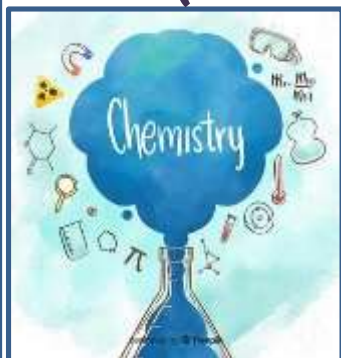


KENDRIYA VIDYALAYA SANGATHAN
REGIONAL OFFICE, RAIPUR

STUDENT SUPPORT MATERIAL
(CAPSULES AND CASE-STUDY BASED QUESTIONS)



Class - XII

CHEMISTRY

SESSION 2020-21



STUDENT SUPPORT MATERIAL

INSPIRATION

- + **Ms. CHANDANA MANDAL**, Deputy Commissioner, KVS RO Raipur.
- + **Sh. A.K. MISHRA**, Assistant Commissioner, KVS RO Raipur.
- + **Smt. BIRJA MISHRA**, Assistant Commissioner, KVS RO Raipur.

MENTOR

- ❖ **Sh. J. PRASAD**, Principal, Kendriya Vidyalaya Dongargarh.

CONTENT DEVELOPMENT TEAM

- Smt. M. SHARDA RAO, PGT Chemistry, KV No.2 NTPC Korba.
- Smt. FARHANA KHAN, PGT Chemistry, KV BMY Bhilai.
- Sh. SANTOSH KUMAR CHAINI, PGT Chemistry, KV Raigarh.
- Sh. WASIM KHAN, PGT Chemistry, KV Dongargarh.
- Sh. RUDRAKANT JHA, PGT Chemistry, KV No.2 Raipur.
- Sh. JAIRAM KHUTE, PGT Chemistry, KV No.3 Kusmunda Korba.
- Sh. VIJAY KUMAR SAHU, PGT Chemistry, KV Baikunthpur.
- Sh. MANISH KUMAR GAUTAM, PGT Chemistry, KV Jhagrakhand.
- Sh. PIYUSH KUMAR, PGT Chemistry, KV Chirimiri.
- Sh. SHIVSHANKAR MATE, PGT Chemistry, KV Dantewada.

TEAM FOR EDITING, COMPILATION AND PREPARATION OF E-BOOK

- **Sh. WASIM KHAN**, PGT Chemistry, KV Dongargarh.
- **Sh. ABHISHEK BHASKAR**, Computer Instructor, KV Dongargarh.

Index

CHEMISTRY
CLASS - XII
INDEX

Sr. No.	Particulars	Page No.
1	Details of Revised Syllabus (2020-21)-	4 - 5
2	Deleted Topics for Session 2020-21	6 - 10
3	Solid State	11 - 14
4	Solutions	14 - 21
5	Electro Chemistry	21 - 24
6	Chemical Kinetics	24 - 28
7	Surface Chemistry	28 - 32
8	p-Block Elements	32 - 41
9	d & f- Block Elements	41 - 47
10	Co-ordination Compounds	47 - 53
11	Haloalkanes and Haloarenes	53 - 58
12	Alcohols, Phenols and Ethers	59 - 65
13	Aldehydes, Ketones and Carboxylic Acids	66 - 83
14	Amines	83 - 94
15	Bio Molecules	94 - 99
16	Sample Paper – 1	100 - 112
17	Sample Paper – 2	113 - 124
18	Sample Paper – 3	125 - 143
19	Sample Paper – 4	144 - 153
20	Sample Paper – 5	154 - 169
21	General Revision Plan	170
22	Special Revision Plan	171 - 172
23	Special Material for Organic Chemistry	173 - 195



**SYLLABUS
CHEMISTRY
CLASS-XII**

Unit I: Solid State 8 Periods

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects.

Unit II: Solutions 8 Periods

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties.

Unit III: Electrochemistry 7 Periods

Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis.

Unit IV: Chemical Kinetics 5 Periods

Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions).

Unit V: Surface Chemistry 5 Periods

Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, colloidal state: distinction between true solutions, colloids and suspension; lyophilic, lyophobic, multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation.

Unit VII: p-Block Elements 7 Periods

Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen preparation properties and uses; compounds of

Nitrogen: preparation and properties of Ammonia and Nitric Acid.

Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: preparation, properties and uses, classification

of Oxides, Ozone, Sulphur -allotropic forms; compounds of Sulphur: preparation properties and uses

of Sulphur-dioxide, Sulphuric Acid: properties and uses; Oxoacids of Sulphur (Structures only).

Group 17 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of Chlorine and Hydrochloric acid, interhalogen compounds, Oxoacids of halogens (structures

only).

Group 18 Elements: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

Unit VIII: d and f Block Elements 7 Periods

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first-row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, color, catalytic property, magnetic properties, interstitial compounds, alloy formation.

Lanthanoids - Electronic configuration, oxidation states and lanthanoid contraction and its consequences.

Unit IX: Coordination Compounds 8 Periods

Coordination compounds - Introduction, ligands, coordination number, color, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT.

Unit X: Haloalkanes and Haloarenes. 9 Periods

Haloalkanes: Nomenclature, nature of C–X bond, physical and chemical properties, optical rotation

mechanism of substitution reactions.

Haloarenes: Nature of C–X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only).

Unit XI: Alcohols, Phenols and Ethers 9 Periods

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of

phenol, electrophilic substitution reactions, uses of phenols.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

Unit XII: Aldehydes, Ketones and Carboxylic Acids 10 Periods

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical

and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses.

Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit XIII: Amines 7 Periods

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Unit XIV: Biomolecules 8 Periods

Carbohydrates - Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L

configuration

Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins.

Nucleic Acids: DNA and RNA.

CLASS XII - CHEMISTRY

DETAILS OF REVISED SYLLABUS 2020-21

CHEMISTRY SYLLABUS IN NCERT TEXT BOOK	DELETED PORTIONS	CHEMISTRY REVISED / REDUCED SYLLABUS 2020-21
<u>UNIT – 1 SOLID STATE</u> Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three-dimensional lattices, calculation of density of unit cell, packing in solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties. Band theory of metals, conductors, semiconductors and insulators and n and p type semiconductors.	1. Electrical and magnetic properties. 2. Band theory of metals, conductors, semiconductors and insulators and 3. n and p type semiconductors.	1. Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). 2. Unit cell in two dimensional and three-dimensional lattices. 3. Calculation of density of unit cell. 4. Packing in solids, packing efficiency. 5. Voids, number of atoms per unit cell in a cubic unit cell, point defects.
<u>UNIT – 2 SOLUTIONS</u> Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Van't Hoff factor.	1. Abnormal molecular mass 2. 2. van't Hoff factor	1. Types of solutions 2. Expression of concentration of solutions of solids in liquids 3. Solubility of gases in liquids, solid solutions, Raoult's law. 4. Colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of masses using colligative properties.
<u>UNIT-3 ELECTROCHEMISTRY</u> Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, fuel cells, corrosion.	1. Lead accumulator, fuel cells. 2. Corrosion. 3. law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells	1. Redox reactions, EMF of a cell, standard electrode potential. 2. Nernst equation and its application to chemical cells. 3. Relation between Gibbs energy change and EMF of a cell. 4. Conductance in electrolytic solutions. 5. Specific and molar conductivity, variations of conductivity with concentration. 6. Kohlrausch's Law. 7. electrolysis.

<u>UNIT-4 CHEMICAL KINETICS</u> Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment), activation energy, Arrhenius equation.	1. Concept of collision theory (elementary idea, no mathematical treatment). 2. activation energy, Arrhenius equation.	1. Rate of a reaction (Average and instantaneous) 2. Factors affecting rate of reaction: concentration, temperature, catalyst. 3. Order and molecularity of a reaction. 4. Rate law and specific rate constant. 5. Integrated rate equations and half-life (only for zero and first order reactions)
<u>Unit 5 - Surface Chemistry</u> Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis: homogenous and heterogenous, activity and selectivity of solid catalysts; enzyme catalysis, colloidal state: distinction between true solutions, colloids and suspension; lyophilic, lyophobic, multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion - types of emulsions.	(1) emulsion - types of emulsions. (2) catalysis: homogenous and heterogeneous. (3) activity and selectivity of solid catalysts; (4) enzyme catalysis,	1. Adsorption - physisorption and chemisorption. 2. Factors affecting adsorption of gases on solids. 3. Colloidal state: distinction between true solutions, colloids and suspension. 4. Lyophilic, lyophobic, multi-molecular and macromolecular colloids. 5. Properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation.
UNIT 6 : GENERAL PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENTS	ENTIRE UNIT – DELETED	
<u>Unit 7 :p-Block Elements</u> Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen preparation properties and uses; compounds of Nitrogen: preparation and properties of Ammonia and Nitric Acid, Oxides of Nitrogen (Structure only); Phosphorus - allotropic forms, compounds of Phosphorus: Preparation and properties of Phosphine, Halides and Oxoacids (elementary idea only). Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: preparation, properties and uses, classification of Oxides, Ozone, Sulphur - allotropic forms; compounds of Sulphur:	1. Preparation and properties of Phosphine. 2. Sulphuric Acid: industrial process of manufacture, 3. Oxides of Nitrogen (Structure only); 4. Phosphorus - allotropic forms, compounds of Phosphorus: 5. Preparation and properties of Halides and Oxo acids (elementary idea only)	<u>GROUP -15 ELEMENTS:</u> 1. General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; 2. Nitrogen preparation properties and uses; compounds of Nitrogen: 3. Preparation and properties of Ammonia and Nitric Acid. <u>GROUP 16 ELEMENTS:</u> 4. General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties. 5. Dioxygen: preparation, properties and uses. 6. Classification of Oxides, Ozone, 7. Sulphur -allotropic forms; <u>Compounds of Sulphur:</u> 8. Preparation properties and uses of Sulphur-dioxide.

preparation properties and uses of Sulphur-dioxide, Sulphuric Acid: industrial process of manufacture, properties and uses; Oxoacids of Sulphur (Structures only). Group 17 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of Chlorine and Hydrochloric acid, interhalogen compounds, Oxoacids of halogens (structures only). Group 18 Elements: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.		<p>9. Sulphuric Acid: properties and uses; Oxoacids of Sulphur (Structures only).</p> <p>GROUP 17 ELEMENTS:</p> <p>10. General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties;</p> <p>Compounds of halogens.</p> <p>11. Preparation, properties and uses of Chlorine and Hydrochloric acid.</p> <p>12. interhalogen compounds, Oxoacids of halogens (structures only).</p> <p>GROUP 18 ELEMENTS:</p> <p>13. General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.</p>
<p><u>Unit 8: d and f Block Elements</u></p> <p>General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first-row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$. Lanthanoids - Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences. Actinoids - Electronic configuration, oxidation states and comparison with lanthanoids</p>	<ol style="list-style-type: none"> 1. Chemical reactivity of lanthanoids, Actinoids 2. -Electronic configuration, oxidation states and comparison with lanthanoids. 3. Preparation and properties of $KMnO_4$ and $K_2Cr_2O_7$ 	<ol style="list-style-type: none"> 1. General introduction, electronic configuration, occurrence and characteristics of transition metals. 2. General trends in properties of the first-row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation. 3. Lanthanoids - Electronic configuration, oxidation states and lanthanoid contraction and its consequences
<p><u>Unit 9: Coordination Compounds</u></p> <p>Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT; structure and stereoisomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological system).</p>	<ol style="list-style-type: none"> 1. Structure and stereoisomerism, 2. importance of coordination compounds (in qualitative analysis, extraction of metals and biological system). 	<ol style="list-style-type: none"> 1. Coordination compounds - Introduction, ligands, coordination number, colour. 2. Magnetic properties and shapes. 3. IUPAC nomenclature of mononuclear coordination compounds. 4. Bonding, Werner's theory, VBT, and CFT.

<p><u>Unit 10: Haloalkanes and Haloarenes</u></p> <p>Haloalkanes: Nomenclature, nature of C—X bond, physical and chemical properties, optical rotation mechanism of substitution reactions. Haloarenes: Nature of C—X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only). Uses and environmental effects of dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.</p>	<p>1. Uses and environmental effects of dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.</p>	<p>Haloalkanes:</p> <ol style="list-style-type: none"> Nomenclature, nature of C-X bond. Physical and chemical properties. Optical rotation mechanism of substitution reactions. <p>Haloarenes:</p> <ol style="list-style-type: none"> Nature of C-X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only).
<p><u>Unit 11: Alcohols, Phenols and Ethers</u></p> <p>Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol. Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols. Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses</p>	<p>1. uses with special reference to methanol and ethanol.</p>	<p>Alcohols:</p> <ol style="list-style-type: none"> Nomenclature, methods of preparation. Physical and chemical properties (of primary alcohols only). Identification of primary, secondary and tertiary alcohols. Mechanism of dehydration. <p>Phenols:</p> <ol style="list-style-type: none"> Nomenclature, methods of preparation. Physical and chemical properties. Acidic nature of phenol. Electrophilic substitution reactions. uses of phenols. <p>Ethers:</p> <ol style="list-style-type: none"> Nomenclature, methods of preparation, physical and chemical properties, uses
<p><u>Unit 12 : Aldehydes, Ketones and Carboxylic Acids</u></p> <p>Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses. Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.</p>		<p>Aldehydes and Ketones:</p> <ol style="list-style-type: none"> Nomenclature, nature of carbonyl group. Methods of preparation. Physical and chemical properties. Mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses. <p>Carboxylic Acids:</p> <ol style="list-style-type: none"> Nomenclature, acidic nature, Methods of preparation, Physical and chemical properties; uses.
<p><u>Unit 13 : Amines</u></p> <p>Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines. Diazonium salts: Preparation, chemical reactions and</p>	<p>1. Diazonium salts: Preparation, chemical reactions and importance in synthetic</p>	<p>Amines:</p> <ol style="list-style-type: none"> Nomenclature. Classification. Structure, methods of preparation. Physical and chemical properties, uses. Identification of primary, secondary and tertiary amines.

importance in synthetic organic chemistry	organic chemistry.	
<u>Unit 14 - : Biomolecules</u> Carbohydrates Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates. Proteins -Elementary idea of amino acids, peptide bond, polypeptides, proteins, structure of proteins primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Hormones Elementary idea excluding structure. Vitamins Classification and functions. Nucleic Acids: DNA and RNA	1. Oligosaccharides (SUCROSE, maltose). 2. polysaccharides (starch, cellulose, glycogen) 3. importance of carbohydrates. 4. Vitamins—classification and functions. Enzymes. 5. Hormones Elementary idea excluding structure.	Carbohydrates - 1. Classification (aldoses and ketoses), monosaccharides (glucose and fructose). PROTEINS 2. D-L configuration Proteins -Elementary idea of - amino acids, peptide bond, polypeptides. 3. Proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only)- 4. Denaturation of proteins. 5. Nucleic Acids: DNA and RNA.
Unit 15- Polymers	ENTIRE UNIT - DELETED	
Unit 16 - Chemistry in Everyday life	ENTIRE UNIT — DELETED	

UNIT-I SOLID STATE

SYLLABUS: Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects

GIST OF THE UNIT

TERMS

Amorphous and Crystalline Solids

Molecular solids

Covalent or Network solid

No of lattice points per unit cell

No of atoms per unit cell (z)

Coordination Number

Calculation of number of voids

Relation between r and a

Packing Efficiency

Calculations Involving Unit Cell Dimensions

Frenkel Defect:

Schottky Defect

Impurity Defects

Metal excess defect due to anionic vacancies (F-centres)

EXPLANATIONS

Amorphous- short range order, Irregular shape, isotropic. No sharp MP, so also called pseudo solids or super cooled liquids eg-glass
Crystalline Solids- long range order, regular shape, anisotropic. Sharp MP, so called true solids. eg : NaCl

Ar, CCl₄, H₂O (ice)

SiO₂ diamond

Simple cubic -8, BCC- 9, FCC – 14, End-Centered- 10

Simple cubic -1, BCC- 2, FCC – 4, End-Centered- 2

FCC- 6:6 BCC- 8:8

Let the number of close packed spheres be N, then: The number of octahedral voids generated = N The number of tetrahedral voids generated = 2N

Simple Cubic → $a = 2r$, BCC → $4r = a\sqrt{3}$

FCC → $4r = a\sqrt{2}$

$$d = \frac{zM}{a^3 N_A}$$

M=molar mass (g/mol) a = edge length in cm , $N_A = 6.023 \times 10^{23}$

Cation is dislocated to an interstitial site. It does not change the density of the solid.
Frenkel defect is shown by ionic substance in which there is a large difference in the size of ions, for example, ZnS, AgCl, AgBr and AgI due to small size of Zn²⁺ and Ag⁺ ions.

A vacancy defects. The number of missing cations and anions are equal. Density decreases. For example, NaCl, KCl, CsCl and AgBr.

If molten NaCl containing a little amount of SrCl₂ is crystallized, it creates cationic vacancies. The cationic vacancies thus produced are equal in number to that of Sr²⁺ ions.

If molten NaCl containing a little amount of SrCl₂ is crystallized, it creates cationic vacancies. The cationic vacancies thus produced are equal in number to that of Sr²⁺ ions.

When alkali metal halides are heated in an atmosphere of alkali metal vapor, they become colored. During heating electrons released by metal diffuse into the crystal and

Metal excess defect due to the presence of extra cations at interstitial sites:

occupy anionic sites, which are called F-centers. NaCl, LiCl, KCl acquires yellow, pink, violet color when heated in vapors of Na, Li and K respectively. Zinc oxide is white in colour at room temperature. On heating it loses oxygen and turns yellow. The excess Zn^{2+} ions move to interstitial sites and the electrons to neighboring interstitial sites.

COMPREHENSION BASED QUESTIONS-

I. Read the following passage and answer the questions that follow:

Solids may be classified as amorphous and crystalline. Amorphous solids are isotropic whereas crystalline solids are anisotropic. Solids can also be classified on the basis of type of forces of attraction as ionic, covalent, metallic and molecular solids. Unit cells represent crystal lattice. Types of crystal lattice-bcc, fcc, simple cubic, end centered cubic are most common in seven crystal systems and 14 bravais lattices. The constituent particles arrange in square close packing, bccp, fccp, hcp. Packing efficiency of hcp and fccp is 74%, bccp 68% and simple cubic packing (52%). The vacant sites in packing are called voids, tetrahedral and octahedral being most common. Density of solids can be calculated by using - $d = \frac{Z \cdot M}{N_A \cdot A^3}$. There are defects in crystal lattice, point defects like Frenkel and Schottky. Non-stoichiometric defects are metal excess type and metal deficient type and impurity defects.

a) Which type of defects is shown by ZnS ?

Ans. Frenkel defect.

(b) A given metal has fcc structure with edge length of 361 pm. What is radius of atom?

Ans. $4r = \frac{\sqrt{2} a}{4} \Rightarrow r = \frac{1.414 \times 361}{4} = 127 \text{ pm}$

(c) A compound is formed by cation 'C' which occupy 75% of octahedral voids and anion 'A' form hcp. What is formula of compound?

Ans. C_3A_4

(d) What happens when ZnO is heated and why?

Ans. It becomes yellow due to metal excess defect.

(e) What type of solid is silicon carbide (Carborundum)?

Ans. Covalent solid

II. Common salt we use in our daily food is sodium chloride (NaCl). Free flowing table salt of popular brand used in the house of chemist was observed to have the density equal to 2.058 g/cc. The theoretical standard density of sodium chloride is 2.165 g/cc.

Answer the following questions:

i) Which type of defect is present in the free flowing salt?

ii) Is the defect stoichiometric?

iii) What type of ionic solids show Schottky defect?

iv) Define coordination number. What is the coordination number of NaCl ?

v) What is the packing efficiency in simple cubic lattice?

Ans. (i) Schottky defect

Ans. (ii) stoichiometric

Ans. (iii) For Schottky defect the size of cation and anion should be similar and coordination number should be high i.e., 6 or more.

Ans. (iv) The nearest neighbors with which a given sphere is in contact is called coordination sphere. The coordination number of NaCl is 6.

Ans. (v) The packing efficiency in simple cubic lattice = 52.4%

CONCEPTUAL QUESTIONS -

One mark questions -

1. What is the formula of a compound in which the element Y forms hcp lattice and atoms of X occupy $\frac{1}{3}$ rd of octahedral voids?

Ans. XY_3

2. What would be the nature of solid if there is no energy gap between valence band and conduction band?

Ans. Metallic solid

3. Analysis shows that FeO has a non-stoichiometric composition with formula $\text{Fe}_{0.95}\text{O}$. Give reason.

Ans. Some Fe^{2+} ions are replaced by Fe^{3+} ions; $3\text{Fe}^{2+} = 2\text{Fe}^{3+}$ to maintain electrical neutrality.

4. Name the defect in the following crystal.

X^+	Y^-	X^+	Y^-
Y^-	O	Y^-	X^+
X^+	O	X^+	Y^-
Y^-	X^+	Y^-	X^+

Ans. Schottky defect

5. What is the coordination number of atoms in a

(i) bcc structure, and (ii) fcc structure?

Ans. (i) 8 (ii) 12

6. "Crystalline solids are anisotropic in nature". What does this statement mean?

Ans. It means that some of their physical properties show different values when measured along different directions in the same crystal. [The substances exhibiting directional differences in properties are termed anisotropic]

Two marks questions -

7. An element crystallizes in a bcc. Lattice with cell edge of 400 pm. Calculate the density if 250 g of this element contain 2.5×10^{24} atoms? Ans. 3.125 g cm^{-3}

Ans. Hint - first find the atomic mass of element from the formula, $m/M = N_o/N_A$

8. Account for the following:

i) Schottky defect lowers the density of a related solid.

ii) Conductivity of silicon increases on doping it with phosphorus.

Ans.i) In Schottky defect, some ions are missing (or due to vacancies) from their normal sites due to which density decreases.

Ans.ii) This is due to availability of unpaired or odd electron provided by phosphorus.

9. a) Why does presence of excess of lithium makes LiCl crystals pink?

b) A solid with cubic crystals is made of two elements P and Q. Atoms of Q are at the corners of the cube and P at the body centers. What is the formula of the compound?

Ans.a) When a crystal of LiCl is heated in an atmosphere of Li vapours, the Li atoms lose electron to form Li^+ ions. The released electrons diffuse into the crystals and occupy anionic sites (F-centers) which absorb energy from light and impart pink colour to the LiCl crystal.

Ans.b) We know that in simple cubic, number of atoms at corner = $1/8 \times 8 = 1$

So the formula of the compound is PQ.

10. a) Why do the window glasses of old buildings become blurred and turbid ?

b) Why do the window glasses of old buildings become thick at the bottom?

Ans. a) With the passage of time, glass undergoes crystallization to some extent, i.e. it acquires crystalline character. This is due to heating in the day time and cooling slowly in the night time, i.e. the process of annealing occurs.

Ans. a) Glass behaves as a super cooled liquid, i.e. it has the property to flow. Thus, due to gravity the glass sheets become thick at the bottom.

Three marks questions -

11 a) Based on the nature of intermolecular forces, classify the following solids:

Sodium sulphate, Hydrogen

b) What happens when CdCl_2 is doped with AgCl?

c) Why do ferri-magnetic substances show better magnetism than anti-ferromagnetic substances?

Ans. (a) Sodium sulphate = ionic solid, Hydrogen = molecular solid (non-polar)

Ans. (b) Cationic vacancies are generated.

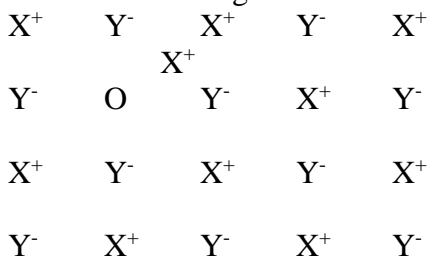
Each Cd^{2+} replaces two Ag^+ ions. It occupies the site of one ion and the other site remains vacant. Thus cationic vacancies are produced and it is an Impurity defect.

Ans. (c)

12. Chromium crystallizes in bcc structure. If its edge length is 300 pm, find its density. Atomic mass of chromium is 52 u. ($N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$) Ans. 6.396 g cm^{-3}

Ans. Use the formula of density of the unit cell

13. Examine the given defective crystal:



Answer the following questions:

- Is the above defect stoichiometric or non-stoichiometric?
- Write the term used for this type of defect.
- Why do silver halides show this type of defect?

Ans. (i) Stoichiometric defect

Ans. (ii) Frenkel defect

Ans. (iii) Due to large difference in the size of cation and anion.

14. An element 'X' (At. Mass = 40 g mol^{-1}) having fcc structure, has unit cell edge length of 400 pm. Calculate the density of 'X' and the number of unit cells in 4 g of 'X'. ($N_A = 6.022 \times 10^{23} \text{ mol}^{-1}$) Ans.
Density = 4.15 g cm^{-3} ; Number of unit cells = 1.5×10^{22}

UNIT-II SOLUTIONS

SYLLABUS: Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult's law, colligative properties - relative lowering of vapor pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties.

GIST OF THE UNIT

Mass percent

$$\text{w/w\% Composition} = \frac{\text{w Solute}}{\text{w Solution}} \times 100$$

Mass of solute present per 100 g. of solution

Molarity [M]:

$$\frac{\text{no. of moles of solute}}{\text{volume of solution (L)}}$$

No. of moles of solute present per liter of solution in called 'molarity of solution'. It is temperature dependent.

Molality [m]:

$$= \frac{\text{No. of moles of solute}}{\text{Mass of solvent (in kg)}}$$

No. of moles of solute present per kg of solvent is called molality. It is temperature independent.

Mole Fraction:

For two component system made of A and B, $X_A = \frac{n_A}{n_A + n_B}$, $X_B = \frac{n_B}{n_A + n_B}$, Sum of all the components is 1; $X_A + X_B = 1$

Ratio of number of moles of a component in solution to the total no. of moles of all the components is called mole fraction (x) of the component.

Henry's law :

$$p_A = K_H \cdot X_A$$

The solubility of a gas in a liquid at a particular temp. is directly proportional to the pressure of the gas in equilibrium with the liquid at that temp.

Applications of Henry's Law

1. To minimize the painful effects accompanying the decompression of deep sea divers, He is mixed with O₂ is used in breathing gas.

2. To increase the solubility of CO₂ in soft drinks and soda water, the bottle is sealed under pressure

RAOULT'S LAW**Roult's law for a solution containing two miscible liquids**

The partial vapour pressure of each component of a solution is directly proportional to its mole fraction at a given temperature. Suppose A and B are two volatile components of a solution. Therefore according to Roult's law

$$P_A \propto \chi_A, P_A = P_A^0 \times \chi_A \text{ and}$$

$$P_B \propto \chi_B, P_B = P_B^0 \times \chi_B$$

Therefore total vapour pressure of the solution: $P_s = P_A + P_B$

For a binary solution $\chi_A + \chi_B = 1$,

so $\chi_B = 1 - \chi_A$ and $\chi_A = 1 - \chi_B$

$$P_s = P_A^0 + (P_B^0 - P_A^0) \chi_B \quad \text{OR}$$

$$P_s = P_B^0 + (P_A^0 - P_B^0) \chi_A$$

Roult's law for a solution containing a non-volatile solute:

The relative lowering of vapour pressure for a solution containing a non-volatile solute is equal to mole fraction of the solute when solvent alone is volatile.

$$\frac{P_A^0 - P_A}{P_A^0} = \chi_B$$

$$P_A^0 = V.P \text{ of pure solvent}$$

$$P_A = V.P \text{ of solution}$$

Where $P_A^0 - P_A$ is lowering of vapour pressure of solution

IDEAL AND NON-IDEAL SOLUTIONS:**Ideal Solution**

1. Follows Roult's law at all temperature and concentrations. $P = P_A + P_B$
2. Intermolecular forces in resulting solution are same as in pure components. $A - B = A - A = B - B$

3. No change in volume while mixing components. $\Delta V_{\text{mix}} = 0$

4. No heat change take place while mixing the components. $\Delta H_{\text{mix}} = 0$

5. Eg: n - hexane + n - heptanes & benzene + toluene

Non Ideal Solution

1. Does not follow Roult's law at all temperature and pressure. $P \neq P_A + P_B$
2. Intermolecular forces in resulting solution are different from inter molecular force of pure components. $A - B \neq A - A, B - B$

3. Change in volume while mixing components. $\Delta V_{\text{mix}} \neq 0$

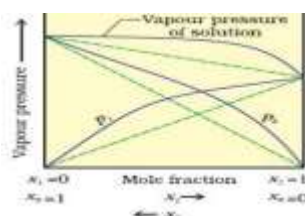
4. Heat changes take place while mixing the components. $\Delta H_{\text{mix}} \neq 0$

5. Eg: Acetone + Water & Acetone + CHCl₃

NON IDEAL SOLUTIONS

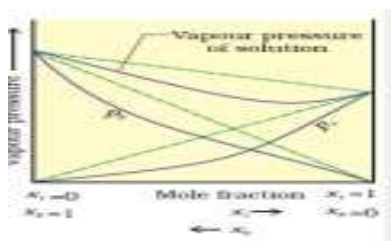
Showing Positive deviation from Roul't's Law

1. Vapour pressure of resulting solution is greater than sum of partial pressure of components. $P > P_A + P_B$
2. Resulting intermolecular force is weaker than pure components.
3. $\Delta V_{\text{mix}} = +ve$
4. $\Delta H_{\text{mix}} = +ve$
5. Eg: Acetone + Water, Alcohol + Water, Carboxylic Acid + Water



Showing Negative deviation from Roul't's Law

1. Vapour pressure of resulting solution is less than sum of the partial pressure of pure components. $P < P_A + P_B$
2. Resulting intermolecular force is stronger than pure components.
3. $\Delta V_{\text{mix}} = -ve$
4. $\Delta H_{\text{mix}} = -ve$
5. Eg: Acetone + CHCl_3 , HNO_3 + H_2O



Azeotrope: :- The mixture of liquids which boils at a constant temperature like a pure liquid and possess same composition of the components in liquid as well as in vapour

◉ Minimum Boiling Azeotrope: Boils at a temperature lower than boiling point of pure components. [95% Alcohol by volume]

◉ Maximum Boiling Azeotrope: Boils at a temperature higher than boiling point of pure components. [68% HNO_3 by mass]

Colligative Properties: -The properties of dilute solutions which depend only on number particles of solute present in the solution and not on their identity are called colligative properties

1-Relative Lowering of Vapour Pressure:

$$\frac{p_1^0 - p_1}{p_1^0} = \frac{w_2 \times M_1}{M_2 \times w_1}$$

The relative lowering of vapour pressure of a solution containing a non-volatile solute is equal to the mole fraction of the solute present in the solution.

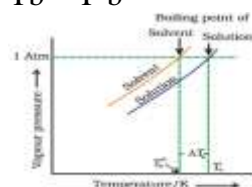
2. Elevation of Boiling Point:

$$\Delta T_b \propto m \text{ [molality]}$$

$$\Delta T_b = K_b m$$

K_b = Molal Elevation Constant or Ebullioscopic constant

Difference between boiling of solution containing non volatile solute and B.P. of pure solvent is called elevation of B.P. $\Delta T_b = T_b - T_b^0$



3. -Depression of Freezing Point:

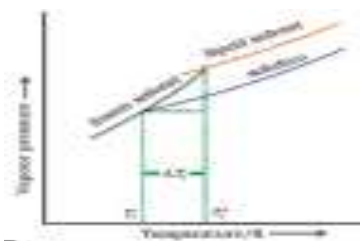
$$\Delta T_f \propto m \text{ [molality]}$$

$$\Delta T_f = K_f m$$

K_f = Molal Depression Constant or Cryoscopic constant

Difference in freezing point of pure solvent and freezing point of solution is called 'Depression in Freezing Point'.

$$\Delta T_f = T_f^0 - T_f$$



4. Osmotic Pressure:

$$\pi V = nRT$$

$$\pi V = \frac{W_B RT}{M_B}$$

π = Osmotic pressure

R = Gas constant.

Reverse Osmosis: If pressure greater than osmotic pressure is applied then, flow of solvent molecules is reversed, i.e. from a higher concentration solution to lower concentrated solution. This phenomenon is called “Reverse Osmosis”. It is used in water purification and desalination of water.

Abnormal molecular mass—When the molecular mass of the substance determined by any of the colligative properties is different from its theoretically calculated molar mass, the substance is said to show abnormal molecular mass. It is due to – 1) the solution is not dilute 2) when the solute undergoes association or dissociation in solution

Van't Hoff Factor: It is defined as the ratio of the experimental value of the colligative property to the calculated value of the colligative property.

$$i = \frac{\text{observed value of colligative property}}{\text{Normal value of colligative property}}$$

$$i = \frac{\text{Normal molecular mass}}{\text{Observed molecular mass}}$$

Colligative property is always inversely proportional to molecular mass

The value of i predicts the nature of the solute in the solution.

If $i = 1$, solute behaves normally in solution.

* If $i > 1$, solute undergoes dissociation in solution

* If $i < 1$, solute undergoes association in solution

COMPREHENSION BASED QUESTIONS-

A. The properties of dilute or ideal solutions which depend only upon the concentration of the solute in the solution and no other characteristics are known as colligative properties. There are in all four such properties i.e. relative lowering in vapour pressure, osmotic pressure, elevation in boiling point temperature and depression in freezing point temperature. All of them help in calculating the observed molar mass of the solute which is inversely proportional to the colligative property involved. Out of these, osmotic pressure may be regarded as the best for the determination of molecular mass of the solute. According to Van't Hoff theory of dilute solution,

$\pi = CRT$, where ' π ' is the osmotic pressure while ' C ' is the molar concentration of the solution.

(1) When liquids A and B are mixed, hydrogen bonding occurs. The solutions will show:

- Positive deviation from Raoult's law
- Negative deviation from Raoult's law
- No deviation from Raoult's law
- Slightly increase in volume

(2) The azeotropic mixture of water and HCl boils at 108.5°C when the mixture is distilled.
It is possible to obtain:

- Pure HCl
 - Pure water
 - Pure water as well as pure HCl
 - Neither HCl nor water in their pure states.
- (3) On freezing an aqueous solution of sugar, the solid which starts separating out is:
- Sugar
 - Ice
 - Solution with the same composition
 - Solution with different composition
- (4) The value of osmotic pressure does not depend upon:
- Concentration of the solution
 - Temperature of the solution
 - Number of the particles of the solute present
 - Structure of the solute particles
- (5) Effect of adding a non-volatile solute to a solvent is:
- to lower the vapour pressure
 - to increase the freezing point
 - to increase the boiling point
 - to decrease the osmotic pressure
- B.** The four colligative properties of the dilute solutions help in calculating the molecular mass of the solute which is often called observed molecular mass. It may be same as the theoretical molecular mass (calculated from the molecular formula) if the solute behaves normally in solution. In case, it undergoes association or dissociation, the observed molar mass gives different results. The nature of the solute in solution is expressed in terms of Van't Hoff factor (i) which may be 1 (if the solute behaves normally), less than 1 (if the solute associates) and more than 1 (if the solute dissociates). The extent of association or dissociation is represented by α which is:
- $$\alpha = \frac{i-1}{\frac{1}{n}-1} \text{ (for association) or } \frac{i-1}{n-1} \text{ (for dissociation)}$$
- (1) The Van't Hoff factor for dilute solution of glucose is:
- Zero
 - 1
 - 1.5
 - 2
- (2) Which of the following is incorrect?
- Molecular mass of NaCl found by osmotic pressure measurements is half of theoretical value.
 - Molecular mass of CH_3COOH in benzene found by cryoscopic method is double the theoretical value.
 - Osmotic pressure of 0.1M glucose solution is half of that of 0.1M NaCl solution.
 - Molecular mass of HCl found by any colligative property will be same in aqueous solution and in benzene solution.
- (3) Benzoic acid undergoes dimerization in benzene solution. The Van't Hoff factor is related to degree of association ' α ' of the acid as:
- $i = 1-\alpha$
 - $i = 1+\alpha$
 - $i = 1-\alpha/2$
 - $i = 1+\alpha/2$
- (4) 0.1M $\text{K}_4[\text{Fe}(\text{CN})_6]$ is 60% ionized. What will be Van't Hoff factor?
- 1.4
 - 2.4
 - 3.4
 - 4.4
- (5) The molar mass of the solute sodium hydroxide obtained from the measurements of Osmotic pressure of its aqueous solution at 27°C is 25 g mol^{-1} . Therefore, the percentage ionization of solution is:
- 75
 - 60
 - 80
 - 70

Answers-

A- 1(b); 2(d); 3.(b); 4(d); 5(a,c) B- 1(b); 2(d); 3.(c); 4(c); 5(b)

MCQ

- Which of the following units is useful in relating concentration of solution with its vapour pressure?
(a) Mole fraction (b) parts per million (c) mass percentage (d) molality
- Value of Henry's constant K_H

- (a) increases with increase in temperature
 - (b) decreases with increase in temperature
 - (c) remains constant
 - (d) first increases, then decreases
3. Increasing the temperature of an aqueous solution will cause
 - (a) decrease in molality
 - (b) decrease in molarity
 - (c) decrease in mole fraction
 - (d) decrease in % (w/w)
 4. Which of the following mixtures will show a positive deviation from Roul't's law?
 - (a) Phenol and aniline
 - (b) Chloroform and acetone
 - (c) Nitric acid and water
 - (d) Methanol and acetone
 5. Colligative properties depend on
 - (a) the nature of the solute
 - (b) the number of solute particles in solution
 - (c) the physical properties of solute
 - (d) the nature of the solvent
 6. Which of the following aqueous solutions should have the highest boiling point?
 - (a) 1.0M NaOH
 - (b) 1.0M NH_4NO_3
 - (c) 1.0 M Na_2SO_4
 - (d) 1.0M KNO_3
 7. The unit of ebullioscopic constant is
 - (a) K kg mol^{-1}
 - (b) $\text{K}^{-1} \text{ kg mol}$
 - (c) $\text{K kg}^{-1} \text{ mol}^{-1}$
 - (d) $\text{K kg}^{-1} \text{ mol}$
 8. In comparison to a 0.01 M solution of glucose, the depression in freezing point of a 0.01 M MgCl_2 solution is
 - (a) the same
 - (b) about twice
 - (c) about three times
 - (d) about six times
 9. An unripe mango placed in a concentrated salt solution to prepare pickles shrinks 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
 10. The values of Van't Hoff factors for KCl, NaCl and K_2SO_4 respectively are-
 - (a) 2, 2 and 2
 - (b) 2, 2 and 3
 - (c) 1, 1 and 2
 - (d) 1, 1 and 1

ANSWERS: 1(a); 2(a); 3(b); 4(d); 5(b);6(c);7(a);8(c);9(d);10(b)

ASSERTION& REASON TYPE QUESTIONS

Note: In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- i. Assertion and reason both are correct statements and reason is correct explanation for assertion.
- ii. Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- iii. Assertion is correct statement but reason is wrong statement.
- iv. Assertion and reason both are incorrect statements.

1. Assertion: Molarity of a solution in liquid state changes with temperature.

Reason: The volume of a solution changes with change in temperature.

2. Assertion: If on mixing the two liquids, the solution becomes hot, it implies that it shows negative deviation from Roul't's law.

Reason: Solution which shows negative deviation from Roul't's law are accompanied by decrease in volume.

3. Assertion: Greater the value of Henry's constant of a gas in a particular solvent, greater is the solubility of the gas at the same pressure and temperature.

Reason: Solubility of a gas is directly proportional to its Henry's constant at the same pressure and temperature.

4. Assertion: When a solution is separated from the pure solvent by a semi-permeable membrane, the solvent molecules pass through it from pure solvent side to the solution side.

Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.

5. Assertion: Azeotropic mixtures are formed only by non-ideal solutions and they may have boiling points either greater than or less than both the components.

Reason: The composition of the vapour phase is same as that of liquid phase of the azeotropic mixture.

ANSWERS: 1(i); 2(ii); 3(iv); 4(iii); 5(ii)

SHORT ANSWER QUESTIONS

1. Vapour pressure of two liquid A & B are 120 and 180mm Hg at a given temp. If 2 mole of A and 3 mole of B are mixed to form an ideal soln, calculate the vapour pressure of solution at same temperature.

A- Total moles = 2 + 3 = 5

$$\begin{aligned} P_{\text{solution}} &= P_A^* \times_A + P_B^* \times_B \\ &= \frac{2}{5} \times 120 + \frac{3}{5} \times 180 \\ &= 48 + 108 \\ &= 156 \text{ mm.} \end{aligned}$$

2. 18 g of glucose, $\text{C}_6\text{H}_{12}\text{O}_6$ (Molar mass = 180 g mole⁻¹) is dissolved in 1 Kg of water in a sauce pan. At what temperature will this solution boil?

A- w_1 = weight for solvent (H_2O) = 1 Kg

w_2 = weight of solute glucose = 18 gm

M_2 = molar mass of solute, glucose = 180 g mole⁻¹

$$K_b = 0.52 \text{ K Kg mole}^{-1}$$

$$\begin{aligned} T_b^0 &= 373.15 \text{ K} \\ \Delta T_b &= \frac{K_b \times 1000 \times w_2}{M_2 \times w_1} = 0.052 \text{ K} \end{aligned}$$

$$\Delta T_b = T_b - T_b^0 \Rightarrow 0.052 = T_b - 373.15 \Rightarrow T_b = 373.202 \text{ K}$$

3. (i) Why is osmotic pressure considered to be a colligative property?

(ii) What happens when a plant cell is placed in

(a). Hypertonic solution (b). Hypotonic solution

(iii) Equimolar solutions of NaCl and glucose are not isotonic. Why?

A- (i) Osmotic pressure depends upon the number of moles of solute per litre of the solution irrespective of the nature of the solute. Hence, osmotic pressure is a colligative property

(ii) (a) its protoplasm shrinks but its shape remains same due to rigid cell wall. This is called plasmolysis.

(b) Its protoplasm swells and applies pressure on the cell wall. But does not burst due to rigid wall.

(iii) NaCl gets dissociated to two ions (Na^+ and Cl^-) and exerts almost double osmotic pressure than glucose

4. The vapour pressures of pure liquids A and B are 450 and 700 mm Hg respectively at 350K. Find the composition of liquid mixture if the total pressure is 600 mm Hg. Also find the composition in vapour

$$P_T = x_{1l}(\text{in liquid phase}) (P_1^0 - P_2^0) + P_2^0$$

$$600 = x_{1l}(\text{in liquid phase}) (450 - 700) + 700$$

$$x_{1l}(\text{in liquid phase}) = 0.4 \quad x_{2l}(\text{in liquid phase}) = 0.6$$

$$P_1 = 450 \times 0.4 = 180 \quad P_2 = 700 \times 0.6 = 420$$

$$x_1 = \frac{180}{600} = 0.3 \quad x_2 = \frac{420}{600} = 0.7$$

5. (i) What is anti-freeze?

(ii) Why should the solution of non-volatile solute freeze at a lower temperature?

(iii) Will the depression in freezing point be same or different if 0.1 mole of sugar, 0.1 mole of glucose is dissolved in one litre of water?

(iv) Why is it advised to add ethylene glycol to water in car radiator while driving in a hill station?

(v) A solution containing 18 g of non-volatile solute in 200 g water freezes at 272.07 K. calculate the molar mass of solute. (Given $K_f = 1.86 \text{ K/m}$).

Ans (i) Those substances which are used in depressing the freezing point of water

(ii) A solution containing a non-volatile solute has lower V.P. than the pure solvent. As a result its V.P.

becomes equal to the solid solvent at a lower temperature than pure solvent.

(iii) The depression in freezing point will be same in both the solutions because both are non-electrolytes and give same number of solute particles

(iv) Ethylene glycol lowers the freezing point of water and therefore does not freeze in the radiator.

(v) $\Delta T_f = K_f \times m$

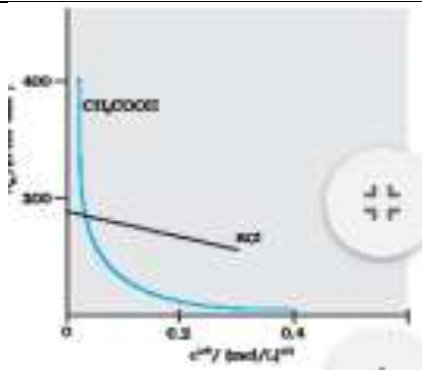
$$273 - 272.07 = 1.86 \times \frac{18 \times 1000}{M \times 200}$$

$$0.93 = 1.86 \times \frac{90}{M} \Rightarrow M = 180 \text{ g/mol}$$

UNIT-III ELECTROCHEMISTRY

SYLLABUS- Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis.

GIST OF THE UNIT

Conductance :	Reciprocal of the resistance $C = 1/R$ Unit is Ω^{-1}
Specific Resistance/Resistivity	$\rho = R A / l$ Unit is ohm.cm
Specific Conductance or Conductivity : Conductivity of any conductor is the reciprocal of specific resistance and is denoted by κ (Greek work Kappa)	$k = 1/\rho = 1/RA = 1/R \times l/A$ Unit: S cm-1 $k = C \times G^*$ ($G^* = l/A = \text{Cell constant, Unit Cm}^{-1}$) Variation of k (Conductivity) with concentration: k directly proportional to concentration.
Molar Conductivity : It is defined as the conducting power of all the ions produced by one gram mol of an electrolyte in a solution.	It is denoted by Λ_m . $\Lambda_m = \frac{\kappa \times 1000}{\text{Molarity}}$ Unit of Λ_m is $\text{Scm}^2\text{mol}^{-1}$
Variation of molar conductivity with concentration: In case of strong electrolyte like KCl, Λ_m does not increase appreciably because number of ions does not increase much whereas mobility of ions increases on dilution. In case of weak electrolyte like CH_3COOH , Λ_m increases appreciably with decrease in concentration because both number of ions as well as mobility of ions increase with decrease in concentration i.e. on dilution.	
Kohlrausch's Law : According to this law, molar conductivity of an electrolyte, at infinite dilution can be expressed as the sum of contributions from its individual ions. e.g. $\Lambda_m^\infty = \nu_+ \lambda_+^\infty + \nu_- \lambda_-^\infty$ or $\Lambda_m^\infty = \nu_+ \lambda_+^\infty + \nu_- \lambda_-^\infty$	Application of Kohlrausch's Law 1. For calculation of limiting molar conductivity $\Lambda_m^\infty = \nu_+ \lambda_+^\infty + \nu_- \lambda_-^\infty$ 2. For calculation of degree of dissociation $\alpha = \frac{\Lambda}{\Lambda^\infty}$ 3. For calculation of dissociation constant. (K_a) $K_a = \frac{c\alpha^2}{(1-\alpha)} = \frac{c\Lambda^2}{\Lambda^\infty(\Lambda^\infty - \Lambda)}$

Where v_+ and v_- are the number of cations and anions per formula of electrolyte (e.g. $v_+ = v_- = 1$ in NaCl but $v_+ = 1$ and $v_- = 2$ for CaCl_2).	
Nernst equation for half cell (Single electrode):	$E_{M^{n+}/M} = E^\circ_{M^{n+}/M} - \frac{RT}{nF} \ln \frac{1}{[M^{n+}]} \quad \text{OR} \quad E_{M^{n+}/M} = E^\circ_{M^{n+}/M} - \frac{0.0591}{n} \log \frac{1}{[M^{n+}]}$
Nernst equation for complete cell	$E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.059}{n} \log \frac{[\text{product}]}{[\text{react.}]}$
Equilibrium constant (K_c)	At equilibrium $Q_c = K_c$ and $E_{\text{cell}} = 0$ $E^\circ_{\text{cell}} = \frac{0.059}{n} \log K_c$
Electrochemical Cell and Gibbs energy of the reaction:	$\Delta_r G = -nFE$ $\Delta_r G^\circ = -nFE^\circ \qquad \Delta_r G^\circ = -2.303RT \log K_c$
Faraday's first law of electrolysis : Amount of substance deposited(W) at any electrode is directly proportional to supplied charge(Q).	$W = Z \cdot Q$ or $W = Z \cdot I \cdot t$ where 'Z' is electrochemical equivalent, 'I' is current in amperes & 't' is time in seconds
Faraday's second law of electrolysis : when the same amount of current is passed through different electrolytes/elements connected in series, the mass of the substance liberated/deposited at the electrodes in g is directly proportional to their chemical equivalent.	$W \propto E$ and $W_1/W_2 = E_1/E_2$ Where W_1 and W_2 are mass of substance 1 and 2 respectively and E_1 and E_2 are their equivalent masses.

COMPREHENSION BASED QUESTIONS

I. Read the given passage and answer the questions 1to5 that follow:

Galvanic cells that are designed to convert the energy of combustion of fuels like hydrogen, methane, methanol, etc. directly into electrical energy are called fuel cells. One of the most successful fuel cells uses the reaction of hydrogen with oxygen to form water. The cell was used for providing electrical power in the Apollo space programme. The water vapours produced during the reaction were condensed and added to the drinking water supply for the astronauts. In the cell, hydrogen and oxygen are bubbled through porous carbon electrodes into concentrated aqueous sodium hydroxide solution. Catalysts like finely divided platinum or palladium metal are incorporated into the electrodes for increasing the rate of electrode reactions.

a) Write the cathodic & anodic reactions taking place in $\text{H}_2\text{-O}_2$ fuel cell.

Ans. Cathodic reaction- $\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^- \rightarrow 4\text{OH}^-(\text{aq})$

Anodic reaction- $2\text{H}_2(\text{g}) + 4\text{OH}^-(\text{aq}) \rightarrow 4\text{H}_2\text{O}(\text{l}) + 4\text{e}^-$

Ans. b) Write two advantages of fuel cells over other cells.

i) Higher efficiency of about 70 %

ii) The cell runs continuously as long as the reactants are supplied.

c) In fuel cell finely divided platinum or palladium metal are incorporated into the electrodes for increasing the rate of electrode reactions. How does catalyst increase the rate of a reactions?

Ans- Lowers activation energy for the reaction by one or another way.

d) Why are catalyst used in finely divided form?

Ans. finely divided form has greater surface area.

MCQ-

1. The limiting molar conductivity for NaCl, KBr and KCl are 126,152 and150

$\text{Scm}^2\text{mol}^{-1}$, the limiting molar Conductivity of NaBr is:

a. 278 $\text{Scm}^2\text{mol}^{-1}$ b. 176 $\text{Scm}^2\text{mol}^{-1}$

c. 128 $\text{Scm}^2\text{mol}^{-1}$ d. 302 $\text{Scm}^2\text{mol}^{-1}$

2. Limiting molar conductivity of NH_4OH is equal to -:
 - a. $\Lambda^\circ \text{mNH}_4\text{Cl} + \Lambda^\circ \text{mNaCl} + \Lambda^\circ \text{mNaOH}$
 - b. $\Lambda^\circ \text{mNaOH} + \Lambda^\circ \text{mNaCl} - \Lambda^\circ \text{mNH}_4\text{Cl}$
 - c. $\Lambda^\circ \text{mNaOH} - \Lambda^\circ \text{mNH}_4\text{Cl} - \Lambda^\circ \text{mHCl}$
 - d. $\Lambda^\circ \text{mNH}_4\text{Cl} + \Lambda^\circ \text{mNaOH} - \Lambda^\circ \text{mNaCl}$
3. How is electrical conductance of a conductor related with length and area of cross-section of the conductor ?
 - a. $G = l \cdot a \cdot k^{-1}$
 - b. $G = k \cdot l \cdot a^{-1}$
 - c. $G = k \cdot a \cdot l^{-1}$
 - d. $G = k \cdot l \cdot a^{-2}$
4. The potential of a hydrogen electrode at $\text{pH} = 10$ is
 - a. 0.591 V b. 0.00V c. -0.591 V d. -0.059 V
5. Which cell will measure standard electrode potential of copper electrode?
 - (i) $\text{Pt (s)} | \text{H}_2 (\text{g}, 0.1 \text{ bar}) | \text{H}^+ (\text{aq.}, 1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, 1 \text{ M}) | \text{Cu}$
 - (ii) $\text{Pt(s)} | \text{H}_2 (\text{g}, 1 \text{ bar}) | \text{H}^+ (\text{aq.}, 1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, 2 \text{ M}) | \text{Cu}$
 - (iii) $\text{Pt(s)} | \text{H}_2 (\text{g}, 1 \text{ bar}) | \text{H}^+ (\text{aq.}, 1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, 1 \text{ M}) | \text{Cu}$
 - (iv) $\text{Pt(s)} | \text{H}_2 (\text{g}, 1 \text{ bar}) | \text{H}^+ (\text{aq.}, 0.1 \text{ M}) || \text{Cu}^{2+} (\text{aq.}, 1 \text{ M}) | \text{Cu}$
6. The difference between the electrode potentials of two electrodes when no current is drawn through the cell is called _____.
 - (i) Cell potential
 - (ii) Electromotive Force
 - (iii) Potential difference
 - (iv) Cell voltage

ANSWERS:

1(c); 2(d); 3(c); 4(c); 5(c); 6(b)

ASSERTION& REASON TYPE QUESTIONS

Note : In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Both assertion and reason are true and the reason is the correct explanation of assertion.
 - (b) Both assertion and reason are true and the reason is not the correct explanation of assertion.
 - (c) Assertion is true but the reason is false.
 - (d) Both assertion and reason are false.
 - (e) Assertion is false but reason is true.
1. **Assertion :** Cu is less reactive than hydrogen.
Reason : $E^\circ \text{Cu}^{2+}/\text{Cu}$ is negative.
 2. **Assertion :** E° cell should have a positive value for the cell to function.
Reason : $E_{\text{cathode}} < E_{\text{anode}}$
 3. **Assertion :** Conductivity of all electrolytes decreases on dilution.
Reason : On dilution number of ions per unit volume decreases.
 4. **Assertion :** Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.
Reason : For weak electrolytes degree of dissociation increases with dilution of solution.
 5. **Assertion :** Electrolysis of NaCl solution gives chlorine at anode instead of O_2 .
Reason : Formation of oxygen at anode requires overvoltage.
 6. **Assertion :** For measuring resistance of an ionic solution an AC source is used.
Reason : Concentration of ionic solution will change if DC source is used.
 7. **Assertion :** Current stops flowing when $E_{\text{Cell}} = 0$.
Reason : Equilibrium of the cell reaction is attained.
 8. **Assertion :** $E_{\text{Ag}^+/\text{Ag}}$ increases with increase in concentration of Ag^+ ions.
Reason : $E_{\text{Ag}^+/\text{Ag}}$ has a positive value.
 9. **Assertion :** Copper sulphate can be stored in zinc vessel.
Reason : Zinc is less reactive than copper.
 10. **Assertion:** Cu dissolves in HNO_3
Reason: In nitric acid it is oxidized by nitrate ion and not by hydrogen ion

ANSWERS:

1(a); 2(c); 3(d); 4.(a); 5(a); 6(a); 7 (a); 8(e); 9(d); 10(a)

EXPECTED QUESTIONS

1. Arrange the following metals in order of their increasing reducing power.

$K^+/K = -2.93V$, $Ag^+/Ag = 0.80V$, $Hg^{2+}/Hg = 0.79V$, $Mg^{2+}/Mg = -2.37V$

$Cr^{3+}/Cr = -0.74V$.

Ans. Lower the reduction potential, easily it gets oxidized hence greater is the reducing power, therefore the increasing order of reducing power is $Ag < Hg < Cr < Mg < K$.

2. Define conductivity and molar conductivity.

Ans. The conductance of a solution of 1 cm length and area of cross section equal to 1cm^2 is known as conductivity. The conductivity of electrolytic solution containing 1 mole of electrolyte between 2 large electrodes at one cm apart is known as molar conductivity.

3. What is limiting molar conductivity?

Ans. The molar conductivity of an electrolyte at zero concentration is known as Limiting molar conductivity.

4. What is unit of molar conductivity?

Ans: $\Lambda^m = \frac{K \times 1000}{M} = \text{Scm}^2/\text{mol}^{-1}$

5. The conductivity of 0.20M solution of KCl at 298 K is 0.0248 Scm^{-1} . Calculate its molar conductivity.

Ans.: $\Lambda^m = \frac{K \times 1000}{M} = \frac{0.0248 \times 1000}{0.20} = 124 \text{ Scm}^2 \text{ mol}^{-1}$

6. How much faraday is required to produce 40g Al from Al_2O_3 ?

Ans: $Al^{3+} + 3e^- \rightarrow Al$ (27g)

27g Al is deposited by 3f

40g Al will be deposited by $= \frac{3 \times 40}{27} = 4.44 F$

7. Predict the products of electrolysis of $AgNO_3$ with Silver electrodes.

Ans. $AgNO_3 \rightarrow Ag^+ + NO_3^-$

Reaction at cathode $Ag^+ + e^- \rightarrow Ag$

Reaction at anode $Ag \rightarrow Ag^+ + e^-$

8. Predict if the reaction between the following is feasible? Fe^{3+} and Br^- .

Ans: $Fe^{3+} + Br^- \rightarrow Fe^{2+} + \frac{1}{2}Br_2$

$E^\circ_{\text{cell}} = 0.77V - 1.09V = -0.32V$ not feasible

9. Explain Kohlrausch's law.

Ans: The Limiting molar conductivity of an electrolyte can be represented as sum of individual contribution of cation and anion of the Electrolytic

$\Lambda^\circ_m = \nu \Lambda^\circ_+ + \nu \Lambda^\circ_-$

10. Calculate emf of the following cell

$Cd/Cd^{2+} (.10 M)/H^+ (.20 M)/H_2 (0.5 \text{ atm})/Pt$

[Given E° for $Cd^{2+}/Cd = -0.403V$]

Ans: $E_{\text{cell}} = E^\circ_{\text{cell}} - \frac{0.0591}{n} \log \frac{[Cd^{2+}]}{[H^+]^2}$

$E^\circ_{\text{cell}} = 0 - (-0.403V) = 0.403V$

$= 0.403 - \frac{0.0591}{2} \log \frac{(0.10)}{(0.2)^2} = 0.400V$

CHEMICAL KINETICS

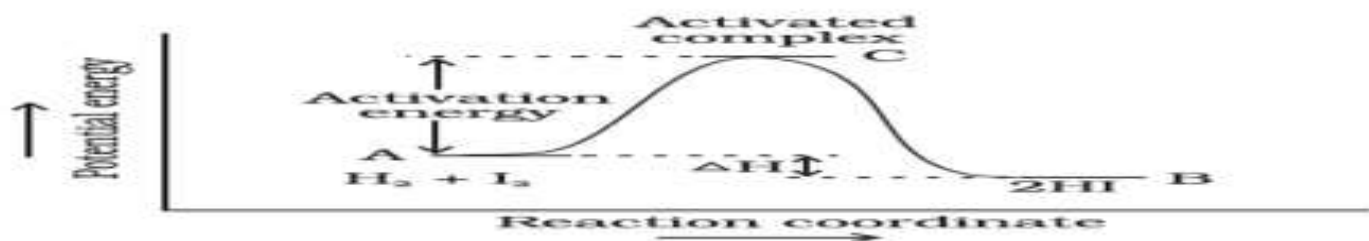
(APPROXIMATE WEIGHTAGE OR THE TOPIC – 5 MARKS)

REVISED/REDUCED SYLLABUS FOR THE SESSION – 2020-21:

- ✓ Rate of reaction (Average & Instantaneous)
- ✓ Factors affecting reaction rate.
- ✓ Order & molecularity of a reaction.
- ✓ Rate law & specific rate constant.
- ✓ Integrated rate equations and half-life (only for zero & first order reactions)

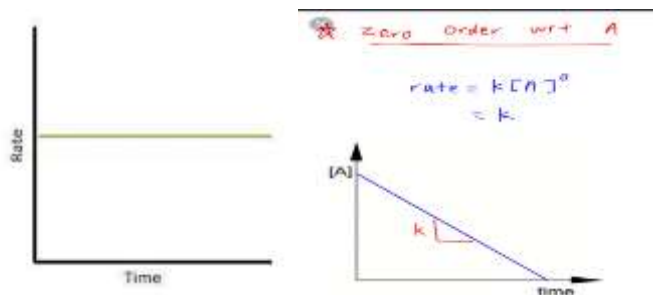
✓ IMPORTANT POINTS :

No	CONCEPT	DETAILS (THEORY & FORMULA)
	Rate of Reaction	Change of concentration of reactants & products per unit time. -----> B, Rate = decrease in conc of reactant / time taken OR Rate = increase in conc o product / time interval Unit = $\text{mol L}^{-1} \text{s}^{-1}$
	Expression or reaction rate	Consider a reaction, $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$ $R = -\Delta[\text{N}_2]/\Delta t = -1/3\Delta[\text{H}_2]/\Delta t = 1/2\Delta[\text{NH}_3]/\Delta t$ Rate o disappearance of N_2 & $\text{H}_2 = -\Delta[\text{N}_2]/\Delta t = -\Delta[\text{H}_2]/\Delta t$ Rate o appearance of ammonia = $\Delta[\text{NH}_3]/\Delta t$ Rate of disappearance of N_2 = rate o reaction Rate of disappearance of H_2 = 3 x rate o reaction & Rate o formation o NH_3 = 2 x rate of reaction
	Factors affecting reaction rate	Reaction rate increases with increase in concentration of reactants, temperature & catalyst. A catalyst decreases the activation energy and promotes more amounts of reactants to cross energy barrier.
	Order of reaction (n)	Sum of no of moles of reactants on which reaction rate depends. It is an experimental quantity, can be zero or fractional value.
	Molecularity of reaction (m)	Sum of stoichiometric coefficient of reactants in a balanced chemical equation. It is a theoretical value & can't be zero or fractional value.
	Integrated rate equation	For zero order reaction = $k = [A]_0 - [A] / t$ For first order = $k = (2.303 / t) \log [A]_0 / t$
	Unit of rate constant	for any order = $\text{mol}^{1-n} \text{L}^{n-1} \text{s}^{-1}$ (where n is the order of reaction)
	Half -life of a reaction	Time in which half of the reaction is completed or half of the reactant is consumed. For zero order $t_{1/2} = [R]_0 / 2k$, for first order $t_{1/2} = 0.693/k$
	Arrhenius equation	$\log k_2/k_1 = E_a / 2.303R [1/T_1 - 1/T_2]$
	Activation energy	Energy required by the reactant molecules to cross the energy barrier.
	Pseudo 1 st order reaction	The bimolecular reaction in which one of the reactants is taken in excess so that the reaction follows 1 st order kinetics.

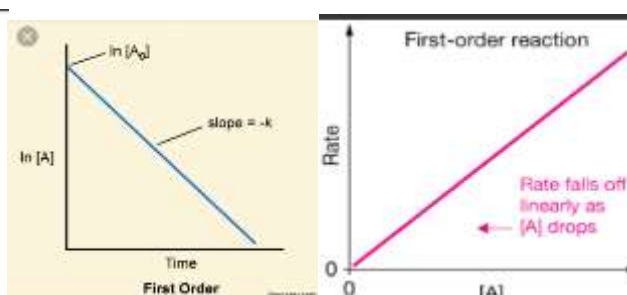


GRAPHICAL REPRESENTATIONS OF ZERO & FIRST ORDER REACTION

ZERO ORDER REACTION



FIRST ORDER REACTION



QUESTION BANK

MCQs

1. A reaction is first order with respect to reactant A. What will be the initial rate, if concentration of reactant becomes halved?
(a) Halved (b) doubled (c) tripled (d) not changed
2. What is the ratio of the rate of decomposition of N_2O_5 to the rate of formation of NO_2 ?
 $2\text{N}_2\text{O}_5(\text{g}) \longrightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$
(a) 1:4 (b) 2:1 (c) 4:1 (d) 1:2
3. In the first order reaction, the concentration of the reactant is reduced to $1/4^{\text{th}}$ in 60 minutes. What will be its half-life?
(a) 120 min (b) min (c) 30 min (d) 25 min
4. Which of the following reaction ends in infinite time?
(a) Zero order (b) First order (c) Second order (d) Third order
5. The rate constant of a zero order reaction is-
(a) directly proportional to initial concentration (b) doesn't depend on concentration
(c) inversely proportional to initial concentration (d) can't say
6. The first order reaction takes 80 minutes to complete 99.9%. What will be its half-life?
(a) 8 min (b) 16 min (c) 24 min (d) 32 min
7. A catalyst increases the reaction rate by:
(a) decreasing enthalpy (b) increasing internal energy
(c) decreasing activation enthalpy (d) increasing activation enthalpy
8. Chemical kinetics is the study to find out:
(a) the feasibility of a chemical reaction (b) speed of a reaction
(c) extent to which a reaction will proceed (d) all of the above
9. The rate of a reaction:
(a) increases as the reaction proceeds (b) decreases as the reaction proceeds
(c) remains the same as the reac. Proceeds (d) may increase or decrease as the reaction proceeds
10. Which of the following influences the reaction rate performed in a solution?
(a) Temperature (b) Activation energy (c) Catalyst (d) All of the above

ANSWERS – 1.(a) 2.(d), 3.(c), 4.(b), 5.(a), 6.(a), 7.(a), 8.(d), 9.(d), 10.(d)

ASSERTION- REASON TYPE QUESTIONS

READ THE STATEMENTS GIVEN AS ASSERTION & REASON BOTH AND CHOOSE THE CORRECT OPTION AS (A)/(B)/(C)/(D) AS PER THE FOLLOWING INSTRUCTIONS.

Choose (A) – if both assertion & reason are correct statements and reason is the correct explanation of assertion.

Choose (B) - if both assertion & reason are correct statements and reason is not the correct explanation of assertion.

Choose (C) – if assertion is the correct statement & reason is incorrect statement.

Choose (D) – if assertion is incorrect statement and reason is the correct statement.

1. ASSERTION – Order of reaction can be zero or fractional.
REASON – Order of a reaction cannot be determined from a balanced chemical reaction.
2. ASSERTION – Order and molecularity of a reaction is always same.
REASON – Order is determined experimentally whereas molecularity can be identified by a balanced reaction.
3. ASSERTION – Rate constant of a zero order reaction has the same unit as the rate of a reaction.
REASON – Rate constant of a zero order reaction does not depend upon the concentration of the reactant.
4. ASSERTION – In a first order reaction, the concentration of the reactant is doubled, its half-life is also doubled.
REASON – Half-life of a reaction does not depend upon initial concentration of the reactant

in a first order reaction.

5. ASSERTION – Average rate and instantaneous rate of a reaction has the same unit.

REASON – Average rate becomes instantaneous rate when time interval is too small.

ANSWERS – 1- (B), 2-(D), 3-(A), 4-(D), 5- (B)

Case based assertion-reason questions

Read the following passage and answer the given questions:

Chemical kinetics, the branch of **physical chemistry** that is concerned with understanding the rates of **chemical reactions**. It is to be contrasted with **thermodynamics**, which deals with the direction in which a process occurs but in itself tells nothing about its rate. Thermodynamics is time's arrow, while chemical kinetics is time's clock. Chemical kinetics relates to many aspects of **cosmology, geology, biology, engineering**, and even **psychology** and thus has far-reaching implications. The principles of chemical kinetics apply to purely physical processes as well as to chemical reactions.

The **rate of a reaction** is defined in terms of the rates with which the products are formed and the reactants (the reacting substances) are consumed. For chemical systems it is usual to deal with the concentrations of substances, which is defined as the amount of substance per unit volume. The rate can then be defined as the concentration of a substance that is consumed or produced in unit time. Sometimes it is more convenient to express rates as numbers of molecules formed or consumed in unit time.

(Ref: **Kelth J. Laidler**, Former Professor of Chemistry, University of Ottawa, Ontario. Author of *The World of Physical Chemistry*.)

In these questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- c) Assertion is correct statement but reason is wrong statement
- d) Assertion is wrong statement but reason is correct statement.

1. Assertion: The rate of a reaction is the rate of change of concentration of a reaction or a product.

Reason: Rate of reaction remains constant during the course of reaction.

2. Assertion: Instantaneous rate is used to predict the rate of reaction at a particular moment of time.

Reason: Average rate is constant for the time interval for which it is calculated.

3. Assertion: All collisions of reactant molecules lead to product formation.

Reason: Only those collisions in which molecules have correct orientation and sufficient kinetic energy lead to compound formation.

4. Assertion: The enthalpy of reaction remains constant in the presence of a catalyst.

Reason: A catalyst lowers down the activation energy but the difference in energy of reactant and product remains same.

Answers:

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

VERY SHORT ANSWER TYPE QUESTIONS (1 MARK)

1. What is the effect of adding a catalyst on :

(a) Activation energy (E_a) and (b) Gibbs energy (ΔG) of a reaction.

Ans – (a) E_a decreases (b) Gibbs energy doesn't change.

2. What is the order of reaction whose rate constant has the same unit as the rate of reaction?

Ans – Zero order reaction

3. What is the overall order of reaction which has the rate expression $r = k[A]^2[B]^0$?

Ans – $2+0=2^{\text{nd}}$ order reaction

4. Unit of 1st order reaction and pseudo 1st order reaction is same. This statement is true or not.

Ans – True

5. If a 1st order reaction takes 90 minutes for 75% completion. What will be its half-life?

Ans - 45 minutes.

6. A reaction is 2nd order in A. How is the rate affected if the concentration of A is doubled?

Ans – rate of reaction becomes quadruples.

7. How is the rate constant affected when temperature is raised by 10°C?

Ans – Generally the rate constant becomes doubled.

8. Define the term instantaneous rate of reaction.

Ans – The change in conc of either reactants or products when time interval is taken as zero.

9. How the half-life of a reaction varies with change in initial concentration of a reactant?

Ans – $t_{1/2} \propto [R]^{1-n}$, where n is the order of reaction.

10. What is the unit of rate constant of a 3/2 order reaction?

Ans – $\text{mol}^{-1/2} \text{L}^{1/2} \text{s}^{-1}$

SHORT ANSWER TYPE QUESTIONS (2/3 MARK)

1. In a reaction $2A \rightarrow B$, the concentration of A decreases from 0.5 M to 0.4 M in 10 minutes. Calculate the rate during this time interval.

Ans – rate = $-\frac{1}{2} \Delta[A]/\Delta t$, = $-[0.40-0.50]/10$, = $0.01 \text{ mol l}^{-1} \text{ s}^{-1}$

2. The rate constant of a first order reaction is 60 S^{-1} . How much time it will take to reduce the concentration of the reactant to 1/10th of its initial value?

Ans – $t = 2.303/k \log [R]_0/[R]$, = $2.303/60 \log 10$, = 3.8×10^{-2} seconds.

3. A 1st order reaction has the rate constant $k = 5.5 \times 10^{-12} \text{ S}^{-1}$. Find its half-life.

Ans – $t_{1/2} = 0.693/k$, = $0.693/5.5 \times 10^{-12}$, = 1.3×10^{-11} sec.

4. Show that a 1st order reaction takes 10 times more time to complete 99.9% reaction than its half-life.

Ans – $t_{1/2} = 0.693/k$

Find $t_{99.9} = 2.303/k \log 100/0.1$, = $2.303/k \cdot 3 \log 10$, = $6.909/k$

Compare $t_{1/2}$ & $t_{99.9}$ we get $t_{99.9} = t_{1/2} \times 10$

5. The decomposition of NH_3 on Pt surface is a zero order reaction. What are the rate of formations of N_2 & H_2 if $k = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{s}^{-1}$.

Ans – rate of formation of $\text{N}_2 = 2.5 \times 10^{-4} \text{ mol L}^{-1} \text{s}^{-1}$ &

rate of formation of $\text{H}_2 = 7.5 \times 10^{-4} \text{ mol L}^{-1} \text{s}^{-1}$

6. A 1st order reaction is 40% complete in 50 minutes. Calculate the value of rate constant. At what time will the reaction be 80% completed?

Ans – find k by taking values $a = 100$ & $a-x = 60$ i.e. = 0.01028 min^{-1} and then using this value of k, find the time when the reaction will complete 80%, i.e. = 156.52 min.

SURFACE CHEMISTRY

(POINTS TO REMEMBER)

(APPROXIMATE WEIGHTAGE OF THE CHAPTER – 4/5 MARKS)

REVISED/REDUCED SYLLABUS FOR THE SESSION – 2020-21:

- Adsorption – physical & chemical
- Colloidal state- classification & properties

IMPORTANT POINTS TO REMEMBER-

1. The branch of chemistry deals with the surface phenomenon is called surface chemistry.
2. Adsorption – The accumulation of species at the surface rather than in bulk of an adsorbent is called adsorption.
3. Desorption – Removal of adsorbed particles from the surface of an adsorbent is called desorption. It is essential so that the new reactant molecules can adsorb & reaction is going on.
4. Sorption – Adsorption & absorption both take place simultaneously.
5. Types of adsorption –

- Physical adsorption – weak van-der Waal force involved, reversible, decreases with increase of temperature, enthalpy of adsorption is low.
- Chemical adsorption – strong chemical bond involved, irreversible, first increases with increase of temperature and then decreases, enthalpy of adsorption is high.
6. Adsorption isotherm – The variation in the amount of gas adsorbed by the adsorbent with pressure at constant temperature can be expressed by a graph, called adsorption isotherm.
 7. Factors affecting adsorption:
 - (a) Increase with increase in surface area.
 - (b) Low temp is favourable for physical adsorption & high temp for chemical adsorption
 - (c) Increases with increase of pressure.
 - (d) Easily liquefiable gases are readily adsorbed.
 8. Colloid – a heterogeneous system in which a substance is dispersed (1-1000nm size) in another substance called dispersion medium.
 9. Dialysis – process to remove the unwanted substances from a colloidal system using a membrane.
 10. Electro dialysis – when dialysis takes place in electrical field to remove ionic impurities.
 11. Brownian movement- Zig-zag motion of colloidal particles is called Brownian movement.
 12. Tyndall effect – scattering of beam of light by the colloidal particles is called Tyndall effect so that the path of the light becomes visible.
 13. Electrophoresis – the movement of colloidal particles when an electric field is applied because the colloidal particles have charge.
 14. Peptization – converting a freshly prepared precipitate into a colloidal solution using a suitable electrolyte called peptizing agent, is called peptization.
 15. Coagulation – process of setting colloidal particles using various methods (heating, shaking or an electrolyte is added) is called coagulation. The electrolyte used for the coagulation a colloid is called coagulating agent.
 16. Hardy Schulz rule – the coagulating or flocculating power of an ion is directly proportional to the charge on the ion. More charge – more coagulating power.
 $\text{Na}^+ < \text{Mg}^{2+} < \text{Al}^{3+}$ - for coagulating negatively charged colloids.
 $\text{Cl}^- < \text{SO}_4^{2-} < \text{PO}_4^{3-}$ for coagulating positively charged colloids.
 17. A potential develops between fixed layer and diffused layer in a colloidal system is called ZETA potential.

QUESTION BANK

MCQs

1. Which is favorable for physical adsorption?
 (a) High T & High P (b) High T & Low P (c) Low T & High P (d) All of the above
2. The term sorption stands for:
 (a) Absorption (b) Adsorption (c) Desorption (d) Both a & b
3. A small amount of FeCl_3 solution is added to a ppt of $\text{Fe}(\text{OH})_3$, a reddish brown colloidal solution is obtained. This process is called:
 (a) Dialysis (b) Peptization (c) Coagulation (d) Dispersion
4. Main reason for the stability of lyophobic sol is:
 (a) Charge on particles (b) Size of particles (c) Tyndall effect (d) All the above
5. Which of the following interface is not feasible:
 (a) Liquid-liquid (b) Solid-liquid (c) Liquid-gas (d) Gas-gas
6. Hemoglobin is the example of:
 (a) Positively charged (b) negatively charged (c) Both (d) none of these
7. Coagulation can take place by:
 (a) Adding oppositely charged colloid (b) Adding an electrolyte

- (c) By boiling (d) All of the above
8. Which electrolyte is most suitable for precipitation of As_2S_3 sol?
(a) NaCl (b) MgCl_2 (c) AlCl_3 (d) all of the above

ANSWERS – 1-(c), 2-(d), 3-(b), 4-(a), 5-(d), 6-(a), 7-(d), 8-(c)

ASSERTION- REASON TYPE QUESTIONS

READ THE STATEMENTS GIVEN AS ASSERTION & REASON BOTH AND CHOOSE THE CORRECT OPTION AS (A)/(B)/(C)/(D) AS PER THE FOLLOWING INSTRUCTIONS.

Choose (A) – if both assertion & reason are correct statements and reason is the correct explanation of assertion.

Choose (B) - if both assertion & reason are correct statements and reason is not the correct explanation of assertion.

Choose (C) – if assertion is the correct statement & reason is incorrect statement.

Choose (D) – if assertion is incorrect statement and reason is the correct statement.

1. ASSERTION – An ordinary filter paper stops the flow of colloidal particles.
REASON – Pore size of filter paper becomes more than the size of colloidal particles.
2. ASSERTION – Enthalpy of Chemisorption is high.
REASON- Chemisorption is caused by chemical bond formation.
3. ASSERTION – Gas mask is usually used for breathing in coal mines to adsorb poisonous gases.
REASON – Physisorption decreases with increase in temperature.
4. ASSERTION – Desorption is the process of removal of products from the catalyst's surface.
REASON – Desorption is not essential for further adsorption.
5. ASSERTION – Preferential adsorption is not required to get charge on colloidal particles.
REASON – Potential difference between fixed and diffused layer of oppositely charged is called zeta potential.

ANSWERS – 1-(C), 2- (A), 3- (B), 4- (C), 5- (D)

Read the passage given below and answer the following questions.

The foundation of colloidal chemistry was laid down by an English chemist, Thomas Graham in 1861. Various others such as Tyndall, Hardy and many more contributed to the advancements in the field. The colloidal phenomenon invented by Tyndall sketched the line of distinction between a true and a colloidal solution. The same phenomenon is encountered in a dark room and dense canopy of trees found in forest.

In these questions, a statement of assertion followed by a statement of reason is given.

Choose the correct answer out of the following choices.

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
- c) Assertion is correct statement but reason is wrong statement.
- d) Assertion is wrong statement but reason is correct statement.

2.1 Assertion (A): A colloid is a heterogeneous system.

Reason (R) Colloidal particles have an enormous surface.

2.2 Assertion (A): Scattering of light illuminates the path of beam in the colloidal dispersion.

Reason(R): Colloidal solutions as well as true solutions show Tyndall effect.

OR

Assertion (A): The sky looks blue to us.

Reason(R): Dust particles along with suspended in air scatter blue light.

2.3 Assertion: Colloidal solutions show colligative properties.

Reason: Colloidal particles are larger in size.

2.4 Assertion (A): Colloidal particles always carry an electric charge.

Reason(R): The nature of charge is the same on all the particles in a given colloidal particles.

VERY SHORT ANSWER TYPE QUESTIONS (1 MARK)

1. What is the charge on AgI colloidal sol formed when AgNO_3 is added to excess of KI ?

Ans- Negative charge AgI/I^-

2. Differentiate (i) O/W & (ii) W/O emulsions.

Ans- (i) oil is dispersed in water dispersion medium. (ii) water is dispersed in oil dispersion medium.

3. What are the main reasons for the stability of colloidal sol?

Ans – Charge on colloidal particles and Brownian movement

4. Write the dispersed phase and dispersion medium of milk.

Ans – both are liquids.

5. Write one similarity in between Physisorption & Chemisorption.

Ans – Both are surface phenomenon and both are exothermic process.

6. What type of colloid is formed when a gas is dispersed in a liquid?

Ans- Foam

7. What is meant by selectivity of a catalyst?

Ans – formation of various products by using a suitable catalyst.

8. What is protective colloid?

Ans- Lyophilic colloids that protect the lyophobic colloids from coagulation are called protective colloids.

9. Define electrophoresis.

Ans- movement of colloidal particles under the influence of electric field is called electrophoresis.

10. What is peptization/

Ans- converting a freshly prepared precipitate into a colloidal solution using a suitable electrolyte called peptizing agent, is called peptization.

11. Why is it necessary to remove CO gas when ammonia is obtained from Haber's process?

Ans – because CO gas acts as a poison for the catalyst.

12. Which will adsorb more amount of gas, a lump of charcoal or a powder of charcoal?

Ans – a powder because more surface area will provide more adsorption.

13. Define Brownian movement.

Ans – zig-zag motion of colloidal particles is called Brownian movement.

14. Define Tyndall effect.

Ans - scattering of beam of light by the colloidal particles is called Tyndall effect so that the path of the light becomes visible.

SHORT ANSWER TYPE QUESTIONS (2/3 MARK)

1. Write any two differences between Lyophilic & Lyophobic colloids.

Ans –1. Lyophilic sol is prepared easily whereas lyophobic sol needs effort. 2. Lyophilic sols are more stable whereas lyophobic does not.

2. Why is adsorption always exothermic?

Ans – because the force of attraction (physical or chemical) increases when particles of a dispersed phase are adsorbed on the surface of dispersion medium and we know that whenever force of attraction increases the certain amount of energy is released.

3. What is demulsification? Name two demulsification methods.

Ans – separation of particles of dispersed phase & dispersion medium in an emulsion is called demulsification. It can be done by (i) centrifugation (ii) boiling.

4. Why is it essential to wash the precipitate with water before estimating it quantitatively?

Ans – because some amount of electrolyte is mixed with the precipitate and can affect the weight of precipitate so it has to be removed by washing with water.

5. Why the ester hydrolysis is slow in the beginning of reaction and become faster after some time?

Ans – as we know that after the hydrolysis of an ester, an alcohol & a carboxylic acid are formed and the acid formed acts as a catalyst, therefore the reaction becomes faster after some time.

6. Define the following terms:

- (i) Coagulation (ii) Dialysis (iii) Emulsifying agent.

Ans - Read the important points at the beginning of the topic.

An emulsifying agent is the chemical which gives stability to an emulsion. For example soap is an emulsifier for oil/water emulsion.

7. Compare physical and chemical adsorption.

Ans – Read the important points given at the beginning.

8. Give reason:

- (i) Alum is applied in case of a cut leading to bleeding.
(ii) Leather gets hardened after tanning.
(iii) True solutions do not show Tyndall effect.

Ans – (i) negative ions of alum coagulates the positively charged blood.

(ii) Due to coagulation.

(iii) Size of true solution particle is less than 1 nm so not able to scatter the light.

9. What happens when –

- (i) A freshly prepared precipitate of ferric hydroxide is shaken with small amount of ferric chloride.
(ii) Persistent dialysis of a colloidal solution is carried out.

Ans – (i) Peptization takes place.

(iii) Coagulation takes place.

10. What are Multimolecular, Macromolecular and Associated colloids?

Ans – Multimolecular colloids are the aggregation of neutral particles of size in the range of colloids. Example- Sulphur sol, Gold sol

Macromolecular colloids are the colloid in which the size of individual particle is in the range of colloids. Example – protein sol, starch sol

Associated colloids are the aggregation of charged particles of size in the range of colloids. Example – micelle

UNIT- VII (P-BLOCK Elements)

SYLLABUS

REVISED SYLLABUS:

Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen preparation properties and uses; compounds of Nitrogen: preparation and properties of Ammonia and Nitric Acid.

Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: preparation, properties and uses, classification of Oxides, Ozone, Sulphur -allotropic forms; compounds of Sulphur: preparation properties and uses of Sulphur-dioxide, Sulphuric Acid: properties and uses; Oxoacids of Sulphur (Structures only).

Group 17 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of Chlorine and Hydrochloric acid, interhalogen compounds, Oxoacids of halogens (structures only). **Group 18 Elements:** General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

DELETED PORTION: Preparation and properties of Phosphine, Sulphuric Acid: industrial process of manufacture, Oxides of Nitrogen (Structure only); Phosphorus – allotropic forms, compounds of Phosphorus: Preparation and properties of Halides
And Oxo acids (elementary idea only).

SUMMARY

Group 15 Elements :

In p-block elements, the last electron enters in the outer most p-orbital. There are six groups of p-block elements in the Periodic Table, numbering from 13 to 18. Their valence shell electronic configuration is ns^2np^{1-6} (except for He).

Electronic configuration Their valence shell electronic configuration is ns^2np^3 .

Element	Atomic number	Electronic configuration
Nitrogen (N)	7	[He] $2s^2, 2p^3$
Phosphorus (P)	15	[Ne] $3s^2, 3p^3$
Arsenic (As)	33	[Ar] $3d^{10}, 4s^2, 4p^3$
Antimony (Sb)	51	[Kr] $4d^{10}, 5s^2, 5p^3$
Bismuth (Bi)	83	[Xe] $4f^{14}, 5d^{10}, 6s^2, 6p^3$

Physical Properties:-

- Dinitrogen is a diatomic gas while all others are solids.
- N & P are non-metals. As & Sb metalloids & Bi is a metal.
- This is due to decrease in ionization enthalpy & increase in atomic size.
- Electro negativity decreases down the group.

Chemical properties:-

- Common oxidation states: -3, +3 & +5.
- Due to inert pair effect, the stability of +5 state decreases down the group & stability of +3 state increases.
- In the case of Nitrogen all Oxidation states from +1 to +4 tend to disproportionate in acid solution, E.g.:- $3HNO_2 \rightarrow HNO_3 + H_2O + 2NO$
- A disproportionation reaction is the reaction in which same chemical species gets oxidised as well as reduced.

Anomalous behaviour of Nitrogen :-

- due to its small size, high electronegativity, high
- ionization enthalpy and absence of d-orbital.
- N has unique ability to form $p\pi-p\pi$ multiple bonds whereas the heavier members of this group do not form $p\pi-p\pi$ because their atomic orbitals are so large & diffuse that they cannot have effective overlapping.
- Nitrogen exists as diatomic molecule with triple bond between the two atoms whereas
- other elements form single bonds in elemental state.
- N cannot form $d\pi-p\pi$ due to the non availability of d-orbitals whereas other elements can.

Trends In Properties:-

- Thermal Stability(decreasing order) – $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
- Bond(E-H) Dissociation Enthalpy(decreasing order)- $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
- Reducing character(decreasing order) – $BiH_3 > SbH_3 > AsH_3 > PH_3 > NH_3$
- Basic character(decreasing order)- $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$
- Acidic character(decreasing order)- $N_2O_3 > P_2O_3 > As_2O_3 > Sb_2O_3 > Bi_2O_3$
- Boiling points(decreasing order)- $BiH_3 > SbH_3 > NH_3 > AsH_3 > PH_3$
- Acidic Character(decreasing order)- $N_2O_5 > N_2O_4 > N_2O_3$

Group 16 Elements : These elements are known as chalcogens, i.e. ore forming elements.

Electronic configuration their valence shell electronic configuration is ns^2np^4

Element	Atomic number	Electronic configuration
Oxygen (O)	8	[He] $2s^2 2p^4$
Sulphur (S)	16	[Ne] $3s^2 3p^4$
Selenium (Se)	34	[Ar] $3d^{10}, 4s^2 4p^4$
Tellurium (Te)	52	[Kr] $4d^{10}, 5s^2 5p^4$
Polonium (Po)	84	[Xe] $4f^{14}, 5d^{10}, 6s^2 6p^4$

ATOMIC & PHYSICAL PROPERTIES

Ionisation enthalpy decreases from oxygen to polonium.

Oxygen atom has less negative electron gain enthalpy than Sulphur because of the small size and interelectronic repulsion. However, from S onwards the value again becomes less negative up to polonium.

Electro negativity gradually decreases from oxygen to polonium, metallic character increases from oxygen to polonium. So, Oxygen & S are non-metals, selenium and tellurium are metalloids.

CHEMICAL PROPERTIES

Common oxidation state: **-2, +2, +4 & +6.**

Due to inert pair effect, the stability of +6 decreases down the group and stability of +4 increases.

Oxygen exhibits +1 state in O_2F_2 , +2 in OF_2 .

Anomalous behaviour of oxygen: due to its small size, high electronegativity and absence of d-orbitals.

TREND IN PROPERTIES

Acidic character- **$H_2O < H_2S < H_2Se < H_2Te$**

Thermal stability- **$H_2O > H_2S > H_2Se > H_2Te$**

Reducing character- **$H_2S < H_2Se < H_2Te$**

Boiling point- **$H_2S < H_2Se < H_2Te < H_2O$**

Reducing property of dioxides- **$SO_2 > SeO_2 > TeO_2$**

Stability of halides- **$F > Cl > Br > I$**

Group 17 Elements :

The 17 group of Periodic Table are collectively known as halogens (salt forming elements).

Electronic configuration their valence shell electronic configuration is **$ns^2 np^5$**

Element	Atomic number	Electronic configuration
Fluorine (F)	9	[He] $2s^2 2p^5$
Chlorine (Cl)	17	[Ne] $3s^2 3p^5$
Bromine (Br)	35	[Ar] $3d^{10}, 4s^2 4p^5$
Iodine (I)	53	[Kr] $4d^{10}, 5s^2 5p^5$
Astatine (At)	85	[Xe] $4f^{14}, 5d^{10}, 6s^2 6p^5$

OXIDATION STATES: -

+1, +3, +5, +7 oxidation states (Fluorine exhibits only -1 oxidation state)

Fluorine forms two oxides OF_2 and O_2F_2 . These are essentially oxygen fluorides because of the higher electro negativity of fluorine than oxygen.

Anomalous behavior of fluorine- due to its small size, highest electro negativity, low F-F bond dissociation enthalpy and absence of d-orbitals.

TRENDS IN PROPERTIES

Bond dissociation Enthalpy (Increasing order): $\text{I}_2 < \text{F}_2 < \text{Br}_2 < \text{Cl}_2$

Oxidizing property – $\text{F}_2 > \text{Cl}_2 > \text{Br}_2 > \text{I}_2$

Acidic strength- $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$

Stability & bond dissociation enthalpy- $\text{HF} > \text{HCl} > \text{HBr} > \text{HI}$

Stability of oxides of halogens- $\text{I} > \text{Cl} > \text{Br}$

Ionic character of halides – $\text{MF} > \text{MCl} > \text{MBr} > \text{MI}$

Group 18 Elements :

The 18 group of the Periodic Table consists of colourless, odorless gases at room temperature, isolated by WILLIAM RAMSAY IN 1898 FROM AIR.

Electronic configuration their valence shell electronic configuration is ns^2np^5 except He.

Element	Atomic number	Electronic configuration
Helium (He)	2	$1s^2$
Neon (Ne)	10	$[\text{He}] 2s^2 2p^6$
Argon (Ar)	18	$[\text{Ne}] 3s^2 3p^6$
Krypton (Kr)	36	$[\text{Ar}] 3d^{10}, 4s^2 4p^6$
Xenon (Xe)	54	$[\text{Kr}] 4d^{10}, 5s^2 5p^6$
Radon (Rn)	86	$[\text{Xe}] 4f^{14}, 5d^{10}, 6s^2 6p^6$

Atomic radii large as compared to other elements in the period since it corresponds to Vander Waals' radii.

Inert – due to complete octet of outermost shell, very high ionization enthalpy & electron gain enthalpies are almost zero.

The first noble compound prepared by Neil Bartlett was XePtF_6

$\text{O}_2^+\text{PtF}_6^-$ led to the discovery of XePtF_6 since first ionization enthalpy of molecular oxygen (1175kJmol^{-1}) was almost identical with that of Xenon (1170kJmol^{-1}).

Multiple Choice Questions

1. In solid state PCl_5 is a

- (a) covalent solid
- (b) octahedral structure
- (c) ionic solid with $[\text{PCl}_6]^+$ octahedral and $[\text{PCl}_4]^-$ tetrahedral
- (d) ionic solid with $[\text{PCl}_4]^+$ tetrahedral and $[\text{PCl}_6]^-$ octahedral

Ans-(d)

2. Strong reducing behavior of H_3PO_2 is due to

- (a) low oxidation state of phosphorus
- (b) presence of two -OH groups and one P – H bond
- (c) presence of one -OH group and two P – H bonds

(d) high electron gain enthalpy of phosphorus

Ans-(c)

3. Maximum covalency of nitrogen is

(a) 3 (b) 5 (c) 4 (d) 6

Ans-(c)

4. A brown ring is formed in the ring test for NO_3 ion. It is due to the formation of

(a) $[\text{Fe}(\text{H}_2\text{O})_5(\text{NO})]^{2+}$

(b) $[\text{Fe}(\text{H}_2\text{O})_4(\text{NO}_2)]^{2+}$

(c) $\text{FeSO}_4 \cdot \text{NO}_2$

(d) $\text{FeSO}_4 \cdot \text{NO}_3$

Ans-(a)

5. Which of the following is isoelectronic pair?

(a) ICl_2 , ClO_2 (b) BrO_2^- , BrF_2^+ (c) ClO_2 , BrF (d) CN^- , O_3

Ans (b)

ASSERTION REASON TYPE QUESTIONS

In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Both 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.
- (e) Both assertion and reason are wrong statements.

1. Assertion: HI cannot be prepared by the reaction of KI with concentrated H_2SO_4

Reason: HI has lowest H–X bond strength among halogen acids.

Ans (b)

2. Assertion: Both rhombic and monoclinic Sulphur exist as S_8 but oxygen exists as O_2 .

Reason: Oxygen forms $p\pi - p\pi$ multiple bonds due to small size and small bond length but $p\pi - p\pi$ bonding is not possible in Sulphur.

Ans (a)

3. Assertion: NaCl reacts with concentrated H_2SO_4 to give colourless fumes with pungent smell. But on adding MnO_2 the fumes become greenish yellow.

Reason: MnO_2 oxidizes HCl to chlorine gas which is greenish yellow

Ans (a)

4. Assertion: Reaction of SO_2 and H_2S in the presence of Fe_2O_3 catalyst gives elemental Sulphur.

Reason: SO_2 is a reducing agent.

Ans (c)

5. Assertion: The heavier p-block elements do not form strong π bonds.

Reason: The heavier elements of p-block form $d\pi - d\pi$ bonds.

Ans (a)

6. Assertion : The O-O bond length in ozone is identical with that in molecular oxygen

Reason : The ozone molecule is a resonance hybrid of two canonical structures.

Ans (d)

1 MARK QUESTIONS

1. The stability of +5 oxidation state decreases down the Group-15. Why?

Ans. The stability of +5 oxidation state decreases due to inert pair effect.

2. Why are pentahalides of Group-15 elements, more covalent than their trihalides?

Ans. In +5 oxidation state, elements have more polarizing power than in +3 oxidation state, so the covalent character of bond is more in pentahalides.

3. The stability of -3 oxidation state, decreases down the group for group 15.

Ans. It is due to increase in size and metallic character or decrease in electro negativity down the group.

4. Why is BiH_3 the strongest reducing agent amongst all the Hydrides of Group-15 elements.

Ans. Down the group, the size of element increases and so the length of E---H bond decreases.

Thus Bi-----Hbond is weakest and easily evolves H_2 gas, which is a reducing agent.

5. Why is Dinitrogen inert at room temperature?

Ans. Due to presence of Triple bond between the Nitrogen atoms, its bond dissociation enthalpy is very high, making it inert at room temperature.

6. Why does NO_2 dimerise?

Ans. NO_2 contains odd number of valence electrons. It is converted to stable N_2O_4 molecule on dimerization.

7. H_2S is less acidic than H_2Te . Why?

Ans. Due to decrease in E---H bond dissociation enthalpy, down the group, acidic character increases.

8. Why does O_3 act as a powerful oxidizing agent?

Ans. It decomposes to give O_2 and nascent Oxygen, so it is a strong oxidizing agent.

9. Why is O_2 paramagnetic in nature?

Ans. It is because it has 2 unpaired electrons in its antibonding orbital.

10. Write down a reaction of Ozone layer depletion.

Ans. $\text{NO} + \text{O}_3 \longrightarrow \text{NO}_2 + \text{O}_2$

11. Which form of Sulphur shows paramagnetic behavior?

Ans. S_2 , as it has 2 unpaired electrons in its antibonding orbital.

12. Why SF_4 can be hydrolyzed but SF_6 cannot?

Ans. It is because SF_6 has a stable octahedral structure and steric effect due to which it cannot be hydrolyzed.

13. Name 2 poisonous gases that can be prepared by Chlorine.

Ans. Mustard gas, Phosgene.

14. Give reason for the bleaching action of chlorine.

Ans. In aqueous solution Cl_2 liberates Nascent Oxygen. This Nascent Oxygen brings about oxygen to bleach the colored substances.

15. Why I---Cl is more reactive than I_2 .

Ans. I---Cl bond is weaker than I-----I bond. Consequently, I-----Cl bond breaks easily. Hence it is more reactive.

16. Why are the elements of Group-18, known as noble gases?

Ans. As they have stable, fully filled configuration, they react with very few elements so, they are known as noble gases.

17. Nobel gases have very low boiling point. Why?

Ans. Nobel gases being monoatomic, they do not have any intermolecular forces of attraction, except weak

Dispersion/ London forces. So, they liquefy as well as boil at a very low temperature.

18. Why Helium is used in scuba diver's apparatus?

Ans. It is because it is less soluble in blood/ has very low solubility in blood.

19. Why is it difficult to study the chemistry of Radon?

Ans. It is because, Radon is Radioactive in nature.

20. Why are Halogens colored?

Ans. It is because Halogens absorb radiation in visible region which results in excitation of outer shell Electrons to higher energy level so, they display different colors.

2 Marks questions-

1. a. Does the hydrolysis of XeF_6 lead to a Redox reaction?

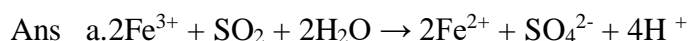
b. Bond angle in PH_4^+ is higher than that in PH_3 . Why?

Ans. a. No, the products of hydrolysis are XeOF_4 and XeO_2F_2 where the oxidation states of all the elements remain the same as it was in the reacting state.

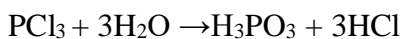
b. Both are sp^3 hybridized. In PH_4^+ all the four orbitals are bonded whereas in PH_3 there is a lone pair of electrons on P, which is responsible for lone pair-bond pair repulsion in PH_3 reducing the bond angle to less than $109^\circ 28'$.

2. a. What happens when Sulphur dioxide is passed through an aqueous solution of Fe (III) salt?

b. Why does PCl_3 fume in moisture?



b. PCl_3 hydrolyses in the presence of moisture giving fumes of HCl.

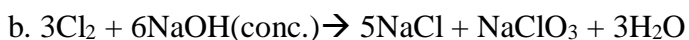
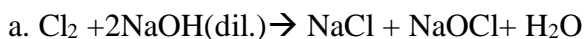


3. What happens when-

a. Chlorine reacts with cold and dilute NaOH.

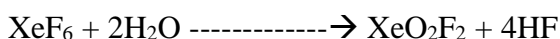
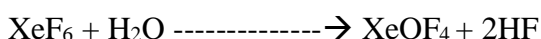
b. Chlorine reacts with hot and concentrated NaOH.

Ans.



4. Give the equations for partial hydrolysis of XeF_6 .

Ans.



5. How Ozone is estimated?

Ans. When Ozone reacts with an excess of potassium iodide solution, with a borate buffer (pH=9.2), Iodine is liberated which can be titrated against a standard solution of sodium thiosulphate. This is used for estimation of Ozone.

6. Compare the bleaching action of SO_2 and Cl_2 .

Ans. SO_2 does temporary bleaching, while Cl_2 does permanent bleaching.

SO₂ bleaches via reduction and Cl₂ bleaches via oxidation.

7. What happens when

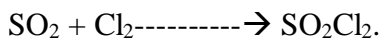
(a) Sulphuric acid reacts with sugar?

(b) SO₂ reacts with Chlorine.

Ans. (a) It forms Carbon black (dehydration of sugar).



(b) It forms Sulphuryl Chloride.



8. a) Although electron gain enthalpy of fluorine is less negative as compared to chlorine, fluorine is a stronger oxidizing agent than chlorine. Why?

b) Halogens have maximum negative electron gain enthalpy in the respective periods of the periodic table. Why?

Ans. a) It is due to

(i) low enthalpy of dissociation of F-F bond.

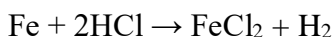
(ii) high hydration enthalpy of F

b) Halogens have the smallest size in their respective periods and therefore high effective nuclear charge. As a consequence, they readily accept one electron to acquire noble gas electronic configuration.

9. a) When HCl reacts with finely powdered iron, it forms ferrous chloride and not ferric chloride. Why?

b) Why is $K_{a2} \ll K_{a1}$ for H₂SO₄ in water?

Ans. a) Its reaction with iron produces H₂.



Liberation of hydrogen prevents the formation of ferric chloride.

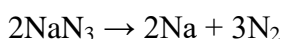
b) H₂SO₄ is a very strong acid in water largely because of its first ionization to H₃O⁺ and HSO₄⁻.

The ionization of HSO₄⁻ to H₃O⁺ and SO₄²⁻ is very small. That is why $K_{a2} \ll K_{a1}$.

10. a) Write the reaction of thermal decomposition of sodium azide.

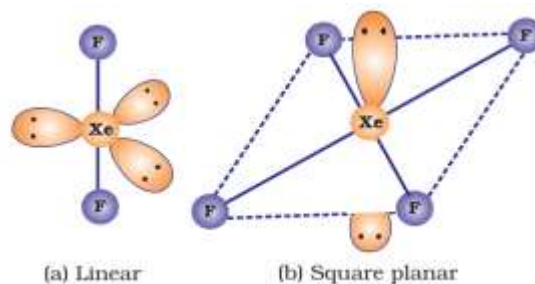
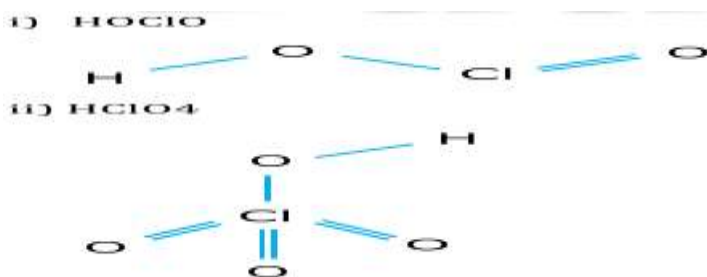
b) Mention the conditions required to maximize the yield of ammonia.

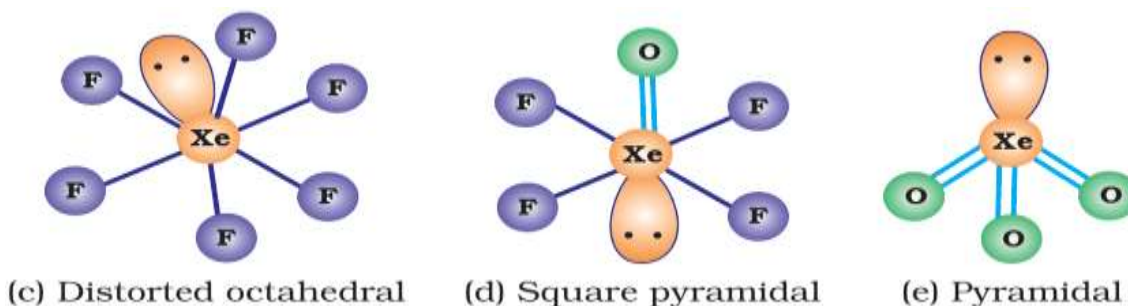
Ans. a) Thermal decomposition of sodium azide gives dinitrogen gas.



b) Pressure- 200 atm, Temperature – 700 K, Catalyst Fe in presence of Al₂O₃

IMPORTANT STRUCTURES



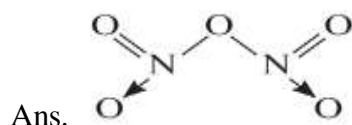


CASE-BASED/PASSAGE-BASED INTEGRATED

Read the following passage and answer the questions that follow:

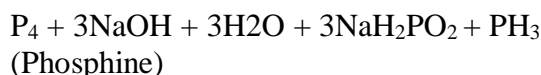
Group 15 elements consist of N, P, As, Sb, Bi with general electronic configurations $2np^3$ and oxidation states +3 and +5. Nitrogen differs from rest of the elements. Phosphorus show allotropy and is more reactive than Nitrogen. Hydrides of group 15 elements show variation in bond angle, boiling point, basic character, stability and reducing character. Oxides of group 15 elements show decrease in acidic character and more increase in basic character. Nitrogen forms large number of oxides. Halides of group 15 elements are mostly covalent. Nitrogen and phosphorus form Oxoacids along with As. Nitric acid is manufactured by Ostwald process and useful for nitration and as oxidizing agent. NH_3 is used in manufacture of fertilizers. HNO_3 reacts with metals and non-metals to give different products under different conditions. Phosphorus reacts with oxygen, halogens, nitric acid, NaOH to form different products.

a) Draw the structure of oxides of nitrogen in which oxidation state of nitrogen is +5.



b) What happens when white phosphorus reacts with NaOH in inert atmosphere? Write the reaction involved.

Ans. Sodium hypophosphite and poisonous gasphosphine is formed.



c) Which one out of PCl_4^+ and PCl_4^- is not likely to exist, why?

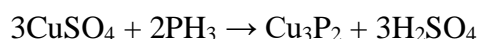
Ans. PCl_4^- is not likely to exist because when phosphorous accepts 3 electrons from 3 chlorine atoms it completes its **octet**, so it is **unable to** take one more electron from one more Cl^- so the formation of PCl_4^- is difficult. Hence, PCl_4^+ compound is more **likely to exist**.

d) Write the formula of the compound of phosphorus which is obtained when $\text{HNO}_3(\text{conc.})$ oxidizes phosphorus.

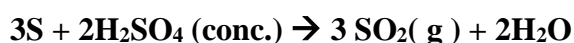
Ans. H_3PO_4 (Phosphoric acid)

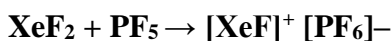
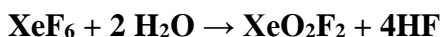
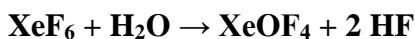
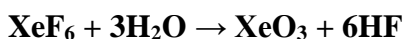
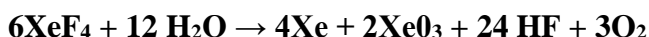
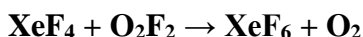
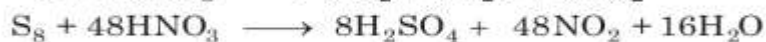
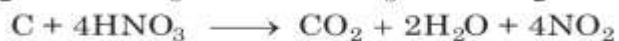
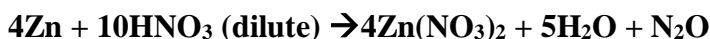
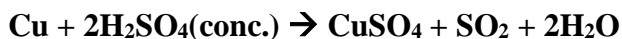
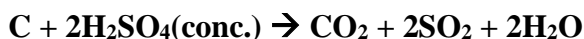
e) What happen when copper sulphate reacts with phosphine gas? Give chemical equation.

Ans. Copper (II) phosphide and sulphuric acid are formed.



IMPORTANT REACTIONS





UNIT-VIII d-BLOCK ELEMENTS

REVISED SYLLABUS-

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first-row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation.

Lanthanoids - Electronic configuration, oxidation states and lanthanoid contraction and its consequences.

DELETED PORTION:

Chemical reactivity of lanthanoids, Actinoids –Electronic configuration, oxidation states and comparison with lanthanoids. Preparation and properties of KMnO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$

SUMMARY

The d-block of the periodic table contains the elements of the groups 3-12 in which the d-orbitals are progressively filled. There are mainly three series of the elements, 3d-series (Sc to Zn) 4d-series (Y to Cd) and 5d-series (La to Hg omitting Ce to Lu). The fourth 6d-series which begins with Ac is still incomplete. The two series of the inner-transition metals, (4f and 5f) are known as lanthanoids and actinoids respectively.

CASE-BASED/PASSAGE-BASED INTEGRATED

Read the given passage and answer the questions that follow:

(I) The d-block of the periodic table contains the elements of the groups 3 to 10 and are known as transition elements. In general, the electronic configuration of these elements is $(n-1) d^{1-10} ns^{1-2}$.

The d-orbitals of the penultimate energy level in their atoms receive electrons giving rise to the three rows of the transition metals i.e., 3d, 4d and 5d series. However, Zn, Cd and Hg are not regarded as transition elements. Transition elements exhibit certain characteristic properties like variable oxidation states, complex formation, formation of coloured ions, alloys, catalytic activity etc. Transition metals are hard (except Zn, Cd and Hg) and have a high melting point.

(a) Why are Zn, Cd and Hg non-transition elements?

Ans. It is because neither they nor their ions have incompletely filled d-orbitals.

(b) Which transition metal of 3d series does not show variable oxidation state?

Ans. Scandium (Sc) and Zinc (Zn).

(c) Why do transition metals and their compounds show catalytic activity?

Ans. It is because they show variable oxidation state, can form intermediate complexes and have large surface area for adsorption of gases.

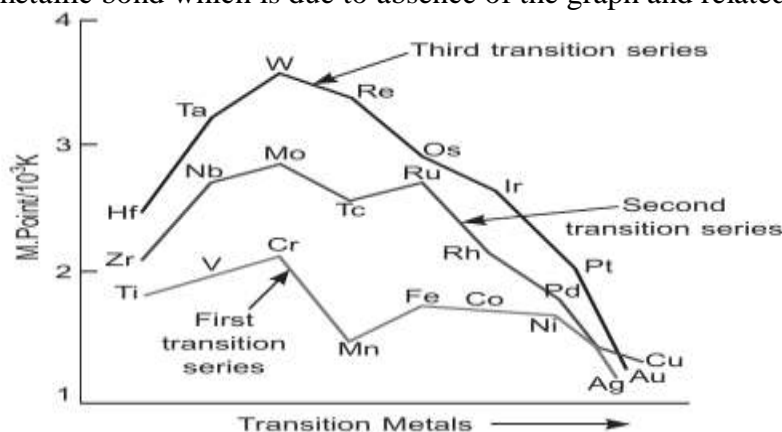
(d) Why are melting points of transition metals high?

Ans. It is due to strong inter atomic forces of attraction due to presence of unpaired electrons.

(e) Why is Cu^{2+} ion coloured while Zn^{2+} ion is colourless?

Ans. It is because Cu^{2+} has one unpaired electron and undergoes d-d transition by absorbing light from visible region and radiate blue colour, whereas Zn^{2+} is colourless due to absence of unpaired

(II) Observe the graph of transition metal and their melting points and answer the questions based on weak metallic bond which is due to absence of the graph and related concepts.



(a) Why does W (tungsten) has highest melting colourless in aqueous solution?

Ans. It is due to presence of unpaired electrons and there is more frequent metal-metal bonding in 5d series than 3d and 4d series.

(b) Which element in 3d series has lowest enthalpy of atomization and why?

Ans. Zinc has lowest enthalpy of atomization due to weak metallic bond which is due to absence of unpaired electrons.

(c) Why is mercury liquid?

Ans. It is due to larger size, absence of unpaired electron and weak inter atomic attraction and weaker metallic bond.

(d) Why are transition metals less electro positive?

Ans. It is due to smaller atomic size and higher ionization enthalpies.

(e) How does density vary from left to right in 3d series and why?

Ans. Density goes on increasing from Sc to Cu because atomic mass increases more than atomic volume.

(III) Observe the table given below belonging to 3d series, their first, second, third ionization enthalpy and $E^\circ M^{2+}/M$ and $E^\circ M^{3+}/M^{2+}$ and answer the questions that follow based on table and related concepts.

Element	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
I st ionisation enthalpy	631	656	650	652	717	762	758	736	745	905 kJ mol ⁻¹
II nd ionisation enthalpy	1245	1320	1376	1635	1513	1564	1648	1757	1962	1736
III rd ionisation enthalpy	2451	2721	2874	2995	3258	2964	3238	3401	3561	3839
$E^\circ_{M^{2+}/M}$ in volts	–	–1.63V	–1.18V	–0.91V	–1.18V	–0.44V	–0.28V	–0.25V	+0.34V	–0.76V
$E^\circ_{M^{3+}/M^{2+}}$ in volts	–	–0.37V	–0.26V	–0.41V	+1.57V	+0.77V	+1.97V	–	–	–

(a) Why does zinc have highest first ionization enthalpy?

Ans. It is because Zn has completely filled '4s' orbital which is stable.

(b) Why is 3rd ionization enthalpy of Mn high?

Ans. It is because after losing 2 electrons, it becomes 3d⁵ which is more stable.

(c) Why is Cr³⁺ more stable than Cr²⁺?

Ans. It is because Cr³⁺(t_{2g}³) half-filled orbitals are more stable than Cr²⁺(3d⁴).

(d) Why is $E^\circ Mn^{2+}/Mn = -1.18V$?

Ans. It is due to low enthalpy of atomization, sublimation enthalpy, ionization enthalpy.

(e) Why is $E^\circ Cu^{2+}/Cu = +0.34V$?

Ans. It is due to high ionization enthalpy and low hydration enthalpy

(f) Why is Fe³⁺ more stable than Fe²⁺?

Ans. Fe³⁺ (3d⁵) is half filled which is more stable than Fe²⁺ (3d⁶).

(g) Why is Mn³⁺ good oxidizing agent and $E^\circ Mn^{3+}/Mn^{2+} = 1.57V$?

Ans It is because it can gain one electron easily to form Mn²⁺(3d⁵) which is more stable that is why

$E^\circ Mn^{3+}/Mn^{2+} = 1.57V$

Multiple Choice Questions

1. Which of the following statement about transition element is not correct?

- (a) They show variable oxidation states.
- (b) They exhibit diamagnetic and paramagnetic properties.
- (c) All ions are coloured
- (d) They exhibit catalytic property.

Ans – (c)

2. The magnetic moment is associated with its spin angular momentum and orbital angular momentum. Spin only magnetic moment value of Cr³⁺ ion is

- (a) 2.87 B.M. (b) 3.87 B.M. (c) 3.47 B.M (d) 3.57 B.M

Ans – (b)

3. Manganese exhibits maximum oxidation state in:

- (a) K₂MnO₄ (b) KMnO₄ (c) MnO₂ (d) Mn₃O₄

Ans – (b)

4. Electronic configuration of a transition element X in +3 oxidation state is [Ar]3d⁵. What is its atomic number?

- (a) 25 (ii) 26 (iii) 27 (iv) 24

Ans – (b)

5. Metallic radii of some transition elements are given below. Which of these elements will have highest density?

Element	Fe	Co	Ni	Cu
Metallic radii/pm	126	125	125	128

(a) Fe (b) Ni (c) Co (d) Cu

Ans – (d)

ASSERTION -REASONING QUESTIONS

(A) Both 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: Manganese has an exceptionally low melting point in 3d series.

Reason: Manganese has weak metallic bonds due to electronic repulsion. Ans (C)

2. Assertion: Scandium does not show variable oxidation state.

Reason: Scandium has only one electron in the 3d orbital. Ans (B)

3. Assertion: Fe^{2+} readily oxidizes to Fe^{3+} in solution.

Reason: Fe^{3+} has a stable d^5 configuration. Ans (A)

4. Assertion: Zirconium and Hafnium have similar properties.

Reason: Zirconium and Hafnium lie in the same group of the periodic table. Ans (B)

5. Assertion: Highest oxidation states of d-block metals are usually seen in oxides and oxo anions.

Reason: Oxygen is capable of forming $p\pi - d\pi$ bonds with transition metals. Ans (A)

6. Assertion: Zn, Cd and Hg cannot be regarded as transition elements.

Reason: These elements do not belong to d-block of the periodic table. Ans (C)

7. Assertion: Misch metal is a pyrophoric alloy.

Reason: Misch metal is prepared from lanthanoids. Ans (B)

8. Assertion: Transition metals show very low degree of para magnetism.

Reason: Transition metal atoms have large number of unpaired electrons. Ans (D)

9. Assertion: Potassium permanganate is a good oxidizing agent in acidic medium.

Reason: Permanganate readily reduces to manganese dioxide in acidic medium. Ans (C)

10. Assertion: Transition metals have high enthalpy of atomization.

Reason: d-block elements have strong metallic bonds. Ans (A)

ONE MARK QUESTION

1. Zinc, cadmium and mercury are not considered as transition metals. Why?

Ans. Zinc, cadmium and mercury have fully filled d^{10} configuration. Therefore, they are not considered as transition metal.

2. Write the general configuration of d- block elements.

Ans. General electronic configuration of d- block elements is $(n-1)d^{1-10} ns^{1-2}$.

3. Transition metals generally form coloured ions. Why?

Ans. Due to presence of unpaired electron, crystal field splitting & d-d transition.

4. Which of the following will be colored?

Sc^{3+} , V^{2+} , Mn^{2+} , Cu^{+} , Ni^{2+} .

Ans Coloured ions will be those which have unpaired electrons

Sc^{3+}	Colourless
------------------	------------

5.

V^{2+}	Coloured
-----------------	----------

Give an explanation for the catalytic properties shown by transition metals.

Mn^{2+}	Coloured
------------------	----------

Ans. Because of multiple oxidation state / ability to form complex / having large surface

Cu^{+}	Colourless
-----------------	------------

area

Ni^{2+}	Coloured
------------------	----------

6.

Why transition metals form large number of

interstitial compounds?

Ans. Because small non-metallic atoms (H, B, C, N etc) are able to fit in the interstitial sites of transition metal lattice to form interstitial compounds.

7. Why do transition elements show variable oxidation states?

Ans – Due to participation of (n-1) d and ns electron in bond formation.

8. Name a transition element which does not exhibit variable oxidation states.

Ans- Scandium.

9. Which of the 3d series of the transition metals exhibits the largest number of oxidation states and Why?

Ans – In 3d series Mn shows the highest oxidation state of +7 as it has maximum no. of unpaired e⁻.

10. Why is the highest oxidation state of a metal exhibited in its oxide or fluoride only?

Ans – Oxygen and fluorine have small size and high electro negativity. Hence, they can oxidize the metal to the highest oxidation state.

11. Cu^{+} is not stable in aqueous solution. Why?

Ans- Many Cu(I) compounds are unstable in aqueous solution and undergo disproportionate.



The stability of Cu^{2+} rather than Cu^{+} is due to more –ve hydration enthalpy of Cu^{2+} than Cu^{+} which is much more and compensate for the II ionization enthalpy

12. Which is the stronger reducing agent Cr^{2+} or Fe^{2+} and why?

Ans Cr^{2+} is the stronger reducing agent because in case of Cr^{2+} to Cr^{3+} change in configuration is from d⁴ to d³ and in Fe^{2+} to Fe^{3+} the change is from d⁶ to d⁵. In medium like water d³ is more stable as compared to d⁵ due to half-filled t_{2g} configuration.

13. Co^{2+} is stable in aqueous solution but in the presence of complexing agent, it is easily oxidized. Why?

Ans-In the presence of complexing agent, oxidation state of Co changes from +2 to +3 due to CFSE which is more and compensate the $\Delta_i H_3$.

14. E^0 for $\text{Mn}^{3+}/\text{Mn}^{2+}$ is more positive than for $\text{Fe}^{3+}/\text{Fe}^{2+}$. Why?

Ans. Mn^{3+} has the configuration $3d^4$ while that of Mn^{2+} is $3d^5$. So Mn^{3+} easily undergo reduction to Mn^{2+} having stable $3d^5$ configuration resulting in higher value of standard reduction potential.

Fe^{3+} is more stable than Fe^{2+} because of having $3d^5$ configuration and reduction to Fe^{2+} will not be easy resulting in the decreased value of E^0 .

15. The highest oxidation state is exhibited in oxo-anions of a transition metal and not in metal fluorides. Suggest a reason.

Ans. The ability of oxygen to stabilize these high oxidation states exceeds that of fluorine due to ability of oxygen to form multiple bonds to metals. Thus the highest Mn fluoride is MnF_4 whereas the highest oxide is Mn_2O_7 .

16. Ce^{4+} is a good oxidizing agent and Eu^{2+} is a good reducing agent. Why?

Ans. The most stable oxidation state in lanthanoids is +3 and all lanthanoids try to attain it. Thus, Ce^{4+} will easily accept an electron i.e. get reduced thus behaving like a good oxidizing agent. The opposite applies to Eu^{2+} which loses an electron to attain +3 oxidation state behaving as a good reducing agent.

TWO MARKS QUESTION

1. Explain 'Misch metal' and write its use.

Ans. It is an alloy of 95% Lanthanoid and 5% iron and traces of S, C, Ca and Al. Used in lighter flint, bullet tips etc.

2. What is the General electronic configuration and common oxidation state of Lanthanoids?

Ans. General electronic configuration = $4f^{1-14} 5d^{0-1} 6s^2$ and common oxidation state +3

THREE MARKS QUESTION

1. Explain Lanthanoid contraction, its cause & consequence

Ans. Lanthanoid contraction – The cumulative effect of the regular decrease in size or radii of Lanthanoid with increase in atomic number is called Lanthanoid contraction.

Causes – The shape of f orbitals is diffused. They have poor shielding effect due to which the effective nuclear charge increases with increase in atomic number. This causes a decrease in atomic radii

Consequences – Due to Lanthanoid contraction-

1. Radii of the members of the third transition series is similar to those of second transition series.
2. It becomes difficult to separate Lanthanoids.

Five marks question

Give reasons-

- (i) Transition metals have high melting points.
- (ii) Second and third transition series have similar radii.
- (iii) Second ionization is difficult from Cu and Cr whereas it is easy for Zn.
- (iv) Most of the transition elements are paramagnetic.
- (v) The d^1 configuration is very unstable in ions. Why?

Ans (i) In transition metals besides ns electrons, (n-1) d electrons can also participate in bonding making

stronger metallic bonds. This increases their melting points.

(ii) Due to Lanthanoid contraction, there is a decrease in size of 5d series. This makes their sizes same as sizes of elements of 4d series.

(iii) In Cr the electronic configuration is $3d^5 4s^1$ and for Cu, it is $3d^{10} 4s^1$. In these after first ionization, which removes the electron from 4s, second ionization requires disturbance in half filled or fully filled configuration which requires high enthalpy whereas the configuration of Zn is $3d^{10} 4s^2$. Here after second ionization, the configuration of Zn is completely filled. Therefore, second ionization is easier for Zn but difficult for Cr and Cu.

(iv) Para magnetism in transition elements arises due to presence of one or more unpaired electrons in atomic orbitals.

(v) The ions with d1 configuration have the tendency to lose the only electron present in d-subshell to acquire stable d^0 configuration.

UNIT IX COORDINATION COMPOUNDS

REVISED SYLLABUS- Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT.

DELETED PORTION: Structure and stereoisomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological system).

SUMMARY :

Coordination compounds: are those addition molecular compounds which retain their identity in solid state as well as in dissolved state. In these compounds. the central metal atom or ion is linked by ions or molecules with coordinate bonds. $K_4[Fe(CN)_6]$

Double Salts: These are the addition molecular compounds which are stable in solid state but dissociate into constituent ions in the solution. e.g.,

Mohr's salt: $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ get dissociated into Fe^{2+} , NH_4^+ and SO_4^{2-} ions.

IMPORTANT TERMS:

1. Complex ion or Coordination Entity : It is an electrically charged species in which central metal atom or ion is surrounded by number of ions or neutral molecules.

(i) Cationic complex entity It is the complex ion which carries positive charge. e.g., $[Pt(NH_3)_4]^{2+}$

(ii) Anionic complex entity It is the complex ion which carries negative charge. e.g., $[Fe(CN)_6]^{4-}$

2. Central Atom or Ion : The atom or ion to which a fixed number of ions or groups are bonded . It is also referred as Lewis acid. e.g., in $[NiCl_2(H_2O)_4]$. Ni is central metal atom.

3. Ligands : Ligands is electron donating species (ions or molecules) bonded to the Central atom .These may be charged or neutral.

Ligands are of the following types:

(i) Unidentate It is a ligand, which has one donor atom. e.g., H_2O , NH_3 .

(ii) Bidentate It is the ligand. which have two donor sites. $\text{C}_2\text{O}_4^{2-}$

(iii) Polydentate It is the ligand, which have several donor sites. e.g., $[\text{EDTA}]^{4-}$ is hexadentate ligand.

(iv) Ambidentate ligands These are the monodentate ligands which can ligate through two different sites, e.g. NO_2^- , SCN^- , etc.

(v) Chelating ligands- Di or polydentate ligands cause cyclisation around the metal atom which are known as chelates, such ligands Uses two or more donor atoms to bind a single metal ion and are known as chelating ligands.

4. **Coordination Number:** It is defined as the number of coordinate bonds formed by central metal atom, with the ligands.

5. **Coordination Sphere:** The central ion and the ligands attached to it are enclosed in square bracket which is known as coordination sphere.

NOTE: Colour in Coordination Compounds

The crystal field theory attributes the colour of the coordination compounds due to d-d transition of the electron, i.e., electron jump from t_{2g} level to higher e_g level.

CASE-BASED/PASSAGE-BASED INTEGRATED QUESTIONS

Read the given passage and answer the questions that follow:

Complex compounds play an important role in our daily life. Werner's theory of complex compounds says every metal atom or ion has primary valency (oxidation state) which is satisfied by negatively charged ions which are ionisable whereas secondary valency (coordination number) is non-ionisable, satisfied by ligands (+ve, -ve, neutral) but having lone pair. Primary valency is non-directional, secondary valency is directional. Complex compounds are name according to IUPAC system. Valence bond theory helps in determining shapes of complexes based on hybridization, magnetic properties, outer or inner orbital complex. EDTA is used to treat lead poisoning, cis-platin as anticancer agents. Vitamin B₁₂ is complex of cobalt. Hemoglobin, oxygen carrier is complex of Fe^{2+} and chlorophyll essential for photosynthesis is complex of Mg^{2+} .

Questions:

(a) What is the oxidation state of Ni in $[\text{Ni}(\text{CO})_4]$?

Ans. Zero

(b) One mole of $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ reacts with excess of AgNO_3 to yield 2 mole of AgCl . Write formula of complex. Write IUPAC name also.

Ans. $[\text{Cr}(\text{H}_2\text{O})_5\text{Cl}]\text{Cl}_2 \cdot \text{H}_2\text{O}$, Pentaqua chloride chromium (III) chloride.

(c) Name the hexadentate ligand used for treatment of lead poisoning.

Ans. EDTA^{4-} (ethylene diamine tetra acetate)

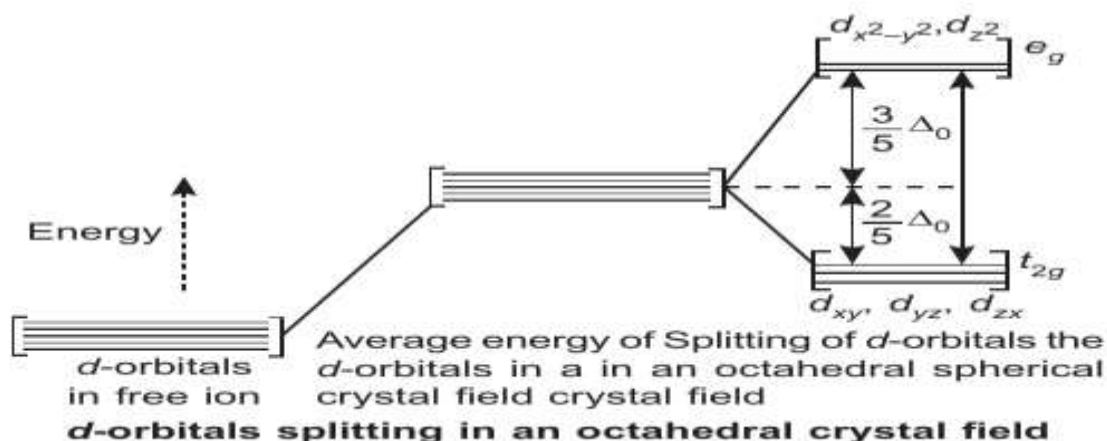
(d) What is hybridization of $[\text{CoF}_6]^{3-}$? [$\text{Co} = 27$]. Give its shape and magnetic properties.

Ans. sp^3d^2 , octahedral, paramagnetic. It is outer orbital complex.

(e) Out $[\text{Fe}(\text{CO})_5]$, $[\text{Fe}(\text{C}_2\text{O}_4)_3]^{3-}$, $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$, $[\text{Fe}(\text{CN})_6]^{3-}$, which is most stable?

Ans. $[\text{Fe}(\text{CO})_5]$ is most stable because CO is strongest ligand.

II Observe the diagram of splitting of d-orbitals in octahedral field and answer the questions based on the diagrams and related studied concepts.



(a) What is crystal field splitting energy?

Ans :The energy difference between the two sets of d-orbitals is called crystal field splitting energy denoted by Δ_0 .

(b) Why $d_{x^2-y^2}$, d_{z^2} have higher energy than d_{xy} , d_{yz} , d_{zx} orbitals in octahedral crystal field?

Ans. The orbitals $d_{x^2-y^2}$, d_{z^2} lying in the direction of ligands, will experience greater repulsion and their energies will be raised relative to their positions in symmetrical field as compared to orbitals d_{xy} , d_{yz} , d_{zx} lying in between the axis away from the approach of ligand.

(c) What is relationship between (CFSE) Δ_0 and strength of ligand?

Ans. Greater the (CFSE) Δ_0 , more will be strength of ligand.

(d) What is electronic configuration of d^5 ion if $\Delta_0 < P$?

Ans. $t_{2g}^3 e_g^2$

(e) What is spectrochemical series?

Ans. The series in which ligands are arranged in increasing order of magnitude of crystal field splitting energy (Δ_0) is called spectrochemical series.

Assertion and Reason Type Questions

In the following questions, a statement of Assertion (A) followed by a statement of Reason ® is given. Choose the correct option out of the following choices.

- (a) Assertion and Reason both are true, Reason is the correct explanation of Assertion.
- (b) Assertion and Reason both are true but Reason is not the correct explanation of Assertion.
- (c) Assertion is true, Reason is false.
- (d) Assertion is false, Reason is true.

1. Assertion (A): Toxic metal ions are removed by the chelating ligands.

Reason ®: Chelate complexes tend to be more stable.

Ans: (A)

2. Assertion (A): $(\text{Fe}(\text{CN})_6)^{3-}$ ion shows magnetic moment corresponding to two unpaired electrons.

Reason ®: Because it has d^2sp^3 type hybridization.

Ans: (D)

3. Assertion(A) : $[\text{Co}(\text{NH}_3)\text{Br}]\text{SO}_4$ gives white precipitate with barium chloride.

Reason® : The complex dissociates in the solution to give Br^- and SO_4^{2-} . Ans (C)

4.Assertion(A) : Low spin tetrahedral complexes are not formed.

Reason® : For tetrahedral complexes, CFSE is lower than pairing energy. Ans : (A)

5. Assertion(A): According to crystal field theory during complex formation, the d orbitals split and form two sets of orbitals t_{2g} and e_g .

Reason®: Splitting of d – orbitals occurs only in case of strong field ligands. Ans :(C)

6.Assertion(A): $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ is sp^3d^2 hybridized and paramagnetic complex ion.

Reason® : It has four unpaired electrons. Ans: (A)

MULTIPLE CHOICE QUESTIONS

1. Which of the following is a complex of metal other than transition metal?

(a) Hemoglobin (b) Chlorophyll (c) Ferrocene (d) Vitamin B12 **Ans :(b)**

2. Which of the following is not a double salt but a coordinate compound?

(a) $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ (b) $\text{FeSO}_4 \cdot (\text{NH}_4)_2\text{SO}_4 \cdot 6\text{H}_2\text{O}$
(c) $\text{K}_2\text{SO}_4 \cdot \text{Al}_2(\text{SO}_4)_3 \cdot 24\text{H}_2\text{O}$ (d) $4\text{KCN} \cdot \text{Fe}(\text{CN})_2$ **Ans :(d)**

3. The donor atoms in ethylenediaminetetraacetate ion is

(a) two N and two O (b) two N and four O (c) four N and two O (d) three N and three O **Ans :(b)**

4. The complex ion $[\text{Cu}(\text{NH}_3)_4]^{+2}$ is

(a) tetrahedral and paramagnetic (b) tetrahedral and diamagnetic
(c) square planar and paramagnetic (d) square planar and diamagnetic **Ans :(c)**

5. The hybrid state of Co in high spin complex, $\text{K}_3[\text{CoF}_6]$ is

(a) $sp^3 d^2$ (b) sp^3 (c) $d^2 sp^3$ (d) $sp^3 d$ **Ans :(a)**

6. In an octahedral crystal field, the t_{2g} orbital are

(a) raised in energy by $0.4 \Delta_o$ (b) lowered in energy by $0.4 \Delta_o$
(c) raised in energy by $0.6 \Delta_o$ (d) lowered in energy by $0.6 \Delta_o$ **Ans :(b)**

7. If $\Delta_o < P$, then the correct electronic configuration for d^4 system will be

(a) $t_{2g}^4 e_g^0$ (b) $t_{2g}^3 e_g^1$
(c) $t_{2g}^0 e_g^4$ (d) $t_{2g}^2 e_g^2$ **Ans :(b)**

8. The tetrahedral complexes are generally high spin. This is because

(a) $\Delta_t < P$ (b) $\Delta_t > P$
(c) $\Delta_t = P$ (d) none of these **Ans :(a)**

9.The primary and secondary valency of copper in the complex $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ are

(a) 2, 4 (b) 4, 2 (c) 0, 4 (d) 1, 4 **Ans :(a)**

10.The hybridization state of the Cu in the compound $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$ is

(a) sp^3 (b) $sp^2 d$ (c) $sp^3 d^2$ (d) dsp^2 **Ans :(d)**

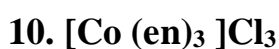
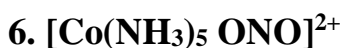
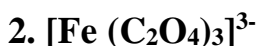
11. Which of the following statement is correct?

- (a) $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is diamagnetic while $[\text{Fe}(\text{CN})_6]^{4-}$ is paramagnetic
- (b) $[\text{Cu}(\text{NH}_3)_4]^{2+}$ is paramagnetic while $[\text{Fe}(\text{CN})_6]^{4-}$ is diamagnetic
- (c) both are paramagnetic
- (d) both are diamagnetic

Ans : (b)

Topic:- Nomenclature of coordination compounds.

1. What IUPAC names of following complexes?



Ans 1. Hexamminecobalt (III) ion

Ans 2. Trioxalatoferrate (III) ion

Ans 3. Tetracyanonickelate (II) ion

Ans 4. Tetraamminedichloridoplatinum (IV) ion

Ans 5. Tetrachloridonickelate (II) ion

Ans 6. Pentamminenitrito –O-cobalt (III) ion

Ans 7. Pentamminechlorido cobalt (III) Chloride

Ans 8. Pentaquacyanido chromium (III) ion

Ans 9. Hexanitrito –N-cobaltate (III) ion

Ans 10. Tris (ethylenediamine) Cobalt (III) Chloride

2. Write formula for the following compounds.

1. Hexammineplatinum (VI) Chloride

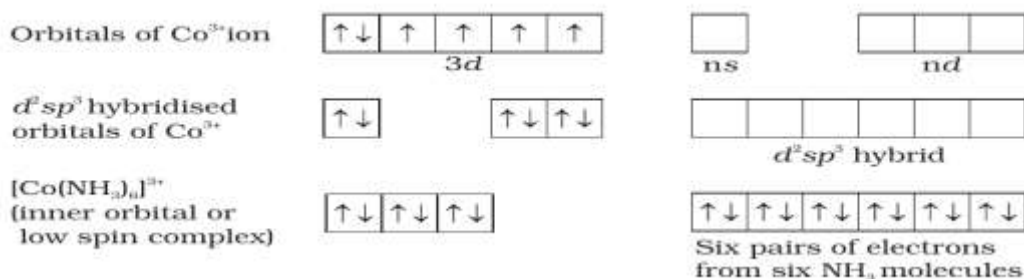
2. Potassium hexacyanoferrate (III) ion
3. diamminedichloridoplatinum (III) ion
4. Tetramminedichloridocobalt (III) ion
5. Annine chlorobis (elhylenediamine) cobalt (III) ion.
6. Hexaamminechromium (III) hexacyanocobaltate (III)
7. Pentramminenitro –N- Cobalt (III) Chloride.
8. Pentramminebromidoocobalt (III) sulphate
9. triamminediaquachlorocobalt (III) Chloride
10. Tetramminedichloridooplatinum (IV) Bromide

Ans1. $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_6$
 Ans2. $\text{K}_3[\text{Fe}(\text{CN})_6]$
 Ans3. $[\text{Pt}(\text{Cl}_2)(\text{NH}_3)_2]^+$
 Ans4. $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
 Ans5. $[\text{CoCl}(\text{en})_2(\text{NH}_3)]^{2+}$
 Ans6. $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
 Ans7. $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
 Ans8. $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{SO}_4$
 Ans9. $[\text{Co}(\text{NH}_3)_3(\text{H}_2\text{O})_2\text{Cl}]\text{Cl}_2$
 Ans10. $[\text{PtCl}_2(\text{NH}_3)_4]\text{Br}_2$

TWO MARKS QUESTION

1. Explain that the complex $[\text{Co}(\text{NH}_3)_6]^{3+}$ is diamagnetic on the basis of valence bond theory.

Ans. In $[\text{Co}(\text{NH}_3)_6]^{3+}$ as all the electrons are paired so it is diamagnetic



2. What are homoleptic and heteroleptic complex explain with suitable example?

Ans. Complexes in which the Central metal ion is bonded to only one kind of donor atom or group.

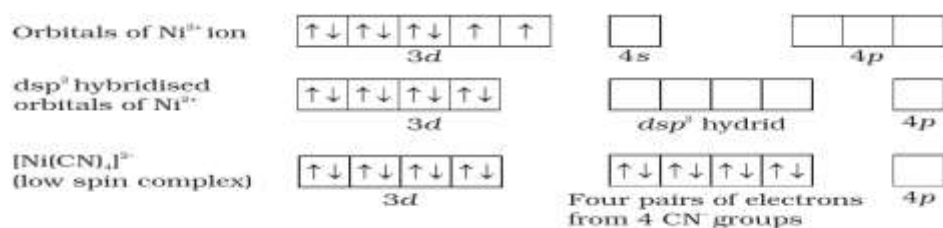
Example- $\text{Co}(\text{NH}_3)_6^{3+}$ only ammonia is the ligand.

Complexes in which the Central metal ion is bound to more than one kind of donor group.

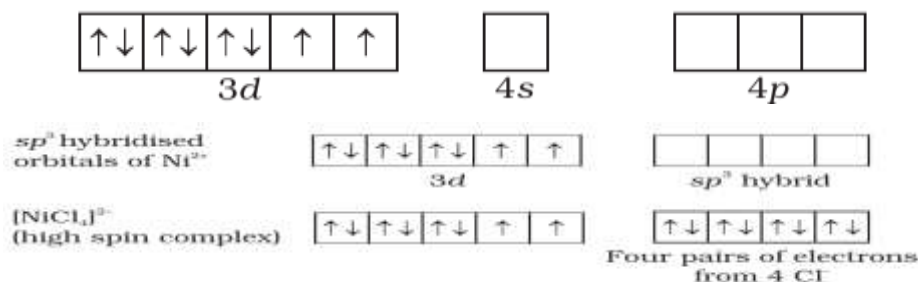
Example- $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$

3. $[\text{Ni}(\text{CN})_4]^{2-}$ is square planar whereas $[\text{NiCl}_4]^{2-}$ is tetrahedral. Explain.

Ans. In $[\text{Ni}(\text{CN})_4]^{2-}$ hybridization is dsp^2 so square planar geometry



In $[\text{NiCl}_4]^{2-}$ hybridisation is sp^3 so tetrahedral geometry



4. State crystal field theory.

Ans According to crystal field theory-1. The metal ligand bond is ionic.

2. Ligands are point charges in case of anions or dipoles in case of neutral molecules

3. When the asymmetrical negative field of ligands surrounds the metal atom or ion, the degeneracy of its d- orbitals is lifted and they split into two sets.

4. The pattern of splitting depends on the nature of crystal field.

5. In general ligands can be arranged in a series in the order of increasing field strength

Called **spectrochemical series-**

$\text{I}^- < \text{Br}^- < \text{SCN}^- < \text{Cl}^- < \text{S}^{2-} < \text{F}^- < \text{OH}^- < \text{C}_2\text{O}_4^{2-} < \text{H}_2\text{O} < \text{NCS}^- < \text{edta}^{4-} < \text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$

5. Why are complexes coloured? When is a coordination compound colourless?

Ans. The colour of complexes is due to d – d transitions of unpaired electron in d-orbitals. The complexes will be colourless if the configuration of metal ion or atom is d^{10} or d^0

Haloalkanes & Haloarenes

Only hard work and thorough study is guarantee for success.

Summary:

Alkyl/ Aryl halides may be classified as mono, di, or polyhalogen (tri-, tetra-, etc.) Compounds depending on whether they contain one, two or more halogen atoms in their structures. Since halogen atoms are more electronegative than carbon, the carbon- halogen bond of alkyl halide is polarized; the carbon atom bears a partial positive charge, and the halogen atom bears a partial negative charge.

Alkyl halides are prepared by the **free radical halogenations** of alkanes, addition of halogen acids to alkenes, replacement of $-\text{OH}$ group of alcohols with halogens using phosphorus halides, thionyl chloride or halogen acids. Aryl halides are prepared by electrophilic **substitution** to arenes. Fluorides and iodides are best prepared by halogen exchange method.

The boiling points of organ halogen compounds are comparatively higher than the corresponding hydrocarbons because of strong dipole-dipole and van der Waals forces of attraction. These are slightly soluble in water but completely soluble in organic solvents.

The polarity of carbon-halogen bond of alkyl halides is responsible for their Nucleophilic **substitution, elimination** and their reaction with metal atoms to form organ **metallic compounds**. Nucleophilic substitution reactions are categorized into $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ on the basis of their kinetic properties. **Chirality** has a profound role in

Understanding the reaction mechanisms of $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions. $\text{S}_{\text{N}}2$ reactions of chiral alkyl halides are characterized by the inversion of configuration while $\text{S}_{\text{N}}1$ reactions are characterized by racemisation.

ASSERTION -REASON TYPE

A statement of assertion is followed by a statement of reason. Mark the correct choice from the options given below:

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

- (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
 (c) Assertion is true but reason is false.
 (d) Both assertion and reason are false.

1. Assertion : S_N2 reactions do not proceed with retention of configuration.

Reason : S_N2 reactions proceed in a single step.

2. Assertion : Tertiary alkyl halides show high reactivity in S_N1 reaction.

Reason : Tertiary carbocation has more stability.

3. Assertion: $\text{CH}_3\text{-CH=CH}_2 \xrightarrow[\text{Cl}_2, 773\text{ K}]{\quad} \text{Cl-CH}_2\text{-CH=CH}_2 + \text{HCl}$

Reason : At high temperature, Cl_2 dissociates into chlorine free radicals which bring about allylic substitution.

4. Assertion : Nucleophilic substitution reaction in an optically active alkyl halide gives a mixture of enantiomers.

Reason : Reaction occurs by S_N1 mechanism.

5. Assertion : Primary allylic halides show higher reactivity in S_N1 reactions than other primary alkyl halides.

Reason : Intermediate carbocation is stabilized by resonance.

MULTIPLE CHOICE QUESTION (MCQs)

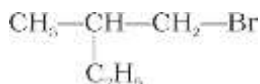
1). Identify the following compounds as primary halide:

- (i) 1-Bromobut-2-ene
- (ii) 4-Bromopent-2-ene
- (iii) 2-Bromo-2-methylpropane
- (iv) 2-Chloro-2-methylpropane

2). Which of the following compounds are gem-dihalides?

- (a) Ethylidenechloride
- (b) Ethylenedichloride
- (c) Methylchloride
- (d) Benzylchloride

3). Which is the correct IUPAC name for



- i) 1-Bromo-2-ethylpropane
- ii) 1-Bromo-2-ethyl-2-methylethane
- iii) 1-Bromo-2-methylbutane
- iv) 2-Methyl-1-bromobutane

4). What should be the correct IUPAC name for diethylbromomethane? i) 1-Bromo-1,1-diethylmethane

ii) 3-Bromopentane

iii) 1-Bromo-1-ethylpropane

iv) 1-Bromopentane

5). Which of the following is /are secondary bromide?

- (i) $\text{CH}_3\text{CH}_2\text{Br}$
- (ii) $(\text{CH}_3)_3\text{CCH}_2\text{Br}$
- (iii) $\text{CH}_3\text{CH}(\text{Br})\text{CH}_2\text{CH}_3$
- (iv) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$

1 Mark Questions

Q.1 What are ambident nucleophiles?

Q.2 Which is a better nucleophile, a bromide ion or iodide ion?

Q.3 Arrange the compounds of each set in order of reactivity towards S_N2 displacement:

2-Bromo-2-methylbutane, 1-Bromopentane, 2-Bromopentane.

Q.4 Arrange the following compounds in increasing order of boiling point.

$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$, $(\text{CH}_3)_3\text{CBr}$, $(\text{CH}_3)_2\text{CHCH}_2\text{Br}$.

Q.5 Define optical activity

Q.6 What is racemic mixture or racemic modification?

Q.7 What are enantiomers?

Q.8 Name the compound formed when Grignard reagent is exposed to moisture.

Q.9 Write the IUPAC name of $(\text{CH}_3)_3\text{CCH}_2\text{Cl}$

Q10. Which of the following undergoes $\text{S}_{\text{N}}1$ faster: 2-chlorobutane or 1-chlorobutane

Q11. Arrange each set of compounds in order of increasing boiling points.

(i) Bromomethane, (ii) Bromoform, (iii) Chloromethane, (iv) Dibromomethane.

Q12. Write the product formed when toluene is chlorinated in presence of sunlight.

Q13. Write the product formed when n-butyl chloride is treated with alcoholic KOH?

Q14. Which has higher dipole moment, Chlorobenzene or Cyclohexylchloride?

Q15. How many centres of Chirality are present in 3-Bromopent-1-ene.

Q16. Haloalkanes react with aq. KOH to form alcohols but react with alc. KOH to form alkenes. Why? (2 Mark)

Q17. Explain why? (2 Mark)

(a) Alkyl halides, though polar, are immiscible in water.

(b) Grignard reagents should be prepared under anhydrous conditions?

Q18. Haloalkanes undergo Nucleophilic substitution whereas haloarenes undergo electrophilic substitution. Why?

(3 Mark)

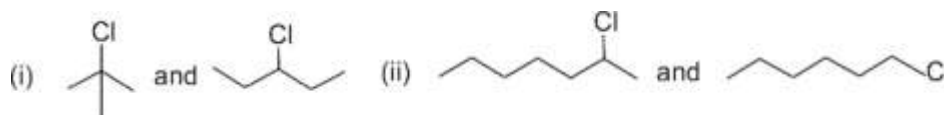
Important questions:

Q1 In the following pairs of halogen compounds, which would undergo $\text{S}_{\text{N}}2$ reaction faster?



Q2 Although, chlorine is an electron withdrawing group, yet it is *ortho* & *para* directing in electrophilic aromatic substitution reactions. Why?

Q3 In the following pairs of halogen compounds, which compound undergoes faster $\text{S}_{\text{N}}1$ reaction?



Q4 Why is sulphuric acid not used during the reaction of alcohols with KI?

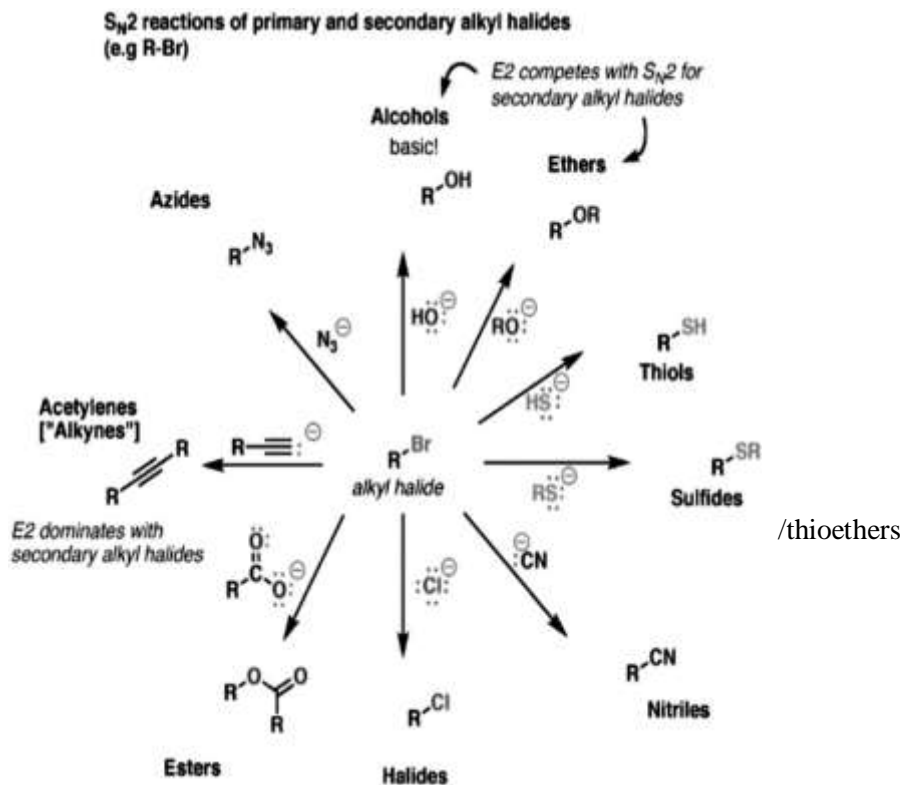
Q5 *p*-Dichlorobenzene has higher m.p. and solubility than those of *o*- and *m*-isomers. Discuss.

Q6 Hydrocarbon C_5H_{10} does not react with chlorine in dark but gives a single monochloro compound $\text{C}_5\text{H}_9\text{Cl}$ in bright sunlight. Identify the hydrocarbon.

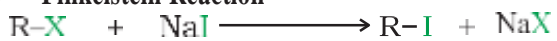
Q8. Aryl halides cannot be prepared by the action of sodium halide in the presence of H_2SO_4 .

MIND MAP FOR CONVERSION

IMPORTANT NAME REACTIONS:

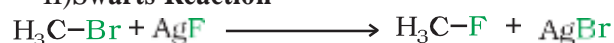


i) Finkelstein Reaction

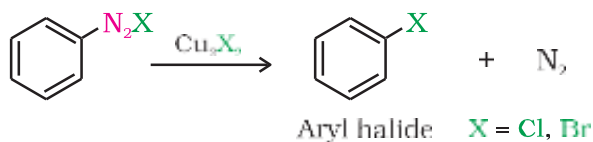


$X = Cl, Br$

II) Swarts Reaction



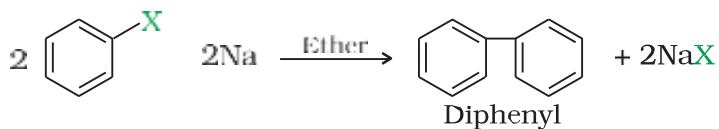
(iii) Sandmeyer's reaction



Wurtz Reaction



Fittig reaction



Wurtz Fittig reaction



Assertion- Reason Answer

Answers: 1-b, 2-a, 3- a, 4-a, 5- a

MCQ ANSWERS

Ans1 :(i) 1-Bromobut-2-ene (1° alkyl halide)

Ans 2: Option (a) is correct . In gem-dihalides both the halogens are attached to the same carbon atom.

Ans3. iii) 1-Bromo-2-methylbutane

Ans4. ii). 3-Bromopentane

Ans5. (iii)

CH₃C

H(Br)

CH₂C

H₃

1 Mark Answers

Ans1. Nucleophilic which can attack through two different sites are called ambident Nucleophilic.

Example: Cyanide ion, CN⁻: & C=N:⁻

Ans2. Iodide ion because it has lower electronegativity and larger size.

Ans3. The reactivity in S_N2 reactions depend upon steric hindrance ;more the steric hindrance slows the reaction The order of reactivity in S_N2 reactions follows the order: 1⁰ > 2⁰ > 3⁰.

1-Bromopentane > 2-Bromopentane > 2-Bromo-2-methylbutane .

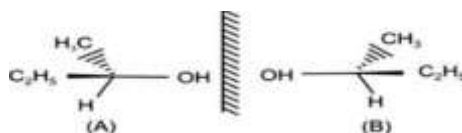
Ans4. The boiling point increases as the branching decreases, so the increasing order of boiling point is: (CH₃)₃CBr < (CH₃)₂CHCH₂Br < CH₃CH₂CH₂CH₂Br

Ans5. The compounds which rotate the plane of polarized light when it is passed through their solutions are called optically active compounds and this property is known as optical activity.

Ans6. A mixture containing two enantiomers in equal proportions will have zero optical rotation,

As the rotation due to one isomer will be cancelled by the rotation due to other isomer. Such a mixture is known as racemic mixture or racemic modification.

Ans7. The stereo isomers related to each other as non superimposable mirror images are called enantiomers.



Ans8 –Alkane

9. 1-chloro-2,2-dimethylpropane

10. 2-chlorobutane.

11. (iii) < (i) < (iv) < (ii)

12. Chloromethylbenzene

13. But-2-ene

14. Cyclohexylchloride

15. One

Ans16. KOH is a strong base, so it completely ionizes in aqueous solution. OH⁻ ions are strong Nucleophilic, so It replaces the halogen atoms and form alcohols. In contrast, an alcoholic solution of KOH contains alkoxide (R-O⁻) ions which being a much stronger base than (OH⁻) ions. Preferentially elimination takes place molecule of HCl from an alkyl chloride to form an alkene.

Ans17.(a) Alkyl halides are polar in nature but it is insoluble in water because alkyl halide molecules are held together by dipole-dipole attraction and water molecules are held together by H-bonds. More energy is required to overcome these attractive forces between the haloalkanes. But less energy is released when haloalkanes and water molecules come together, so haloalkanes are not soluble in water.

(b) Grignard reagents are very reactive, so they react with moisture and form

alkane. $R-Mg-X + H-OH \rightarrow R-H + Mg(OH)X$

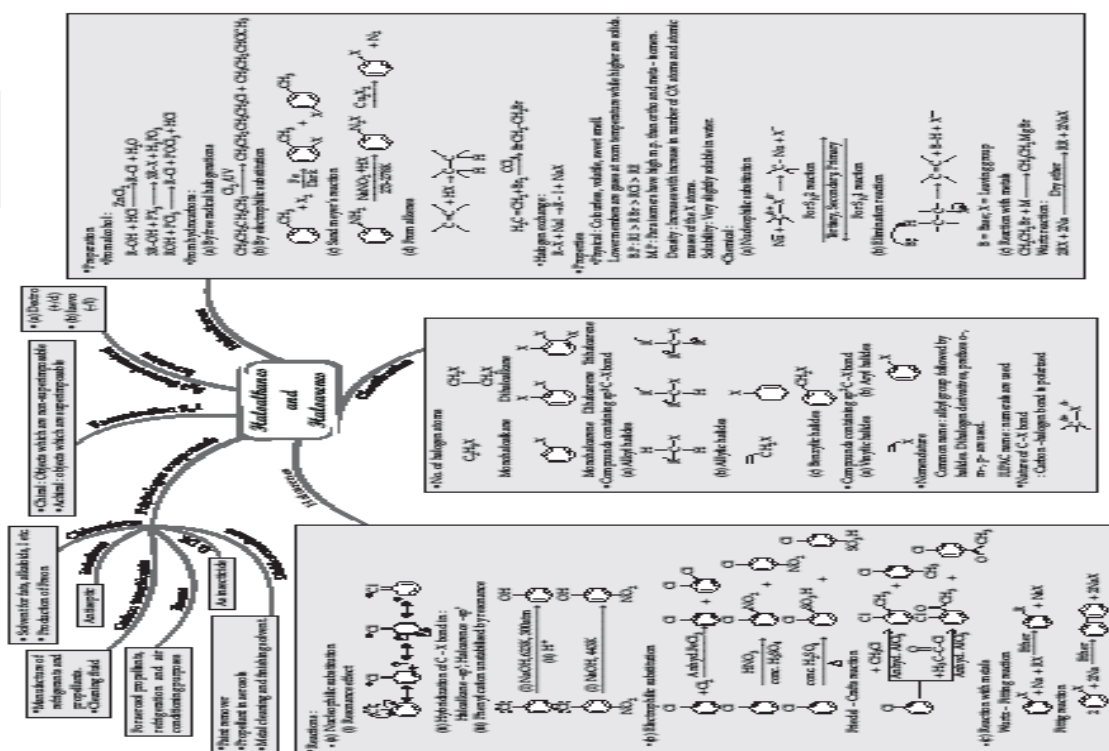
Therefore, it must be prepared and stored under anhydrous conditions.

Ans18. Haloalkanes are more polar than haloarenes. As a result the carbon atom carrying the halogen in haloalkane is more electron-deficient than that in haloarenes. So, haloalkanes undergo nucleophilic substitution more readily than haloarenes.

In contrast, haloarenes contain a benzene ring. Since the typical reactions of benzene are electrophilic substitutions, therefore, haloarenes undergo electrophilic substitution while haloalkanes which do not contain a benzene ring do not undergo electrophilic substitution.

CHAPTER - 10

MIND MAP : LEARNING MADE SIMPLE



Alcohols, Phenols and Ethers

Summary

Alcohols and **phenols** are classified (i) on the basis of the number of hydroxyl groups and (ii) according to the hybridization of the carbon atom, sp^3 or sp^2 to which the $-OH$ group is attached. **Ethers** are classified on the basis of groups attached to the oxygen atom.

Alcohols may be prepared (1) by hydration of alkenes (i) in presence of an acid and (ii) by hydroboration-oxidation reaction (2) from carbonyl compounds by (i) catalytic reduction and (ii) the action of Grignard reagents. Phenols may be prepared by (1) substitution of (i) halogen atom in haloarenes and (ii) sulphonic acid group in aryl sulphonic acids, by $-OH$ group (2) by hydrolysis of diazonium salts and (3) industrially from cumene.

Alcohols are higher boiling than other classes of compounds, namely hydrocarbons, ethers and haloalkanes of comparable molecular masses. The ability of alcohols, phenols and ethers to form intermolecular hydrogen bonding with water makes them soluble in it.

Alcohols and phenols are acidic in nature. **Electron withdrawing groups** in phenol increase its acidic strength and **electron releasing groups** decrease it. Alcohols undergo Nucleophilic substitution with hydrogen halides to yield alkyl halides. Dehydration of alcohols gives alkenes. On oxidation, primary alcohols yield aldehydes with mild oxidizing agents and carboxylic acids with strong oxidizing agents while secondary alcohols yield ketones. Tertiary alcohols are resistant to oxidation.

The presence of $-OH$ group in phenols activates the aromatic ring towards

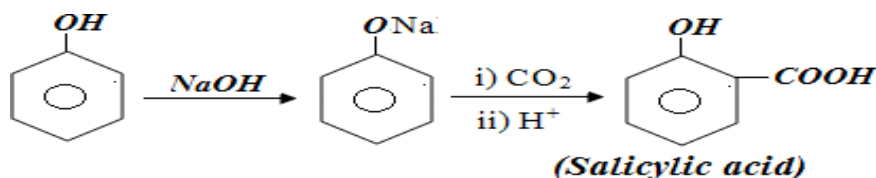
Electrophilic substitution and directs the incoming group to *ortho* and *para* positions due to resonance effect.

Reimer-Tiemann reaction of phenol yields salicylaldehyde. In presence of sodium hydroxide, phenol generates phenoxide ion which is even more reactive than phenol. Thus, in alkaline medium, phenol undergoes **Kolbe's reaction**.

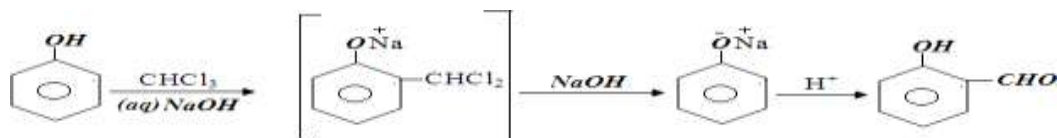
Ethers may be prepared by (i) dehydration of alcohols and (ii) **Williamson synthesis**. The boiling points of ethers resemble those of alkanes while their solubility is comparable to those of alcohols having same molecular mass. The $C-O$ bond in ethers can be cleaved by hydrogen halides. In electrophilic substitution, the alkoxy group activates the aromatic ring and directs the incoming group to *ortho* and *para* positions.

Name Reactions

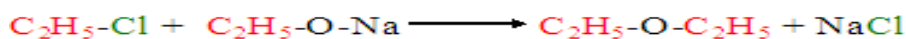
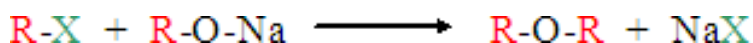
1) KOLBE'S REACTION:



2) REIMER-TIEMANN REACTION:



3) WILLIAMSON SYNTHESIS:



DISTINGUISHING TESTS FOR ORGANIC COMPOUNDS

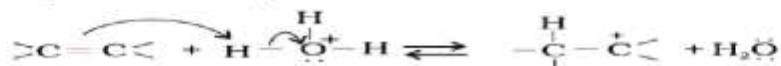
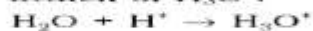
NAME OF TEST	TEST	RESULT
1. LUCAS REAGENT TEST	O.C. + Zn + HCl	Turbidity appears immediately- 3° Alcohol 2. Turbidity appears after 5 min- 2° Alcohol 3. Turbidity appears on heating- 1° Alcohol
2. NEUTRAL FERRIC CHLORIDE TEST	O.C. + Neutral ferric Chloride solution	Violet colour appears- Phenol

1. HYDRATION OF ETHENE

Mechanism

The mechanism of the reaction involves the following three steps:

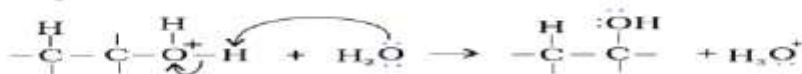
Step 1: Protonation of alkene to form carbocation by electrophilic attack of H_3O^+ .



Step 2: Nucleophilic attack of water on carbocation.



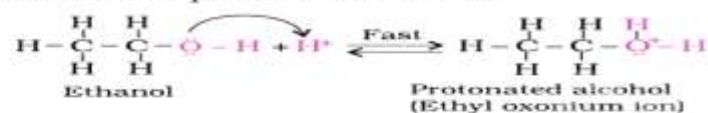
Step 3: Deprotonation to form an alcohol.



2. DEHYDRATION OF ALCOHOL TO GIVE ETHENE

Mechanism

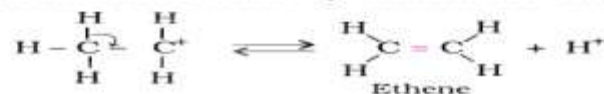
Step 1: Formation of protonated alcohol.



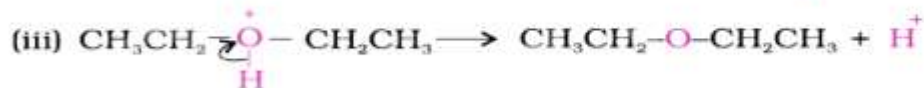
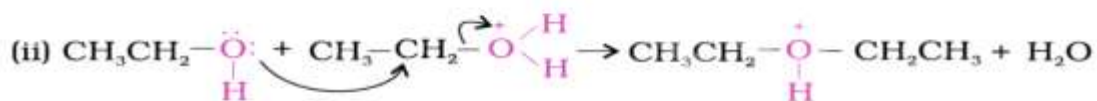
Step 2: Formation of carbocation: It is the slowest step and hence, the rate determining step of the reaction.



Step 3: Formation of ethene by elimination of a proton.



3. DEHYDRATION OF ALCOHOL TO GIVE ETHER



ASSERTION - REASONING QUESTIONS

A statement of assertion is followed by a statement of reason. Mark the correct choice from the options given below :

- (a) Both assertion and reason are true and reason is the correct explanation of assertion.
- (b) Both assertion and reason are true but reason is not the correct explanation of assertion.
- (c) Assertion is true but reason is false.
- (d) Both assertion and reason are false.

1. Assertion : Methyl alcohol is a weaker acid than water.

Reason : Among the aliphatic monohydric alcohols, methyl alcohol is the strongest acid. Assertion : o - Nitrophenol and p - Nitrophenol are separated by steam distillation.

Reason : o-Nitrophenol has intramolecular H - bonding while molecules of p-nitrophenol are linked by intermolecular H - bonding.

3. Assertion : Phenols do not react with phosphorus halides while alcohols do react.

Reason : In phenols C-O bond has partial double bond character due to resonance while it is not so in alcohols.

4. Assertion : Phenol is acidic in nature.

Reason : Phenoxide ion is more resonance stabilised than phenol.

5. Assertion : Tertiary alkyl halide can not be used in Williamson Synthesis.

Reason : Tertiary alkyl halide undergoes elimination reaction to form an alkene.

MULTIPLE CHOICE QUESTIONS (MCQs)

Q.1. Which one of the following compound is obtained by dehydrogenation of secondary alcohols?

- a) Ketone
- b) Aldehyde
- c) Carboxylic acid
- d) Amine

Q.2. Which of the following alcohol is most soluble in water?

- a) Propanol
- b) Hexanol
- c) Pentanol
- d) Butanol

Q.3. On heating aqueous solution of benzene diazonium chloride, which of the following is formed

- (a) benzene
- (b) chloro benzene
- (c) phenol
- (d) aniline

Q.4. Catalytic dehydrogenation of a primary alcohol gives a

- (a) Ketone
- (b) Aldehyde
- (c) Sec . alcohol
- (d) Ester

Q.5. Which is most acidic?

- a). Phenol
- b). 4-nitrophenol
- c). Cresol
- d). 2-nitrophenol

1Mark Questions

Q1. Alcohols are comparatively more soluble in water than hydrocarbons of comparable molecular masses. Explain this fact.

Q2. Preparation of ethers by acid dehydration of secondary or 3° alcohols is not a suitable method?

Q3. Explain why Propanol has higher boiling point than that of the hydrocarbon, butane?

Q4. Explain why is ortho-nitrophenol more acidic than ortho - methoxyphenol?

Q5. Which out of propan-1-ol and propan-2-ol is stronger acid?

Q6. Write IUPC name of $\text{CH}_3\text{OCH}_2\text{OCH}_3$

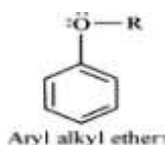
2 Mark Questions

Q7. Give two reactions that show the acidic nature of phenol. Compare acidity of phenol with that of ethanol.

Q8. How does phenol react with Br_2 in CS_2 and bromine water?

Q9. Explain the fact that in aryl alkyl ethers

- (i) The alkoxy group activates the benzene ring towards electrophilic substitution and
- (ii) It directs the incoming substituent to ortho and para positions in benzene ring.



Q.10. Give one chemical test each to distinguish between the following pairs of compounds:

- (i) Phenol and Benzoic acid
- (ii) 1-Propanol and 2-Propanol

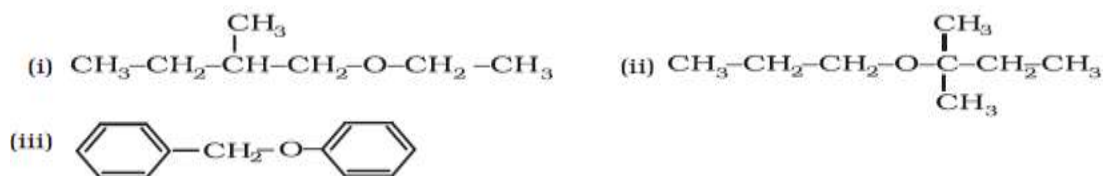
Q.11. How will you convert:

- a) Propene to Propan-2-ol?
- b) Ethanal to Propan-2-ol?

Q.12. Arrange the following as per property indicated:-

- (i) Pentan-1-ol, n-Butane, Pentanal, Ethoxyethane (increasing order of boiling point)
- (ii) Pentan-1-ol, Phenol, 4-methylphenol, 3-nitrophenol (increasing order of acid strength)

Q.13. Give the major products that are formed by heating each of the following ethers with HI. (3 Mark)



Q.14. A compound 'A' with molecular formula $\text{C}_4\text{H}_{10}\text{O}$ is unreactive towards sodium metal. It does not decolorize bromine water and does not react with NaHSO_3 solution. On refluxing 'A' with excess of HI gives 'B' which reacts with aq. NaOH to form 'C'. 'C' can be converted into 'B' by reacting with P and I_2 . 'C' on heating with conc. H_2SO_4 forms 'D' decolorizes bromine water. Identify A to D and write the reactions involved. (5 Mark)

Answer of Assertion- Reason Questions: 1 – b, 2-a, 3- a, 4- a, 5-a

Answer of MCQ Questions: 1-a, 2-a, 3-c, 4-b, 5-d

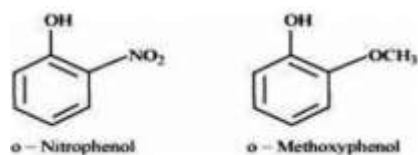
Ans1. Alcohols can form hydrogen bonds with water and break the hydrogen bonds already existing between water molecules. Therefore Alcohols are soluble in water, whereas hydrocarbons cannot form hydrogen bonds with water and hence are insoluble in water.

Ans2. The formation of ethers by dehydration of alcohol is a bimolecular reaction ($\text{S}_{\text{N}}2$). OH group is sterically

hindered. As a result, elimination dominates substitution as 2° & 3° carbocation are more stable. Hence in place of ethers, alkenes are formed.

Ans3. Weak van der Waal's forces of attraction hold the molecules of butane together while those of propanol are held together by stronger intermolecular hydrogen bonding.

Ans4. The nitro-group is an electron-withdrawing group. Therefore decreases the electron density of the ring as well as oxygen. As a result, it is easier to lose a proton. Also, the o-nitrophenoxide ion formed after the loss of proton is stabilized by resonance. Hence, o-nitrophenol is stronger acid. On the other hand, Methoxy group is an electron-releasing group. Thus, it increases the electron density of the oxygen atom and hence, the proton cannot be given out easily. Therefore, o-nitrophenol is more acidic than o-methoxyphenol.

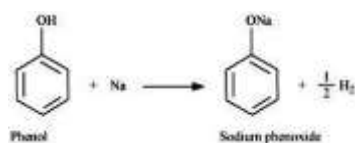


Ans5. Propan-1-ol is stronger acid than propan-2-ol. The acidic strength of alcohols is in the order 1° > 2° > 3°.

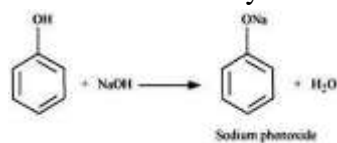
Ans6. Dimethoxymethane

Ans7. The acidic nature of phenol can be proved by the following two reactions:

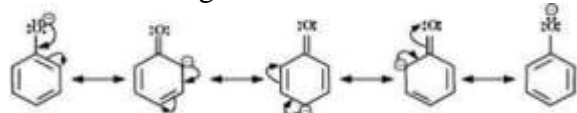
(i) Phenol reacts with sodium to give sodium phenoxide, liberating H₂.



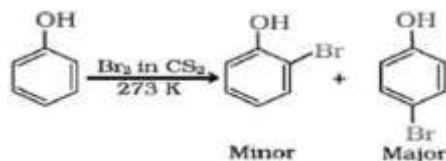
(ii) Phenol reacts with sodium hydroxide to give sodium phenoxide and water.



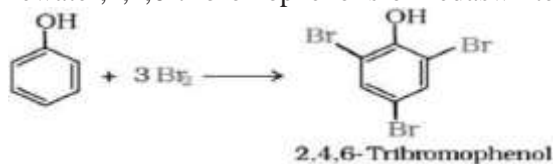
The acidity of phenol is more than that of ethanol. This is because after losing a proton, the phenoxide ion undergoes resonance and gets stabilized whereas ethoxide ion does not.



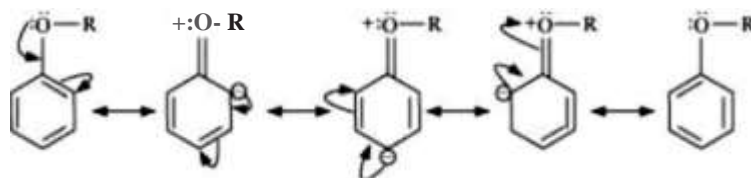
Ans8.(i) When the reaction is carried out in solvents of low polarity such as CHCl₃ or CS₂ and at low temperature, monobromophenols are formed.



(iii) When phenol is treated with bromine water, 2,4,6-tribromophenol is formed as a white precipitate.



Ans9. (i) In arylalkylethers, due to the +R effect of the alkoxy group, the electron density in the benzene ring increases as shown in the following resonance structure.



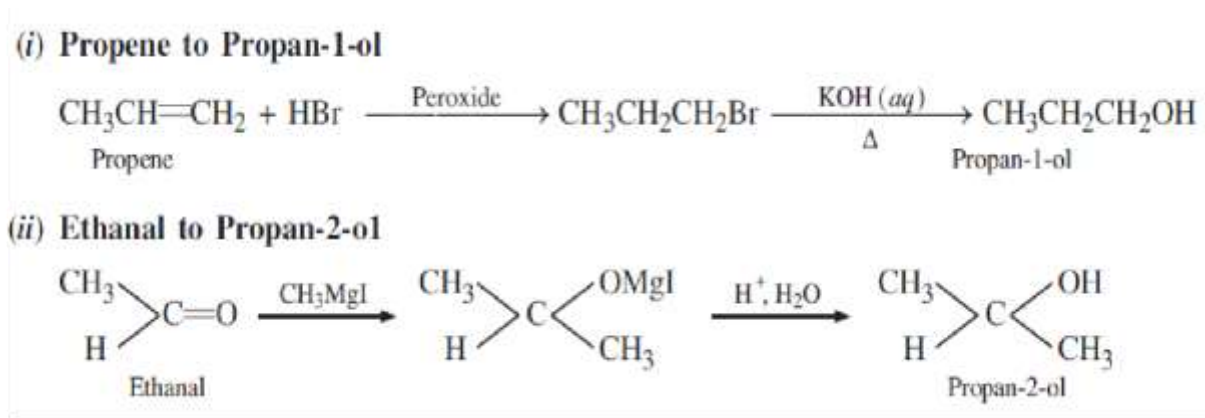
Thus, benzene is activated towards electrophilic substitution by the alkoxy group.

- (iv) It can also be observed from the resonance structures that the electron density increases more at the ortho and para positions than at the meta position. As a result, the incoming substituents are directed to the ortho and para positions in the benzene.

Ans10:(i) Add NaHCO_3 to each. Phenol will not react, benzoic acid will give brisk effervescence due to CO_2 .

- (ii) Add I_2 and NaOH . 2- Propanol will give yellow ppt. of Iodoform, whereas 1- propanol will not give yellow ppt.

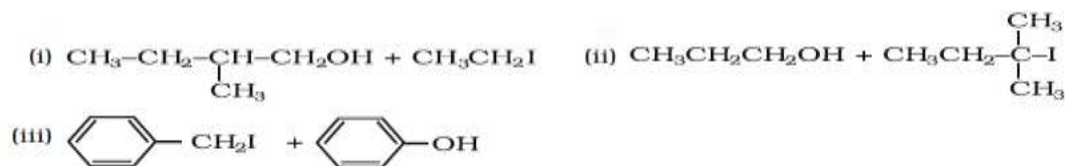
Ans11.



Ans12 : (i) n-butane <ethoxyethane<pentanal< pentan-1-ol

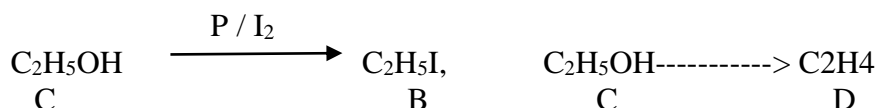
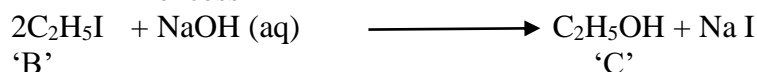
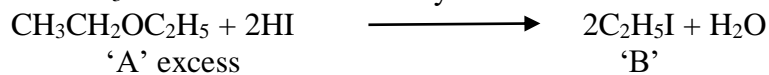
(ii) pentan-1-ol < 4-methylphenol < phenol < 3-nitrophenol.

Ans13.



Ans14. A' is not alcohol

therefore it does not react with Sodium metal. 'A' is not aldehydes and ketones as it does not react with NaHSO_3 'A' is not unsaturated hydrocarbon as it does not add Br_2 (aq) . It is likely to be ether.



A= ethoxyethane, B = iodoethane, C= Ethanol, D= Ethene

CHAPTERS: 1.ALDEHYDES, KETONES & CARBOXYLIC ACID
2. AMINES
3. BIOMOLECULES

REVISED SYLLABUS

Unit XII: Aldehydes, Ketones and Carboxylic Acids

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of Nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses. Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

Unit XIII: Amines

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Unit XIV: Biomolecules Carbohydrates - Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L Configuration

Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only),denaturation of proteins. Nucleic Acids: DNA and RNA.

UNIT XII: ALDEHYDES , KETONES & CARBOXYLIC ACID

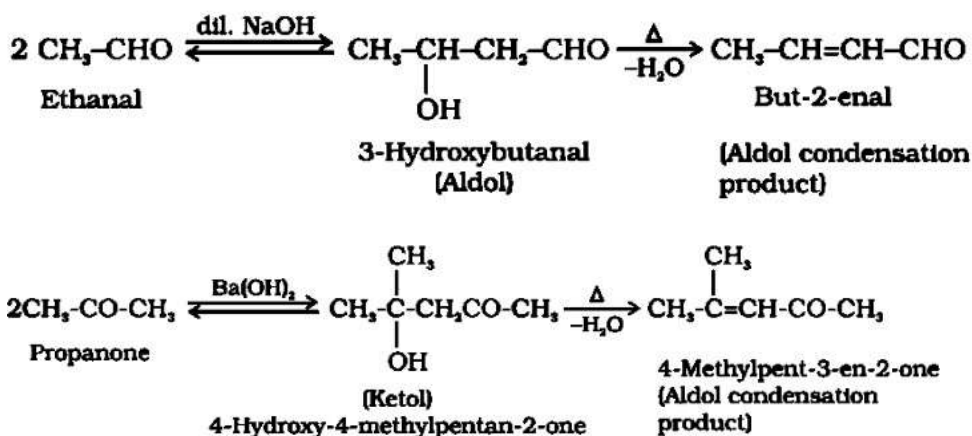
Important tips:

1. Nomenclature(Names & formula)
2. Name reactions
3. Distinguish Test
4. Conversion
5. Word problem
6. Reason based Questions
7. Mechanism

Important name reactions

I NAME REACTIONSBased

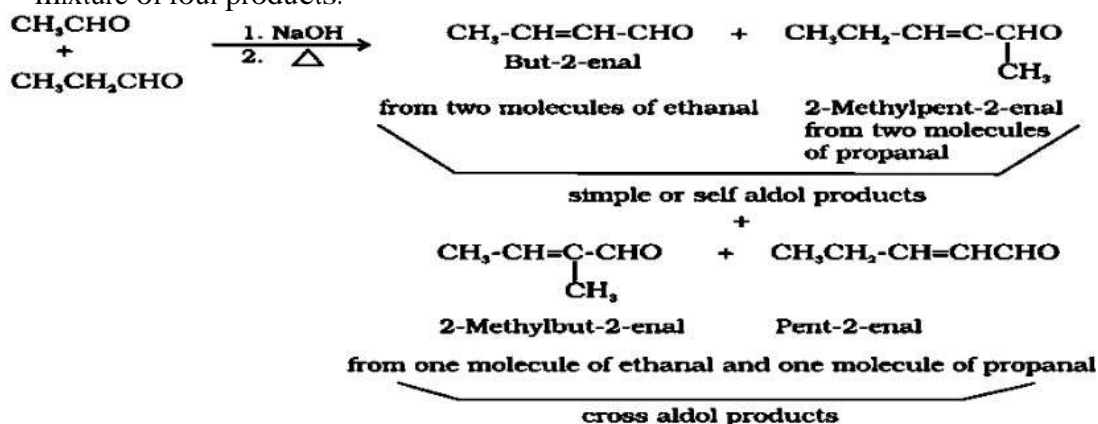
1. **AldolCondensation**:Aldehydes and ketones **having at least one α — hydrogen** undergo a condensation reaction in the presence of **dilute alkali** (NaOH,KOHetc.) as catalyst to form β - hydroxyl aldehydes (aldol) or β —hydroxyl ketone (ketol) respectively.



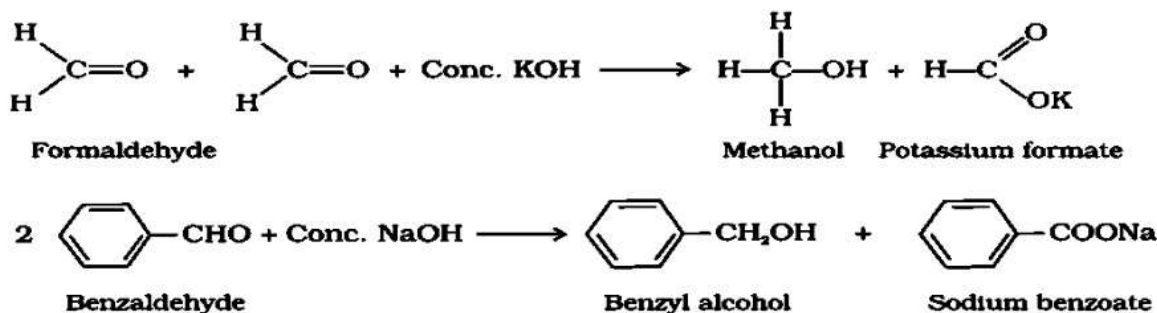
The name **Aldol** is derived from the name so the two function al groups ,aldehydes and alcohol,present in the products.The aldol and ketol readily lose water to give α,β -unsaturated carbonyl compounds which are aldol condensation products

And the reaction is called **Aldol condensation**.Though ketones give ketols(compounds containing a keto and alcohol groups),the general name aldol condensation still applies to the reactions of ketones due to their similarity with aldehydes.

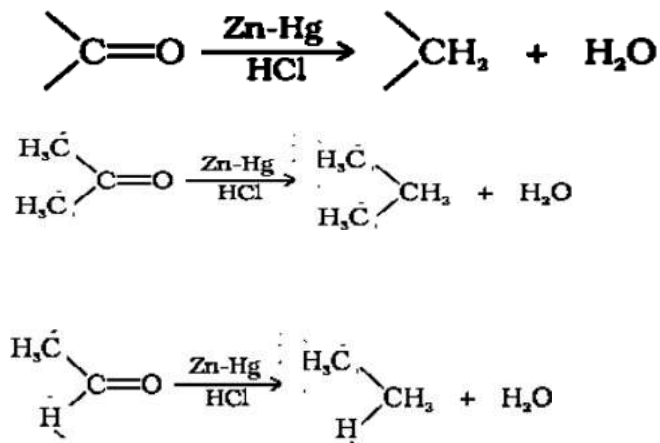
2. **CrossAldolCondensation:** When aldol condensation is carried out between two different aldehydes and /or ketones, it is called **cross aldol condensation**. If both of them contain α -hydrogen atoms, it gives a mixture of four products.



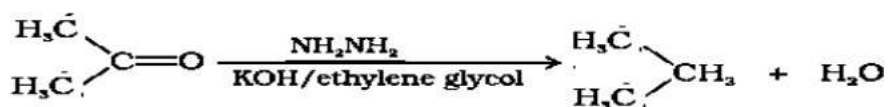
3. **CannizzaroReaction:** Aldehydes, which do not have an α -hydrogen atom, undergo self oxidation and reduction reaction on treatment with concentrated alkali. In this reaction one molecule of the aldehydes is reduced to alcohol and another is oxidized to carboxylic acid salt.



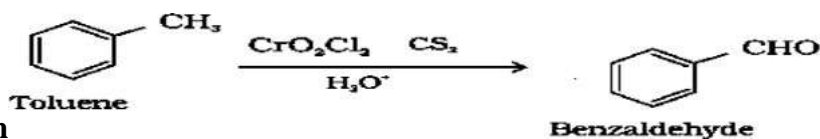
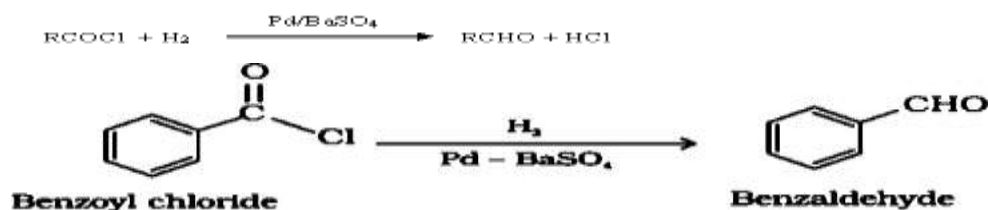
4. **ClemmensenReaction:** The carbonyl group of aldehydes and Ketones are reduced to CH_2 group on treatment with zinc amalgam (Zn/Hg) and concentrated hydrochloric acid. (Conc. HCl)



5. **WolfKishnerReaction:** The carbonyl group of aldehydes and Ketones are reduced to CH_2 group on treatment with hydrazine followed by heating with KOH in presence of ethylene glycol.

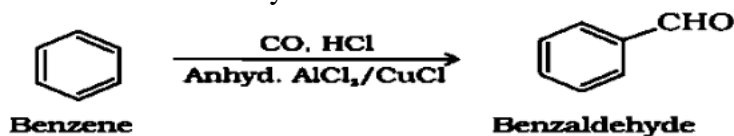


6. **RosenmundReaction:** Acylchloride (acidchloride) is hydrogenated over catalyst palladium on barium sulphate.

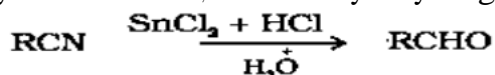


7. **Etard Reaction**

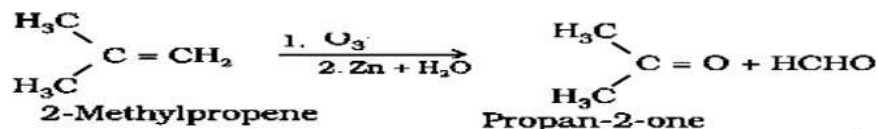
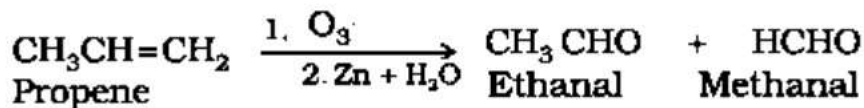
8. **Gatterman-Kochreaction:** When benzene or its derivative is treated with carbon monoxide and hydrogen chloride in the presence of anhydrous aluminium chloride or cuprous chloride, it gives benzaldehyde or substituted benzaldehyde.



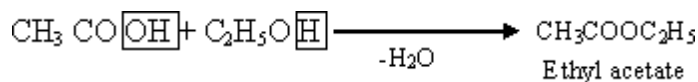
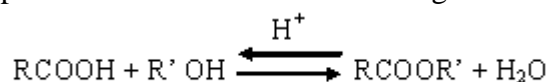
9. **StephenReaction:** Nitriles are reduced to corresponding imine with stannous chloride in the presence of hydrochloric acid, which on hydrolysis give corresponding aldehyde.



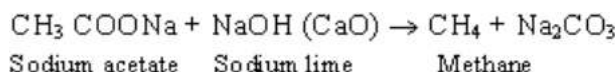
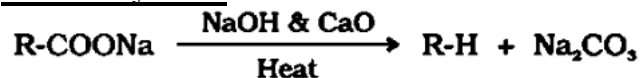
10. **Ozonolysis:** Ozonolysis of alkenes involves the addition of ozone molecule to alkene to form ozonide, and then cleavage of the ozonide by Zn-H₂O to Aldehyde and/ or Ketones.



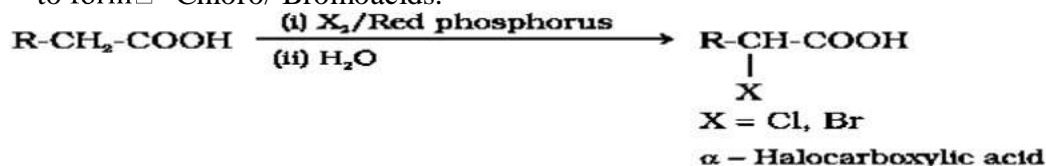
11. **Esterification:** Esters are generally prepared by heating carboxylic acids with alcohols in the presence of conc. H_2SO_4 or HCl gas.



12. **Decarboxylation:** Sodium salts of acids when heated with sodalime, alkanes are formed.

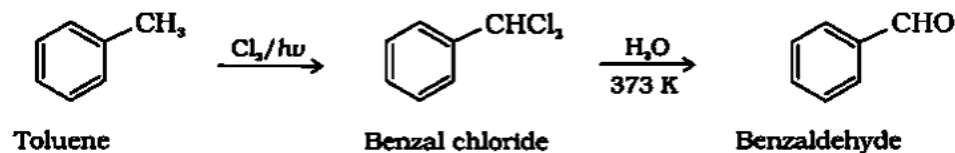


13. **HellVolhardZelinskyReaction** of carboxylic acids having an α -H atom with Cl_2/Br_2 in presence of red P to form α -Chloro/ Bromoacids.

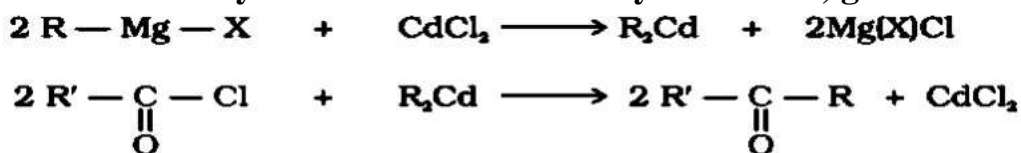


IMPORTANT REACTIONS

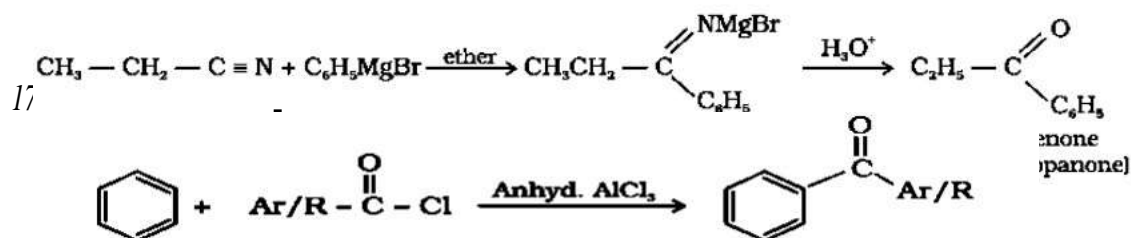
14. **Side chain chlorination of toluene** gives benzal chloride, which on hydrolysis gives benzaldehyde. This is a commercial method of manufacture of benzaldehyde.



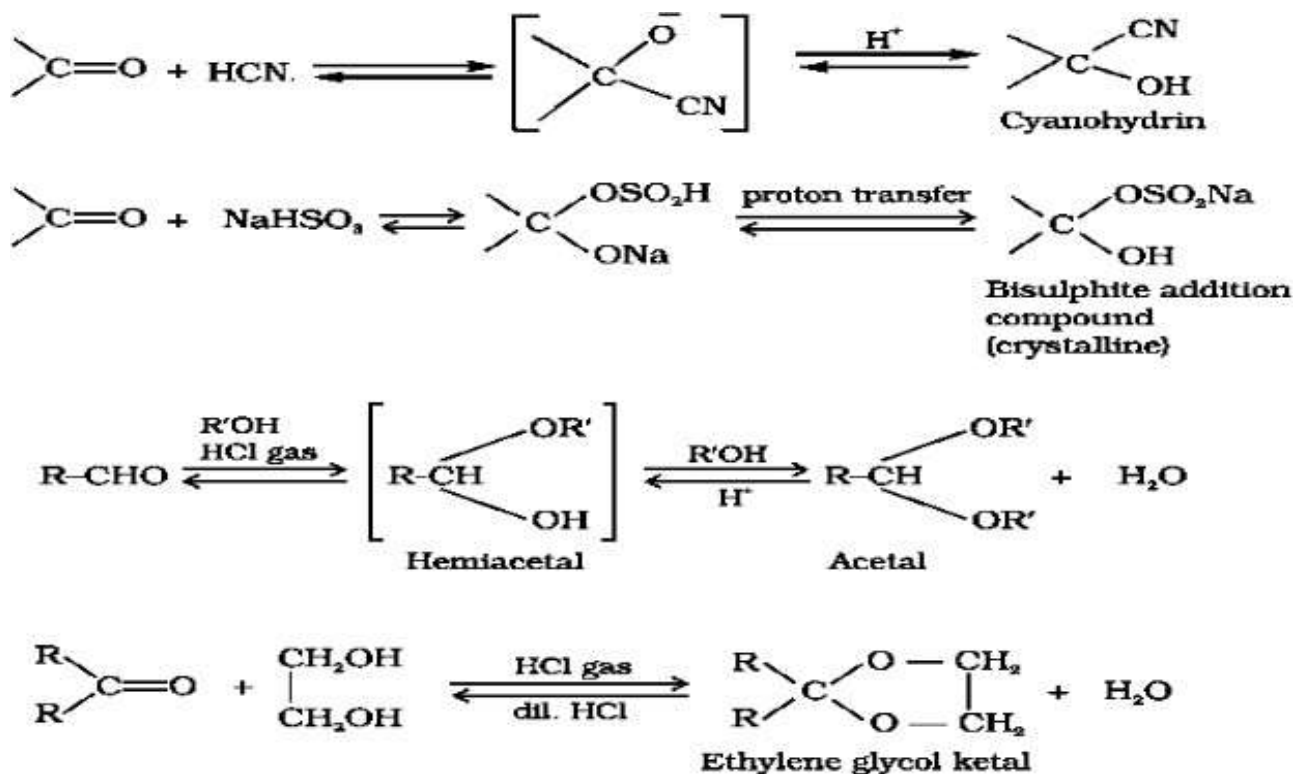
ketones.



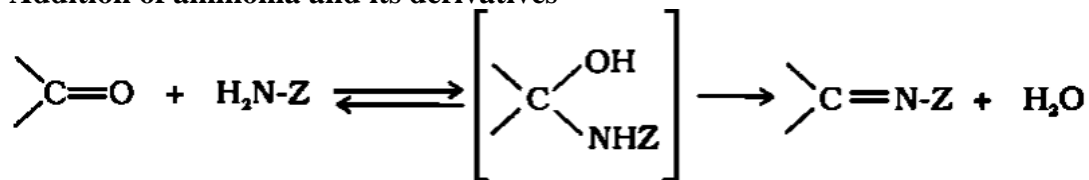
16. Reaction of a nitrile with Grignard reagent followed by hydrolysis yields a ketone



18. Nucleophilic addition reactions:



19. Addition of ammonia and its derivatives



Z = Alkyl, aryl, OH, NH₂, C₆H₅NH, NHCONH₂,

Important Distinguish test:

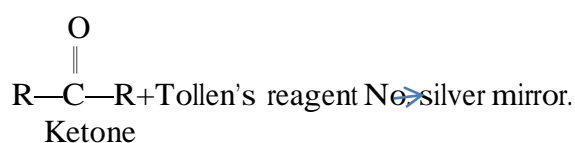
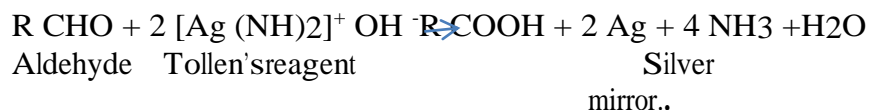
20. Tollens test

[Aliphatic Aldehydes (e.g.Ethanal,Propanale ETC & Aromatic Aldehydes (Benzaldehyde etc.)]

Tollens reagent: Ammoniacal. AgNO_3 or $[\text{Ag}(\text{NH}_3)_2]^+\text{OH}^-$

Test: On warming an aldehydes with freshly prepared ammoniacal silver nitrate solution (Tollens' reagent), a bright silver mirror [Ag] is produced due to the **formation of silver metal**.

Reaction:



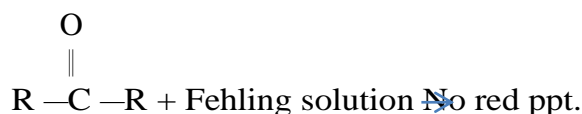
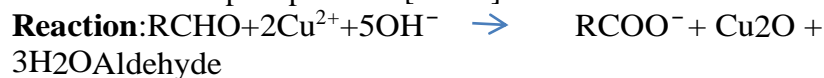
Important Note: Ketones do not give this test

21. Fehling's test:

[Only Aliphatic Aldehydes (e.g. Ethanal, Propanal etc)]

Fehling's reagent: Fehling solution A is Aqueous copper sulphate and Fehling solution B is alkaline sodium potassium tartarate (Rochelle salt)

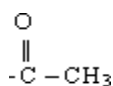
Test: On heating an aldehydes with Fehling's reagent, (equal amount of Fehling solution A & Fehling solution B) a reddish brown precipitate of $[\text{Cu}_2\text{O}]$ is obtained.



Important Note: Ketones do not give this test & also Aromatic aldehydes do not reduce Fehling solution

22. Iodoform Test (Aldehydes & Ketones)

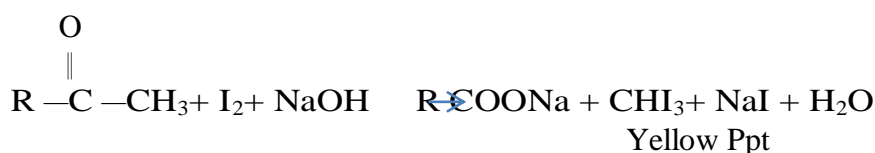
[Aldehydes & Ketones containing $-\text{COCH}_3$ linkage e.g. Ethanal (Acetaldehyde) Propanone (Acetone) etc.]



Reagent: I_2/NaOH

Test: Aldehydes & Ketones containing $-\text{COCH}_3$ linkage on reaction I_2/NaOH gives **Yellow Ppt** of CHI_3

Reaction



23. Sodium bicarbonate test

Aliphatic & Aromatic Carboxylic acids give this test.

Reagent: NaHCO_3 Sodium Hydrogen carbonate

Test: Carboxylic acids on reaction with NaHCO_3 (Sodium Hydrogencarbonate) gives **effervescence due to evolution of CO_2 gas.**



Special

24. Test for Methanoic acid (Formic acid)

Methanoic acid (Formic acid) give **Tollen's test & Fehling's test.**



(Silver Mirror)



(Red ppt)

Give a Chemical test to distinguish between pair of organic compound

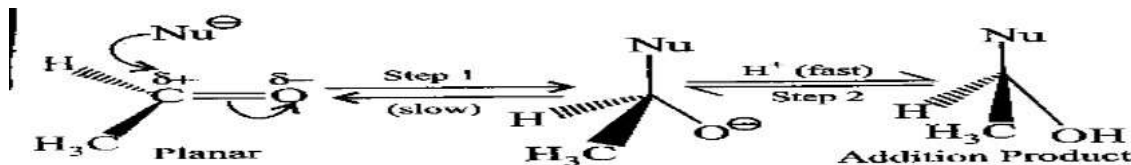
1. Propanal and Propanone	
2. Acetophenone and Benzophenone	7. Ethanal and Propanal
3. Phenol and Benzoic acid	8. Acetone and Acetaldehyde
4. Benzoic acid and Ethyl benzoate	9. Acetaldehyde and Benzaldehyde
5. Pentan-2-one and Pentan-3-one	10. Ethanoic acid and Ethynyl chloride
6. Benzaldehyde and Acetophenone	11. Formic acid and Acetic

II Mechanism Based Questions

I. Mechanism for Nucleophilic addition reaction in carbonyl compounds

Nucleophiles are CN^- , Cl^- , OH^- etc.

Mechanism - Nucleophile attacks electrophilic sp^2 hybridised carbon the hybridization changes to sp^3 and a tetrahedral alkoxide intermediate is formed which reacts with proton to form addition product.



Reactivity: Aldehydes are generally more reactive than ketones in Nucleophilic addition reactions due to steric and electronic reasons. Sterically, the presence of two relatively large substituents in ketones hinders the approach of nucleophile to carbonyl carbon than in aldehydes having only one such substituent. Electronically, aldehydes are more reactive than ketones because two alkyl groups reduce the electrophilicity of the carbonyl more effectively than in former.

QUESTION BANK

MCQ

- Which of the following compounds is most reactive towards nucleophilic addition reactions?
(i) Ethanal (ii) Propanone (iii) Acetophenone (iv) Benzophenone.
- The correct order of increasing acidic strength is:
(i) Phenol < Ethanol < Chloroacetic acid < Acetic acid
(ii) Ethanol < Phenol < Chloroacetic acid < Acetic acid
(iii) Ethanol < Phenol < Acetic acid < Chloroacetic acid
(iv) Chloroacetic acid < Acetic acid < Phenol < Ethanol
- The reagent which does not react with both, acetone and benzaldehyde.
(i) Sodium hydrogensulphite
(ii) Phenyl hydrazine
(iii) Fehling's solution
(iv) Grignard reagent
- Cannizaro reaction is not given by:
(i) Methanal
(ii) Benzaldehyde
(iii) Chloral
(iv) Ethanal
- Which of the following compounds will give butanone on oxidation with alkaline KMnO_4 solution?
(i) Butan-1-ol
(ii) Butan-2-ol
(iii) Both of these
(iv) None of these
- In Clemmensen Reduction carbonyl compound is treated with:
(i) Zinc amalgam + HCl (ii) Sodium amalgam + HCl
(iii) Zinc amalgam + HNO_3 (iv) Sodium amalgam + HNO_3

7. A carbonyl compound reacts with hydrogencyanide to form cyanohydrin which on hydrolysis forms a racemic mixture of α - hydroxyl acids. The carbonyl compound is:
 - (i) Formaldehyde
 - (ii) Acetaldehyde
 - (iii) Acetone
 - (iv) Diethyl ketone
8. The first product formed during reduction of aldehydes with hydrazine and KOH, is :
 - (i) R-CN
 - (ii) RCONH₂
 - (iii) RCH=NH
 - (iv) RCH=N-NH₂
9. Benzaldehyde and acetone can be best distinguished using:
 - (i) Fehling's solution
 - (ii) Sodium hydroxide solution
 - (iii) 2,4- DNP
 - (iv) Tollen's reagent
10. Iodoform test is not given by:
 - (i) 3-Pentanone
 - (ii) 2- Pentanone
 - (iii) Ethanal
 - (iv) Ethanol

1 Mark Questions:

1. Write IUPAC name of $\text{CH}_3\text{COCH}_2\text{COCH}_3$.
2. Why aldehydes are more reactive than ketones towards nucleophiles?
3. Why boiling point of aldehydes and ketones are lower than of corresponding carboxylic acids?
4. Why Ethanoic acid is a weaker acid than benzoic acid?
5. Why Monochloro ethanoic acid has higher pK_a value than dichloroacetic acid?
6. Although phenoxide ion has more number of resonating structures than carboxylate ion. Carboxylic acid is a stronger acid than phenol. Give two reasons.
7. What type of aldehyde undergo Cannizaro's reaction?
8. Write short note on Clemmensen reduction.
9. What happens when ethylbenzene is oxidised with alkaline KMnO_4 ?
10. How is benzaldehyde prepared from toluene?
11. Why Electrophilic substitution in benzoic acid takes place at meta position?
12. Why Benzoic acid less soluble in water than Acetic acid?
13. Mention a use of formalin in industry.
14. Among formaldehyde and acetaldehyde which will give aldol reaction and why?
15. What is Schiff's base? Write use of Schiff's base?

Assertion Reason type question:

Note : In the following questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (i) Assertion and reason both are correct and reason is correct explanation of assertion.
- (ii) Assertion and reason both are wrong statements.
- (iii) Assertion is correct statement but reason is wrong statement.
- (iv) Assertion is wrong statement but reason is correct statement.
- (v) Assertion and reason both are correct statements but reason is not correct explanation of assertion.

1. Assertion : Formaldehyde is a planar molecule.

Reason : It contains sp^2 hybridised carbon atom.

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 .

3. Assertion : The α -hydrogen atom in carbonyl compounds is less acidic.

Reason : The anion formed after the loss of α -hydrogen atom is resonance stabilised.

4. Assertion : Aromatic aldehydes and formaldehyde undergo Cannizzaro's reaction.

Reason : Aromatic aldehydes are almost as reactive as formaldehyde.

5. Assertion : Aldehydes and ketones, both react with Tollen's reagent to form silver mirror.

Reason : Both, aldehydes and ketones contain a carbonyl group.

3 Marks Question:

1. Give the name of reagents to bring about the following transformations:
 - (i) Benzoyl Chloride to benzaldehyde
 - (ii) Benzene to Benzaldehyde
 - (iii) Benzene to acetophenone.
2. How ethanol and benzaldehyde react with the reagents: (i) NaOH (ii) Tollen's reagent
3. Write the chemical equations when acetic acid reacts with:
 - (i) Br_2 in presence of phosphorus
 - (ii) Methanol in presence of H_2SO_4
 - (iii) NaOH
4. (i) How will you distinguish Pentan-2-one and Pentan-3-one by chemical test?
 - (ii) How will you convert propanone into propane.
 - (iii) Arrange the following compounds in the decreasing order of acidic strength
4- Nitrobenzoic acid, Benzoic acid, 4- methoxy benzoic acid.
5. Give the structure of the following compounds.
 - a. 4-Nitropropionophenone
 - b. 2-Hydroxycyclopentanecarbaldehyde
 - c. Phenyl acetaldehyde
6. Name the electrophile produced in the reaction of benzene with benzoyl chloride in the presence of anhydrous AlCl_3 . Name and write the reaction also.
7. Oxidation of ketones involves carbon-carbon bond cleavage. Name the products formed on oxidation of 2, 5-dimethylhexan-3-one.
8. What products will be formed on reaction of propanal with 2-methylpropanal in the presence of NaOH ? What products will be formed? Write the name of the reaction also.
9. Account for following:
 - (i) Cyclohexanone forms cyanohydrin in good yield but 2,2,6- trimethyl cyclohexanone does not.
 - (ii) There are two —NH_2 groups in semicarbazide. However, only one is involved in the formation of semicarbazones.
 - (iii) During the preparation of esters from carboxylic acid and an alcohol in the presence of an acid catalyst, the water on the ester should be removed as fast as it is formed.
10. Predict the products formed when cyclohexanecarbaldehyde reacts with following reagents:
 - (i) PhMgBr and then H_3O^+
 - (ii) Zinc amalgam and hydrochloric acid
 - (iii) Excess ethanol and acid.

Wordproblems

1. An organic compound A which has a 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 sodium salt of acid. C when heated with sodalime yields an aromatic hydrocarbon D. Deduce structures A-D

- An organic compound A with molecular formula $C_4H_{10}O$ undergoes oxidation to give B C_4H_8O . B forms an oxime but does not reduce Fehling solution. Reacts with I_2 and KOH to form iodoform. Derive the structures of A and B and write the reactions.
- An organic compound with molecular formula $C_5H_{10}O$ forms 2,4-DNP derivative, but does not answer Tollens test. It was oxidised to a carboxylic acid B with molecular formula $C_3H_6O_2$ when treated with alkaline $KMnO_4$ under vigorous conditions. The sodium salt of B gave a hydrocarbon C on Kolbe's electrolytic reaction. Identify A, B, and C and write the reactions involved.
- An organic compound with molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollens' reagent, and undergoes Cannizzaro reaction. On vigorous oxidation, it gives 1,2 benzene dicarboxylic acid. Identify the compound.

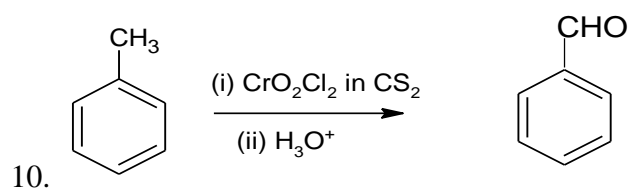
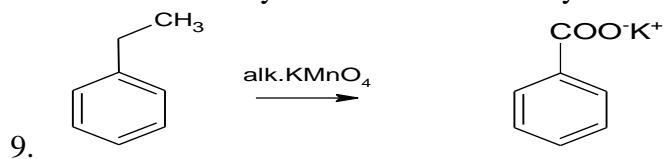
Answers

MCQ

- (i)
- (iii)
- (iii)
- (iv)
- (ii)
- (i)
- (ii)
- (iv)
- (iv)
- (i)

1Mark :

- Pentane-2,4-dione.
- Due to less +I effect in aldehydes relative to ketones.
- Due to presence of intermolecular hydrogen bonding in carboxylic acid.
- The resonance stability of benzoate ion is more than ethanoate ion.
- Due to less -I effect in monochloroacetic acid relative to dichloroacetic acid.
- (i) Due to greater resonance stability of carboxylate ion than phenoxide ion.
(ii) Negative charge is present on more electronegative oxygen atom in carboxylate ion.
- Aldehydes which do not have alpha hydrogen atom.
- It reduces aldehydes and ketones into hydrocarbons in presence of zinc and concentrated hydrochloric acid.



- Because electron density is more at meta position as $-COOH$ group decreases electron density at ortho and para position.
- Due to nonpolar nature of benzene ring.
- To manufacture Bakelite and in tanning of hides.
- Acetaldehyde gives aldol reaction due to presence of alpha hydrogen atom.

15. A compound with general formula $R_2C=NR'$ ($R' \neq H$). It is used as intermediate in organic synthesis, catalyst, pigments and dyes.

ASSERTION REASON ANSWERS:

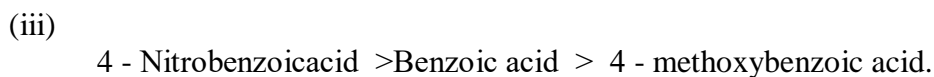
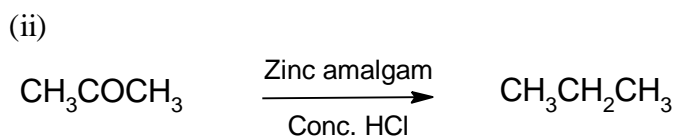
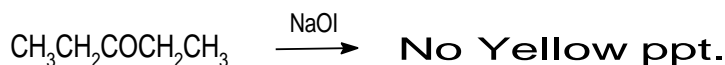
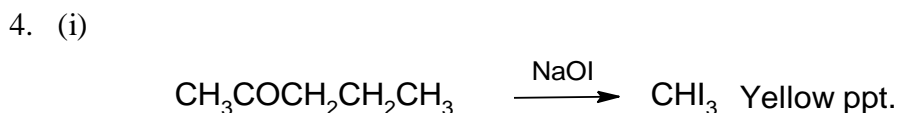
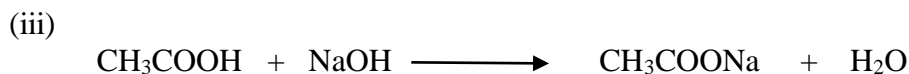
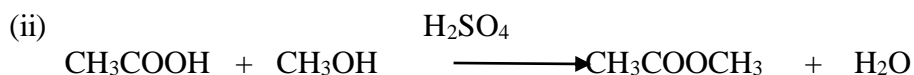
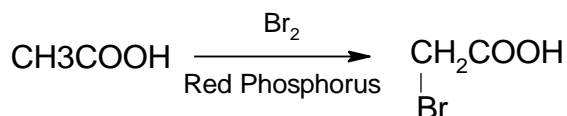
1. (i)
2. (v)
3. (iv)
4. (iii)
5. (iv)

3 MARK ANSWERS

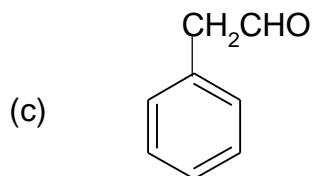
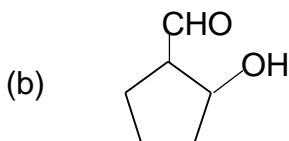
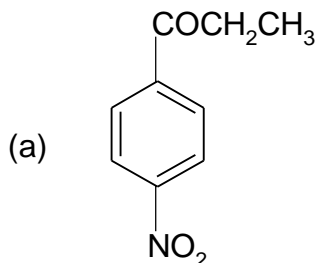
1. (i) H_2 gas with $Pd/BaSO_4$ (ii) CO with HCl (iii) $CH_3COCl/Anhyd, AlCl_3$
2. (i) $NaOH$: Ethanol does not react with $NaOH$ but Benzaldehyde gives Cannizaro reaction.

$$C_6H_5CHO + C_6H_5CHO + Conc. NaOH \longrightarrow C_6H_5CH_2OH + C_6H_5COONa$$
 (ii) Tollen's reagent: Ethanol does not reduce Tollen's reagent but Benzaldehyde reduces Tollen's reagent.

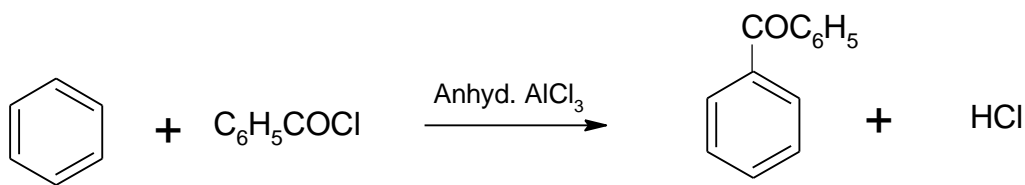
$$C_6H_5CHO + [Ag(NH_3)_2]^+ + 2OH^- \longrightarrow C_6H_5COO^- + NH_3 + 2Ag + H_2O$$
3. (i)



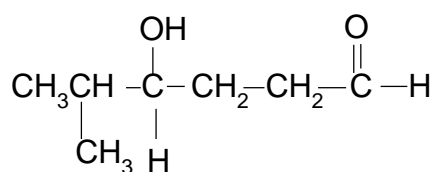
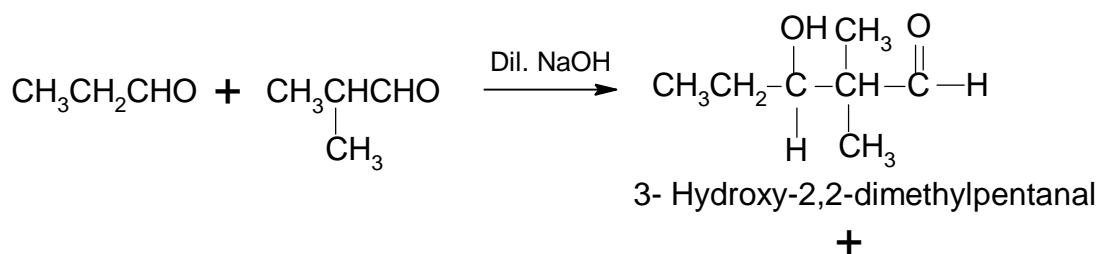
5.



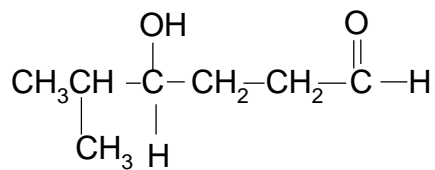
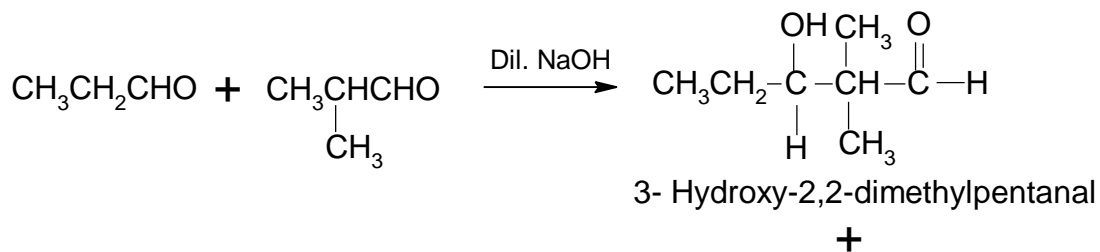
6. Benzoyl carbonium $C_6H_5C^+O$, Friedel craft benzoylation reaction



7. Ethanoic acid CH_3COOH
 Propanoic acid $\text{CH}_3\text{CH}_2\text{COOH}$
 Butanoic acid $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$



8. 4- Hydroxy-5-methylhexanal

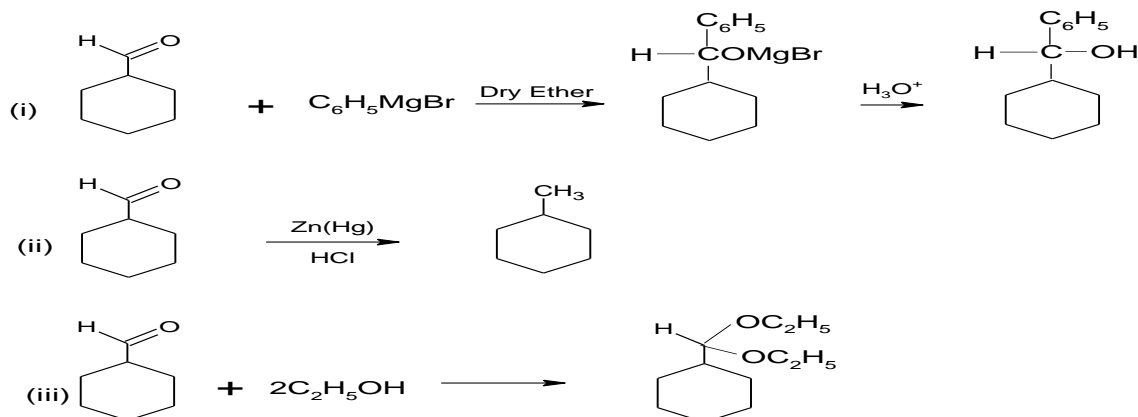


- 4- Hydroxy-5-methylhexanal

9. (i) Due to steric hindrance in 2,2,6- trimethyl cyclohexanone does not form cyanohydrin in good yield.
 (ii) Because electron pair of one $-\text{NH}_2$ group is delocalise due to resonance and can not act as nucleophile.

(iii) To shift equilibrium in forward direction.

10.



Answer of word problem

1: A is $\text{C}_6\text{H}_5\text{CHO}$; B is $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$; C is $\text{C}_6\text{H}_5\text{COONa}$; D is C_6H_6

2:Bis $\text{CH}_3\text{COCH}_2\text{CH}_3$ So A is $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$

3: A is a ketone B is $\text{CH}_3\text{CH}_2\text{COOH}$, C is C_2H_6 A is $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$

4: compound is an aldehyde.2.

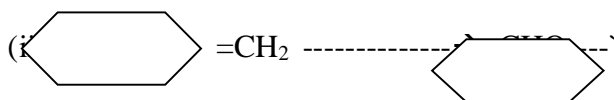
–CHO group is directly attached to benzene ring 3. It must be ortho substituted benzaldehyde. So the compound is o-ethylbenzaldehyde

Important Question based on Previous year cbse board examination 2010-11

1. Draw the structure of 4-chloropentane -2-one.
 2. Illustrate the following name reaction:
 - (i). Cannizzaro's reaction
 - (ii). Clemmensen reduction
 - (b). How would you obtain the following :
 - (i). But-2-enal from ethanol
 - (ii) Butanoic acid from butanol
 - (iii) Benzoic acid from ethylbenzene
- Or
- (a). Give chemical test to distinguish between the following :
 - (i). Benzoic acid and ethyl benzoate
 - (ii) Benzaldehyde and acetophenone
 - (b). Complete each synthesis by missing reagents or products in the following :

$\Delta + \text{SOCl}_2$

 - (i) $\text{C}_6\text{H}_5 - (\text{COOH})_2 \longrightarrow$
 - (ii) $\text{H}_2\text{NCONHNH}_2$



2011-12

1. Write the IUPAC name of the following
 $\text{CH}_3\text{-CH}_2\text{-CH=CH-CHO}$
2. Write a suitable chemical
3. (a). Write a suitable chemical equation to complete each of the following transformation :
 - (i). Butan-1-ol to butanoic acid
 - (ii) 4-Methylacetophenone to benzene-1,4-dicarboxylic acid

(b) An organic compound with molecular formula $C_9H_{10}O$ forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro's reaction. On vigorous oxidation it gives 1,2 benzenedicarboxylic acid. Identify the compound.

Or

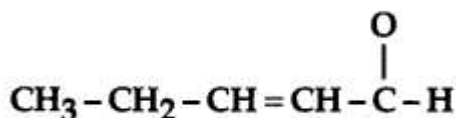
- (a). Give chemical tests to distinguish between
- Propanol and propanone
 - Benzaldehyde and acetophenone
- (b). Arrange the following compounds in an increasing order of their property as indicated:
- Acetaldehyde, acetone, Methyl tert-butyl ketone (reactivity towards HCN)
 - Benzoic acid, 3,4- Dinitrobenzoic acid, 4 – Methoxybenzoic acid (acid strength)
 - $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$, $(CH_3)_2CHCOOH$ (acid strength)

Set-3

1. Write the IUPAC name of the following :
- $CH_3-CH_2-CH=CH-CHO$

2012-13

1. Write the IUPAC name of the following: [1]



2. (a). Write a suitable chemical equation to complete each of the following transformations:

- Butan-1-ol to butanoic acid
- 4-Methylacetophenone to benzene-1, 4-dicarboxylic acid

(b) An organic compound with molecular formula $C_9H_{10}O$ forms 2, 4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro's reaction. On vigorous oxidation, it gives 1, 2-benzene dicarboxylic acid. Identify the compound.

OR

- (a) Give chemical tests to distinguish between:

- Propanol and propanone
- Benzaldehyde and acetophenone

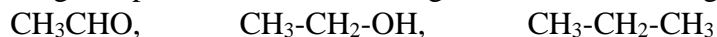
- (b) Arrange the following compounds in increasing order of their property as indicated:

- Acetaldehyde, Acetone, Methyl tert-butyl ketone (reactivity towards HCN)
- Benzoic acid, 3, 4-dinitrobenzoic acid, 4-Methoxy-benzoic acid (acid strength)
- $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$, $(CH_3)_2CHCOOH$ (acid strength)

3. Write the IUPAC name of $Ph-CH=CH-CHO$. [1] (set-2)

2013-14

1. Rearrange the following compounds in the increasing order of their boiling points:



2. (a). How will you convert the following :

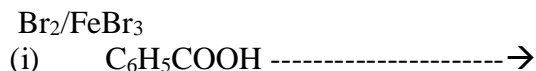
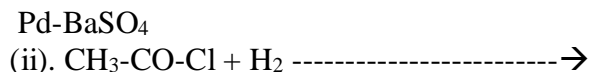
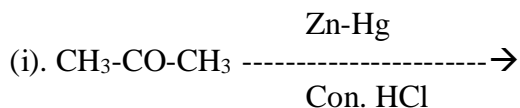
- Propanone to Propan -2-ol
- Ethanal to 2- hydroxypropanoic acid
- Toluene to benzoic acid

- (b). Give simple chemical test to distinguish between:

- Pentan -2-one and Pentane -3-one
- Ethanal and Propanal

Or

Write the Product of the following reaction:

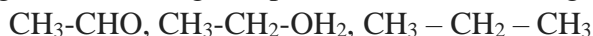


(b). Which acid of each pair shown here would you expect to be stronger ?

(i). F-CH₂-COOH or Cl-CH₂-COOH

(ii). C₆H₅-OH or CH₃COOH

1. Rearrange the following compounds in the increasing order of their boiling points: [1]



2014-15

1. Write the structure of p-methylbenzaldehyde. [1]

2. (a) Write the products formed when CH_3CHO reacts with the following reagents:

(i) HCN

(ii) H₂N-OH

(iii) CH_3CHO in the presence of dilute NaOH

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

(i) Benzoic acid and Phenol

(ii) Propanal and Propanone

OR

(a) Account for the following:

(i) Cl-CH₂COOH is stronger acid than CH₃COOH.

(ii) Carboxylic acids do not give reactions of carbonyl group.

(b) Write the chemical equations to illustrate the following name reactions:

(i) Rosenmund reduction

(ii) Cannizzaro's reaction

(c) Out of $\text{CH}_3\text{CH}_2\text{-CO-CH}_2\text{-CH}_3$ and $\text{CH}_3\text{CH}_2\text{-CH}_2\text{-CO-CH}_3$,

which gives iodoform test? [5]

Set-2

1. Write the structure of 4-chloropentan-2-one. [1]

2015-16

1. (a). Name the reagents used in the following reactions :

(i) C₆H₅ - COCl $\xrightarrow{\hspace{1cm}}$ C₆H₅ - CHO

(ii) CH₃ - COONa $\xrightarrow{\hspace{1cm}}$ CH₄

OR

Arrange the following compounds in increasing order of their property as indicated :

(i) CH₃COCH₃, C₆H₅ -CO -C₆H₅, CH₃CHO (reactivity towards nucleophilic addition reaction)

(ii) Cl -CH (Cl)-COOH, Cl-CH₂-COOH, CCl₃ - COOH (acidic character)

2. Predict the products of the following reactions :



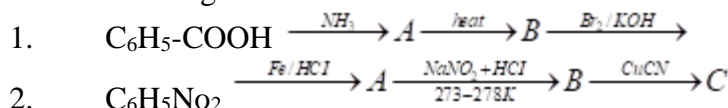
(a). CH_3CHO ----- \rightarrow ?

$\text{CO}_2, \text{H}_3\text{O}^+$
(b). $\text{C}_6\text{H}_5\text{MgBr}$ ----- \rightarrow ?

LiAlH_4
(c). CH_3CN ----- \rightarrow ?

2016-17

1. An organic compound 'X' having molecular formula $\text{C}_4\text{H}_8\text{O}$ gives orange-red ppt. with 2,4-DNP reagent. It does not reduce Tollen's reagent but gives yellow ppt. of iodoform on heating. It gives compound which undergoes NaOI. Compound X on reduction with LiAlH_4 gives compound 'Y' which undergoes dehydration reaction on heating with conc. H_2SO_4 to form But-2-ene. Identify the compounds X and Y.
2. Give reasons:
 1. The α -hydrogen atoms of aldehydes and ketones are acidic in nature.
 2. Oxidation of aldehydes is easier than ketones.
 3. $\text{CH}_2=\text{CH}-\text{COOH}$ is more acidic than $\text{CH}_3\text{CH}_2\text{CH}_2-\text{COOH}$.
3. Complete the following reactions:



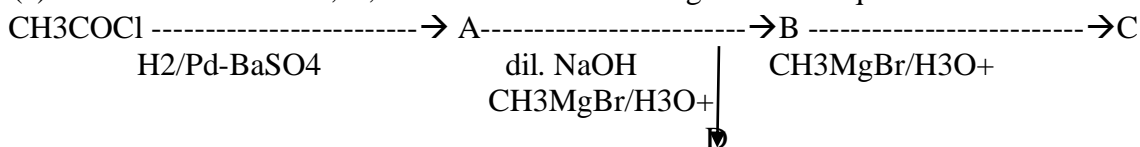
2017-18

Set-1

1. (a). 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.
- (b) Give simple chemical test to distinguish between the following pairs of compounds :
 - (i) Acetophenone and benzaldehyde
 - (ii) Benzoic acid and ethylbenzoate

OR

- (a) Write structures of A, B, C and D in the following reaction sequence :



- (b) Arrange the following compounds in the increasing order of their boiling points :
 CH_3CHO , $\text{CH}_3\text{CH}_2\text{OH}$, CH_3OCH_3 , CH_3COOH

2018-19

Set-1

3. How do you convert the following ?
 - (a) Ethanal to Propanone
 - (b) Toluene to Benzoic acid

OR

Account for the following :

- (a) Aromatic carboxylic acids do not undergo Friedel-Crafts reaction.
 - (b) pK_a value of 4-nitrobenzoic acid is lower than that of benzoic acid.
2. (A), (B) and (C) are three non-cyclic functional isomers of a carbonyl compound with molecular formula $\text{C}_4\text{H}_8\text{O}$. Isomers (A) and (C) give positive Tollens' test whereas isomer (B) does not give Tollens' test but gives positive Iodoform test. Isomers (A) and (B) on reduction with $\text{Zn}(\text{Hg})/\text{conc. HCl}$ give the same product (D).

(a) Write the structures of (A), (B), (C) and (D).

(b) Out of (A), (B) and (C) isomers, which one is least reactive towards addition of HCN ?

COMPARTMENT-

1. An aromatic organic compound 'A' with molecular formula C_8H_8O gives positive DNP and iodoform tests. It neither reduces Tollens' reagent nor does it decolourise bromine water. Write the structure of 'A'.
 2. (I). Give reasons :
 - (a) $HCHO$ is more reactive than CH_3-CHO towards addition of HCN.
 - (b) pK_a of O_2N-CH_2-COOH is lower than that of CH_3-COOH .
 - (c) Alpha hydrogen of aldehydes & ketones is acidic in nature.
 3. (ii) Give simple chemical tests to distinguish between the following pairs of compounds :
 - (a) Ethanal and Propanal
 - (b) Pentan-2-one and Pentan-3-one
- OR
- (i) Write structure of the product(s) formed :
 - (a) $CH_3-CH_2-COOH \xrightarrow{Cl_2, \text{ red phosphorus}}$
 - (b) $C_6H_5COCl \xrightarrow{H_2, Pd - BaSO_4}$
 - (c) $2HCHO \xrightarrow{\text{Conc. KOH}}$
- (ii) How will you bring the following conversions in not more than two steps :
 - (a) Propanone to propene
 - (b) Benzyl chloride to phenyl ethanoic acid

2019-20

1. Carry out the following conversions :
 - (i) P-nitrotoluene to 2-bromobenzoic acid
 - (ii) Propanoic acid to acetic acid
 2. An alkene with molecular formula C_5H_{10} on ozonolysis gives a mixture of two compounds, B and C. Compound B gives positive Fehling test and also reacts with iodine and NaOH solution. Compound C does not give Fehling solution test but forms iodoform. Identify the compounds A, B and C.
- OR
- (a) Carry out the following conversions :
 - (i) Benzoic acid to aniline
 - (ii) Bromomethane to ethanol
- (b) Write the structure of major product(s) in the following :
 - (a). H_2N-NH_2
 - (i). $CH_3-CH_2-CHO \xrightarrow{\hspace{2cm}} \rightarrow$
 - (b) KOH Glycol/heat
 - (ii). $CH_3-C(CH_3)_2-CHO \xrightarrow{\text{Conc. NaOH}} \rightarrow$
 - (iii). $C_6H_5COOH \xrightarrow{\hspace{2cm}} \rightarrow$

NaOH

COMPARTMENT-

1. Draw the structure of semicarbazone of cyclopentanone.

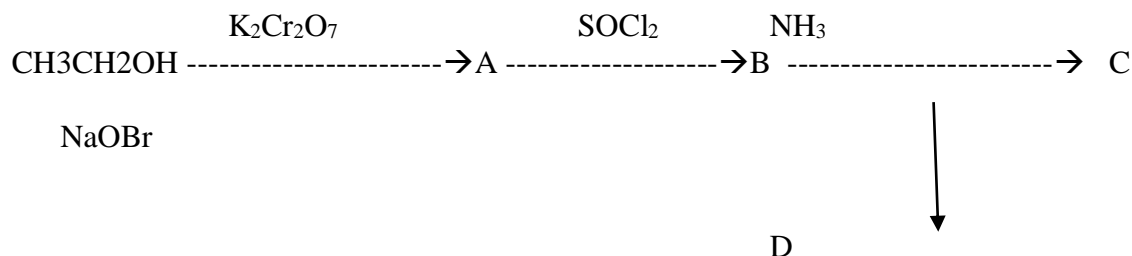
OR

Draw the structure of product formed when propanal is treated with zinc amalgam and concentrated hydrochloric acid.

2. (a). An organic compound with the molecular formula C_7H_6O forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro reaction. On oxidation, it gives benzoic acid. Identify the compound and state the reactions involved.
- (b) Give chemical tests to distinguish between the following pair of compounds :
 - (i) Phenol and propanol
 - (ii) Benzoic acid and benzene

OR

(a) Predict the products of the following :



(b) Arrange the following in increasing order of acidic character :



2020-21-

set-1

- Assertion (A) : Reactivity of ketones is more than aldehydes.
Reason (R) : The carbonyl carbon of ketones is less electrophilic as compared to aldehydes.
- Write the products formed when $(\text{CH}_3)_3\text{C} - \text{CHO}$ reacts with the following reagents :
 - CH_3COCH_3 in the presence of dilute NaOH
 - HCN
 - Conc. NaOH

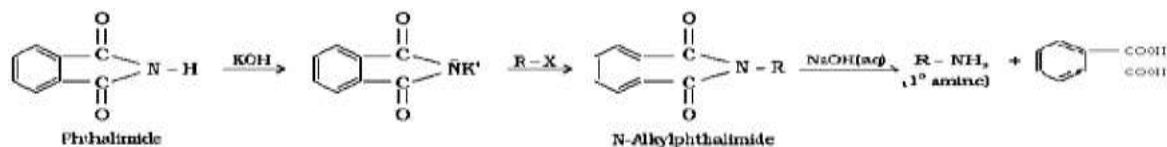
UNIT:XIIAMINES

IUPAC Nomenclature Based

Formula	IUPAC Name	Suffix	Prefix
$\text{R} - \text{NH}_2$	Alkanamine	amine	amino

NAME REACTIONS Based

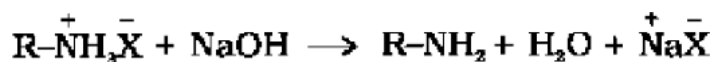
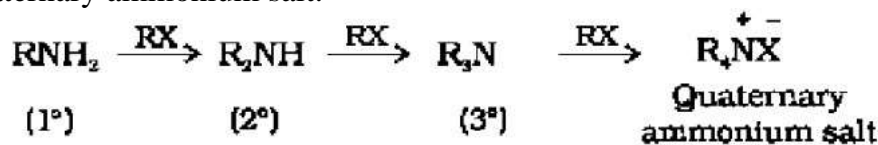
- Hoffmann bromamide degradation reaction:** When primary amides are treated with bromine in the presence of an alkali, a primary amine containing one carbon less than the amide is formed.
 $\text{RCONH}_2 + 4\text{NaOH} + \text{Br}_2 \rightarrow \text{RNH}_2 + 2\text{NaBr} + \text{Na}_2\text{CO}_3 + 2\text{H}_2\text{O}$
- Gabriel phthalimide synthesis:** 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 donot undergo Nucleophilic substitution with the anion formed by phthalimide.

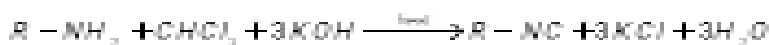
- Ammonolysis:** An alkyl or benzyl halide on reaction with an ethanolic solution of ammonia undergoes

Nucleophilic substitution reaction in which the halogen atom is replaced by an amino(–NH₂) group. This process of cleavage of the C–X bond by ammonia molecule is known as **ammonolysis**. The reaction is carried out in a sealed tube at 373K. The primary amine thus obtained behaves as a nucleophile and can further react with alkyl halide to form secondary and tertiary amines, and finally quaternary ammonium salt.



Note: Ammonolysis has the disadvantage of yielding a mixture of primary, secondary and tertiary amines and also a quaternary ammonium salt. However, primary amine is obtained as a major product by taking large excess of ammonia.

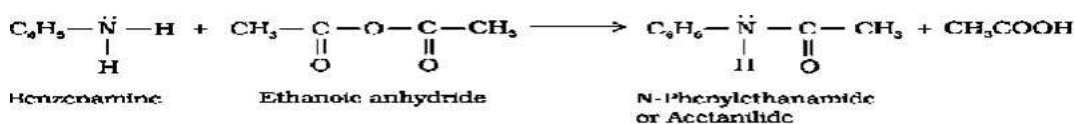
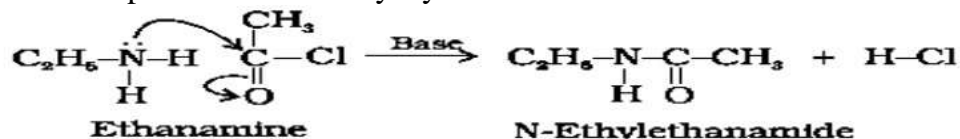
4. **Carbylamine reaction (Isocyanide test):** Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines which are foul smelling substances.



Note: Secondary and tertiary amines do not show this reaction. It is used as a test for primary amines

1. **Acylation:** (Replacement of hydrogen atom of –NH₂ or >N–H group by the acyl group.)

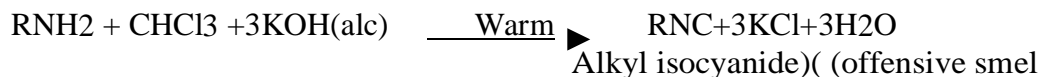
Aliphatic and aromatic primary and secondary amines react with acid chlorides, anhydrides and esters by nucleophilic substitution reaction. This reaction is known as acylation. The products obtained by acylation reaction are known as amides.



Chemical Test

Isocyanide test (Carbylamine reaction)

- ☐ **Primary Aliphatic** (e.g. Ethanamine) & **Aromatic amines** (e.g. Aniline) give this test.
- ☐ **Reagent:** Chloroform (CHCl₃) + Alcoholic KOH
- ☐ **Test:** Aliphatic and aromatic primary amines on heating with chloroform and ethanolic potassium hydroxide form isocyanides or carbylamines which are foul smelling substances. (Unpleasant odor)
- ☐ **Reaction:**

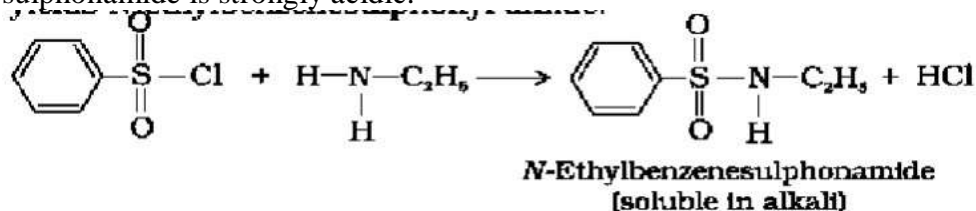


- ☐ **Important note:** Secondary and tertiary amines do not give this test.

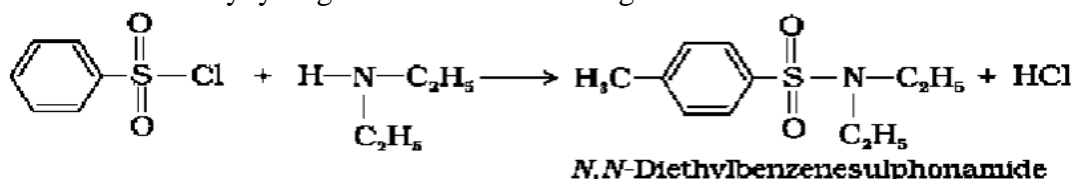
Heinsberg test

- **To distinguish between Primary (1^o), Secondary (2^o), & Tertiary (3^o) Amines.**
- **Reagent:** Benzenesulphonyl chloride C₆H₅SO₂Cl (Heinsberg reagent)

Test: (i) **Primary amine** reacts with benzenesulphonyl chloride (Heinsberg reagent) to give N-Ethylbenzenesulphonyl amide which is soluble in alkali because the hydrogen attached to nitrogen in sulphonamide is strongly acidic.



(ii) **Secondary amine** reacts with benzenesulphonyl chloride (Heinsberg reagent) to give N,N-diethylbenzenesulphonamide which is insoluble in alkali. Since N,N-diethylbenzenesulphonamide does not contain any hydrogen atom attached to nitrogen atom.

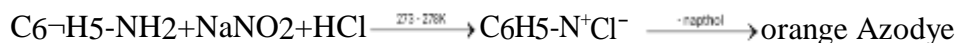


(iii) Tertiary amines do not react with benzenesulphonyl chloride.

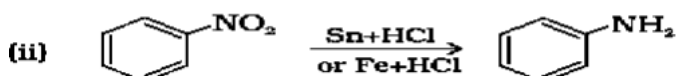
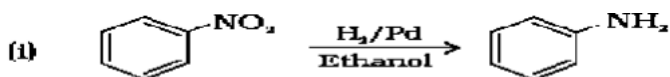
Important note: Now day's benzenesulphonyl chloride is replaced by **p-toluenesulphonyl chloride**.

Azo dyestest

- **Aniline & its derivative give this test.**
- **Reagent:** (NaNO₂ + HCl) [Nitrous acid] followed by β-naphthol
- **Test:** Aniline on reaction with NaNO₂ + HCl at 273-278 K gives BDC which forms a brilliant orange dye with β-naphthol in sodium hydroxide.
- **Reaction:**

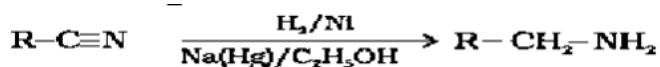


IMPORTANT REACTIONS

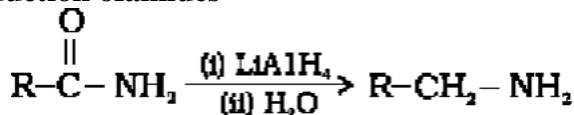


2. Reduction of nitro compounds

3. Reduction of nitriles

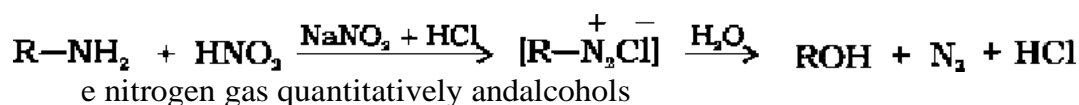


4. Reduction of amides

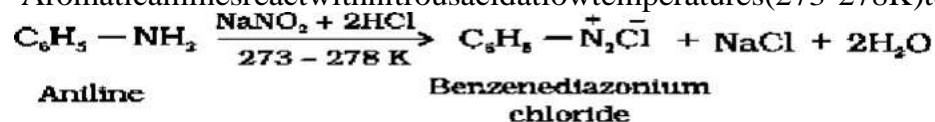


5. Reaction with nitrous acid

- Primary aliphatic amines react with nitrous acid to form aliphatic diazonium salts which being unstable, liberate

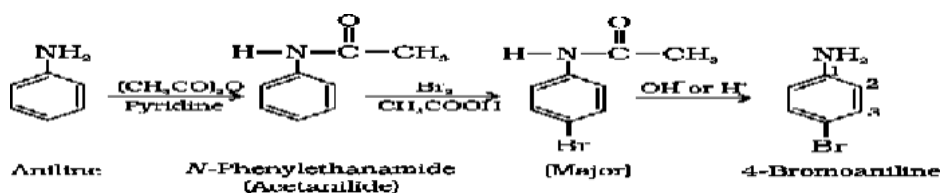
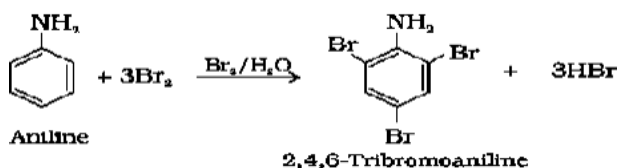


- Aromatic amines react with nitrous acid at low temperatures (273-278K) to form diazonium salts

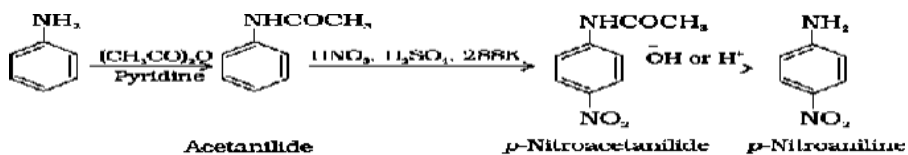
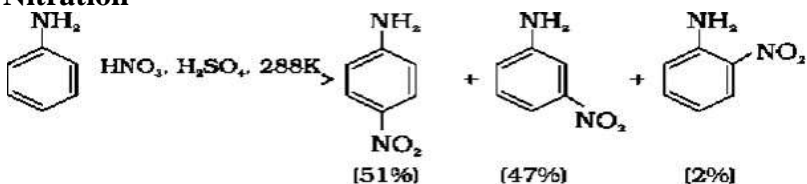


6. Electrophilic substitution (–NH₂ group is ortho and para directing)

- Bromination



- Nitration



CHARACTERS OF AMINES

Basic strength in gaseous phase $\text{Et}_3\text{N} > \text{Et}_2\text{NH} > \text{EtNH}_2 > \text{NH}_3$

Basic strength in aqueous $\text{Et}_2\text{NH} > \text{EtNH}_2 > \text{NH}_3 > \text{PhNH}_2$

Basic strength $\text{p-Toluidine} > \text{Aniline} > \text{p-Nitroaniline}$

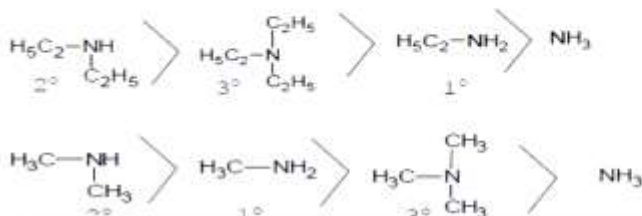
p^{Kb} value $\text{PhNH}_2 > \text{PhNHCH}_3 > \text{EtNH}_2 > \text{Et}_2\text{NH}$

Solubility $\text{EtNH}_2 > \text{Et}_2\text{NH} > \text{PhNH}_2$

Basic strength $\text{Et}_2\text{NH} > \text{CH}_3\text{NH}_2 > \text{PhNMe}_2 > \text{PhNH}_2$

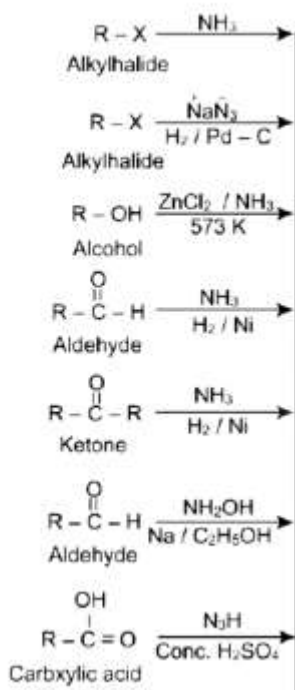
Boiling point $\text{EtOH} > \text{EtNH}_2 > \text{Et}_2\text{NH}$

Basic strength in Aqueous medium



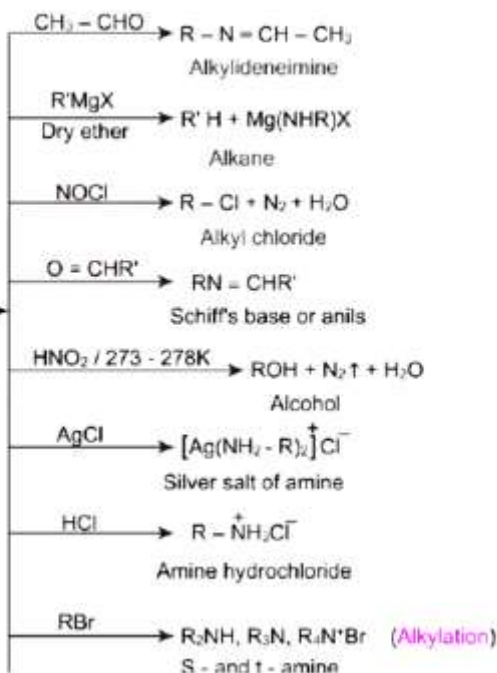
ALIPHATIC AMINES

PREPARATION



**R-NH₂
Amine**

PROPERTIES



1 MARK QUESTIONS

- Amongst the following, the strongest base in aqueous medium is
(a) CH_3NH_2 (b) $(\text{CH}_3)_3\text{NH}_2$ (c) $(\text{CH}_3)_2\text{NH}$ (d) $\text{C}_6\text{H}_5\text{NHCH}_3$
- Which of the following alkyl halides is best suitable for this reaction through $\text{S}_\text{N}1$ mechanism?
(a) CH_3Br (b) $\text{C}_6\text{H}_5\text{Br}$ (c) $\text{C}_6\text{H}_5\text{CH}_2\text{Br}$ (d) $\text{C}_2\text{H}_5\text{Br}$
- Which of the following reagents would not be a good choice for reducing an aryl nitro compound to an amine
(a) $\text{H}_2(\text{excess})/\text{Pt}$ (b) LiAlH_4 in ether (c) Fe and HCl (d) Sn and HCl
- The source of nitrogen in Gabriel synthesis of amines is
(a) Sodium azide (b) Sodium Nitrite (c) Potassium cyanide, (d) Potassium phthalimide
- The best reagent for converting 2-phenylpropanamide into 2-phenylpropanamine is
(a) excess H_2 (b) Br_2 in aqueous NaOH
(c) iodine in the presence of red phosphorus (d) LiAlH_4 in ether
- Which of the following compounds will dissolve in an alkali solution after it undergoes reaction with Hinsberg's reagent?
a. $(\text{CH}_3)_3\text{N}$ (b) CH_3NH_2 (c) $(\text{C}_2\text{H}_5)_2\text{NH}$ (d) $\text{C}_6\text{H}_5\text{NHC}_6\text{H}_5$
- An organic compound A on treatment with NH_3 gives B which on heating gives C. C when treated with Br_2 in the presence of KOH produces ethylamine, Compound A is
a. $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$ (b) CH_3COOH
(c) $\text{CH}_3\text{CH}_3\text{COOH}$ (d) $\text{CH}_3\text{-CH}_2\text{COOH}$
- Which of the following can not be prepared by Sandmeyer's reaction?
a. Chlorobenzene (b) Bromobenzene
(c) Iodobenzene (d) Fluorobenzene

ASSERTION REASON QUESTIONS

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
 (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
 (c) Assertion is correct statement but reason is wrong statement.
 (d) Assertion is wrong statement but reason is correct statement.

1. Assertion: Acylation of amines gives a mono substituted product whereas alkylation of amines gives poly substituted product.

Reason: Acyl group sterically hinders the approach of further acyl group

2. Assertion : Hoffmann's bromamide reaction is given by primary amines.

Reason : Primary amines are more basic than secondary amines

3. Assertion: N-Ethyl benzene sulphonamide is soluble in alkali.

Reason: Hydrogen attached to nitrogen in sulphonamide is strongly acidic.

4. Assertion: Only a small amount of HCl is required in the reduction of nitro

compounds with iron scrap and HCl in the presence of steam.

Reason: FeCl_2 formed gets hydrolysed to release HCl during the reaction

5. Assertion: Acetanilide is less basic than aniline

Reason: Acetylation of aniline results in decrease of electron density on nitrogen.

6. Assertion: In strongly acidic solutions, aniline becomes more reactive towards electrophilic reagents.

Reason: The amino group being completely protonated in strongly acidic solution, the lone pair of electrons on the nitrogen is no longer available for resonance.

7. Assertion: In order to convert R-Cl to pure R-NH_2 , Gabriel-phthalimide synthesis can be used.

Reason: With proper choice of alkyl halides, phthalimide synthesis can be used to prepare 1^o, 2^o or 3^o amines

Word problems based on reactions

- i) An aromatic compound A on treatment with aqueous ammonia and heating forms compound B which on heating with Br_2 and KOH forms compound C of molecular formula $\text{C}_6\text{H}_7\text{N}$. Write the structures and IUPAC names of compounds A, B, C.
- ii) A compound A has the molecular formula $\text{C}_7\text{H}_7\text{NO}$. On treatment with Br_2 and NaOH it gives B. B gives a foul smelling substance C on treatment with CHCl_3 and KOH. B on treatment with NaNO_2 and HCl at 0°C and mixing with alkaline phenol gives a red dye D. Identify A to D.
- iii) A compound A has the molecular formula $\text{C}_7\text{H}_7\text{NO}$. On heating with P_2O_5 gives B $\text{C}_7\text{H}_5\text{N}$. B on hydrolysis gives an acid C $\text{C}_7\text{H}_6\text{O}_2$. B on reduction with $\text{Na/C}_2\text{H}_5\text{OH}$ gives D $\text{C}_7\text{H}_9\text{N}$ a basic compound. D on treatment with NaNO_2 and HCl evolves N_2 forming E $\text{C}_7\text{H}_8\text{O}$. This on oxidation gives C. C is also formed on heating A with HCl. Identify A to E.
- iv) A compound X having molecular formula $\text{C}_3\text{H}_7\text{NO}$ reacts with Br_2 in presence of KOH to give another compound Y. The compound Y reacts with HNO_2 to form ethanol and N_2 gas. Identify the compounds X and Y and write the reactions involved.
- v) A compound A with molecular formula $\text{C}_2\text{H}_3\text{Cl}$ on treatment with AgCN gives two isomeric compounds of unequal amounts with the molecular formula $\text{C}_3\text{H}_3\text{N}$. The minor of these two products on complete reduction with H_2 in the presence of nickel gives a compound B with molecular formula $\text{C}_3\text{H}_9\text{N}$. Deduce the structures of A, B, & C and write the reactions involved.

Reasoning based Questions

- i) Amines are less acidic than alcohols of comparable molecular masses.
- ii) Primary amines have higher boiling point than tertiary amines?
- iii) Aliphatic amines are stronger bases than aromatic amines?
- iv) Aromatic primary amines can not be prepared by Gabriel phthalimide synthesis?
- v) pK_b of aniline is more than that of methyl amine.
- vi) Ethyl amine is soluble in water whereas aniline is not.
- vii) Methyl amine in water reacts with ferric chloride to precipitate hydrated ferric oxide.
- viii) Although amino group is o- and p- directing in aromatic electrophilic substitution reactions, aniline on nitration gives a substantial amount of m-nitroaniline.
- ix) Aniline does not undergo Friedel-Crafts reaction.
- x) Diazonium salts of aromatic amines are more stable than those of aliphatic amines.
- xi) Gabriel phthalimide synthesis is preferred for synthesizing primary amines.
- xii) How do you account for the miscibility of ethoxy ethane with water.

- xiii) Direct nitration of aniline is not carried out. Explain why?
 xiv) The presence of a base is needed in the ammonolysis of alkyl halides.

ANSWERS OF MCQ

1-c 2-a 3-c 4-d 5-b 6-b 7-c 8-d

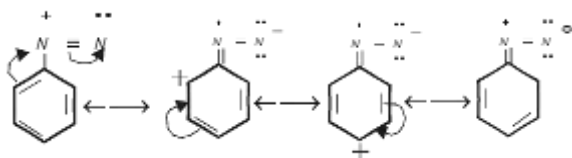
ANSWERS OF WORD PROBLEM

- i) Since C is formed by Hoffmann Bromamide reaction, it is a primary amine So Structure is $C_6H_5NH_2$, B is $C_6H_5CONH_2$ A is carboxylic acid C_6H_5COOH .
 ii) A is benzamide B is Aniline, C is phenyl isocyanide D is p-Hydroxy azobenzene
 iii) A-Benzamide, B-Phenyl cyanide C-benzoic acid
 D- Benzylamine
 E-Benzyl alcohol
 iv) $X=CH_3CH_2CONH_2$ $Y=CH_3CH_2NH_2$
 v) A= CH_3CH_2Cl , On reaction with $AgCN$ it gives CH_3CH_2CN (Minor) & CH_3CH_2NC (Major)
 B= $CH_3CH_2CH_2NH_2$

ANSWER OF REASONING QUESTIONS

- i) Amines are less acidic than alcohols because oxygen is more electronegative and small in size than nitrogen, therefore O-H bond breaks early than N-H bond.
 ii) Primary amines have higher boiling point than tertiary amines. In primary amines RNH_2 , the molecules have intermolecular hydrogen bonding but the same cannot be present in the case of tertiary amines (R_3N) \therefore the boiling points of primary amines are higher than the tertiary amines
 iii) Aliphatic amines are stronger bases than aromatic amines. Because in aliphatic amines electron releasing group is present, and in aniline, the lone pair of electron of nitrogen atom is involved in resonance with benzene ring hence is not easily available for donation. (Draw the resonating structures of aniline)
 iv) Aromatic primary amines cannot be prepared by Gabriel phthalimide synthesis, because in preparation by Gabriel phthalimide synthesis, Ar-X is needed and aryl halides do not undergo nucleophilic substitution easily due to presence of partial double character.
 v) pK_b of aniline is more than that of methyl amine. Since there is +Ve charge on N in some resonating structure therefore it is less basic. Whereas in methyl amine, methyl group donate e^- towards N. electron density increases that's why it is more basic.
 vi) Ethylamine is soluble in water due to the formation of hydrogen bonds with water whereas aniline due to large hydrocarbon part, the extent H-Bonding decreases.
 vii) Methylamine in water reacts with ferric chloride to precipitate hydrated ferric oxide. because Methylamine being more basic than water, accepts a proton from water liberate OH^- ions, these OH^- ions combine with Fe^{3+} to form a brown ppt of hydrated ferric oxide.
 viii) Although amino group is o- and p- directing in aromatic electrophilic substitution reactions, aniline on nitration gives a substantial amount of m-nitro aniline. because Nitration is usually carried out with a mixture of conc HNO_3 and conc H_2SO_4 . In presence of these acids aniline gets protonated to form the anilinium ion which is meta directing.
 ix) Aniline does not undergo Friedel-Crafts reaction. As aniline being a lewis base reacts with lewis acid $AlCl_3$ to form a salt.
 x) Diazonium salts of aromatic amines are more stable than those of aliphatic amines. Because Aryl diazonium ion is stabilized by dispersal of +ve charge on such
 Dispersal occurs in alkyl diazonium ion. Moreover, alkyl diazonium ion immediately loses N_2 molecule

to form alkyl carbocation while aryl diazonium ion does not lose N_2 so easily because aryl carbocation is not stable.



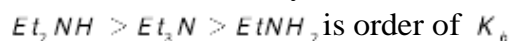
xi) Gabriel phthalimide synthesis gives pure primary amines without any contamination of secondary and tertiary amines therefore it is preferred for synthesizing primary amines.

xii) Ethoxyethane is miscible, 7.5 per 100 mL water, This is due to the fact that oxygen of ether can form hydrogen bonds with water

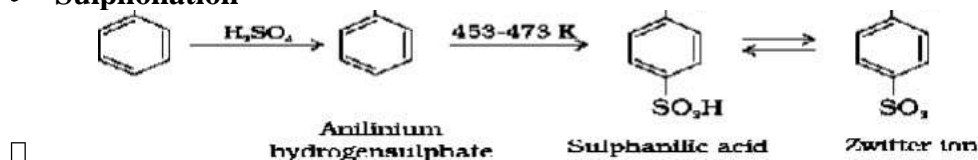
xiii) Direct nitration of aniline yields tarry oxidation products in addition to the nitro derivatives. Moreover, in the strongly acidic medium, aniline is protonated to form the anilinium ion which is meta directing. That is why besides the ortho and para derivatives, significant amount of meta derivative is also formed.

xiv) The presence of a base is needed in the ammonolysis to remove HX and make the reaction forward.

xv) It is the combination of electron releasing nature of alkyl group, H-bonding and steric factors determine the stability of ammonium cations formed in solution therefore



• Sulphonation



Aniline does not undergo Friedel-Crafts reaction (alkylation and acetylation) due to salt formation with aluminium chloride, the Lewis acid, which is used as a catalyst

PRIVIOUS YEARS QUESTIONS

2010-11

- Rearrange the following in an increasing order of their basic strength:
 $C_6H_5NH_2$, $C_6H_5N(CH_3)_2$, $(C_6H_5)_2NH$, CH_3NH_2
- State reasons for the following :
 - pK_b value for aniline is more than that for methylamine .
 - Ethylamine is soluble in water whereas aniline is not soluble in water.
 - Primary amines have higher boiling points than tertiary amines.
- Give a chemical test to distinguish between ethylamine and aniline .(set-3)

2011-12

- Describe the following giving the relevant chemical equation in each case:
 - Carbylamine reaction
 - Hofmann's bromamide reaction

2012-13

- Describe the following giving the relevant chemical equation in each case: [2]
 - Carbylamine reaction
 - Hofmann's bromamide reaction.
- Complete the following reaction equations:
 - $C_6H_5NH_2 + Br_2(aq.) \rightarrow$

2013-14

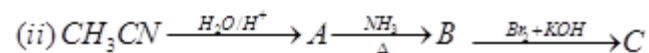
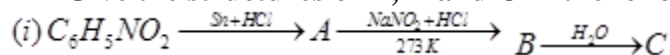
- Write the structure of n-methylethanamine.
- Complete the following reactions:
 - $CH_3CH_2NH_2 + CHCl_3 + alc. KOH \xrightarrow{\quad\quad\quad} \rightarrow$
- Write the structure of N-methylethanamine.

2014-15

- The conversion of primary aromatic amines into diazonium salts is known as -----
- Account for the following: [3]
 - Primary amines ($R-NH_2$) have boiling point than tertiary amines (R_3N).
 - Aniline does not undergo Friedel – Crafts reaction.
 - $(CH_3)_2NH$ is more basic than $(CH_3)_3N$ in an aqueous solution.

Or

Give the structures of A, B and C in the following reactions: [3]

**2015-16**

- How do you convert the following :
 - Aniline to phenol
 - Prop-1-ene to Propan-1-ol
 - Anisole to 2-methoxytoluene

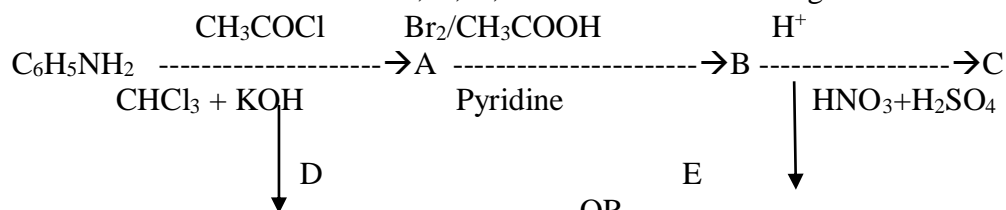
OR

What happens when

- ethanol is treated with Cu at 573 K,
- phenol is treated with CH_3COCl / anhydrous $AlCl_3$,
- ethyl chloride is treated with $NaOCH_3$?

Write chemical equations in support of your answer

- Write the structures of A, B, C, D and E in the following reactions :



OR

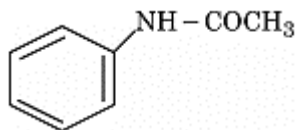
- Write the structures of the main products when benzene diazonium chloride reacts with the following reagents :

- (i) KI (ii) $\text{CH}_3\text{CH}_2\text{OH}$ (iii) Cu/HCl
 (b) Arrange the following in the increasing order of their basic character in an aqueous solution :
 CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$

- (a) Give a simple chemical test to distinguish between the following
 $\text{C}_6\text{H}_5\text{-NH}_2$ and $\text{CH}_3\text{-NH}_2$

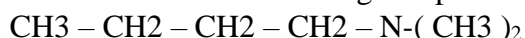
2016-17

1. Write the IUPAC name of the given compound:

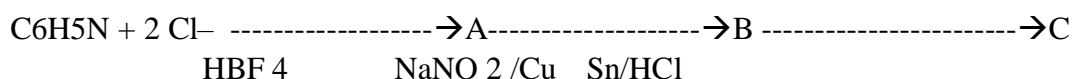
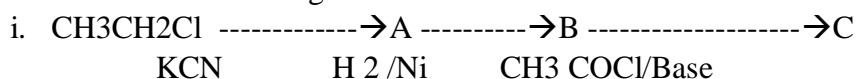


2017-18

1. Write IUPAC name of the following compound :



4. Identify A, B and C in the following reactions :



2018-19

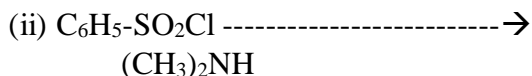
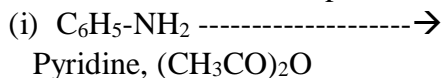
2. (a.) Write the reactions involved in the following :

- Hofmann bromamide degradation reaction
- Gabriel phthalimide synthesis

- (b) Give reasons :

- (i) $(\text{CH}_3)_2\text{NH}$ is more basic than $(\text{CH}_3)_3\text{N}$ in an aqueous solution.
 OR

- (a) Write the structures of the main products of the following reactions :



- (b) Give a simple chemical test to distinguish between Aniline and N,N-dimethylaniline.

- (c) Arrange the following in the increasing order of their pK_b values :



2019-20

1. Write the reaction involved in the Hoffmann bromamide degradation reaction.

OR

1. Propanamine and N,N-dimethylmethanamine contain the same number of carbon atoms, even though Propanamine has higher boiling point than N,N-dimethylmethanamine. Why ?

2. (a). Give one chemical test to distinguish between the compounds of the following pairs :

- (i) CH_3NH_2 and $(\text{CH}_3)_2\text{NH}$

(ii) Aniline and Ethanamine

(b) Why aniline does not undergo Friedel-Crafts reaction ?

COMPARTEMNT-

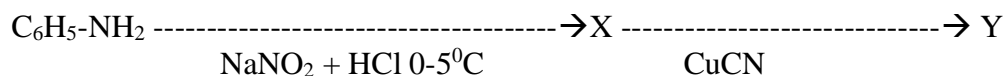
1. (a). Write the product formed when

(i) 2-chloropropane is treated with alc. KOH.

(ii) Aniline reacts with conc. H₂SO₄ at 453 – 473 K.

2. When aniline is heated with CHCl₃ and alc. KOH, a foul smelling compound is formed. What is this compound ?

3. Identify X and Y in the following :



(b) Amino group is o, p-directing for aromatic electrophilic substitution reactions.
Why does aniline on nitration give m-nitroaniline ?

2020-21

set-1

a. C₆H₅-CH₂-NH₂ on heating with CHCl₃ and alcoholic KOH gives foul smell of

- C₆H₅-CH₂OH
- C₆H₅-CH₂NC
- C₆H₅-CH₂CN
- C₆H₅-CH₂Cl

2. (a) Give reasons :

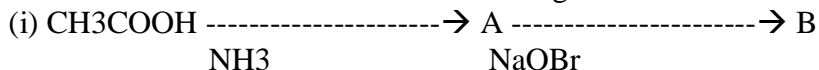
- Although –NH₂ group is o/p directing in electrophilic substitution reactions, yet aniline, on nitration gives good yield of m-nitroaniline.
- (CH₃)₂NH is more basic than (CH₃)₃N in an aqueous solution.
- Ammonolysis of alkyl halides is not a good method to prepare pure primary amines.

(b) Distinguish between the following :

- CH₃CH₂NH₂ and (CH₃CH₂)₂NH
- Aniline and CH₃NH₂

OR

(a) Write the structures of A and B in the following reactions :



(b) Write the chemical reaction of methyl amine with benzoyl chloride and write the IUPAC name of the product obtained.

(c) Arrange the following in the increasing order of their pK_b values :



UNIT XIV:BIOMOLECULES

KEY POINTS	EXPLANATIONS
Monosaccharides	Cannot be hydrolyzed further .eg- glucose, fructose, ribose
Disaccharides	Sucrose (α-D- glucose + β-D-fructose) , Maltose(α-D- glucose + α-D- glucose) Lactose(β-D-galactose + β-D-glucose)
Polysaccharides	Starch (two components—Amylose and Amylopectin) polymer of α-D- glucose
Amylose	Water soluble , 15-20% of starch., unbranched chain , C1 – C4 glycosidic linkage.

Amylopectin	Water insoluble , 80-85% of starch., branched chain polymer, C1–C4 & C1–C6 glycosidic linkage
Cellulose	Straight chain polysaccharide of β -D-glucose units/ joined by C1-C4glycosidic linkage (β -link), not digestible by human / constituent of cell wall of plant cells
Glycogen	Highly branched polymer of α -D- glucose .found in liver, muscles and brain.
reducing sugars	Aldehydic/ ketonic groups free so reduce Fehling's/ Tollens solution and. Eg- maltose and lactose
Non reducing sugars	Aldehydic/ ketonic groups are bonded so can not reduce Fehling's solution and Tollens' reagent. Eg- Sucrose
Anomers.	The two cyclic hemiacetal forms of glucose differ only in the configuration of the hydroxyl group at C1, called <i>anomeric carbon</i> Such isomers, i.e., α -form and β -form, are called anomers.
Invert sugar	Sucrose is dextrorotatory but after hydrolysis gives dextrorotatory glucose and laevorotatory fructose. Since the laevorotation of fructose (-92.4°) is more than dextrorotation of glucose ($+52.5^\circ$), the mixture is laevorotatory. Thus, hydrolysis of sucrose brings about a change in the sign of rotation, from dextro (+) to laevo (–) and the product is named as invert sugar
Glycosidic linkage	Linkage between two mono saccharide
Importance of Carbohydrates	Major portion of our food. / used as storage molecules as starch in plants and glycogen in animals/. Cell wall of bacteria and plants is made up of cellulose./wood and cloth are cellulose / provide raw materials for many important industries like textiles, paper, lacquers and breweries.
essential amino acids	which cannot be synthesised in the body and must be obtained through diet, eg- Valine, Leucine
Nonessential amino acids	which can be synthesised in the body, eg - Glycine, Alanine
zwitter ion.	In aqueous solution, amino acids exist as a dipolar ion known as <i>zwitter ion</i> .
peptide linkage	peptide linkage is an amide formed between –COOH group and –NH ₂ group of two successive amino acids in peptide chain.
1 ^o - str. of proteins:	sequence of amino acids that is said to be the <u>primary structure of protein</u>
2 ^o - str. of proteins:	secondary structure of protein refers to the shape in which a long polypeptide chain can exist. They are found to exist in two types of structures viz. α -helix and β -pleated sheet structure.
Tertiary structure of proteins:	Further folding of the secondary structure. It gives rise to two major molecular shapes viz. fibrous and globular.
Fibrous proteins	Polypeptide chains run parallel, held together by hydrogen and disulphide bonds, fibre– like structure. Water insoluble .Eg- are keratin(in hair, wool, silk) and myosin (present in muscles).
Globular proteins	Chains of polypeptides coil around to give a spherical shape. Water soluble. Eg-Insulin and albumins
Stab.forces 2° & 3°	hydrogen bonds, disulphide linkages, van der Waals and electrostatic forces of attraction.
Denaturation of Proteins	When a protein is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. (During denaturation 2° and 3° structures are destroyed but 1° structure remains intact.) eg- The coagulation of egg white on boiling, curdling of milk
DNA	pentose sugar (D-2-deoxyribose) + phosphoric acid + nitrogenous bases (A , G , C , T)
RNA	pentose sugar (ribose) + phosphoric acid + nitrogenous bases (A , G , C , U)
Nucleoside / tides	Nucleoside \rightarrow sugar + base Nucleotides \rightarrow sugar + base + phosphate
Phosphodiester link	Linkage between two nucleotides in polynucleotides
Functions of Nucleic Acids	DNA reserve genetic information, maintain the identity of different species e is capable of self duplication during cell division, synthesizes protein in the cell.

QUESTION BANK

1. Which of the following polymerized in the liver of animals?
(a) Amylose (b) Cellulose (c) Amylopectin (d) Glycogen
2. Proteins are found to have two different types of secondary structure viz α helix and pleated sheet structure, α helix structure of protein is stabilized by :
(a) Peptide bonds (b) vander Waals forces (c) Hydrogen bonds (d) Dipole-dipole interactions
3. Nucleic acids are the polymers of
(a) Nucleosides (b) Nucleotides (c) Bases (d) Sugars
4. DNA and RNA contains four bases each. Which of the following bases is not present in RNA?
(a) Adenine (b) Uracil (c) Thymine (d) Cytosine
5. The presence or absence of hydroxyl group on which carbon atom of sugar differentiate RNA and DNA
(a) 2nd (b) 4th (c) 3rd (d) 1st
6. Proteins can be classified in to two types on the basis of their molecular shape ie fibrous protein and globular proteins. Examples of globular proteins are :
(a) Insulin (b) Keratin (c) Albumin (d) Myosin
7. The reagent used for obtaining osazone derivatives of fructose is
(a) NH_2OH
(b) $\text{NH}_2\text{-NH}_2$
(c) $\text{NH}_2\text{-NHC}_6\text{H}_5$
(d) 2,4- DNP
8. The disease resulting from the intake of amino acid deficient diet is
(a) kwashiorkor
(b) pernicious anaemia
(c) PEM
(d) haemophilia
9. Keratin present in hair is an example of
(a) fibrous protein
(b) globular protein
(c) conjugated protein
(d) derived protein
10. DNA and RNA differ in
(a) sugar
(b) purines
(c) pyrimidines
(d) both (a) and (b)

ASSERTION & REASON

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.

(b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement

1. Assertion: D (+) –Glucose is dextrorotatory in nature.

Reason: D represents its dextro rotatory nature.

2. All naturally occurring amino acids except glycine are optically active.

Reason: Most naturally occurring amino acids have L-configuration.

3. Assertion: Deoxyribose $C_5H_{10}O_4$ is a carbohydrate

Reason: Carbohydrates are hydrates of carbon compounds which follow $C_n(H_2O)_y$ formula are carbohydrates

4. Assertion: Glycine must be taken through diet.

Reason: It is non-essential amino acid.

5. Assertion: Reducing sugars undergo mutarotation.

Reason: During mutarotation, one pure anomer is converted into an equilibrium mixture of two anomers.

6. Assertion: A solution of sucrose in water is dextro rotary but on hydrolysis in presence of little hydrochloric acid, it becomes laevorotatory.

Reason: Sucrose on hydrolysis gives unequal amounts of glucose and fructose as a result of which change in sign of rotation is observed.

ANSWER OF MCQ

1-d 2-c 3-d 4-d 5-a 6-d 7-c 8-a 9-a 10-d

PRIVIOUS YEAR QUESTIONS

2010-11

1. Explain what is meant by the following :

(i) Peptide linkage

(ii) Pyranose structure of glucose.

2. Write the main structural difference between DNA and RNA. Of the four bases, name those which are common to both DNA and RNA.

3. Write such reaction and facts about glucose which cannot be explained by its open chain structure.

2011-12

1. Write the structure of the product obtained when glucose is oxidized with nitric acid.

2. What is essentially the difference between α - glucose and β -glucose? What is meant by pyranose structure of glucose?

3. Differentiate between thermoplastic and thermo setting polymers. Give one example of each.

Set-3

4. Define the following as related to proteins

(i) Peptide linkage

- (ii) Primary structure
- (iii) Denaturation

5. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain.

2012-13

1. What is essentially the difference between α -glucose and β -glucose? What is meant by pyranose structure of glucose? [3]
2. Write a reaction which shows that all the carbon atoms in glucose are linked in a straight chain. [1](set-3)
3. Define the following as related to proteins: [3]
 - (i) Peptide linkage
 - (ii) Primary structure
 - (iii) Denaturation. (set-3)

2013-14

1. The conversion of primary aromatic amines into diazonium salt is known as _____
2. What are the products of hydrolysis of sucrose?
3. What are the products of hydrolysis of sugar

2014-15

1. What are the products of hydrolysis of sucrose?
2. Define the following terms as related to proteins: [3]
 - (i) Peptide linkage
 - (ii) Primary structure
 - (iii) Denaturation

Set-2

1. What are the products of hydrolysis of maltose? [1]
2. Define the following terms: [3]
 - (i) Glycosidic linkage
 - (ii) Invert sugar
 - (iii) Oligosaccharides

2015-16

1. (i) Which one of the following is an oligosaccharide : starch, maltose, fructose, glucose
- (ii) Write one difference between DNA and RNA.
- (iii). Write the name of the disease caused by the deficiency of Vitamin B1.

2017-18

Set-1

1. (a). Why water soluble vitamins must be supplied regularly in the diet ? Give one example of it.
- (b) Differentiate between the following :
 - (i) Essential and non-essential amino acids.
 - (ii) Fibrous and globular proteins.

2018-19

Set-1

1. Define the following with an example of each :

- (a) Polysaccharides
- (b) Denatured protein
- (c) Essential amino acids

OR

- (a) Write the product when D-glucose reacts with conc. HNO_3 .
- (b) Amino acids show amphoteric behaviour. Why ?
- (c) Write one difference between α -helix and β -pleated structures of proteins.

2019-20

- 1. (a) Give any one property of glucose that cannot be explained by the open chain structure.
- (b) Compare amylase with amylopectin in terms of constituting structure.
- (c) Why do amino acids show amphoteric behaviour ?

COMPARTMENT-

- 1. Name a carbohydrate present in liver, muscles and brain.
- 2. (a). What happens when D-glucose is treated with the following reagents :
 - (i) HI
 - (ii) conc. HNO_3
- 4. What is the basic structural difference between starch and cellulose

2020-21

set-1

- 1. Peptide linkage is present in
 - (A) Carbohydrates
 - (B) Vitamins
 - (C) Proteins
 - (D) Rubber
- 2. Name the disaccharide which on hydrolysis gives two molecules of glucose.
- 3. Define the following terms :
 - (i) Oligosaccharides
 - (ii) Invert sugar

Set-2

- 1. Name the disaccharide which on hydrolysis gives glucose and galactose.
- 2. Which parts of amino acids molecules are linked through hydrogen bonds in the secondary structure of proteins ?
 - (A) NH_2 group
 - (B) COOH group
 - (C) $-\text{CO}-$ and $-\text{NH}-$ groups
 - (D) None of the above
- 3. Define the following terms :
 - (i) Glycosidic linkage
 - (ii) Native protein

SAMPLE PAPER-1 (2020-21)**BLUE PRINT (CHEMISTRY)(043)**

UNIT	PB Q 2(8)	VSA (1 MARK)	SA I (2 MARKS)	SA II (3 MARKS)	LA (5 MARKS)	TOTAL
SOLID STATE	-	1(1)	1(2)	1(3)	-	3(6)
SOLUTIONS	-	2(2)	1(2)	-	-	3(4)
ELECTROCHEMISTRY	-	1(1)	-	-	1(5)	2(6)
CHEMICAL KINETICS	-	-	2(4)	-	-	2(4)
SURFACE CHEMISTRY	1(4)	-	-	-	-	1(4)
P- BLOCK ELEMENTS	-	1(1)	1(2)	1(3)	1(5)	4(11)
d- & f- BLOCK ELEMENTS	-	2(2)	-	1(3)	-	3(5)
COORDINATION COMPOUNDS	-	1(1)	1(2)	-	-	2(3)
HALOALKANES & HALOARENES	-	1(2)	3(6)	-	-	4(7)
ALCOHOLS, PHENOLS & ETHERS	1(4)	1(1)	-	-	-	2(5)
ALDEHYDES, KETONES & CARBOXYLIC ACIDS	-	1(1)	-	-	1(5)	2(6)
AMINES	-	1(1)	-	1(3)	-	2(4)
BIOMOLECULES	-	2(2)	-	1(3)	-	3(5)
	2(8)	14(14)	9(18)	5(15)	3(15)	33(70)

KENDRIYA VIDYALAYA SANGATHAN, RAIPUR REGION
SAMPLE PAPER -1 (2020-21)

CLASS - XII

M.M.70 SUBJECTS – CHEMISTRY (043) TIME: 3 HOURS

General Instructions:

- There are 33 questions in this question paper. All questions are compulsory.
- Section A: Q No. 1 to 16 are objective type questions. Q.No. 1 & 2 are passage based questions carrying 4 marks each while Q.No 3 to 16 carry 1 mark each.
- Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
- Section D: Q.No. 31 to 33 are long answer questions and carry 5 marks each.
- There is no overall choice. However, internal choices have been provided.
- Use of calculator and log table is not permitted.

SECTION A (OBJECTIVE TYPE)

1. Read the passage given below and answer the following questions:

Primary and secondary alcohols are dehydrogenated by copper at 573 K to aldehydes and ketones respectively. In contrast tertiary alcohols are dehydrated to alkenes by heating with copper at 573 K. Similarly, primary alcohols are easily oxidised to form first an aldehyde and then a carboxylic acid while secondary alcohols are oxidised to ketones which are further oxidised to form a mixture of acids. Tertiary alcohols are oxidised with difficulty and with strong oxidising agents in acidic medium. They form first ketones and then acids. In the case of alcohols containing carbon-carbon double bond, some oxidising agents oxidise both double bond and –OH group while other reagents do not affect double bond.

Now answer the following multiple-choice questions, Choose the most appropriate answer:

- | | | |
|-------|--|---|
| (i) | Butan-2-ol on heating with Cu at 573 K give | 1 |
| | (a) butanal (b) 2-butanone (c) propanone (d) but-2-ene | |
| | | |
| | Name of product formed when 2-methyl propanol oxidized with PCC | 1 |
| (ii) | (a) 2-methylPropanal | |
| | (b) 2-methyl propanoic acid | |
| | (c) butanoic acid | |
| | (d) butan-2-one | |
| | | |
| (iii) | The reagent which oxidises 1 ^o alcohol to aldehyde without affecting carbon-carbon double bond | 1 |
| | (a) CrO ₃ in aqueous acetone solution | |
| | (b) aqueous K ₂ Cr ₂ O ₇ | |
| | (c) alkaline KMnO ₄ | |
| | (d) none of these | |
| | | |
| (iv) | RCH ₂ CH ₂ OH can be converted to RCH ₂ CH ₂ COOH by the following sequence of steps (a) PBr ₃ , KCN, H ₃ O ⁺ | 1 |
| | (b) PBr ₃ , KCN, H ₂ /Pt | |

- (c) KCN, H_3O^+
(d) HCN, PBr_3 , H_3O^+

2. **Read the passage given below and answer the following questions**

(Assertion-reason based):

The accumulation of molecular species at the surface rather than in the bulk of a solid or liquid is termed adsorption. There are mainly two types of adsorption of gases on solids, physisorption and chemisorption. If the accumulation of gas on the surface of a solid occurs on account of weak van der Waals' forces, the adsorption is termed as physical adsorption or physisorption. When the gas molecules or atoms are held to the solid surface by chemical bonds, the adsorption is termed chemical adsorption or chemisorption. Physisorption usually lack specificity surface of an adsorption does not show any preference for a particular gas as the van der Waals' forces are universal, nature of adsorbate gases adsorbed as van der Waals' forces are stronger near the critical temperatures, physical adsorption of a gas by a solid is generally reversible.

In these questions, a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices given.

(a) – Assertion & reason both statements are correct and reason is the correct explanation of assertion.

(b) – Assertion & reason both are the correct statements but reason is not the correct explanation of the assertion.

(c) – Assertion is correct statement and reason is incorrect statement.

(d) – Assertion is incorrect statement and reason is correct statement

- | | | |
|--------|---|---|
| (v) | Assertion: Chemisorption involves high energy of activation
Reason: Molecules of hydrogen dissociate to form hydrogen atom which is held on the surface by Chemisorption. | 1 |
| (vi) | Assertion: finely divided and porous substances having large surface areas are good adsorbents.
Reason: The extent of adsorption increases with the increase of the surface area of the adsorbent. | 1 |
| (vii) | Assertion: Enthalpy of physisorption is quite low.
Reason: The attraction between gas molecules and solid surface is only due to weak van der Waals' forces. | 1 |
| (viii) | Assertion: physisorption is highly specific in nature.
Reason: Low temperature is favorable for physisorption. | 1 |

Following questions (No 3 to 11) are multiple choice questions carrying 1 mark each.

- | | | |
|----|---|---|
| 3. | Which of the following is a fibrous protein?
(a) Glycoprotein
(b) Keratin
(c) Proteases
(d) Prolamine | 1 |
| 4. | To prepare alkanes containing odd number of carbon atoms, Wurtz reaction is not preferred because:
(a) a lot of reaction mixture goes wasted.
(b) a mixture of three different alkyl halides has to be used.
(c) a mixture of four different alkyl halides has to be used.
(d) a mixture of two different alkyl halides has to be used. | 1 |

5. Direct nitration of aniline yields a significant amount of meta derivative. To obtain more p-nitro derivative, one or more of the below can be done _____. 1
 (a) reacting with acetic anhydride
 (b) by increasing temperature
 (c) controlling the nitration reaction
 (d) all the above
6. Which of the following is a homoleptic complex? 1
 (a) $[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$
 (b) $[\text{CoCl}_2(\text{en})_2]^+$
 (c) $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$
 (d) $[\text{Cu}(\text{NH}_3)_4]^{+2}$
7. The correct order of the packing efficiency in different types of unit cells is: 1
 (a) $\text{fcc} < \text{bcc} > \text{simple cubic}$
 (b) $\text{fcc} > \text{bcc} > \text{simple cubic}$
 (c) $\text{bcc} < \text{fcc} > \text{simple cubic}$
 (d) $\text{fcc} < \text{bcc} < \text{simple cubic}$
8. The catalyst which is used in the preparation of NH_3 by Haber's process. 1
 (a) $\text{Mg}_2\text{O}_3 + \text{K}_2\text{O}$
 (b) $\text{Al}_2\text{O}_3 + \text{K}_2\text{O}$
 (c) $\text{NaO}_3 + \text{K}_2\text{O}$
 (d) None of these
9. The SI unit of molar conductivity is 1
 (a) $\text{S m}^2 \text{ mol}^{-1}$
 (b) $\text{S m}^{-1} \text{ mol}^{-1}$
 (c) $\text{S m}^{-2} \text{ mol}$
 (d) $\text{S m}^3 \text{ mol}^{-1}$
10. Which of the following ion does not give colored solution? 1
 (a) Fe^{2+}
 (b) Zn^{2+}
 (c) Cr^{3+}
 (d) Mn^{2+}
11. Which of the following ions has the highest magnetic moment? 1
 (a) Zn^{2+}
 (b) Ti^{3+}
 (c) Sc^{3+}
 (d) Mn^{2+}

(Q. No 12 to 16) are Assertion- Reason type questions carrying 1 mark each.)
(Instructions for these questions are as same as given in question no.2)

12. **Assertion:** Purine base present in DNA are adenine and guanine. 1
Reason: The base thymine is present in RNA whereas base uracil is present in DNA.
13. **Assertion:** When a solution is separated from the pure solvent by a semipermeable membrane, 1
 the solvent molecules pass through it from the pure solvent side to the solution side.

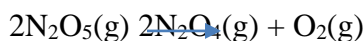
Reason: Diffusion of solvent occurs from a region of high concentration solution to a region of low concentration solution.

14. **Assertion:** Ethanol is a weaker acid than phenol. 1
Reason: Sodium ethoxide cannot be prepared by the reaction of ethanol with aqueous NaOH.
15. **Assertion:** Molarity of a solution in liquid state changes with temperature. 1
Reason: The volume of a solution changes with a change in temperature.
16. **Assertion:** The pK_a of acetic acid is lower than that of phenol. 1
Reason: Phenoxide ion is more resonance stabilized than acetic ion.

SECTION B

The following questions, Q. No 17 to 25 are short answer I type carrying 2 marks each.

17. The rate constant for a first order reaction is 60 s^{-1} . How much time will it take to reduce the initial concentration of the reactant to its $1/16^{\text{th}}$ value? 2
18. The following data were obtained during the first order thermal decomposition of N_2O_5 (g) at constant volume: 2



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

Calculate the rate constant.

Or

In a first order reaction, time required for completion of 99.9% of the reaction is n times the half-life of the reaction. Identify n by proper calculation.

19. (a) Write the formula of the following coordination compound: 1+1
Tetraammineaquachloridocobalt(III) chloride
 (b) Explain $[\text{Co}(\text{NH}_3)_6]^{3+}$ is an inner orbital complex whereas $[\text{Ni}(\text{NH}_3)_6]^{2+}$ is an outer orbital complex.

Or

(a) Calculate the overall complex dissociation equilibrium constant for the $\text{Cu}(\text{NH}_3)_4^{2+}$ ion, given that stability constant for this complex is 2.1×10^{13} .

(b) What will be the correct order for the wavelengths of absorption in the visible region for the following: $[\text{Ni}(\text{NO}_2)_6]^{4-}$, $[\text{Ni}(\text{NH}_3)_6]^{2+}$, $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$

20. A compound is formed by two elements M and N. The element N forms ccp and atoms of M occupy $1/3^{\text{rd}}$ of tetrahedral voids. What is the formula of the compound? 2
21. Vapour pressure of pure water at 298 K is 23.8 mm Hg. 50 g of urea (NH_2CONH_2) is dissolved in 850 g of water. Calculate the Vapour pressure of water for this solution and its relative lowering. 2
22. (a) Why is **ICl** more reactive than **I₂**? 1+1
 (b) Write the hybridization, geometry and shape for the compound **BrF₃**?
23. Identify all the possible monochloro structural isomers expected to be formed on free radical monochlorination of $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$. 2
24. (a) Arrange set of organic compounds in order of increasing boiling points. 1+1

- Bromomethane, Bromoform, Chloromethane, Dibromomethane(b) Carry out the following conversion: 2-Chloropropane to 1-propanol
25. Write the mechanism of the following reaction: 2
 $\text{nBuBr} + \text{KCN} \xrightarrow{\text{EtOH-H}_2\text{O}} \text{nBuCN}$

SECTION C

Q.No 26 to 30 are long answer II type carrying 3 marks each.

26. An element with molar mass $2.7 \times 10^{-2} \text{ kg mol}^{-1}$ forms a cubic unit cell with edge length 405 pm. If its density is $2.7 \times 10^3 \text{ kg m}^{-3}$, what is the nature of the cubic unit cell? 3
27. (a) Why is BiH_3 the strongest reducing agent amongst all the hydrides of group 15 elements? 1
 (b) Give the name of gas released by the thermal decomposition of ammonium dichromate. 1
 Write the reaction involved.
 (c) Arrange the elements of oxygen family in the increasing order of magnitude of electron gain enthalpy? 1
28. (a) The $E^\circ(\text{M}^{2+}/\text{M})$ value for copper is positive(+0.34V). What is possible reason for this? 1+1+1
 (b) Which is a stronger reducing agent Cr^{2+} or Fe^{2+} and why?
 (c) Calculate the spin only magnetic moment of $\text{M}^{2+}_{(\text{aq})}$ ion ($Z=27$).
Or
 (a) Explain why Cu^+ ion is not stable in aqueous solution?
 (b) List two characteristics of interstitial compounds.
 (c) Name the elements present in alloys brass and bronze?
29. (a) Carry out the conversion: $\text{Cl}-(\text{CH}_2)_4-\text{Cl}$ into hexan-1,6-diamine? 1+1+1
 (b) Tertiary amines do not react with benzene sulphonyl chloride. Explain.
 (c) How will you prepare p-bromoaniline in higher yield by brominating?
Or
 (a) Aniline does not give Friedel-Crafts reaction. Explain.
 (b) Write chemical reaction of aniline with benzoyl chloride and write the name of the product formed.
 (c) pK_b of aniline is more than that of methylamine. Explain.
30. (a) Write chemical equation of the reaction of glucose with acetic anhydride? 1+1+1
 (b) Name all the components of nucleotide. Also give the name of linkage present in the formation of dinucleotide.
 (c) Give the name of pairs of bases that are bonded by hydrogen bonds in the double strand helix structure of DNA.

SECTION D (VERY LONG ANSWER - III TYPE)

Q.No 31 to 33 are long answer III type carrying 5 marks each.

31. (a) Describe the variation of conductivity and molar conductivity with concentration for both weak and strong electrolyte. 2+3
 (b) The electrical resistance of a column of 0.05 mol L^{-1} NaOH solution of diameter 1 cm and length 50 cm is $5.55 \times 10^3 \text{ ohm}$. Calculate its resistivity, conductivity, and molar conductivity.
Or
 (a) Limiting molar conductivity for NaCl, HCl and NaAc are 126.4, 425.9 and $91.0 \text{ S cm}^2 \text{ mol}^{-1}$ respectively. Calculate limiting molar conductivity for HAc.
 (b) The cell in which the following reaction occurs:

$2\text{Fe}^{3+}(\text{aq}) + 2\text{I}^{-}(\text{aq}) \rightleftharpoons 2\text{Fe}^{2+}(\text{aq}) + \text{I}_2(\text{s})$ has $E^{\circ}_{\text{cell}} = 0.236 \text{ V}$ at 298 K.
Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.

- 32.** (a) (i) Write the reaction of thermal decomposition of sodium azide. **2+3**
 (ii) Why is nitrogen gas less reactive at room temperature?
 (b) (i) Why does O_3 act as a powerful oxidizing agent?
 (ii) How is O_3 estimated quantitatively?
 (iii) State two importance of noble gases.

Or

- (a) Give the balanced chemical reaction for:
 (i) action of HCl on potassium permanganate.
 (ii) $\text{XeF}_6 + 2\text{H}_2\text{O} \rightleftharpoons$
 (b) Arrange the following in the order of property indicated for each set:
 (i) $\text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2$ - (increasing bond dissociation enthalpy)
 (ii) HF, HCl, HBr, HI - (increasing acid strength)
 (iii) $\text{NH}_3, \text{PH}_3, \text{AsH}_3, \text{SbH}_3, \text{BiH}_3$ - (increasing base strength)

- 33.** (a) Give the chemical test to distinguish between the following compounds. **2+3**
 (i) Propanal and Propanone
 (ii) Phenol and Benzoic acid

(b) An organic compound with the molecular formula $\text{C}_9\text{H}_{10}\text{O}$ forms 2,4-DNP derivative, reduces tollen's reagent and undergo Cannizzaro reaction. On vigorous oxidation, it gives 1,2-benzenedicarboxylic acid. Identify the compound and give the possible reactions involved.

Or

- (a) Bring out the following conversion in not more than two steps:
 (i) Benzene to m-Nitroacetophenone
 (ii) Benzoic acid to m-Nitrobenzyl alcohol.
 (b) An organic compound contains 69.77% carbon, 11.63% hydrogen and rest oxygen. The molecular mass of the compound is 86. It does not reduce Tollens' reagent but forms an addition compound with sodium hydrogensulphite and give positive iodoform test. On vigorous oxidation it gives ethanoic and propanoic acids. Write the possible structure of the compound and reaction involved.

CLASS-XII

SUB: - Chemistry

**QUES
TION
NO.**

1	(i) (b)	1+1+1+1
	(ii) (a)	
	(iii) (a)	
	(iv) (a)	
2	(v) (b)	1+1+1+1
	(vi) (a)	
	(vii) (a)	
	(viii) (d)	
3	(b)	1
4	(d)	1
5	(a)	1
6	(d)	1
7	(b)	1
8	(d)	1
9	(a)	1
10	(b)	1
11	(d)	1
12	(c)	1
13	(c)	1
14	(c)	1
15	(a)	1
16	(c)	1
17	$2\text{N}_2\text{O}_5(\text{g}) \rightarrow 2\text{N}_2\text{O}_4(\text{g}) + \text{O}_2$ Start t=0 0.5 atm 0 0 At time t 0.5-2x atm 2x x Total $p_t = 0.5 + x$ Thus $x = p_t - 0.5$ $P(\text{of N}_2\text{O}_5) = 0.5 - 2x$ $\quad\quad\quad = 1.5 - 2p_t$ At time t=100, $p_t = 0.512$ atm Thus $p(\text{of N}_2\text{O}_5) = 0.476$ atm Using first order equation, $k(\text{rate constant}) = 4.98 \times 10^{-4} \text{ s}^{-1}$	1
		1

18	$k = \frac{2.303}{t} \log \left(\frac{[A_0]}{[A]} \right)$ $t_{99.9\%} = \frac{2.303}{k} \log \left(\frac{100}{0.1} \right)$ $\Rightarrow t_{99.9\%} = \frac{2.303}{k} \log 1000$ $t_{99.9\%} = \frac{2.303}{k} (3)$ $\Rightarrow t_{99.9\%} = \frac{6.906}{k}$ $t_{99.9\%} \simeq 10 \times \frac{0.69}{k}$ $t_{99.9\%} \simeq 10 t_{1/2}$	1 +1
19	<p>(a) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$</p> <p>(b) Because Co^{3+} have 6 electrons that will fill all the t_{2g} orbitals and no extra unpaired electron is left behind and thus we get d^2sp^3 hybridization while in the case of Ni^{2+} complex it has 2 unpaired electrons that will give it sp^3d^2 hybridization.</p> <p>OR</p> <p>(a) dissociation constant is the reciprocal of stability constant, that is 4.7×10^{-14}.</p> <p>(b) The order of the ligand in the spectrochemical series: $\text{H}_2\text{O} < \text{NH}_3 < \text{NO}_2^-$ Hence the energy of the observed light will be in the order: $[\text{Ni}(\text{H}_2\text{O})_6]^{2+} < [\text{Ni}(\text{NH}_3)_6]^{2+} < [\text{Ni}(\text{NO}_2)_6]^{4-}$ Thus, wavelengths absorbed will be in the opposite order.</p>	1+1
20	M_2N_3	2
21	<p>Vapour pressure of pure water $p_o = 23.8 \text{ mm Hg}$</p> <p>If 50 g of urea is added in 850 g of water than mole fraction of water $X_w = 0.98$</p> <p>Than the new value of the Vapour pressure = $p_o X_w$ $= 23.4 \text{ mm Hg}$</p>	1 1
22	<p>(a) Because ICl is polar in nature while I_2 is non-polar thus it is less reactive.</p> <p>(b) Hybridization = sp^3d</p>	1 1

Geometry= trigonal bipyramidal
Shape = bent-T

- 23 There will be four different compounds by the free radical monochlorination 1/2+1/2+1/2+1/2



OR

- 24 (a) Boiling point increases with increase in molecular mass 1+1

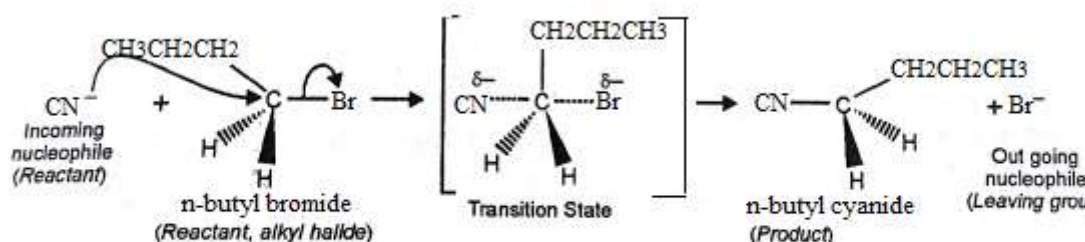
Chloromethane, Bromomethane, Dibromomethane, Bromoform

(b) 2-chloropropane followed by elimination by alcoholic KOH, propene will be formed which will be hydrated by hydroboration oxidation will form 1- propanol.

- 25 KCN has nucleophile CN^- ion which is a ambident nucleophile. 1+1

Therefore, it can attack the carbon atom of C-Br bond in n-BuBr either through C or N. Since C-C bond is stronger than C-N bond the attack occurs through C to form n- Butyl cyanide.

Steps of mechanism



- 26 The nature of the unit cell means its rank(Z) 1

$$d(\text{density}) = \frac{ZM}{N_A a^3}$$

$$\text{then we get } Z = \frac{d N_A a^3}{M}$$

$$Z = \frac{(2.7 \times 10^3 \text{ kg m}^{-3}) (4.05 \times 10^{-10} \text{ m})^3 (6.022 \times 10^{23} \text{ mol}^{-1})}{2.7 \times 10^{-2} \text{ kg mol}^{-1}} \quad 1$$

$$Z = 3.99 \approx 4 \text{ i.e. the cubic unit cell is face-centred.} \quad 1$$

- 27 (a) Because BiH_3 is the least stable among the hydrides of group 15. 1+1+1

(b) Nitrogen gas will release. Reaction involved is



(c) $\text{O} < \text{Po} < \text{Te} < \text{Se} < \text{S}$

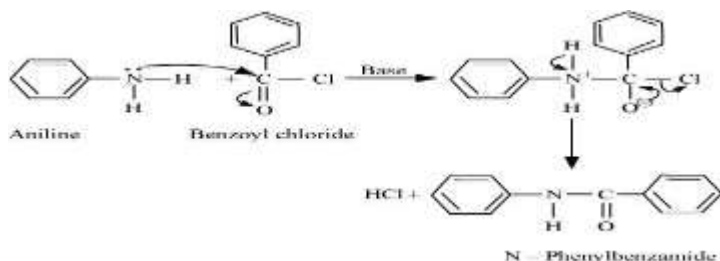
- 28 (a) It is due to the much more negative hydration enthalpy of $\text{Cu}^{2+}(\text{aq})$ than Cu. 1+1+1
 (b) Cr^{2+} is stronger reducing agent than Fe^{2+}
 Reason: d^4 to d^3 occurs in case of Cr^{2+} to Cr^{3+}
 But d^6 to d^5 occurs in case of Fe^{2+} to Fe^{3+}
 (c) root 15

Or

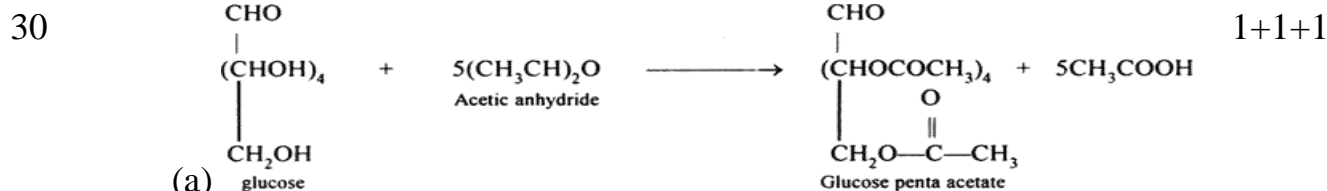
- (a) Cu^+ in aqueous solution undergoes disproportionation
 $2\text{Cu}^+(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + \text{Cu}(\text{s})$
 The E° value for this is favorable.
 (b) (i) They have higher melting point, higher than those of pure metals.
 (ii) They are chemically inert.
 (c) brass — copper and zinc
 Bronze — copper and tin
 29 (a) $\text{Cl}-(\text{CH}_2)_4-\text{Cl} + 2\text{KCN} \rightarrow \text{CN}-(\text{CH}_2)_4-\text{CN} \xrightarrow{\text{LiAlH}_4} \text{hexan-1,6-diamine}$ 1+1+1
 (b) Because it is a tertiary amine and that's why it does not have any hydrogen attached to it for the release of HCl.
 (c) this process should be followed:
 (i) Reaction of acetylation with acetic anhydride
 (ii) followed by attack of Br_2 with CH_3COOH
 (iii) then to remove amide part we do hydrolysis

OR

- (a) Because due to the presence of lone pairs on nitrogen it acts as Lewis base and AlCl_3 is a Lewis acid. Thus an acid base reaction takes place between them and Friedel-Crafts reaction does not take place.
 (b) The product formed is N-Phenylbenzamide



- (c) Aniline has a higher pK_b value because its lone pair is involved in resonance and is very less present for donation. Thus, it acts as a weak base and thus has a higher value.



- (b) Components of nucleotide - ribose sugar, phosphoric acid, base
 Linkage - Phosphodiester linkage
 (c) Adenine – Thymine

Cytosine – Guanine

- 31 (a) Conductivity always decreases on dilution for both strong and weak electrolyte. 2+3

Molar conductivity will increase with dilution for both strong and weak electrolyte but with different manner. For strong electrolyte there will not be much increase in molar conductivity because almost all the ions had dissociated. For weak electrolyte the value first increases for a small amount but suddenly it jumps to the infinite value.

(b) given that, $C=0.05 \text{ mol L}^{-1}$, diameter= 1cm, length= 50cm,
 $R=5.55 \times 10^3$

Then resistivity = $RA/l = 87.135 \text{ cm}$

Conductivity = $1/\text{resistivity} = 0.01148 \text{ Scm}^{-1}$

Molar conductivity = $(K \times 1000)/C = 229.6 \text{ Scm}^2 \text{ mol}^{-1}$

Or

(a)

$$\Lambda^\circ_{\text{NaCl}} = 126.4 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda^\circ_{\text{HCl}} = 425.9 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda^\circ_{\text{CH}_3\text{COONa}} = 91.0 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Lambda^\circ_{\text{CH}_3\text{COOH}} = \Lambda^\circ_{\text{CH}_3\text{COONa}} + \Lambda^\circ_{\text{HCl}} - \Lambda^\circ_{\text{NaCl}}$$

$$= 91.0 + 425.9 - 126.4 = 390.5 \text{ S cm}^2 \text{ mol}^{-1}$$

(b) $n=2$, $E^\circ_{\text{cell}} = 0.236 \text{ V}$ at 298 K

$$G^\circ = -nFE^\circ = -45.54 \text{ kJ/mol}$$

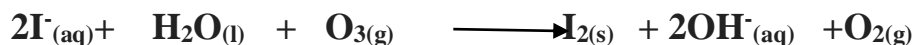
$$\log Kc = nE^\circ_{\text{cell}}/0.0591 = 9.62 \times 10^7$$

- 32 (a) (i) $2\text{NaN}_3 \rightarrow 2\text{Na} + 3\text{N}_2$ 2+3

(ii) Because of strong p(pi)-p(pi) overlap resulting into the triple bond.

(b) (i) Due to the ease with which it releases the atoms of nascent oxygen it acts as a powerful oxidising agent.

(ii) When O_3 is treated with excess of KI solution buffered with borate buffer (pH = 9.2), I_2 is liberated quantitatively.



The I_2 thus liberated is titrated against a standard solution of sodium thiosulphate using starch as an indicator.



(iii) 1. Ar is used in electric bulbs.

2. Xe is used in head lights of car.

Or



- (b)(i) $I_2 < F_2 < Br_2 < Cl_2$
(ii) $HF < HCl < HBr < HI$
(iii) $BiH_3 < SbH_3 < AsH_3 < PH_3 < NH_3$

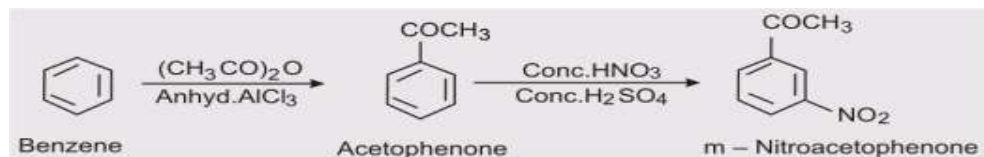
33

- (a) (i) iodoform test propanal donot give but propanone gives.
(ii) by baking soda test, benzoic acid is a strong organic acid and thus it will give this test but phenol donot.
(b) The compound is o-ethyl benzaldehyde.

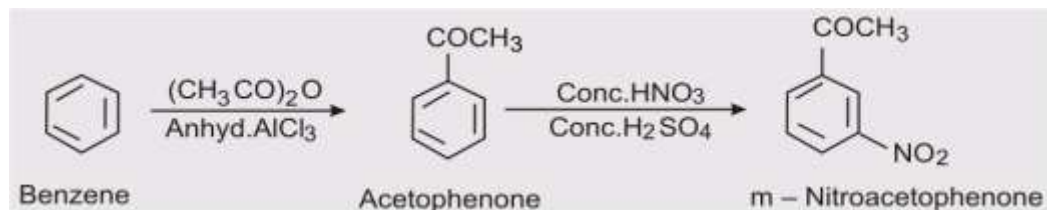
1+1+1+1
+1

Or

- (a) (i)



- (ii)



- (b) The compound is pentan-2-one.

SAMPLE PAPER-2 (2020-21)

CLASS-XII

BLUE PRINT

SUB: - Chemistry

S.N O.	UNIT	PASSAGE BASED QUESTIONS 1X4=4	VSA 1MARK	SAI 2MARKS	SAII 3MARKS	LA 5MARKS	TOTAL
1	SOLID STATE	0	0	2(4)	0	0	11(24)
2	SOLUTION	0	0	0	0	0	
3	ELECTROCHEMISTRY	0	3(3)	1(2)	1(3)	0	
4	CHEMICAL KINETICS	0	1(1)	1(2)	0	0	
5	SURFACE CHEMISTRY	0	1(1)	1(2)	0	1(5)	
6	p-BLOCK ELEMENTS	1(4)	1(1)	1(2)	0	1(5)	9(19)
7	d-BLOCK ELEMENTS	0	1(1)	1(2)	0	0	
8	COORDINATION CHEMISTRY	0	2(2)	1(2)	0	0	
9	HALOALKANE & HALOARENES	0	1(1)	0	1(3)	0	13(27)
10	ALCOHOL, PHENOL & ETHERS	0	1(1)	1(2)	1(3)	0	
11	ALDEHYDES, KETONES & CARBOXYLIC ACID	1(4)	1(1)	0	1(3)	0	
12	AMINES	0	1(1)	0	1(3)	0	33(70)
13	BIOMOLECULES	0	1(1)	0	0	1(5)	
	TOTAL	2(8)	14(14)	9(18)	5(15)	3(15)	

SAMPLE PAPER-2 [2020-21 (XIth)]

Subject: Chemistry (043)

Max. marks :70

Time: 3 Hrs

General Instructions:

Read the following instructions carefully.

- There are 33 questions in this question paper. All questions are compulsory.
- Section A: Q. No. 1 to 16 are objective type questions. Q. No. 1 and 2 are passage based questions carrying 4 marks each while Q. No. 3 to 16 carry 1 mark each.
- Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
- Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each.
- There is no overall choice. However, internal choices have been provided.
- Use of calculators and log tables is not permitted.

SECTION A (OBJECTIVE TYPE)

1. Read the passage given below and answer the following questions:

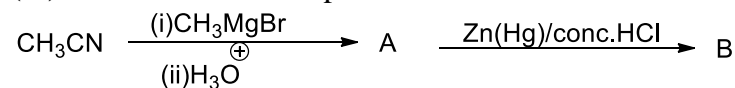
(1x4=4)

Aldehydes, ketones and carboxylic acids are few of the major classes of organic compounds containing carbonyl group. Aldehydes are prepared by dehydrogenation or controlled oxidation of primary alcohols and controlled or selective reduction of acyl halides. Ketones are prepared by Oxidation of secondary alcohols and hydration of alkynes. Carboxylic acids are prepared by the Oxidation of primary alcohols, aldehydes and alkenes by hydrolysis of nitriles and by treatment of Grignard reagents with carbon dioxide.

The following questions are multiple choice questions. Choose the most appropriate answer:

- (i) Name a method by which both aldehydes and ketones can be prepared.
- Hydration of alkynes
 - Ozonolysis of alkenes
 - Oxidation of alcohols
 - All of the above
- (ii) How you distinguish between aliphatic aldehydes and aromatic aldehydes?
- Fehling's test
 - Benedict's test
 - Iodoform test
 - Hinsberg reagent

(iii) Name the main compounds A and B formed in the following reaction:



- $\text{CH}_3\text{CH}_2\text{COOH}$, $\text{CH}_3\text{CH}_2\text{CH}_3$
- $\text{CH}_3\text{CH}_2\text{CHO}$, C_2H_6
- CH_3COCH_3 , $\text{CH}_3\text{CH}_2\text{CH}_3$
- CH_3COCH_3 , C_2H_6

(iv) The reagent which does not react with both, acetone and benzaldehyde.

- Sodium hydrogensulphite
- Phenyl hydrazine
- Fehlings' solution
- Grignard reagent

Or,

Through which of the following reactions number of carbon atoms can be increased in the chain?

- (a) Grignard reaction
- (b) Cannizzaro reaction
- (c) Clemmenson reduction
- (d) HVZ reaction

2. Read the following passage and answer the following questions:

(1 x 4= 4)

Ammonia is a colourless gas with a pungent odour. Its freezing and boiling points are 198.4 and 239.7 K respectively. In the solid and liquid states, it is associated through hydrogen bonds as in the case of water and that accounts for its higher melting and boiling points than expected on the basis of its molecular mass. The ammonia molecule is trigonal pyramidal with the nitrogen atom at the apex. It has three bond pairs and one lone pair of electrons as shown in the structure.

In these questions a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.
- (i) **Assertion:** Ammonia is manufactured on industrial scale by Haber's process, where high pressure favours formation of ammonia.

Reason: Le Chatelier's principle cannot explain the requirement for high pressure.

- (ii) **Assertion:** Molybdenum is used as a promoter in the production of ammonia.

Reason: Molybdenum increases the efficiency of the catalyst Iron, resulting in better yield of ammonia.

- (iii) **Assertion:** Ammonia acts as a Lewis acid.

Reason: Nitrogen in ammonia has a lone pair of electrons with it.

- (iv) **Assertion:** Ammonia is used as a refrigerant.

Reason: Ammonia has better heat transfer properties than most of chemical refrigerants.

Or,

Assertion: NO, dimerises into N₂O₄.

Reason: N₂O₄, is highly unstable.

Following questions (No. 3-11) are Multiple Choice Questions carrying 1 mark each:

3. We have three aqueous solutions of NaCl labelled as A, 'B and 'C with concentrations 0.1 M, 0.01 M and 0.001 M, respectively. The value of van't Hoff factor for these solutions will be in the order

- (a) $i_A < i_B < i_C$
- (b) $i_A > i_B > i_C$
- (c) $i_A = i_B = i_C$
- (d) $i_A < i_B > i_C$

Or,

An electrochemical cell can behave like an electrolytic cell when

- (a) $E_{\text{cell}} = 0$
- (b) $E_{\text{cell}} > E_{\text{ext}}$
- (c) $E_{\text{cell}} < E_{\text{ext}}$
- (d) $E_{\text{cell}} = E_{\text{ext}}$

4. What is the IUPAC name of the complex [Ni(NH₃)₆Cl₂]?

- (a) Dichloridohexaaminenickel(IV)
- (b) Hexaamino-dichloridonickel(II)
- (c) Hexaamminenicke(II)dichloride
- (d) Hexaamminenickel(II)chloride

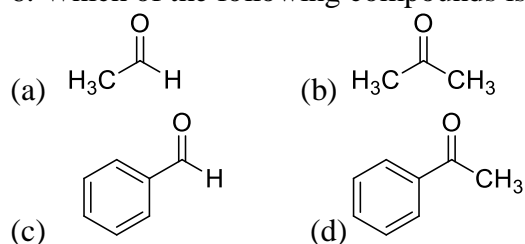
Or,

Transition elements form binary compounds with halogens. Which of the following elements will form MF₃ type compounds?

- (a) Co
- (b) Cu

- (c) Ni
 (d) All of the above
5. For the reaction $A \rightarrow B$, the rate of reaction becomes three times when the concentration of A is increased by nine times. What is the order of reaction?

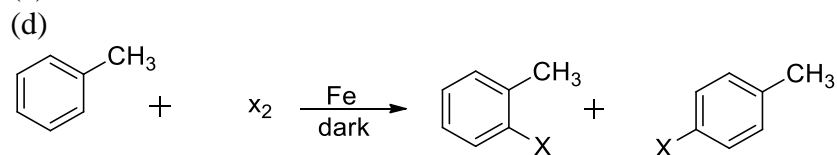
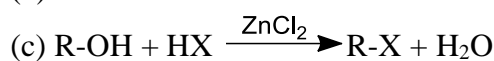
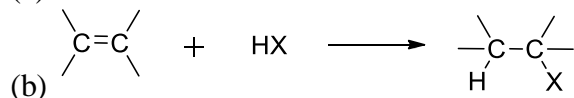
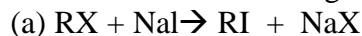
- (a) 1
 (b) 2
 (c) $1/2$
 (d) 0
6. Which of the following compounds is most reactive towards nucleophilic addition reactions?



7. Electronic configuration of a transition element X in +3 oxidation state is $[Ar]3d^5$. What is its atomic number?

- (a) 25
 (b) 26
 (c) 27
 (d) 24
8. Which of the following should be most volatile?
- (i) $CH_3CH_2NH_2$ (ii) $(CH_3)_3N$ (iii) $CH_3CH_2NHCH_3$ (iv) $CH_3CH_2CH_3$
- (a) (ii)
 (b) (iv)
 (c) (i)
 (d) (iii)

9. Which of the following is halogen exchange reaction ?



10. 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) $NaCl + H_2SO_4$
 (c) Cl_2 gas in dark
 (d) Cl_2 gas in the presence of iron in dark
11. Give IUPAC name of the compound given below.

- (a) 2-Chloro-5-hydroxyhexane
 (b) 2-Hydroxy-5-chlorohexane
 (c) 5-Chlorohexan-2-ol
 (d) 2-Chlorohexan-5-ol

11. Which of the following complexes are homoleptic ?

- (a) $[Co(NH_3)_4Cl_2]^+$
 (b) $[Ni(CN)_4]^{2-}$
 (c) $[Ni(NH_3)_4Cl_2]$
 (d) All of the above

Or,

Identify the incorrect statement about the behaviour of ethane-1,2-diamine as a ligand.

- (a) It is a neutral ligand
- (b) It is a didentate ligand
- (c) It is a chelating ligand
- (d) It is a unidentate ligand

In the following questions (Q. No. 12 -16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.

12. Assertion (A): When NaCl is added to a water a depression in freezing point is observed.

Reason (R): The lowering of vapour pressure of a solution causes depression in the freezing point.

13. Assertion (A) : Both rhombic and monoclinic sulphur exist as S_8 but oxygen exists as O_2 .

Reason (R): Oxygen forms pm-pr multiple bond due to small size and small bond length, but $p\pi = p\pi$ bonding is not possible in sulphur.

14. Assertion (A): In presence of enzyme, substrate molecule can be attacked by the reagent effectively.

Reason (R): Active sites of enzymes hold the substrate molecule in a suitable position.

15. Assertion (A): Λ_m for weak electrolytes shows a sharp increase when the electrolytic solution is diluted.

Reason (R): For weak electrolytes degree of dissociation increases with dilution of solution.

16. Assertion (A) : Copper sulphate can be stored in zinc vessel.

Reason (R): Zinc is more reactive than copper.

Or,

Assertion (A): Electrolysis of NaCl solution gives chlorine at anode instead of O_2 .

Reason (R): Formation of oxygen at anode requires over voltage.

Section 'B'

The following questions (Q.No 17-25) are Short Answer Type - I and carry 2 marks each.

17. Name the two oxo-metal anions of the first series of the transition metals in which the metal exhibits the oxidation state equal to its group number.

18. Define the following terms :

- G) Lyophilic colloid,
- (ii) Zeta potential

Or,

Explain the following phenomena with the help of Henry's law:

- (i) Painful condition known as bends.
- (ii) Feeling of weakness and discomfort in breathing at high altitude.

19. Write the mechanism of acid dehydration of ethanol to yield ethene

Or,

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

- (a) Ethanol and Phenol
- (b) Propanol and 2-methylpropan -2-ol

20. (i) Oxygen shows catenation behaviour less than sulphur. Why?

(ii) Give reason for the following: $PbCl_4$ is more covalent than $PbCl_2$.

21. A reaction is first order with respect to reactant A and is second order with respect to reactant B :

- (a) Write differential rate equation for the above mentioned reaction.
- (b) How is the rate affected when the concentration of B is tripled in the above reaction?

Or,

The rate constant for the first order decomposition of N_2O_5 at temperature $25^\circ C$ is $3 \times 10^{-2} \text{ min}^{-1}$. If the initial concentration of N_2O_5 is $2 \times 10^{-3} \text{ mol/L}$, how long will it take to drop the concentration to $5 \times 10^{-4} \text{ mol/L}$? ($\log 4 = 0.6021$)

22. Calculate the number of unit cells in 8.1 g of aluminium if it crystallizes in a fcc structure. (Atomic mass of Al = 27 g mol^{-1})

23. (a) Using valence bond theory, write the hybridization and magnetic character of the $[\text{Fe}(\text{CN})_6]^{4-}$. (Atomic no. of Fe = 26)

(b) Write the electronic configuration of d^6 on the basis of crystal field theory when:

(i) $\Delta_0 < P$ and

(ii) $\Delta_0 > P$ complex

Or,

(a) Although both $[\text{NiCl}_4]^{2-}$ and $[\text{Ni}(\text{CO})_4]$ have sp^3 hybridisation yet $[\text{NiCl}_4]^{2-}$ is paramagnetic and $[\text{Ni}(\text{CO})_4]$ is diamagnetic. Give reason. (Atomic no. of Ni = 28)

(b) Write the electronic configuration of d^5 on the basis of crystal field theory when.

(i) $\Delta_0 < P$ and (ii) $\Delta_0 > P$

24. Write the name of the cell which is generally used in transistors. Write the reactions taking place at the anode and the cathode of this cell.

25. Give reasons:

(a) In stoichiometric defects, NaCl exhibits Schottky defect and not Frenkel defect

(b) Silicon on doping with Phosphorous forms n-type semiconductor.

Section 'C'

(Q.No 26-30) are Short Answer Type II carrying 3 marks each.

26. 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.

(iii) Cumene is a better starting material for the preparation of phenol.

Or,

Write the product(s) formed when

(i) 2-Bromopropane undergoes dehydrohalogenation reaction.

(ii) Chlorobenzene undergoes nitration reaction.

(ii) Methylbromide is treated with KCN.

27. What happens when

(i) $(\text{CH}_3)_3\text{C-OH}$ is treated with Cu at 573 K,

(ii) Anisole is treated with $\text{CH}_3\text{Cl}/\text{anhydrous AlCl}_3$.

(ii) Phenol is treated with Zn dust?

Write chemical equation in support of your answer.

Or,

How will you convert the following in not more than two steps:

(a) Benzoic acid to Benzaldehyde

(b) Acetophenone to Benzoic acid

(c) Ethanoic acid to 2-Hydroxyethanoic acid

28. (i) How many coulombs are required to reduce 1 mole $\text{Cr}_2\text{O}_7^{2-}$ to Cr^{3+} ?

(ii) The conductivity of 0.001028 M acetic acid is $4.95 \times 10^{-5} \text{ S/cm}$. Calculate the dissociation constant acetic acid if Λ°_m for acetic acid is $390.5 \text{ S cm}^2 \text{ mol}^{-1}$.

29. Account for the following:

(a) Although amino group is o, p-directing in aromatic electrophilic substitution reactions, aniline on nitration gives a substantial amount of m-nitroaniline.

(b) Diazonium salts of aromatic amines are more stable than those of aliphatic amines.

(c) Gabriel phthalimide synthesis is preferred for synthesising primary amines.

30. How are the following conversions carried out ?

(i) Propene to propan-2-ol

(ii) Benzyl chloride to Benzyl alcohol

(iii) Anisole to p-Bromoanisole

Section 'D'

(Q.No 31 to 33) are Long Answer Type carrying 5 marks each.

31. (i) Write three distinctive features of chemisorption, which are not found in physisorption.

(ii) What role does adsorption play in heterogeneous catalysis ?

Or,

What is the difference between multi-molecular and macro-molecular colloids ? Give one example of each. How are associated colloids different from these two types of colloids?

32.(a)What are essential and non-essential amino acids? Give two examples of each type.

(b)Define the following as related to proteins

(i) Peptide linkage (ii) Primary structure (iii) Denaturation.

Or,

(a)Define the following with a suitable example in each.

(i) Oligosaccharides

(ii) Denaturation of protein

(b)Write the reactions involved when D-glucose is treated with the following reagents:

(i) Br₂ water

(ii) H₂N-OH

(ii) (CH₃CO)₂O

33. On heating compound (A) gives a gas (B) which is a constituent of air. This gas when treated with 3 mol of hydrogen (H₂) in the presence of a catalyst gives another Gas (C) which is basic in nature. Gas (C) on further oxidation in moist condition gives a compound (D) which is a part of acid rain. Identify compounds (A) to (D) and also give necessary equations of all the steps involved.

Or,

(i) Account for the following:

(a) Reducing character decreases from SO₂ to TeO₂.

(b) HClO₃ is a stronger acid than HClO.

(c) Xenon forms compounds with fluorine and oxygen only.

(ii)Complete the following equations:

(a) $4\text{NaCl} + \text{MnO}_2 + 4\text{H}_2\text{SO}_4 \rightarrow$

(b) $6\text{XeF}_4 + 12\text{H}_2\text{O} \rightarrow$

SECTION A(MCQ)

Q.N.	ANSWERS	MARKS
1(i)	d	1
1(ii)	b	1
1(iii)	c	1
1(iv)	c	1
Or,1(iv)	a	1
2(i)	c	1
2(ii)	a	1
2(iii)	a	1
2(iv)	a	1
OR 2(iv)	b	1
3	b	1
Or 3	d	1
4	d	1
Or 4	a	1
5	c	1
6	a	1
7	b	1
8	b	1
9	a	1
Or 9	a	1
10	c	1
11	b	1
Or 11	d	1
12	a	1
13	a	1
14	a	1
15	a	1
16	c	1
Or 16	a	1

ANSWERS

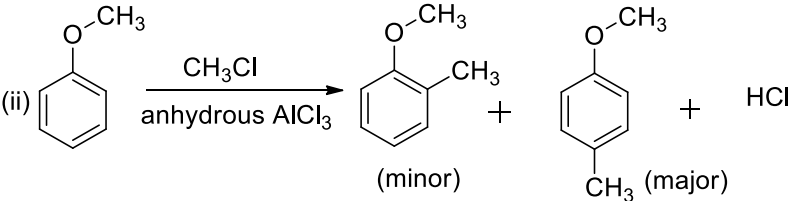
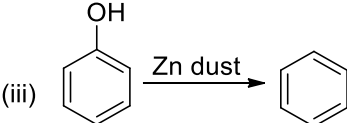
17. MnO_4^- Oxidation number = 7, Gp = 7 1
 $\text{Cr}_2\text{O}_7^{2-}$ Oxidation number = 6, Gp = 6 1
18. **Lyophilic colloid**-solvent loving these colloids can be prepared by simply mixing of dispersion phase into dispersion medium e.g. Starch sol. 1
Zeta potential- Potential differences betⁿ fixed and diffused layer on coloids. 1
OR 1
(a) When sea diver comes out of deep sea the solubility of nitrogen in blood decreases due to decrease in pressure, leads to formation of bubbles of N in blood cause pain. 1
(b) Due to low pressure of oxygen at high altitude, limited O supplied to brain, we feel nausea. 1
19. complete reaction mechanism of acid dehydration of alcohol at 443 K: 1/2
- $$\begin{array}{ccccc}
 2\text{CH}_3\text{CH}_2\text{OH} & \xrightarrow[\text{Conc sulphuric acid}]{\Delta} & 2\text{CH}_2=\text{CH}_2 & + & 2\text{H}_2\text{O} \\
 \text{Ethanol} & & \text{Ethene} & & \text{Water}
 \end{array}$$
- $\text{CH}_3-\text{CH}_2-\ddot{\text{O}}-\text{H} \xrightarrow{\text{H}^+} \text{CH}_3-\text{CH}_2-\overset{+}{\text{O}}-\text{H}$ 1/2
 $\text{CH}_3-\text{CH}_2-\overset{+}{\text{O}}-\text{H} \xrightarrow{\text{H}^+} \text{CH}_3-\overset{+}{\text{C}}\text{H}_2-\text{H}_2\text{O}$ 1/2
 $\text{CH}_3-\overset{+}{\text{C}}\text{H}_2-\text{H}_2\text{O} \xrightarrow{\text{H}^+} \text{CH}_2=\text{CH}_2$ 1/2
20. (a) Due to stronger S-S bond (213kJ/mol) than the O-O bond (138kJ/mol) sulphur has much greater tendency for catenation than oxygen. 1
(b) B/z the sum of all for ionisation enthalpy is very high in Pb^{4+} while Pb^{2+} form easily & stable also. (higher OS form covalent compounds while lower O.S forms ionic compounds.) 1
21. (a) Rate = $k[\text{A}][\text{B}]^2$ 1
(b) $d[\text{B}]/dt = 3^2 = 9$ 1
Or,
For a first order reaction, we have $t = 2.303/K \log[\text{A}]_0/[\text{A}]$ 1/2
- $$\begin{aligned}
 &= \frac{2.303}{3 \times 10^{-2} \text{ min}^{-1}} \log \frac{2 \times 10^{-3}}{5 \times 10^{-4}} && 1/2 \\
 &= \frac{2.303}{3 \times 10^{-2}} \log 4 \quad (\log 4 = 0.6021) && 1/2 \\
 &= 46.22 \text{ min.} && 1/2
 \end{aligned}$$
22. Number of Al atoms = no. of moles $\times N_A$ 1/2
 $= \text{mass of Al} / \text{atomic mass} \times 6.022 \times 10^{23}$
 $= 8.1/27 \times 6.022 \times 10^{23} = 1.806 \times 10^{23}$ 1/2
No. of atoms in one unit cell of fcc = 4 1/2
Total no. of unit cell = $1.806 \times 10^{23} / 4$
 $= 4.515 \times 10^{22}$ 1/2

- 23 (a) Hybridisation - d^2sp^3 , Diamagnetic $\frac{1}{2} + \frac{1}{2}$
- (b) (i) $t_{2g}^6 e_g^0$ (ii) $t_{2g}^4 e_g^2$ $\frac{1}{2} + \frac{1}{2}$
- OR**
- (a) $[NiCl_4]^{2-}$ = Cl^- is weak ligand , Ni^{2+} have 2 unpaired electrons in it , paramagnetic, $\frac{1}{2} + \frac{1}{2}$
 $[Ni(CO)_4]$ = CO is strong ligand, Ni have no unpaired electron in it, Diamagnetic
- (b) (i) $t_{2g}^5 e_g^0$ (ii) $t_{2g}^3 e_g^2$ $\frac{1}{2} + \frac{1}{2}$
24. Dry cell (Laclanche cell) 1
 At anode – $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$ $\frac{1}{2}$
 At cathode – $2MnO_2(s) + 2NH_4^+_{(aq)} + 2e^- \rightarrow Mn_2O_3(s) + 2NH_{3(g)} + H_2O_{(l)}$ $\frac{1}{2}$
25. (a) To show the Frenkel defect size of cations should be less than anions. Due to small size of Ag^+ cations (in silver halides) , they fit into interstitial sites, but Na^+ ions cannot fit into the interstitial sites. 1
 (b) Phosphorus is a pentavalent impurities (electron rich impurities) forms n type of semiconductors. 1

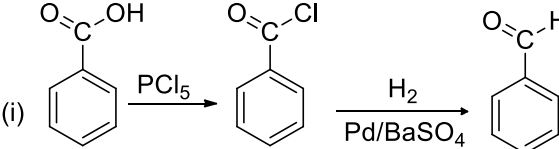
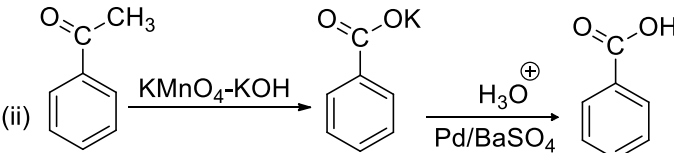
SECTION C

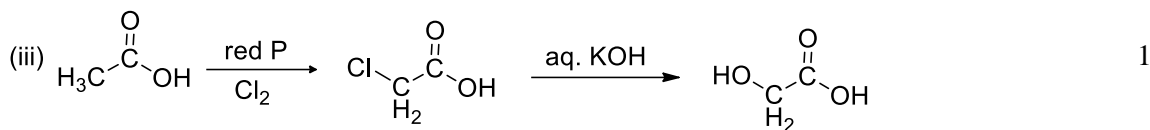
26. (a) Due to polar nature & hydrogen bonding in alcohol with water. But hydrocarbon being nonpolar insoluble in water. 1
 (b) Due to $-I$ effect of NO_2 group o-nitrophenol is a strong acid but due to $+I$ effect of CH_3 group p-cresol is weak acid. 1
 (c) Due to following reasons – (i) a cheap reagent easily convert into phenol & acetone. 1
 (ii) Acetone is a widely used byproduct form in this reaction. 1

OR

- (i) Prop-1-ene is form (Reaction) 1
 (ii) Ortho & para nitro chlorobenzene is form (reaction) 1
 (iii) CH_3CN is form. 1
27. (i) $H_3C-\overset{\overset{CH_3}{|}}{C}-OH \xrightarrow[573\text{ K}]{Cu} H_3C-\overset{\overset{CH_3}{|}}{C}=CH_2 + H_2O$ 1
- (ii)  1
- (iii)  1

OR

- (i)  1
- (ii)  1



28. (i) Since 1 mol of $\text{Cr}_2\text{O}_7^{2-}$ to 2Cr^{3+} requires 6 Faraday charge. 1
Therefore required quantity of electricity will be $6 \times 96500 \text{ C} = 578922 \text{ C}$

(ii) $\frac{A_m}{c} = \frac{\kappa}{0.001028 \text{ mol L}^{-1}} \times \frac{1000 \text{ cm}^3}{\text{L}} = 48.15 \text{ S cm}^2 \text{ mol}^{-1}$ 1/2

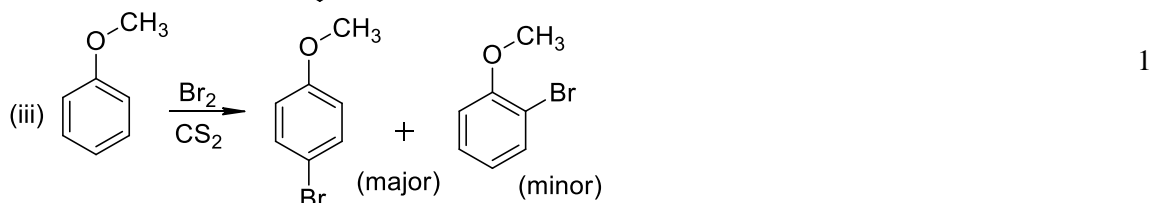
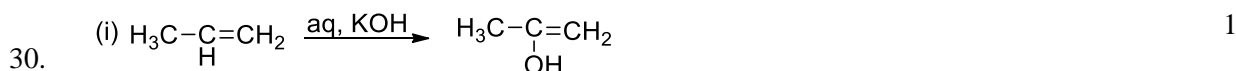
$$\alpha = \frac{A_m}{A_m^0} = \frac{48.15 \text{ S cm}^2 \text{ mol}^{-1}}{390.5 \text{ S cm}^2 \text{ mol}^{-1}} = 0.1233$$
 1/2

$$K = \frac{c\alpha^2}{(1-\alpha)} = \frac{0.001028 \text{ mol L}^{-1} \times (0.1233)^2}{1-0.1233} = 1.78 \times 10^{-5} \text{ mol L}^{-1}$$
 1

29. (a) Due to the formation of anilinium ion during nitration of aniline which is a meta directing in nature form substantial amount of meta nitro aniline. 1

(b) Due to dispersal of positive charge on benzene ring it shows resonance stabilisation & form stable aromatic salt, but not stable resonance is in aliphatic salt. 1

(c) GTS gives pure 1° amines without contamination of 2° & 3° amines. Therefore it is preferred for synthesis of 1° amines. 1



SECTION D

31. (a) (i) Chemisorption is uni-molecular layered while physisorption is multi-molecular layered. 1

(ii) No compound formation takes place in physisorption while surface compound form in chemical adsorption. 1

(iii) Physisorption is reversible but chemisorption is irreversible. 1

(b) provides surface area for reaction, & decreases activation energy value. 2

OR

Multimolecular colloids – Those colloids in which particles are formed by combination of atoms or molecules which are very small in size to form particles of colloidal size, eg. Sulphur sol, Gold sol etc. 1+1

Macromolecular colloids - Those colloids in which particles are bigger in size, i.e. they are polymers eg. Starch in water, egg albumin in water, cellulose in alcohol etc. 1+1

Associated colloids- Those colloids which behave like electrolyte (true solution) at low concentration but colloidal as colloidal solution at high concentration, eg. Soap & detergents are associated colloids. 1

32. (a) **Essential amino acids** are required by the human body, but they cannot be synthesised in the body. They must be taken through food. For example: valine and leucine. **Non-** 2

essential amino acids are also required by the human body, but they can be synthesised in the body. For example: glycine, and alanine

(b)(i) The amide formed between $-\text{COOH}$ group of one molecule of an amino acid and $-\text{NH}_2$ group of another molecule of the amino acid by the elimination of a water molecule is called a peptide linkage. 1

(ii) The primary structure of protein refers to the specific sequence in which various amino acids are present in it, i.e., the sequence of linkages between amino acids in a polypeptide chain. The sequence in which amino acids are arranged is different in each protein. A change in the sequence creates a different protein. 1

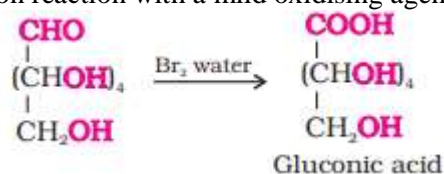
(iii) In a biological system, a protein is found to have a unique 3-dimensional structure and a unique biological activity. In such a situation, the protein is called native protein. However, when the native protein is subjected to physical changes such as change in temperature or chemical changes such as change in pH, its H-bonds are disturbed. This disturbance unfolds the globules and uncoils the helix. As a result, the protein loses its biological activity. This loss of biological activity by the protein is called denaturation. During denaturation, the secondary and the tertiary structures of the protein get destroyed, but the primary structure remains unaltered. One of the examples of denaturation of proteins is the coagulation of egg white when an egg is boiled. 1

OR

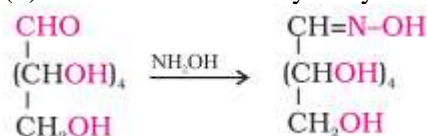
(a) (i) **Oligosaccharides** : These are the saccharides containing 2 to 10 number monosaccharides units joined together by glycosidic linkage. eg:- maltose , galactose 1

(ii) **Denatured protein** : Denatured protein are the protein is when subjected to physical change like change in temperature or chemical change like pH, the hydrogen bonds are disturbed and loses its biological activity. eg:- The coagulation of egg white on boiling. 1

(b)(i) Glucose gets oxidised to six carbon carboxylic acid (gluconic acid) on reaction with a mild oxidising agent like bromine water. 1



(ii) Glucose reacts with hydroxylamine to form an oxime. 1



(iii) Acetylation of glucose with acetic anhydride gives glucose pentaacetate. 1



A = NH_4NO_2 , B = N_2 gas , C = NH_3 , D = HNO_3 (write reactions of each steps) 5

OR

I(a) Tendency to show higher oxidation state decreases from S to Te 1

(b) ClO_3^- is more stable than ClO^- due to dispersal of $-ve$ charge on the three O atoms. Therefore HClO_3 is a stronger acid than HClO . 1

(c) Because of high electronegativity of O & F, they oxidise Xe to their higher oxidation states. 1

(ii) (a) $4\text{NaCl} + \text{MnO}_2 + 4\text{H}_2\text{SO}_4 \rightarrow \text{MnCl}_2 + 4\text{NaHSO}_4 + 2\text{H}_2\text{O} + \text{Cl}_2$ 1

(b) $6\text{XeF}_4 + 12\text{H}_2\text{O} \rightarrow 4\text{Xe} + 2\text{XeO}_3 + 24\text{HF} + 3\text{O}_2$ 1

KENDRIYA VIDYALAYA SANGATHAN

RAIPUR-REGION

CLASS-XII

SUB- CHEMISTRY

MODEL QUESTION PAPER -3

BLUE PRINT

CHAPTER	MCQ (1 MARK)	A & R (1 MARK)	SA (2 MARKS)	SA (3 MARKS)	SA (5 MARKS)	TOTAL
SOLID STATE	4(1)		1(2)			6
SOLUTION	1(1)		2(2)			5
ELECTROCHEMISTRY			1(2)	1(3)		5
CHEMICAL KINETICS			1(2)		1(5)	7
SURFACE CHEMISTRY		4(1)				4
P-BLOCK ELEMENTS			1(2)	2(3)		8
d & f BLOCK ELEMENTS		1(1)			1(5)	6
Co-ORDINATION CHEMISTRY	3(1)	1(1)		1(3)		7
HALOALKANES & HALOARENES	1(1)	1(1)	1(2)			4
ALCOHOL, PHENOL & ETHER		1(1)			1(5)	6
ALDEHYDE, KETONE & CARBOXYLIC ACID	2(1)	1(1)	1(2)			5
AMINES	2(1)		1(2)			4
BIOMOLECULES				1(3)		3
	13(1)	9(1)	9(2)	5(3)	3(5)	70

KENDRIYA VIDYALAYA SANGATHAN
RAIPUR REGION

SAMPLE PAPER - 3
CHEMISTRY THEORY (043)

MM:70

Time: 3 Hours

General Instructions:

1. Take 15 minutes for reading the question paper.
 2. All questions are compulsory.
 3. Section A- Q. No.1 to 16 are MCQ questions carry 1 mark.
 4. Section B - Q.No.17 to 25 are short answer questions and carry 2 marks each.
 5. Section C - Q. No. 26 to 30 are short answer questions and carry 3 marks each.
 6. Section D - Q. No. 31 to 33 are long answer questions carrying 5 marks each.
 7. There is no overall choice. However, internal choices have been provided.
 8. Use of calculators and log tables is not permitted.
-

SECTION A

Q.1 Read the passage given below and answer the following questions:

Defects in Solids

Departure from a perfectly ordered arrangement of constituent particles is called defect or imperfection. In solids, when the ratio between cations and anions remains the same after defect, it is termed as stoichiometric defects. Schottky and Frenkel defects are categorised into stoichiometric defects. In Schottky defect equal number of cations and anions are missing while in Frenkel defect cations are missing from lattice sites and occupy interstitial sites. In non-stoichiometric defects, the ratio of cations and anions changes as a result of the defect. Metal excess and metal deficiency defects are non-stoichiometric defects.

Q.1(i)- The appearance of colour in solid alkali metal halides is generally due to- [1]

- | | |
|----------------------------|--------------------|
| (a) Schottky defect | (b) Frenkel defect |
| (c) Interstitial positions | (d) F-centre |

Q.1(ii) Schottky defect defines imperfection in the lattice structure of a: [1]

- | | |
|------------|------------|
| (a) Solid | (b) Gas |
| (c) Liquid | (d) Plasma |

OR

The correct statement regarding defects in crystalline solid is: [1]

- (a) Frenkel defects is a dislocation defect.
- (b) Frenkel defects decrease the density of crystalline solids.
- (c) Frenkel defects is found in halides of alkaline metals.

(d) Schottky defects have no effect on the density of crystalline solids.

Q.1-(iii) Which of the following is true-

[1]

- (a) Schottky defects decrease density.
- (b) Frenkel defects increase the dielectric constant of crystal.
- (c) Stoichiometric defects make the crystal conductor of electricity.
- (d) All of these.

Q.1(iv) Which of the following crystal exhibit both the Frenkel defect and the Schottky defect [1]

- | | |
|----------|----------|
| (a) AgCl | (b) KBr |
| (c) ZnS | (d) AgBr |

Q.2 Read the passage given below and answer the following questions:

In these questions a statement of assertion is followed by a statement of reason . Choose the correct answer out of the following choices.

- (a) Assertion and reason both are correct and reason is correct explanation for assertion.
- (b) Assertion and reason both are correct but reason is not correct explanation for assertion.
- (c) Assertion is correct statement but reason is wrong statement.
- (d) Assertion is wrong statement but reason is correct statement.

Adsorption

Adsorption is the phenomenon of attracting and retaining the molecules of a substance on the surface of a solid resulting into a higher concentration on the surface than in the bulk. There are several examples, which reveal that the surface of a solid has the tendency to attract and retain the molecules of the phase with which it comes into contact. These molecules remain only at the surface and do not go deeper into the bulk. The molecular species or substance, which concentrates or accumulates at the surface is termed adsorbate and the material on the surface of which the adsorption takes place is called adsorbent. Adsorption is essentially a surface phenomenon, the molecules on surface possess unbalanced or residual attractive forces. These forces of the adsorbent are responsible for attracting the adsorbate particles on its surface. Another important factor featuring adsorption is the heat of adsorption that is adsorption is invariably an exothermic process.

Q.2(i) **Assertion:** Adsorption is a surface phenomenon.

[1]

Reason: It is due to the presence of unbalanced or residual forces at the surface of liquid or solid phase.

Q.2(ii) **Assertion:** During adsorption heat is absorbed.

[1]

Reason: There is formation of bond between the adsorbate and the adsorbent during chemisorption.

Q.2(iii) **Assertion:** Free energy change is negative for adsorption.

[1]

Reason: Adsorption is accompanied by decrease in enthalpy as well as decrease in entropy of the system.

Q.2(iv) **Assertion:** Adsorption process is spontaneous, [1]

Reason: There is a decrease in Gibbs energy change

OR

Assertion: There is increase in the entropy of the gas after adsorption. [1]

Reason: When a gas is adsorbed, the freedom of movement of its molecules become restricted.

Q.3 Amine that cannot be prepared by Gabriel-Phthalimide synthesis is: [1]

- (a) Aniline (b) Benzyl amine
(c) Methyl amine (d) Iso-butyl amine

Q.4 Which of the following aqueous solution should have the highest boiling point? [1]

- (a) 1.0 M NaOH (b) 1.0 M NH_4CO_3
(c) 1.0 M $\text{Al}_2(\text{SO}_4)_3$ (d) 1.0 M Na_2SO_4

OR

The system that forms maximum boiling azeotrope is:

- (a) Ethyl alcohol- water (b) Carbon disulphide- Acetone
(c) Benzene –Toluene (d) Acetone-Chloroform

Q.5- Which of the following compounds will undergo Cannizzaro reaction? [1]

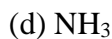
- (a) CH_3CHO (b) CH_3COCH_3
(c) $\text{C}_6\text{H}_5\text{CHO}$ (d) $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$

Q.6 The most convenient method to prepare primary amine containing one carbon atom less is:[1]

- (a) Gabriel phthalimide synthesis (b) Reductive amination of aldehydes
(c) Hofmann bromamide reaction (d) Reduction of isonitriles

Q.7-Which of the following species is not expected to be a ligand? [1]

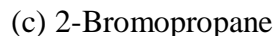
- (a) CO (b) NH_4^+



Q.8- Molecules whose mirror image is non super imposable over them are known as chiral.

Which of the following molecules is chiral in nature?

[1]



OR

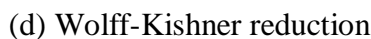
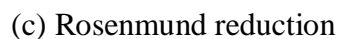
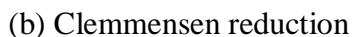
The position of Br in the compound $\text{CH}_3\text{CH}=\text{CHCH}_2(\text{Br})$ is classified as:



Q.9-Hydrocarbons are formed when aldehydes and ketones are reacted with amalgamated

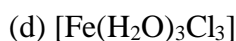
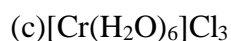
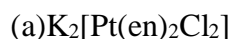
zinc and conc.HCl. The reaction is called:

[1]



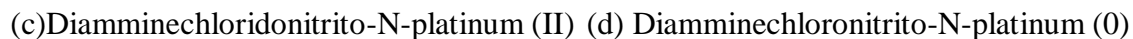
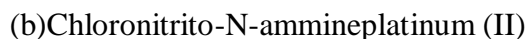
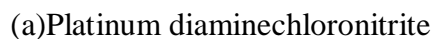
Q.10- Which of the following will give a white precipitate upon reacting with AgNO_3 ?

[1]



Q.11- IUPAC name of $[\text{Pt}(\text{NH}_3)_2\text{Cl}(\text{NO}_2)]$ is:

[1]



In the following questions (Q. No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices:

(a) Assertion and reason both are correct and reason is correct explanation for assertion.

(b) Assertion and reason both are correct but reason is not correct explanation for assertion.

(c) Assertion is correct statement but reason is wrong statement.

(d) Assertion is wrong statement but reason is correct statement.

Q.12- Assertion (A): Oxalate ion is a bidentate ligand. [1]

Reason (R): Oxalate ion has two donor atoms.

Q.13-Assertion (A): Phosphorus chlorides (tri and penta) are preferred over thionyl chloride for the preparation of alkyl chlorides from alcohols.

Reason (R): Thionyl chlorides give pure alkyl halides [1]

OR

Assertion (A): KCN reacts with methyl chloride to give methyl isocyanide.

Reason (R): CN^- is an ambident nucleophile. [1]

Q.14-Assertion (A): p-nitro phenol is more acidic than phenol.

Reason (R): Nitro group helps in the stabilization of the phenoxide ion by dispersal of negative charge due to resonance. [1]

Q.15 Assertion (A): The α -hydrogen atom in carbonyl compounds is less acidic. [1]

Reason (R): The anion formed after the loss of α hydrogen atom is resonance stabilized.

Q.16- Assertion (A): Zn, Cd and Hg cannot be regarded as transition elements. [1]

Reason (R): These elements do not belong to the d-block of the periodic table.

SECTION B

Q.17-You are provided with a compound A, which upon treatment with aqueous NH_3 and then heating gives a compound B, which upon heating with Br_2 and KOH gives aniline.

Identify A and B. [2]

OR

Write the name and draw structures of the main products when aniline reacts with the following reagents-

(i) Br_2 water (ii) $(\text{CH}_3\text{CO})_2\text{O}$ /pyridine [1+1]

Q.18-Your class went to visit Bhabha Atomic Research Centre lab and found there a bottle of chemical labelled as 4.9% H_2SO_4 by mass. What would be the strength of the acid in molarity if the density is marked as 1.5 g/mL [2]

Q.19-(a) Write IUPAC name of $[\text{Co}(\text{H}_2\text{O})_3(\text{NH}_3)_3]\text{Cl}_3$. [1]

Give one example of ambidentate ligand. [1]

Q.20- Draw the structure of the followings- (a) H_2SO_3 (b) HClO_3 1+1]

Q.21- A reaction is first order with respect to reactant A and is second order with respect to reactant B :

(a) Write differential rate equation for the above mentioned reaction. [1]

(b) How is the rate affected when the concentration of B is tripled in the above reaction? [1]

OR

The rate constant for the first order decomposition of N_2O_5 at temperature 25°C is

$3 \times 10^{-2} \text{ min}^{-1}$. If the initial concentration of N_2O_5 is $2 \times 10^{-3} \text{ mol/L}$, how long will it take

to drop the concentration to $5 \times 10^{-4} \text{ mol/L}$? ($\log 4 = 0.6021$) [2]

Q.22- Write any two differences between $\text{S}_{\text{N}}1$ and $\text{S}_{\text{N}}2$ reactions. [2]

Q.23- Give chemical tests to distinguish between the following pairs of compounds:

(a) Phenol and Benzoic acid. [1]

(b) pentan-2-one and pentan-3-one. [1]

OR

Give chemical tests to distinguish between the following pairs of compounds:

(a) Acetaldehyde and Acetone. [1]

(b) Formaldehyde and Formic acid. [1]

Q.24- Do the following conversions.

(a) Methyl chloride to acetone. [1]

(b) Propan-1-ol to propanoic acid. [1]

Q.25- Suppose your classroom is hanging in space and surrounded by similar classrooms in all possible directions leaving no space among them. If each corner of your classroom is occupied by a laddoo of 40 kg which is shared equally by all the touching rooms, what will be the share (in kg) of your class at one corner? Justify your answer. [2]

OR

Cu-crystal has a face centred cubic (fcc) structure. Atomic radius of Cu-atom is 128 pm. What is the density of Cu metal? (Atomic mass of Cu is 63.5 u.) [2]

SECTION C

Q.26-(a) Why is $[\text{NiCl}_4]^{2-}$ paramagnetic while $[\text{Ni}(\text{CN})_4]^{2-}$ is diamagnetic

(Atomic no. of Ni = 28u). [1]

(b) Why are low spin tetrahedral complexes rarely observed. [1]

(c) What is spectrochemical series? [1]

Q.27-Give reason-

(a) F_2 has lower bond dissociation energy than Cl_2 . [1]

(b) Nobel gases form compounds with fluorine and oxygen only. [1]

(c) ICl is more reactive than I_2 . [1]

OR

Complete the following reaction:

(a) $\text{XeF}_6 + \text{NaF} \longrightarrow$ [1]

(b) NaOH (cold and dil) + $\text{Cl}_2 \longrightarrow$ [1]

(c) $\text{XeF}_6 + \text{H}_2\text{O} \longrightarrow$ [1]

Q.28- (a) On the basis of the standard reduction electrode potential (E°) values, which of the following reaction is feasible at the cathode during the electrolysis of aqueous AgCl solution and why?



(b) Define limiting molar conductivity. [1]

Q.29- (a) Draw open structure of glucose. [1]

(b) What is denaturation of protein. [1]

(c) Write one structural difference between DNA and RNA. [1]

Q.30 (a) C-X bond length in halobenzene is smaller than C-X bond length in $\text{CH}_3\text{-X}$. Give reason. [2]

(b) Which property of KCN and AgCN is different from each other which leads KCN to give cyanide but AgCN to give isocyanide in nucleophilic substitution of haloalkanes? [1]

OR

Write name and structure of the major product of the following reactions:

(a) When 2-methyl propene reacts with HCl .

[1]

(b) Benzenediazonium chloride reacts with CuBr_2 in presence of HBr.

[1]

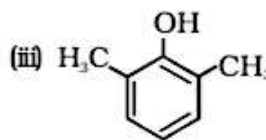
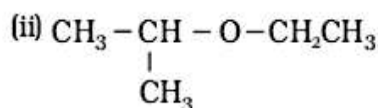
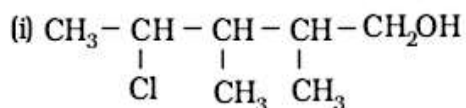
(c) Chlorobenzene reacts with Mg metal in presence of dry ether.

[1]

SECTION D

Q.31-(a) Write IUPAC name of the following compounds:

[1+1+1]



(b) Alcohols are comparatively more soluble in water than hydrocarbons of comparable molecular masses. Give reason.

[2]

OR

A bottle in your chemistry lab is labelled with the molecular formula of the chemical present

[3]

in it as $\text{C}_2\text{H}_6\text{O}$. Write the two functional isomers of this compound and explain, which isomer

should have higher boiling point?

(b) Write complete reaction mechanism of acid dehydration of alcohol at 443 K.

[2]

Q.32-(a) Write any 3 differences between order and molecularity of a reaction?

[3]

(b) Determine the overall order of a reaction which has the rate law

[1]

$$R = K [A]^{5/2} [B]^{3/2}$$

(c) What is the unit of a rate constant of a first order reaction

[1]

OR

(a) A first order reaction has a rate constant $1.25 \times 10^{-3} \text{ s}^{-1}$. How long will 6 g of this reactant take to

reduce to 4 g?

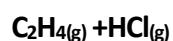
[3]

(b) Predict order of reaction in the following cases:

(i) A reaction for which

$$K = 2.3 \times 10^{-5} \text{ mol}^{-1} \text{ L s}^{-1}$$

[1]



$$K = [\text{C}_2\text{H}_5\text{Cl}]$$

[1]

Q.33-(a) Why transition elements act as catalysts. Give one example of their catalytic property. [2]

(b) Out of Sc^{3+} and Ni^{2+} , which one is coloured and why? [2]

(c) What is Lanthanoid contraction? [1]

OR

(a) Why E^0 for $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is much more positive than $\text{Fe}^{3+}/\text{Fe}^{2+}$? [2]

(b) Cu (I) has d^{10} configuration whereas Cu(II) has d^9 configuration, still Cu(II) is more stable in aqueous solution than Cu(I). Give reason. [2]

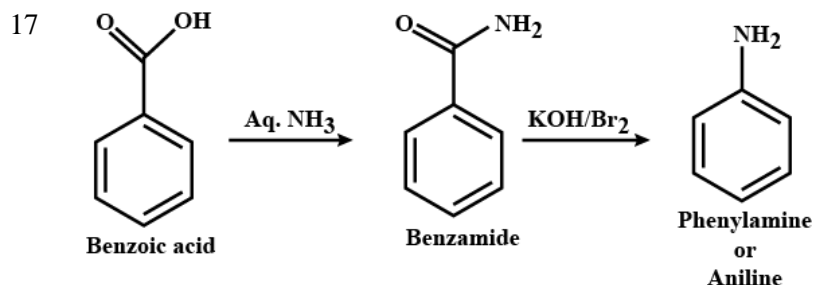
(c) Why do the second and third transition series elements have almost similar atomic radii? [1]

-----XXX-----

**KENDRIYA VIDYALAYA SANGATHAN
RAIPUR-REGION
MODEL QUESTION PAPER-3
CHEMISTRY THEORY (043), CLASS -12
MARKING SCHEME**

SECTION A(MCQ)

Q.N.	ANSWERS	MARKS
1(i)	d	1
1(ii)	a	1
OR 1(ii)	a	1
1(iii)	d	1
1(iv)	d	1
2(i)	a	1
2(ii)	d	1
2(iii)	b	1
2(iv)	a	1
OR 2(iv)	d	1
3	a	1
4	c	1
OR 4	d	1
5	c	1
6	c	1
7	b	1
8	a	1
OR 8	a	1
9	b	1
10	c	1
11	c	1
12	a	1
13	d	1
OR 13	d	1
14	a	1
15	d	1
16	c	1



A B

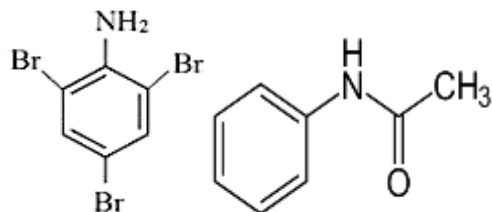
A = benzoic acid, B = benzamide (either structure or name)

1+1

OR

(i) 2,4,6-Tribromoaniline. (ii) acetanilide/ N-Phenylacetamide

$\frac{1}{2} + \frac{1}{2}$



$\frac{1}{2} + \frac{1}{2}$

18.
$$\text{Molarity} = \frac{\% \text{ by mass} \times 1000 \times \text{density}}{\text{Molar mass} \times 100}$$

1

$M = 4.9 \times 1000 \times 1.5 / 98 \times 100 = 0.75 \text{ M}$

1

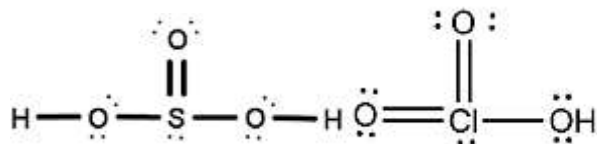
19. (a) Triamminetriaquacobalt(III)chloride.

1

(b) $\text{CN}^- / \text{SCN}^- / \text{NO}_2^-$

1

20. (a) H_2SO_3 (b) HClO_3



1 + 1

21. (a) $\text{Rate} = k[\text{A}][\text{B}]^2$
(b) $(d[\text{B}])^2 = 3^2 = 9$

1

1

OR

For a first order reaction, we have $t = 2.303/K \log[\text{A}]_0/[\text{A}]$

$\frac{1}{2}$

$$= \frac{2.303}{3 \times 10^{-2} \text{ min}^{-1}} \log \frac{2 \times 10^{-3}}{5 \times 10^{-4}}$$

$\frac{1}{2}$

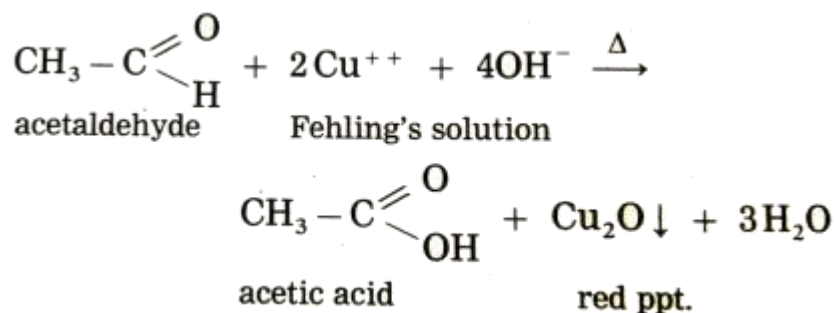
$$= \frac{2.303}{3 \times 10^{-2}} \log 4 \quad (\log 4 = 0.6021)$$

$\frac{1}{2}$

$$= 46.22 \text{ min.}$$

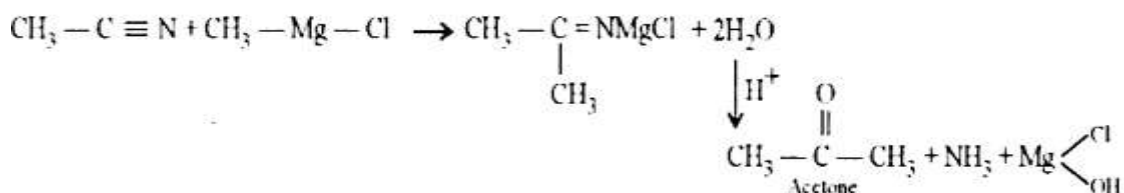
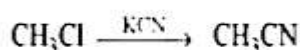
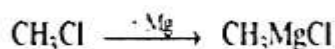
$\frac{1}{2}$

22. any two out of the following:



(b) distinguish between formaldehyde and formic acid: by treating with NaHCO_3 formic acid gives CO_2 bubbles but formaldehyde does not.

24. (a) Conversion: from methyl chloride to acetone



(b) Conversion: From Propan-1-ol to Propanoic acid



25. Share by our class = $40 \times 1/8 = 5$ kg at one corner.

OR

In face centred cubic arrangement face diagonal is four times the radius of atoms

$$\text{face diagonal} = 4 \times 128 = 512 \text{ pm}$$

$$\text{Face diagonal} = \sqrt{2} \times \text{edge length}$$

$$\text{Edge length} = 512 / \sqrt{2} = 362 \times 10^{-10} \text{ cm}$$

$$\text{Volume of the unit cell} = (362 \times 10^{-10})^3 \text{ cm}^3 = 47.4 \times 10^{-24} \text{ cm}^3$$

In a face centred cubic unit cell, there are four atoms per unit cell

$$\text{Mass of unit cell} = 4 \times 63.5 / 6.023 \times 10^{23} \text{ g} = 4.22 \times 10^{-22} \text{ g}$$

$$\text{Density} = \text{mass of unit cell} / \text{volume of unit cell} = 4.22 \times 10^{-22} / 47.4 \times 10^{-24} = 8.9 \text{ g cm}^{-3}$$

SECTION C

26. (a) The presence of CN^- ligand, which is a strong ligand, can pair all electrons in $[\text{Ni}(\text{CN})_4]^{2-}$ and thus it is **diamagnetic** in nature but Cl^- is a weak ligand and is unable to pair up the unpaired electrons and thus $[\text{NiCl}_4]^{2-}$ is **paramagnetic** in nature. 1
- (b) In tetrahedral complex, the d-orbital is splitting to small as compared to octahedral. Hence, the orbital splitting energies are not enough to force pairing. As a result, low spin configurations are rarely observed in tetrahedral complexes. 1
- (c) A **series** in which ligand are arranged in order of increasing magnitude of crystal field splitting, is called **spectrochemical series**. 1
27. (a) due to small size and e—e- repulsion 1
- (b) Because F and O are more electronegative atoms and hence are more reactive. 1
- (c) Interhalogen bond is weaker than intra halogen bond. 1

OR

- (i) $\text{Na}^+ [\text{XeF}_7]^-$ 1
- (ii) $\text{NaCl} + \text{NaOCl} + \text{H}_2\text{O}$ 1
- (iii) $\text{XeOF}_4 + 2\text{HF}$ 1
28. (a) At the cathode $\text{Ag}^+_{(\text{aq})} + \text{e}^- \rightarrow \text{Ag}_{(\text{s})}$ reaction is feasible, because Ag^+ ion has higher reduction potential i.e. higher E° value. 1+1
- (b)) Limiting molar conductivity or the molar conductivity of solution at infinite dilution is the sum of molar conductivities of cations and anions. 1
29. (a) 1
- $$\begin{array}{c}
 \text{H} \quad \text{O} \\
 \diagdown \quad \diagup \\
 \text{C} \\
 | \\
 \text{H} - \text{C} - \text{OH} \\
 | \\
 \text{HO} - \text{C} - \text{H} \\
 | \\
 \text{H} - \text{C} - \text{OH} \\
 | \\
 \text{H} - \text{C} - \text{OH} \\
 | \\
 \text{CH}_2\text{OH}
 \end{array}$$
- (b) The loss of biological activity of **proteins** when a **protein** in its native form, is subjected 1

to physical change like change in temperature or chemical change like change in pH, is called **denaturation of protein**.

- (c) The three main **structural differences between RNA and DNA** are as follows: **RNA** is single-stranded while **DNA** is doublestranded. **RNA** contains uracil while **DNA** contains thymine. **RNA** has the sugar ribose while **DNA** has the sugar deoxyribose.(any one) 1

30. (a) The Sp^2 hybridised carbon in halo benzene is more electronegative due to greater s-character and holds the electron pair of **C-X bond** more tightly **than** Sp^3 hybridised carbon of CH_3-X with less s-character. Thus, **C-X bond length** in CH_3-X is bigger **than** **C-X** in **halobenzene**. 2

- (b) KCN is ionic but AgCN is covalent. 1

OR

(a) 2-Methyl-2-chloropropane ($CH_3C(CH_3)_2Cl$) 1

(b) Bromobenzene (C_6H_5Br) 1

- (c) Benzene magnesium chloride. (C_6H_5MgCl)

SECTION D

31. (a) 1
- (i) 4-Chloro-2,3-dimethylpentan-1-ol 1
- (ii) 2-Ethoxypropane 1
- (iii) 2,6-Dimethylphenol 1
- (b) In alcohols O-H bond is polar due to the more electronegative oxygen atom hence it is easily dissolved in water which is also a polar solvent. 2

OR

- (a) The two functional isomers are C_2H_5OH and CH_3OCH_3 1
- Alcohol will have higher boiling point due to strong intermolecular forces arising due to polar O-H bond. 1

- (b) complete reaction mechanism of acid dehydration of alcohol at 443 K:

- 33 (a) **Transition metals** and their compounds function as **catalysts** either because of their ability to change oxidation state or, in the case of the **metals**, to adsorb other substances on to their surface and activate them in the process. 1
 EXAMPLE: Iron in the Haber Process, Nickel in the hydrogenation of C=C bonds, Vanadium(V) oxide in the Contact Process, Iron ions in the reaction between persulphate ions and iodide ions or any other correct example.(any one) 1
- (b) Ni^{2+} is coloured due to presence of 2 unpaired electrons in (n-1)d orbitals. 1+1
- (c) The **lanthanide contraction** is the greater-than-expected decrease in ionic radii of the elements in the lanthanoid series from La to Lu. 1+1
- OR** 1
- (a) Mn^{3+} to Mn^{2+} gives $3d^4$ to $3d^5$ (half filled) stable configuration so its E° value is more positive whereas Fe^{3+} to Fe^{2+} gives $3d^5$ to $3d^6$, which is less stable hence its E° value is low.
- (b) Cu^{2+} has more negative hydration enthalpy than Cu^+ in aqueous medium. 1+1
- (c) Due to lanthanoid contraction. 1+1
- 1

-----XXXXXXXX-----

K. V. SANGATHAN, RAIPUR REGION

SAMPLE PAPER -4

2020-21

CLASS-XII CHEMISTRY

BLUE PRINT

S No	UNIT	PASSAGE BASED QUESTIONS	MCQ/ A& R Qus 1 MARK	SA I 2 MARKS	SA II 3 MARKS	LA 5 MARKS	TOTAL Qus No (MARKS)
1	SOLID STATE		1(1)	1(2)	1(3)		
2	SOLUTION		1(1) 1(1)	1(2)			11(24)
3	ELECTROCHEMISTRY		1(1)			1(5)	
4	CHEMICAL KINETICS		...	1(2) 1(2)			
5	SURFACE CHEMISTRY	1(4)	...				
6	p-BLOCK ELEMENTS		1(1)	1(2)	1(3)	1(5)	
7	d-BLOCK ELEMENTS		1(1) 1(1)		1(3)		9(19)
8	COORDINATION CHEMISTRY		1(1)	1(2)			
9	HALOALKANE & HALOARENES		1(1)	1(2) 1(2)			
10	ALCOHOL, PHENOL & ETHERS	1(4)	1(1)	1(2)			13(27)
11	ALDEHYDES KETONES & CARBOXYLIC ACID		1(1)			1(5)	
12	AMINES		1(1)		1(3)		
13	BIOMOLECULES		1(1) 1(1)		1(3)		
	TOTAL	2(8)	14(14)	9(18)	5(15)	3(15)	33(70)

KENDRIYA VIDYALAYA SANGATHAN, RAIPUR REGION
SAMPLE PAPER – 4
2020-21
CLASS - XII

M.M.70 SUBJECTS – CHEMISTRY TIME: 3 HOURS

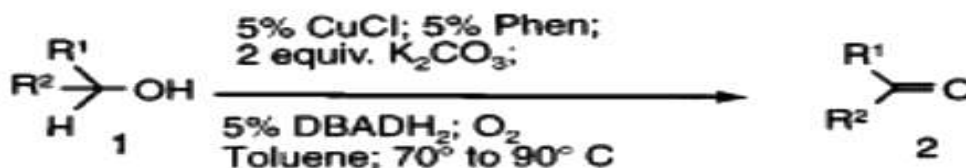
General Instructions:

- There are 33 questions in this question paper. All questions are compulsory.
- Section A: Q No. 1 to 16 are objective type questions. Q.No. 1 & 2 are passage based questions carrying 4 marks each while Q.No 3 to 16 carry 1 mark each.
- Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each.
- Section D: Q.No. 31 to 33 are long answer questions and carry 5 marks each.
- There is no overall choice. However, internal choices have been provided.
- Use of calculator and log table is not permitted.

SECTION A (OBJECTIVE TYPE)

1. Read the passage given below and answer the following questions:

An efficient, aerobic catalytic system for the transformation of alcohols into carbonyl compounds under mild conditions, copper-based catalyst has been discovered. This copper-based catalytic system utilizes oxygen or air as the ultimate, stoichiometric oxidant, producing water as the only by-product



A wide range of primary, secondary, allylic, and benzylic alcohols can be smoothly oxidized to the corresponding aldehydes or ketones in good to excellent yields. Air can be conveniently used instead of oxygen without affecting the efficiency of the process. However, the use of air requires slightly longer reaction times. This process is not only economically viable and applicable to large-scale reactions, but it is also environmentally friendly.

The following questions are multiple choice questions. Choose the appropriate option.

- (i) The carbonyl compound formed when ethanol gets oxidised using this copper-based catalyst can also be obtained by ozonolysis of:
 - (a) But-1-ene (b) But-2-ene (c) Ethene (d) Pent-1-ene
- (ii) The Copper based catalyst mention in the study above can be used to convert:
 - (a) propanol to propanonic acid
 - (b) propanone to propanoic acid
 - (c) propanone to propan-2-ol
 - (d) propan-2-ol to propanone
- (iii) 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
- (iv) Which test are used to distinguish primary, secondary and tertiary alcohols.
 - (a) Lucas test
 - (b) Victor Meyer test
 - (c) Oxidation method test
 - (d) All of the above

2. Read the passage given below and answer the following questions (Assertion-reason based):

Earlier the term 'colloid' was used for a category of substances. However later, the term colloidal state of matter was preferred. Colloidal dispersions have been classified into different types depending upon the physical state of the dispersed phase and the dispersion medium or the nature of interactions between them or the nature of the colloidal particles. They are prepared in the industry or in the laboratory by a number of methods and then purified. Their physical properties have also been studied in detail. Hardy and Schulze made a substantial contribution in studying the coagulation of the colloids. The protective action of lyophilic colloids was studied by Zsigmondy and he introduced term called 'Gold number'.

In these questions a statement of assertion followed by a statement of reason is given.

Choose the correct answer out of the following choices.

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
- b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
- c) Assertion is correct statement but reason is wrong statement.
- d) Assertion is wrong statement but reason is correct statement.

(i) Assertion : Lyophilic sols are more stable.

Reason : Lyophilic sols are extensively hydrated.

(ii) Assertion : Purification of colloids is necessary.

Reason : It is done by dialysis.

(iii) Assertion : Fog is an aerosol.

Reason : Dispersed phase and dispersion medium of fog are gas and liquid respectively.

(iv) Assertion : Out of NaCl and K₂SO₄, NaCl is more effective for coagulation of Ferric hydroxide sol.

Reason: Greater the valency of oppositely charged ion of electrolyte, faster is the coagulation of sol.

*** Following questions (No 3 to 11) are multiple choice questions carrying 1 mark each.

3. A 5% solution of Cane Sugar (molecular mass = 342 gmol^{-1}) is isotonic with 1% solution of substance X. The molecular mass of X is:
(a) 34.2 (b) 171.2 (c) 68.4 (d) 136.8
4. Name the simplest amino acid
(a) Alanine (b) Tyrosine (c) Glycine (d) Asparagine

OR

The bond between two units of monosaccharide through O atom is called-

- (a) Peptide linkage (b) Pyranose ring (c) Glycosidic linkage (d) Furanose ring
5. The mixture of Ethyl Iodide and Ethyl Bromide is an example of –
(a) Ideal solution (b) non ideal solution (c) Dilute solution (d) Concentrate solution
6. Zinc and mercury do not show variable valency like d-block elements because–
(a) they are soft
(b) their d-shells are complete
(c) they have only two electrons in the outermost subshell
(d) their d-shells are incomplete

OR

Which of the following ion has electronic configuration $[\text{Ar}] 3d^7$?

- (a) Ni^{2+} (b) Co^{2+} (c) Co^{3+} (d) Mn^{3+}

7. In this reaction acetamide is converted to methanamine
(a) Gabriel phthalimide synthesis
(b) Carbylamine reaction
(c) Stephen's reaction
(d) Hoffmann bromamide reaction

OR

IUPAC name of the o-toluidine:

- (a) N,N- dimethylaniline (b) 3-Aminotoluene
(c) N- methyl-N phenylmethanamine (d) 2-Aminotoluene
8. Which of the following ligands is ambidentate ligand?
(a) SCN^- (b) NO_2^- (c) CN^- (d) All of these

OR

Oxidation number & coordination number of central metal atom in the complex $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ –

- (a) +3 & 4 (b) +3 & 5 (c) +2 & 6 (d) +3 & 6
9. In which of the following pairs, both the ions are coloured in aqueous solutions?
(a) Ni^{2+} & Ti^{3+} (b) Sc^{3+} & Ti^{3+} (c) Sc^{3+} & Co^{2+} (d) Ni^{2+} & Cu^+
10. Which of the following is most reactive towards SN_1 reaction?
(a) $\text{C}_6\text{H}_5\text{C}(\text{CH}_3)\text{C}_6\text{H}_5\text{Br}$ (b) $\text{C}_8\text{H}_5\text{CH}_2\text{Br}$

- (c) $\text{C}_6\text{H}_5\text{CH}(\text{C}_6\text{H}_5)\text{Br}$ (d) $\text{C}_6\text{H}_5\text{CH}(\text{CH}_3)\text{Br}$

11. The number of lattice points in End-centered unit cell are :-

- (a) 14 (b) 10 (c) 9 (d) 1

Following questions (No 12 to 16) are Assertion- Reason type questions carrying 1 mark each.

(In these questions a statement of assertion followed by a statement of reason is given.

Choose the correct answer out of the following choices.)

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.

- c) Assertion is correct statement but reason is wrong statement.
 d) Assertion is wrong statement but reason is correct statement.

12. **Assertion** – D(+)Glucose is dextrorotatory in nature.
Reason – 'D' represents its dextrorotatory nature.
 (a) A (b) B (c) C (d) D
13. **Assertion** – Assertion : Ozone is more powerful oxidizing agent than O_2 .
Reason – Ozone is diamagnetic but O_2 is paramagnetic.
 (a) A (b) B (c) C (d) D
14. **Assertion** – Henry's constant for all the gases are same.
Reason – Mole fraction of a gas in a solution is directly proportional to the partial pressure of the gas in vapour phase.
 (a) A (b) B (c) C (d) D
 OR
Assertion – Ethanol and water forms maximum boiling azeotrope.
Reason – Mixture of ethanol and water shows positive deviation from Raoult's law.
 (a) A (b) B (c) C (d) D
15. **Assertion** – Carboxylic acids have more BP than aldehydes, ketones and even alcohols of comparable molecular masses.
Reason – This is due to more extensive association of carboxylic acid molecules through intermolecular hydrogen bonding.
 (a) A (b) B (c) C (d) D
16. **Assertion** – Methyl chloride can give methane as well as ethane separately.
Reason – Wurtz reaction proceeds through free radical mechanism.
 (a) A (b) B (c) C (d) D

SECTION B (SHORT ANSWER - I TYPE)

*** Q.No 17 to 25 are short answer I type carrying 2 marks each.

17. Account for the following:
 (i) $Cl-CH_2COOH$ is stronger acid than CH_3COOH .
 (ii) Carboxylic acids do not give reactions of Carbonyl group.
 OR
 Carry out the following conversions (not more than two steps)
 (i) Aniline to Phenol
 (ii) Ethanoic acid to Ethanal
18. The boiling point of benzene is 353.23 K. When 1.80 g of a non-volatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354.11 K. Calculate the molar mass of the solute. K_b for benzene is $2.53 K kg mol^{-1}$
19. (i) $[Cr(NH_3)_6]^{3+}$ is paramagnetic while $[Ni(CN)_4]^{2-}$ is diamagnetic. Explain why?
 (ii) Write the IUPAC names of the compounds $[Pt(NH_3)_2Cl(NO_2)]$
 OR
 (a) $[NiCl_4]^{2-}$ & $[Ni(CO)_4]$ both have tetrahedral geometry but different magnetic behavior. Why?
 (b) Write the IUPAC name of $[Fe(NH_3)_2(CN)_4]^-$ ion.
20. A reaction is 2nd order with respect to a reactant. How is the rate affected, if the concentration of the reactant is – (i) doubled (ii) reduced to half?

OR

The decomposition of N_2O_5 in Carbon tetrachloride solution has been found to be first

order with respect to N_2O_5 with rate constant $k = 6.2 \times 10^{-4} \text{ s}^{-1}$



(i) Calculate the rate of reaction when $[\text{N}_2\text{O}_5] = 2.50 \text{ mol L}^{-1}$

(ii) What concentration of N_2O_5 would give rate of $4.2 \times 10^{-3} \text{ mol L}^{-1} \text{ s}^{-1}$?

21. Show that in a first order reaction, time required for completion of 99.9% is 10 times of half-life ($t_{1/2}$) of the reaction.
22. Which among the following undergoes SN^1 reaction faster?
Benzylchloride or Cyclohexylmethylchloride.
Explain the reason for the answer.
23. Draw the structures of followings –
(a) XeF_2 (b) XeO_3
24. Write the mechanism of acid catalysed dehydration of Ethanol to yield Ethene.
25. A compound forms hexagonal close-packed structure. What is the total number of voids in 0.5 mol of it? How many of these are tetrahedral voids?

SECTION C (SHORT ANSWER – II TYPE)

***Q.no. 26-30 are short answer II type carrying 3 marks each.

26. Give reason-

- (i) E^θ of Cu is +0.34V while that of Zn is -0.76V
(ii) Transition metal exhibited highest oxidation states in oxoanions of a metal.
(iii) Transition metals form coloured ions.

OR

- (a) The d^1 configuration is very unstable in ions.
(b) E_0 for $\text{Mn}^{3+}/\text{Mn}^{2+}$ is much more positive than $E_0 \text{ Cr}^{3+}/\text{Cr}^{2+}$ or $E_0 \text{ Fe}^{3+}/\text{Fe}^{2+}$.
(c) Transition metals and many of their compounds show paramagnetic behaviour.
27. Arrange the following in increasing order of property specified.
(a) $\text{C}_2\text{H}_5\text{-NH}_2$, $(\text{C}_2\text{H}_5)_2\text{NH}$, $(\text{C}_2\text{H}_5)_3\text{N}$, NH_3 - basic strength in gaseous phase.
(b) $\text{C}_2\text{H}_5\text{-OH}$, $\text{C}_2\text{H}_5\text{-NH}_2$, $\text{CH}_3\text{-COOH}$ – boiling point
(c) $\text{C}_6\text{H}_5\text{-NH}_2$, $\text{C}_2\text{H}_5\text{-NH}_2$ and $\text{C}_2\text{H}_5\text{-NH-C}_2\text{H}_5$ – pK_b

OR

Account for the following:

- (i) pK_b of aniline is more than that of methylamine.
(ii) Ethylamine is soluble in water whereas aniline is not.
(iii) Methylamine in water reacts with ferric chloride to precipitate hydrated ferric oxide.
28. Silver crystallises in a face – centred cubic lattice with all the atoms at the lattice points. The length of the edge of the unit cell as determined by X – ray diffraction studies is found to be $4.077 \times 10^{-8} \text{ cm}$. The density of silver is 10.5 g/cm^3 . Calculate the atomic mass of silver.
- Or
- A metal crystallizes into cubic system FCC and BCC having edge lengths 3.5\AA & 3.0\AA respectively. Calculate the ratio of densities of FCC & BCC unit cells.
29. (a) Differentiate between globular and fibrous protein.
(b) What type of bonding helps in stabilising α – helix structure of proteins?
(c) Give one example of essential and non – essential amino acid
30. Account for the following:
(i) Nitrogen does not form penta halide.
(ii) SF_6 is inert while SF_4 is highly reactive towards hydrolysis.
(iii) Halogens are strong oxidising agents.

SECTION D (LONG ANSWER TYPE)

***Q.no. 30-33 are long answer type carrying 5 marks each.

31. (i) Arrange the following in the increasing order of bond dissociation enthalpy: F_2 , Cl_2 , Br_2 , I_2
(ii) Draw the shape of XeF_2
(iii) X_2 is a greenish yellow gas with pungent offensive smell used in purification of water.
It partially dissolves in water to give a solution which turns blue litmus red. When X_2 is passed through $NaBr$ solution, Br_2 is obtained.
(a) Identify X_2 , name the group to which it belongs.
(b) Why aqueous solutions of X_2 act as a bleaching agent?
(c) What happens when X_2 react with hot and conc. $NaOH$? Write equation.

OR

- (a) Answer the following questions.

- (i) Arrange the oxoacids of chlorine in decreasing order of acidic strength.
(ii) What is aqua-regia? Write the formula of the complex formed when Gold dissolves

In aqua regia.

- (b) A greenish yellow gas "A" with pungent & suffocating odour is a powerful bleaching agent. "A" on treatment with dry slaked lime gives bleaching powder. Identify "A" and explain the reason for its bleaching action. State its bleaching action is permanent or temporary.

32. (a) 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 addition product with $NaHSO_3$. Compound B gives negative Tollen's test and positive iodoform test. On drastic oxidation B gives compound C along with formic acid. Identify compounds A, B and C.
(b) Give a chemical test to distinguish between following pair of compounds:
(i) Ethanol and Methoxymethane
(ii) Phenol and Aniline

OR

- (a) Write chemical equations involved for the following reaction-

- (i) Cannizzaro reaction
(ii) Clemmensen reduction

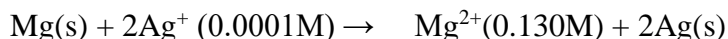
- (b) How will you convert?

- (a) Ethanol to 3-hydroxybutanal
(b) Benzaldehyde to benzophenone
(c) Acetone to propene

33. (i) If E^0 for Copper electrode is +0.34 V, calculate e.m.f value when the solution in contact with it is 0.1M in Copper ions? How does e.m.f for Copper electrode change when concentration of Cu^{2+} ion in the solution is decreased?
(ii) Why is alternating current used for measuring resistance of an electrolytic solution?
(iii) State Kohlrausch's law of independent migration of ions.

OR

- (i) Represent the cell in which the following reaction takes place



Calculate its E_{cell} if standard electrode potential = 3.17 V.

- (ii) Suggest a way to determine the ΔH_m of water.
(iii) Why does the conductivity of a solution decrease with dilution?

The cell is



The Nernst equation is

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{2F} \ln \frac{[\text{Mg}^{2+}]}{[\text{Ag}^{+}]}$$

$$E_{\text{cell}} = 3.17 \text{ V} - \frac{0.059 \text{ V}}{n} \log \left[\frac{0.130}{(0.0001)^2} \right]$$

$$E_{\text{cell}} = 3.17 \text{ V} - \frac{0.059 \text{ V}}{n} \times 7.114$$

$$E_{\text{cell}} = 3.17 \text{ V} - 0.21 \text{ V}$$

$$E_{\text{cell}} = +2.96 \text{ V}.$$

(ii) $\Lambda^0_{\text{m}}(\text{H}_2\text{O}) = [\Lambda^0_{\text{m}}(\text{HCl}) + \Lambda^0_{\text{m}}(\text{NaOH})] - \Lambda^0_{\text{m}}(\text{NaCl})$

(iii) Correct reason

KENDRIYA VIDYALAYA SANGATHAN, RAIPUR REGION
MARKING SCHEME
Sample Paper –4
XII 2020-21
CHEMISTRY

Q. No.	VALUE POINTS	Marks
1	(i)b (ii) d (iii) a (iv) d	1x4=4
2	(v) a (vi) b (vii) c (viii) d	1x4=4
3-16	3.(a) 4. (c) 5. (a) 6. (b) 7. (d) 8. (d) 9. (a) 10. (a) 11. (b) 12. (b) 13. (b) 14. (d)	1

	15. (a) 16. (b)	
17	(i) In ClCH ₂ COOH, Cl atom is withdrawing and increases polarity of O-H bond and stabilizes conjugate base. But CH ₃ COOH, CH ₃ group is electron releasing and decreases the polarity of O-H bond and destabilizes conjugate base. (ii) Carboxylic acid is a resonance hybrid of following structures.	1+1
	 Electrophillic character of Carbonyl Carbon is reduced due to resonance. OR (i) (ii)	1+1
18	NCERT example 2.8 M ₂ = 58 g mol ⁻¹	2
19	(a) Cr ³⁺ has electronic configuration [Ar]3d ³ It undergoes d ² sp ³ hybridisation to form six hybrid orbitals which are occupied by electron pairs donated by six ammonia ligands. Ni ²⁺ has electronic configuration [Ar]3d ⁸ It undergoes dsp ² hybridisation to form 4 hybrid orbitals which are occupied by electron pairs donated by four cyanide ligands. (b) diamminechloridonitrito-N-platinum(II) OR (a) +2 oxidation state, 2 unpaired electrons & 0 oxidation state, no unpaired electrons. (b) Diaminetetracyanidoferrate(III)	1+1
20	(i) rate of reactions quadruples (ii) rate of reaction 1/4 th OR (i) r = k[N ₂ O ₅] = 6.2 x 10 ⁻⁴ s ⁻¹ x 2.50molL ⁻¹ = 1.55 x 10 ⁻³ molL ⁻¹ s ⁻¹ (ii) r = k[N ₂ O ₅] 4.2 x 10 ⁻³ molL ⁻¹ s ⁻¹ = 6.2 x 10 ⁻⁴ s ⁻¹ [N ₂ O ₅] [N ₂ O ₅] = $\frac{4.2 \times 10^{-3} \text{mol L}^{-1}\text{s}^{-1}}{6.2 \times 10^{-4} \text{s}^{-1}}$ = 6.77molL ⁻¹ s ⁻¹	1+1
21	Example 4.8 NCERT t/t _{1/2} =10	2
22	Benzyl chloride undergoes S _N ¹ reaction faster.	2

28	<p>Solution : We know that $\rho = \frac{Z \times M}{a^3 \times N_0 \times 10^{-30}}$ or $M = \frac{\rho \times a^3 \times N_0 \times 10^{-30}}{Z}$</p> <p>According to available data :</p> <p>Edge length (a) = $4.077 \times 10^{-8} \text{ cm} = 4.077 \times 10^{-8} \times 10^{10} = 407.7 \text{ pm}$</p> <p>No. of atoms per unit cell (Z) = 4 , Density of silver = 10.50 g cm^{-3} (\therefore fcc structure)</p> <p>Avogadro's Number (No.) = $6.022 \times 10^{23} \text{ mol}^{-1}$</p> <p>$\therefore$ Atomic mass of the element (M)</p> $= \frac{(10.50 \text{ g cm}^{-3}) \times (407.7)^3 \times (6.022 \times 10^{23} \text{ mol}^{-1}) \times (10^{-30} \text{ cm}^3)}{4} = 107.09 \text{ g mol}^{-1}$ <p>Or</p> <p>For FCC Z=4 & for BCC Z=2 and densities of both cubic systems are given apply the formula of density for both the cubic system and find the ratio as- d : d' = 3.17 : 1</p>	3
29	<p>(a) Any one difference</p> <p>(b) H – bonding</p> <p>(c) Give 1 example each</p>	1+1+1
30	<p>(a) Due to the absence of vacant d orbitals in its valence shell.</p> <p>(b) SF₆ is octahedral and Sulphur is sterically protected by six Fluorine atoms. Whereas SF₄ has sea saw structure.</p> <p>(c) They readily accept electrons due to small size and high nuclear charge and by gaining one electron they become stable.</p>	1+1+1
31	<p>(i) I₂ < F₂ < Br₂ < Cl₂</p> <p>(ii) Correct Structure (linear)</p> <p>(iii) (a) Cl₂, 17 group</p> <p>(b) Cl₂ when dissolved in water releases nascent Oxygen</p> <p>(c) $3\text{Cl}_2 + 6\text{NaOH} \rightarrow 5\text{NaCl} + \text{NaClO}_3 + 3\text{H}_2\text{O}$</p> <p>OR</p> <p>(a) (i) HClO₄ > HClO₃ > HClO₂ > HClO</p> <p>(ii) Mixture of conc. HCl & conc. HNO₃ on 3:1 ratio Complex is AuCl₄⁻</p> <p>(b) “A” = Cl₂ gas</p> <p>Cl₂ + H₂O -----> HCl + HOCl</p> <p>HOCl -----> HCl + O</p> <p>Coloured substance + O -----> Colourless substance</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1/2 + 1/2</p> <p>2+3</p>
32	<p>(a) A- 1 Propyne</p> <p>B-Propanone</p> <p>C- Acetic Acid</p> <p>(i) Na metal test / any other suitable test</p> <p>(ii) carbylamines test / any other suitable test</p> <p>OR</p> <p>(a) (i) Any suitable reaction to describe Cannizzaro reaction</p> <p>(ii) Any suitable reaction to describe Clemmensen reduction.</p> <p>(b) (i) correct conversion</p> <p>(ii) correct conversion</p> <p>(iii) correct conversion</p>	<p>3+2</p> <p>2+3</p>

$$\begin{aligned}
 \text{(i) } E_{\text{Cu}^{2+}/\text{Cu}} &= E^{\circ}_{\text{Cu}^{2+}/\text{Cu}} - \frac{0.059}{2} \log \left[\frac{1}{\text{Cu}^{2+}} \right] \\
 &= +0.34 - \frac{0.059}{2} \log \left[\frac{1}{0.1} \right] \\
 &= +0.34 - \frac{0.059}{2} \log 10 \\
 &= +0.34 - \frac{0.059}{2} \times 1 \\
 &= +0.34 - 0.0295 \\
 &= 0.31 \text{ V}
 \end{aligned}$$

When conc. of Cu^{2+} ion in solution is decreased, emf of Cu electrode will decrease.

(ii) If direct current is used composition of the solution is changed.

(iii) Kohlrausch's law of independent migration of ions states that the limiting molar conductivity of an electrolyte can be represented as the sum individual contributions of its cations & anions.

Or

(i)

The cell is

$\text{Mg(s)} \mid \text{Mg}^{2+}(\text{aq}) (0.130 \text{ M}) \parallel \text{Ag}^{+}(\text{aq}) (0.0001 \text{ M}) \mid \text{Ag(s)}$

The Nernst equation is

$$E_{\text{cell}} = E^{\circ}_{\text{cell}} - \frac{RT}{2F} \ln \frac{[\text{Mg}^{2+}]}{[\text{Ag}^{+}]}$$

$$E_{\text{cell}} = 3.17 \text{ V} - \frac{0.059 \text{ V}}{n} \log \left[\frac{0.130}{(0.0001)^2} \right]$$

$$E_{\text{cell}} = 3.17 \text{ V} - \frac{0.059 \text{ V}}{n} \times 7.114$$

$$E_{\text{cell}} = 3.17 \text{ V} - 0.21 \text{ V}$$

$$E_{\text{cell}} = +2.96 \text{ V.}$$

(ii) $\Lambda^{\circ}m(\text{H}_2\text{O}) = [\Lambda^{\circ}m(\text{HCl}) + \Lambda^{\circ}m(\text{NaOH})] - \Lambda^{\circ}m(\text{NaCl})$

(iii) Correct reason

3+2

KENDRIYA VIDYALAYA SANGATHAN, RAIPUR REGION PRE-BOARD EXAM. 2020-21

CLASS-XII

BLUE PRINT

SUB: - Chemistry

S.N O.	UNIT	PASSAGE BASED QUESTIONS 1X4=4	VSA 1MARK	SAI 2MARKS	SAII 3MARKS	LA 5MARKS	TOTAL
1	SOLID STATE	0	1(1)	1(2)	1(3)	0	
2	SOLUTION	0	2(2)	1(2)	0	0	
3	ELECTROCHEMISTRY	0	1(1)	0	0	1(5)	11(24)

4	CHEMICAL KINETICS	0	0	2(4)	0	0	
5	SURFACE CHEMISTRY	1(4)	0	0	0	0	
6	p-BLOCK ELEMENTS	0	1(1)	1(2)	1(3)	1(5)	}
7	d-BLOCK ELEMENTS	0	2(2)	0	1(3)	0	
8	COORDINATION CHEMISTRY	0	1(1)	1(2)	0	0	
9	HALOALKANE & HALOARENES	0	1(1)	3(6)	0	0	
10	ALCOHOL, PHENOL & ETHERS	1(4)	1(1)	0	0	0	
11	ALDEHYDES, KETONES & CARBOXYLIC ACID	0	1(1)	0	0	1(5)	}
12	AMINES	0	1(1)	0	1(3)	0	
13	BIOMOLECULES	0	2(2)	0	1(3)	0	
	TOTAL	2(8)	14(14)	9(18)	5(15)	3(15)	33(70)

CHEMISTRY THEORY (043)
Model Question Paper-5
Session-2020-21

MM:70 Time: 3 Hours

General Instructions. Read the following instructions carefully.

- There are 33 questions in this question paper. All questions are compulsory.
- Section A: Q. No. 1 to 2 are case-based questions having four MCQs or Reason Assertion type based on given passage each carrying 1 mark

- c) Section A: Question 3 to 16 are MCQs and Reason Assertion type questions carrying 1 mark each
- d) Section B: Q. No. 17 to 25 are short answer questions and carry 2 marks each.
- e) Section C: Q. No. 26 to 30 are short answer questions and carry 3 marks each
- f) Section D: Q. No. 31 to 33 are long answer questions carrying 5 marks each
- g) Use of calculators and log tables is not permitted.

SECTION A (OBJECTIVE TYPE)

1. Read the passage given below and answer the following questions:

Monohydric alcohols are found in great variety in natural flavour and fragrance materials. Many chemical types are represented: aliphatic, alicyclic, polycyclic, heterocyclic, terpenoid, saturated, unsaturated, etc. In flavour and odour they cover practically the entire useful spectrum. Some are present in low concentrations and others are the principal components of the natural products. Flavourists and perfumers first formulated sophisticated flavours and fragrances using naturally occurring alcohols. As the art and science progressed, chemists devised synthetic routes to many of the important natural alcohols and produced them cheaper and in higher quality. Commercial synthesis of some natural alcohols, such as, geraniol, citronellol, menthol and linalool has had a very significant impact on the economics of the flavor and fragrance industry. The preparation and use of the more important monohydric alcohols are reviewed.

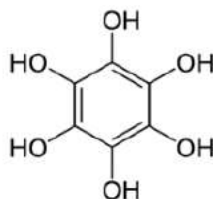
(Reference :J.Dorsky (1981). *Monohydric Alcohols in the Flavour and Fragrance Industry*. AMERICAN CHEMICAL SOCIETY)

1. The Following are multiple choice questions. Choose the most appropriate answer:

1.1 The monohydric alcohol which is used in wines and personal care:

- a) C_4H_9OH
- b) C_2H_5OH
- c) C_7H_{16}
- d) Glycol - $(CH_2OH)_2$

1.2 Name the following compound in the basis of structure given below:



- a) Glycerol (Trihydric)
- b) Hydroxyquinol (Trihydric)
- c) Alditol (Polyhydric)
- d) Hexaphenol (Polyhydric)

1.3 Which one is the correct increasing order of the solubility of alcohol?

- a) N-Butyl Alcohol < Isobutyl Alcohol < Sec Butyl Alcohol < Tert Butyl Alcohol

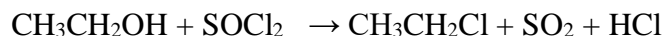
- b) N-Butyl Alcohol > Tert Butyl Alcohol > Isobutyl Alcohol > Sec Butyl Alcohol
 c) Isobutyl Alcohol < N-Butyl Alcohol < Sec Butyl Alcohol < Tert Butyl Alcohol
 d) N-Butyl Alcohol > Isobutyl Alcohol > Sec Butyl Alcohol > Tert Butyl Alcohol

OR

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

- a) Propan-1-ol, butan-2-ol, butan-1-ol, pentan-1-ol
 b) Propan-1-ol, butan-1-ol, butan-2-ol, pentan-1-ol
 c) Pentan-1-ol, butan-2-ol, butan-1-ol, propan-1-ol
 d) Pentan-1-ol, butan-1-ol, butan-2-ol, propan-1-ol

1.4 In the following reaction, alcohol forms chloroethane by reaction with SOCl_2 :



Name the reagent used in this reaction.

- a) Conc. H_2SO_4 at 433 to 443 K
 b) Pyridine
 c) PCl_5
 d) Anhydrous ZnCl_2

2. Read the passage given below and answer the following questions.

(1x4=4)

The foundation of colloidal chemistry was laid down by an English chemist, Thomas Graham in 1861. Various others such as Tyndall, Hardy and many more contributed to the advancements in the field. The colloidal phenomenon invented by Tyndall sketched the line of distinction between a true and a colloidal solution. The same phenomenon is encountered in a dark room and dense canopy of trees found in forest.

2. In these questions (Q. No 5-8), a statement of assertion followed by a statement of reason is given.

Choose the correct answer out of the following choices.

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
 b) Assertion and reason both are correct statements but reason is not correct explanation for assertion
 c) Assertion is correct statement but reason is wrong statement.
 d) Assertion is wrong statement but reason is correct statement.

2.1 Assertion (A): A colloid is a heterogeneous system.

Reason (R) Colloidal particles have an enormous surface.

2.2 Assertion (A): Scattering of light illuminates the path of beam in the colloidal dispersion.

Reason(R): Colloidal solutions as well as true solutions show Tyndall effect.

OR

Assertion (A): The sky looks blue to us.

Reason(R): Dust particles along with suspended in air scatter blue light.

2.3 Assertion: Colloidal solutions show colligative properties.

Reason: Colloidal particles are larger in size.

2.4 Assertion (A): Colloidal particles always carry an electric charge.

Reason(R): The nature of charge is the same on all the particles in a given colloidal particles.

Following questions (No. 3 -11) are multiple choice questions carrying 1 mark each:

3. Both Frenkel and Schottky defects are present in –

- (a) AgBr
 (b) AgCl
 (c) AgI

(d)ZnS

4. Which of the following is a colligative property

- (a) Vapour pressure
- (b) Boiling point
- (c) Osmotic pressure
- (d) All of above

5. Which of following statement is wrong?

- (a) d-Block elements belong to groups 3 to 12
- (b) All transition elements are metals
- (c) All elements of d-block are transition elements
- (d) d-block elements are present in between s & p block elements in periodic table

OR

By what name the d-block elements are known?

- (a) More electropositive elements
- (b) Less electropositive elements
- (c) Transition elements
- (d) Inner transition elements

6. The geometry of complex involving dsp^2 hybridization is:

- (a) Square planar
- (b) Tetrahedral
- (c) Octahedral
- (d) Trigonal planar

OR

In which of the following hybrid orbitals, octahedral complex is formed?

- (a) sp^3d^2
- (b) dsp^2
- (c) sp^3
- (d) sp^3d

7. Lucas test can be used to distinguish between:

- (a) Phenol and p-cresol
- (b) Propan-1-ol and ethanol
- (c) Butan-1-ol and 2-methylpropan-2-ol
- (d) Ethanol and glycol

8. CH_3CHO and $C_6H_5CH_2CHO$ can be distinguished chemically by :

- a) Benedict's test
- b) Tollen's reagent
- c) Fehling's reagent
- d) Iodoform test

9. The reaction of any primary amine with chloroform and ethanolic solution of KOH is called:

- (a) Hofmann's reaction
- (b) Reimer Tiemann reaction
- (c) Carbylamines reaction
- (d) Kolbe's reaction

OR

Hinsberg's reagent is

- (a) C_6H_5COCl
- (b) CH_3COCl
- (c) $C_6H_5SO_2Cl$
- (d) $C_6H_5CH_2Cl$

10. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to

- (a) Increase in number of ions
- (b) Increase in ionic mobility of ions

- (c) 100% ionization of electrolyte at normal dilution at normal
(d) Increase in both, i.e., number of ions and ionic mobility of ions

11. Which proteins are generally insoluble in water?

- (a) Tertiary proteins
(b) Globular protein
(c) Fibrous proteins
(d) Primary proteins

OR

Which of the following reagent does not react with glucose?

- (a) NH_2OH
(b) HCN
(c) 2,4-DNP reagent
(d) Br_2 water

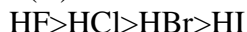
In the following questions (Q. No. 12 - 16) a statement of assertion followed by a statement of reason is given. Choose the correct answer out of the following choices.

- a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

12. Assertion (A) : The solubility of gases increase with increase of pressure.

Reason(R): Raoult's law gives the relation between pressure and solubility of a gas in a solvent.

13. Assertion (A): The acidic strength of hydrogen halides varies in the order:



Reason(R): The bond dissociation enthalpy of H-X decreases down the group.

OR

Assertion (A) : The elements of group 16 have lower ionization enthalpy values compared to those of group 15 in the corresponding periods.

Reason(R): Group 15 elements have extra stable half-filled p-orbitals electronic configurations.

14. Assertion (A) : Aryl halides are extremely less reactive towards nucleophilic substitution reactions.

Reason(R): Due to +R effect, the C-Cl bond acquires partial double bond character which makes the bond cleavage difficult.

15. Assertion(A): DNA is responsible for maintaining the identity of different species of organisms over millions of years.

Reason(R): DNA is the chemical basis of heredity and may be regarded as the reverse of genetic information.

16. Assertion (A) : The enthalpies of atomization of transition metals are quite high.

Reason (R) : They have large number of unpaired e^- in their atoms.

SECTION B

The following questions, Q.No 17 – 25 are short answer type and carry 2 marks each.

17. Tungsten crystallizes in body centred cubic unit cell. If the edge of the unit cell is 316.5 pm. What is the radius of tungsten atom?

OR

Gold (atomic radius = 0.144 nm) crystallises in a face-centred unit cell. What is the length of a side of the unit cell?

18. State Henry's law. Calculate the solubility of CO_2 in water at 298 K under 760 mm Hg.

(K_H for CO_2 in water at 298 K is 1.25×10^6 mm Hg)

19. For a reaction $A + B \rightarrow P$

$$\text{Rate of reaction} = k[A][B]^2$$

i) How is the rate of reaction affected if the concentration of B is doubled?

ii) What is the overall order of reaction if A is present in large excess?

20. A first order reactions has a rate constant $1.15 \times 10^{-3} \text{ s}^{-1}$. How long will 5 g of this reactant take to reduce to 3 g?

OR

A first order reaction takes 40 min for 30% decomposition. Calculate $t_{1/2}$.

21. What happens when?

(i) Concentration H_2SO_4 is added to calcium fluoride.

(ii) SO_3 is passed through water.

22. Write IUPAC name and hybridisation of the following complexes:

(i) $[\text{Ni}(\text{CO})_4]$

(ii) $[\text{CoF}_6]^{3-}$

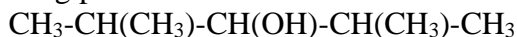
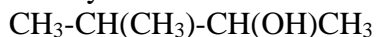
23. The following compounds are given to you:

2-Bromopentane, 2-Bromo-2-methylbutane, 1-Bromopentane

(a) Write the compound which is most reactive towards $\text{S}_{\text{N}}2$ reaction.

(b) Write the compound which is most reactive toward β -elimination reaction.

24.a) Identify the chiral molecule in the following pair :



b) Write the structure of the major product when chlorobenzene is treated with methyl chloride in the presence of sodium metal and dry ether.

OR

How do you convert the following?

(i) Prop-1-ene to 1-Nitropropane

(ii) Ethanol to propanenitrile

25. Give reasons for the following :

a) The presence of $-\text{NO}_2$ group at ortho or para position increases the reactivity of haloarenes towards nucleophilic substitution reactions.

b) p-dichlorobenzene has higher melting point than that of ortho or meta isomer.

SECTION C

Q.No 26 -30 are Short Answer Type II carrying 3 marks each.

26. Silver crystallises in fcc lattice. If edge length of the cell is $4.07 \times 10^{-5} \text{ cm}$ and density is 10.5 g cm^{-3} , calculate atomic mass of silver.

27. Give the reason

(i) Why ICl is more reactive than I_2 ?

(ii) Why fluorine forms only one oxoacid, HOF

(ii) Why reducing character increases from HF to HI .

28. Account for the following

(i) Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4.

(ii) Zirconium and Hafnium exhibit similar properties.

(iii) Transition metals act as catalysts.

OR

What is lanthanoids contraction? Explain two consequences of lanthanoids contraction.

29.a) Give one chemical test to distinguish between the compounds of the following pairs :

i) CH_3NH_2 and $(\text{CH}_3)_2\text{NH}$

ii) Aniline and ethanamine

b) Why aniline does not undergo Friedal-Crafts reaction ?

30. What happens when D-glucose is treated with the following reagents?

(i) HI

- (ii) Bromine water
- (iii) HNO_3

OR

Give answer of the following -

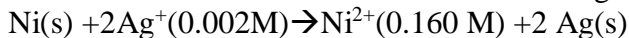
- (i) Denaturation of proteins
- (ii) Give an example each for fibrous protein and globular protein.
- (iii) Write one difference between nucleoside and a nucleotide.

SECTION D

Q.No 31 to 33 are long answer type carrying 5 marks each.

31. (i) The standard electrode potential for Daniell cell is 1.1 V. Calculate the standard Gibbs energy for the reaction.
2+3

(ii) Calculate the emf of the cell in which the following reaction takes place:



Given that $E^\circ_{\text{cell}} = 1.05\text{V}$

OR

(i) Λ°_m for NaCl, HCl and NaAc are 126.4, 425.9 and 91.0 $\text{Scm}^2\text{mol}^{-1}$ respectively. Calculate Λ°_m for HAc.
2+3

(ii) Conductivity of 0.00241 M acetic acid is $7.896 \times 10^{-5} \text{Scm}^{-1}$. Calculate its molar conductivity and if Λ°_m for acetic acid is $390.5 \text{Scm}^2\text{mol}^{-1}$, what is its dissociation constant.

32. (A) Arrange the following –

2+3

- (i) $\text{F}_2, \text{Cl}_2, \text{Br}_2, \text{I}_2$ – increasing bond dissociation enthalpy.
- (ii) $\text{HF}, \text{HCl}, \text{HBr}, \text{HI}$ – increasing acid strength.

(B) Give the reason following –

- (i) When Cl_2 reacts with excess of F_2 , ClF_3 is formed and not FCl_3 .
- (ii) H_2S is less acidic than H_2Te . Why?
- (iii) Why is H_2O a liquid and H_2S a gas?

OR

(A) Complete the following reaction:

2+3

- i) $\text{XeF}_2 + \text{H}_2\text{O} \rightarrow$
- ii) $\text{XeF}_4 + \text{SbF}_5 \rightarrow$

(B) Draw the following structure:

- i) XeF_2 (ii) $\text{H}_2\text{S}_2\text{O}_7$ (iii) XeO_3

33. (A) Distinguish the following –

2+3

- (i) Benzaldehyde and Acetophenone
- (ii) Propanal and Propanone

(B) How will they convert the following

- (i) Propanone to Propene
- (ii) Benzene to m-Nitroacetophenone
- (iii) Benzoic acid to m-Nitrobenzyl alcohol

OR

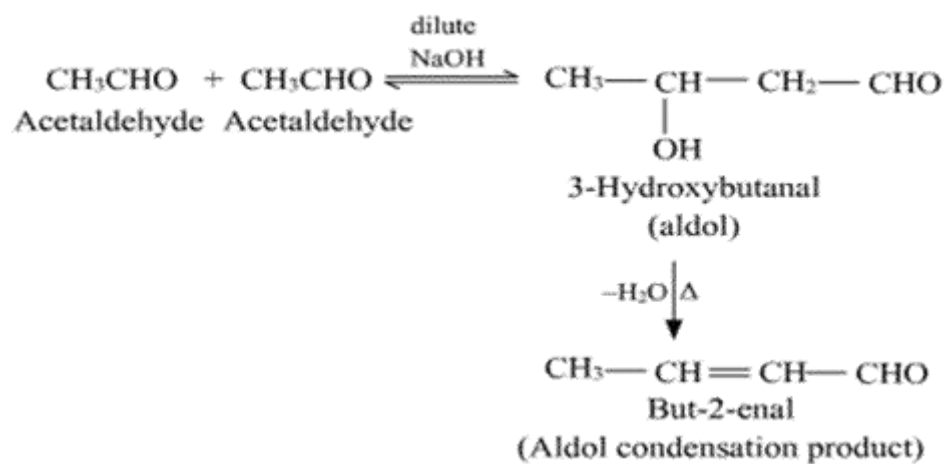
(A) A and B are two functional isomers of compound $\text{C}_3\text{H}_6\text{O}$. On heating with NaOH and I_2 , isomer A forms yellow precipitate of Iodoform whereas isomer B does not form any precipitate. Write the formulae of A and B.

2+3

(B) Write the products of the following reactions.

- (i) $2\text{C}_6\text{H}_5\text{CHO} + \text{conc. NaOH} \rightarrow$
- (ii) $\text{C}_6\text{H}_5\text{-CH}_2\text{-CH}_3 + \text{KMnO}_4/\text{H}^+ \rightarrow$
- (iii) $2\text{CH}_3\text{-CHO} + \text{dil. NaOH/Heat} \rightarrow$

-----X-----



CHEMISTRY - MARKING SCHEME 2020-21
MODEL QUESTION PAPER-5
SECTION A

Q.No.	Value Point	Marks
1.1	b	1
1.2	d	1
1.3	a or a	1
1.4	b	1
2.1	b	1
2.2	c or a	1
2.3	b	1
2.4	b	1
3	a	1
4	d	1
5	c or c	1
6	a or a	1
7	c	1
8	d	1
9	c or c	1
10	a	1
11	c or c	1
12	c	1
13	d or a	1
14	b	1
15	a	1
16	a	1

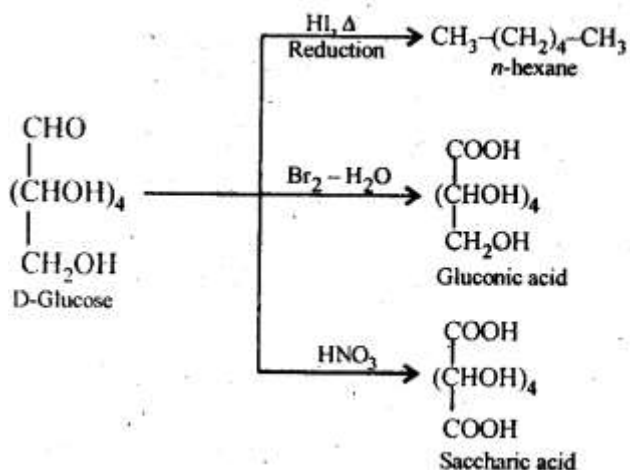
SECTION B, C, D

Q.No	VALUE POINTS	MARKS
	SECTION B	
17.	<p>For bcc unit cell, $r = \frac{\sqrt{3}}{4} a$</p> <p>$\therefore r = \frac{\sqrt{3}}{4} \times 316.5 \text{ pm} = 137.04 \text{ pm}$</p> <p style="text-align: center;">OR</p> <p>$r = 0.144 \text{ nm}$</p> <p>$a = 2\sqrt{2}r$</p> <p>$= 2 \times 1.414 \times 0.144 \text{ nm}$</p> <p>$= 0.407 \text{ nm}$</p>	2
18	<p>Henry's law states that the partial pressure of the gas in vapour phase(p) is directly proportional to the mole fraction of the gas (x) in the solution.</p> <p>$P = K_H X$ where, K_H is Henry, law constant</p>	1+1

	<p>For the solution of CO₂ in water P=760 mm Hg K_H=1.25 x10⁶ mm Hg According to Henry's law P=K_HX X=p/K_H=760/1.25x10⁶ X=608 x10⁻⁶ =6.08 x 10⁻⁴</p>	
19	<p>(i) A + B → P Rate of reaction, r = k[A][B]² If concentration of B is doubled, Rate of reaction, r' = k [A][2B]² r' = 4 x k[A][B]² r' = 4 x r So, if concentration of B is doubled, rate of reaction becomes 4 times. (ii) Rate of reaction, r=k[A][B]² If A is present in large excess, the rate law becomes r = k'[B]², where ,k' = k[A] Thus, the overall order of reaction is two.</p>	1+1
20	<p>Applying first order kinetic equation,</p> $t = \frac{2.303}{k} \log \frac{a}{(a-x)}$ <p>Given: k = 1.15 × 10⁻³ sec⁻¹, a = 5 g, (a - x) = 3 g</p> <p>So,</p> $t = \frac{2.303}{1.15 \times 10^{-3}} \log \frac{5}{3} = 444.27 \text{ sec}$ <p>OR</p> $k = \frac{2.303}{t} \log \frac{[A_0]}{[A]}$ $k = \frac{2.303}{40 \text{ min}} \log \frac{100}{70}$ $k = \frac{2.303}{40} \times 0.155 = 0.00892 \text{ min}^{-1}$ $t_{1/2} = \frac{0.693}{k}$ $t_{1/2} = \frac{0.693}{0.00892} \text{ min}$ $t_{1/2} = 77.7 \text{ min}$	2
21	<p>(i) It forms hydrogen fluoride. CaF₂ + H₂SO₄ → CaSO₄ + 2HF (ii) It dissolves SO₂ to give H₂SO₄. SO₃ + H₂O → H₂SO₄</p>	2
22	<p>(i) [Ni(CO)₄] IUPAC Name : Tetracarbonylnickel(o) Hybridization: sp³</p>	2

	(ii) $[\text{CoF}_6]^{3-}$ IUPAC Name: Hexafluoridocobaltate(III)ion Hybridization = sp^3d^2	
23	(a) 1-Bromopentane (b) 2-Bromo-2-methylbutane	2
24	a) $\text{CH}_3\text{-CH}(\text{CH}_3)\text{-CH}(\text{OH})\text{CH}_3$ b) 1-chloro-4-methylbenzene OR (i) $\begin{array}{ccc} \text{CH}_3\text{-CH=CH}_2 + \text{HBr} & \xrightarrow{\text{Peroxide}} & \text{CH}_3\text{-CH}_2\text{-CH}_2\text{Br} \\ \text{Propene} & & \text{1-Bromopropane} \\ & & \downarrow \text{Ag NO}_2 \\ & & \text{Ag Br} + \text{CH}_3\text{-CH}_2\text{-CH}_2\text{NO}_2 \\ & & \text{1-Nitropropane} \end{array}$ (ii) $\begin{array}{ccccc} \text{CH}_3\text{-CH}_2\text{-OH} + \text{KBr} & \xrightarrow{\text{H}_2\text{SO}_4} & \text{CH}_3\text{-CH}_2\text{-Br} & \xrightarrow[\text{-KBr}]{\text{in alcohol}} & \text{CH}_3\text{-CH}_2\text{-CN} \\ \text{Ethanol} & & \text{Bromoethane} & & \text{Propanenitrile} \end{array}$ Reflux with KCN	2
25	a) The presence of nitro group at ortho- and para- positions withdraws the electron density from the benzene ring and thus facilitates the attack of the nucleophile on haloarene. The carbanion thus formed is stabilised through resonance. b) It is due to symmetry of para- isomers that fits in crystal lattice better as compared to ortho- and meta- isomers.	2
SECTION C		
26	<p>Ans. $M = \frac{\rho \times a^3 \times N_A}{z}$</p> <p>Given $\rho = 10.5 \text{ g cm}^{-3}$; $a = 4.07 \times 10^{-8} \text{ cm}$; $z = 4$ (FCC lattice)</p> <p>$\therefore M = \frac{(10.5 \text{ g cm}^{-3}) \times (4.07 \times 10^{-8} \text{ cm})^3 \times (6.022 \times 10^{23} \text{ mol}^{-1})}{4}$</p> <p>$= 107.09 \text{ g mol}^{-1}$.</p>	3 (1+ 1+1)
27	(i) ICl is more reactive than I_2 because the bond dissociation enthalpy of I-Cl bond is lower than I-I bond in I_2 , which is due to the polar nature of I-Cl bond.	3(1 +1 +1)

	<p>(ii) Fluorine forms only one oxoacid because F can form compounds only in one oxidation state which is due to its highest electronegativity and absence of d-orbitals in it.</p> <p>(iii) Reducing character increases from HF to HI due to decrease in bond dissociation enthalpy of H-X bond. The decrease in bond dissociation enthalpy helps in the easy removal of hydrogen.</p>	
28	<p>(i) Mn shows the highest oxidation state of +7 with oxygen due to the ability of oxygen to form multiple bond.</p> <p>(ii) Because of lanthanoid contraction, Zr and Hf have similar sizes, due to which they exhibit similar properties.</p> <p>(iii) Transition metals act as catalysts due to their ability to show variable oxidation states. They can form unstable intermediates and carry out the reaction with alternate pathway with lower activation energy.</p> <p style="text-align: center;">OR</p> <p>The steady decrease in the size of atoms and ions of elements of lanthanoid series with increasing atomic number from La to Lu is called lanthanoid contraction. This is because the new electron enters the 4f orbitals that offer poor shielding effect due to their offer poor shielding effect due to their diffused shape. As a result, effective nuclear charge increases and atomic/ionic size decreases. The consequences of lanthanoids contraction are ;</p> <p>(a) Basicity of hydroxides</p> <p style="padding-left: 40px;">It is due to lanthanide contraction that there is variation in the basic strength of lanthanide hydroxides. Basic strength decreases from $\text{La}(\text{OH})_3$ to $\text{Lu}(\text{OH})_3$ due to increase in covalent character of hydroxide. Hence, $\text{La}(\text{OH})_3$ is most basic whereas $\text{Lu}(\text{OH})_3$ is least basic.</p> <p>(b) Difficulty in separation of lanthanoids:</p> <p style="padding-left: 40px;">Since the decreases in atomic/ionic radii along the lanthanoids is very small, their chemical properties are similar. Due to this, the separation of lanthanoids in pure state is difficult.</p>	3 (1+ 1+1)
29	<p>a) i) Methylamine gives carbylamine reaction but not dimethylamine. ii) Reaction with nitrous acid aniline forms benzenediazonium chloride and ethanamine gives ethanol.</p> <p>b) Aniline being a Lewis base reacts with Lewis acid AlCl_3 to form a salt. As a result, the nitrogen atom becomes positively charged and is not in position to activate the ring for electrophilic substitution reaction. Consequently aniline does not undergo Friedal-Crafts reaction.</p>	1+1 +1
30		3+1 +1 +1)



OR

(i) When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed due to which globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of proteins.

(ii) Keratin is a fibrous protein while egg albumin is a globular protein.

(iii) Nucleoside = Sugar + Base

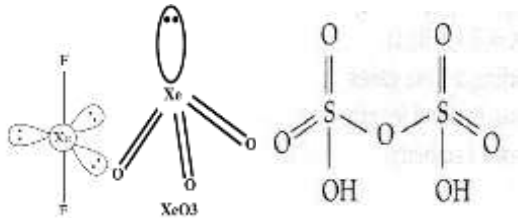
Nucleotide = Sugar + Base + Phosphate

SECTION D

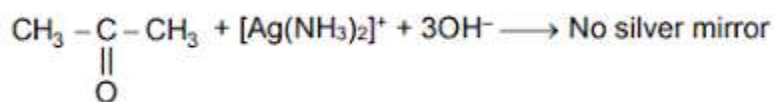
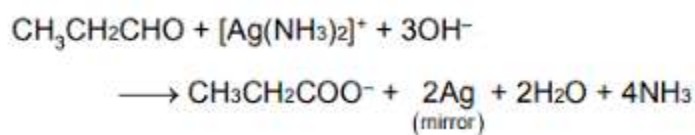
31	<p>i)</p> $\text{Zn}_{(s)} + \text{Cu}^{2+}_{(aq)} \rightarrow \text{Zn}^{2+}_{(aq)} + \text{Cu}_{(s)}$ <p>Here, value of $n = 2$</p> $G^\circ = -nFE^\circ_{\text{cell}}$ $= -(2 \text{ mol}) (96500 \text{ C mol}^{-1} \times 1.10 \text{ V})$ $= -212,300 \text{ CV}$ $= -212,300 \text{ J} = -212.30 \text{ kJ}$ <p>(Coulomb \times Volt = Joule)</p> <p>ii)</p> $E^\circ = E^\circ_{\text{cell}} - \frac{0.0591}{n} \log \frac{[\text{Ni}^{2+}]}{[\text{Ag}^+]^2}$ $= 1.05 \text{ V} - \frac{0.0591}{2} \log \frac{(0.160)}{(0.002)^2}$ $= 1.05 - \frac{0.0591}{2} \log (4 \times 10^4)$ $= 1.05 - \frac{0.0591}{2} (4.6021)$ $= 1.05 - 0.14 = 0.91 \text{ V}$ $E^\circ_{\text{cell}} = 0.91 \text{ V}$	5 (2+ 3)
----	--	----------------

OR

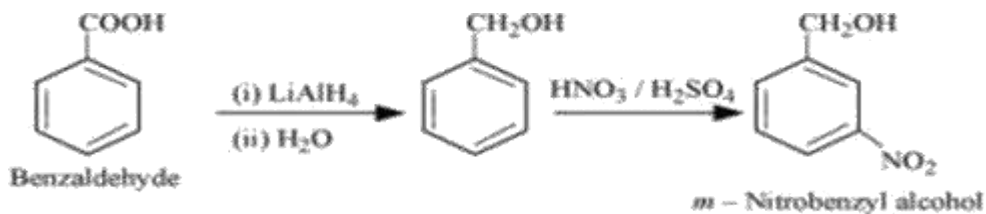
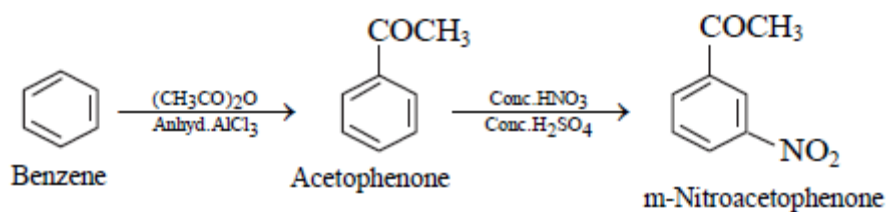
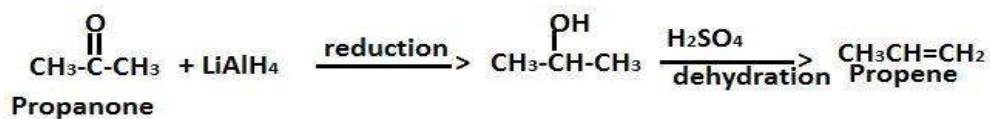
$$\begin{aligned}
 \Lambda^\circ_m(\text{CH}_3\text{COOH}) &= ? \\
 \Lambda^\circ_m(\text{HCl}) &= 426 \text{ S cm}^2 \text{ mol}^{-1} \\
 \Lambda^\circ_m(\text{NaCl}) &= 126 \text{ S cm}^2 \text{ mol}^{-1} \\
 \Lambda^\circ_m(\text{CH}_3\text{COONa}) &= 91 \text{ S cm}^2 \text{ mol}^{-1} \\
 \Lambda^\circ_m(\text{CH}_3\text{COOH}) &= \Lambda^\circ_m(\text{HCl}) + \Lambda^\circ_m(\text{CH}_3\text{COONa}) - \Lambda^\circ_m(\text{NaCl}) \\
 &= 426 + 91 - 126 \\
 &= 391 \text{ S cm}^2 \text{ mol}^{-1}
 \end{aligned}$$

	$\Lambda_m^{\circ} = \frac{k \times 1000}{M}$ $= \frac{7.896 \times 10^{-5} \text{ S cm}^{-1} \times 1000 \text{ cm}^3 \text{ L}^{-1}}{0.00241 \text{ mol L}^{-1}}$ $= 32.76 \text{ S cm}^2 \text{ mol}^{-1}$ $\alpha = \frac{\Lambda_m}{\Lambda_m^{\circ}} = \frac{32.76}{390.5} = 8.39 \times 10^{-2}$ $K_a = \frac{C\alpha^2}{1-\alpha} = \frac{0.00241 \times (8.39 \times 10^{-2})^2}{1 - 8.39 \times 10^{-2}}$ $= 1.86 \times 10^{-5}$	
32	<p>(1) (i) $\text{I}_2 < \text{F}_2 < \text{Br}_2 < \text{Cl}_2$ (ii) $\text{HF} < \text{HCl} < \text{HBr} < \text{HI}$ (2) (i) ClF_3 is formed not FCl_3 because of absence of d-orbitals in fluorine. Chlorine can exceed its covalence by making use of d-orbitals but fluorine cannot.</p> <p>(ii) H-S bond is stronger than H-Te bond. Due to this, the bond dissociation enthalpy (E-H) is higher in H_2S which makes the removal of H^+ difficult. Hence, H_2S is less acidic than H_2Te.</p> <p>(iii) Due to smaller size and higher electronegativity of oxygen as compared to sulphur, there is extensive hydrogen bonding in H_2O. Whereas, the molecules of H_2S are held together only by weak van der Waals' force of attraction. Hence, H_2O exists as a liquid and H_2S as a gas.</p> <p>OR</p> <p>(1) (i) $2 \text{XeF}_2(\text{s}) + 2 \text{H}_2\text{O}(\text{l}) \rightarrow 2 \text{Xe}(\text{g}) + 4 \text{HF}(\text{aq}) + \text{O}_2(\text{g})$ (ii) $\text{XeF}_4 + \text{SbF}_5 \rightarrow [\text{XeF}_3]^+ [\text{SbF}_6]^-$</p> <p>(2)</p> 	5 (2+ 3)
33	<p>(I) (i) By Iodoform test</p> <p>$\text{C}_6\text{H}_5\text{COCH}_3 + 3 \text{NaOI}$ Acetophenone ↓ $\text{C}_6\text{H}_5\text{COONa} + \text{CHI}_3 \downarrow + 2 \text{NaOH}$ Iodoform</p> <p>$\text{C}_6\text{H}_5\text{CHO} \xrightarrow{\text{NaOH}}$ No yellow ppt of iodoform Benzaldehyde</p>	5 (2+ 3)

ii) By Tollen test

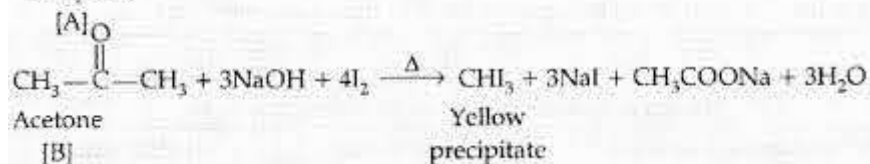
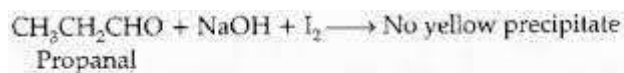


(2)

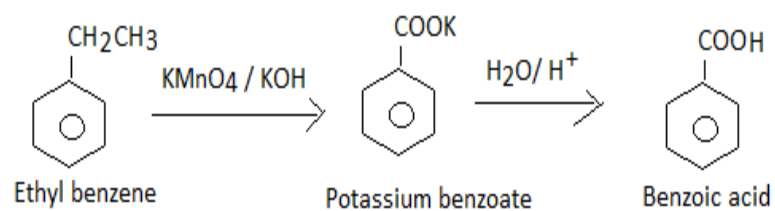
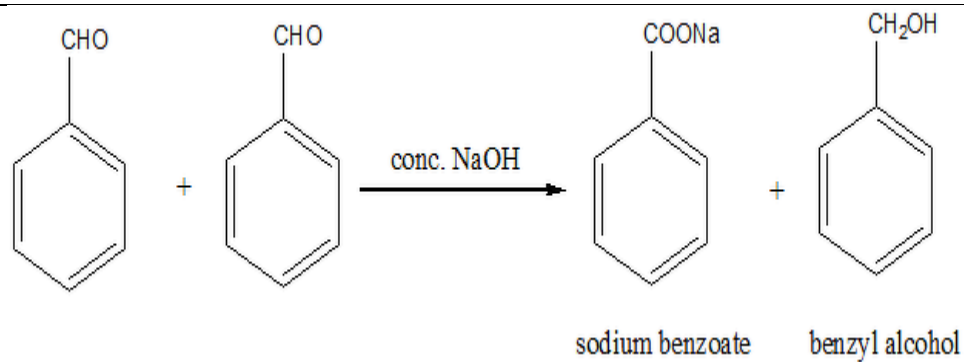


OR

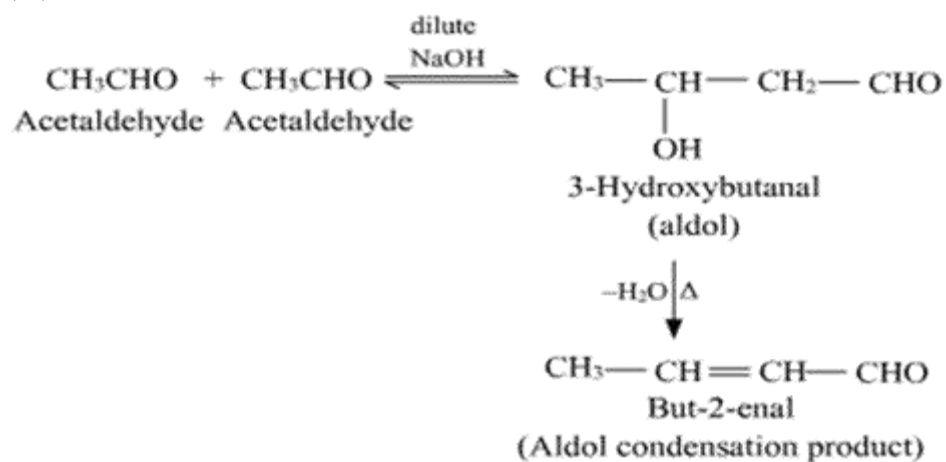
(1)



(2)(i)



(ii),
(iii)



REVISION PLAN

1. Skim through the NCERT books from cover to cover

As per the trends of the last few years, the Class 12 Boards question paper has questions all from the NCERT. So, you will need to remember every example of reactions, both organic and inorganic.

When practicing numerical, make sure you cover all the examples in between chapters and the exercise questions at the end of each chapter.

2. Concentrate on the units with the highest weightage

The following units hold the highest weightage for Class 12 Chemistry Board exams in decreasing order:

- p-Block Elements
- Aldehydes, Ketones and Carboxylic acids
- d-and f-Block Elements
- Solutions
- Electrochemistry
- Chemical Kinetics

3. Go through previous years' question papers

Questions are often repeated in Chemistry and solving previous years' question papers goes a long way to helping you ace in your Chemistry exams as it helps you with time management along with an understanding of the question pattern.

If you haven't been solving these papers, don't waste your time at this last minute. Instead, sit with a solved question paper book of previous years and go through each and every question.

Solve the trickier numerical in your notebook and mark the kind of Reaction questions asked often.

4. Memorise the formulae for Physical Chemistry

If you are good at Maths, you might find Physical Chemistry right up your alley. Physical Chemistry constitutes of Units 1 to 5 and constitutes a total of 23 marks. Write down and memorise all the formulae and make sure you solve at least one or two questions of the style you find most difficult.

5. Practice Reasoning type Organic and Inorganic questions

In such questions, make sure you provide the correct reasons. The previous years' questions will help you understand what kinds of questions are likely to be asked..

6. Concentrate on p-Block elements and Coordination Compounds chapters for Inorganic Chemistry

Inorganic Chemistry is a good target area for those who are good at theory. Units 7-9 which constitute Inorganic Chemistry carry a total of 19 marks. Memorising the reactions are very important here. You can expect around 8 marks or more to be asked from p-Block.

Noble gases and Halogens are important topics and often have questions asked from them. Practice these areas well.

From p-Block chapter, also practice drawing the structures of the different elements.

p-Block and d-Block elements cannot be learned quickly but if you have notes, it will be quick to revise.

7. Name reactions and conversions are very important

Units 10 to 14 constitute Organic Chemistry and this 29-mark portion is the heaviest bulk of the Class 12 Chemistry Board exam. True Chemistry lovers probably enjoy this section and don't even consider it too difficult.

Name reactions are very important, as are questions such as Nucleophilic substitution/addition, Electrophilic substitution/addition.

Also revise and practice a couple of step-by-step conversion questions from one compound to another.

8. Practice IUPAC naming and the identification of compounds through different reagents

IUPAC naming of compounds is important for 1-mark questions. You should go through the rules and practice a couple to make sure you understand this.

Very short answer type questions can be asked on the identification of compounds through different reagents and you should practice the same.

Revision Plan

Foreword: This plan is suggestive only. Each teacher can modify the plan according to the needs of the students and their ability.

Note: Select two important reaction daily and assign to the students

DATE	UNIT	Topics	Slip Test
01.04. 2021	1(Solid State)	Distinction Between Crystalline And Amorphous Solid, Anisotropy, Unit Cell And The Number Of Particles In Unit Cells, Determining Formula Of Compound, Packing Efficiency.	
02.04. 2021	Holiday(Good Friday)	Home assignment : Henry's Law, Raoult's Law, Kohlrausch Law, Hardy schulze Rule. Five important name reaction from organic reaction	
03.04. 2021	Sunday		
05.04. 2022	1(Solid State)	Calculations Involving Unit Cell Dimensions, Imperfections In Solids	Test 1
06.04. 2021	2(Solution)	Numerical Formula Concerning Concentration Of Solution, Colligative Properties And Numerical Problems,	
07.04. 2021	2(Solution)	Ideal And Non Ideal Solution Reverse Osmosis, Azeotropes	Test 2
08.04. 2021	3(Electrochemistry)	Variation Of Conductivity And Molar Conductivity With Dilution, Numerical Problems Based On Conductivity And Molar Conductivity	
09.04. 2021	3(Electrochemistry)	Nernst Equation And Numerical Problems	Test 3
10.04. 2021	Sunday	Self Revision by the students	
11.04. 2021	4(Chemical Kinetics)	Difference Between Order And Molecularity Of Reaction, Pseudo First Order Reaction And Example, Zero Order Reaction With Example,	
12.04. 2021	4(Chemical Kinetics)	Numerical Problem Based On Integrated Rate Equation Of First Order Reaction, Exercise Question Number 4.9, 4.14	Test 4
13.04. 2021	5(Surface Chemistry)	Difference Between Physisorption And Chemisorption, Adsorption Isotherm, Colloid, Classification, Peptization, Dialysis, Electrodialysis, Tyndall Effect, Brownian Movement, Charge On Colloids, Zeta Potential, Electrophoresis, Coagulation.	
14.04. 2021	7(P- Block Elements)	It Is Better To Focus Type Of Question (Increasing Decreasing Order Question, Reason Questions,	
15.04. 2021	7(P- Block Elements)	Reactions, Structure Based Questions, Identify A, B, C, D, E Questions	Test 5
16.04. 2021	8(D And F Block Elements)	Lanthanoid Contraction Reason And Consequences, Transition Element Definition And Electronic Configuration, Properties Focusing On Colour, Magnetic Property, Catalytic Property, Formation Of Complex Compound, Interstitial Compound Formation, Exercise Question 8.11, 8.17, 8.21, 8.22	
17.04. 2021	Sunday	Self Revision by the students	
18.04. 2021	9(Coordination Compounds)	Example 9.1, Ambidentate Ligand, Denticity, Coordination Number, Homoleptic And Heteroleptic Complexes, Iupac Names, Structural Isomerism, VBT, CFT, Intext 9.5, 9.6, Exercise 9.18	

19.04.2021	Part I NCERT	Test of Part I	It is Test 6
20.04.2021	10(Haloalkane And	Nomenclature And Structure	
21.04.2021	Haloarenes),11(Alcohols, Phenols	Name Reactions	
22.04.2021	And Ethers),12(Aldehydes, Ketones And Carboxylic Acids),13(Amines)	Chemical Test To Distinguish The Given Pair Of Compounds, Identification of compounds A,B,C,D,E	
23.04.2021		Reaction Mechanisms,Some Important Chemical Reactions	Test 7
24.04.2021	Sunday	Self Revision by the students	
25.04.2021	10 to 13	Reasoning Based Questions,	
26.04.2021	14(Biomolecules)	Evidence For Cyclic Structure Of Glucose, Anomers, Essential And Nonessential Amino Acids, Zwitter Ion, Peptide Linkage, Fibrous And Globular Protein, Primary And Secondary Structure Of Protein	
27.04.2021	14(Biomolecules)	Denaturation Of Protein, Nucleoside And Nucleotide, Structural Difference Between DNA And RNA,Biological function of Nucleic Acids.	Test 8
28.04.2021	10 to 14	Revision of NCERT Part II by the students under supervision of the teacher	
29.04.2021	10 to 14	Test of Part II	Test 9
30.04.2021	1 to 14	Common errors in chemistry answer sheets and Important tips for scoring high score	

Groups	Test	Groups	Test
Unsaturation		$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{group}$	
Terminal alkynes'		Aromatic aldehyde	
C – X (single bond)		Carboxylic acid	
Primary, Secondary and Tertiary Alcohol		Formic acid	
Ethyl alcohol and all 2-hydroxy alcohol		Aromatic primary amine	
Phenol		Aliphatic and aromatic primary amine	
Carbonyl group		Primary amine	
Aldehydes and only methyl ketone		Secondary amine	
Aldehydes		Tertiary amine	

Groups	Test	Groups	Test
Unsaturation	Bromine water Or Baeyer's test	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{group}$	Iodoform Test
Terminal alkynes'	Tollen's reagent:	Aromatic aldehyde	Tollen's test
C – X (single bond)	AgNO ₃ Test	Carboxylic acid	Sodium bicarbonate test
Primary, Secondary and Tertiary Alcohol	Lucas Test	Formic acid	Tollen Test Or Fehling Test
Ethyl alcohol and all 2-hydroxy alcohol	Iodoform test	Aromatic primary amine	Azo-dye test
Phenol	Neutral ferric chloride,	Aliphatic and aromatic primary amine	Carbylamine test
Carbonyl group	2,4-dinitrophenyl hydrazine test:	Primary amine	Hinsberg Test
Aldehydes and only methyl ketone	Sodium bisulphate test:	Secondary amine	Hinsberg Test
Aldehydes	Tollen Test Or Fehling Test	Tertiary amine	Hinsberg Test

DISTINGUISH TESTS

Group	Test	Observation	Description
Unsaturation	Bromine water	Disappearance of orange-red colour of bromine water	$\boxed{\text{Br}_2} \text{ (Orange - red colour)} + \begin{matrix} \text{R}-\text{CH}=\text{CH}-\text{R} \\ \text{(Alkene)} \end{matrix} \xrightarrow{\text{CCl}_4} \begin{matrix} \text{Br} & \text{Br} \\ & \\ \text{R}-\text{CH} & -\text{CH}-\text{R} \end{matrix}$ $+ \begin{matrix} \text{R}-\text{C}\equiv\text{C}-\text{R} \\ \text{(Alkyne)} \end{matrix} \xrightarrow{\text{CCl}_4} \begin{matrix} \text{Br} & & \text{Br} \\ & & \\ \text{R}-\text{C} & - & \text{C}-\text{R} \\ & & \\ \text{Br} & & \text{Br} \end{matrix}$ <p style="text-align: center;">(Colourless)</p>
	Baeyer's test	When alkaline KMnO_4 is added to an unsaturated hydrocarbon, disappearance of pink colour indicates unsaturation. In this process MnO_2 is formed (brown colour).	$\boxed{\text{Cold dilute KMnO}_4} \text{ (Pink)} \xrightarrow{\begin{matrix} \text{R}-\text{CH}=\text{CH}-\text{R} \\ \text{(Alkene)} \end{matrix}} \begin{matrix} \text{R}-\text{CH} & - & \text{CH}-\text{R} \\ & & \\ \text{OH} & & \text{HO} \end{matrix} + \boxed{\begin{matrix} \text{MnO}_2 \\ \text{Brown Ppt.} \end{matrix}}$ $\xrightarrow{\begin{matrix} \text{R}-\text{C}\equiv\text{C}-\text{R}_1 \\ \text{(Alkyne)} \end{matrix}} \text{RCOOH} + \text{R}_1\text{COOH} + \boxed{\begin{matrix} \text{MnO}_2 \\ \text{Brown Ppt.} \end{matrix}}$ $\xrightarrow{\begin{matrix} \text{R}-\text{C}\equiv\text{C}-\text{H} \\ \text{(Terminal Alkyne)} \end{matrix}} \text{RCOOH} + \text{CO}_2 + \text{H}_2\text{O} + \boxed{\begin{matrix} \text{MnO}_2 \\ \text{Brown Ppt.} \end{matrix}}$
Terminal alkynes	Tollen's reagent:	White precipitate will obtain	$\text{R}-\text{C}\equiv\text{CH} \xrightarrow[\text{Ammonical silver nitrate}]{\text{Ag(NH}_3)_2\text{OH}} \text{R}-\text{C}\equiv\text{C Ag}$ <p style="text-align: center;">White ppt</p>
	Ammonical cuprous chloride:	Red precipitate will obtain	$\text{R}-\text{C}\equiv\text{CH} \xrightarrow[\text{Amm. Cuprous chloride}]{\text{Cu(NH}_3)_2\text{Cl}} \text{R}-\text{C}\equiv\text{C Cu}$ <p style="text-align: center;">Red ppt.</p>
C-X (single bond)	AgNO_3 Test	The halo compound boiled with aq. KOH and then treated with acidified AgNO_3 . (For Cl white ppt and for Br yellow ppt. will obtain)	$\text{R-X} \xrightarrow[\text{Boil}]{\text{aqueous KOH}} \text{R-OH} + \text{K X} \xrightarrow[\text{AgNO}_3]{\text{HNO}_3} \text{Ag X}$ <p style="text-align: center;">Precipitate</p>

Alkyl Halides and Haloalkanes Page 13

Group	Test	Observation	Description
Primary, Secondary and Tertiary Alcohol	Lucas Test (HCl & ZnCl_2)	Alcohol treated with Lucas reagent. If turbidity appears immediately --- Tertiary alcohol. If turbidity appears after some time --- Secondary alcohol If turbidity appears after heating--- Primary alcohol	$\begin{matrix} \text{R} \\ \\ \text{R}-\text{C}-\text{OH} \\ \\ \text{R} \end{matrix} \xrightarrow[\text{Room temperature}]{\text{ZnCl}_2 + \text{HCl}} \begin{matrix} \text{R} \\ \\ \text{R}-\text{C}-\text{Cl} \\ \\ \text{R} \end{matrix}$ <p style="text-align: center;">Tertiary alcohol Cloudiness appears immediately</p> $\begin{matrix} \text{R} \\ \\ \text{R}-\text{CH}-\text{OH} \end{matrix} \xrightarrow[\text{Room temperature}]{\text{ZnCl}_2 + \text{HCl}} \begin{matrix} \text{R} \\ \\ \text{R}-\text{CH}-\text{Cl} \end{matrix}$ <p style="text-align: center;">Secondary alcohol Cloudiness appears within five minutes</p> $\text{R}-\text{CH}_2-\text{OH} \xrightarrow[\text{Heat}]{\text{Lucas reagent}} \text{R}-\text{CH}_2-\text{Cl}$ <p style="text-align: center;">Primary alcohol Cloudiness appears upon heating</p>
Ethyl alcohol and all 2-hydroxy alcohol	Iodoform test	When ethyl alcohol or 2-hydroxy alcohol treated with I_2 and NaOH (NaOI) a yellow precipitate of iodoform will form.	$\begin{matrix} \text{OH} \\ \\ \text{H}_3\text{C}-\text{CH}-\text{R} \\ \\ \text{Alcohol} \end{matrix} + \text{I}_2 \xrightarrow{\text{NaOH}} \text{CHI}_3 + \text{RCOONa}$ <p style="text-align: center;">Iodoform (Yellow precipitate)</p>
Phenol	Neutral ferric chloride,	Phenol when reacts with neutral ferric chloride, it produces violet colour.	$6 \text{ } \text{C}_6\text{H}_5\text{-OH} \xrightarrow{\text{FeCl}_3} [\text{Fe}(\text{OC}_6\text{H}_5)_6]^{3-} + 3 \text{HCl}$ <p style="text-align: center;">Violet colouration</p>
Carbonyl group	2,4-dinitrophenyl hydrazine test:	Carbonyl compound react with 2,4-dinitrophenylhydrazine to form yellow or orange crystals.	$\text{C=O} + \text{H}_2\text{N-NH-C}_6\text{H}_3(\text{NO}_2)_2 \longrightarrow \text{C=N-NH-C}_6\text{H}_3(\text{NO}_2)_2$ <p style="text-align: center;">Carbonyl compound 2,4-DNP Yellow / orange crystal</p>

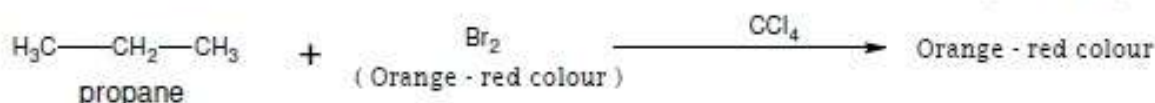
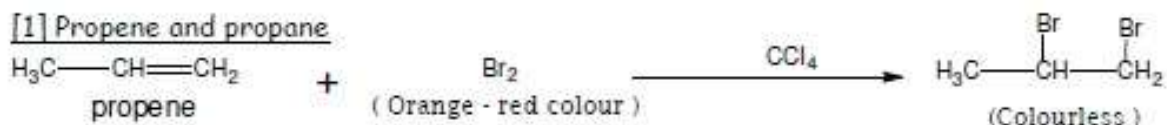
Group	Test	Observation	Description
Aldehydes and only methyl ketone	Sodium bisulphate test:	Aldehydes and methyl ketones both form crystalline addition product with NaHSO ₃	$\begin{array}{c} \text{R} \\ \\ \text{C}=\text{O} \\ \\ \text{H} \end{array} \text{Aldehyde} + \text{NaHSO}_3 \longrightarrow \begin{array}{c} \text{OH} \\ \\ \text{R}-\text{C}-\text{SO}_3^+ \text{Na}^- \\ \\ \text{H} \end{array}$ $\begin{array}{c} \text{R} \\ \\ \text{C}=\text{O} \\ \\ \text{H}_3\text{C} \end{array} \text{Methylketone} + \text{NaHSO}_3 \longrightarrow \begin{array}{c} \text{OH} \\ \\ \text{R}-\text{C}-\text{SO}_3^+ \text{Na}^- \\ \\ \text{CH}_3 \end{array}$
Aldehydes	Tollen Test	On warming with ammonical silver nitrate solution (Tollen reagent) in alkaline medium, aldehyde gives silver mirror on the side of test tube.	$\text{R}-\text{C}(=\text{O})-\text{H} \xrightarrow[3 \text{ OH}^-]{2 [\text{Ag}(\text{NH}_3)_2]^+} \text{RCOO}^- + 2 \text{Ag} + 2 \text{H}_2\text{O} + 4 \text{NH}_3$
	Fehling Test	Fehling solution is alkaline solution of copper sulphate containing sodium potassium tartarate. Aldehyde gives reddish brown precipitate of Cu ₂ O with Fehling solution.	$\text{R}-\text{C}(=\text{O})-\text{H} \xrightarrow[5 \text{ OH}^-]{2 \text{ Cu}^{2+}} \text{Cu}_2\text{O} + 3 \text{H}_2\text{O} + \text{RCOO}^-$
$\text{H}_3\text{C}-\text{C}(=\text{O})-$ group	Iodoform Test	When aldehyde or ketone containing such type of groups are treated with I ₂ and NaOH (NaOI) a yellow precipitate of iodoform will form	$\text{H}_3\text{C}-\text{C}(=\text{O})-\text{R} + \text{I}_2 + \text{NaOH} \xrightarrow{\text{Iodoform test}} \text{CHI}_3 + \text{RCOONa}$ <p style="text-align: center;">Iodoform (Yellow precipitate)</p>
Aromatic aldehyde	Tollen's test	With Fehling solution give negative test and with Tollen's reagent give positive test.	<p>Aromatic aldehyde + Tollen's reagent \longrightarrow Silver mirror</p> <p>Aromatic aldehyde + Fehling solution \longrightarrow Negative test</p>
Carboxylic acid	Sodium bicarbonate test	Brisk effervescence (production of CO ₂) will produce when carboxylic acid treated with sodium bicarbonate.	$\text{RCOOH} + \text{NaHCO}_3 \longrightarrow \text{RCOONa} + \text{H}_2\text{O} + \text{CO}_2$

Group	Test	Observation	Description
Formic acid	Tollen Test	On warming with ammonical silver nitrate solution (Tollen reagent) in alkaline medium, Formic acid gives silver mirror on the side of test tube.	$\text{HCOOH} \xrightarrow{\text{Tollen's reagent}} \text{Ag} + \text{CO}_3^{2-} + \text{H}_2\text{O}$ <p style="text-align: center;">Silver mirror</p>
	Fehling Test	Fehling solution is alkaline solution of copper sulphate containing sodium potassium tartarate. Formic acid gives reddish brown precipitate of Cu ₂ O with Fehling solution.	$\text{HCOOH} \xrightarrow{\text{Fehling solution}} \text{Cu}_2\text{O} + \text{CO}_3^{2-} + \text{H}_2\text{O}$ <p style="text-align: center;">Reddish brown ppt</p>
Aromatic primary amine	Azo-dye test	Aromatic primary amine produce diazonium salt when treated with NaNO ₂ and HCl. If the diazonium salt treated with phenol an orange dye will produce, with aniline it will produce yellow dye.	$\text{C}_6\text{H}_5\text{NH}_2 \xrightarrow[\text{Diazotisation}]{\text{NaNO}_2 + \text{HCl}} \text{C}_6\text{H}_5\text{N}_2^+ \text{Cl}^- + \text{NaCl} + \text{H}_2\text{O}$ <p style="text-align: center;">Benzenediazonium chloride</p> $\text{C}_6\text{H}_5\text{N}_2^+ \text{Cl}^- \xrightarrow[\text{Coupling reaction}]{\text{H}-\text{C}_6\text{H}_4-\text{OH}} \text{C}_6\text{H}_5\text{N}=\text{N}-\text{C}_6\text{H}_4-\text{OH}$ <p style="text-align: center;">(Orange dye)</p> $\text{C}_6\text{H}_5\text{N}_2^+ \text{Cl}^- \xrightarrow[\text{Coupling reaction}]{\text{H}-\text{C}_6\text{H}_4-\text{NH}_2} \text{C}_6\text{H}_5\text{N}=\text{N}-\text{C}_6\text{H}_4-\text{NH}_2$ <p style="text-align: center;">p-Aminoazobenzene (Yellow dye)</p>
Aliphatic and aromatic primary amine	Carbylamine test	When a primary amine is heated with alcoholic caustic potash and chloroform, an offensive smelling compound called carbylamine (alkyl or arylisocyanide) is formed.	$\text{Primary amine} + \text{KOH} + \text{CHCl}_3 \longrightarrow \text{Isonitrile}$ <p style="text-align: center;">(Offensive smell)</p>

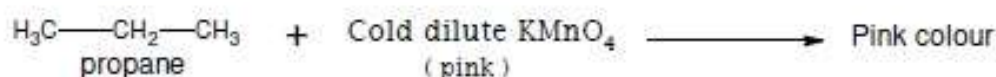
Group	Test	Observation	Description
Primary amine	Hinsberg Test (The reagent used in this test is benzene sulphonyl chloride)	It gives sulphonamide with hinsberg reagent, this sulphonamide is soluble in NaOH or KOH.	$\text{R}-\underset{\text{H}}{\text{N}}-\text{H} + \text{Cl}-\text{S}(=\text{O})_2-\text{C}_6\text{H}_5 \longrightarrow \text{R}-\underset{\text{H}}{\text{N}}-\text{S}(=\text{O})_2-\text{C}_6\text{H}_5$ <p>1° amine</p> <p>Acidic hydrogen N-alkylbenzenesulphonamide</p> <p>\downarrow KOH</p> $\text{R}-\text{N}^--\text{S}(=\text{O})_2-\text{C}_6\text{H}_5 \text{ K}^+$ <p>Water soluble potassium salt of sulfonamide</p>
Secondary amine		With hinsberg reagent, it forms sulphonamide, which is insoluble in NaOH or KOH	$\text{R}-\underset{\text{R}}{\text{N}}-\text{H} + \text{Cl}-\text{S}(=\text{O})_2-\text{C}_6\text{H}_5 \longrightarrow \text{R}-\underset{\text{R}}{\text{N}}-\text{S}(=\text{O})_2-\text{C}_6\text{H}_5$ <p>2° amine</p> <p>N,N-Dialkylbenzenesulphonamide</p> <p>\downarrow KOH</p> <p>Water insoluble precipitate</p>
Tertiary amine		Tertiary amine do not react with hinsberg reagent, because it is not having replaceable hydrogen.	$\text{R}-\underset{\text{R}}{\text{N}}-\text{R} + \text{Cl}-\text{S}(=\text{O})_2-\text{C}_6\text{H}_5 \longrightarrow \text{No reaction}$ <p>3° amine</p>

Compounds	Test	Compounds	Test
Propene & propyne		Pentan-2-one & pentan-3-one	
Propyne & propane		Propanal & Benzaldehyde	
Propyne & propene		Ethanoic acid & Methanoic acid	
Chloro ethane & chloro benzene		Ethanal & Methanal	
Chloro cyclohexane & Chloro benzene		Acetophenone & Benzophenone	
Chloroethane & Bromoethane		Benzoic acid & Ethyl benzoate	
Benzyl chloride & Chloro benzene		Acetophenone & Benzaldehyde	
Ethyl chloride & Vinyl chloride		Methyl amine & Dimethylamine	
n-propyl alcohol & isopropyl alcohol		Ethyl amine & Aniline	
Methyl alcohol & Ethyl alcohol		Aniline & N-methylaniline	
Ethyl alcohol & Acetone		Aniline & Benzylamine	
Ethyl alcohol & Phenol		Secondary amine & tertiary amine	
Benzoic acid & Phenol		Glucose & Fructose	
Propanone & Propanol		Glucose & Sucrose	
Propanone & Propanal		Glucose & Starch	
Propanal & Ethanal			

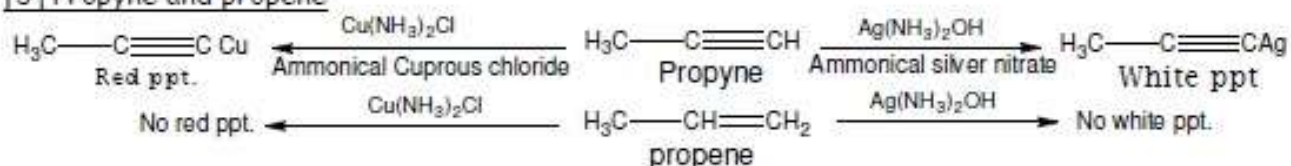
[1] Propene and propane



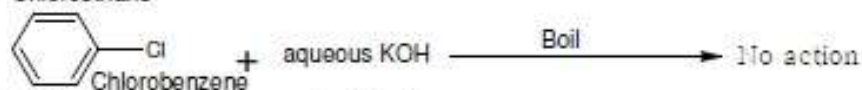
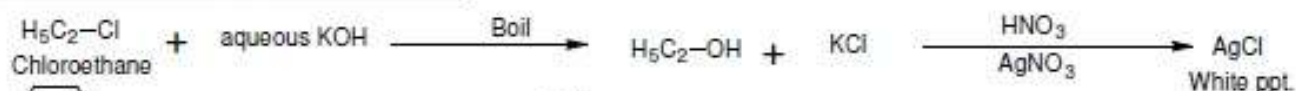
[2] Propyne and propane



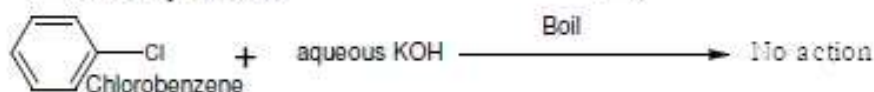
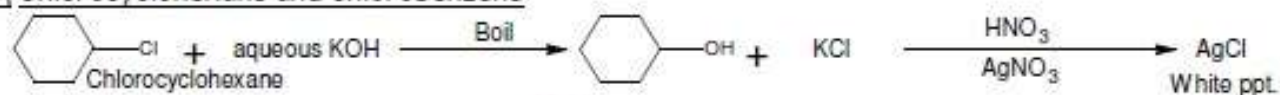
[3] Propyne and propene



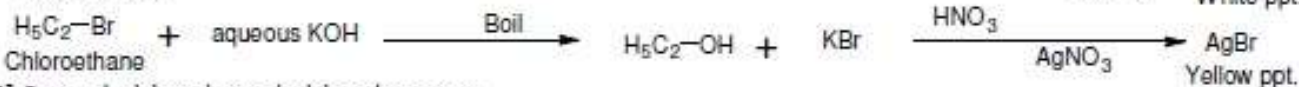
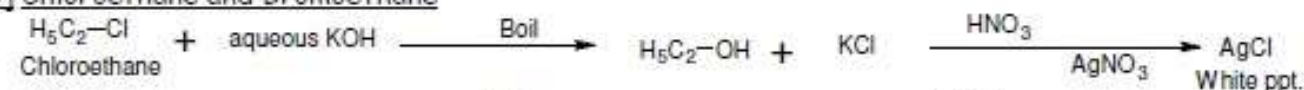
[4] Chloroethane and chlorobenzene



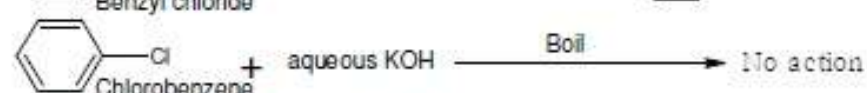
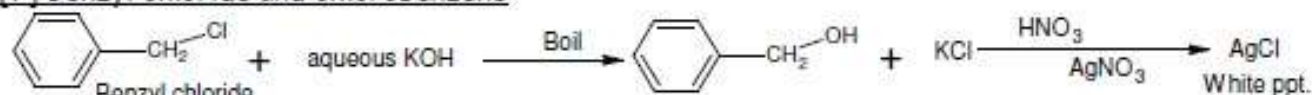
[5] Chlorocyclohexane and chlorobenzene



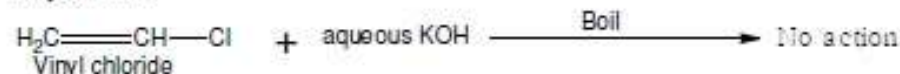
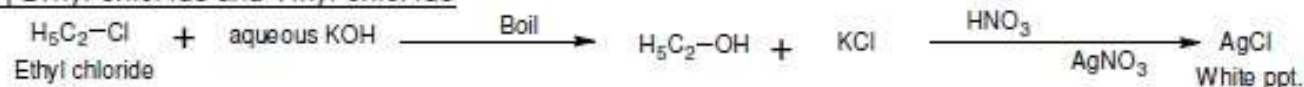
[6] Chloroethane and Bromoethane



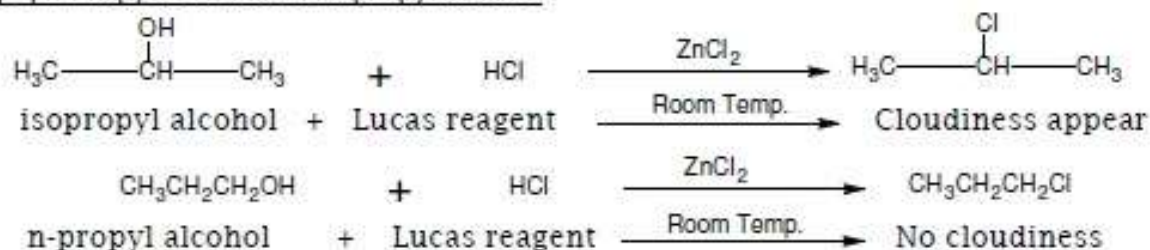
[7] Benzyl chloride and chlorobenzene



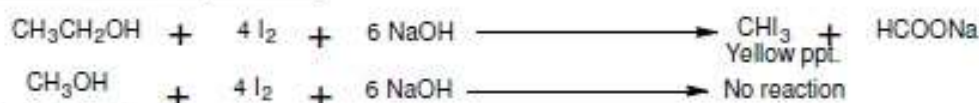
[8] Ethyl chloride and Vinyl chloride



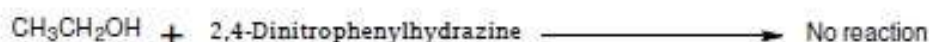
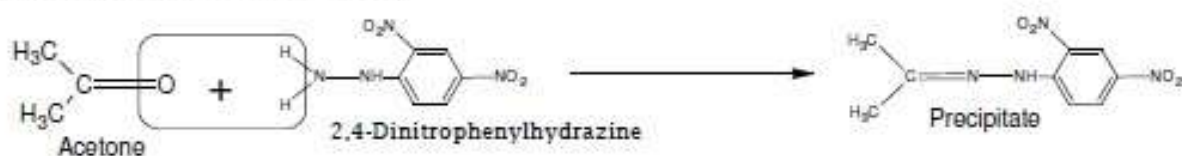
[9] n-Propylalcohol and isopropyl alcohol



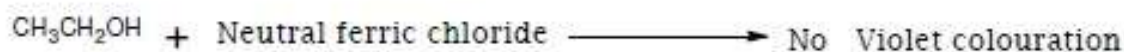
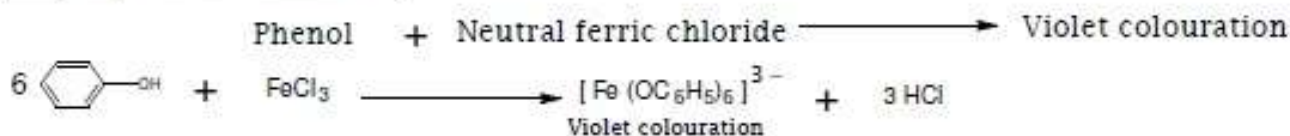
[10] Methyl alcohol and ethyl alcohol



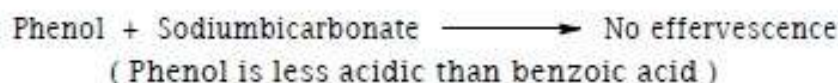
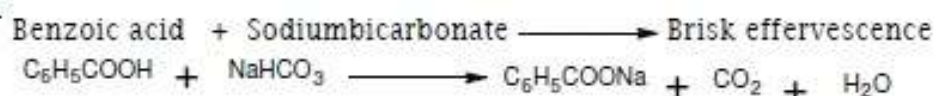
[11] Ethyl alcohol and Acetone



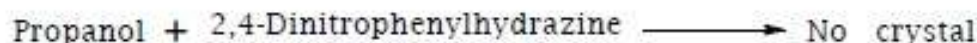
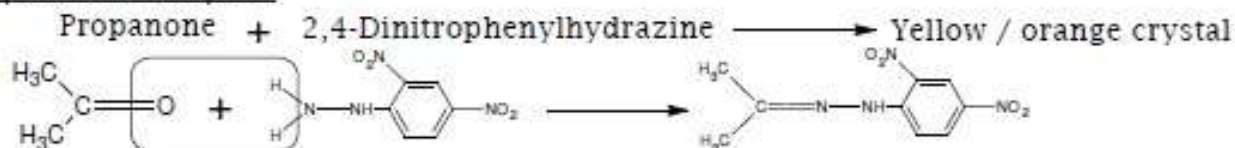
[12] Ethyl alcohol and Phenol



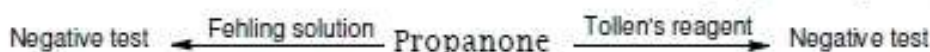
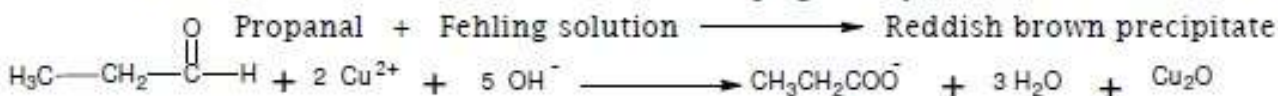
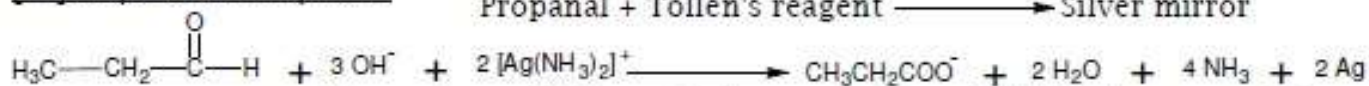
[13] Benzoic acid and Phenol



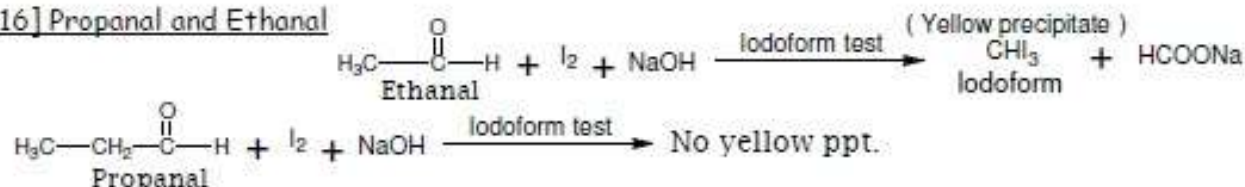
[14] Propanone and Propanol



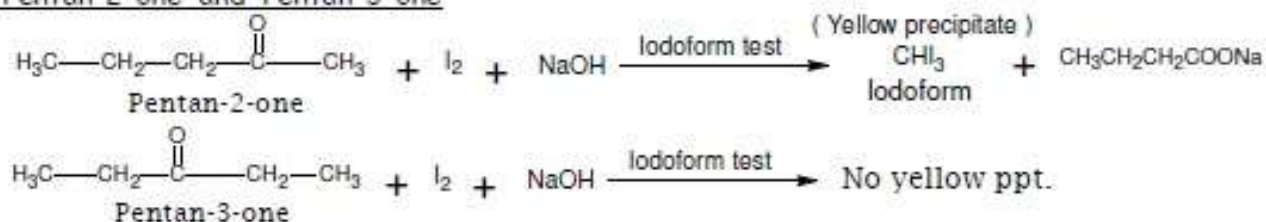
[15] Propanal and Propanone



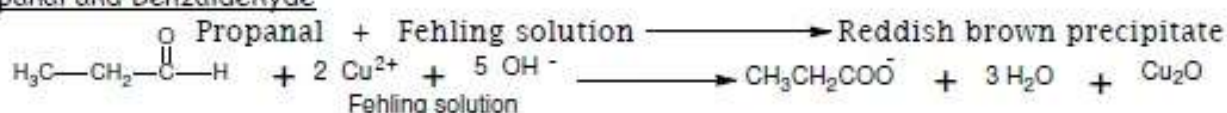
[16] Propanal and Ethanal



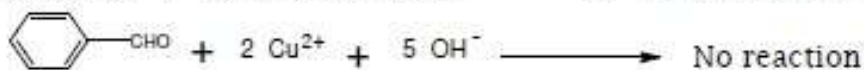
[17] Pentan-2-one and Pentan-3-one



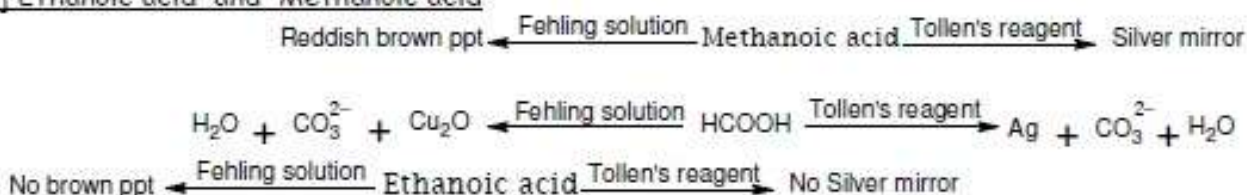
[18] Propanal and Benzaldehyde



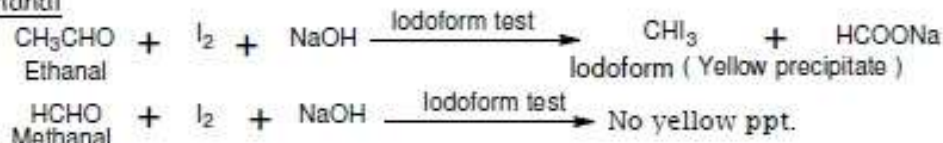
Benzaldehyde + Fehling solution \longrightarrow No precipitate



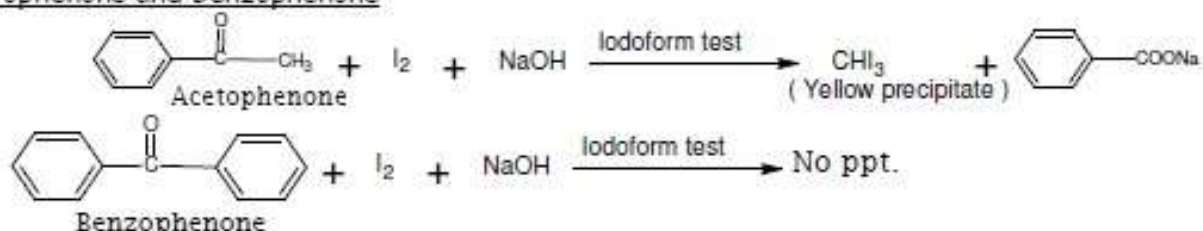
[19] Ethanoic acid and Methanoic acid



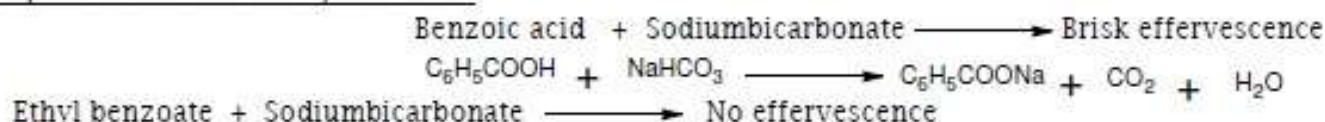
[20] Ethanal and Methanal



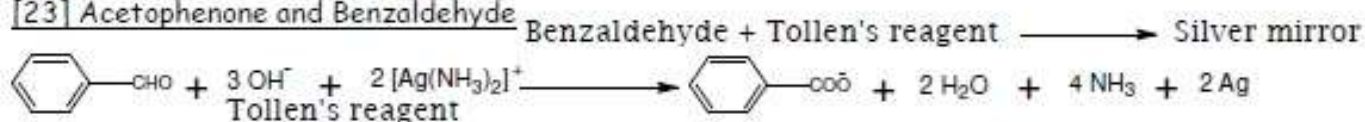
[21] Acetophenone and Benzophenone



[22] Benzoic acid and Ethyl benzoate

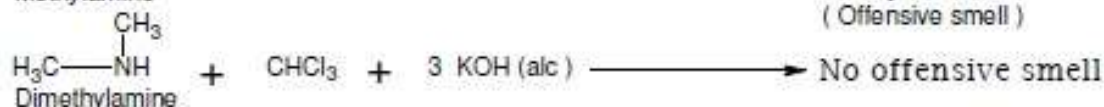


[23] Acetophenone and Benzaldehyde

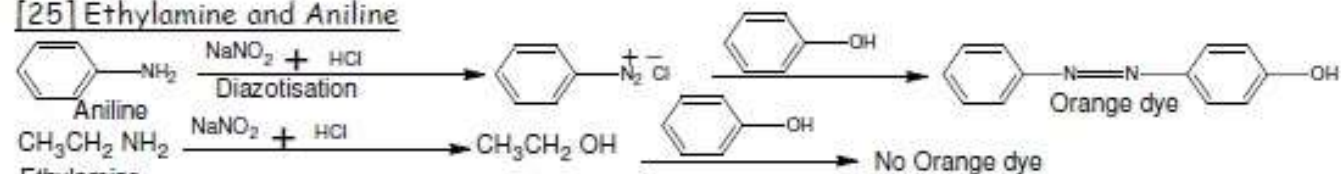


Acetophenone + Tollen's reagent \longrightarrow No Silver mirror

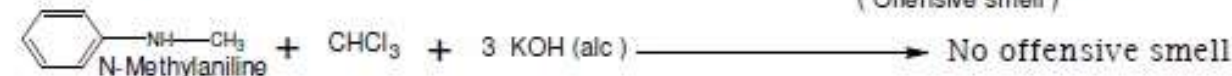
[24] Methylamine and dimethylamine



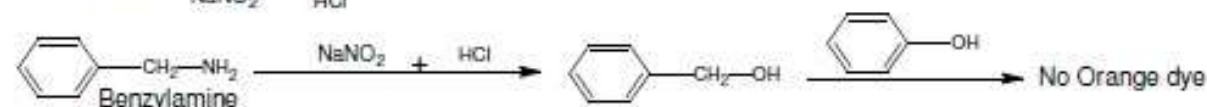
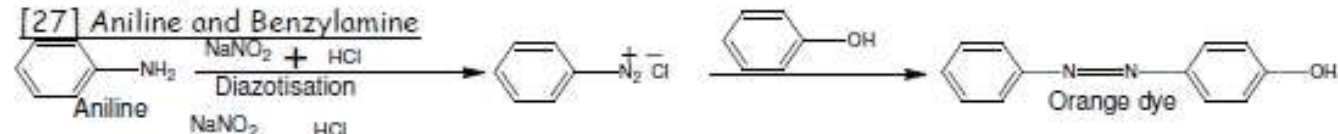
[25] Ethylamine and Aniline



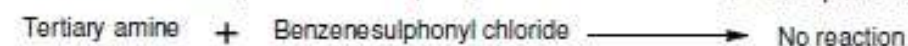
[26] Aniline and N-methylaniline



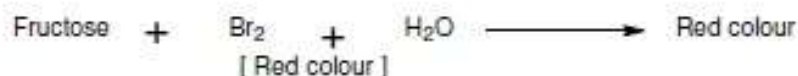
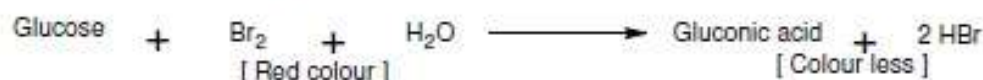
[27] Aniline and Benzylamine



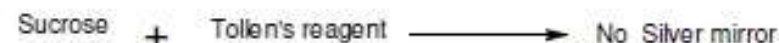
[28] Secondary and tertiary amine



[29] Glucose and Fructose



[30] Glucose and Sucrose



[31] Glucose and starch



OR



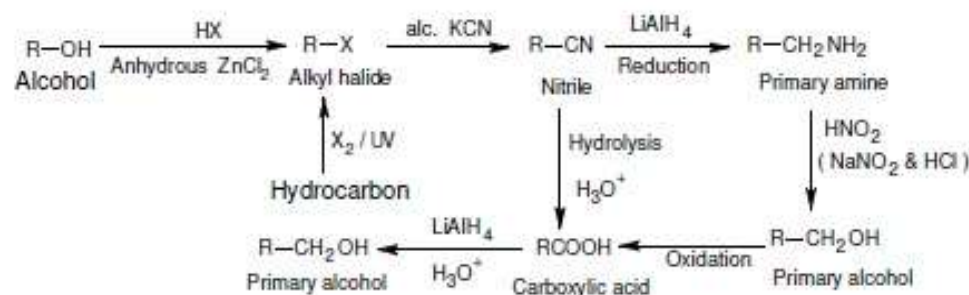
Organic Chemistry Conversions

Broadly you can classify conversions into two types – aliphatic and aromatic.

Aliphatic Conversions

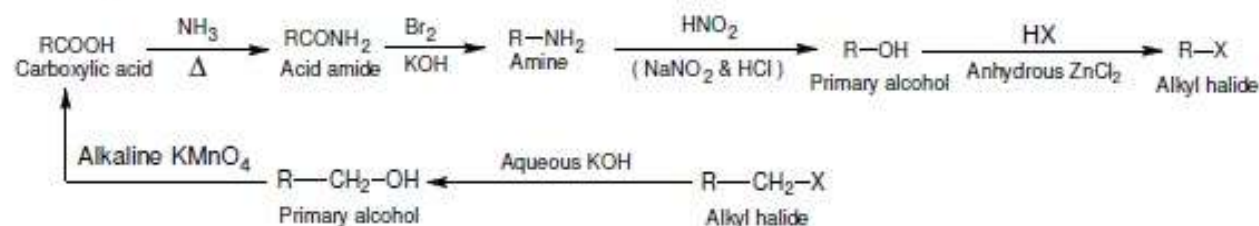
a). For stepping up the series:

Stepping up the series means that the product has one carbon more than that of reactant. For such kind of a conversion, convert the given compound to an alkyl halide and then to a cyanide and then to the required organic compound as asked in the question. This way, the product has one carbon more than the reactant.



b). For stepping down the series:

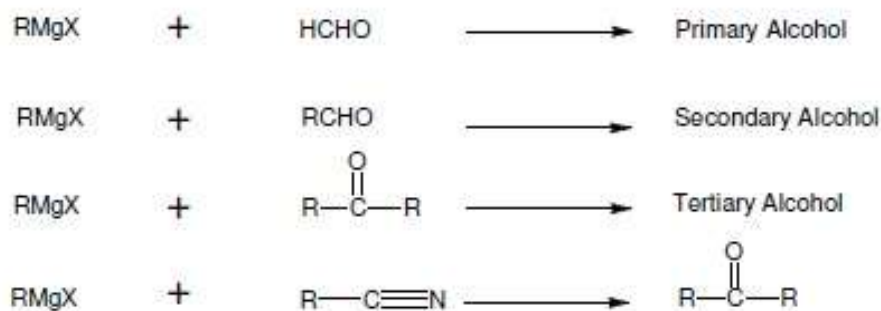
Stepping down the series means that the product has one carbon less than that of its reactant. For such kind of a conversion, convert the given compound to an amide and then let it undergo Hoffmann bromamide degradation reaction. Then you convert it to the required product as asked in the question.



c). Reaction with Grignard's reagent:

Grignard's reagent is a versatile reagent and can be used for many conversions. Some of its reactions are given below:

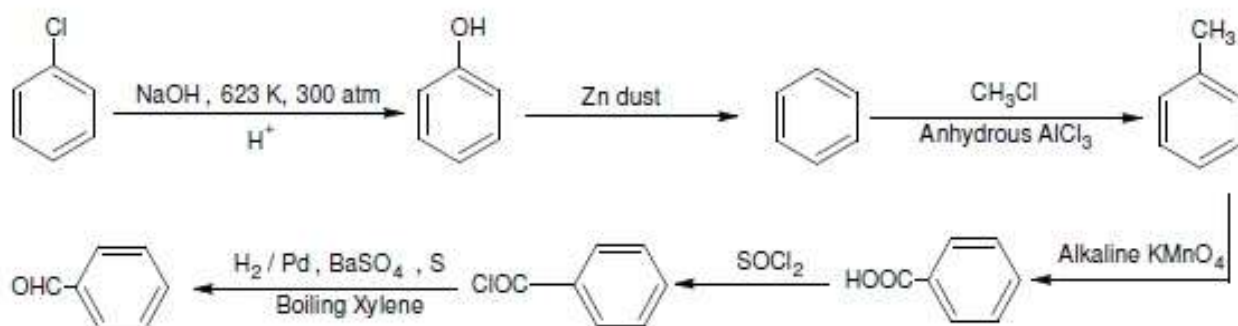




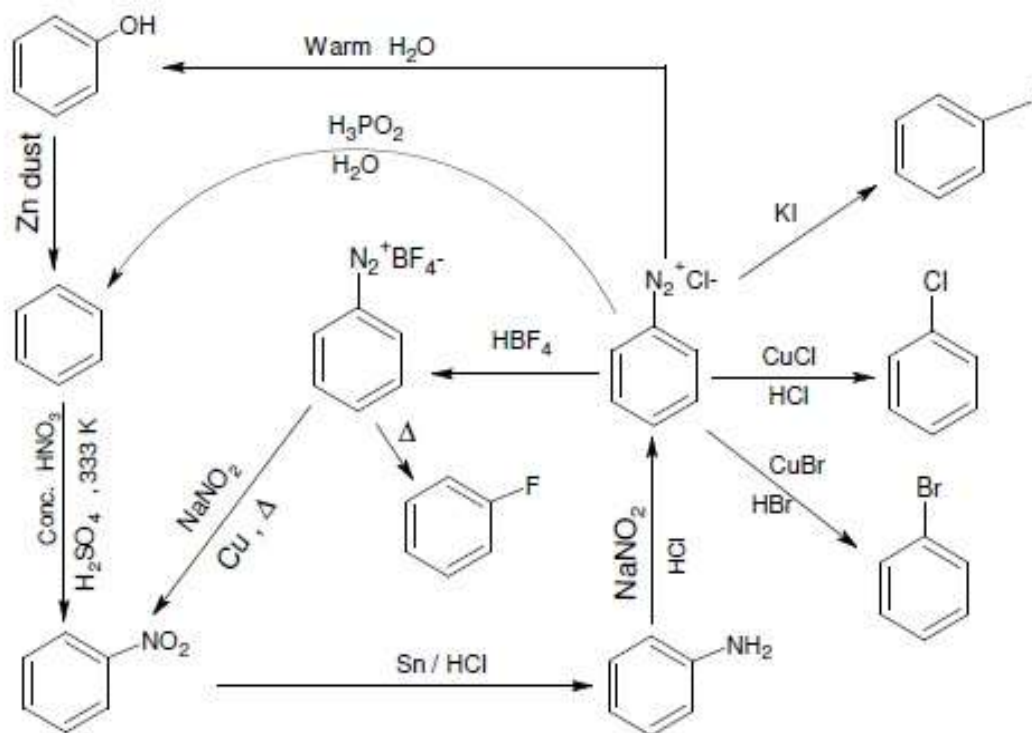
Aromatic Conversions

There are two types of conversions possible in this case:

a. When the functional group contains carbon atom:



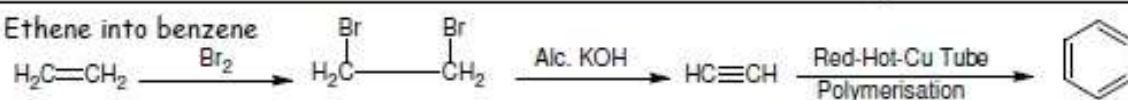
b. When the functional group does not contain carbon atom:



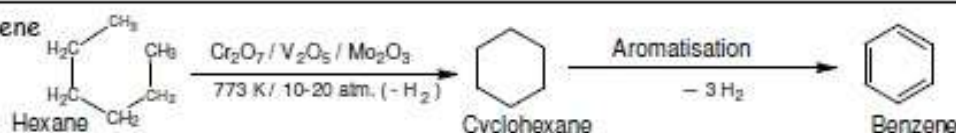
Ethyne into benzene



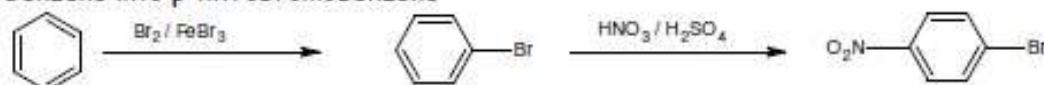
Ethene into benzene



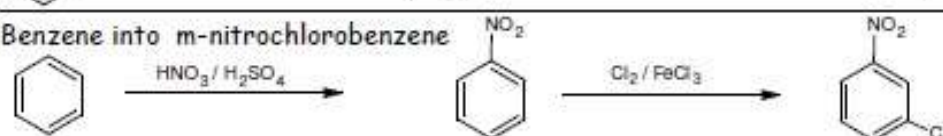
Hexane into benzene



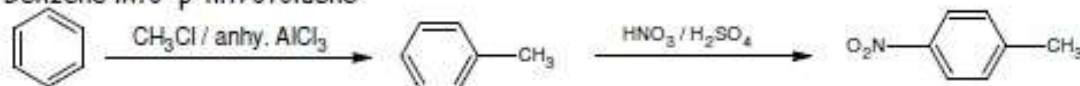
Benzene into p-nitrobromobenzene



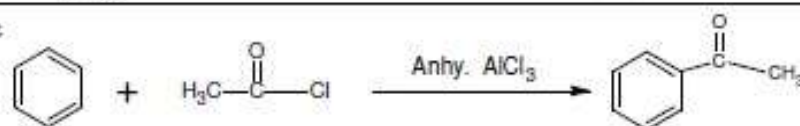
Benzene into m-nitrochlorobenzene



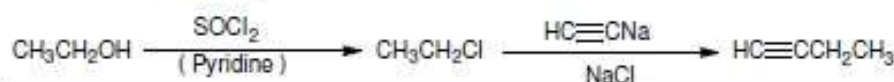
Benzene into p-nitrotoluene



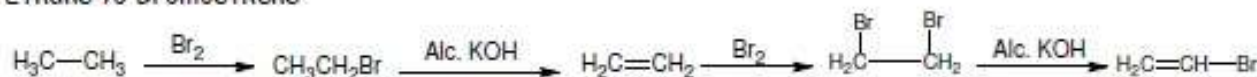
Benzene into Acetophenone



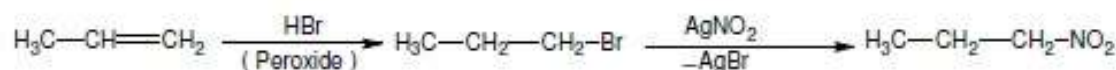
Ethanol into but-1-yne



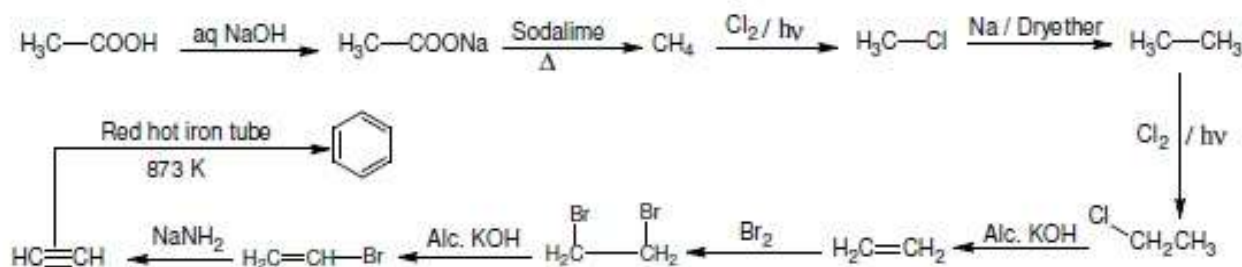
Ethane to Bromoethene

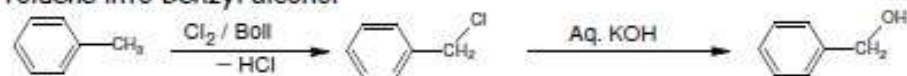
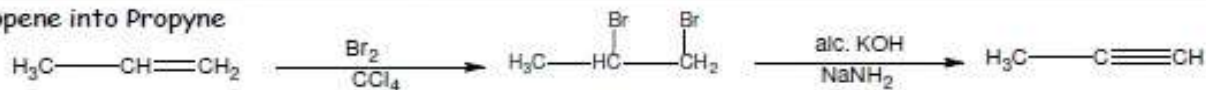
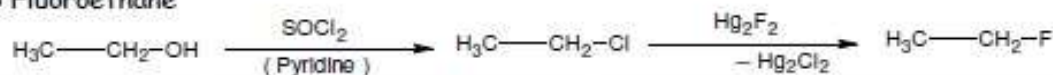
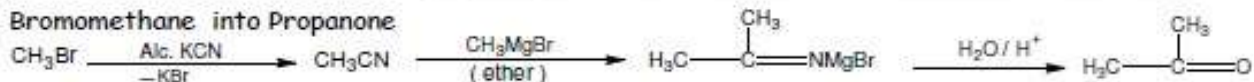
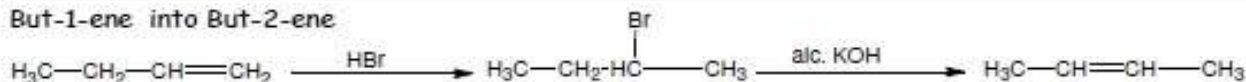
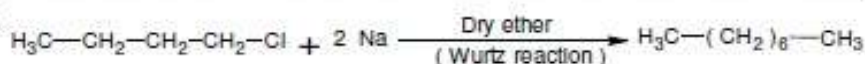
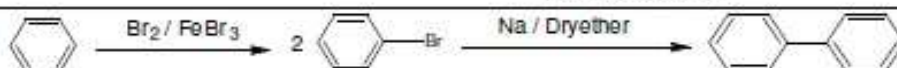
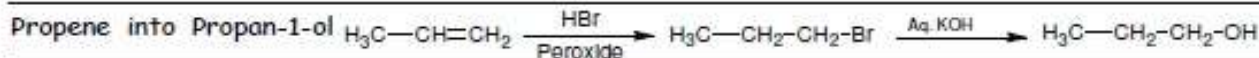
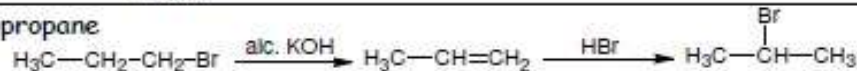
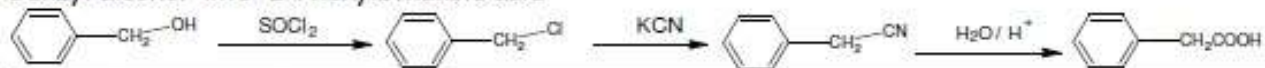
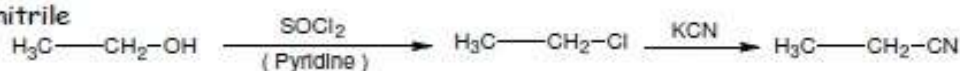
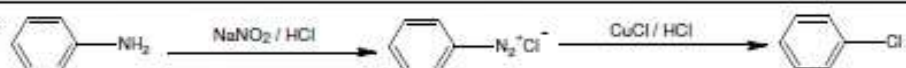
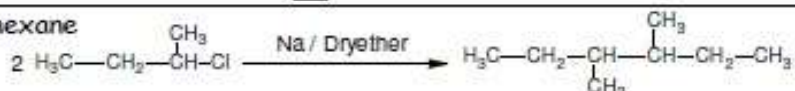
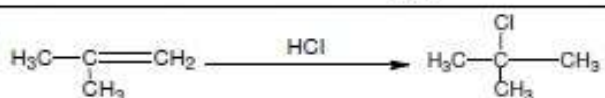
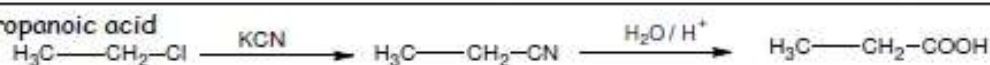
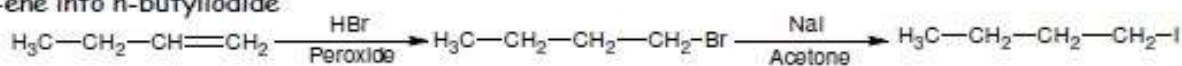
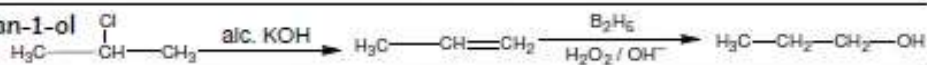
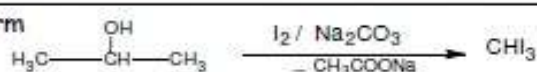
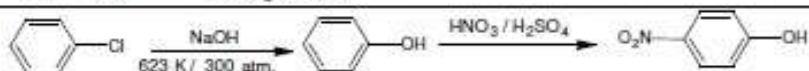


Propene into 1-nitropropane

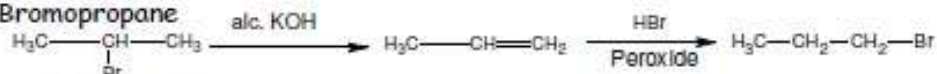


Ethanoic acid into Benzene

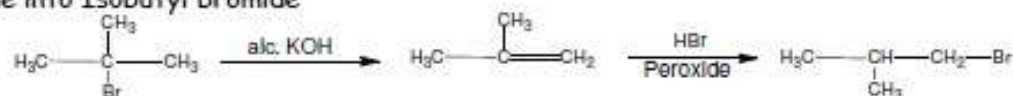


Toluene into Benzyl alcohol**Propene into Propyne****Ethanol into Fluoroethane****Bromomethane into Propanone****But-1-ene into But-2-ene****1-Chlorobutane into n-Octane****Benzene into Biphenyl****Propene into Propan-1-ol****1-Bromopropane into 2-Bromopropane****Benzyl alcohol into 2-Phenylethanoic acid****Ethanol into Propanenitrile****Aniline into Chlorobenzene****2-Chlorobutane into 3,4-Dimethylhexane****2-Methylpropene into 2-Chloro-2-methylpropane****Ethylchloride into Propanoic acid****But-1-ene into n-butyliodide****2-Chloropropane into Propan-1-ol****Isopropyl alcohol into Iodoform****Chlorobenzene into p-nitrophenol**

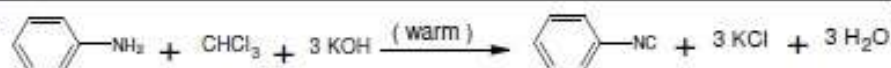
2-Bromopropane into 1-Bromopropane



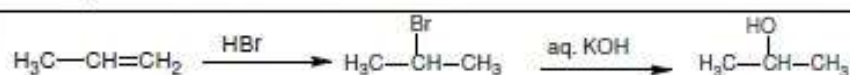
tert.butyl bromide into Isobutyl bromide



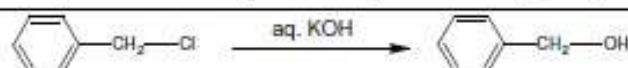
Aniline into Phenylisocyanide



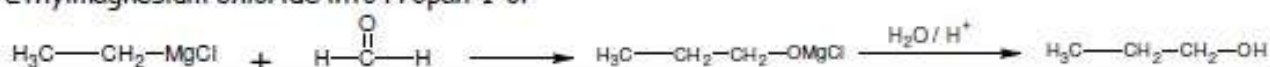
Propene into Propan-2-ol



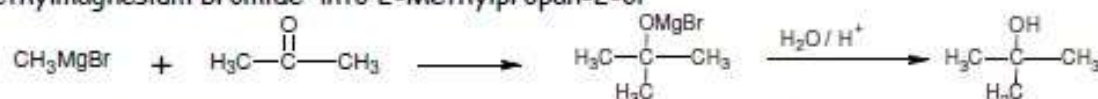
Benzyl chloride into Benzyl alcohol



Ethylmagnesium chloride into Propan-1-ol



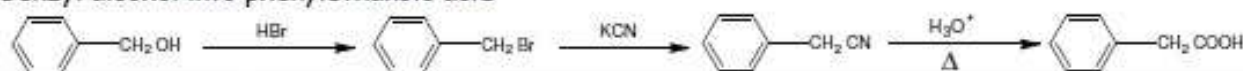
Methylmagnesium bromide into 2-Methylpropan-2-ol



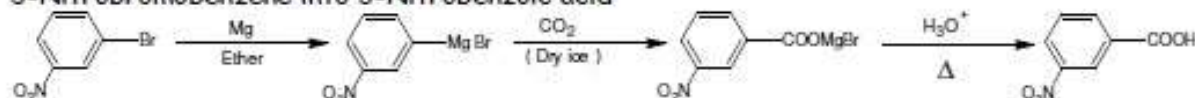
Butan-1-ol into Butanoic acid



Benzyl alcohol into phenylethanoic acid



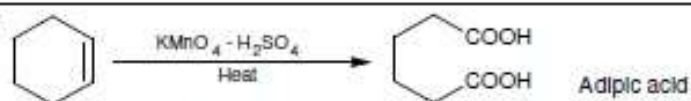
3-Nitrobromobenzene into 3-Nitrobenzoic acid



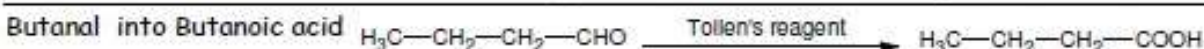
4-Methylacetophenone into Benzene-1,4-dicarboxylic acid



Cyclohexene into Hexane-1,6-dioic acid



Butanal into Butanoic acid



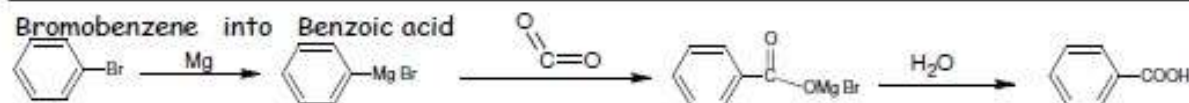
Ethylbenzene into Benzoic acid



Acetophenone into Benzoic acid



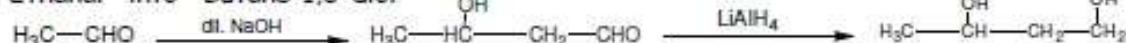
Bromobenzene into Benzoic acid



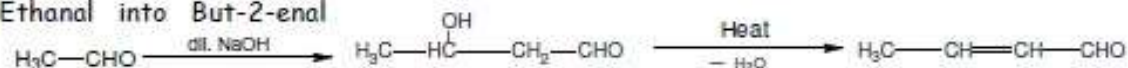
Phenylethene (Styrene) into Benzoic acid



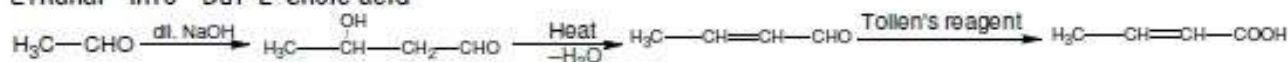
Ethanal into Butane-1,3-diol



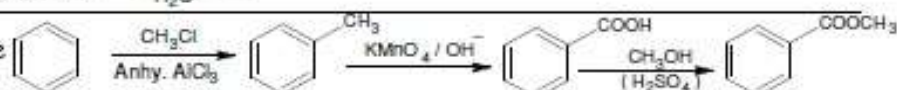
Ethanal into But-2-enal



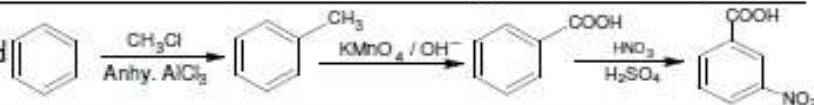
Ethanal into But-2-enoic acid



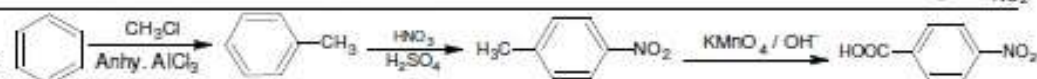
Benzene into methylbenzoate



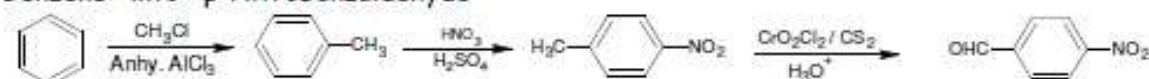
Benzene into m-Nitrobenzoic acid



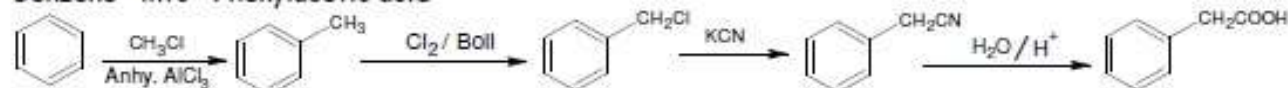
Benzene into p-Nitrobenzoic acid



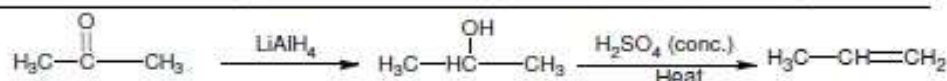
Benzene into p-Nitrobenzaldehyde



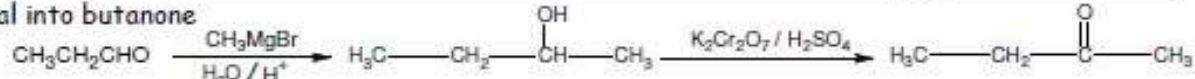
Benzene into Phenylacetic acid



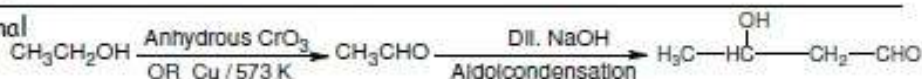
Propanone into propene



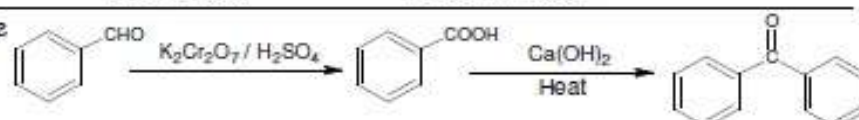
Propanal into butanone



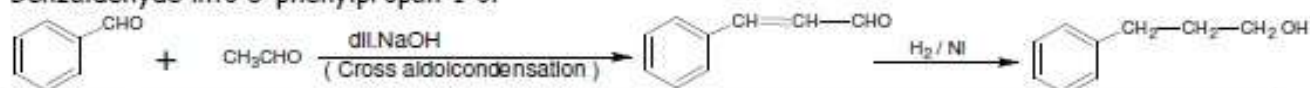
Ethanol into 3-hydroxybutanal



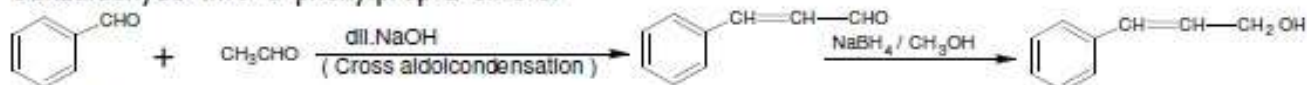
Benzaldehyde into benzophenone



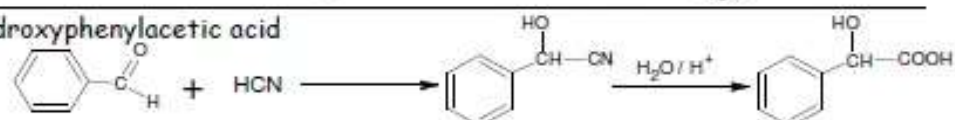
Benzaldehyde into 3-phenylpropan-1-ol



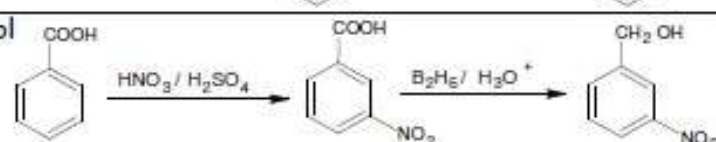
Benzaldehyde into 3-phenylprop-2-en-1-ol



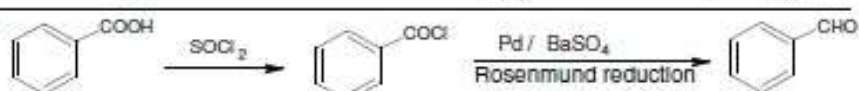
Benzaldehyde into α-Hydroxyphenylacetic acid

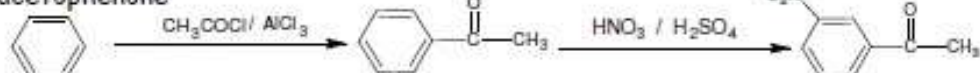
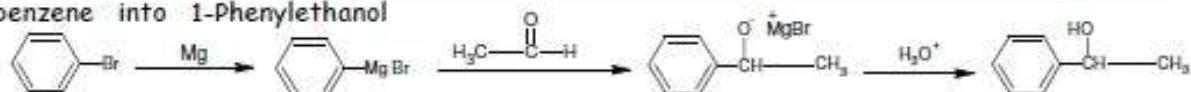
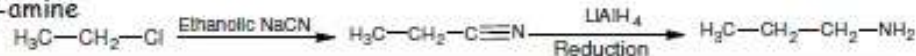
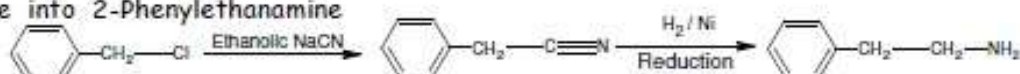
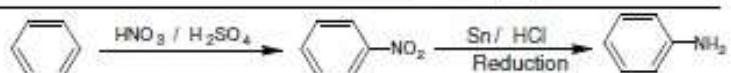
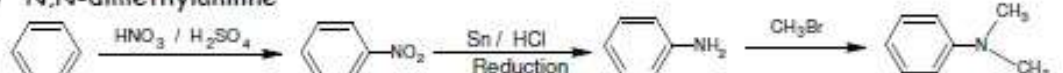
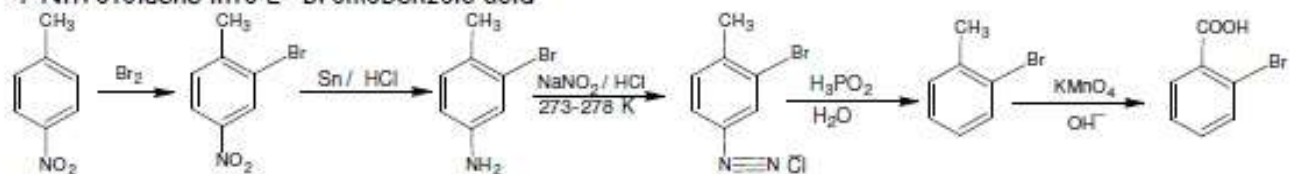
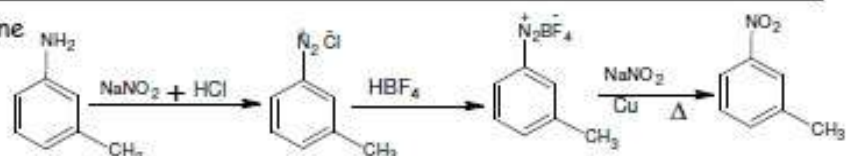
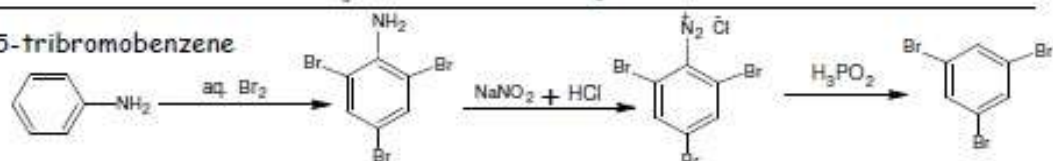
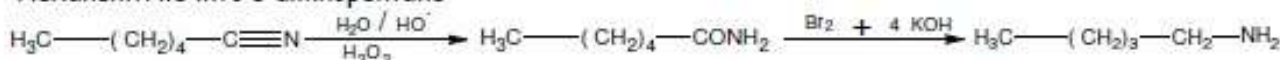
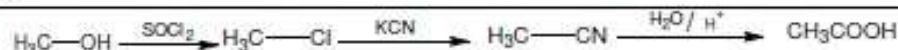
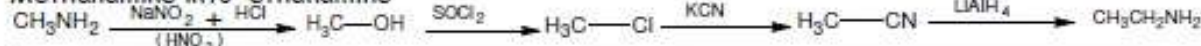
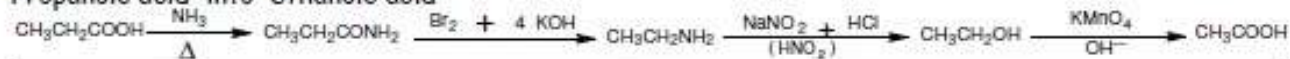


Benzoic acid into m-Nitrobenzyl alcohol

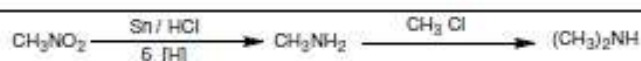


Benzoic acid into Benzaldehyde

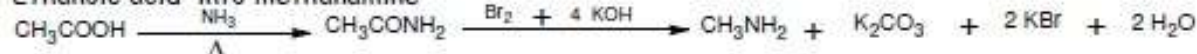


Benzene into m-Nitroacetophenone**Bromobenzene into 1-Phenylethanol****Chloroethane into propan-1-amine****Chlorophenylmethane into 2-Phenylethanamine****Benzene into Aniline****Benzene into N,N-dimethylaniline****1,6-Dichlorobutane into hexane-1,6-diamine****4-Nitrotoluene into 2-bromobenzoic acid****3-Methylaniline into 3-nitrotoluene****Aniline into 1,3,5-tribromobenzene****Hexanenitrile into 1-aminopentane****Methanol into ethanoic acid****Ethanamine into methanamine****Methanamine into ethanamine****Ethanoic acid into Propanoic acid****Propanoic acid into ethanoic acid**

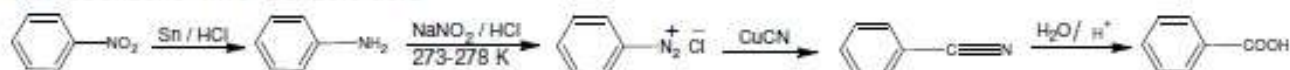
Nitromethane into dimethylamine



Ethanoic acid into methanamine



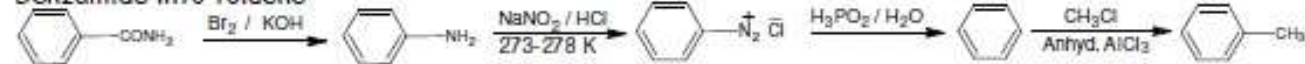
Nitrobenzene into benzoic acid



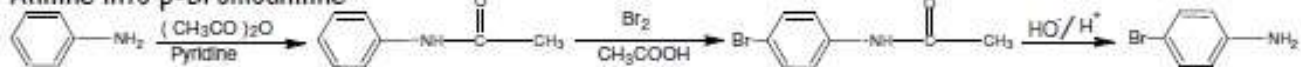
Benzoic acid into aniline



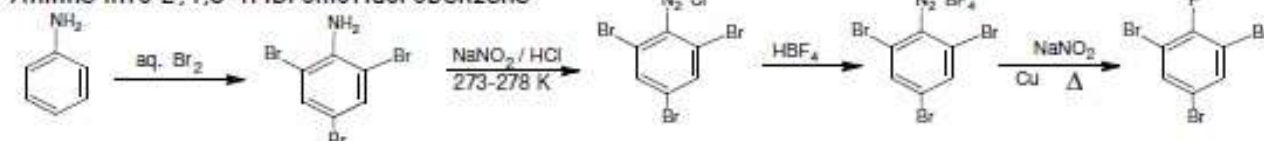
Benzamide into toluene



Aniline into p-Bromoaniline



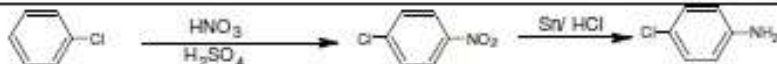
Aniline into 2,4,6-tribromofluorobenzene



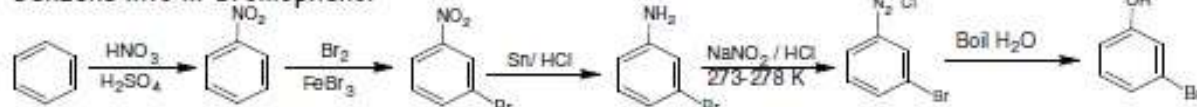
Aniline into benzyl alcohol



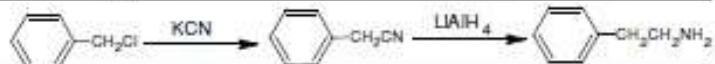
Chlorobenzene into p-Chloroaniline



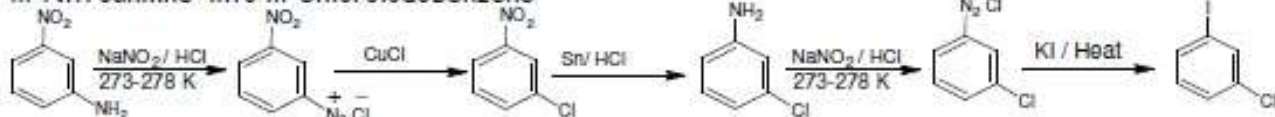
Benzene into m-bromophenol



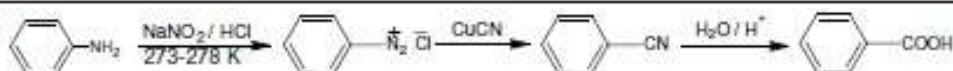
Benzyl chloride into 2-Phenylethanamine



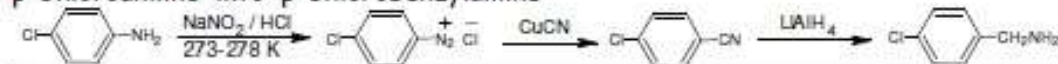
m-Nitroaniline into m-Chloriodobenzene



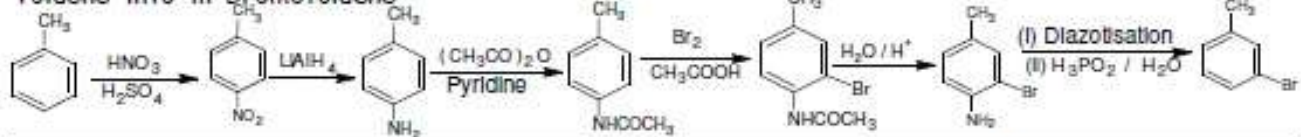
Aniline into Benzoic acid



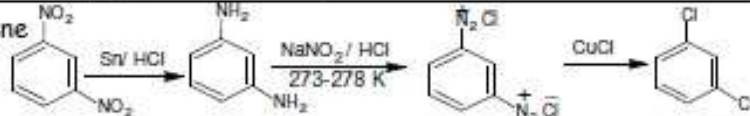
p-Chloroaniline into p-Chlorobenzylamine



Toluene into m-Bromotoluene

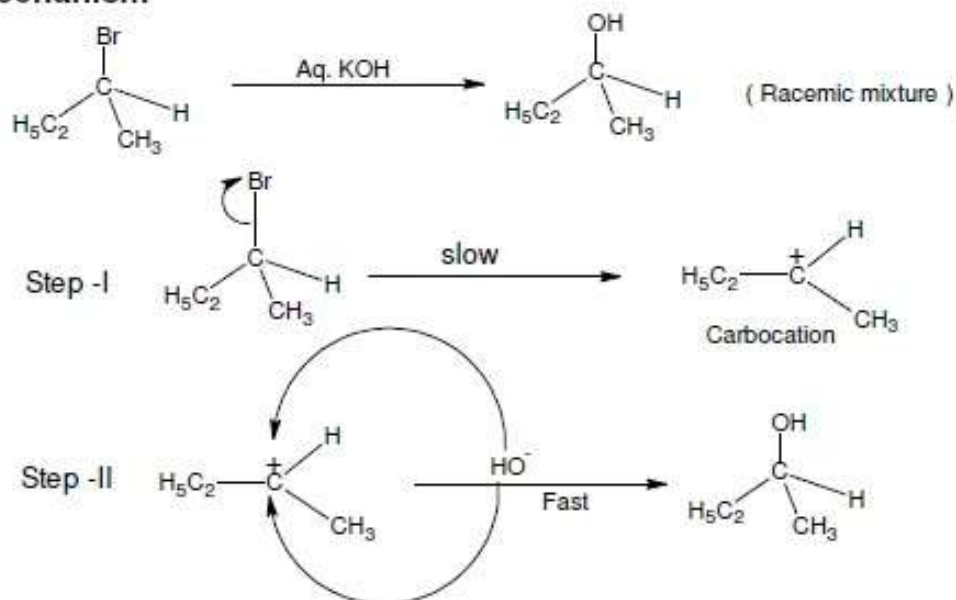


m-Dinitrobenzene into m-Dichlorobenzene

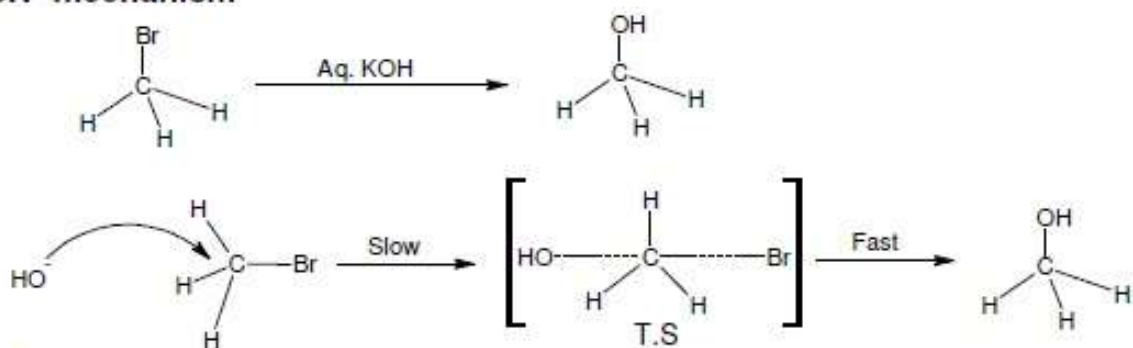


ORGANIC CHEMISTRY MECHANISM

1. SN¹ mechanism



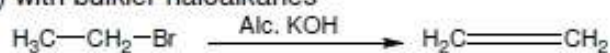
2. SN² mechanism



3. Elimination reaction in haloalkane

In general elimination reaction occurs:

- (i) in the presence of a strong and/or bulkier base,
- (ii) at high temperature and
- (iii) with bulkier haloalkanes



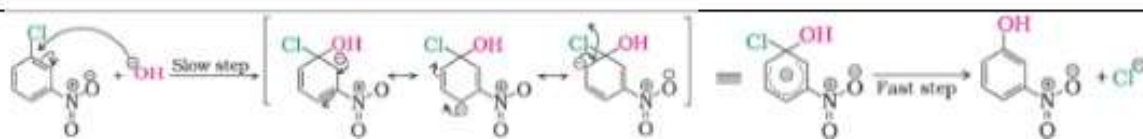
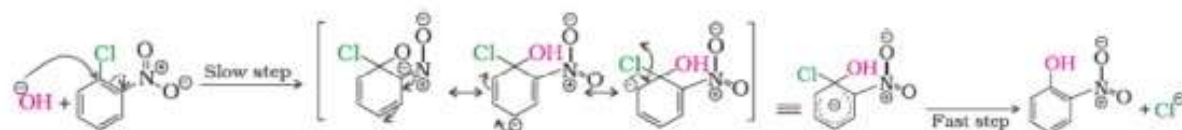
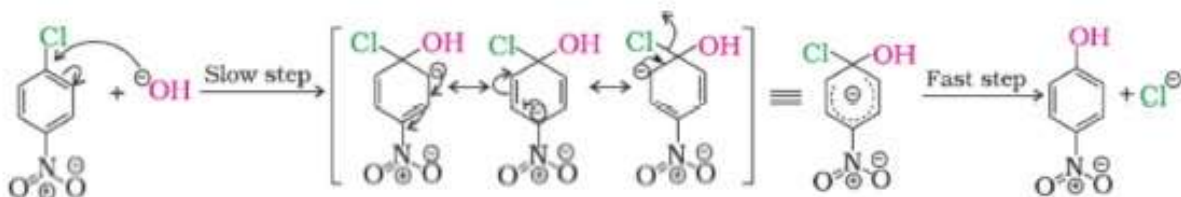
The alcoholic KOH results in the formation of a strong base, ethoxide ion,



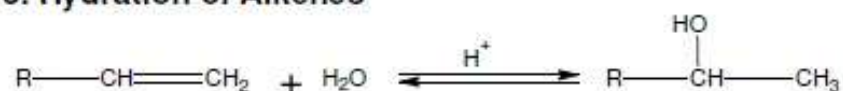
The much stronger ethoxide ion abstracts a proton to form alkene



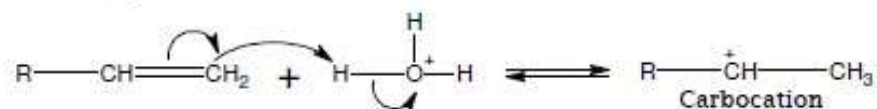
4. Effect of substituent on nucleophilic substitution on aryl halides



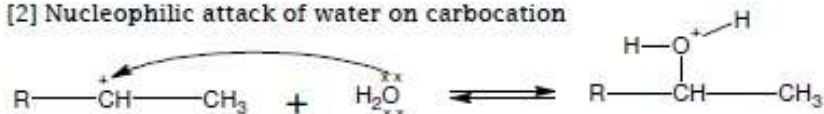
5. Hydration of Alkenes



[1] Protonation of alkene



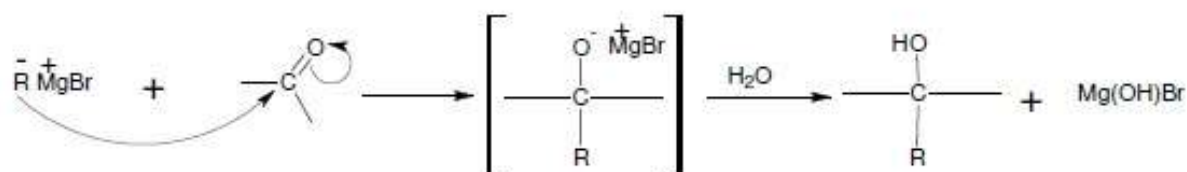
[2] Nucleophilic attack of water on carbocation



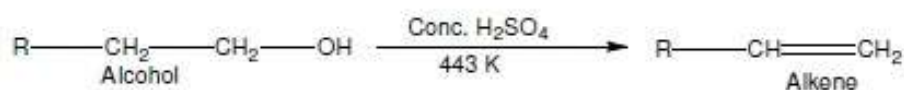
[3] Deprotonation to form an alcohol



6. Addition of Grignard Reagent to Aldehydes & Ketones



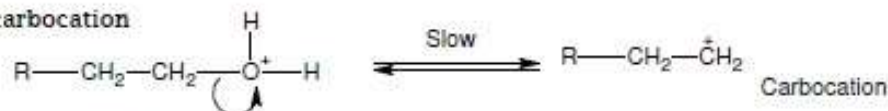
7. Dehydration of alcohol for the formation of Alkene



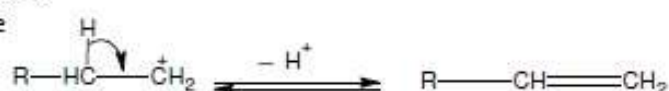
[1] Protonation of alcohol



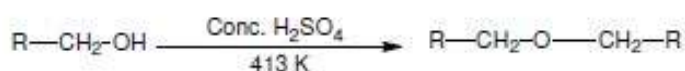
[2] Formation of carbocation



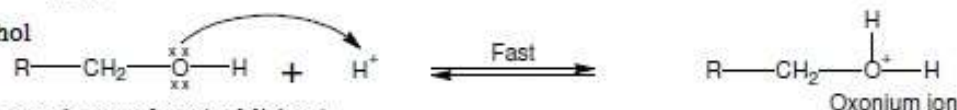
[3] Deprotonation to form an alkene



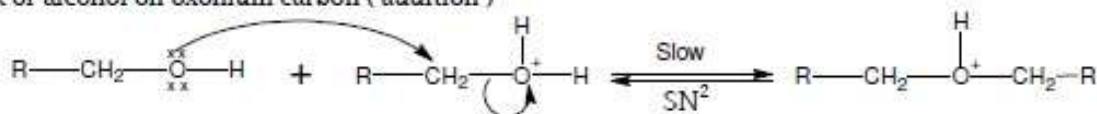
8. Dehydration of alcohol for the formation of Ether



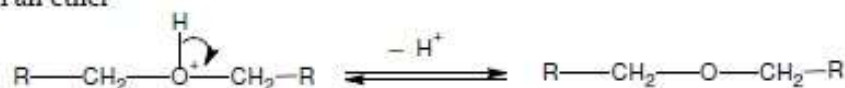
[1] Protonation of alcohol



[2] Attack of alcohol on oxonium carbon (addition)



[3] Deprotonation to form an ether

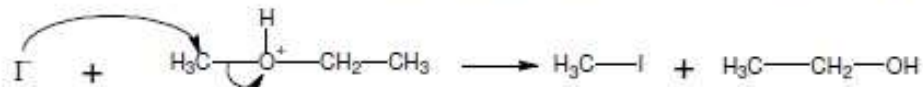


9. Reaction of HI with ether

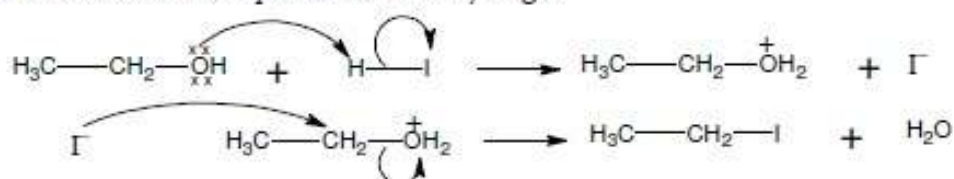
[1] Protonation of ether



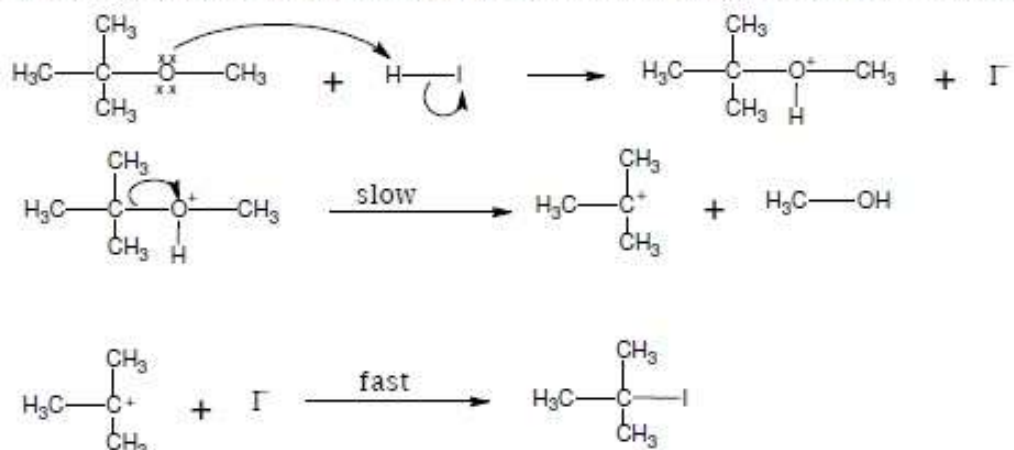
[2] I^- acts as nucleophile and attack the least substituted carbon of the oxonium ion by SN^2 mechanism



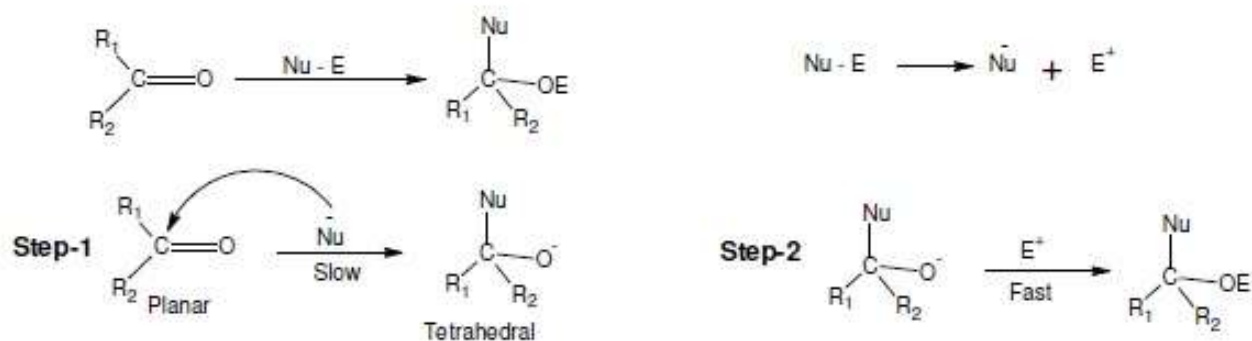
[3] If excess of HI is there and temperature is very high:



If there is tertiary alkyl group, then the reaction will proceed by SN^1 mechanism.



10. Nucleophilic addition of aldehydes & ketones

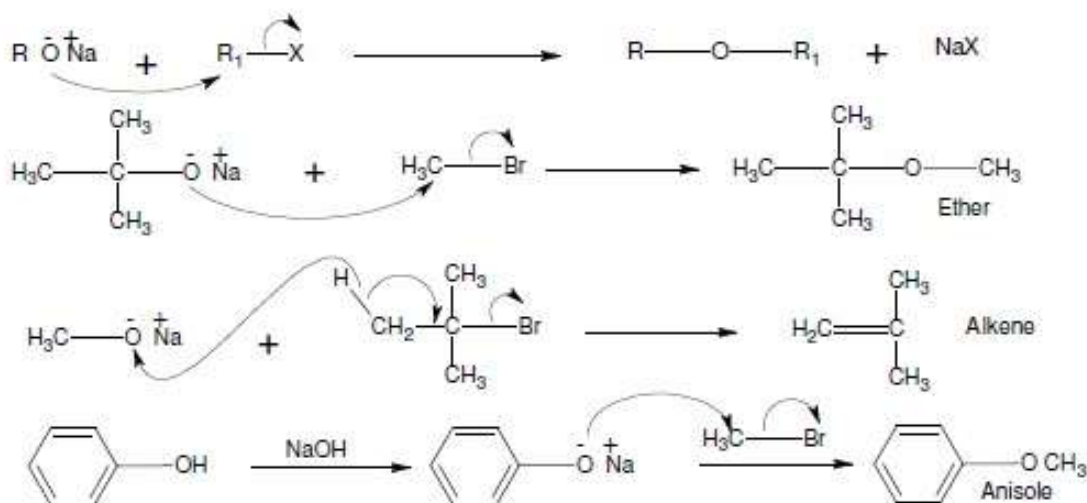


11. Willamson synthesis

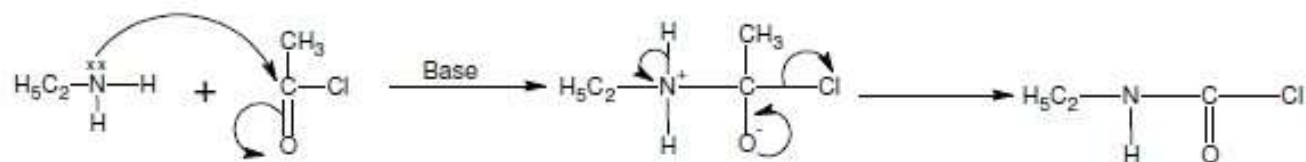
This is used to prepare both simple and mixed ether

The reaction involves SN^2 attack of an alkoxide ion on primary alkyl halide.

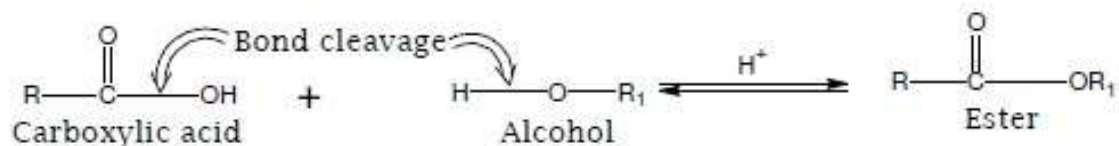
If alkyl halide used is tertiary then alkene will be the main product.



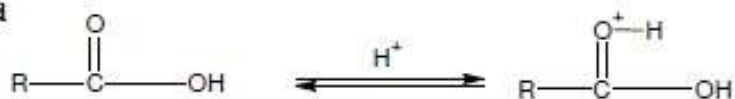
12. Acylation of amines



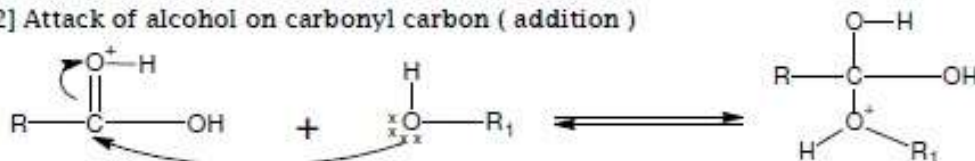
13. Esterification



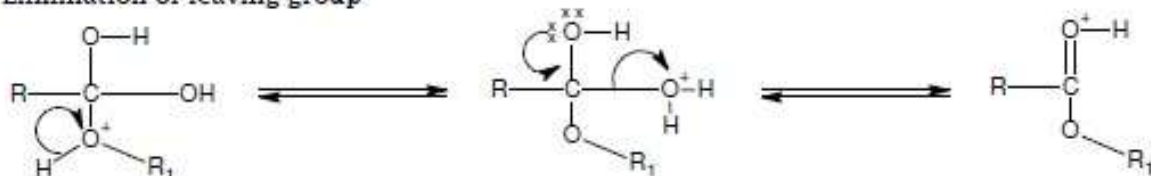
[1] Protonation of carboxylic acid



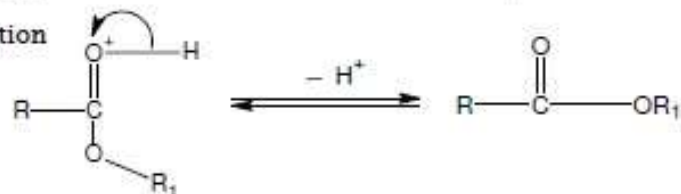
[2] Attack of alcohol on carbonyl carbon (addition)



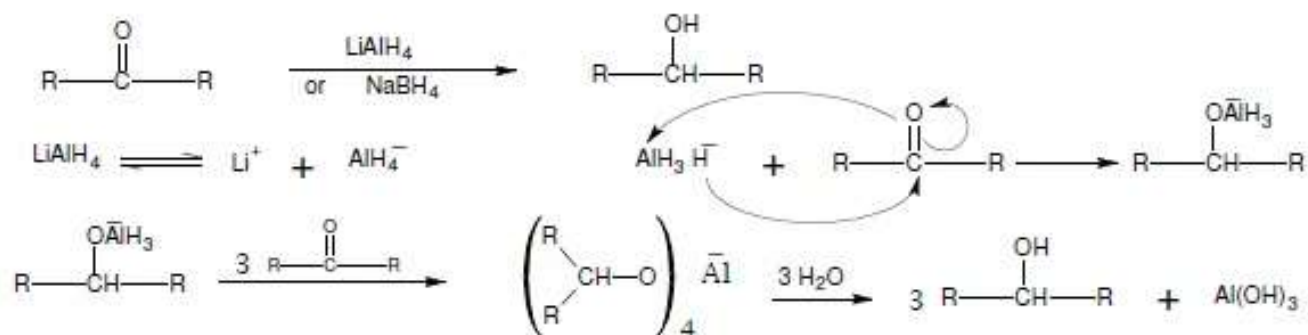
[3] Elimination of leaving group




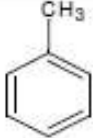

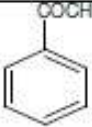
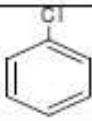
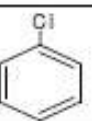
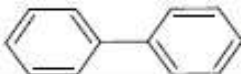
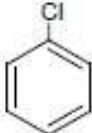
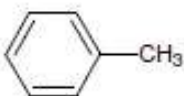
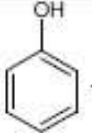
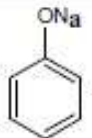
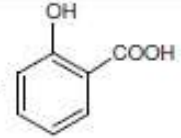
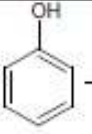
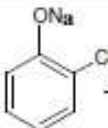
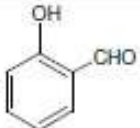
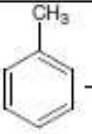
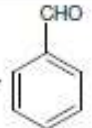

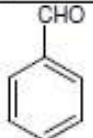
[4] Deprotonation



14. Reduction by LiAlH₄



NAME REACTIONS

1.	Finkelstein	$\text{CH}_3\text{Br} + \text{NaI} \longrightarrow \text{CH}_3\text{I} + \text{NaBr}$
2.	Swarts	$\text{CH}_3\text{Br} + \text{AgF} \longrightarrow \text{CH}_3\text{F} + \text{AgBr}$
3.	Friedel-Crafts Alkylation	 $+ \text{H}_3\text{C}-\text{Cl} \xrightarrow{\text{Anhydrous AlCl}_3}$ 
4.	Friedel-Crafts Acylation	 $\xrightarrow[\text{Anhydrous AlCl}_3]{\text{CH}_3\text{COCl}}$ 
5.	Wurtz	$\text{H}_3\text{C}-\text{Cl} + \text{Cl}-\text{CH}_3 \xrightarrow{2\text{Na}} \text{H}_3\text{C}-\text{CH}_3 + \text{NaCl}$
6.	Fittig	 $+ $  $\xrightarrow[\text{Dry ether}]{2\text{Na}}$  $+ \text{NaCl}$
7.	Wurtz-Fittig	 $+ \text{Cl}-\text{CH}_3 \xrightarrow[\text{Dry ether}]{2\text{Na}}$  $+ \text{NaCl}$
8.	Kolbe	 $\xrightarrow{\text{NaOH}}$  $\xrightarrow[\text{ii) H}^+]{\text{i) CO}_2}$ 
9.	Reimer-Tiemann	 $\xrightarrow{\text{CH}_3\text{Cl} + \text{NaOH}}$  $\xrightarrow{\text{H}^+}$ 
10.	Williamson	$\text{CH}_3\text{-Br} + \text{CH}_3\text{-ONa} \longrightarrow \text{CH}_3\text{-O-CH}_3 + \text{NaBr}$
11.	Stephen	$\text{H}_3\text{C-CN} + \text{SnCl}_2 + \text{HCl} \longrightarrow \text{H}_3\text{C-CH=NH} \xrightarrow{\text{H}_3\text{O}^+} \text{H}_3\text{C-CHO}$
12.	Etard	 $\xrightarrow[\text{H}_3\text{O}^+]{\text{CrO}_2\text{Cl}_2}$ 
13.	Gatterman – Koch	 $\xrightarrow[\text{Anhydrous AlCl}_3]{\text{CO / HCl}}$ 

14.	Rosenmund reduction	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl} \xrightarrow[\text{Pd / BaSO}_4]{\text{H}_2} \text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$
15.	Clemmensen reduction	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3 \xrightarrow[\text{Conc. HCl}]{\text{Zn - Hg}} \text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$
16.	Wolff-Kishner reduction	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3 \xrightarrow[\text{ii) KOH / Ethylene glycol / } \Delta]{\text{i) NH}_2\text{-NH}_2} \text{H}_3\text{C}-\text{CH}_2-\text{CH}_3$
17.	Tollens' test	$\text{R-CHO} + 2 [\text{Ag}(\text{NH}_3)_2]^+ + 3 \text{OH}^- \longrightarrow \text{R-COO}^- + 2\text{Ag} \downarrow + 2\text{H}_2\text{O} + 4 \text{NH}_3$
18.	Fehling's test	$\text{R-CHO} + 2 \text{Cu}^{2+} + 5 \text{OH}^- \longrightarrow \text{R-COO}^- + \text{Cu}_2\text{O} \downarrow + 3\text{H}_2\text{O}$
19.	Iodoform	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3 \xrightarrow[\text{OR, NaOI}]{\text{I}_2 / \text{NaOH}} \text{CHI}_3 \downarrow + \text{CH}_3\text{COONa}$
20.	Aldol condensation	$2 \text{H}_3\text{C}-\text{CHO} \xrightarrow{\text{dil NaOH}} \text{H}_3\text{C}-\overset{\text{OH}}{\text{CH}}-\text{CH}_2-\text{CHO} \xrightarrow{\Delta} \text{H}_3\text{C}-\text{CH}=\text{CH}-\text{CHO}$
21.	Cannizzaro	$\text{HCHO} + \text{HCHO} \xrightarrow{\text{Conc. NaOH}} \text{HCOONa} + \text{H}_3\text{C}-\text{OH}$
22.	Hell-Volhard-Zelinsky (HVZ)	$\text{H}_3\text{C}-\text{COOH} \xrightarrow[\text{ii) H}_2\text{O}]{\text{i) Cl}_2 / \text{Red Phosphorus}} \text{H}_2\underset{\text{Cl}}{\text{C}}-\text{COOH}$
23.	Hoffmann bromamide degradation	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}_2 \xrightarrow[\text{NaOH}]{\text{Br}_2} \text{H}_3\text{C}-\text{NH}_2$
24.	Carbylamine	$\text{R-NH}_2 + \text{CHCl}_3 + 3 \text{KOH} \xrightarrow{\Delta} \text{R-NC} + 3 \text{KCl} + 3 \text{H}_2\text{O}$
25.	Diazo	$\text{C}_6\text{H}_5\text{NH}_2 \xrightarrow[273 - 278 \text{ K}]{\text{NaNO}_2 + \text{dil HCl}} \text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-$
26.	Sandmeyer.	$\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow{\text{CuCl} / \text{HCl}} \text{C}_6\text{H}_5\text{Cl} + \text{N}_2$
27.	Gatterman	$\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- \xrightarrow{\text{Cu} / \text{HCl}} \text{C}_6\text{H}_5\text{Cl} + \text{N}_2$
28.	Coupling	$\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^- + \text{H}-\text{C}_6\text{H}_4-\text{OH} \xrightarrow{\text{OH}^-} \text{C}_6\text{H}_5\text{N}=\text{N}-\text{C}_6\text{H}_4-\text{OH}$