. This is used to prepare symmetrical and unsymmetrical ethers by treating alkyl halide with either sodium alkoxide or sodium phenoxide.

$$\underset{\text{Bromomethane}}{CH_3Br} + \underset{\text{Sod. ethoxide}}{C_2H_5O^-Na^+} \longrightarrow \underset{\text{Methoxy ethane}}{CH_3OC_2H_5} + NaBr$$

$$\underset{\text{Bromoethane}}{C_2H_5Br} + \underset{\text{Sod. ethoxide}}{C_2H_5O^-Na^+} \longrightarrow \underset{\text{Ethoxy ethane}}{C_2H_5OC_2H_5} + NaBr$$

$$\underset{\text{Chloroethane}}{C_2H_5Cl} + \underset{\text{Sod. phenoxide}}{C_6H_5O^-Na^+} \longrightarrow \underset{\text{Ethoxy benezene}}{C_6H_5OC_2H_5} + NaBr$$

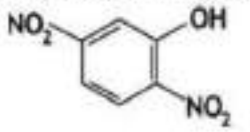
Q20. A.. Write the IUPAC name of the given compound: (CBSE 2015)



$$HO-CH_2-\underset{\displaystyle CH_2}{\underset{|}{CH}}-CH_2-OH$$

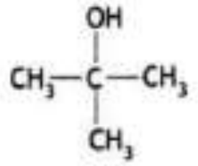
Ans 2-Methylpropane-1, 3-diol

b. Write the IUPAC name of the given compound: (CBSE Delhi 2015)



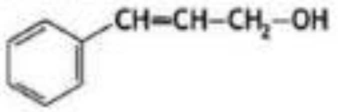
Ans.2,5 Dinitrophenol

c. Draw the structural formula of the 2-methylpropan-2-ol molecule. (CBSE Delhi 2017)



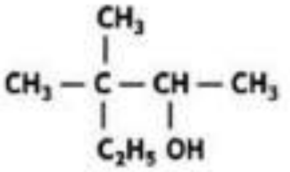
$$CH_3-\overset{\displaystyle OH}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-CH_3$$

d.Write the IUPAC name of the following compound: (CBSE AI 2017)



Ans. 3-Phenylprop-2-en-1-ol

e.Write the IUPAC name of the following: (CBSE AI 2018)



$$CH_3-\overset{\displaystyle CH_3}{\overset{|}{\underset{\displaystyle C_2H_5}{\underset{|}{C}}}}-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3$$

Ans. 3, 3-Dimethylpentan-2-ol

MINIMUM LEARNING MATERIAL
CHAPTER-ALDEHYDES KETONES AND CARBOXYLIC ACID

Multiple choice questions

1. The oxidation of toluene to benzaldehyde by chromyl, chloride is called
   - (a) Etard reaction
   - (b) Riemer-Tiemann reaction
   - (c) Wurtz reaction
   - (d) Cannizzaro's reaction

Ans. a) Etard reaction

2. There is a large difference in the boiling points of butanal and butanal-1-oldueto
   - (a) intermolecular hydrogen bonding in butan-1-ol

(b) intermolecular hydrogen bonding in butanal
(c) higher molecular mass of butan-1-ol
(d) resonance shown by butanal

Ans (a) intermolecular hydrogen bonding in butan-1-ol

3. The addition of HCN to carbonyl compounds is an example of
(a) nucleophilic addition
(b) electrophilic addition
(c) free radical addition
(d) electromeric addition

Ans . (a) nucleophilic addition

4. Which of the following will not give aldol condensation?
(a) Phenyl acetaldehyde
(b) 2-Methylpentanal
(c) Benzaldehyde
(d) 1-Phenylpropanone

Ans (c) Benzaldehyde

5. Which of the following compounds will undergo Cannizzaro reaction?
(a) CH_3CHO
(b) CH_3COCH_3
(c) C_6H_5CHO
(d) $C_6H_5CH_2CHO$

Ans. (c) C_6H_5CHO

6. What is the test to differentiate between penta-2-one and pentan-3-one?
(a) Iodoform test
(b) Benedict's test
(c) Fehling's test
(d) Aldol condensation test

Ans. (a) Iodoform test

7. Hydrocarbons are formed when aldehydes and ketones are reacted with amalgamated zinc and conc. HCl. The reaction is called
(a) Cannizzaro reaction
(b) Clemmensen reduction
(c) Rosenmund reduction
(d) Wolff-Kishner reduction

Ans. (b) Clemmensen reduction

8. In order of reactivity of CH_3CHO, $CH_3COC_2H_5$ and CH_3COCH_3 is
(a) $CH_3CHO > CH_3COCH_3 > CH_3COC_2H_5$
(b) $C_2H_5COCH_3 > CH_3COCH_3 > CH_3CHO$
(c) $CH_3COCH_3 > CH_3CHO > C_2H_5COCH_3$
(d) $CH_3COCH_3 > C_2H_5COCH_3 > CH_3CHO$

Ans. (a) $CH_3CHO > CH_3COCH_3 > CH_3COC_2H_5$

9. Which of the following does not answer iodoform test?
(a) n-Butyl alcohol
(b) sec-Butyl alcohol
(c) Acetophenone
(d) Acetaldehyde

Ans. (a) n-Butyl alcohol

10. The fruity smellis of

a. Aldehyde
b Ketone
c. Ester
d. Alkane

Ans . Ester

ASSERTION REASONING TYPE QUESTIONS

These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses.
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

1. **Assertion :** The boiling points of aldehydes and ketones are higher than hydrocarbons and ethers of comparable molecular masses.
   Reason : There is a weak molecular association in aldehydes and ketones arising out of the dipole-dipole interactions.

   Ans.a

2. **Assertion :** Compounds containing –CHO group are easily oxidised to corresponding carboxylic acids.
   Reason : Carboxylic acids can be reduced to alcohols by treatment with $LiAlH_4$

   Ans. B.

3. **Assertion :** Formaldehyde is a planar molecule.
   Reason : It contains sp^2 hybridised carbon atom.

Ans a

Short answer type Questions

Q1. What is Tollen's reagent? Write one usefulness of this reagent. (All India 2010)
Ans

Ammonical silver nitrate solution is called Tollen's reagent.

Uses: It is used to test aldehydes. Both aliphatic and aromatic aldehydes reduce Tollen's reagent to shining silver mirror. It is also used to distinguish aldehydes from ketones.

$$\underset{\text{Tollen's reagent}}{2[Ag(NH_3)_2]^+} + \underset{\text{Aldehyde}}{RCHO} + 3OH^- \xrightarrow{\text{Heat}}$$

$$\underset{\text{Silver mirror}}{2Ag\downarrow} + \underset{\text{Carboxylate ion}}{RCOO^-} + 2H_2O$$

Q2. Arrange the following compounds in an increasing order of their reactivity in nucleophilic addition reactions : ethanal, propanal, propanone, butanone. (Delhi 2012)
Answer:
Butanone < Propanone < Propanal < Ethanal
Q3. Give a chemical test to distinguish between Benzoic acid and Phenol. (Comptt. Delhi 2012)
Answer:
Benzoic acid forms a brisk effervescence with $NaHCO_3$ solution but phenol does not respond to this test.

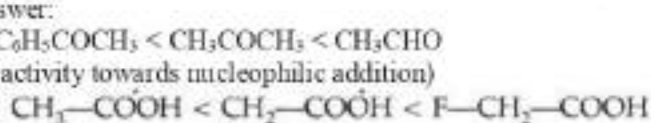
Q4. Give a chemical test to distinguish between Ethanal and Propanal. (Comptt. Delhi 2012)
Answer:
Ethanal on heating with I_2 in NaOH gives a yellow ppt of iodoform but propanal does not respond to this test.

Q5. Formaldehyde does not take part in Aldol condensation. Why ? (Comptt. All India 2012)
Answer:
Formaldehyde does not contain a-hydrogen atom. Therefore it does not take part in aldol condensation.

Q6. Aldehydes and Ketones have lower boiling points than corresponding alcohols. Why ? (Comptt. All India 2012)
Answer:
It is due to weak molecular association in aldehydes and ketones arising out of the dipole- dipole interactions.

Q7. Ethanal is soluble in water. Why? (All India 2013)
Answer:
Ethanal is soluble in water due to H-bonding between the polar carbonyl group and water molecules.

Q8. Arrange the following compounds in increasing order of their property as indicated :
(i) CH_3COCH_3, $C_6H_5COCH_3$, CH_3CHO
(reactivity towards nucleophilic addition reaction)
(ii) $Cl—CH_2—COOH$, $F—CH_2—COOH$, $CH_3—COOH$ (acidic character) (All India 2015)
Answer:
(i) $C_6H_5COCH_3 < CH_3COCH_3 < CH_3CHO$
(Reactivity towards nucleophilic addition)

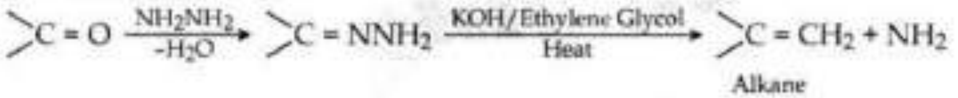


$$(ii)\ CH_3—COOH < \underset{\underset{Cl}{|}}{CH_2}—COOH < F—CH_2—COOH$$

(Increasing acidic character)

Q9. Write the equations involved in the following reactions:
(i) Wolff-Kishner reduction
(ii) Etard reaction (Delhi 2017)
Answer:

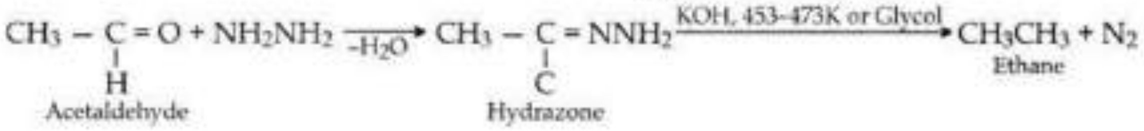
(i) Wolff-Kishner reduction



$$>C=O \xrightarrow[-H_2O]{NH_2NH_2} >C=NNH_2 \xrightarrow[\text{Heat}]{\text{KOH/Ethylene Glycol}} >C=CH_2 + NH_2$$

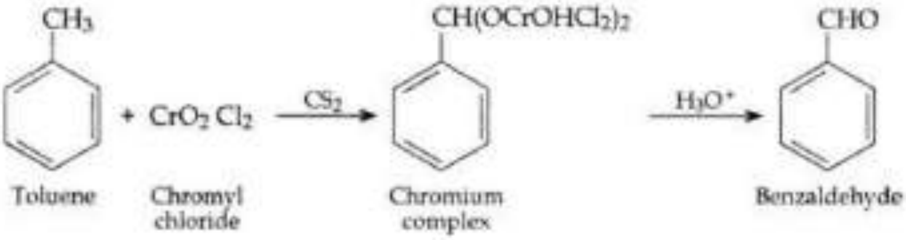
Alkane

Or



$$\underset{\text{Acetaldehyde}}{CH_3-\underset{H}{\overset{|}{C}}=O} + NH_2NH_2 \xrightarrow{-H_2O} \underset{\text{Hydrazone}}{CH_3-\underset{C}{\overset{|}{C}}=NNH_2} \xrightarrow{\text{KOH, 453-473K or Glycol}} \underset{\text{Ethane}}{CH_3CH_3} + N_2$$

(ii) Etard reaction



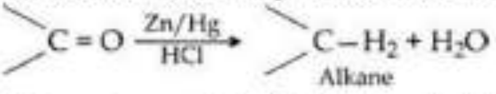
Q10. Write the reactions involved in the following reactions: (Delhi 2017)

(i) Clemmensen reduction

(ii) Cannizzaro reaction

Answer:

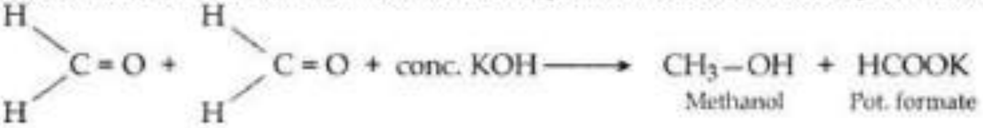
(i) Clemmensen reduction. The carbonyl group of aldehyde and ketones is reduced to CH_2 group on treatment with zinc amalgam and concentrated hydrochloric acid.



$$>C=O \xrightarrow[HCl]{Zn/Hg} >C-H_2 + H_2O$$

Alkane

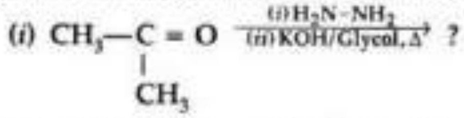
(ii) Cannizzaro reaction. Aldehydes, which do not have an a-hydrogen atom undergo self oxidation and reduction on treatment with conc, alkali and produce alcohol and carboxylic acid salt.



$$H_2C=O + H_2C=O + \text{conc. KOH} \longrightarrow \underset{\text{Methanol}}{CH_3-OH} + \underset{\text{Pot. formate}}{HCOOK}$$

SHORT ANSWER QUESTIONS (3 MARK EACH)

Q11. Predict the products of the following reactions : (Delhi 2015)

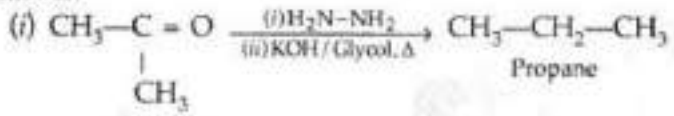


$$\textbf{(i)}\ CH_3-\underset{CH_3}{\overset{|}{C}}=O \xrightarrow[\text{(ii) KOH/Glycol},\Delta]{\text{(i) }H_2N-NH_2} ?$$

$$\textbf{(ii)}\ C_6H_5-CO-CH_3 \xrightarrow{NaOH/I_2} ? + ?$$

$$\textbf{(iii)}\ CH_3COONa \xrightarrow[\Delta]{NaOH/CaO} ?$$

Answer:



$$\text{(i)}\ \underset{\text{Acetone}}{CH_3-\underset{CH_3}{\overset{|}{C}}=O} \xrightarrow[\text{(ii) KOH/Glycol},\Delta]{\text{(i) }H_2N-NH_2} \underset{\text{Propane}}{CH_3-CH_2-CH_3}$$

$$\text{(ii)}\ \underset{\text{Acetophenone}}{C_6H_5-CO-CH_3} \xrightarrow{NaOH/I_2} \underset{\text{Sodium benzoate}}{C_6H_5COONa} + \underset{\text{Iodoform}}{CHI_3} + NaI + H_2O$$

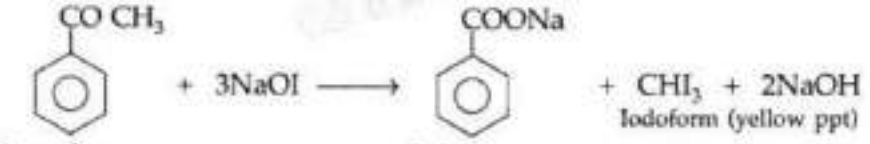
$$\text{(iii)}\ CH_3COONa \xrightarrow[\Delta]{NaOH/CaO} CH_4 + Na_2CO_3$$

Q12. Give chemical tests to distinguish between the following pairs of compounds :
(i) Propanal and Propanone
(ii) Acetophenone and Benzophenone
(iii) Phenol and Benzoic acid (All India 2009)

(i) Propanal and propanone: Propanal gives a positive test with the Fehling solution in which a red ppt. of cuprous oxide is obtained while propanone does not respond to test

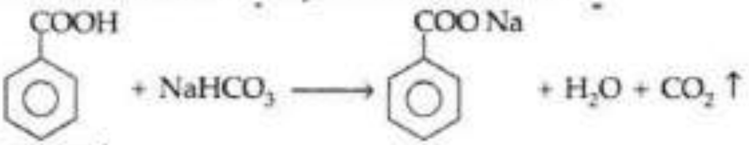
$$CH_3CH_2CHO + \underset{\text{Fehling solution}}{2Cu^{2+} + 5OH^-} \longrightarrow \underset{\text{Sodium propionate}}{CH_3CH_2COONa} + \underset{\text{Red ppt.}}{Cu_2O} + 3H_2O$$

(ii) Acetophenone and Benzophenone: They can be distinguished by iodoform test which is given by only acetophenone with the formation of yellow ppt. while benzophenone does not respond to iodoform test



Acetophenone Sod. benzoate

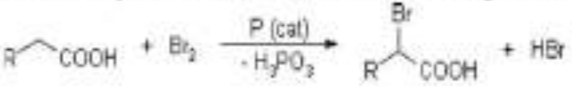
(iii) Phenol and Benzoic acid: On addition of NaHCO$_3$ to both solutions carbon dioxide gas is evolved with benzoic acid while phenol does not form CO$_2$



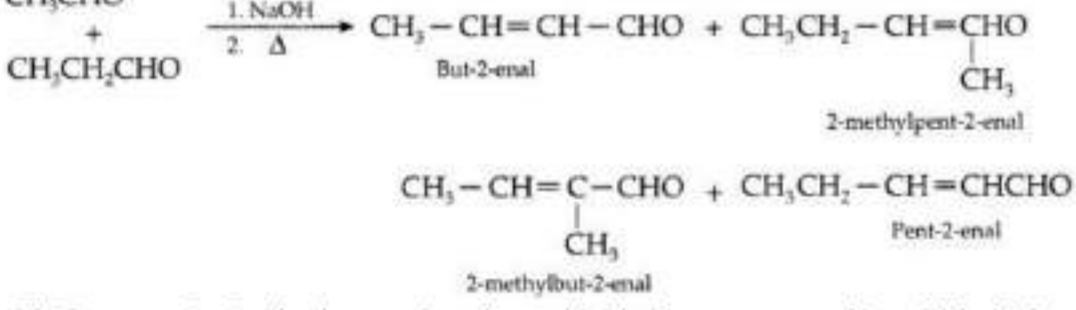
Benzoic acid

Q13. Write short note on
a.Hell Vohlard Zelhinsky reaction
b.Cross Aldol condensation
c. Rosenmund reduction

a. Hell Vohlard Zelhinsky reaction - In the Hell Volhard Zelinsky reaction PBr3 is used to replace the carboxylic OH with a bromide, resulting in a carboxylic acid bromide.



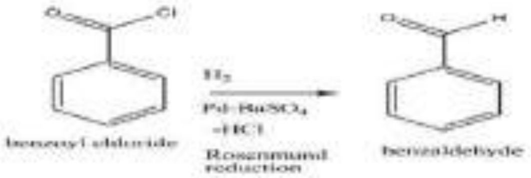
b. Cross Aldol Condensation : When aldol condensation is carried out between two different aldehydes or ketones, it is called cross aldol condenstation.



$$\begin{array}{l} CH_3CHO \\ \quad + \\ CH_3CH_2CHO \end{array} \xrightarrow[2.\ \Delta]{1.\ NaOH} \underset{\text{But-2-enal}}{CH_3-CH=CH-CHO} + \underset{\text{2-methylpent-2-enal}}{CH_3CH_2-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}HO}$$

$$\underset{\text{2-methylbut-2-enal}}{CH_3-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-CHO} + \underset{\text{Pent-2-enal}}{CH_3CH_2-CH=CHCHO}$$

c. The Rosenmund reduction is a reaction where acid chlorides are converted into aldehydes by employing hydrogen gas over palladium poisoned by barium sulfate



Q14. Account for the following :

(i) Propanal is more reactive than propanone towards nucleophilic reagents.

(ii) Electrophilic substitution in benzoic acid takes place at meta position.

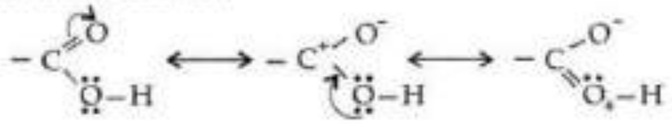
(iii) Carboxylic acids do not give characteristic reactions of carbonyl group.

Ans

(i) Due to steric and + I effect of two methyl groups in propanone.

(ii) The benzene ring of benzoic acid undergoes electrophilic substitution reaction such as nitration, sulphonation etc. Since the — COOH group in benzene is an electron withdrawing group, therefore it is meta directing group.

(iii) The carboxylic carbon is less electrophilic than carbonyl carbon because of the possible resonance structure.



Q15. a) Write the product(s) in the following :

(*i*) $\mathbf{2CH_3CHO \xrightarrow{dil\ NaOH} ?}$

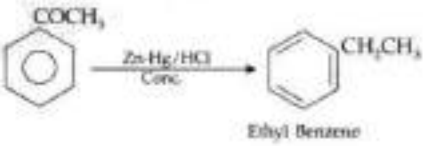
(*ii*)

b. Give simple test to differentiate between Benzoic acid and Ethyl benzoate (Comptt. Delhi 2016)

(*a*) (*i*) **Aldol condensation** :

$$2CH_3CHO \xrightarrow{NaOH(aq)} CH_3-\overset{\overset{\large OH}{|}}{C}H-CH_2-CHO$$

(*ii*) **Clemmensen reduction** :



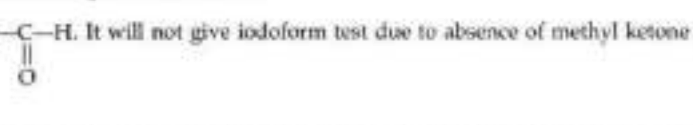
b. On adding NaHCO$_3$, benzoic acid produces brisk effervescence of C02 gas whereas ethylbenzoate does not.

$$C_6H_5COOH + NaHCO_3 \rightarrow \underset{\text{Sodium Benzoate}}{C_6H_5COONa} + CO_2\uparrow + H_2O$$

Long Answer Question 5 mark each

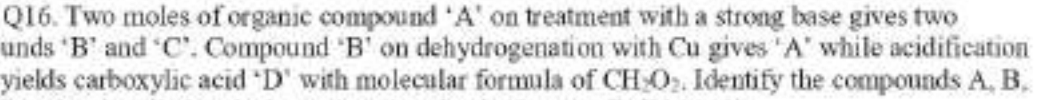
Q15. A and B are two functional isomers of compound C_3H_6O. On heating with NaOH and I_2, isomer B forms yellow precipitate of iodoform whereas isomer A does not form any precipitate. Write the formulae of A and B. (All India 2016)

Ans . The given compound has molecular formula C3H60. One of its functional isomer i.e., B shows iodoform test which can be only shown by compounds having methyl ketone so the compound B will be Acetone or 2-propanone. Its functional isomer A will be propanal.



$$\underset{\underset{(B)}{\text{Propan-2-one}}}{CH_3-\underset{\underset{O}{\|}}{C}-CH_3} + 3NaOH + I_2 \xrightarrow[-3H_2O]{\Delta} \underset{\underset{\text{(Yellow ppt)}}{\text{Iodoform}}}{3CHI_3} + CH_3COONa$$

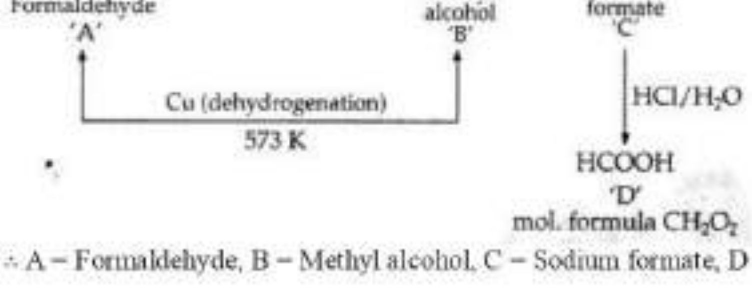
The formula of compound (A) will be



$CH_3-CH_2-\underset{\underset{O}{\|}}{C}-H$. It will not give iodoform test due to absence of methyl ketone group $\left(-\underset{\underset{O}{\|}}{C}-CH_3\right)$.

Q16. Two moles of organic compound 'A' on treatment with a strong base gives two compounds 'B' and 'C'. Compound 'B' on dehydrogenation with Cu gives 'A' while acidification of 'C' yields carboxylic acid 'D' with molecular formula of CH_2O_2. Identify the compounds A, B, C and D and write all chemical reactions involved. (Comptt. Delhi 2013)

Answer:



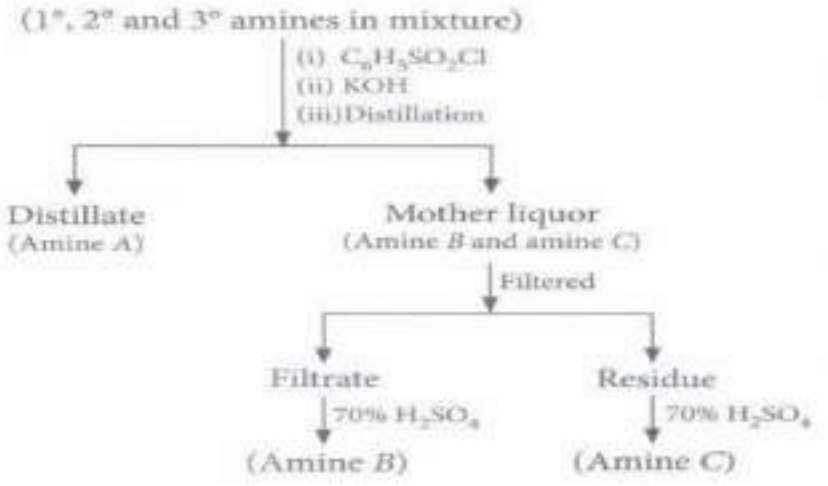
∴ A – Formaldehyde, B – Methyl alcohol, C – Sodium formate, D – Formic acid

MINIMUM LEARNING MATERIAL
CHAPTER - Amines

Case Based Questions

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

When the mixture contains the three amine salts (1°,2° and 3°) along with quaternary salt, it is distilled with KOH solution. The three amines distill, leaving the quaternary salt unchanged in the solution. Then the mixture of amines is separated by fractional distillation, Hinsbergs method and Hoffmann's method.



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

(i) Hinsberg reagent is

(a) aliphatic sulphonyl chloride **(b) phthalamide**

(c) aromatic sulphonyl chloride **(d) anhydrous $ZnCl_2$ + conc. HCl.**

(ii) Primary amine with Hinsberg's reagent forms

(a) N-alkyl benzene sulphonamide soluble in KOH solution
(b) N-alkyl benzene sulphonamide insoluble in KOH solution
(c) N,N-dialkyl benzene sulphonamide soluble in KOH solution
(d) N,N-dialkyl benzene sulphonamide insoluble in KOH solution.

(iii) To separate amines in a mixture Hoffmann's method is used. The Hoffmann's reagent is

(a) benzene sulphonyl chloride **(b) diethyl oxalate**

(c) benzene isocyanide **(d) p-toulenesulphonic acid.**

(iv) 3° amines with Hinsberg's reagent give

(a) no reaction **(b) product which is same as that of 1° amine**
(c) product which is same as that of 2° amine **(d) products which is a quaternary salt.**

Ans

(i) (c)
(ii) (a): A primary amine forms N-alkylbenzene sulphonamide which because of the presence of an

acidic hydrogen on the N-atom dissolves in aqueous KOH.

(iii) (a)

(iv) (a): Tertiary amine does not contain a replaceable hydrogen on the nitrogen atom. So, 3^0 amine does not react with Hinsberg's reagent.

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

Amines are alkyl or aryl derivatives of ammonia formed by replacement of one or more hydrogen atoms. Alkyl derivatives are called aliphatic amines and aryl derivatives are known as aromatic amines. The presence of aromatic amines can be identified by performing dye test. Aniline is the simplest example of aromatic amine. It undergoes electrophilic substitution reactions in which -NH_2 group strongly activates the aromatic ring through delocalisation oflone pair of electrons of N-atom. Aniline undergoes electrophilic substitution reactions. Ortho and para positions to the -NH_2 group become centres of high electrons density. Thus, -NH_2 group is ortho and para-directing and powerful activating group. The following questions are multiple choice questions.

Choose the most appropriate answer:

(i) Cyclohexylamine and aniline can be distinguished by

(a) Hinsberg test (b) carbylamine test (c) Lassaigne test (d) azo dye test

(ii) Which of the following compounds gives-dye test?

(a) Aniline (b) Methyl amine (c) Diphenyl amine (d) Ethyl amine

(iii) Oxidation of aniline with manganese dioxide and sulphuric acid produces

(a) phenylhydroxylamine (b) nitrobenzene (c) p-benzoquinone (d) phenol.

(iv) Aniline when treated with conc, HNO_3 and H_2SO_4 gives

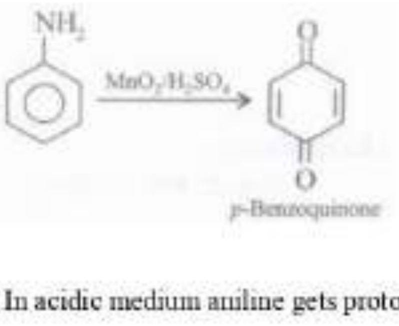
(a) phenylhydroxylamine (b) m-nitroaniline (c) p-benzoquinone (d) nitrobenzene.

Ans

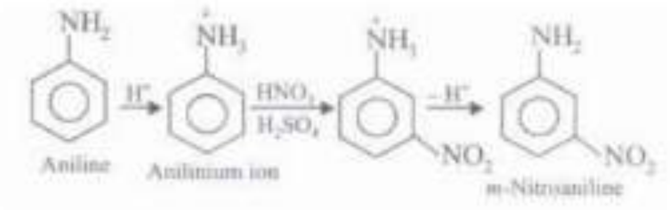
(i) (d)azo dye test

(ii) (a): Aromatic primary amines give dye test.

(iii) (c) :



(iv) (b): In acidic medium aniline gets protonated to anilinium ion which is meta-directing



Multiple Choice Questions

Question 1.

Nitrogen atom of amino group is ....hybridised.

(a) sp
(b) sp^2
(c) sp^3
(d) sp^{3}d

Answer: (c) sp^3

Question 2.

The most convenient method to prepare primary (i Amine) amine containing one carbon atom less is

(a) Gabriel phthalmidie synthesis
(b) Reductive amination of aldehydes
(c) Hofmann bromamide reaction
(d) Reduction of isonitriles

Answer (c) Hofmann bromamide reaction

Question 3.

When excess of ethyl iodide is treated with ammonia, the product is

(a) ethylamine
(b) diethylamine
(c) triethylamine
(d) tetrathylammonium iodide

Answer(d) tetraethylammonium iodide

Question 4.

Amides may be converted into amines by a reaction named after

(a) Hofmann Bromamide
(b) Claisen
(c) Perkin
(d) Kekule

Answer (a) Hofmann Bromamide

Question 5.
Tertiary amines have lowest boiling points amongst isomeric amines because
(a) they have highest molecular mass
(b) they do not form hydrogen bonds
(c) they are more polar in nature
(d) they are most basic in nature

Answer (b) they do not form hydrogen bonds

---

1 MARK QUESTIONS

Question 1.
Why is an alkylamine more basic than ammonia? (Delhi 2009)
Answer:
Due to electron releasing inductive effect (+1) of alkyl group, the electron density on the nitrogen atom increases and thus, it can donate the lone pair of electrons more easily than ammonia.

Question 2.
Arrange the following compounds in an increasing order of basic strengths in their aqueous solutions : NH_3, CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$ (All India 2009)
Answer:
Basicity order (due to stability of ammonium cation)
$(CH_3)_2\ NH > CH_3NH_2 > (CH_3)_3\ N > NH_3$

Question 3.
Give the IUPAC name of H2N — CH2—CH2—CH = CH2. (Delhi 2010)
Answer:
IUPAC name : But-3-ene-1-amine

Question 4.
Arrange the following compounds in an increasing order of their solubility in water : C6H5NH2, (C2H5)2NH, C2HSNH2 (Delhi & All India 2011)
Answer:
$C_6H_5NH_2 < (C_2H_5)_2NH < C2_2H_5NH_2$

Question 5.
Arrange the following in the decreasing order of their basic strength in aqueous solutions: CH_3NH_2, $(CH_3)_2$ NH, $(CH_3)_3N$ and NH_3 (Delhi 2012)
Answer:
$(CH_3)_2\ NH > CH_3NH_2 > (CH_3)_3\ N > NH_3$

2 MARKS QUESTIONS-

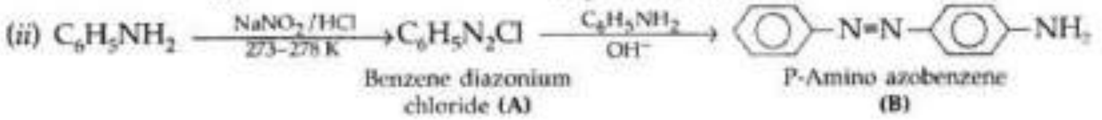
Question 1.
Identify A and B in each of the following processes : (All India 20100

$$(i)\ CH_3CH_2Cl \xrightarrow{NaCN} A \xrightarrow[Ni/H_2]{reduction} B \quad (ii)\ C_6H_5NH_2 \xrightarrow{NaNO_2/HCl} A \xrightarrow[OH^-]{C_6H_5NH_2} B$$

Answer:

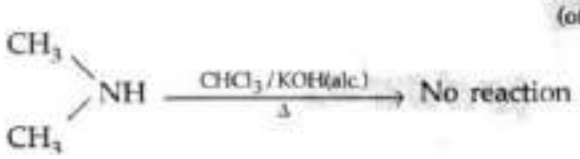
$$(i)\quad \underset{\text{Chloroethane}}{CH_3CH_2Cl} \xrightarrow{NaCN} \underset{\text{Propanenitrile (A)}}{CH_3CH_2\ C \equiv N} + NaCl$$

$$\underset{\text{(A)}}{CH_3CH_2\ C \equiv N} \xrightarrow[Ni/H_2]{reduction} \underset{\text{Propanamine (B)}}{CH_3CH_2CH_2NH_2}$$



Question 2.
Give the chemical tests to distinguish between the following pairs of compounds :
(i) Methylamine and Dimethylamine
(ii) Aniline and N-methylaniline (All India 2010)
Answer:
(i) Methylamine and Dimethylamine :
By Carbylamine test: Methylamine being a primary amine gives this test but Dimethylamine being a secondary amine does not.

$$CH_3NH_2 + CHCl_3 + 3KOH\ (alc.) \xrightarrow{\Delta} \underset{\substack{\text{Methyl isocyanide}\\ \text{(offensive smell)}}}{CH_3N \rightleftarrows C} + 3KCl + 3H_2O$$



(ii) Aniline and N-methylaniline
By Carbylamine test : Aniline is a 1° aromatic amine while N-methylaniline is a secondary aromatic amine. Therefore only 1° aromatic amine gives this test.

$$C_6H_5NH_2 + CHCl_3 + 3KOH\ (alc.) \xrightarrow{\Delta} \underset{\substack{\text{Phenyl isocyanide}\\ \text{(offensive smell)}}}{C_6H_5\ N \rightleftarrows C} + 3KCl + 3H_2O$$

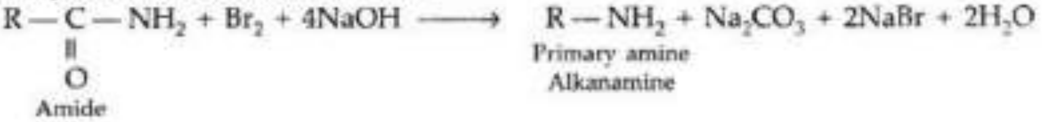
$$\underset{\text{N-methylaniline}}{C_6H_5{-}NH{-}CH_3} \xrightarrow{CHCl_3/KOH(alc.)} \text{No reaction}$$

Question 3.
Describe the following giving the relevant chemical equation in each case :
(i) Carbylamine reaction
(ii) Hofmann's bromamide reaction (All India 2012)
Answer:
(i) Carbylamine reaction : Aliphatic and aromatic primary amines on heating with chloroform and ethanolic KOH form isocyanides or carbylamines which are foul smelling substances. This reaction is

known as carbylamines reaction.

$$\underset{\text{Primary amine}}{R-NH_2} + \underset{\text{Chloroform}}{CHCl_3} + 3KOH \xrightarrow{\Delta} \underset{\text{Carbylamine}}{R-NC} + 3KCl + 3H_2O$$

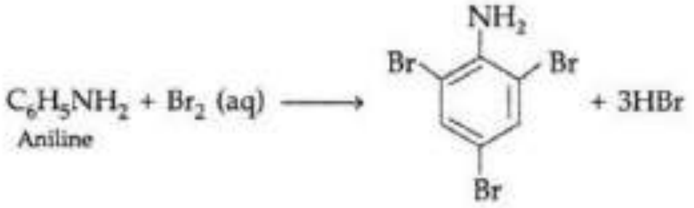
(ii) Hofmann's bromamide reaction : Primary amines can be prepared by treating an amide with Br_2 in an aqueous or alcoholic soln of NaOH.



$$\underset{\text{Amide}}{R-\underset{\underset{O}{\|}}{C}-NH_2} + Br_2 + 4NaOH \longrightarrow \underset{\substack{\text{Primary amine}\\ \text{Alkanamine}}}{R-NH_2} + Na_2CO_3 + 2NaBr + 2H_2O$$

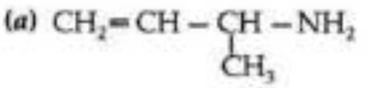
Question 4.
Complete the following reaction equations : (All India 2012)
(i) $C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow$
(ii) $C_6H_5NH_2 + Br_2\,(aq) \rightarrow$
Answer:

$$(i)\ C_6H_5N_2Cl + H_3PO_2 + H_2O \rightarrow \underset{\text{Benzene}}{C_6H_6} + N_2 + H_3PO_3 + HCl$$

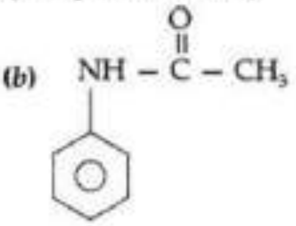


2, 4, 6-tribromoaniline

Question 5.
Give IUPAC names of the following compounds : (Comptt. Delhi 2012)

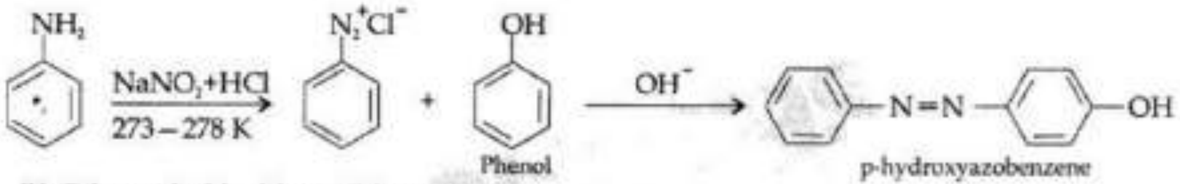


$$(a)\ CH_2=CH-\underset{CH_3}{\underset{|}{CH}}-NH_2$$

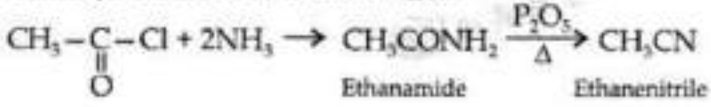


Answer:
(a) IUPAC name : Methyl prop-2-en-1-amine
(b) IUPAC name : Phenyl acetamide

Question 6.
How are the following conversions carried out :
(a) Aniline to p-hydroxyazobenzene
(b) Ethanoyl chloride to Ethanenitrile. (Comptt. Delhi 2012)
Answer:
(a) Aniline to p-hydroxyazobenzene



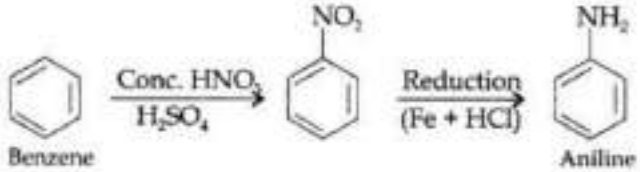
(*b*) **Ethanoyl chloride to Ethanenitrile**



$$CH_3-\underset{\underset{O}{\|}}{C}-Cl + 2NH_3 \rightarrow \underset{\text{Ethanamide}}{CH_3CONH_2} \xrightarrow[\Delta]{P_2O_5} \underset{\text{Ethanenitrile}}{CH_3CN}$$

Question 7.
How are the following conversions carried out?
(i) CH_3CH_2Cl to $CH_3CH_2CH_2NH_2$
(ii) Benzene to aniline (Comptt. Delhi 2012)
Answer:

(*i*) CH_3CH_2Cl + alc KCN $\rightarrow CH_3CH_2CN \xrightarrow{LiAlH_4} \underset{\text{Propanamine}}{CH_3CH_2CH_2NH_2}$

(*ii*)


MINIMUM LEARNING MATERIAL

CHAPTER- BIOMOLECULES

MCQ QUESTIONS (1*10=1marks)

1. **Which of the following gives positive Fehling solution test?**
   a) Protein
   b) Sucrose
   c) Glucose
   d) Fats
2. **The symbols D and L represents**
   a) the optical activity of compounds.
   b) the relative configuration of a particular stereoisomer.
   c) the dextrorotatory nature of molecule.
   d) the levorotatory nature of molecule.
3. **The function of glucose is to**
   a) Provides energy
   b) Promote growth
   c) Prevent diseases
   d) Perform all above

4. **Which of the following compound is different from the rest?**
    a) Sucrose
    b) Maltose
    c) Lactose
    d) Glucose
5. **The two functional groups presents in a typical carbohydrate are:**
    a) -CHO and -COOH
    b) >C=O and -OH
    c) -OH and -CHO
    d) -OH and -COOH
6. **Biomolecules are**
    a) Aldehydes and Ketones
    b) Acids and Esters
    c) Carbohydrates , proteins and fats
    d) Alcohols and phenols
7. **Which of the following is a disaccharide?**
    a) Lactose
    b) Starch
    c) Cellulose
    d) Fructose

8. **The commonest disaccharide has the molecular formula**
    a) $C_{10}H_{18}O_9$
    b) $C_{10}H_{20}O_{10}$
    c) $C_{18}H_{22}O_{11}$
    d) $C_{12}H_{22}O_{11}$
9. **A carbohydrates the cannot be hydrolyzed into simpler unit is called**
    a) Polysaccharides
    b) Trisaccharides
    c) Disaccharides
    d) Monosaccharides
10. **Isomerization of glucose produces**
    a) Galactose
    b) Fructose
    c) Mannose
    d) Aldose

2 MARKS QUESTIONS

1. **What structural feature is required for a carbohydrate to behave as reducing sugar?**
2. **Name the two components of starch? Which one is water-soluble?**
3. **What are vitamins? How are they classified?**
4. **What are essential and non-essential amino acids? Give one example of each type.**
5. **Name four types of intermolecular forces which stabilize 2° and 3°structure of proteins.**
6. **On electrolysis in acidic solution, amino acids migrate towards cathode while in alkaline solution they migrate towards anode.Why?**

3 MARKS QUESTIONS

1. **(i) Name four bases present in DNA.**
   (ii) Which of them is not present in RNA.
   (iii) Name the disease caused by deficiency of vitamin D.

2. **(i) Except for vitamin B12, all other vitamins of a group B, should be supplied regularly in the diet. Why**

   (ii) Name the vitamin responsible for the coagulation of blood.

3. **(i) List two important functions of proteins in the human body.**

   (ii) Which nucleic acid is responsible for carrying out protein synthesis in the cell.

4. **(i) How many asymmetric carbon atoms are present in D(+) glucose?**

   (ii) Name a water soluble vitamin which is a powerful antioxidant. Give its one natural source

   (iii) Name the deficiency diseases resulting from lack of Vitamins A and E in the diet

ANSWER KEY

MCQ QUESTIONS

1. **C) Glucose**
2. **B) the relative configuration of a particular stereoisomer**
3. **A) provides energy**
4. **D) glucose**
5. **C) -OH and -CHO**
6. **C) carbohydrates,protein and fats**
7. **A) lactose**
8. **D)** $C_{12}H_{22}O_{11}$
9. **D) monosaccharides**
10. **B) fructose**

2 MARKS QUESTION

1. The presence of an aldehydic group (- CHO)(- CHO) such as glucose, mannose, galactose, and other reducing sugars, or a -ketol group (- CO - CH2OH)(- CO - CH2OH) such as fructose, is one of the structural properties of reducing sugars
2. Starch consists of two major components i.e. amylose and amylopectin. Amylose is water-soluble, out of the two components, but amylopectin is water-insoluble
3. Vitamins are chemical molecules that are important micronutrients that an organism need in little amounts for its metabolism to function properly. Essential nutrients are unable to be produced in the body, either entirely or in adequate amounts, and must therefore be acquired from food.

Classification of vitamins: Water-soluble and fat-soluble vitamins are the two types of vitamins. There are 13 vitamins in humans: four fat-soluble vitamins (A, D, E, and K) and nine water-soluble vitamins (8 B vitamins and vitamin C).

4. Essential amino acids are amino acids that the body cannot synthesize or manufacture and must be obtained through dietary supplements.

   Example: valine, tryptophan etc

5. Hydrogen bonds, disulphide connections, van der Waals, and electrostatic forces of attraction are the primary factors that stabilize the secondary and tertiary structures of proteins

6. Amino acid exists as a dipolar ion. When an ion transforms to a positive ion during electrolysis in an acidic medium, it migrates to the cathode, whereas when an ion changes to a negative ion during electrolysis in a basic medium, it migrates to the anode.In acidic solution, COO - group of zwitter ion formed from αα -amino acid is protonated and NH3+ groups is left unchanged while in basic solution deprotonation converts NH+3 to NH2 and COO− is left unchanged

3 MARKS QUESTION

1. (i) Adenine, Guanine, Thymine and Cytosine are the four nitrogen bases present in DNA

   (ii) Thymine is absent in RNA. Instead of thymine, Uracil is present in RNA.

   (iii) Rickets is a condition in which children's bones become weak and mushy. A deficiency of vitamin D in the body causes rickets. Vitamin D is required for calcium and phosphorus to be used in the formation of bones.

2. (i) B vitamins are necessary for the correct functioning of the body's cells. They aid in the conversion of food into energy (metabolism), the formation of new blood cells, and the maintenance of healthy skin, brain, and other bodily structures.

   (ii) Vitamin K is important for blood clotting and avoiding excessive bleeding

3. **(i)** Protein is required for body cell development and their repair function in case of wear and tear of cells. Protein is the vital part of the building components of organs, muscles, skin, and hormones
   (ii) Ribonucleic acid, or RNA, is primarily engaged in the process of protein synthesis.

4. **(i)** The glucose molecule has four chiral carbon atoms

   (ii) Water soluble vitamin: Vitamin C
   Natural source: Amla

   (iii) Deficiency of Vitamin A causes Xerophthalmia and deficiency of Vitamin E causes Sterility

CBSE

Additional Practice Questions
Subject: Chemistry Theory (043)
Class: XII 2023-24

Max. marks: 70 **Time: 3 hours**

General Instructions:

(a) There are 33 questions in this question paper with internal choice.

(b) **SECTION A** comprises **16** multiple -choice questions carrying 1 mark each.

(c) **SECTION B** comprises **5** short answer questions carrying 2 marks each.

(d) **SECTION C** comprises **7** short answer questions carrying 3 marks each.

(e) **SECTION D** comprises **2** case - based questions carrying 4 marks each.

(f) **SECTION E** comprises **3** long answer questions carrying 5 marks each.

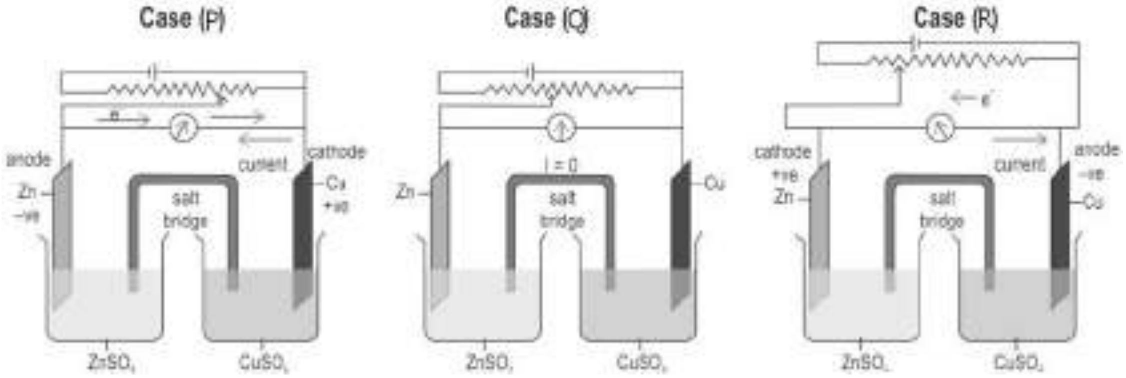
(g) All questions are compulsory.

(h) Use of log tables and calculators is not allowed.

Section A

The following questions are multiple -choice questions with one correct answer. Each question carries 1 mark. There is no internal choice in this section.

1 Sunita set up three cells as shown below:



She applied external potential in all the three cells. The potential is increased slowly, till the opposing voltage reaches the value of 1.1 V.

Which of the following statements is INCORRECT?
(a) Electrons flow from Zn rod to Cu rod hence current flows from Cu to Zn in case (P).
(b) The chemical reaction takes place in case (Q) till the opposing voltage reaches 1.1 V.
(c) Zinc is deposited at the zinc electrode and copper dissolves at copper electrode in case (P).
(d) Electrons flow from Cu to Zn and current flows from Zn to Cu in case (R).

2 Two compounds M and N have the general formula $C_nH_{2n}O$ but different structural formulae.
i) Compound N belongs to that homologous series where the first member contains 3 carbon atoms.
ii) Compound M reacts with one equivalent of monohydric alcohol in the presence of dry hydrogen chloride to yield a hemiacetal.

Identify the homologous series to which compounds M and N belong to?
(a) Both the compounds are aldehydes.
(b) Compound M is an aldehyde and compound N is a ketone.
(c) Both the compounds are ketones.
(d) Compound N is an aldehyde and compound M is a ketone.

3 During a quiz competition, team A and team B have to answer a tie question on the characteristics of RNA.
Their responses are as follows:

Name	**Team**	**Response**
Adrika	**A**	Different RNA molecules of a cell are involved in the synthesis of proteins.
Shaakho	**A**	The single-stranded helix of RNA folds upon itself to form the secondary structure.
Rounak	**B**	The C-2 atom of the pentose sugar for a ribose nucleotide contains an -OH group.
Ritama	**B**	The message for the synthesis of a particular protein is present only in the RNA.

What is the expected result of the quiz and why?
(a) Team A wins the quiz as both the responses are correct.
(b) Team B wins the quiz as both the responses are correct.
(c) Team A loses the quiz as Adrika's response is incorrect.
(d) Team B loses the quiz as Rounak's response is incorrect.

4 What will be the change in the hybridisation of C when a nucleophile attacks the electrophilic centre of the carbonyl group?

(a) sp^2 to sp
(b) sp^3 to sp^2
(c) sp^3 to sp
(d) sp^2 to sp^3

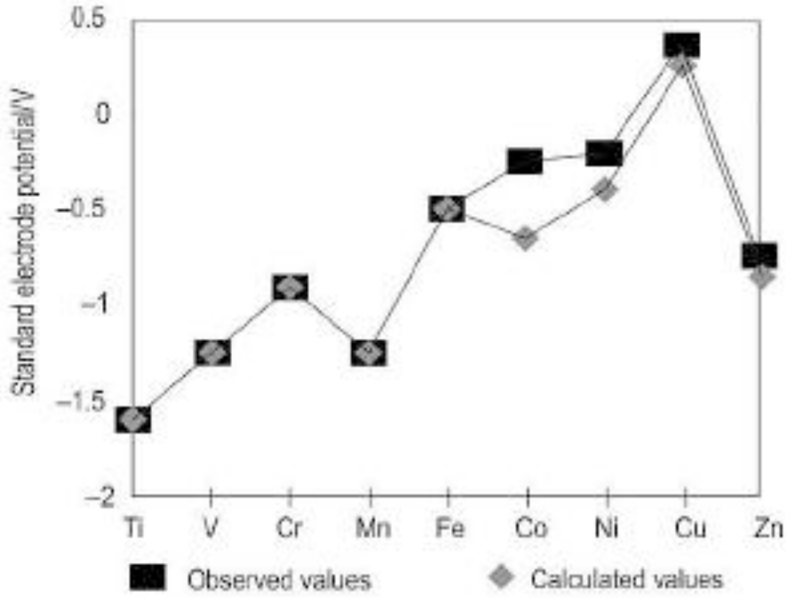
5 Four compounds, CH_3Cl, CH_3Br, C_2H_5Br and C_3H_7I are represented by the letters M, N, O and P in the table below (*in random order*). The boiling points are also given on the table.

Boiling points(BP)	-24.2°C	38°C	3.56° C	101.6°C
Compound	M	N	O	P

Which of the four compounds does 'N' most likely represent?

(a) CH_3Cl
(b) CH_3Br
(c) C_2H_5Br
(d) C_3H_7I

6 Study the graph given below.



Observed and calculated values for the standard electrode potentials
$(M^{2+} \rightarrow M^0)$ of the elements Ti to Zn

Based on the graph given, which element will MOST LIKELY be involved in the following reaction?

Metal + conc. sulphuric acid → Metal sulphate + sulphur dioxide + water
(a) Cu
(b) Co
(c) Ti
(d) Zn

7 The table given below shows the results of three experiments on the rate of the reaction between compounds P and Q at a constant temperature.

Experiment	The initial concentration of P (mol dm^{-3})	The initial concentration of Q (mol dm^{-3})	Initial rate (mol dm^{-3} s^{-1})
1	0.1	0.2	1.10×10^{-4}
2	0.3	0.2	9.91×10^{-4}
3	0.3	0.1	4.96×10^{-4}

Based on the data, what will be the rate equation for the reaction between P and Q?

(a) $k[P]^2[Q]$
(b) $k[P][Q]^2$
(c) $k[P][Q]$
(d) $k[P]$

8 The table below shows the K_H values for some gasses at 293 K and at the same pressure.

K_H values (kbar)	144.97	69.16	76.48	34.86
Gas	Helium	Hydrogen	Nitrogen	Oxygen

In which of the following are the gases arranged in their decreasing order of solubility (from left to right)?

(a) Helium > Nitrogen > Hydrogen > Oxygen
(b) Hydrogen > Helium > Nitrogen > Oxygen

(c) Nitrogen > Hydrogen > Oxygen > Helium
(d) Oxygen > Hydrogen > Nitrogen > Helium

9 Sampriti took 4 acids. Help her to arrange the acids from left to right, in the increasing order of their acidity:
2, 4, 6 - Trinitrophenol, acetic acid, phenol, and benzoic acid.

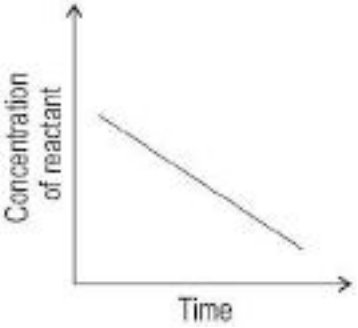
	(a) 2, 4, 6 - Trinitrophenol, acetic acid, benzoic acid, phenol (b) phenol, acetic acid, benzoic acid, 2, 4, 6 - Trinitrophenol (c) 2, 4, 6 - Trinitrophenol, benzoic acid, acetic acid, phenol (d) phenol, benzoic acid, acetic acid, 2, 4, 6 – Trinitrophenol
10	An archeologist found that the percentage of carbon-14 in a wooden artifact was 20% of what carbon-14 would have been in the wood when it was cut from the tree. What would be the approximate age of this wooden artifact? *(Given the half-life of carbon-14= 5730 years)* (a) 5,790 years (b) 12,060 years (c) 13,300 years (d) 38,000 years
11	Sourima was having a severe headache. She took a medicine to relieve her pain. The medicine is industrially prepared by: (a) mononitration of phenyl methanoate (b) acetylation of salicylic acid in presence of an acid (c) hydrogenation of anisole with Br_2 in ethanoic acid (d) nitration of anisole with a mixture of concentrated sulphuric and nitric acids
12	Which of the following options give the correct arrangement of the atomic radii of the 3d, 4d, and 5d transition series of elements? (a) atomic radii of 3d < atomic radii of 4d < atomic radii of 5d (b) atomic radii of 3d < atomic radii of 4d ≈ atomic radii of 5d (c) atomic radii of 3d ≈ atomic radii of 4d > atomic radii of 5d (d) atomic radii of 3d > atomic radii of 4d > atomic radii of 5d
13	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): 2-Methoxy-2-methyl propane reacts with hydrogen iodide to form methyl alcohol and 2-Iodo-2-methylpropane. Reason (R): The reaction given in (A) follows S_N2 mechanism. Which of the following is correct? (a) Both A and R are true, and R is a correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.
14	Two statements are given below - one labeled Assertion (A) and the other labeled Reason (R). Assertion (A): In acetaldehyde, the carbonyl carbon acts as a Lewis acid and the carbonyl oxygen acts as a Lewis base.

	Reason (R): Carbonyl compounds have substantial dipole moments. Which of the following is correct? (a) Both A and R are true, and R is a correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.
15	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A)**:** Denaturation of protein does not change the primary structure of proteins. Reason (R): The bonding between the carbon and hydrogen atoms during denaturation of proteins remains intact. Which of the following is correct? (a) Both A and R are true, and R is the correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.
16	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): Copper does not form copper (II) sulphate on reaction with dil. sulphuric acid. Reason (R): The standard potential for Cu^{+2}|Cu electrode is negative. Which of the following is correct? (a) Both A and R are true, and R is a correct explanation of A. (b) Both A and R are true, but R is not the correct explanation of A. (c) A is true, but R is false. (d) A is false, but R is true.

Section B

This section contains 5 questions with internal choice in one question. The following questions are very short answer type and carry 2 marks each.

17 Given below is a graph of concentration of reactant vs time for a reaction.



(a) Based on the graph above draw a rate of reaction vs concentration of reactant graph for the same reaction.
(b) What will be the order of this reaction? Justify.

18 'Colligative properties help in determining the molar masses of the solutes.'
The method based on which colligative property is preferred over others for determining molar masses of biomolecules and why?

19 In which of the two compounds $CH_3CH_2CH_2Cl$ or C_6H_5Cl will the C-Cl bond be longer? Why?

20 Correctly match the items in the 'Reactants' column with those in the 'Product' column.

Reactants	**Products**
(a) Cyclohexene heated in the presence of $KMnO_4$ and H_2SO_4	(i) Butanal
(b) Propanenitrile hydrolysed after reduction in the presence of stannous chloride and hydrochloric acid	(ii) 2-Chloro-2-phenylacetic acid
	(iii) Adipic acid
	(iv) Propiophenone

OR

Aqueous hydrogen cyanide is allowed to react separately with propanone and ethanal. In which case will the rate of reaction be faster and why?

21 Glucose does not give a positive result with the Schiff's reagent in the Schiff's test.
Based on the above information
(a) Give a reason for the observation.
(b) What type of carbonyl group is present in a glucose molecule?

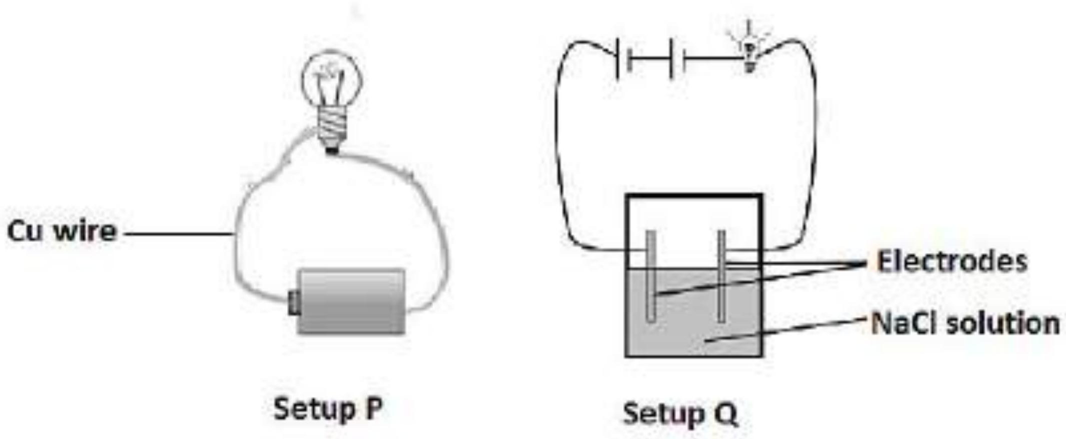
Section C

This section contains 7 questions with internal choice in one question. The following questions are short answer type and carry 3 marks each

22 A metal (M) forms two different compounds O and P with two different ligands. Ligand present in compound O is Cl^- and that in compound P is CN^-. The metal M has 4 electrons in the d orbital. Complete the table given below based on the above information:

	Compound O	Compound P
Field strength of the ligands		
Electronic configuration for metal M in the complex		
Type of complex that will be formed(High spin/low spin)		

23 Abhisrija arranged two setups P and Q as shown below.



Both experiments are carried out at 25°C.

(a) Name the current carriers in setup P and Q.
(b) What is the effect of an increase in temperature on the conductivity of NaCl solution and Cu wire?
(c) What happens to the chemical composition of NaCl and Cu wire when current is passed through both setups for a prolonged period of time?

24 Draw the structure of:

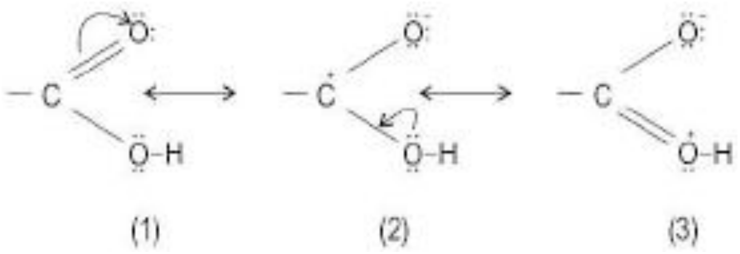
(a) 3-Methylphenol

(b) 2,4,6-Trinitrophenol

(c) Benzene-1,3-diol

25 (a) If acetaldehyde, propane, propanone, acetic acid, and ethyl alcohol are arranged in the increasing order of their boiling points, which two compounds are expected to be at the third and the fourth position?

(b) The resonance structures of the carboxylic acid group are shown below, which of them is the most stable and why?



26 (a) Write a balanced equation for the reaction between glucose and hydrogen cyanide. What inference can we draw from it?

(b) Samta reacted glucose with acetic anhydride. Will the reaction help her to determine the number of secondary alcoholic groups and the number of primary alcoholic groups that are present in a glucose molecule? Justify your answer.

27 Three sets of pairs (i) and (ii) of S_N1 reactions are given below.
For each set of reactions state which reaction (i) or (ii) is expected to be slower? Justify your answer.

(a) (i) $(CH_3)_3CCl + CH_3CH_2O^- \rightarrow (CH_3)_3COCH_2CH_3 + Cl^-$ [In presence of ethanol]

(ii) $(CH_3)_3CCl + 2\ CH_3CH_2O^- \rightarrow (CH_3)_3COCH_2CH_3 + Cl^-$ [In presence of ethanol]

(b) (i) $(CH_3)_3CCl + H_2O \rightarrow (CH_3)_3COH + HCl$

(ii) $(CH_3)_3CBr + H_2O \rightarrow (CH_3)_3COH + HBr$

(c)(i) $(CH_3)_3CCl + H_2O \rightarrow (CH_3)_3COH + HCl$

(ii) $C_6H_5Cl + H_2O \rightarrow C_6H_5OH + HCl$

28 (a) Write any four methods to increase the rate of a reversible reaction in the forward direction.
(b) What is the unit for rate of reaction in SI units?

Section D

The following questions are case -based questions. Each question has an internal choice and carries 4 marks.

29 One of the most distinctive properties of transition metal complexes is their wide range of colours. This means that some of the visible spectrum is being removed from white light as it passes through the sample, so the light that emerges is no longer white. The colour of the complex is complementary to that which is absorbed. The complementary colour is the colour generated from the wavelength left over; for example, if green light is absorbed by the complex, the complex appears red.

The colour of a co-ordination compound depends on two factors:
- presence of ligands: For example, anhydrous $CuSO_4$ is white, but $CuSO_4.5H_2O$ is blue in colour.

- influence of ligands: If ligands like 'en' are added to $[Ni(H_2O)_6]^{2+}$ in the molar ratios en: Ni, 1:1, 2:1, 3:1 a series of reactions and their associated colour changes occur.

(a) Give an example of another complex that shows properties similar to those shown in the compound of Cu mentioned above.
What is the geometry of the central metal atom of this complex?

(b) What is the type of ligand added above to $[Ni(H_2O)_6]^{2+}$ to demonstrate the influence of ligand on colours of complex compounds?

(c) Complete the table given below:

en:Ni	Colour absorbed
2:1	
3:1	

OR

en:Ni	Formula of the ion formed
1:1	
3:1	

30 Conductivity measurements are used routinely in many industrial and environmental applications as a fast, inexpensive and reliable way of measuring the ionic content in a solution.

For example, the measurement of conductivity is a typical way to monitor and continuously trend the performance of water purification systems.

In many cases, conductivity is linked directly to the total dissolved solids (TDS). High quality deionized water has a conductivity of about 5×10^{-6} S/m at STP, typical drinking water is in the range of 0.02–0.08 S/m, while sea water is about 5 S/m.

According to research, the TDS in a sample of fresh water can be calculated as TDS (mg/L) = $10^4 \times 0.65 \times$ conductivity (S/m).

The conductivity of a sample of water taken from a borewell is given as 0.13 S /m at STP.

A conductivity cell is created using the water above. The resistance of the cell is found to be 10 ohms.

(a) What is the cell constant of the cell given above?

(b) What is the amount of TDS in the sample of water taken?

(c) According to some studies TDS of 250 mg/L represents a good source of drinking water. What would the conductivity of such a sample of water be? If such water was made by diluting the sample of water given above, what would be the resistance of a conductivity cell made using that?

OR

If the resistance of a cell made from diluting the sample of water taken above was found to be 79 ohms, calculate the TDS of the new sample.

Section E

The following questions are long answer type and carry 5 marks each. All questions have an internal choice.

31 Answer any **five** questions with respect to the series of ions given below:
Sc^{+3}, Ti^{+4}, V^{+4}, V^{+2}, Cr^{+2}, Fe^{+3}, Ni^{+2},Cu^{+2}, Zn^{+2}

(a) Which of these ions are isoelectronic?
(b) Why do Sc^{+3}, Ti^{+4}, and Zn^{+2} form colourless aqueous solution?
(c) Which ion(s) from the list is/are not transition element(s) and why?
(d) Cr forms two types of oxides - Cr^{+2} and Cr^{+3}. Which of them is expected to turn red litmus blue?
(e) Arrange the following ions in the increasing order of their magnetic moments: Sc^{+3}, V^{+2}, V^{+4}, Ni^{+2}.
(f) Why are alloys mostly prepared from transition metals?
(g) Which ion can also has a +1 oxidation state?

[Atomic number of: Sc =21, Ti =22, V =23, Cr=24, Fe=26, Ni=28, Cu=29, Zn=30]

32 The following table contains osmotic pressure data for three compounds dissolved in various solvents.

Compound	Concentration, C (g/L)	Osmotic pressure (atm)
Cellulose	12.5	0.0021
Protein	28.5	0.0026
Haemoglobin	5	0.0018

(R = 0.083 L bar mol^{-1} K^{-1})

(a) If the concentration of protein is doubled keeping all other variables constant, what will be the osmotic pressure of the new solution?
(b) When one litre of cellulose solution was heated to 315 K, its osmotic pressure changed to 0.00248 atm. What is the molecular mass of the cellulose in the solution?
(c) A solution of 10 g of protein in a litre of solvent was found to be isotonic to the haemoglobin solution given above in the table, at the same temperature. If the molecular weight of the protein is 130,000 g/mol, what is the molecular weight of haemoglobin.

OR

The relation between the osmotic pressure of three solutions A, B, and C is:
$\pi_B < \pi_C$
$\pi_C > \pi_A$
$\pi_A > \pi_B$
The three solutions have the same molarity and are at the same temperature.
(a) For which of the solutions is the value of 'i' expected to be the greatest? Give a reason.

(b) Which of the solutions is MOST LIKELY to be glucose, potassium sulphate, and sodium chloride?

(c) Which of the solutions is expected to give a vapour pressure-mole fraction graph similar to that of an acetone-chloroform mixture? Give reason.

33 The compound $C_6H_5NHCOCH_3$ is obtained when compound A reacts with acetic anhydride in presence of pyridine. This compound A does not undergo Friedel-Crafts reaction.
(a) Write the reaction showing the formation of $C_6H_5NHCOCH_3$ from compound A.
(b) The pH of the aq. solution of A is less than 7. Is this statement true? Give reason.
(c) State what type of functional group can be introduced into compound A, that will:
  (i) increase the pH of the aqueous solution

(ii) decrease the pH of the aqueous solution

(d) What do you observe when compound A reacts with bromine water at room temperature?

OR

Parul was given two test tubes. One of the test tubes contained ethyl amine and the other contained aniline. To distinguish between the two compounds, she adds a reagent X to both the test tubes. She observes that in only one of the test tubes a yellow dye is formed.

(a) Identify the reagent X.
(b) Describe how this reagent is prepared and give a reason why it is not readily available in a laboratory.
(c) Which of the two compounds forms the yellow dye?
(d) Draw the structure of the yellow dye formed.

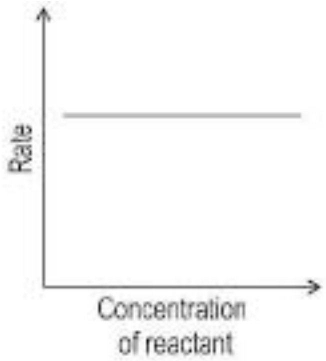
CBSE

Additional Practice Questions - Marking Scheme

Subject: Chemistry Theory (043)

Class: XII 2023-24

Section A	
1	(c) Zinc is deposited at the zinc electrode and copper dissolves at copper electrode in case (P).
2	(b) Compound M is an aldehyde and compound N is a ketone.
3	(a) Team A wins the quiz as both the responses are correct.
4	(d) sp^2 to sp^3
5	(c) C_2H_5Br
6	(a) Cu
7	(a) $k[P]^2[Q]$
8	(d) Oxygen > Hydrogen > Nitrogen > Helium
9	(b) phenol, acetic acid, benzoic acid, 2, 4, 6 - Trinitrophenol
10	(c) 13,300 years
11	(b) acetylation of salicylic acid in presence of an acid
12	(b) atomic radii of 3d< atomic radii of 4d ≈ atomic radii of 5d
13	(c) A is true, but R is false.
14	(a) Both A and R are true, and R is a correct explanation of A.

15	(b) Both (A) and (R) true but (R) is not the correct explanation of (A).
16	(c) A is true, but R is false.
Section B	
17	(a) 1 mark for the correct graph:  (b) The rate of the reaction is independent of the concentration of the reactant. Therefore, the reaction is a zero-order reaction. *[1 mark]*
18	The method based on osmotic pressure is preferred over others for determining molar masses of biomolecules. It is preferred for biomolecules as the pressure measurement is done around room temperature and biomolecules are generally not stable at higher temperatures. *[Give 1 mark for identifying the correct property and 1 mark for the correct reason. Students may write the answer in their own words.]*
19	The C-Cl bond in $CH_3CH_2CH_2Cl$ is longer than C-Cl bond in C_6H_5Cl. *[1 mark]* Reason: - The C-atom of C-Cl bond in $CH_3CH_2CH_2Cl$ is sp^3 hybridised while that in C_6H_5Cl is sp^2 hybridised. So the C-Cl bond in $CH_3CH_2CH_2Cl$ is longer than in C_6H_5Cl. **OR** - The C-Cl bond in chlorobenzene has a partial double bond character due to resonance. So, the C-Cl bond in chlorobenzene is shorter than in $CH_3CH_2CH_2Cl$. *[1 mark]*

20

Reactants	**Products**
(a)	(iii)
(b)	(i)

[Give 1 mark for each correct match]

OR

The rate of reaction will be faster in ethanal. In propanone, the presence of the two methyl groups causes steric hindrance that reduces the access of the nucleophile toward the carbonyl C. This is not the case for ethanal. Hence the rate of reaction will be faster with ethanal than with propanone.

[Give 1 mark for identifying the compound which will react faster and 1 mark for the reason. Students may write the answer in their own words.]

21

(a) The -OH group present on the C5 atom in the glucose molecule forms a six-membered ring with the -CHO group to form a cyclic hemiacetal structure. Thus, glucose does not give a positive result with the Schiff's reagent in the Schiff's test. *[1 mark]*

(b) The carbonyl group present in glucose is aldehydic. *[1 mark]*

Section C

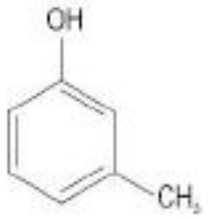
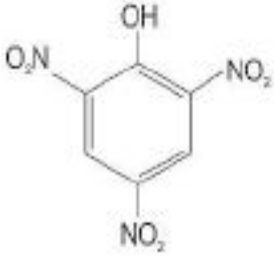
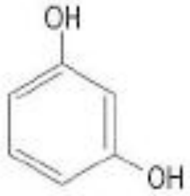
22

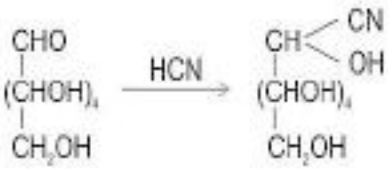
	Compound O	Compound P
Field strength of the ligands	weak field ligand	strong field ligand
Electronic configuration for metal M in the complex	t_{2g}^3, e_g^1	t_{2g}^4, e_g^0
Type of complex that will be formed (High spin/low spin)	high spin	low spin

[Give 0.5 marks for each correct answer]

23

(a) - The current carriers in setup P are free mobile electrons.
- The current carriers in setup Q are ions present in the solution.
[Give 0.5 marks for each correct answer]

	(b) - In NaCl solution conductivity rises with a rise in temperature. - In Cu wire, the conductivity reduces with a rise in temperature. *[Give 0.5 marks for each correct answer]* (c) - When current is passed through the setup Q for prolonged time, the chemical composition changes due to electrochemical reactions. - When current is passed through setup P for prolonged time, the chemical composition remains the same. *[Give 0.5 marks for each correct answer]*
24	(a) The structure of 3-Methylphenol is  (b) The structure of 2,4,6-Trinitrophenol is  (c) The structure of Benzene-1,3-diol is  *[Give 1 mark for each correct answer]*
25	(a) Acetaldehyde and ethyl alcohol are expected to be at the third and the fourth positions respectively. *[Give 0.5 marks for each correct answer.]*

	(b) The structure (3) is most stable. This is because structure (3) has all the atoms with a complete octet or duplet in case of hydrogen. *(Give 1 mark each for the explanation and identification of the most stable resonance structure.)*
26	(a) The balanced reaction between glucose and hydrogen cyanide is:  The inference drawn from the above reaction is that glucose contains a carbonyl group in it. *[Give 0.5 marks each for the correct structural formula of glucose and the product formed. Name of the product is not required, and 1 mark for the correct inference]* (b) - The reaction will not help her to determine the number of secondary alcoholic groups and the number of primary alcoholic groups in a glucose molecule. [0.5 marks] - The primary and secondary alcoholic groups in a glucose molecule, both undergo acetylation with acetic anhydride. [0.5 marks]
27	1 mark for each of the following: (a) Both the reactions occur at the same rate as S_N1 reactions are independent of the concentration of the nucleophile. (b) The reaction (i) will be slower as Br^- is a better leaving group than Cl^-. (c) Reaction (ii) will not occur as the C-Cl bond has a partial double bond character due to resonance. *[No marks to be awarded if justification is not given.]*
28	(a) 0.5 marks each for any four correct points such as: - increasing the concentration of reactants - decreasing the concentration of products - using a catalyst - carrying out the reaction at the optimum temperature. *[marks to be given for any other relevant point]* (b) mol $m^{-3}s^{-1}$ *[1 mark]*

Section D

29

(a) Another complex that shows similar properties as shown in the compound of Cu stated here is $[Ti(H_2O)_6]Cl_3$. The geometry of the complex is octahedral.

[Give 0.5 marks for each correct answer. Any other correct answer to be accepted.]

(b) When a ligand can bind through two donor atoms as in the ligand 'en' added to $[Ni(H_2O)_6]^{2+}$ it is said to be a didentate ligand. *[1 mark]*

(c)

en:Ni	Colour absorbed
2:1	red
3:1	blue green

[Give 1 mark for each correct answer]

OR

en:Ni	Formula of the ion formed
1:1	$[Ni(H_2O)_4(en)]^{2+}$
3:1	$[Ni(en)_3]^{2+}$

[Give 1 mark for each correct answer]

30

(a) Cell constant = 10 ohms × 0.13 S/m = 1.3 m^{-1} *[1 mark]*

(b) TDS = $10^4 \times 0.65$ x conductivity (S/m)
TDS = $10^4 \times 0.65 \times 0.13$ = 845 mg/L *[1 mark]*

(c) TDS = $10^4 \times 0.65$ x conductivity (S/m)
conductivity = $250/(10^4 \times 0.65)$

conductivity = 0.038 S/m *[1 mark]*

conductivity = cell constant/R
R = cell constant/ conductivity
R = 1.3/0.038 = 34.2 ohms *[1 mark]*

	OR R = cell constant/conductivity conductivity = 1.3/79 conductivity = 0.016 S/m *[1 mark]* TDS = $10^4 \times 0.65$ x conductivity TDS = $10^4 \times 0.65$ x 0.016 TDS = 104 mg/L *[1 mark]*
Section E	
31	(a) Sc^{+3} and Ti^{+4} are isoelectronic with 18 electrons in them. *[Give 1 mark for the correct answer]* (b) Colour of coordination compounds arise due to the d-d transitions. Sc^{+3} and Ti^{+4} ions do not have any electrons in their 3d orbitals and Zn^{+2} has fully filled 3d orbital. So, d-d transitions do not occur in these ions and thus they are colourless. *[Give 1 mark for the correct answer]* (c) Zn^{+2} ion from the list is not an ion of a transition metal because it has a complete $3d^{10}$ orbital. It cannot lose any electron from the $3d^{10}$ and they are all paired. So, it is not a transition metal ion. *[Give 1 mark for identifying the correct ion and the reason together]* (d) CrO is expected to turn red litmus blue as it is basic in nature. *[Give 1 mark for the correct answer]* (e) The increasing order of the magnetic moments of the given ions are: Sc^{+3}, V^{+4}, Ni^{+2}, V^{+2} *[Give 1 mark for the correct answer]* (f)The transition metals have similar radii. Hence, alloys are readily formed by these metals. *[Give 1 mark for the correct answer].* (g) Cu ion can also have a +1 oxidation state. *[Give 1 mark for the correct answer].*

32	a) Osmotic pressure = CRT If the concentration is doubled without a change in temperature, the osmotic pressure also will be doubled. Thus, osmotic pressure of the new solution will be 0.0052 atm. (1 mark) b) M = wRT/(πV), where w is the mass of the solute taken, V is the volume of the solution taken. In one liter of solution, there are 12.5 g of solute ∴ M = 12.5 g × 0.083 L bar mol-1 K-1 × 315 K/((0.00248 ×1.01 bar)(1 L) M = 130,474 g mol-1 (1 mark for correct formula, 1 mark for the correct answer) c) M1 = w1RT/(π1V1) - (1) for haemoglobin M2 = w2RT/(π2V2) - (2) for protein [1 mark] For isotonic solutions, osmotic pressure is equal. Dividing we get, M2/M1 = (C2RT)/(C1RT), where C1=w1/V1 and C2=w2/V2 130000/M1 = 10/5 ∴ M1= 65000 g/mol [1 mark] **OR** (a) The value of 'i' is expected to be the highest for solution C. From the given relations we can conclude that $\pi_C > \pi_A > \pi_B$ Since the osmotic pressure of solution C is the highest, therefore the value of 'i' will be highest in solution C. *[Give 1 mark each for the correct order and the reason]* (b) Solution C is most likely to be potassium sulphate. Solution A is most likely to be sodium chloride. Solution B is most likely to be glucose. [*Give 0.5 marks for each correct identification*] (c) Solution B is most likely to give a vapour pressure-mole fraction graph similar to that of an acetone-chloroform mixture. [*Give 0.5 marks for the correct answer]* Acetone-chloroform solution has strong H-bonding in it. H-bonding is seen only in the glucose solution but not in the potassium sulphate and sodium chloride

solutions. Hence, it is expected to give a vapour pressure-mole fraction graph similar to that of an acetone-chloroform mixture.
[Give 1 mark for correct answer]

33

(a) The reaction is:

Compound A
[Give 1 mark for the correct reaction.]

(b) The given statement is not correct. Compound A is aniline. The presence of a lone pair of electrons on the N-atom makes it a Lewis base. So, the pH of the aq. solution of aniline is always more than 7.
[Give 1 mark for the correct explanation. Students can write the answer in their own words]

(c) 1 mark each for the following:

(i) introducing electron releasing groups like -OCH_3 and -CH_3

(ii) introducing electron withdrawing groups like -NO_2 and -COOH

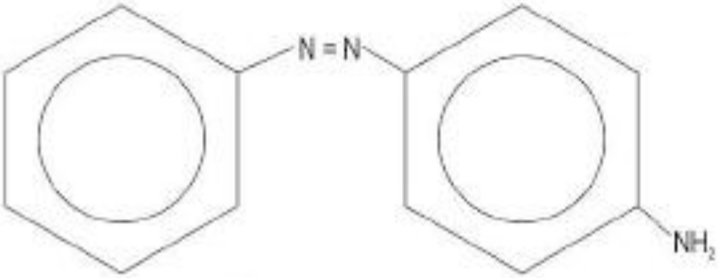
(d) Aniline reacts with bromine water at room temperature to give a white precipitate of 2,4,6-tribromoaniline.
[Give 1 mark for the correct observation. Name of the product formed may not be written. Students can write the answer in their own words]

OR

(a) Benzenediazonium chloride
(b) 1 mark each for the following:

- Benzendiazonium chloride is prepared by adding sodium nitrite to a mixture of aniline in hydrochloric acid at 0 °C - 5 °C.

- Benzenediazonium chloride is very unstable and therefore is prepared and used immediately.
(c) Aniline reacts with the reagent to form the yellow dye.

	(d)  Yellow azo dye

ANIMATED & CLASSROM TEACHING VIDEOS PLAYLISTS

(As per revised CBSE Curriculum– 2023-24)

ANIMATED VIDEOSPLAYLISTS (CLASS 1)

Class 1 EVS(EnglishLanguage)(CBSE)	Click here for playlist
Class 1 Mathematics (EnglishLanguage)(CBSE)	Click here for Playlist
Class 1 EVS (HindiLanguage)(CBSE)	Click here for Playlist
Class 1 Mathematics(Hindi Language)(CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 2)

Class 2 EVS (EnglishLanguage)(CBSE)	Click here for Playlist
Class 2 Mathematics (EnglishLanguage)(CBSE)	Click here for Playlist
Class 2 EVS(HindiLanguage)(CBSE)	Click here for Playlist
Class 2 Mathematics (Hindi Language)(CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 3)

Class 3 Mathematics (EnglishLanguage)(CBSE)	Click here for Playlist
Class 3 EVS (EnglishLanguage)(CBSE)	Click here for Playlist
Class 3 EVS (HindiLanguage)(CBSE)	Click here for Playlist
Class 3 Mathematics (HindiLanguage)(CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 4)

Class 4 Mathematics (EnglishLanguage)(CBSE)	Click here for Playlist
Class 4 EVS(EnglishLanguage)(CBSE)	Click here for Playlist
Class 4 Mathematics (HindiLanguage)(CBSE)	Click here for Playlist
Class 4 EVS (HindiLanguage)(CBSE)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 4)

Class 4 General Science (CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 5)

Class 5 Mathematics (EnglishLanguage)(CBSE)	Click here for Playlist
Class 5 Science (EnglishLanguage)(CBSE)	Click here for Playlist
Class 5 Mathematics(HindiLanguage)(CBSE)	Click here for Playlist
Class 5 Science (HindiLanguage)(CBSE)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 5)

Class 5 General Science (CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS(CLASS 6)

Class 6 Mathematics (EnglishLanguage)(CBSE)	Click here for Playlist

Class 6 Social Science (EnglishLanguage)(CBSE)	Click here for Playlist
Class 6 Science (EnglishLanguage) (CBSE)	Click here for Playlist
Class 6 Mathematics (Hindi Language)(CBSE)	Click here for Playlist
Class 6 Science All Chapters (CBSE)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 6)

Class 6 Mathematics (CBSE)	Click here for Playlist
Class 6 Social Science (CBSE)	Click here for Playlist
Class 6 Sanskrit (CBSE)	Click here for Playlist
Class 6 Hindi (CBSE)	Click here for Playlist
Class 6 Science (CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 7)

Class 7 Science(CBSE)	Click here for Playlist
Class 7 Mathematics(CBSE)	Click here for Playlist
Class 7 Social Science(CBSE)	Click here for Playlist
Class 7 Mathematics(CBSE)	Click here for Playlist
Class 7 Science (CBSE)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 7)

Class 7 Science (CBSE)	Click here for Playlist
Class 7 Hindi (CBSE)	Click here for Playlist
Class 7 Sanskrit (CBSE)	Click here for Playlist
Class 7Social Science (CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 8)

Class 8 Science(CBSE)	Click here for Playlist
Class 8 Mathematics(CBSE)	Click here for Playlist
Class 8 Social Science(CBSE)	Click here for Playlist
Class 8 Mathematics(CBSE)	Click here for Playlist
Class 8 Science(CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 9)

Class 9 Biology(CBSE)	Click here for Playlist
Class 9 Physics(CBSE)	Click here for Playlist
Class 9 Chemistry(CBSE)	Click here for Playlist
Class 9 Social Science (CBSE)	Click here for Playlist
Class 9 Mathematics (CBSE)	Click here for Playlist
Class 9 Science (CBSE)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 9)

Class 9 Social Science (CBSE)	Click here for Playlist
Class 9 Mathematics(CBSE)	Click here for Playlist
Class 9 English (CBSE)	Click here for Playlist

Class 9 Hindi (CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 10)

Class 10 Biology (CBSE)	Click here for Playlist
Class 10 Physics (CBSE)	Click here for Playlist
Class 10 Chemistry (CBSE)	Click here for Playlist
Class 10 Social Science (CBSE)	Click here for Playlist
Class 10 Mathematics(CBSE) (English Language)	Click here for Playlist
Class 10 Mathematics(CBSE) (Hindi Language)	Click here for Playlist
Class 10 Science(CBSE) (Hindi Language)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 10)

Class 10 English (CBSE)	Click here for Playlist
Class 7 Hindi (CBSE)	Click here for Playlist
Class 10 Mathematics (CBSE)	Click here for Playlist
Class 10 Social Science (CBSE)	Click here for Playlist
Class 10 Magical Science Board Exam Preparation in 1 min (CBSE)	Click here for Playlist
Class 10: Science (CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 11)

Class 11 Physics (CBSE) (English Language)	Click here for Playlist
Class 11 Chemistry (CBSE) (English Language)	Click here for Playlist
Class 11 Biology (CBSE) (English Language)	Click here for Playlist
Class 11 Mathematics(CBSE) (English Language)	Click here for Playlist
Class 11 Accountancy (CBSE) (English Language)	Click here for Playlist
Class 11 Business Studies (CBSE) (English Language)	Click here for Playlist
Class 11 Statistics (CBSE) (English Language)	Click here for Playlist
Class 11 Biology (CBSE) (Hindi Language)	Click here for Playlist
Class 11 Mathematics (CBSE) (Hindi Language)	Click here for Playlist
Class 11 Physics (CBSE) (Hindi Language)	Click here for Playlist
Class 11 Chemistry (CBSE) (Hindi Language)	Click here for Playlist
Class 11Micro Economy (CBSE) (English Language)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 11)

Class 11Mathematics (CBSE)	Click here for Playlist
Class 11 Accounts (CBSE)	Click here for Playlist
Class 11 Business Studies (CBSE)	Click here for Playlist
Class 11 Hindi (CBSE)	Click here for Playlist
Class 11 Psychology (CBSE)	Click here for Playlist
Class 11 Economics (CBSE)	Click here for Playlist
Class 11 Physics (CBSE)	Click here for Playlist
Class 11 Chemistry (CBSE)	Click here for Playlist
Class 11 English (CBSE)	Click here for Playlist
Class 11 Biology (CBSE)	Click here for Playlist
Class 11 Biology Shorts (CBSE)	Click here for Playlist

ANIMATED VIDEOS PLAYLISTS (CLASS 12)

Class 12 Physics (CBSE)	Click here for Playlist
Class 12 Chemistry (CBSE)	Click here for Playlist
Class 12 Biology(CBSE)	Click here for Playlist
Class 12 Macro Economy (CBSE)	Click here for Playlist
Class 12Economic (CBSE)	Click here for Playlist
Class 12 Mathematics (CBSE)	Click here for Playlist
Class 12 Accountancy (CBSE)	Click here for Playlist
Class 12 Business Studies (CBSE)	Click here for Playlist
Class 12 Physics (CBSE)	Click here for Playlist
Class 12 Mathematics (CBSE)	Click here for Playlist
Class 12 Biology (CBSE)	Click here for Playlist
Class 12 Chemistry (CBSE)	Click here for Playlist

CLASSROOM TEACHING VIDEOS PLAYLISTS (CLASS 12)

Class 12 CHEMISTRY (CBSE)	Click here for Playlist
Class 12 Business Studies (CBSE)	Click here for Playlist
Class 12 Hindi (CBSE)	Click here for Playlist
NEET Biology in 1 min	Click here for Playlist
Class 12 History (CBSE)	Click here for Playlist
Class 12 Political Science (CBSE)	Click here for Playlist
Class 12 Physics (CBSE)	Click here for Playlist
Class 12 Biology (CBSE)	Click here for Playlist
Class 12 : Accounts (CBSE)	Click here for Playlist

Subject Wise Groups Secondary and Senior Secondary

Secondary Groups (IX & X)

SST	**Mathematics**	**Science**	**English**
Click to Join	Click to Join	Click to Join	Click to Join
	Hindi	**Information Techonology (402)**	
	Click to Join	Click to Join	

Senior Secondary Groups (XI & XII)

Physics	**Chemistry**	**English**	**Mathematics**
Click to Join	Click to Join	Click to Join	Click to Join
Biology	**Accountancy**	**Economics**	**BST**
Click to Join	Click to Join	Click to Join	Click to Join
History	**Geography**	**Sociology**	**Hindi Elective**
Click to Join	Click to Join	Click to Join	Click to Join
Hindi Core	**Home Science**	**Sanskrit**	**Psychology**
Click to Join	Click to Join	Click to Join	Click to Join
Political Science	**Painting**	**Vocal Music**	**Comp. Science**
Click to Join	Click to Join	Click to Join	Click to Join
IP	**Physical Education**	**App. Mathematics**	**IIT /NEET**
Click to Join	Click to Join	Click to Join	Click to Join
Leagal Studies	**Entrepreneurship**	**French**	**Teachers Jobs**
Click to Join	Click to Join	Click to Join	Click to Join

SOE CBSE Principals (Group for Principals Only)

Click to Join

Rules & Regulations of the Group

1. No introduction
2. No Good Morning/Any wish type message
3.No personal Chats & Messages
4. No Spam
5. You can also ask your difficulties here.

Just get learning resources & post learning resources.

Helpline number only WhatsApp: +91-95208-77777

Why Artham Resource Material?

Resource materials for teachers and students are essential tools for effective teaching and learning. They provide valuable information, guidance, and support to both teachers and students, making the teaching and learning process more efficient and productive.

For teachers, Artham resource materials include lesson plans, instructional guides, assessment tools, professional development materials, and teaching aids. These materials are well researched and created according to 2023-24 NEP and NCERT guidelines.

For students, resource materials can include textbooks, study guides, homework assignments, reference books, online learning platforms, and educational videos. These materials can be obtained from school libraries, educational publishers, online resources, and teachers.

Both teachers and students can also benefit from Artham educational resources which are free and openly licensed educational materials that can be used and shared for teaching and learning. Artham resource material include textbooks, courses, lesson plans, and multimedia resources that are available online.

In summary, resource materials are critical components of effective teaching and learning. They provide a wealth of information and support that can enhance the quality of education and help students achieve academic success.

Teachers and students can also purchase these resources from the links provided with every resource.

JOIN TELEGRAM GROUP/CHANNELS FOR CLASS WISE HIGH QUALITY RESOURCE MATERIAL

SOE CBSE Groups

- Click to Join CBSE Group...All classes
- Click to Join SOE CBSE Kindergarten Group
- Click to Join SOE CBSE Class 1 Group
- Click to Join SOE CBSE Class 2 Group
- Click to Join SOE CBSE Class 3 Group
- Click to Join SOE CBSE Class 4 Group
- Click to Join SOE CBSE Class 5 Group
- Click to Join SOE CBSE Class 6 Group
- Click to Join SOE CBSE Class 7 Group
- Click to Join SOE CBSE Class 8 Group
- Click to Join SOE CBSE Class 9 Group
- Click to Join SOE CBSE Class 10 Group
- Click to Join SOE CBSE Class 11 (Science) Group
- Click to Join SOE CBSE Class 11 (Commerce) Group
- Click to Join SOE CBSE Class 11 (Humanities) Group
- Click to Join SOE CBSE Class 12 (Science) Group
- Click to Join SOE CBSE Class 12(Commerce) Group

- Click to Join SOE CBSE Class 12 (Humanities) Group
- Click to Join SOE JEE/NEET Group
- Click to Join SOE CUET Group
- Click to Join SOE NDA, OLYMPIAD, NTSE Group
- Click to Join SOE School Principal Professional Development Group
- Click to Join SOE School Teacher Professional Development Group
- Click to Join SOE CBSE Project File Group for Class 9th to 12th All Subjects

SOE ICSE Groups

- Click to Join SOE ICSE Kindergarten Group
- Click to Join SOE ICSE Class 1 Group
- Click to Join SOE ICSE Class 2 Group
- Click to Join SOE ICSE Class 3 Group
- Click to Join SOE ICSE Class 4 Group
- Click to Join SOE ICSE Class 5 Group
- Click to Join SOE ICSE Class 6 Group
- Click to Join SOE ICSE Class 7 Group
- Click to Join SOE ICSE Class 8 Group
- Click to Join SOE ICSE Class 9 Group
- Click to Join SOE ICSE Class 10 Group
- Click to Join SOE ICSE Class 11 (Science) Group
- Click to Join SOE ICSE Class 11 (Commerce) Group
- Click to Join SOE ICSE Class 11 (Humanities) Group
- Click to Join SOE ICSE Class 12 (Science) Group
- Click to Join SOE ICSE Class 12(Commerce) Group
- Click to Join SOE ICSE Class 12 (Humanities) Group
- Click to Join SOE JEE/NEET Group
- Click to Join SOE CUET Group
- Click to Join SOE NDA, OLYMPIAD, NTSE Group
- Click to Join SOE School Principal Professional Development Group
- Click to Join SOE School Teacher Professional Development Group

Nageen CBSE Channels

- Click to Join Nageen CBSE Kindergarten Channel
- Click to Join Nageen CBSE Class 1 Channel
- Click to Join Nageen CBSE Class 2 Channel
- Click to Join Nageen CBSE Class 3 Channel
- Click to Join Nageen CBSE Class 4 Channel
- Click to Join Nageen CBSE Class 5 Channel
- Click to Join Nageen CBSE Class 6 Channel
- Click to Join Nageen CBSE Class 7 Channel
- Click to Join Nageen CBSE Class 8 Channel
- Click to Join Nageen CBSE Class 9 Channel
- Click to Join Nageen CBSE Class 10 Channel
- Click to Join Nageen CBSE Class 11 (Science) Channel
- Click to Join Nageen CBSE Class 11 (Humanities) Channel
- Click to Join Nageen CBSE Class 11 (Commerce) Channel
- Click to Join Nageen CBSE Class 12 (Science) Channel
- Click to Join Nageen CBSE Class 12 (Commerce) Channel
- Click to Join Nageen CBSE Class 12 (Humanities) Channel

- Click to Join JEE/NEET Channel
- Click to Join CUET Channel
- Click to Join NDA, OLYMPIAD, NTSE Channel

Nageen ICSE Channels

- Click to Join Nageen ICSE Kindergarten Channel
- Click to Join Nageen ICSE Class 1 Channel
- Click to Join Nageen ICSE Class 2 Channel
- Click to Join Nageen ICSE Class 3 Channel
- Click to Join Nageen ICSE Class 4 Channel
- Click to Join Nageen ICSE Class 5 Channel
- Click to Join Nageen ICSE Class 6 Channel
- Click to Join Nageen ICSE Class 7 Channel
- Click to Join Nageen ICSE Class 8 Channel
- Click to Join Nageen ICSE Class 9 Channel
- Click to Join Nageen ICSE Class 10 Channel
- Click to Join Nageen ICSE Class 11 (Science) Channel
- Click to Join Nageen ICSE Class 11 (Commerce) Channel
- Click to Join Nageen ICSE Class 11 (Humanities) Channel
- Click to Join Nageen ICSE Class 12 (Science) Channel
- Click to Join Nageen ICSE Class 12 (Commerce) Channel
- Click to Join Nageen ICSE Class 12 (Humanities) Channel
- Click to Join JEE/NEET Channel
- Click to Join CUET Channel
- Click to Join NDA, OLYMPIAD, NTSE Channel