SMART SKILLS

SYLLABUS 2017 - 2018

CHEMISTRY

INDEX

CLASS XII (2016-17)

(THEORY)

Total Periods (Theory 160 + Practical 60)

Time: 3 Hours **70 Marks**

Unit No.	Title	No. of Periods	Marks
Unit I	Solid State	10	23
Unit II	Solutions	10	
Unit III	Electrochemistry	12	
Unit IV	Chemical Kinetics	10	
Unit V	Surface Chemistry	08	
Unit VI	General Principles and Processes of Isolation of Elements	08	19
Unit VII	p -Block Elements	12	
Unit VIII	d -and f -Block Elements	12	
Unit IX	Coordination Compounds	12	
Unit X	Haloalkanes and Haloarenes	10	28
Unit XI	Alcohols, Phenols and Ethers	10	
Unit XII	Aldehydes, Ketones and Carboxylic Acids	10	
Unit XIII	Organic Compounds containing Nitrogen	10	
Unit XIV	Biomolecules	12	
Unit XV	Polymers	08	
Unit XVI	Chemistry in Everyday Life	06	
	Total	**160**	**70**

Unit I: Solid State **10 Periods**

Classification of solids based on different binding forces: molecular, ionic, covalent and metallicsolids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and threedimensional 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.

Unit II: Solutions **10 Periods**

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases inliquids, solid solutions, colligative properties - relative lowering of vapour pressure, Raoult's law,elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecularmasses using colligative properties, abnormal molecular mass, Van't Hoff factor.

Unit III: Electrochemistry **12 Periods**

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variationsof conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementaryidea), dry cell -electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standardelectrode potential, Nernst equation and its application to chemical cells, Relation between Gibb'senergy change and EMF of a cell, fuel cells, corrosion.

Unit IV: Chemical Kinetics **10 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 rateconstant,integrated rate equations and half life (only for zero and first order reactions), concept ofcollision theory (elementary idea, no mathematical treatment). Activation energy, Arrheniusequation.

Unit V: Surface Chemistry **08 Periods**

Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis,homogenous and heterogenous activity and selectivity; enzyme catalysis colloidal state distinctionbetween true solutions, colloids and suspension; lyophilic, lyophobic multimolecularandmacromolecular colloids; properties of colloids; Tyndall effect, Brownian movement,electrophoresis,coagulation, emulsion - types of emulsions.

Unit VI: General Principles and Processes of Isolation of Elements **08 Periods**

Principles and methods of extraction - concentration, oxidation, reduction - electrolytic method andrefining; occurrence and principles of extraction of aluminium, copper, zinc and iron.

Unit VII:"p"-Block Elements 12 Periods

Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states,trends in physical and chemical properties; Nitrogen preparation properties and uses; compoundsof Nitrogen, preparation and properties of Ammonia and Nitric Acid, Oxides of Nitrogen(Structureonly) ; Phosphorus - allotropic forms, compounds of Phosphorus: Preparation and Properties ofPhosphine, 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, classificationof Oxides, Ozone, Sulphur -allotropic forms; compounds of Sulphur: Preparation Properties anduses 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 anduses of Chlorine and Hydrochloric acid, interhalogen compounds, Oxoacids of halogens (structuresonly).

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

Unit VIII: "d" and "f" Block Elements 12 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, 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 lanthanoidcontraction and its consequences.

Actinoids - Electronic configuration, oxidation states and comparison with lanthanoids.

Unit IX: Coordination Compounds 12 Periods

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic propertiesand shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner'stheory, VBT, and CFT; structure and stereoisomerism, importance of coordination compounds (inqualitative inclusion, extraction of metals and biological system).

Unit X: Haloalkanes and Haloarenes. 10 Periods

Haloalkanes: Nomenclature, nature of C -X bond, physical and chemical properties, mechanism ofsubstitution reactions, optical rotation.

Haloarenes: Nature of C -X bond, substitution reactions (Directive influence of halogen inmonosubstituted compounds only).

Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane,iodoform, freons, DDT.

Unit XI: Alcohols, Phenols and Ethers **10 Periods**

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primaryalcohols 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 ofphenol, electrophillic 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, physicaland chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen inaldehydes: uses.

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

Unit XIII: Organic compounds containing Nitrogen **10 Periods**

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

Cyanides and Isocyanides - will be mentioned at relevant places in text.

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Unit XIV: Biomolecules **12 Periods**

Carbohydrates - Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), D-Lconfiguration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose,glycogen); Importance of carbohydrates.

Proteins -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure ofproteins - 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.

Unit XV: Polymers **08 Periods**

Classification - natural and synthetic, methods of polymerization (addition and condensation),copolymerization, some important polymers: natural and synthetic like polythene, nylon polyesters,bakelite, rubber. Biodegradable and non-biodegradable polymers.

Unit XVI: Chemistry in Everyday life **06 Periods**

Chemicals in medicines - analgesics, tranquilizers antiseptics, disinfectants, antimicrobials,antifertility drugs, antibiotics, antacids, antihistamines.

Chemicals in food - preservatives, artificial sweetening agents, elementary idea of antioxidants.

Cleansing agents- soaps and detergents, cleansing action.

CHEMISTRY (CODE-043)
QUESTION PAPER DESIGN
CLASS - XII (2014-15)

Time 3 Hours **Max. Marks: 70**

S. No.	**Typology of Questions**	**Very Short Answer (VSA) (1 mark)**	**Short Answer-I (SA-I) (2 marks)**	**Short Answer–II (SA-II) (3 marks)**	**Value Based Question (4 marks)**	**Long Answer (L.A.) (5 marks)**	**Total Marks**	**% Weigh-tage**
1	Remembering (Knowledge based Simple recall questions, to know specific facts, terms, concepts, principles, or theories, Identify, define, or recite, information)	2	1	1	-	-	7	10%
2	Understanding- (Comprehension -to be familiar with meaning and to understandconceptually, interpret, compare, contrast, explain,paraphrase information)	-	2	4	-	1	21	30%
3	Application (Use abstract information in concrete situation, to apply knowledge to new situations, Use given content to interpret asituation, provide an example, or solve a problem)	-	2	4	-	1	21	30%
4	High Order Thinking Skills (Analysis &Synthesis- Classify,compare, contrast, or differentiate between different pieces of information, Organize and/or integrate uniquepieces of	2	-	1	-	1	10	14%

	information from a variety of sources)							
5	**Evaluation and Multi Disciplinary-** (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	1	-	2	1	-	11	16%
	TOTAL	**5x1=5**	**5x2=10**	**12x3=36**	**1x4=4**	**3x5=15**	**70(26)**	**100%**

QUESTION WISE BREAK UP

Type of Question(s)	Mark(s) per Question	Total No. of Questions	Total Marks
VSA	1	5	05
SA-I	2	5	10
SA-II	3	12	36
VBQ	4	1	04
LA	5	3	15
Total		**26**	**70**

1. **Internal Choice:** *There is no overall choice in the paper. However, there is an internal choice in one question of 2 marks weightage, one question of 3 marks weightage and all the three questions of 5 marksweightage.*

2. *The above template is only a sample. Suitable internal variations may be made for generating similar templates keeping the overall weightage to different form of questions and typology of questions same.*

PRACTICALS

Evaluation Scheme for Examination	**Marks**
Volumetric Analysis	08
Salt Analysis	08
Content Based Experiment	06
Project work	04
Class record and viva	04
Total	**30**

PRACTICALS SYLLABUS 60 Periods

Micro-chemical methods are available for several of the practical experiments. Wherever possible, such techniques should be used.

A. Surface Chemistry

(a) Preparation of one lyophilic and one lyophobic sol
  Lyophilic sol - starch, egg albumin and gum
  Lyophobic sol - aluminium hydroxide, ferric hydroxide, arsenous sulphide.
(b) Dialysis of sol-prepared in (a) above.
(c) Study of the role of emulsifying agents in stabilizing the emulsion of different oils.

B. Chemical Kinetics

(a) Effect of concentration and temperature on the rate of reaction between Sodium Thiosulphate andHydrochloric acid.
(b) Study of reaction rates of any one of the following:
  (i) Reaction of Iodide ion with Hydrogen Peroxide at room temperature using different concentrationof Iodide ions.
  (ii) Reaction between Potassium Iodate, (KIO3) and Sodium Sulphite: (Na2SO3) using starch solution asindicator (clock reaction).

C. Thermochemistry

Any one of the following experiments
i) Enthalpy of dissolution of Copper Sulphate or Potassium Nitrate.
ii) Enthalpy of neutralization of strong acid (HCI) and strong base (NaOH).
iii) Determination of enthaply change during interaction (Hydrogen bond formation) between Acetoneand Chloroform.

D. Electrochemistry

Variation of cell potential in $Zn/Zn^{2+}||Cu^{2+}/Cu$ with change in concentration of electrolytes ($CuSO_4$ or$ZnSO_4$) at room temperature.

E. Chromatography

i) Separation of pigments from extracts of leaves and flowers by paper chromatography and determinationof R_f values.

ii) Separation of constituents present in an inorganic mixture containing two cations only (constituentshaving large difference in $R_f$values to be provided).

F. Preparation of Inorganic Compounds

i) Preparation of double salt of Ferrous Ammonium Sulphate or Potash Alum.

ii) Preparation of Potassium Ferric Oxalate.

G. Preparation of Organic Compounds

Preparation of any one of the following compounds

i) Acetanilide

ii) Di -benzal Acetone

iii) p-Nitroacetanilide

iv) Aniline yellow or 2 - Naphthol Aniline dye.

H. Tests for the functional groups present in organic compounds:

Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (Primary) groups.

I. Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in givenfood stuffs.

J. Determination of concentration/ molarity of KMnO4 solution by titrating it against a standardsolution of:

i) Oxalic acid,

ii) Ferrous Ammonium Sulphate

(Students will be required to prepare standard solutions by weighing themselves).

K. Qualitative analysis

Determination of one cation and one anion in a given salt.

Cation- NH_4^+, Pb^{2+}, Cu^{2+} As^{3+}, Al^{3+}, Fe^{3+}, Mn^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+},

Anions-CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, PO_4^{3-}; CH_3COO^-

(Note: Insoluble salts excluded)

PROJECT

Scientific investigations involving laboratory testing and collecting information from other sources.

A few suggested Projects.

- Study of the presence of oxalate ions in guava fruit at different stages of ripening.
- Study of quantity of casein present in different samples of milk.
- Preparation of soybean milk and its comparison with the natural milk with respect to curd formation, effect of temperature, etc.
- Study of the effect of Potassium Bisulphate as food preservative under various conditions (temperature, concentration, time, etc.)
- Study of digestion of starch by salivary amylase and effect of pH and temperature on it.
- Comparative study of the rate of fermentation of following materials: wheat flour, gram flour, potato juice, carrot juice, etc.
- Extraction of essential oils present in Saunf (aniseed), Ajwain (carum), Illaichi (cardamom).
- Study of common food adulterants in fat, oil, butter, sugar, turmeric power, chilli powder and pepper.

Note: Any other investigatory project, which involves about 10 periods of work, can be chosen with theapproval of the teacher.

MONTHWISE SYLLABUS DISTRIBUTION

MONTHS: March, April, May

Unit III: Electrochemistry (Periods 14)

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell- electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, fuel cells; corrosion.

Unit IV: Chemical Kinetics (Periods 12)

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, Arrhenious equation

Unit I: Solid State (Periods 12)

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, 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.

Unit II: Solutions (Periods 12)

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, 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.

Unit VII: p-Block Elements (Periods 14)

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); Phosphorous-allotropic forms; compounds .of phosphorous: preparation and properties of phosphine, halides (PCI3, PCls) and oxoacids (elementary idea only)

Practicals:

EXPERIMENT- 1-6

Qualitative analysis
Determination of one cation and one anion in a given salt.

Cations - Pb^{2+} Cu^{2+} As^{3+} Al^{3+} Fe^{3+} Mn^{2+} Zn^{2+} Co^{2+} Ni^{2+} Ca^{2+} Sr^{2+} Ba^{2+} Mg^{2+} NH_4^+
Anions – CO_3^{2-}, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_2^-, NO_3^-, Cl^-, Br^-, I^-, PO_4^{3-}; CH_3COO^-
(Note: Insoluble salts excluded)

PROJECT WORK

MONTH : JULY
Unit VII: p-Block Elements (continued)

Group16 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen: preparation, properties and uses; simple oxides; Ozone. Sulphur - allotropic forms; compounds of sulphur: 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, trends in physical and chemical properties; compounds of halogens: preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens I (structures only).

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

Unit V: Surface Chemistry (Periods 8)

Adsorption - physisorption and chemisorption; factors affecting adsorption of gases on solids; catalysis: homogenous and heterogeneous, activity and selectivity: enzyme catalysis; colloidal state: distinction between true solutions, colloids and suspensions; lyophilic, lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation; emulsion - types of emulsions.

Unit X: Haloalkanes and Haloarenes (Periods 12)

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions.

EXPERIMENT No.: 7-8

Determination of concentration/molarity of $KMnO_4$ solution by titrating it against a standard solution of:
i) Oxalic acid,
ii) Ferrous ammonium sulphate
(Students will be required to prepare standard solutions by weighing themselves).

EXPERIMENT No.: 9-10

Preparation of one lyophilic and one lyophobic sol.
(a) Lyophilic sol- starch
(b) Lyophobic sol- ferric hydroxide.

MONTH : AUGUST

Unit X: Haloalkanes and Haloarenes (continued)

Haloarenes: Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only). Uses and environmental effects of - dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

Unit XI: Alcohols, Phenols and Ethers (Periods 12)

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses of methanol and ethanol
Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophillic substitution reactions, uses of phenols.
Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

EXPERIMENT No.: 11, 12

Effect of concentration on the rate of reaction between sodium thiosulphate and hydrochloric acid

Effect of temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid

MONTH: SEPTEMBER- OCTOBER

Unit XII: Aldehydes, Ketones and Carboxylic Acids (Periods 12)

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: Organic compounds containing Nitrogen (Period 10)

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.
Cyanides and Isocyanides - will be mentioned at relevant places in context.
Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Unit XV: Polymers (Periods 8)

Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polythene, nylon, polyesters, bakelite, rubber. Biodegradable and non- biodegradable polymers

Unit XIV: Biomolecules (Periods 12)

Carbohydrates - Classification (aldoses and ketoses), monosaccal1rides (glucose and tfuctose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); importance.
Proteins - Elementary idea of a - amino acids, peptide bond, polypeptides, proteins, structure of amines-primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes.
Vitamins -Classification and functions. Nucleic Acids: DNA and RNA.

Unit XVI: Chemistry in Everyday life (Period 8)

Chemicals in medicines - analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistanlines.
Chemicals in food - preservatives, artificial sweetening agents.
Cleansing agents - soaps and detergents, cleansing action

EXPERIMENT No.: 13-18

Tests for the functional groups present in organic compounds:
Alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (primary) groups.

EXPERIMENT No.: 19-20

Preparation of lnorganic Compounds:
i) Preparation of double salt of ferrous ammonium sulphate
ii) Preparation of double salt of potash alum.

EXPERIMENT No.: 21-23

Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs.

MONTH: NOVEMBER

Unit IX: Coordination Compounds (Period 12)

Coordination 'Compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds.bonding; isomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems).

Unit VIII: d and f Block Elements (Period 14)

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 $K_2Cr_20_7$ and $KMnO_4$.

Lanthanoids - electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction.

Actinoids - Electronic configuration, oxidation states.

Unit VI: General Principles and Processes of Isolation of Elements (Periods 8)

Principles and methods of extraction - concentration, oxidation, reduction electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron.

. **EXPERIMENT No.: 24**
Chromatography
To separate the constituents present in an inorganic mixture containing Fe3+ and Cu2+ using paper chromatography and determination of their R_f values.

EXPERIMENT No.: 25
Preparation of Di-benzal Acetone

Assignment 1

Chapter 1: Solid State

1. What is the maximum possible coordination number of an atom in
   (1) hcp crystal structure
   (2) ccp crystal structure of an element?

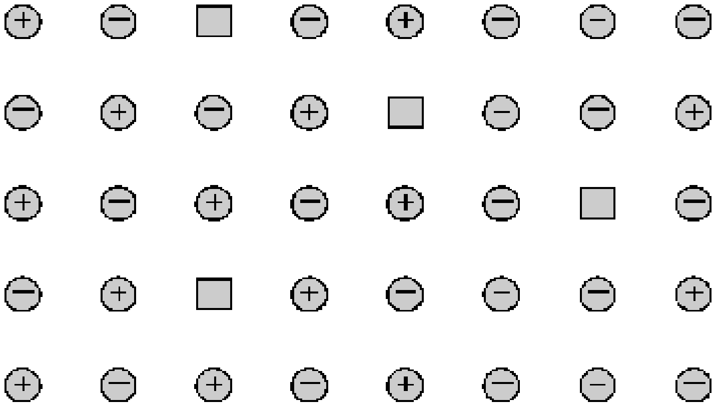
2. a) What is meant by 'doping' in a semiconductor?
   b) Account for the following:
   (i) Frenkel defect not found in alkali metal halides.
   (ii) Impurity doped silicon is a semiconductor.
   (iii) alkali metal halides sometimes coloured, which are otherwise colourless

3. Which point defect in crystals
   (i) does not alter the density of the solid
   (ii) decreases the density of the solid
   (iii) Increases the density of the solid?

4. Classify each of the following solids as ionic, metallic, molecular, network (covalent) or amorphous.
   a) tetra phosphorus decaoxide (P_4O_{10})
   b) Brass
   c) Rb
   (d) Graphite
   (e) Ammonium Phosphate
   (f) SiC

5. Name the type of point defect that occurs in a crystal of zinc sulphide

6. Examine the illustration of a portion of the defective crystal given below and answer the following questions.



   (a) What are these type of vacancy defects called?
   (b) How is the density of a crystal affected by these defects?
   (c) What type of ionic substances show such defect?
   (d) How is the stoichiometry of the compound affected?

7. In an ionic compound the anion (N^-) form cubic close type of packing. While the cation(M^+) ions occupy one third of the tetrahedral voids. Deduce the empirical formula of the compound and the coordination number of (M^+) ions.

8. What is the formula of a compound in which the element Y forms the ccp lattice and atom X occupy 1/3rd of the tetrahedral voids?

9. (i) What type of magnetism is shown in the following alignment of magnetic moment?

   ↑ ↓↑↓ ↑ ↓↑↓ ↑↓

   (ii) What type of semiconductor is produced when boron is doped with silicon?

   (iii) What type of magnetism is shown by a substance if magnetic moments of domains are arranged in same direction ?

10. 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? (r = 137 pm)

11. An element with density 11.2 gcm^{-3} forms a lattice with edge length of $4 \text{ X } 10^{-8}$ cm. Calculate the atomic mass of the element. (Given: N_A= 6.022 x 1023 mol^{-1})

12. An element crystallizes in a f.c.c. lattice with cell edge of 250 pm. Calculate the density if 300 g of this element contain $2 \text{ X } 10^{-24}$ atoms

13. Analysis shows that metal oxide has the formula $M_{0.96}O$. What fractions of metal exist as M^{+2} and M^{+3} ions? (M^{2+} =0.916; M^{3+} = 0.08)

14. Iron has a body centred cubic unit cells with cell edge of 286.65 pm. The density of iron is 7.874 g cm^{-3}. Use this information to calculate Avogadro's number. (At. Mass of Fe = 55.845 $gmol^{-1}$) ($6.02 \text{ x } 10^{23}$ mol^{-1})

15. Explain the following with suitable examples:

   (i) Ferrimagnetic
   (ii) n-type semiconductor
   (iii) Antiferromagnetism
   (iv) Paramagnetism
   (v) Frenkel defect in crystals
   (vi) Ferromagnetism

16. Due to frequent power cuts, Ashwani wanted to buy an invertor. He has two options. Either he can buy an ordinary invertor, which is quite cheap, or a solar invertor with solar panels, which is expensive. David, his friend and a student of science, advised him to buy solar invertor with solar panels. After reading the above, passage answer the following questions.

   (a) Why David advised Ashwani to buy more expensive solar invertor with solar panels?
   (b) Which element is generally used for making solar panels?
   (c) Is this element, conductor insulator or a semi-conductor?
   (d) What are the values associated with the above decision?

Practice Assignment

Solid State

1. One day Anil and his daughter, Neha were travelling in a bus from Chandigarh to Solan in Himachal Pradesh. His daugheer Neha is a student of science. On the way a lady sitting next to Anil showed him some pebbles which were shining like gold. The lady offered to sell these pebbles for just Rs. 1000 claiming that these pebbles are very rich in gold. However, Neha advised his father not to buy these pebbles. After reading the above passage answer the following questions
   (a) Identify the golden coloured mineral which the lady was trying to sell to Anil.
   (b) What is the cause of metallic lusture of this mineral.
   (c) What are the values associated with Neha's advise to her father?

2. The well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral there are 4 Ca^{2+} ions and $8F^{-}$ ions and that Ca^{2+} ions are arranged in a fcc lattice. The F^{-} ions fill all tetrahedral holes in the face centred cubic lattice of Ca^{2+} ions. The edge of the unit cell is $5.46X10^{-8}$ in length. The density of the solid is 3.18g cm^{-3}. Use this information to calculate Avogadro's number (Molar mass of Ca F_2 = 78.08 g mol-1)

3. Analysis shows that Nickel oxide has the formula $Ni_{0.98}O$. What fractions of metal exist as Ni^{+2} and Ni^{+3} ions?

4. Aluminium metal forms a ccp crystal structure. Its atomic radius is 125×10^{-12} m.
   i) Calculate the length of the side of the unit cell
   ii) How many such unit cells are there in 1.00 m^3 of Aluminium?

5. An element has a body centered cubic structure with a cell edge of 288 pm. The density of the element is 7.2g/cm^3. Calculate the number of atoms present in 208 g of the element.

6. Sodium has a bcc structure with nearest neighbor distance 365.9pm. Calculate its density.(Na = 23u)

<u>Assignment</u>

Chapter 2: Solutions

1) State the formula relating pressure of a gas with its mole fraction in a liquid solution in contact with it. Name the law and mention its two applications.

2) Two liquids A and B boil at 145^0C and 190^0C respectively. Which of them has a higher vapour pressure at 80^0C?

3) (a) Why is the vapour pressure of a solution of glucose in water lower than that of water?
(b) A 6.90 M solution of KOH in water contains 30% by mass of KOH. Calculate the density of the KOH solution? (molar mass of KOH = 56 g/mol)
(1.288 g/ml)

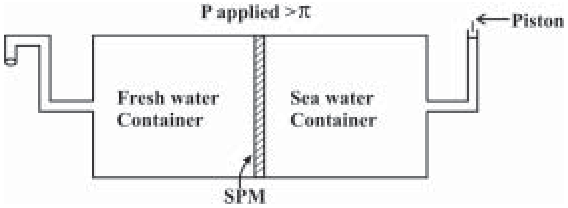
4) Define azeotropes. What type of azeotrope is formed by positive deviation from Raoult's law? Give an example.

5) Differentiate between molality and molarity of a solution. What is the effect of change in temperature of a solution on its molality and molarity?

6) 3.9g of benzoic acid dissolved in 49g of benzene shows a depression in freezing point of 1.62K. Calculate the van't Hoff factor and predict the nature of solute (associated or dissociated). K_f for benzene = 4.9 K Kg mol^{-1})

7) Explain with suitable examples in each case why the molar masses of some substances determined with the help of colligative properties are (i) higher (ii) lower than actual values

8) Given below is the sketch of a plant for carrying out a process.



(i) Name the process occurring in the above plant.
(ii) To which container does the net flow of solvent take place?
(iii) Name one SPM which can be used in this plant.
(iv) Give one practical use of the plant.

9) (a) Calculate the freezing point of solution when 1.9 g of MgC*l*2(M=95 g mol–1) was dissolved in 50 g of water, assuming MgC*l*2 undergoes complete ionization. (Kf for water = 1.86 K kg mol–1)
(b) (i) Out of 1 M glucose and 2 M glucose, which one has a higher boiling point and why ?
(ii) What happens when the external pressure applied becomes more than the osmotic pressure of solution ?

10) a) When 2.56 g of sulphur was dissolved in 100 g of CS2, the freezing point lowered by 0.383 K. Calculate the formula of sulphur (Sx).
(Kf for CS2 = 3.83 K kg mol–1, Atomic mass of Sulphur = 32 g mol–1]

b) Blood cells are isotonic with 0.9% sodium chloride solution. What happens if we place blood cells in a solution containing
   a. 1.2% sodium chloride solution ?
   b. 0.4% sodium chloride solution ?

11) State Raoult's law for solutions of volatile liquids. Taking suitable examples explain the meaning of positive and negative deviations from Raoult's law. What is the sign of $\Delta H_{mix}$for positive deviation?

12) a) Define the term osmotic pressure. Describe how the molecular mass of a substance can be determined by a method based on measurement of osmotic pressure.
b) Determine the osmotic pressure of a solution prepared by dissolving 0.025g of K_2SO_4 in 2L of water at 25°C, assuming that is completely dissociated.
(R=0.0821 L atm/K/mol, molar mass of K_2SO_4= 174g/mol)

13) 15 g of an unknown molecular material was dissolved in 450 g of water. The resulting solution was found to freeze at -0.34°C. What is the molar mass of this material? K_f for water = 1.86 K Kg mol^{-1}). (182 g mol^{-1})

14) A solution is prepared by dissolving 1.25g of oil of winter green (methyl salicylate) in 99.0g of benzene has a boiling point of 80.31⁰C. Determine the molar mass of this compound.
(B.P. of pure benzene = 80.10⁰C and Kb for benzene = 2.53⁰C kg mol^{-1})
(152.21 g/mol)

15) A 1.00 molal aqueous solution of trichloroacetic acid (CCl_3COOH) is heated to its boiling point. The solution has the boiling point of 100.18°C. Determine the van't Hoff factor for trichloroacteic acid (Kb for water = 0.512 K Kg mol^{-1}). (i= 0.35)

16) Geeta Devi is a poor tribal woman. Her daughter, Sita Devi is a student of science in a nearby Christian school. Geeta Devi cannot afford a pressure cooker. Whenever Geeta Devi cooks dal she generally add salt to the dal (lentils) only after it is fully cooked. One day Sita Devi suggested her to add salt to the dal before cooking. Geeta Devi found that the dal cooked faster when salt is added to it before cooking.

Read the above passage and answer the following questions.
(a) Why adding salt to dal before cooking helped in faster cooking?
(b) Suggest any other step to Geeta Devi to cook the dal faster.
(c) What values are associated with Sita Devi's suggestions?

Practice Assignment

Chapter 2: Solutions

1. Calculate the temperature at which a solution containing 54 g of glucose, ($C_6H_{12}O_6$), in 250g of water will freeze (k_f for water = 1.86 k mol^{-1} Kg).

2. The Henry law constant for oxygen dissolved in water is 4.34 x 10^4 atm at 25^0C. If the partial pressure of oxygen in air is 0.2 atm. under ordinary atmospheric conditions. Calculate the concentration (in moles per litre) of dissolved oxygen in water in equilibrium with air at 25^0C.

3. Define the following terms:
   - (i) Mole fraction
   - (ii) Isotonic solutions
   - (iii) Van;t Hoff factor
   - (iv) Ideal solution.

4. What is the Van't Hoff factor for a compound which undergoes tetramerization in an organic solvent?

5. Benzoic acid completely dimerizes in benzene. What will be the vapour pressure of a solution containing 61 g of benzoic acid per 500 g benzene when the vapour pressure of pure benzene at the temperature of experiment is 66.6 torr? What would have been the vapour pressure in the absence of dimerisation?

6. Two elements A and B form compounds having molecular formulae AB_2 and AB_4. When dissolved in 20 g of benzene, 1 g of AB_2 lowers the freezing point by 2.3 K whereas 1g of AB_4 lowers it by 1.3 K. The molar depression constant for benzene is 5.1 K Kg mol^{-1}. Calculate the atomic masses of A and B.

7. Phenol associates in benzene to a certain extent to form a dimer. A solution containing 20 X 10^{-3} kg of phenol in 1 kg of benzene has its freezing point lowered by 0.69K. Calculate the fraction of phenol that has dimerised (K_f = 5.1 KKg mol^{-1})

8. 100 g of a protein is dissolved in just enough water to make 10.0 ml of solution. If this solution has an ostomic pressure of 13.3 mm Hg at 25^0C, what is the molar mass of the protein?

9. Calculate the amount of KCl which must be added to 1 Kg of water so that the freezing point is depressed by 2K. (Kf for water = 1.86 /K Kg mol^{-1}) (40.05 g)

10. A decimolar solution of $K_4[Fe(CN)_6]$ is 50% dissociated at 300K. Calculate the osmotic pressure of the solution in atm.

11. Heptane and Octane form an ideal solution at 373 K. The vapour pressures of the pure liquids at this temperature are 105.2 KPa and 46.8 KPa respectively. If the solution

contains 25 g of heptane and 28.5 g of octane, calculate
(i) vapour pressure exerted by heptane.
(ii) vapour pressure exerted by solution.
(iii) mole fraction of octane in the vapour phase.

12. A solution is made by dissolving 30 g of a nonvolatile solute in 90 g of water. It has a vapour pressure 2.8 KPa at 298 K. At 298 K, vapour pressure of pure water is 3.64 KPa. Calculate the molar mass of the solute.

13. What type of azeotrope is formed on mixing nitric acid and water?

14. An antifreeze solution is prepared from 222.6 g of ethylene glycol ($C_2H_4(OH)_2$) and 200 g of water. Calculate the molality of the solution. If the density of this solution be 1.072 g ml^{-1}, what will be the molarity of the solution?

(9.1 M; 17.95 m)

15. Sushma is a housewife. To save money she buys cold drinks like Coke, Pepsi, Limca Fanta etc. in large botytles (2 l or more). As these bottles are quite large she prefers not to keep them in her fridge. She generally opens the bolttle, pour the cold drink, add ice and serve. She finds that the cold drink which was quite fizzy when she opens a new bottle hardly has any fizz by the time the bottle is finished, say after 2-3 days. One day her friend Kamakpreet Kaur visited her. She is a lecturer of Chemistry in a school. She advised Sushma to thoroughly chill the bottle before opening it and then keep the same in fridge, tightly capped, till it is fully consumed.

Read the above passage and answer teh following questions.
(a) Do you think Kamalreet Kaur's advice can help Sushma in this matter? Give reason for your answer.
(b) What are the values associated with Kamalpreet Kaur's advice?

Assignment

Chapter 3: Electrochemistry

1. (i) Define molar conductivity of a solution and write their units and the relation between the two. How does molar conductivity changes with change in concentration of solution for weak and strong electrolyte.
   (ii) Define limiting molar conductivity. Why is the conductivity of an electrolyte solution decrease with the decrease in concentration?

2. What are fuel cells? Give electrode reactions of H_2-O_2 fuel cell. Name any other fuel which can be used instead of H_2.

3. From the given cells :
   Lead storage cell, Mercury cell, Fuel cell and Dry cell
   Answer the following :
   (i) Which cell is used in hearing aids ?
   (ii) Which cell was used in Apollo Space Programme ?
   (iii) Which cell is used in automobiles and inverters ?
   (iv) Which cell does not have long life ?

4. The resistance of a conductivity cell containing 0.001 M KCl solution is 1500 Ω at 298K. What is the cell constant, if the conductivity of 0.001 M KCl solution at 298K is 0.146×10^{-3} Scm^{-1}?
   ($0.219\ cm^{-1}$)

5. The E^o values corresponding to the following two reduction electrode processes are:
   $Cu^+ / Cu = +0.52\ V$; $Cu^{2+}/Cu^+ = +0.16\ V$
   Formulate the galvanic cell for their combination. What will be the standard cell potential for it? Calculate $\Delta_r G^o$ for the cell reaction? ($F = 96500\ Cmol^{-1}$)

6. Account for the following :
   1. Alkaline medium inhibits the rusting of iron.
   2. Iron does not rust even if the zinc coating is broken in a galvanized iron pipe.

7. Three iron sheets have been coated separately with three metals (A, B and C) whose standard electrode potentials are given below:

Metal	A	B	C	Iron
E^o values	-0.46 V	-0.66 V	-0.20 V	- 0.44 V

   Identify in which case rusting will take place faster when coating is damaged.

8. Write the reactions occurring during the electrolysis of ;
   a) Solution of dil. Sulphuric acid using platinum electrodes.
   b) Aqueous Silver Nitrate solution using Silver electrodes.
   c) Aqueous Sodium Chloride solution.

9. In a Leclanche cell, write the following :
   a) The chemical equations involved at the cathode.

b) Change in oxidation state of Mn

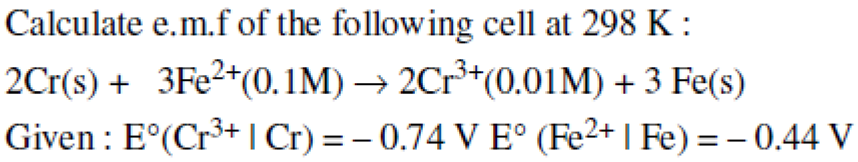
c) The complex entity formed between Zn^{2+} (aq.) and NH_3(g).

10. $Cu^{2+} + 2e^- \longrightarrow Cu \qquad E^o = +0.34$ V

$Ag^+ + e^- \longrightarrow Ag \qquad E^o = +0.80$ V

(a) Construct a galvanic cell using the above data.

(b) For what concentration of Ag^+ ions will the emf of the cell be zero at 25°C, if the concentration of Cu^{2+} is 0.01 M ? [log 3.919 = 0.593] (calc. not reqd.)

11. 

Calculate e.m.f of the following cell at 298 K :

$2Cr(s) + 3Fe^{2+}(0.1M) \rightarrow 2Cr^{3+}(0.01M) + 3\,Fe(s)$

Given : $E^\circ(Cr^{3+} \mid Cr) = -0.74$ V $E^\circ(Fe^{2+} \mid Fe) = -0.44$ V

12. How many coulombs of electric charge must be passed through a solution of silver nitrate to coat a silver sheet of area 100 cm^2 on both the sides with a 0.005 mm thicklayer. Density of silver is 10.5 g/cm^3. Relative atomic mass of silver is 108.

(938.2 C)

13. (i) State Kohlaursch law of independent migration of ions. Write an expression for the molar conductivity of acetic acid at infinite dilution according to Kohlaursch law.

(ii) Calculate Λ^0_m for acetic acid. Given that

Λ^0_m (HCl) = 426 $Scm^2\ mol^{-1}$

Λ^0_m (NaCl) = 126 $Scm^2\ mol^{-1}$

Λ^0_m (CH_3COONa) = 91 $Scm^2\ mol^{-1}$ (391 Scm^2mol^{-1})

14. What type of battery is lead storage battery? Write the anode and the cathode reactions and overall reaction occurring in a lead storage battery when current is drawn from it.

15. Calculate the emf of the following cell at 298K:

$Fe(s) \mid Fe^{2+}(0.001M) \mid\mid H^+(1M) \mid H_2(g)(1bar), Pt(s)$

Given E^o_{cell}=0.44V

16. Following reactions occur at the cathode during the electrolysis of aqueous silver chloride solution:

$Ag^+ + e^- \longrightarrow Ag \qquad E^o = +0.80$ V

$H^+ + e^- \longrightarrow \tfrac{1}{2} H_2 \qquad E^o = +0.00$ V

On the basis of standard reduction potential values, which reaction is feasible at the cathode and why?

Practice Assignment

Chapter 3: Electrochemistry

1. Conductivity of 0.00241 M acetic acid is 7.896 X 10^{-5} Scm^{-1}. Calculate its molar conductivity. If Λo for acetic acid is 390.5 Scm^2mol^{-1}, what is its dissociation constant?

2. Explain with examples the terms weak and strong electrolytes? How can these be distinguished? With the help of a diagram explain the difference in the variation of molar conductivity with concentration for strong and weak electrolytes

3. Calculate the emf of the cell $Mg|Mg^{2+}(0.1\ M)||Cu^{2+}(0.0001\ M)|Cu$ at 298 K. Given $E^o_{Mg2+/Mg}$ = -2. 37 V and $E^o_{Cu2+/Cu}$ = + 0. 34 V.

4. A voltaic cell is set up at 25°C with the following half –cells;
   $Al|\ Al^{3+}$ (0.001 M) and $Ni|\ Ni^{2+}$ (0.50 M)
   Calculate the cell voltage [$E^0_{Ni2+|Ni}$ = -0.25 V, $E^0_{Al3+|Al}$ = -1.66 V]
   (1.45 V)
5. The following chemical reaction is occuring in an electrochemical cell
   $$Mg(s) + 2Ag^+(0.0001\ M) \longrightarrow Mg^{2+}(0.10\ M) + 2Ag(s)$$

   The E^o values are Mg^{+2}/Mg = -2.36 V and Ag^+/Ag = 0.80V
   For this cell calculate / write
   (a) The carriers of current within this cell.
   (b) E^o value for the electrode $2\ Ag^+/2\ Ag$.
   (c) Standard cell potential E^o_{cell} .
   (d) Cell potential E_{cell}
   (e) How will the value of E_{cell} change if the concentration of Ag^+ (aq.) is increased?
   (f) Symbolic representation of the above cell.
   (g) Will the above cell reaction be spontaneous?

6. In the button cell , widely used in watches , the following reaction takes place
   $$Zn_{(s)} + Ag_2O_{(s)} + H_2O_{(l)} \longrightarrow Zn^{2+}_{(aq)} + 2\ Ag_{(s)} + 2OH^-$$
   Determine E^0 and ΔG^0 for the reaction.
   (given: $E^0_{Ag+/Ag}$ = 0.80 V , $E^0_{Zn2+/Zn}$ = -0.76 V)
   (E=1.56 V, ΔG^o = -301.08 KJ mol^{-1})

7. Three electrolytic cells A, B and C containing solutions of zinc sulphate, silver nitrate and copper sulphate, respectively are connected in series. A stready current of 1.5 ampere was passed through them until 1.45 g of silver were deposited at the cathode of cell B. How long did the current flow? What mass of copper and what mass of zinc were deposited in the concerned cells? (Atomic masses of Ag = 108, Zn = 65.4, Cu = 63.5)
8. (i) When a current of 0.75 A is passed through a $CuSO_4$ solution for 25 min, 0.369 of copper is deposited at the cathode. Calculate the atomic mass of copper.
   (ii) Calculate the equilibrium constant for the reaction

$Zn(s) \quad + \quad 2Cd^{+2}(aq) \longrightarrow Zn^{2+}(aq) \quad + \quad 2Cd(s)$.
If $E^{o}_{Zn2+/Zn}$ = - 0.763 V and $E^{o}_{Cd2+/Cd}$ = -- 0.403 V.

Assignment

Chapter 4: Chemical Kinetics

1. For the reaction :

   $Cl_2\ (g) \quad + \quad 2\ NO\ (g) \longrightarrow 2NOCl\ (g)$

   The rate law is expressed as rate $= k\,[Cl_2][NO]^2$
   What is the overall order of the reaction?

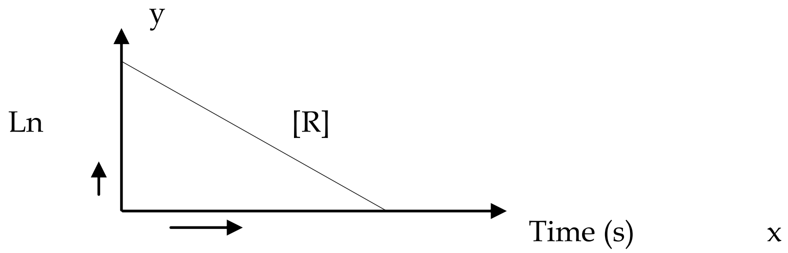
2. For a reaction :
   Pt
   2NH3(g) --® N2(g) + 3H2(g)

   Rate = k
   (i) Write the order and molecularity of this reaction.
   (ii) Write the unit of k.
3. A first order reaction takes 69.3 minutes for 50% completion. Set up an equation for the determining the time needed for 80% completion of this reaction.
   (Calculation of result is not required).

4. Explain the following terms:
   (i) Rate constant (k)
   (ii) Half life period of a reaction($t_{1/2}$)
5. What do you understand by the 'order of reaction' ? Identify the reaction order from each of follwing units of reaction rate constant :
   (i) L^{-1} mol s^{-1}
   (ii) L mol^{-1} s^{-1}
6. The rate of a particular reaction triples when temperature changes from $50^{0}C$ to $100^{0}C$. Calculate the activation energy of the reaction.
   [log 3 = 0.4771, R = 8.314 JK^{-1} mol^{-1}]
   (22.01 KJ/mol)

7. Give an example of pseudo first order reaction.

8. A reaction, reactant $\longrightarrow$ product is represented by the graph below. predict



   (i) The order of the reaction in this case.

(ii) What does the slope of the graph represent?
(iii) What are the units of rate constant k?
(iv) Give the relationship between k and $t_{1/2}$ (half life period).
(v) Draw the plot of log [R]o/[R] vs. time (s)

9. For the reaction

$2\,NO_{(g)} + Cl_{2}(g) \longrightarrow 2NOCl\,(g)$

The followingdata were collected . All the measurements were taken at 263 K:

Experiment No.	Initial(NO) (M)	Initial(Cl_2) (M)	Intial rate of disappearance of Cl_2 (M/min)
1	0.15	0.15	0.60
2	0.15	0.30	1.20
3	0.30	0.15	2.40
4	0.25	0.25	?

Write the expression for the rate law.
(a) Calculate the value of rate constant and specify in units.
(b) What is initial rate of disappearance of Cl_2 inexp.4 ?
[(a) k= 177,7 $M^{-2}\,min^{-1}$; (b) Rate = 2.8 M min^{-1}]

10. The decomposition of NH_3 on platinum surface, $2NH_3\,(g) \xrightarrow{Pt} N_2\,(g) + 3H_2(g)$ is a zero order reaction with k = 2.5 x 10^{-4} MS^{-1}. What are the rates of production of N_2 and H_2 ?

(2.5 x 10^{-4} Ms^{-1}, 7.5 x 10^{-4} Ms^{-1})

11. For a certain chemical reaction:
$2A + 2B \longrightarrow 2C + D$

The experimentally obtained information is tabulated below.

Experiment	[A]o	[B]o	Initial rate of reaction
1.	0.30	0.30	0.096
2.	0.60	0.30	0.384
3.	0.30	0.60	0.192
4.	0.60	0.60	0.768

For this reaction
(i) derive the order of reaction w.r.t both the reactants A and B.
(ii) write the rate law.
(iii) calculate the value of rate constant k. ($k = 3.5\ l^2 mol^{-2}\ s^{-1}$)
(iv) write the expression for the rate of reaction in terms of A and C.

12. For an elementary reaction

$2A + B \longrightarrow 3C$

the rate of appearance of C at time 't' is 1.3 x 10^{-4} mol $l^{-1}s^{-1}$

Calculate at this time

i) rate of the reaction.

ii) Rate of disappearance of A.

{ (i) 4.33 x 10-5 mo/l/s, (ii) 8.66 x 10^{-5} mol/l/s) }

13. The following data were obtained during the first order thermal decomposition of SO_2Cl_2 at a constant volume:

$SO_2Cl_2 (g) \longrightarrow SO_2 (g) + Cl_2(g)$

Experiment	Time/s^{-1}	Total pressure/atm
1	0	0.4
2	100	0.7

Calculate the rate constant. (Given log 4 = 0.6021, log 2 = 0.3010)

14. For a reaction, A+ B → P, the reaction is of first order in reactant A and second order in reactant B.

(i) How is the rate of this reaction affected when the concentration of B doubled.

(ii) What is the overall order of rection if A is present in large excess..

15. The rate constant for the first order decomposition of H_2O_2 is given by the following equation :

$$\log k = 14.2 - \frac{1.0 \times 10^4}{T} K$$

Calculate E_a for this reaction and rate constant k if its half-life period be 200 minutes. (Given : R = 8.314 J K^{-1} mol^{-1})

16. The rate constant for a reaction of zero order in A is 0.0030 mol L^{-1} s^{-1}. How long will it take for the initial concentration of A to fall from 0.10 M to 0.075 M.

(t= 8.33 sec)

17. The half life for decay of radioactive ^{14}C is 5730 years. An archaeological arttefact containing wood has only 80% of the ^{14}C activity as found in living trees. Calculate the age of the artefact.

18. For hydrolysis of methyl acetate, the following data were obtained

Time/s^{-1}	0	30	60
$[CH_3COOCH_3]$/mol L^{-1}	0.60	0.30	0.15

(i) Show that it follows pseudo first order reaction, as concentration of water remains constant.

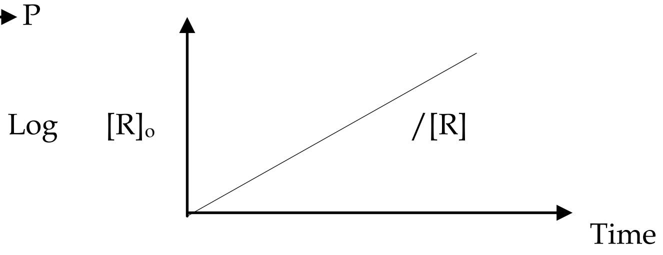
(ii) Calculate the average rate between the time interval 30 to 60 seconds.

[log2=0.3010, log4=0.6020]

Practice Paper

Chapter 4: Chemical Kinetics

1. Answer the following questions on the basis of the curve for a first order reaction $A \longrightarrow P$



a) What is the relation between slope of this line and rate constant?
b) Calculate the rate constant of the above reaction if the slope is 2×10^{-4} S^{-1}

2. A first order decomposition reaction takes 40 minutes for 30% decomposition. Calculate its $t_{1/2}$ value.

3. For the reaction $A \longrightarrow B$, the rate of reaction becomes 27 times when the concentration of A is increased three times. What is the order of the reaction?

4. At elevated temperatures, HI decomposes according to the chemical equation;
$2HI\,(g) \longrightarrow H_2(g) + I_2(g)$ at 443°C. The rate of the reaction increases with concentration of HI, as shown in the following table:

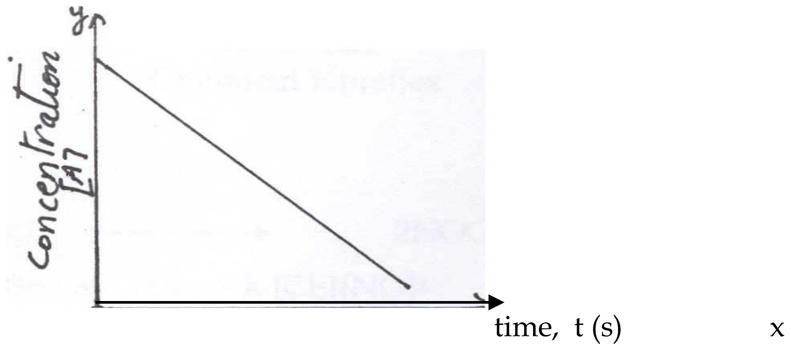
HI (mol/ l)	0.005	0.01	0.02
Rate (mol/l/s)	7.5×10^{-4}	3.0×10^{-3}	1.2×10^{-2}

(a) Determine (i) order of this reaction and
(ii) write the rate expression
(b) Calculate the rate constant and give its units.

5. A first order reaction has a rate constant of 0.0051 min^{-1}. If we begin with 0.10 M concentration of the rectant, what concentration of reactant will remain in solution after 3 hours?

6. (a) The decomposition of N_2O_5 (g) is a first order reaction with a rate constant of 5×10^{-4} sec^{-1} at 45°C. i.e. $2\,N_2O_5\,(g) \longrightarrow 4NO_2\,(g) + O_2\,(g)$. If initial concentration of N_2O_5 is 0.25 M, calculate its concentration after 2 min. Also calculate half life for decomposition of N_2O_5 (g).

7. Consider the reaction $A \xrightarrow{k} P$. The change in concentration of A with time is shown in the following plot.



(i) Predict the order of the reaction.
(ii) Derive the expression for the time required for the completion of the reaction.

8. Derive the general form of the expression for the half-life of a first order reaction.

9. Gurupreet Kaur was born and brought up in Mumbai. She got married in last week of November 2012 and shifted over to Amritsar. She was an expert curd maker. However she find that setting of curd in Amrisar is not as good as it was in Mumbai. Ramandeep Kaur , her sister-in-law , is a student of science. One day , while observing Gurpreet Kaur in the kitchen she advised a slightly modified procedure to prepare curd. She advised Gurupreet Kaur to add some curd to warm milk and keep the same in well insulated container for overnight for the curd to set.
Read the above passage and answer the following questions.
   (a) Do you think Ramandeep Kaur advise will help Gupreet Kaur.
   (b) What is the main cause of curd setting late ?
   (c) What is the scientific reason behind Ramandeep Kaur's advise ?
What values are associated with Ramandeep Kaur advise.

<u>Assignment</u>

Chapter 5: Surface Chemistry

1. (a) How can a colloidal solution and true solution of the same colour be distinguished from each other?
   (b) Define adsorption. Write any two features which distinguish physisorption and chemisorption. Which has higher enthalpy of adsorption?
   (c) List four applications of adsorption.
   (d) Why is ferric chloride preferred over potassium chloride in case of a cut leading to bleeding?
   (e)Name the physical states of dispersed phase and dispersion medium of froth?

2. How does an increase in temperature affect both physical and chemical adsorption?

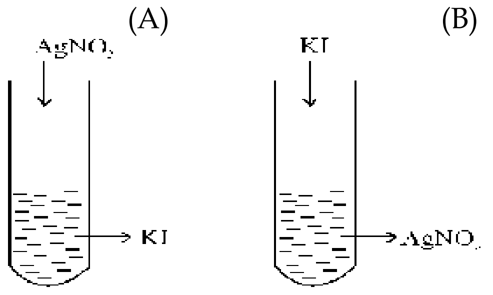
3. What causes Brownian movement in a colloidal solution?

4. What are lyophilic and lyophobic sols? Give one example of each type. Which one of these two types of sols is easily coagulated and why?

5. Explain the following observations:
   a) Lyophilic colloid is more stable than lyophobic colloid.
   b) Coagulation takes place when sodium chloride solution is added to a colloidal solution of ferric hydroxide.
   c) Sky appears blue in colour.
   d) Adsorption of a gas on the surface of solid is generally accompanied by a decrease in entropy, still it is a spontaneous process.
   e) Enzyme catalysts are highly specific in their action.
   f) The enthalpy in case of chemisorption is usually higher than that of physisorption.
   g) Cottrell's smoke precipitator is fitted at the mouth of the chimney used in factories.
   h) Physical adsorption is multilayered, while chemisorption is monolayered.

6. (i) Differentiate between adsorbtion and absorption.
   (ii) Out of $MgCl2$ and $AlCl3$, which one is more effective in causing coagulation of negatively charged sol and why ?
   (iii) Out of sulphur sol and proteins, which one forms multimolecular colloids ?

7. A colloidal solution of AgI is prepared by two different methods shown below:-



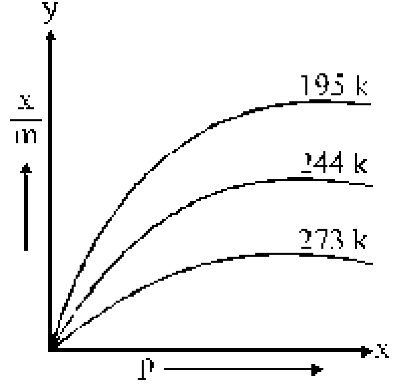
   (a) What is the charge of AgI colloidal particles in the two test tubes (A) and (B)?

(b) Give reasons for the origin of charge.

8. What are the two classes of emulsion? Give one example of each class. State one activity to test the type of emulsion.

9. Describe the following giving an example each:
a) Mechanism of heterogeneous catalysis.
b) Hardy Schulze Rule
c)Emulsification

10. Consider the adsorption isotherms given below and interpret the variation in the extent of adsorption (x/m) when:



(a) (i) temperature increases at constant pressure.
(ii) pressure increases at constant temperature.
(b) Name the catalyst and the promoter used in Haber's process for manufacture of ammonia.

11. (a) In reference to Freundlich adsorption isotherm write the expression for adsorption of gases on solids in the form of an equation.
(b) Write an important characteristic of lyophilic sols.
(c) Based on type of particles of dispersed phase, give one example each of associated colloid and multimolecular colloid.

12. Give reason for the following observations;
(i) Leather gets hardened after tanning.
(ii) Lyophillic sols are more stable than lyophobic sol.
(iii) It is necessary to remove CO when ammonia is prepared by Haber's process.

PRINCIPLES AND PROCESSES OF ISOLATION OF ELEMENTS

Minerals: These are naturally occurring chemical substances which are obtained from earth's crust by mining. In minerals metals are present in either native state or combined state.
Ores: The mineral from which metal can be economically and conveniently extracted is called ore.
Metallurgy: The entire scientific and technological process used for isolation of the metal from the ores is known as metallurgy. The major steps for extraction and isolation of metals are:--

- Concentration of the ore
- Isolation of metal from the concentrated ore
- Purification of metal

I) CONCENTRATION OF ORES

Removal of unwanted materials (ie; clay, sand etc.) from ores is known as concentration. These earthly or undesirable impurities are called GANGUE. Some important procedures are:-

1) Hydraulic washing: This is based on the difference in gravities of the ore and the gangue particles. In this an upward stream of running water is used to wash the powdered on . The lighter gangue particles are washed away and heavier ores are left behind.

2) Magnetic Separation: This is base on the differences in the magnetic properties of the ore components. One of the two, ore or gangue is capable of being attracted by magnetic field.

3) Froth Floatation process: This method is used to remove gangue from sulphide ores. A suspension of powdered ore is made with water. To it collectors (E.g- Pine oil) and Froth stabilizers (e.g., cresol, aniline) are added. Collectors enhance wettability of pine oil and froth stabilizers froth. Mineral particles wetted by oil are carried away with froth and gangue particles move into water.

   Two sulphide ores can be separated using depressants. For eg. NaCN is used to separate ZnS and PbS present in a ore.

4) Chemical Methods(Leaching):
   a) Leaching of Alumina from Bauxite: Bauxite contains SiO_2, iron oxides and titanium oxide as impurities. Powdered ore is treated with concentrated solution ofNaOH at 478-523 K and 35-36 bar pressure.

   $$Al_2O_3(s) + 2NaOH(aq.) + 3H_2O(l) \longrightarrow 2Na[Al(OH)_4]\ (aq.)$$

   The aluminate solution is neutralized by passing CO_2 gas and hydrated Al_2O_3 separated out.

   $$2Na[Al(OH)_4](aq.) + CO_2(g) \longrightarrow Al_2O_3.xH_2O(s) + 2NaHCO_3g)$$

   The sodium silicate remains in the solution and hydrated alumina is filtered, dried and heated to give pure Al_2O_3.

   $$Al_2O_3.xH_2O\ (S) \longrightarrow Al_2O_3\ (s) + x\ H_2O\ (g)$$

b) Other example: In metallurgy of silver and gold, the respective metal is leached with dilute solution of NaCN or KCN in presence of air (Or O_2)

$4M(S) + 8\,CN^-(aq.) + 2H_2O(aq.) + O_2(g) \longrightarrow 4[M(CN)_2]^-(aq.) + 4\,OH^-(aq.)$
$2[M(CN)_2]^-(aq.) + Zn(s) \longrightarrow [Zn(CN)_4]^{2-} + 2\,M(s)$ (M=Ag or Au)

II) **CALCINATION/ROASTING**: The concentrated ore is then converted to its oxide form by heating .
If the concentrated ore is heting strongly in the absence of air to get rid of impurities, and the ore changes to oxide form, it is called calcination. It is generally observed for carbonate ore. $CaCO_3 \longrightarrow CaO + CO_2$
If the concentrated ore is heated in the presence of oxygen, ore gets converted to oxide form and small molecules like SO_2 are released. It generally takes place for sulphide ore.ZnS+ O_2ZnO $\longrightarrow$ + SO_2

III) REDUCTION

Reduction of oxide to metal:
This involves heating of the oxide with a reducing agent like C or CO or even another metal based on reactivity of the metal to be extracted.
$MxOy + yC \longrightarrow xM + yCO$

Extraction of iron from its oxides
$FeO(S) + C(s) \longrightarrow Fe(S/l) + CO(g)$
(Discussed later under extraction of Iron)

Extraction of copper from cuprous oxide:
The sulphide ores are roasted/smelted to give oxides (Most sulphide ores contain iron)
$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$
The oxide is then reduced to metallic copper using coke.
$Cu_2O + C \longrightarrow 2Cu + CO$
In actual process, the ore is heated in a reverberatoryfurnace after mixing with silica. The iron oxide slags off as iron silicate and copper is produced in the form of copper matte. This contains Cu_2S and FeS.
$FeO + SiO_2 \longrightarrow FeSiO_3$ (slag)

Copper matte is then charged into silicalined convertor. Some silica is also added and hot air blast is blown to convert the remaining FeS_2, FeO and Cu_2S/Cu_2O to metallic copper. The reactions taking place are:
$2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$
$FeO + SiO_2 \longrightarrow FeSiO_3$
$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$
$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$
The solidified copper obtained has blistered appearance due to evaluation of SO_2& so is called blister copper.

Extraction of zinc from zinc oxide:

The reduction of zinc oxide is done using coke. For the purpose of heating, the oxide is made into brickettes with coke and clay.

$ZnO + C \xrightarrow{\text{coke, 673K}} Zn + CO$

The metal is distilled off and collected by rapid chilling.

<u>Thermodynamic principles of metallurgy</u>:

Gibb's energy is described by the equation $\Delta G = \Delta H - T\Delta S$.

For any reaction, this change can be described by $\Delta G = -RT\ln K$

Negative ΔG implies positive K and this can happen when reaction proceeds towards products.

(i) If ΔS is positive, on increasing T the value of $T\Delta S$ would increase ($\Delta H < T\Delta S$) and $\Delta H < T\Delta S$) and ΔG becomes negative.

(ii) If reactants and products of two reactions are put together in a system and net ΔG is negative, overall reaction would occur. So the process involves coupling of two reactions and getting sum of their ΔG as negative.

For eg: In reduction of FeO

$FeO (s) \longrightarrow Fe(s) + \frac{1}{2} O_2 (g)$ $[\Delta G_{(FeO,\ Fe)}]$

$C (s) + \frac{1}{2} O_2 (g) \longrightarrow CO (g)$ $[\Delta G_{(C,\ CO)}]$

We couple the two so that net Gibb's energy change becomes

$\Delta G_{(C,CO)} + \Delta G_{(FeO,\ Fe)} = \Delta G$

The resultant will have ΔG as negative.

According to Ellingham diagram, the ΔG^o Vs. T plot representing the reaction goes upward and that representing C CO goes dow$\rightarrow$ard. At temp.above 1073 K the (C,CO) line come below the Fe, FeO line [$\Delta G(C, CO) < \Delta G(Fe, FeO)$]. So coke will be reducing FeO and is itself oxidized to CO.

IV) <u>REFINING</u>

A metal extracted by any method is usually contaminated with some impurity. Some methods are

a) **Distillation**: The impure metal is evaporated to obtain pure metal as distillate. Used for low boiling metals like **Zn and mercury**.

b) **Liquation:** The low melting metal, like **tin** is separated from high melting impurities by this method. The metal is made to flow on sloping surface.

c) **Electrolytic refining**: In this method impure metal is made to act as anode. A strip of same metal in pure form is made cathode. The electrolyte used contains soluble salt of the same metal. The more basic metals remain in the solution and less basic form anode mud.

For e.g**. Copper** is refined by electrolytic method. Anode is impure copper and pure copper strips are taken as cathode and electrolyte is acidified solution of copper sulphate.

Anode: $Cu \longrightarrow Cu^{2+} + 2e^-$

Cathode: $Cu^{2+} + 2e^- \longrightarrow Cu$

d) **Zone refining**: It is based on the fact that melting point of a substance is lowered by the presence of impurities. Consequently when an impure metal in molten state is cooled, crystals of pure metal are solidified first and impurities remain behind in the molten metal which crystallizes later. The semiconductors –silicon and germanium are purified by this method.

e) **Vapour Phase refining**: This method is used for preparing ultrapure metals by forming vapours of the compound of metal and later decomposition to get pure metal.

Eg- 1) **Mond process for refining Ni**

$$Ni + 4CO \xrightarrow{330\text{-}350\ K} Ni(CO)_4$$

volatile complex- nickel tetracarbonyl

At higher temperature,

$$Ni(CO)_4 \xrightarrow{450\text{-}470\ K} Ni + 4CO$$

2) **Van Arkel method for refining of Zr or Ti** : This method is useful for removing all oxygen and nitrogen present as impurity. Crude metal is heated in evacuated vessel with iodine.

$$Zr + 2I_2 \longrightarrow ZrI_4$$

Metal iodide is then heated on a tungsten filament to about 1800 K.

$$ZrI_4 \xrightarrow{\Delta} Zr + 2I_2$$

f) **Chromatographic methods**: This method is based on the principle that different components are differently adsorbed on adsorbent. The mixture is put in a suitable solvent and applied on top of the column. The adsorbent is packed in a glass column. The adsorbed components are removed (eluted) out using suitable solvent (eluent). The weakly adsorbed component is eluted first followed by the more strongly adsorbed and so on. This is called column chromatography. This method is used for purification of elements available in minute quantities and impurities not very different in chemical properties.

EXTRACTION OF ALUMINIUM:

Aluminium is extracted from bauxite ore, $Al_2O_3.2H_20$. It involves two steps:

1. **Concentration (by Baeyer's Process) :** Purification of Bauxite ore is done by Baeyer's process. This Chemical method is called leaching.
   (Explained under methods of concentration)
2. **Reduction { byElectrolysis of fused alumina (Hall-Heroult process)}**: The purified alumina is dissolved in molten cryolite and is electrolyse in an iron tank lined inside with carbon. The molten cryolite decreases the melting point to about 1173 K and also increases conductivity. The anode consists of a number of carbon rods which dip in fused electrolyte. The electrolyte is covered with a layer of powdered coke.

$$\mathbf{2Al_2O_3 + 3C \longrightarrow 4Al + 3CO_2}$$

Reactions at electrodes are:

At Cathode: $Al^{3+}(melt) + 3e^- \longrightarrow Al(l)$

At Anode: $C(s) + O^{2-}(melt) \longrightarrow CO(g) + 2e^-$

$C(s) + 2O^{2-}(melt) \quad CO_2(g) \longrightarrow 4e^-$

Therefore, aluminium is liberated at the cathode and gets collected at the bottom of the tank from where it is removed. The oxygen evolved combines with carbon of anode to form CO or

CO_2 and escapes out. Because of reaction at carbon anodes, these need to be replaced periodically.

3. Refininig of Aluminium:

The aluminium metal obtained above is 99% pure, which is further purified by **Hoop's electrolytic method**. The process is carried out in an iron tank lined with carbon. It has 3 layers of molten liquid having different densities.

(i) The top layer consists of pure Al having carbon electrodes dipping in it. The carbon electrodes act as cathode.
(ii) The middle layer has fluorides of sodium, barium and Aluminium in molten state. This acts as an electrolyte.
(iii) The bottom layer consists of impure Al along with the carbon lining acts as anode.

On passing electric current aluminium ions from the middle layer are discharged at cathode as pure Al. The pure Al is removed from the tapping hole. An equivalent amount of Al from bottom layer moves into the middle layer leaving behind impurities.

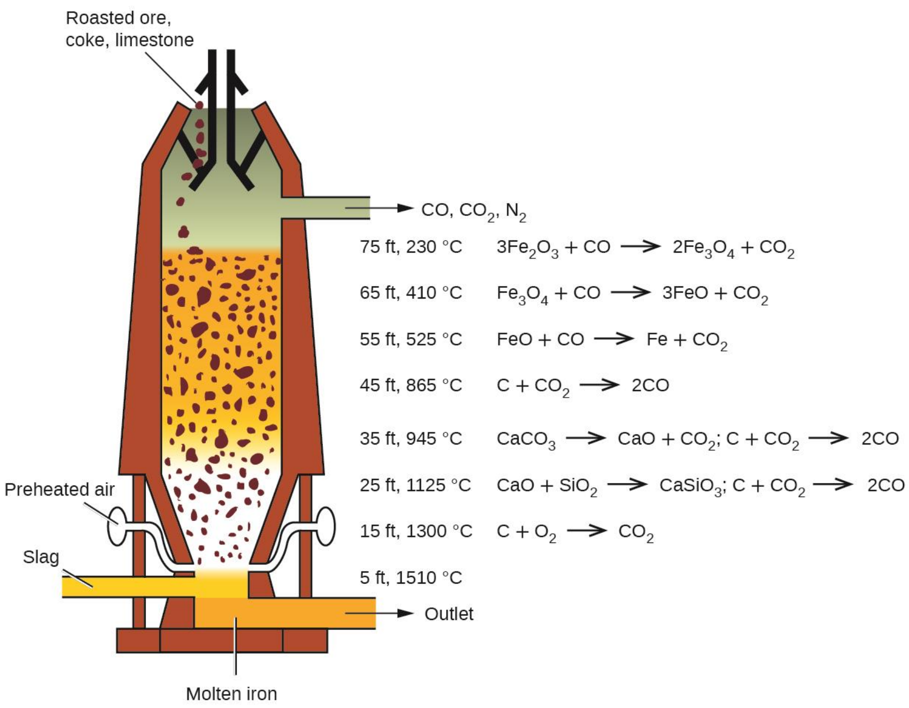
EXTRACTION OF IRON

Iron is the second most abundant element occurring in earth's crust. The common ores are:
Haemite Fe_2O_3
Magnetite Fe_3O_4
Limonite $Fe_2O_3.3H_2O$
Iron Pyrites FeS_2
Siderite $FeCO_3$

Cast Iron is usually extracted from its oxide ore (haematite). It involves the following steps---

1) **Concentration**: The ore is first crushed and crushed ore is concentrated by gravity separation; ie hydraulic washing
2) **Calcination**: The concentrated ore is calcined, ie, heated strongly in limited supply of air in a reverberatoryfurnance. The following changes take place:
    i) Moisture is removed
    ii) Impurities of S, P_4 and As are converted to their gaseous oxides; sO2 , As2O3 and P4O10 which are volatile and escape out.
3) **Reduction (by Smelting)** : The calcined ore is reduced with carbon, ie smelted in a blast furnance. It is a tall cylindrical furnance made of steel llined with fire bricks. It is narrow at the top and has cup and cone arrangement for the introduction of charge and outlet for waste gases. At the base opf furnace, it is provided with ---
    i) Tuyeres arrangement for introduction of hot air
    ii) A tapping hole for withdrawing molten iron and
    iii) An outlet through which slag is flown out.

The calcined ore (8 parts) is mixed with coke (4 parts) and limestone (1part) is introduced from top. At the same time a blast of hot air preheated at 1000 K is blown upwards with the help of tuyers arrangement. The added coke acts as a reducing agent and lime serves as flux. The burning of coke to carbon monoxide supplies most of the heat required for working temperature of furnace and give temp. upto 2200 K at the bottom of furnace. As the gases move up, they meet the descending charge and temp. falls. At the bottom reducing agent is carbon but at the top the reducing agent is CO.



The reactions occurring are:---

1) Combustion zone: At the base coke burns to produce CO_2 which starts rising upward. The reaction is exothermic and heat produced raises the temperature to about 2200 K.

$$C + O_2 \longrightarrow CO_2 \qquad \Delta H = -393.4\ KJ$$

2) Fusion zone: As CO_2 rises upward, it comes in contact with coke and gets reduced to CO.

$$CO_2 + C \longrightarrow 2CO \qquad \Delta H = +63.2\ KJ$$

The reaction is endothermic , the temperature is lowered to 1570 K. The iron produced in the upper region melts. Any Fe_2O_3 if present is reduced by hot coke to iron.

$$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO + heat$$

3) Slag formation zone; In the middle temperature is about 1270K. In this region limestone decomposes.

$$CaCO_3 \longrightarrow CaO + CO_2$$

The lime acts as flux and combines with silica (present as an impurity) to produce slag.

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

The molten slag forms a separate layer above molten iron.

4) Reduction Zone: The temperature near the top of furnace is 875 K. The oxide is reduced by carbon monoxide to iron.

$$FeO + CO \longrightarrow Fe + CO_2$$
$$3Fe_2O_3 + CO \longrightarrow 2Fe_3O_4 + CO_2$$
$$Fe_3O_4 + 4CO \longrightarrow 3Fe + 4CO_2$$
$$Fe_2O_3 + CO \longrightarrow 2FeO + CO_2$$

The spongy iron produced moves down slowly and melts in fusion zone.

At lower hotter part, reaction is

$FeO + C \qquad Fe + CO. \longrightarrow$

It dissolves some carbon, silicon, phosphorus and manganese and forms a layer at the bottom. The iron obtained is called **Pig iron**.

Cast iron is different from Pig Iron and is made by melting pig iron with scrap iron and coke using hot air blast. It has slightly less carbon content (about 3%) . It is extremely hard but brittle.

Wrought iron is purest form of iron and is prepared from cast iron by oxidizing impurities in reverberatory furnace lined with haematite. Haematite oxidizes carbon.

$Fe_2O_3 + 3C \longrightarrow 2Fe + 3CO$

Limestone is added as flux and S, Si and P are oxidized and passed into slag. The metal is then removed.

EXTRACTION OF COPPER:

Copper is mainly extracted from copper pyrites ($CuFeS_2$). The various steps are:

1) **Crushing and concentration**: The ore is crushed in haw crushers and is finally powdered. It is concentrated by froth floatation process.
2) **Roasting**: The concentrated ore is roasted ,i.e, heated strongly in the presence of excess of air in a reverberatory furnace.
   a) Moisture is removed from ore and it becomes dry.
   b) The impurities of S, P_4, As and Sb are removed as their volatile oxides.
      $S + O_2 \longrightarrow SO_2$
      $P_4 + 5O_2 \longrightarrow 2P_2O_5$
      $4As + 3O_2 \longrightarrow 2As_2O_3$
      $4Sb + 3O_2 \longrightarrow 2Sb_2O_3$
   c) Copper pyrites is converted to ferrous sulphide (FeS) and cuprous sulphide (Cu2S)
      $2CuFeS_2 + O_2 \longrightarrow Cu_2S + FeS + SO_2$
      $2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$
      $2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$
3) **Smelting**: The roasted ore is mixed with powdered coke and sand and is strongly heated in a blast furnace . The blast furnace is made of steel and is lined with fire bricks. A blast of hot air is introduced at the lower part of the furnace and changes occurring are:
   a) Ferrous sulphide is oxidized to ferrous oxide which combines with silica to form slag.
      $2FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$
      $FeO + SiO_2 \longrightarrow FeSiO_3$ (slag)
      The slag being lighter forms the upper layer and is removed from time to time.
   b) During roasting if any oxide of copper is formed, it combines with FeS and is changed back into its sulphide
      $2Cu_2S + 3O_2\ 2Cu_2O + \longrightarrow 2SO_2$
      $Cu_2O + FeS \longrightarrow Cu_2S + FeO$ (This changes to slag by combining with SiO_2)
      As a result two separate layers are formed at the bottom of furnace. Upper layer is slag which is removed as waste. The lower layer of molten mass contains mostly cuprous sulphide and some traces of ferrous sulphide. It is called matte and is taken out from tapping hole at bottom.

4) **Bessemerisation**: The molten matte from Blast-furnace is transferred to Bessemer converter. The vessel is made of steel lined inside with lime or MgO. A blast of hot air is mixed with sand is blown into molten matte. During this process ….
   a) Traces of ferrous sulphide present in matte is oxidized to FeO which combines with silica to form slag.
      $2\,FeS + 3O_2 \longrightarrow 2FeO + 2SO_2$

$FeO + SiO_2 \longrightarrow FeSiO_3$ (slag)

b) Copper sulphide is oxidized to cuprous oxide which further reacts with remaining copper sulphide to form copper and sulphur dioxide.

$2Cu_2S + 3O_2 \longrightarrow 2Cu_2O + 2SO_2$

$2Cu_2O + Cu_2S \longrightarrow 6Cu + SO_2$

After the reaction has been completed, the converter is tilted and molten copper is put in moulds. The copper thus obtained is 99% pure and is known as blister copper. The name blister is given because as metal solidifies, the dissolved SO_2 escapes out producing blisters on metal surface.

5) **Refining**: Blister copper is purified by:

a) Poling: Heating strongly in a reverberatory furnace in the presence of excess of air. Impurities are either converted to oxides or converted to slag. Some copper also changes to cuprous oxide. This is reduced back to copper by stirring the molten metal with green poles of wood. This gives 99.5 % pure Cu, which is then purified by electrolytic refining.

b) Electrolytic refining: A thin sheet of metal is made cathode and block of crude metal is made as anode. Both the electrodes are placed in an acidified CuSO4 solution when electric current is passed through the solution, impure Cu from anode goes into the solution and pure Cu from the solution gets deposited on the cathode.

At anode: $Cu \longrightarrow Cu^{2+} + 2e^-$

At Cathode $Cu^{2+} + 2e^- \longrightarrow Cu$

The impurities of Zn, Ni, Fe etc. gets collected below as <u>anode mud.</u>

EXTRACTION OF ZINC

Principal ore of Zinc is Zinc Blende. Extraction is carried out in the following steps:-

1) **Concentration**: Ore is concentrated by froth floatation process.
2) **Roasting**: Concentrated ore is roasted in excess of air at about 1200 K andZnS is converted to ZnO.

$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$

3) **Reduction**: ZnO is reduced by heating with crushed coke at 673 K. For the purpose of heating, the oxide is made into brickettes with coke and clay.

$ZnO + C \xrightarrow{\text{coke, 673K}} Zn + CO$

The metal is distilled off and collected by rapid chilling.

4) **Refining**: Impure metal is refined by electrolysis. In this process, impure zinc is made the anode and a plate of pure zinc is made the cathode. The electrolyte is zinc sulphate with little dil. H2SO4. On passing current zinc is deposited at cathode while equal amount of zinc from anode goes into electrolyte. Thus, pure zinc is obtained on cathode.

Some extractions based on oxidation:

1) **EXTRACTION OF CHLORINE FROM BRINE**

Chlorine is abundant in sea water and hence is obtained from electrolysis of brine solution.

$2Cl^- (aq.) + 2H_2O (l) \longrightarrow 2OH^- (aq.) + H_2(g) + Cl_2(g)$

$\Delta G^o = +422$ KJ and using $\Delta G^o = -nFE^oCell$, $E^o = -2.2$ V .

So it requires emf greater than 2.2 V. But electrolysis requires an excess potential to overcome some hindering reaction. Thus, Cl_2 is obtained by electrolysis giving out H_2 and aqueous NaOH as by products.

2) **EXTRACTION OF GOLD AND SILVER**:

Extraction of Gold involves leaching the metal with CN^- (OXIDATION)

$4Au(s) + 8CN^-(aq.) + 2\,H_2O\,(aq.) + O_2\,(g) \longrightarrow 4[Au(CN)_2]^-(aq.) + 4OH^-\,(aq.)$[oxidation]

$2[Au(CN)_2]^-(aq.) + Zn\,(s) \longrightarrow 2Au(s) + [Zn(CN)_4]^{2-}\,(aq.)$ [Reduction using Zn as reducing agent]

Similarly for Silver

$4Ag(s) + 8CN^-(aq.) + 2\,H_2O\,(aq.) + O_2\,(g) \longrightarrow 4[Ag(CN)_2]^-(aq.) + 4OH^-\,(aq.)$[oxidation]

$2[Ag(CN)_2]^-(aq.) + Zn\,(s) \longrightarrow 2Ag(s) + [Zn(CN)_4]^{2-}\,(aq.)$ [Reduction using Zn as reducing agent]

Assignment

Chapter 6: General Principles and Processes of Isolation of Elements

1. What do you understand by the following terms?
   (a) Roasting (b) Flux (c) Calcination (d) Smelting (e) Slag

2. a) Name the method of refining of metals such as Germanium.
   b) In the extraction of A*l*, impure A*l*2O3 is dissolved in conc. NaOH to form sodium aluminate and leaving impurities behind. What is the name of this process ?
   c) What is the role of coke in the extraction of iron from its oxides ?
3. What does leaching mean?
   (a) Give reactions involved during leaching of bauxite ore.
   (b) Write the reaction involved in the extraction of gold after the gold ore has been leached with NaCN.
   (c) Which solution is used for the leaching of silver metal in the presence of air in the metallurgy of silver?
4. Write the reactions occurring in the different zones of blast furnance during extraction of iron from concentrated Haemetite ore.

5. Explain Hall Heroult process of reduction of aluminium oxide. What is the role of graphite and cryolite in electrometallurgy of aluminium?

6. (a) Why is the froth floatation method selected for the concentration of Sulphide ores? Write reactions taking place in the extractions of zinc from zinc blende.
   (b) An ore sample of galena (PbS) is contaminated with zinc blende (ZnS). Name one chemical compound which can be used to concentrate galena selectively by froth floatation method.

7. (a) What is the role of silica in the extraction of copper?
   (b) Explain electrorefining of copper. Name the common metals present as anode mud in electrorefining of copper.

8. Explain thermodynamic and electrochemical principles of metallurgy.

9. Account for the following facts :
   a) The reduction of a metal oxide is easier if the metal formed is in liquid state at the temperature of reduction.
   b) The reduction of Cr_2O_3 with Al is thermodynamically feasible, yet it does not occur at room temperature.
   c) Pine oil is used in froth floatation method

10. a) Indicate the principle behind the method used for refining of zinc.
    b) Out of C and CO, which is a better reducing agent at the lower temperature range in the blast furnace to extract iron from the oxide ore?
    c) Which form of iron is the purest form of iron?

p Block Elements

General Configuration: $ns^2 np^{1-6}$
Maximum oxidation state = Group 10

Across a period: Covalent radii and metallic character decreases, but electro negativity, electron affinity, oxidizing power and ionization energy increases.

Down the group: Covalent radii and metallic character increases, but electro negativity, electron affinity, oxidizing power and ionization energy decreases.

Inert pair effect: While going down the group, the ns^2 electrons become more and more reluctant to participate in bond formation. This is because down the group bond energy decreases and so the energy required to un-pair ns^2 electrons is not compensated by the energy released in forming two additional bonds.

Group 15

N	**$2s^2 2p^3$**	**Non Metals**	• **Solids and show allotropic modifications** • **s-orbitals in these elements are completely filled and p-orbitals are half filled, making their electronic configuration extra stable.**
P	**$3s^2 3p^3$**		
As	**$4s^2 4p^3$**	**Metalloids**	
Sb	**$5s^2 5p^3$**		
Bi	**$6s^2 6p^3$**	**Metal**	

Down the group covalent radii increases and electro negativity decreases, Ionization energy decreases and hence metallic nature increases. Nitrogen has maximum electro negativity.

There is considerable increase in covalent radius from N to P. However from As to Bi only a small increase in covalent radius is observed.

Successive ionization enthalpy: $\Delta_i H_1 < \Delta_i H_2 < \Delta_i H_3$

Boiling point (bp) increases from top to bottom, but mp increases upto As and decreases upto Bi.

Except N, all elements show allotropy.

Chemical properties of group 15

Oxidation State and Trends in group 15

N	**-3, +3**	• Covalent character decreases down the group. • Most common oxidation state are -3, +3 and +5 • -3 O.S decreases down the group due to increase in size and metallic nature.
P	**-3, +3, +5**	
As	**-3, +3, +5**	
Sb	**+3, +5**	
Bi	**+3, +5**	

- The stability of +5 O.S decreases due to inert pair effect down the group. Only Bi(V) compound is BiF_5

- Nitrogen exhibits +1, +2 and +4 O.S also when it reacts with oxygen. All these O.S tend to disproportionate in acid solution. e.g
  $3HNO_2 \rightarrow HNO_3 + H_2O + 2NO$
- Nitrogen is restricted to a maximum covalency of 4 since 4 orbitals (one s and three p) are available for bonding.
- Phosphorous exhibits nearly all intermediate O.S from +5 and -3.
- The heavier elements have vacant d-orbitals which can be used for bonding as in PF_6^-

Anomalous properties of nitrogen

- Nitrogen differs from the rest of the members of this group due to its smaller size, high electro negativity, high ionization enthalpy and non-availability of d-orbitals.
- Nitrogen can form pπ-pπ multiple bond.
- Nitrogen exists as diatomic molecule with a triple bond.
- Heavier elements do not form pπ-pπ bonds as their atomic orbitals are so large and differs that they cannot have effective overlapping.
- P, As and Sb form P-P, As-As and Sb-Sb single bonds whereas Bi forms metallic bonds. However, N-N single bond is weaker than P-P single bond, because of high inter electronic repulsion of non-bonding electrons owing to small bond length.
- Catenation tendency is weaker in N as N-N bond is much weaker than P-P, As-As and Sb-Sb due to inter electronic repulsions because of small bond length.
- Except nitrogen, the heavier elements can form dπ-pπ bonds, e.g $R_3P=O$ or $R_3P=CH_2$ and also when transition elements like $P(C_2H_5)_3$ and $As(C_6H_5)_3$ act as ligands; they form dπ-dπ bonds.

1) Reactivity towards hydrogen: Form hydrides of formula EH_3
   - Structure pyramidal
   - Bond angle decreases down the group due to decrease in electro negativity.
   - Stability decreases due to increase in size.
   - Reducing character increases due to decrease in stability. NH_3 is a mild reducing agent while BiH_3 is strongest.
   - Basic character decreases in the order: $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.

2) Reactivity towards oxygen: Form two types of oxides of the formula: E_2O_3 and E_2O_5. The oxide in the higher oxidation is more acidic than that of lower oxidation state. Acidic character decreases down the group.
   N_2O_3, $P_2O_3 \rightarrow$ Acidic
   As_2O_3, $Sb_2O_3 \rightarrow$ Amphoteric
   $Bi_2O_3 \rightarrow$ Basic oxide

3) Reactivity towards halogens: They form halides of the formula: EX_3 and EX_5.
   - Nitrogen does not form pentahalide due to absence of the d orbitals.
   - Pentahalides are more covalent than trihalides.
   - All trihalides except those of nitrogen are stable. Only NF_3 is stable. Trihalides except BiF_3 are predominantly covalent.

4) <u>Reactivity towards metals</u>: All these elements react with metals to form their binary compounds exhibiting –3 oxidation state, such as, Ca_3N_2 (calcium nitride) Ca_3P_2 (calcium phosphide), Na_3As_2 (sodium arsenide), Zn_3Sb_2 (zinc antimonide) and Mg_3Bi_2 (magnesium bismuthide).

Dinitrogen

Preparation

1. Dinitrogen is prepared commercially by the liquefaction and fractional distillation of air.
2. In the laboratory, dinitrogen is prepared by treating an aqueous solution of ammonium chloride with sodium nitrite.
   $NH_4CI(aq) + NaNO_2(aq) \rightarrow N_2(g) + 2H_2O(l) + NaCl\ (aq)$
3. $(NH_4)_2Cr_2O_7 \xrightarrow{Heat} N_2 + 4H_2O + Cr_2O_3$
4. Pure nitrogen is obtained by the thermal decomposition of sodium or barium azide.
   $Ba(N_3)_2 \rightarrow Ba + 3N_2$
   $2NaN_3 \rightarrow 2Na + 3N_2$

Properties

1. Dinitrogen is a colourless, odourless, tasteless and non-toxic gas.
2. It is inert at room temperature because of the high bond enthalpy of $N \equiv N$ bond.
3. At high temperature, it directly combines with some metals to form ionic nitrides and with non-metals to form covalent nitrides.
   $6Li + N_2 \xrightarrow{Heat} 2Li_3N$
   $3Mg + N_2 \xrightarrow{Heat} 2Mg_3N_2$
4. It combines with hydrogen at about 773 K to form ammonia:
   $N_2(g) + 3H_2\ (g) \xrightarrow{773K} 2NH_3(g);$ $\Delta_f H^o = -46.1$ kJmol–1
5. It combines with dioxygen only at about 2000 K to form nitric oxide, NO.
   $N_2 + O_2(g) \xleftarrow{Heat} 2NO(g)$

Thermal decomposition of sodium azide gives dinitrogen gas. ($2NaN_3 \rightarrow 2Na + 3N_2$)

Ammonia

Preparation

Ammonia is present in small quantities in air and soil where it is formed by the decay of nitrogenous organic matter e.g., urea.

$$NH_2CONH_2 + 2H_2O \rightarrow (NH_4)_2CO_3 \rightleftharpoons 2NH_3 + H_2O + CO_2$$

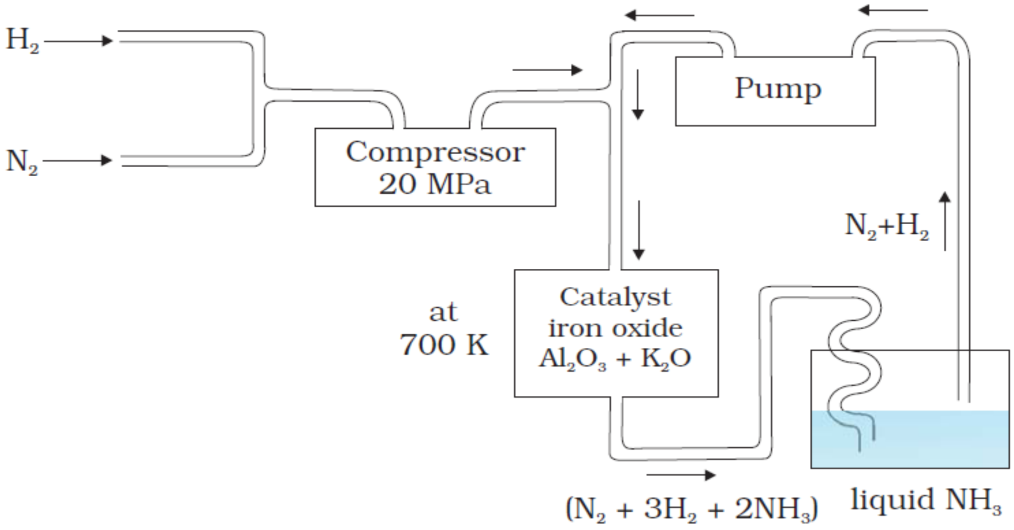
On a small scale ammonia is obtained from ammonium salts which decompose when treated with caustic soda or lime.

$$2NH_4Cl + Ca(OH)_2 \rightarrow 2NH_3 + 2H_2O + CaCl_2$$
$$(NH_4)_2\ SO_4 + 2NaOH \rightarrow 2NH_3 + 2H_2O + Na_2SO_4$$

On a large scale, ammonia is manufactured by Haber's process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g); \qquad \Delta_f H^\ominus = -46.1\ \text{kJ mol}^{-1}$$

The optimum conditions are a pressure of 200 × 10^5 Pa (about 200 atm), a temperature of ~ 700 K with iron oxide and small amount of K_2O and Al_2O_3 as catalyst.



HABER'S PROCESS

Properties

1. Ammonia is a colourless gas with a pungent odour.
2. In the solid and liquid state there exists H-bond, which accounts for its higher melting and boiling points.
3. It is trigonal bipyramidal with three bond pairs and 1 lone pair.
4. Highly soluble

   $$NH_3(g) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

   (weakly basic in aq. Solution)
5. Forms ammonium salts with acids, e.g., NH_4Cl, $(NH_4)_2SO_4$, etc. It precipitates the hydroxides of many metals from their salt solutions. For example,

   $$2FeCl_3(aq) + 3NH_4OH(aq) \rightarrow Fe_2O_3.xH_2O(s) + 3NH_4Cl(aq)$$

   (brown ppt)

   $$ZnSO_4(aq) + 2NH_4OH(aq) \rightarrow Zn(OH)_2(s) + (NH_4)_2SO_4(aq)$$

   (white ppt)
6. Presence of a lone pairs makes it a Lewis base. It donates the electron pair and forms linkage with metal ions.

$$\underset{\text{(blue)}}{Cu^{2+}(aq)} + 4\,NH_3(aq) \rightleftharpoons \underset{\text{(deep blue)}}{[Cu(NH_3)_4]^{2+}(aq)}$$

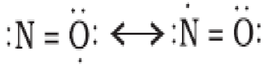
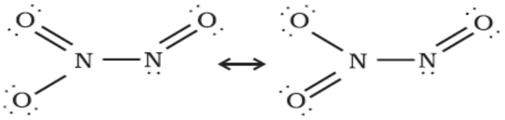
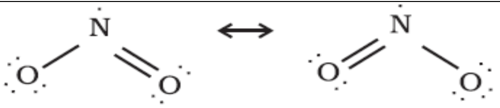
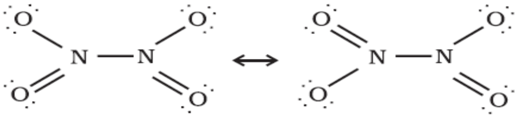
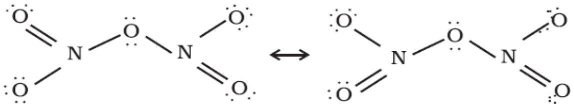
$$\underset{\text{(colourless)}}{Ag^+(aq) + Cl^-(aq)} \rightarrow \underset{\text{(white ppt)}}{AgCl(s)}$$

$$\underset{\text{(white ppt)}}{AgCl(s)} + 2NH_3(aq) \rightarrow \underset{\text{(colourless)}}{\left[Ag(NH_3)_2\right]Cl(aq)}$$

Uses

To produce nitrogenous fertilizers and manufacture of inorganic nitrogen compounds. Liquid ammonia is also used as a refrigerant.

Oxides of Nitrogen

Formula	Oxidation state	Resonance Structures	Common Methods of Preparation
N_2O	+1		$NH_4NO_3 \xrightarrow{\text{Heat}} N_2O + 2H_2O$
NO	+2		$2NaNO_2 + 2FeSO_4 + 3H_2SO_4$ $\rightarrow Fe_2(SO_4)_3 + 2NaHSO_4$ $+ 2H_2O + 2NO$
N_2O_3	+3		$2NO + N_2O_4 \xrightarrow{250\,K} 2N_2O_3$
NO_2	+4		$2Pb(NO_3)_2 \xrightarrow{673\,K}$ $4NO_2 + 2PbO$
N_2O_4	+4		$2NO_2 \underset{\text{Heat}}{\overset{\text{Cool}}{\rightleftharpoons}} N_2O_4$
N_2O_5	+5		$4HNO_3 + P_4O_{10}$ $\rightarrow 4HPO_3 + 2N_2O_5$

NITRIC ACID

Preparation

1. In the laboratory, nitric acid is prepared by heating KNO_3 or $NaNO_3$ and concentrated H2SO4 in a glass retort.
   $NaNO_3 + H_2SO_4 \rightarrow NaHSO_4 + HNO_3$
2. On a large scale it is prepared mainly by Ostwald's process.

$$\underset{\text{(from air)}}{4NH_3(g) + 5O_2(g)} \xrightarrow[\text{500 K, 9 bar}]{\text{Pt / Rh gauge catalyst}} 4NO(g) + 6H_2O(g)$$

3. $2NO(g) + O_2(g) \rightleftarrows 2NO_2(g)$
4. $3NO_2(g) + H_2O(l) \rightarrow 2HNO_3(aq) + NO(g)$
5. NO thus formed is recycled and the aqueous HNO_3 can be concentrated by distillation upto ~ 68% by mass. Further concentration to 98% can be achieved by dehydration with concentrated H_2SO_4.

Properties

1. A colourless liquid. In gaseous state it has a planar structure.
2. In aq. Solution, behaves as a strong acid.
   $HNO_3(aq) + H_2O(l) \rightarrow H_3O^+(aq) + NO_3^-(aq)$
3. Conc. HNO_3 is a strong oxidizing agent and can react with metals and non-metals.
   $3Cu + 8HNO_3(dil) \rightarrow Cu(NO_3)_2 + 2NO + H_2O$
   $Cu + 4HNO_3(conc) \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$
   $4Zn + 10HNO_3(dil) \rightarrow 4Zn(NO_3)_2 + 5H_2O + N_2O$
   $Zn + 4HNO_3(conc) \rightarrow Zn(NO_3)_2 + 2H_2O + 2N_2O$

   With Non-metals

$$I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10\,NO_2 + 4H_2O$$
$$C + 4HNO_3 \rightarrow CO_2 + 2H_2O + 4NO_2$$
$$S_8 + 48HNO_3(\text{conc.}) \rightarrow 8H_2SO_4 + 48NO_2 + 16H_2O$$
$$P_4 + 20HNO_3(\text{conc.}) \rightarrow 4H_3PO_4 + 20\,NO_2 + 4H_2O$$

Brown Ring Test: Aq. Solution of nitrate ion + dil. $FeSO_4$ solution + conc. H_2SO_4 along the sides of the test tube.

$$NO_3^- + 3Fe^{2+} + 4H^+ \rightarrow NO + 3Fe^{3+} + 2H_2O$$

$$[Fe(H_2O)_6]^{2+} + NO \rightarrow \underset{\text{(brown)}}{[Fe(H_2O)_5(NO)]^{2+}} + H_2O$$

PHOSPHORUS

Occurrence: Occurs as fluoroapatite $Ca_5(PO_4)_3F$ and hydroxyapatire $ca_5(PO_4)_3(OH)$

Preparation:

- Calcination of phosphate rock.
- Reduction with coke and sand

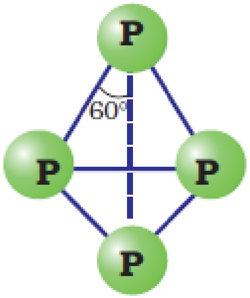
$$2Ca(PO_4)_3 + 6SiO_2 + 10C \xrightarrow{\text{1773K, electric arc}} P_4 \downarrow + 6\,CaSiO_3 + 10CO$$

Vapours condensed to solid under water

Allotropes:

1. **White Phosphorus**:

Condensation of gaseous or liquid state. It glows in dark (chemiluminescence). It is a waxy solid, insoluble in water, soluble in CS_2 and benzene. It is stored under water as it ignites spontaneously in air. It shows phosphopescence.



- **Each 'P' located at the corner of a tetrahedron is attached to 3 other 'P' atoms.**
- **Angle is 60°. P_4 units face lot of angle strain.**
- **It readily catches fire in air to give white dense fumes of P_4O_{10}**

$P_4 + 5O_2 \rightarrow P_4O_{10}$

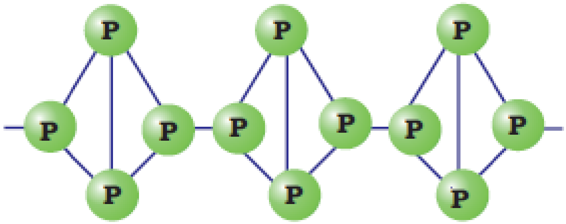
- **It dissolves in NaOH (boiling) to give phosphine.**

$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$ (sodium hypophosphite)

2. **Red Phosphorus**:

White P $\xrightarrow{\text{570K, inert atm.}}$ Red P

It is insoluble in water and CS_2.
It does not glow in the dark.
It has a high melting point (870K), amorphorus, less reactive.
Red P is less reactive than white P.
Safe to handle and shows a polymeric structure.



3. **Black Phosphorus**:

It has two forms: α-black phosphorus and β-black phosphorus.

Red P $\xrightarrow{\text{803k}}$ Black P (α-form)
White P $\xrightarrow{\text{473k, high pressure}}$ Black P (β-form)

It is the most stable variety with an extended layer structure

Uses:

In the form of phosphatic fertilizers.
Manufacture of food grade phosphates.

Detergents, pharmaceuticals, water industry.
Manufacture of organo phosphorus compounds used as pesticides.

Compounds: Hydrides: (MH_3)

NH_3 – Ammonia, most stable, shows H-bonding. Therefore, soluble in water

PH_3 – Phosphine : When pure, it is non inflammable but becomes inflammable owing to the presence of P_2H_4 or P_4 vapours. To purify it from the impurities, it is absorbed in HI to form phosphonium iodide (PH_4I) which on treating with KOH gives off phosphine.

$$PH_4I + KOH \rightarrow KI + H_2O + PH_3$$

AsH_3
SbH_3 no H-bond insoluble in water.Strong reducing agent and poisonous.
BiH_3

Preparation of PH_3:

$$Ca_3P_2 + 6HCl \rightarrow 3CaCl_2 + 2PH_3$$
$$Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + 3Ca(OH)_2$$
$$P_4 + 3KOH + 3H_2O \rightarrow PH_3 + 3KH_2PO_2 \text{ (Potassium hypophosphite)}$$
/NaOH /3NaH_2PO_2

Preparation of AsH_3, SbH_3:

M=As, Sb
$$Zn_3M_2 + 6HCl \rightarrow 2MH_3(g) + 3ZnCl_2$$

- Basic character of hydrides decrease down the group due to decrease in charge density. NH_3 is the most basic whereas ASH_3, SbH_3, BiH_3 do not show any basic properties.
- Thermal stability decreases down the group as the size of the central atom increases and the tendency to form stable M-H bond decreases.
- Reducing character increases down the group, because thermal stability of hydrides decreases.

Properties of Phosphine:

It is a colourless gas with rotten fish smell and is highly poisonous. It explodes in contact with traces of oxidising agents like HNO_3, Cl_2 and Br_2 vapours.

$$PH_3(aq) \xrightarrow{light} \text{Red P} + H_2$$
$$3CuSO_4 + 2PH_3 \rightarrow Cu_3P_2 + 3H_2SO_4$$
$$3HgCl_2 + 2PH_3 \rightarrow Hg_3P_2 + 6HCl$$
(mercury chloride)

Phosphine is weakly basic and gives phosphonium compounds with acids e.g.,

$$PH_3 + HBr \rightarrow PH_4Br$$

Halides:

MX_3 (known for all) MX_5 (except N)

N: $2s^2 2p^3$, It can easily form 3 covalent bonds and 1 coordinate bond. Thus total 4 bonds. Since there is non-availability of d-orbital, it cannot extend its coordination number beyond 4. However, for P and other group 15 elements, 5 covalent bonds can also be formed due to availability of d orbitals. (sp^3d hybridization).

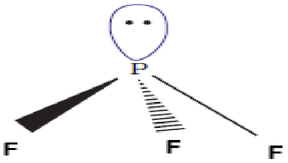
MX_3 **NX_3** **AsX_3** **Covalent** **SbX_3** **BiX_3 – ionic**	**• Ionic character increases down the group, because of increased size of central atom, the electro positive character increases.** **• MX_3 have pyramidal structure.** **• They are hydrolysed by water. (except NX_3)**

Preparation:

$P_4 + 8SOCl_2 \rightarrow 4PCl_3 + 4SO_2 + 2S_2Cl_2$

$P_4 + 6X_2 \rightarrow 4PX_3$;

PF_3 is pyramidal
(in gas phase)



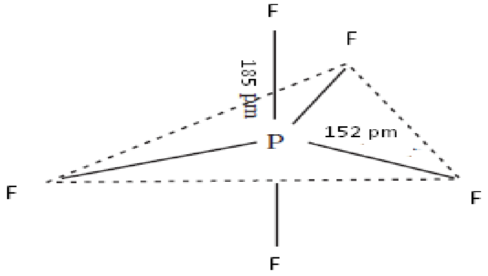
$PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$ (gives fumes)

PCl_3 fumes in moisture due to formation of HCl(g)

$2PCl_3 + O_2 \rightarrow 2POCl_3$ (phosphoryl chloride)

$3CH_3COOH + PCl_3 \rightarrow 3CH_3COCl + H_3PO_3$

$3C_2H_5OH + PCl_3 \rightarrow 3C_2H_5Cl + H_3PO_3$

MX_5 **PX_5 PF_5 PCl_5** **PBr_5** **AsX_5 AsF_5 $AsCl_5$** **SbX_5 SbF_5 $SbCl_5$** **BiX_5 BiF_5**	 **Structure: Trigonal bipyramid**

PF_5 exist as PF_5 molecule in gas and solid state. There are 2 kinds of bond lengths, 3 equatorial and 2 axial bonds.

PCl_5 exist as PCl_5 molecule in gas or liquid and as $[PCl_4]^+ [PCl_6]^-$ in solid state.

PCl_5 reacts with organic compounds.

$C_2H_5OH + PCl_5 \rightarrow C_2H_5Cl + POCl_3 + HCl$

$CH_3COOH + PCl_5 \rightarrow CH_3COCl + POCl_3 + HCl$

Finely divided metals on heating with PCl5 give corresponding chlorides.

$2Ag + PCl_5 \rightarrow 2AgCl + PCl_3$

$Sn + 2PCl_5 \rightarrow SnCl_4 + 2PCl_3$

Preparation:

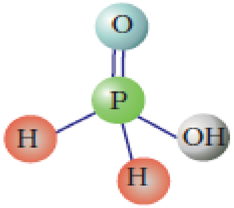
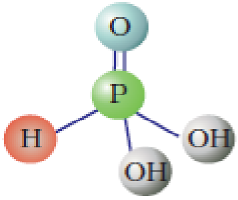
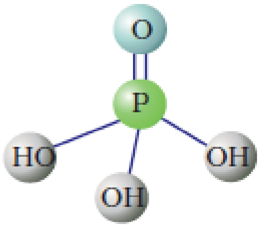
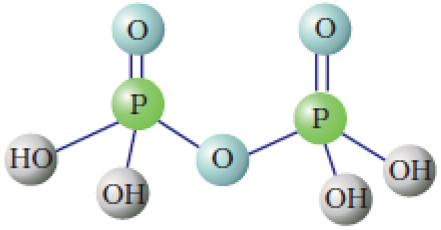
$PCl_3 + Cl_2 \rightarrow PCl_5$
$P_4 + 10Cl_2 \rightarrow 4PCl_5$
$P_4 + 10SO_2Cl_2 \rightarrow 4PCl_5 + 10\ SO_2$

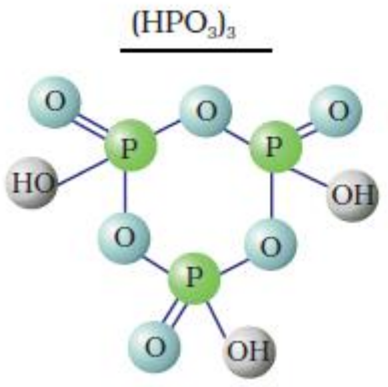
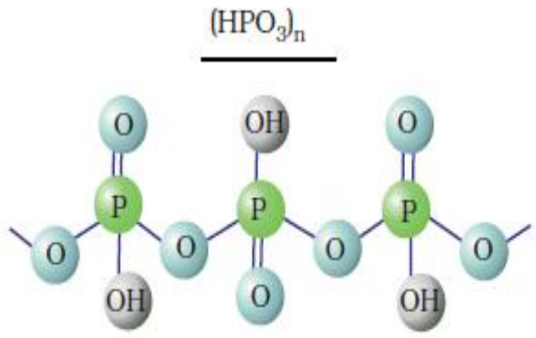
Hydrolysis:

$PCl_5 + H_2O \rightarrow POCl_3 + 2HCl$
$PCl_5 + 3H_2O$ (excess) $\rightarrow H_3PO_3 + 2HCl$

Oxoacids:

All oxoacids have at least oneP=O and one P-OH bond. They have cyclic or linear structure.

H_3PO_2  • **Monoprotic acid** • **Hypophosphorous or Phosphinic acid**	H_3PO_3  • **Phosphorus acid** • **Diprotic acid, forms 2 series of salts: NaH_2PO_3& Na_2HPO_3**
H_3PO_4  • **Orthophosphoric acid** • **Triprotic acid, Na_2HPO_4, NaH_2PO_4, Na_3PO_4** • **Used for manufacture of phosphatic fertilizers.**	$H_4P_2O_7$  • **Diphosphonic acid or Pyrophosphoric acid**

 - **Cyclotrimetaphosphoric acid**	 - **Polymetaphosphoric acid**

+3 oxidation state

$4H_3PO_3 \rightarrow 3H_3PO_4 + PH_3$

The acids with P – H bond have strong reducing properties.

$4AgNO_3 + 2H_2O + H_3PO_2 \rightarrow 4Ag + 4HNO_3 + H_3PO_4$

That is why H_3PO_2 imparts reducing character to the acid as it has 2H atoms bonded to P.

Group 16

Elements in group 16 are Oxygen (O), Sulphur (S), Selenium (Se), Tellurium (Te) and Polonium (Po). Also called Chalcogens.

Occurrence:

1. Oxygen is the most abundant element.
2. Sulphur exists as gypsum $CaSO_4.2H_2O$, Epsom salt $MgSO_4.7H_2O$ or galena PbS, Zinc blende ZnS etc.
3. Selenium and Tellurium as Selenides and Tellurides in sulphur ores.
4. Polonium exists as decay product of thorium and uranium minerals.

Electronic Configuration:

General electronic config – ns^2np^4

Atomic and Ionic Radii:

Due to increase in number of shells, atomic and ionic radii increase from top to bottom in the group.

Ionization Enthalpy:

1. Decreases down the group due to increase in size.
2. Group 16 elements have lower ionization enthalpy than corresponding elements of group 15 due to stability of half filled p-orbital electronic configuration in group 15.

Electron Gain Enthalpy:

1. Oxygen has less negative electron gain enthalpy due to its compact nature.
2. Sulphur onwards the value again becomes negative upto Po.

Electronegativity:
Oxygen is the second most electronegative element, next to fluorine. Within a group electro negativity decreases with increase in atomic number.

Metallic Character:
Increase from oxygen to polonium.

Physical Properties:

O,S → Non-Metals **Se, Te → Metalloids** **Po → Metal**	**1. All of them exhibit Allotropy.** **2. M.P and B.P increases with increase in atomic number but there is large difference in m.p of O and S due to its atomicity – O_2 and S_8.**

Chemical Properties:
1. Stability of -2 oxidation state decreases down the group.
2. Oxygen shows only negative oxidation state of -2 and in case of OF_2, oxidation state of +2.
3. Other elements of the group easily show +2, +4, and +6 oxidation state.
4. Stability of +4 oxidation state increase down the group due to inert pair effect.

Reactivity with Hydrogen:
All the elements form hydrides of the formula H_2E (E = S, Se, Te, Po).

H_2O **H_2S** **H_2Se** **H_2Te** **H_2Po**	**1. Acidic nature increases from H_2O to H_2Te due to decrease in bond dissociation enthalpy.** **2. Thermal Stability decreases from H_2O to H_2Po.** **3. All hydrides except water posses reducing property and this characteristic increases from H_2S to H_2Te.**

Reactivity with Oxygen:
All these elements form oxides of the formula EO_2 and EO_3 where E = S, Se, Te or Po.
1. SO_2 is gas but SeO_2 is solid.
2. Reducing property decreases from SO_2 and TeO_2. SO_2 is reducing and TeO_2 is an oxidising agent.
3. Also form EO_3 type oxides. Both types are acidic.

Reactivity towards halogens:
1. Form halides of the formula EX_6, EX_4 and EX_2.
2. Stability of halides decrease in the order $F^- > Cl^- > Br^- > I^-$.
3. Among hexahalides, hexafluorides are only stable. They (hexafluorides) are gaseous octahedral in nature. Most stable is SF_6 due to steric reasons.
4. Amongst tetrafluorides, SF_4 is gas, SeF_4 is liquid and TeF_4 a solid. They have Sp^3d hybridization and have trigonal bipyramidal structures and are regarded as see-saw geometry.
5. All elements except Se form dichlorides and dibromides. Dihalides have Sp^3 hybridisation.
6. Monohalides are dimeric in nature. E.g – S_2Fe, S_2Cl_2, S_2Br_2, Se_2Cl_2 and Se_2Br_2. Dimeric halides undergo disproportionation as:- $2Se_2Cl_2 \rightarrow SeCl_4 + 3Se$

DIOXYGEN

Methods of Preparation:

1. By heating chlorates, nitrates and permanganates.
   $$2KClO_3 \xrightarrow[MnO_2]{Heat} 2KCl + 3O_2$$
2. Thermal decomposition of oxides.
   $2Ag_2O(s) \rightarrow 4Ag(s) + O_2(g);$ $2Pb_3O_4(s) \rightarrow 6PbO(s) + O_2(g)$
   $2HgO(s) \rightarrow 2Hg(l) + O_2(g);$ $2PbO_2(s) \rightarrow 2PbO(s) + O_2(g)$
3. $2H_2O_2 \rightarrow 2H_2O + O_2$ Catalyst used – finely divided metals and manganese dioxide.
4. On large scale, prepared by electrolysis of water.
5. Industrially, from air → first carbon dioxide and water vapour are removed and remaining gases liquefied are fractionally distilled.

Properties of DIOXYGEN:

1. Colourless and odourless gas.
2. Directly reacts with nearly all metals and non metals except Au, Pt and some noble gases. Its combination with other elements is exothermic.

3. Some reactions with metals and non-metals are :
   $2Ca + O_2 \rightarrow 2CaO$
   $4Al + 2O_2 \rightarrow 2Al_2O_3$
   $P_4 + 5O_2 \rightarrow P_4O_{10}$
   $C + O_2 \rightarrow CO_2$
   $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
   $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
4. Some compounds are catalytically oxidized.
   $2SO_2 + O_2 \xrightarrow{V_2O_5} 2SO_3$
   $4HCl + O_2 \xrightarrow{CuCl_2} 2H_2O$

Uses:

1. Importance in normal respiration and combustion.
2. Oxyacetylene welding.
3. Manufacture of steel.
4. Oxygen cylinders are used in hospitals, high altitude flying and in mountaineering.
5. Combustion of fuels, e.g, hydrazine in liquid oxygen provides thrust in rockets.

OXIDES

A binary compound of oxygen with another element is called oxide.

Oxides can be simple (MgO, Al_2O_3) or mixed (Pb_3O_4, Fe_3O_4). Simple oxides can be acidic, basic or amphoteric oxides.

An oxide which combines with water to give an acid is termed as acidic oxide. (e.g SO_2, CO_2, N_2O_5)

$SO_2 + H_2O \rightarrow H_2SO_3$ (Non metal oxides are acidic)

The oxide which gives a base with water is called basic oxides. Metal oxides are basic (e.g- Na_2O, CaO, BaO)

$CaO + H_2O \rightarrow Ca(OH)_2$

Some metal oxides exhibit dual behavior. They show characteristics of both acidic as well as basic oxides. They are known as amphoteric oxides. E.g Al_2O_3

$Al_2O_3 + 6HCl + 9H_2O \rightarrow 2[Al(H_2O)_6]^{3+} + 6Cl^-$
$Al_2O_3 + 6NaOH + 3H_2O \rightarrow 2Na_3[Al(OH)_6]$

Some oxides are neither acidic nor basic. E.g CO, NO and N_2O

OZONE

Ozone is an allotrope of oxygen. It is too reactive to remain at sea level. At a height of 20km above sea level it is formed from atmospheric oxygen in the presence of sunlight. The ozone layer protects earth's surface from excessive concentration of UV radiation.

Preparation:

When silent electric discharge is passed through dry oxygen, ozonised oxygen (10%) is produced.

$3O_2 \rightarrow 2O_3$ (ΔH=142KJMol-1)

Properties:

1. Pale blue gas, dark blue liquid and violet black solid.
2. In small concentrations, it is harmless and if concentration rises above 100ppm breathing becomes uncomfortable.
3. Ozone is thermodynamically unstable. Its decomposition to oxygen results in liberation of heat and increase in entropy. The two effects results in negative Gibb's energy change for conversion into oxygen. High concentration of ozone can be dangerously explosive.
4. Acts as good oxidising agent because [$O_3 \rightarrow O_2 + O$] due to liberation of nascent oxygen.
   $PbS + 4O_3 \rightarrow PbSO_4 + 4O_2$
   $2I^- + H_2O + O_3 \rightarrow 2OH^- + I_2 + O_2$
   This reaction can be used for estimating O_3 gas. I_2 liberated titrated against standard $Na_2S_2O_3$ solution helps in estimation.
5. Nitrogen oxides emitted from exhaust system of supersonic aeroplanes might be slowly depleting ozone layer in upper atmosphere.
   $NO + O_3 \rightarrow NO_2 + O_2$
6. Ozone layer is also depleted by refrigerants and aerosol sprays.
7.

Bond length is 128pm and bond angle is 117^{o}.

Uses:

1. Used as germicide, disinfectant and sterilizing water.
2. Used for bleaching oils, ivory, flour and starch.
3. Acts as oxidising agent in manufacture of $KMnO_4$.

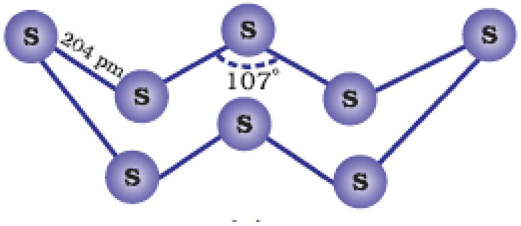
SULPHUR

Allotropic forms of Sulphur:

1. Yellow rhombic sulphur (α-sulphur)
2. Monoclinic sulphur (β-sulphur)

Rhombic is stable at room temperature which transforms to monoclinic when heated above 369k. Rhombic sulphur is yellow in colour, insoluble in water and dissolves to some extent in benzene, alcohol and ether. It is readily soluble in CS_2.

Monoclinic sulphur is stable above 369K and α-sulphur below 369K, called transition temperature, both forms are stable. Both exist as S_8 molecules. At high temperature (~1000k), S_2 is dominant and it is para magnetic.



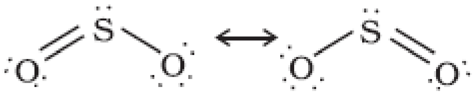
SULPHUR DIOXIDE

Preparation:
1. $S + O_2 \rightarrow SO_2$ Suplhur burnt in air or oxygen gives SO_2 along with a little (6-8%) SO_3.
2. Suplhites with dilute sulphuric acid.
   $SO_3^{2-}(aq) + 2H^+ (aq) \rightarrow H_2O(l) + SO_2(g)$
3. By product of roasting sulphide ores.
   $4FeS_2 + 11O_2(g) \rightarrow 2Fe_2O_3(s) + 8SO_2(g)$

Properties:
1. Colourless gas with pungent smell.
2. Highly soluble in water.
3. Liquifies at room temp. under a pressure of 2atm and boils at 263K.
4. $SO_2(g) + H_2O(l) \rightarrow H_2SO_3(aq)$ (sulphurous acid)
5. $NaOH + SO_2 \rightarrow Na_2SO_3$ (sodium sulphite) + H_2O
   $Na_2SO_3 + H_2O + SO_2 \rightarrow 2NaHSO_3$ (sodium hydrogen sulphite)
6. Reacts with chlorine in the presence of charcoal as catalyst to give sulphuryl chloride.
   $SO_2(g) + Cl_2(g) \rightarrow SO_2Cl_2(l)$
7. Oxidised to sulphur trioxide in the presence of V_2O_5
   $2SO_2(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)$
8. Moist SO_2 behaves as reducing agent. Converts Iron(III) ions to Iron(II) ions and

$2Fe^{3+} + SO_2 + 2H_2O \rightarrow 2Fe^{2+} + SO_4^{2-} + 4H^+$
decolourizes acidified $KMnO_4$ solution
$5SO_2 + 2MnO_4^- + 2H_2O \rightarrow 5SO_4^{2-} + 4H^+ + 2Mn^{2+}$

9. SO_2 is angular.

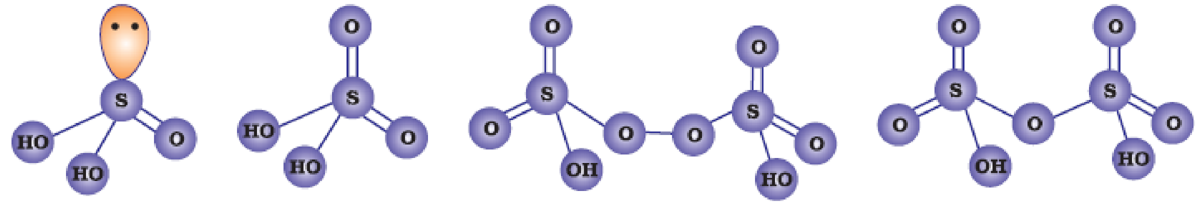


Uses of SO_2:

1. In refining petroleum.
2. In bleaching wool and silk.
3. As an anti-colour, disinfectant and preservative.
4. Sulphuric acid, $NaHSO_3$ and $Ca(HSO_3)_2$ are manufactured from sulpur dioxide.
5. Liquid SO_2 is used as a solvent to dissolve a number of organic and inorganic chemicals.

OXOACIDS OF SULPHUR

Forms oxoacids of the formula H_2SO_3, $H_2S_2O_3$, $H_2S_2O_4$, $H_2S_2O_5$, $H_2S_xO_6$ (x=2 to 5), H_2SO_4, $H_2S_2O_7$, H_2SO_5, $H_2S_2O_8$.



Sulphurous acid (H_2SO_3) Sulphuric acid (H_2SO_4) Peroxodisulphuric acid ($H_2S_2O_8$) Pyrosulphuric acid (Oleum) ($H_2S_2O_7$)

SULPHURIC ACID

Manufacture:

By contact process. The steps are:

1. Burning of sulphur or sulphide ores in air to generate SO_2.
   $S + O_2 \rightarrow SO_2$
   $4FeS_2$ (Iron pyrites) $+ 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$
2. Conversion of SO_2 to SO_3 by the reaction with oxygen in the presence of catalyst V_2O_5.
   $2SO_2(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g) \quad \Delta H^o=-196.6KJmol^{-1}$
   This is the key reaction in the process. High yield of SO_3 will lead to more production of H_2SO_4.
3. Absorption of SO_3 in 98% H_2SO_4 to give Oleum ($H_2S_2O_7$).
   $SO_3 + H_2SO_4 \rightarrow H_2S_2O_7$
4. Dilution of oleum with water to get desired concentration of sulphuric acid.
   $H_2S_2O_7 + H_2O \rightarrow 2\ H_2SO_4$ (Sulphuric acid prepared is 96-98% pure)

Conditions favouring maximum yield of sulphur trioxide:

Key step in the manufacture of sulphuric acid is catalytic oxidation of SO_2 with O_2 to give SO_3.

$$2SO_2(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g) \quad \Delta H^o=-196.6KJmol^{-1}$$

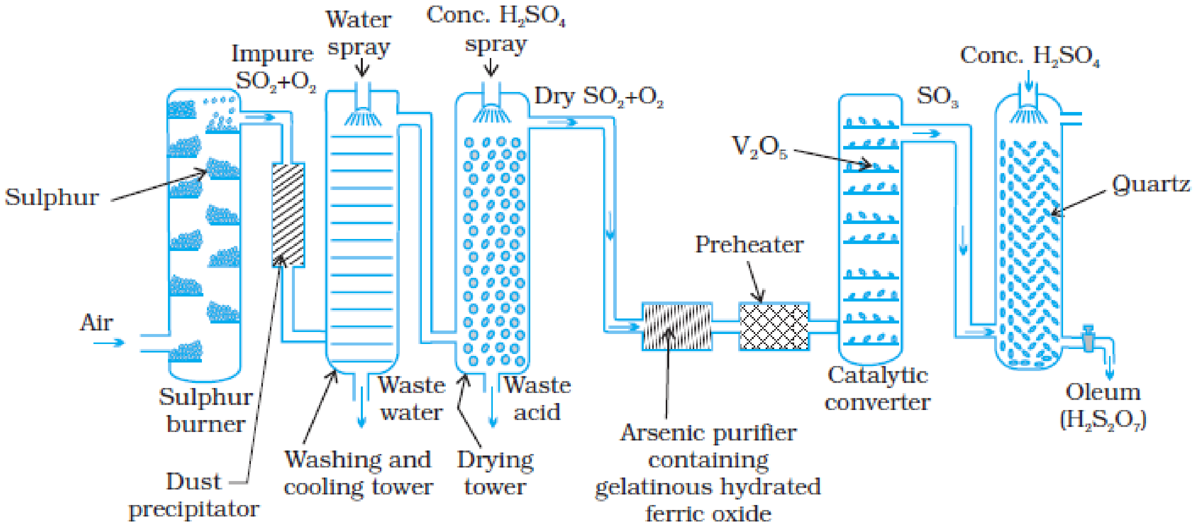
The reaction is exothermic and reversible.

a) **Low temperature**: Favours oxidation of SO_2 as reaction is exothermic (according to Le-Chateliar's principle). But it is essential to have a minimum temperature of 720K, to give maximum yield.

b) **High Pressure**: Favours oxidation as volume of gaseous products are less. A pressure of 2 to 3 bar is sufficient. Very high may cause corrosion of the vessel.

c) **Use of catalyst**: V_2O_5 increases the speed of reaction.

Description of the Plant (Manufacture of H_2SO_4 by Contact Process):



Flow diagram for the manufacture of sulphuric acid

1. **Sulphur burners**: Sulphur or Iron pyrites are burnt.
2. **Purification unit**: The gaseous mixture coming out of sulphur burner is generally impure. Purified as:
   I. **Dust Chambers**: Steam is introduced to remove dust.
   II. **Coolers**: The gases are cooled to about 373K by passing them through cooling pipes.
   III. **Scrubber**: Gases are passed into washing tower which dissolves mist and other soluble impurities.
   IV. **Drying Tower**: A spray of conc. H_2SO_4 used for drying gases.
   V. **Arsenic purifier**: This chamber contains shelves with gelatinous ferric hydroxide. The impurities of arsenic oxide are absorbed by ferric hydroxide.
3. **Testing Box**: The purifies gases are tested by passing a strong beam of light. Impurities present will scatter the light.
4. **Contact Chamber or Converter**: Pure gases are then heated to about 723-823K in a pre-heater and then introduced into contact chamber. It is a cylindrical chamber fitted with iron pipes packed with catalyst V_2O_5. In this SO_2 is oxidized to SO_3.
   As the forward reaction is exothermic, the pre-heating is stopped once the oxidation has started.

5. **Absorption tower**: It is a cylindrical tower packed with acid proof flint. SO_3 escaping out from converter is led from the bottom of the tower and conc. H_2SO_4 (98%) is sprayed from top. SO_3 gets absorbed by H_2SO_4 to form oleum or fuming sulphuric acid.
   $H_2SO_4 + SO_3 \rightarrow H_2S_2O_7$ (oleum)
   Oleum is then diluted with calculated amount of water to get acid of desired concentration.
   $H_2S_2O_7 + H_2O \rightarrow 2H_2SO_4$

PROPERTIES of H_2SO_4:

1. Colourless, dense and oily liquid.
2. Conc. H_2SO_4 dissolves in water with evolution of large quantity of heat. Hence conc. H_2SO_4 must be added slowly in water with constant stirring.
3. Chemical reactions of H_2SO_4 are as a result of:
    a) Volatility
    b) Strong acidic character
    c) Strong affinity of water
    d) Ability to act as oxidising agent
4. In aqueous solution, sulphuric acid ionizes as:
   $H_2SO_4(aq) + H_2O(l) \rightarrow H_3O^+(aq) + HSO_4^-(aq)$ K_{a1}=very large (>10)
   $H_2SO_4^-(aq) + H_2O(l) \rightarrow H_3O^+(aq) + SO_4^{2-}(aq)$ $K_{a2}=1.2x10^{-2}$
   Larger K_{a1} means – easily dissociated into H^+ and HSO_4^- and is a stronger acid.
5. Forms two types of salt:
   Normal sulphates (e.g. sodium sulphate, copper sulphate)
   Acid sulphates (e.g. hydrogen sulphate)
6. Can be used to form more volatile acids from their corresponding salts.
   $2MX + H_2SO_4 \rightarrow 2HX + M_2SO_4$ (X=F,Cl, NO_3)
7. Acts as dehydrating agent. Can dry gases and also removes water from organic compounds.
   $C_{12}H_{22}O_{11} \xrightarrow{H_2SO_4} 12C + 11H_2O$
8. Hot conc. H_2SO_4 is a strong oxidising agent. Both metals and non-metals are oxidized and itself is reduced to SO_2.
   $Cu + 2H_2SO_4$ (conc.) $\rightarrow CuSO_4 + SO_2 + 2H_2O$
   $3S + 2H_2SO_4$ (conc.) $\rightarrow 3SO_2 + 2H_2O$
   $C + 2H_2SO_4$ (conc.) $\rightarrow CO_2 + 2SO_2 + 2H_2O$

USES:

1. Important industrial chemical.
2. Used in manufacture of fertilizers (e.g. ammonium sulphate, superphosphate)
3. Petroleum refining
4. Paints, pigments and dyestuff
5. Detergent industry
6. Metallurgical applications
7. storage batteries
8. Laboratory reagent
9. In the manufacture of nitrocellulose products

GROUP 17

F, Cl, Br, I, At (radioactive) are called halogens. Most reactive non-metals and most electronegative.

F_2: Pale yellow gas
Cl_2: Greenish yellow gas
Br_2: Reddish brown liquid, sparingly soluble in H_2O
I_2: Lustrous, grayish black solid, sublimes on heating sparingly soluble in H_2O, soluble in org. solvents.

Bond Energy:

$F_2 < Cl_2 > Br_2 > I_2$

Anomalous behavior of F_2 is due to the fact that the lone pair of electrons are very close which lead to repulsions.

Electron Affinity:

$F < Cl > Br > I$

This is because F being small in size repels the incoming electron.
Occurs as:
F – Fluorides
Cl – NaCl in oceans
Br – Bromides
I – Iodides and iodates (IO_3^-)

Oxidizing power	$F_2 > Cl_2 > Br_2 > I_2$
Radii	$F < Cl < Br < I$
I.E	$F > Cl > Br > I$
E.N	$F > Cl > Br > I$

Preparation of Halogens:

As halogens are oxidizing, they are prepared by electrolysis.

F_2:
Electrolytic is molten KF + HF, Cathode – mild steel, Anode – Carbon rod
Cathode: $2H^+ + 2e^- \rightarrow H_2(g)$
Anode: $2F^- \rightarrow F_2(g) + 2e^-$
Teflon separates the 2 electrodes to avoid the explosive mixing of H_2 and F_2.
Chemical Method: $K_2MnF_6 + 2SbF_5 \rightarrow 2KSbF_6 + MnF_3 + 0.5F_2$

Cl_2:
Electrolysis of natural brine (NaCl)
By oxidation of HCl by MnO_2 or $KMnO_4$ (Lab Method)

$2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + Cl_2$

By oxidation of NaCl

$2NaCl + 2H_2SO_4 + MnO_2 \rightarrow Na_2SO_4 + MnSO_4 + 2H_2O + Cl_2$

Br_2:

Oxidation of bromide ions from natural brine with Cl_2

$2Br^- + Cl_2 \rightarrow Br_2 + 2Cl^-$

I_2:

Oxidation of bromide ions from natural brine with Cl_2

$2I^- + Cl_2 \rightarrow I_2 + 2Cl^-$

Reduction of iodates with $NaHSO_3$.

$NaIO_3 + 3NaHSO_3 \rightarrow NaI + 3NaHSO_4$

$NaIO_3 + 5NaI + 3H_2SO_4 \rightarrow 3I_2 + 3H_2O + 3Na_2SO_4$

Trends in Group 17:

F_2 **Cl_2** **Br_2** **I_2**	**F is the most electronegative element i.e. has good acceptance of an electron and is therefore the strongest oxidizing agent.** **Oxidizing character decreases down the group. Thus one halogen oxidises halide ions of higher atomic number halogens.**

$F_2 + 2X^- \rightarrow 2F^- + X_2$ (X=Cl, Br, I)

$Cl_2 + 2X^- \rightarrow 2Cl^- + X_2$ (X=Br, I)

$Br_2 + 2I^- \rightarrow 2Br^- + I_2$

Reactivity of halogens with metals or non-metals decreases down the group. $F_2 > Cl_2 > Br_2 > I_2$

e.g. $Mg + Br_2 \rightarrow MgBr_2$

$Xe + 3F_2 \rightarrow XeF_6$

Ionic character of M-X bond decreases down the group. M-f > M-Cl > M-Br > M-I

Low O.S of M $\rightarrow MCl_2$

High O.S of M $\rightarrow MCl_4 \rightarrow$ more covalent than MCl_2

Compounds: **Hydrogen Halides**: **HF, HCl, HBr, HI**

Preparation:

$CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

$2NACl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$

Oxidizing Action:

$F_2 > Cl_2 > H_2SO_4 > Br_2 > I_2$

Similar reactions as above cannot be used for the preparation of HBr and HI as H_2SO_4 is a stronger oxidizing agent and will oxidize the HBR, HI formed to BR_2, I_2 respectively.

$NaBr + H_2SO_4 \rightarrow HBr \rightarrow Br_2\uparrow$

$NaI + H_2SO_4 \rightarrow HI \rightarrow I_2\uparrow$

Methods of preparation for HBr and HI:

$H_2 + Br_2 \xrightarrow{Pt / asbestos} 2HBr$
$2I_2 + N_2H_4 \xrightarrow{573K} 4HI + N_2$

HX are colourless, irritating gases.
HF has a higher b.p due to H-bonding.

Acidic Character:

$HF << HCl < HBr < HI$

Low acidic character of HF is due to strong H-bonding and higher bond dissociation enthalpy. HF is corrosive and attacks glass.

NF_3 is an exothermic compound but BCl_3 is endothermic because bond energy of F_2 is lower than Cl_2 and N-F bond is smaller and stronger than N-Cl bond.

Stability:

Decreases down the group due to decreased bond dissociation enthalpy.
$HF > HCl > HBr > I$

Reducing Nature:

$HF < HCl < HBr < HI$

Oxides:

Halogens form many oxides with oxygen. Fluorine forms only OF_2 and O_2F_2 – oxygen fluorides, they are good fluorinating agents.

$Pu + 3O_2F_2 \rightarrow PuF_6 + 3O_2$ (removed as PuF_6)

O_2F_2 oxidises Pu to PuF_6 and the reaction is used in removing Pu as PuF_6 from spent nuclear fuel.

Chlorine, Bromide and iodine form oxides where o.s ranges from +1 to +7. The higher oxides of halogens tend to be more stable than the lower ones.

Chlorine oxides, Cl_2O, ClO_2, Cl_2O_6 and Cl_2O_7 are highly reactive oxidizing agents. ClO_2 is used as bleaching agent for paper pulp and textiles and in water treatment.

Bromine oxides Br_2O, BrO_2, BrO_3 are least stable halogen oxides. They are powerful oxidizing agents.

The iodine oxides, I_2O_4, I_2O_5, I_2O_7 are insoluble solids and decompose on heating. I_2O_5 is a very good oxidizing agent and is used in the estimation of CO.

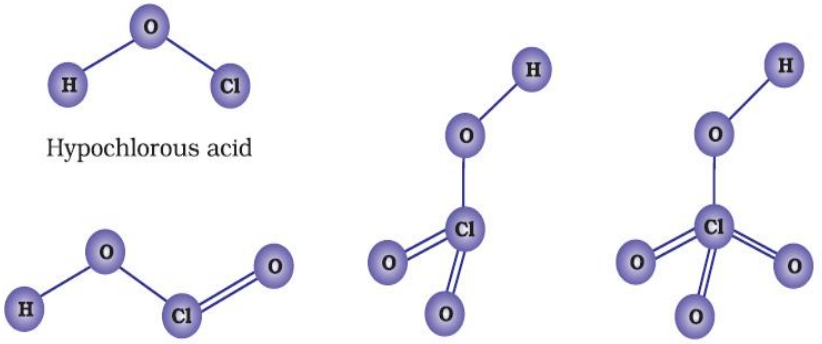
Reactivity towards Metals:

Halogens react with metals to form metal halides. $Mg(s) + Br_2(l) \rightarrow MgBr_2(s)$
Ionic character of the halides decreases in the order: $MF > MCl > MBr > MI$ where M is a monovalent metal.

If metal exhibits more than one O.S, higher O.S halides are more covalent than low O.S halides

Oxoacids of Halogens:

Halic (I) acid (Hypohalous acid)	**HOF (Hypofluorous acid)**	**HOCl (Hypochlorous acid)**	**HOBr (Hypobromous acid)**	**HOI (Hypoiodous acid)**
Halic (III) acid (Halous acid)	**–** **–**	**HOCIO (chlorous acid)**	**–** **–**	**–** **–**
Halic (V) acid (Halic acid)	**–** **–**	**$HOCIO_2$ (chloric acid)**	**$HOBrO_2$ (bromic acid)**	**$HOIO_2$ (iodic acid)**
Halic (VII) acid (Perhalic acid)	**–** **–**	**$HOCIO_3$ (perchloric acid)**	**$HOBrO_3$ (perbromic acid)**	**$HOIO_3$ (periodic acid)**



Hypochlorous acid

Chlorous acid

Chloric acid

Perchloric acid

The structures of oxoacids of chlorine

Inter Halogen Compounds:

When two different halogens react with each other, interhalogen compounds are formed. E.g. XX′, XX′$_3$, XX′$_5$ and XX′$_7$ where X is halogen of larger size and X′ of smaller size and X is more electropositive than X′.

Preparation:

They are prepared by the direct combination or by the action of halogen on lower interhalogen compounds. For e.g.,

$$\underset{\text{(equal volume)}}{Cl_2 + F_2} \xrightarrow{437\,K} 2ClF;$$

$$I_2 + \underset{\text{(excess)}}{3Cl_2} \rightarrow 2ICl_3$$

$$Cl_2 + \underset{\text{(excess)}}{3F_2} \xrightarrow{573\,K} 2ClF_3;$$

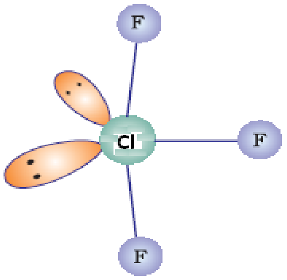
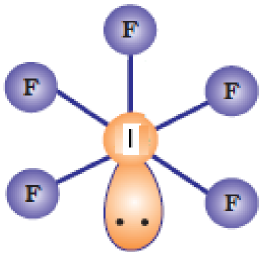
$$\underset{\text{(diluted with water)}}{Br_2 + 3F_2} \rightarrow 2BrF_3$$

$$\underset{\text{(equimolar)}}{I_2 + Cl_2} \rightarrow 2ICl;$$

$$Br_2 + \underset{\text{(excess)}}{5F_2} \rightarrow 2BrF_5$$

Properties:

XX′	**ClF, BrF, IF (unstable), BrCl, ICl, IBr**	

XX′$_3$	**ClF_3 (Bent T-Shaped,, because it is sp3d hybridized)** **BrF_3 (Bent T-Shaped,, because it is sp3d hybridized)** **IF_3 (Bent T-Shaped,, because it is sp3d hybridized)** **ClF_3 (Bent T-Shaped,, because it is sp3d hybridized)**	
XX′$_5$	**IF_5 (Square pyramid)** **BrF_5 (Square pyramid)** **ClF_5 (Square pyramid)**	
XX′$_7$	**IF_7 (Pentagonal bipyramidal)**	

1. They are all covalent and diamagnetic in nature. They are volatile solid or liquid except ClF which is a gas.
2. They are more reactive than halogens because X-X′ bond in inter halogens is weaker than X-X bond in halogens except F-F bond.
3. All these undergo hydrolysis giving halide ion.

   $XX' + H_2O \rightarrow HX' + HOX$ the bigger one forms hypohalous acid.

Uses:

The compounds are used as non aqueous solvents. They are useful fluorinating agents. ClF_3 and BrF_3 are used for the production of UF_6 in the enrichment of ^{235}U.

$$U(s) + 3ClF_3(l) \rightarrow UF_6(g) + 3ClF(g)$$

Properties of Chlorine:

1. Greenish yellow gas with pungent and suffocating odour.
2. Reacts with metals and non-metals to form chlorides.

   $2Al + 3Cl_2 \rightarrow 2AlCl_3$

   $2Na + Cl2 \rightarrow 2NaCl$

   $2Fe + 3Cl_2 \rightarrow 2FeCl$

   $P_4 + 6Cl_2 \rightarrow 4PCl_3$

   $S_8 + 4Cl_2 \rightarrow 4S_2Cl_2$

3. Can react with hydrogen to form HCl.

   $H_2 + Cl_2 \rightarrow 2HCl$

   $H_2S + Cl_2 \rightarrow 2HCl + S$

   $C_{10}H_{16} + 8Cl_2 \rightarrow 16HCl + 10C$

4. With excess of NH_3, chlorine gives nitrogen and ammonium chloride while with excess of chlorine, nitrogen trichloride is formed.

   $8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$; $NH_3 + 3Cl_2 \rightarrow NCl_3 + 3HCl$

   (excess) (excess)

5. With cold and dilute alkalies chlorine produces a mixture of chloride and hypochlorite but with hot and concentrated alkalies it gives chloride and chlorate.
   $2NaOH + Cl_2 \rightarrow NaCl + NaOCl + H_2O$
   (cold and dilute)
   $NaOH + 3Cl_2 \rightarrow 5NaCl + NaClO_3 + 3H_2O$
   (hot and conc.)
6. With dry slaked lime it gives bleaching powder.
   $2Ca(OH)_2 + 2Cl_2 \rightarrow Ca(OCl)_2 + CaCl_2 + 2H_2O$
   The composition of bleaching powder is $Ca(OCl)_2.CaCl_2.Ca(OH)_2.2H_2O$.
7. Chlorine reacts with hydrocarbons and gives substitution products with saturated hydrocarbons and addition products with unsaturated hydrocarbons. For example,
   $CH_4 + Cl_2 \xrightarrow{UV} CH_3Cl + HCl$
   $C_2H_4 + Cl_2 \xrightarrow{\text{Room temp.}} C_2H_4Cl_2$
8. Chlorine water on standing loses its yellow colour due to the formation of HCl and HOCl.
9. It oxidises ferrous to ferric, sulphite to sulphate, sulphur dioxide to sulphuric acid and iodine to iodic acid.
   $2FeSO_4 + H_2SO_4 + Cl_2 \rightarrow Fe_2(SO_4)_3 + 2HCl$
   $Na_2SO_3 + Cl_2 + H_2O \rightarrow Na_2SO_4 + 2HCl$
   $SO_2 + 2H_2O + Cl_2 \rightarrow H_2SO_4 + 2HCl$
   $I_2 + 6H_2O + 5Cl_2 \rightarrow 2HIO_3 + 10HCl$
10. It is a powerful bleaching agent; bleaching action is due to oxidation.
    $Cl_2 + H_2O \rightarrow 2HCl + O$
    Coloured substance + O → Colourless substance

Uses:

1. Used for bleaching woodpulp, bleaching cotton and textiles.
2. In extraction of gold and platinum.
3. In manufacture of dyes, drugs and organic compounds.
4. In sterilizing drinking water.
5. Preparation of poisonous gases such as phosgene ($COCl_2$), tear gas and mustard gas.

HYDROGEN CHLORIDE:

Preparation:

Prepared by heating sodium chloride with concentrated sulphuric acid.

$NaCl + H_2SO_4 \xrightarrow{420K} NaHSO_4 + HCl$

$NaHSO_4 + NaCl \xrightarrow{823K} Na_2SO_4 + HCl$

HCl gas can be dried by passing through concentrated sulphuric acid.

Properties:

1. Colourless and pungent smelling gas. Easily liquefied.
2. Extremely soluble. $HCl(g) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq)$
   Its aqueous solution is called hydrochloric acid.
3. Reacts with NH_3 and gives white fumes. $NH_3 + HCl \rightarrow NH_4Cl$
4. 3 parts of conc. HCl and 1 part of con. HNO_3 forms aqua regia.
   $Au + 4H^+ + NO_3^- + 4Cl^- \rightarrow AuCl_4^+ + NO + 2H_2O$
   $3Pt + 16H^+ + 4NO_3^- + 18Cl^- \rightarrow 3PtCl_6^{2-} + 4NO + 8H_2O$

5. It decomposes salts of weaker acids, e.g., carbonates, hydrogencarbonates, sulphites, etc.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$$
$$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$$
$$Na_2SO_3 + 2HCl \rightarrow 2NaCl + H_2O + SO_2$$

<u>Uses</u>:

1. In manufacture of chlorine, NH_4Cl and glucose.
2. In medicine and as laboratory reagent.

<u>Uses of halogens and its compounds</u>:

F_2	- Manufacture of UF_6 for nuclear power generation and SF_6 for dielectrics.
HF	- Chemicals obtained are chlorofluorocarbons like Freon used as a refrigerant and polytetra-fluorethylene called Teflon used in nonstick pans. - Also used in glass industry as an etching agent and in the manufacture of fluoride salts.
NaF	- Used for fluoridation of water, (1ppm of fluoride in drinking ware prevents tooth decay)
SnF_2	- Used in fluoride toothpastes.
Cl_2	- Used for bleaching paper, pulp, textiles. - Used as disinfectant for sterilizing drinking water. - Used in production of organic compounds- PVC, chlorinated hydrocarbons, pharmaceuticals. - Used in production of inorganic compounds. E.g. HCL, PCl_3, NaOCl
$C_2H_2Br_2$	- Used as gasoline additive.
Br_2	- Used to make AgBr for photography.
I_2	- Used for preparation of iodoform and KI
NaI, $NaIO_3$ or KI, KIO_3	- Added to table salt and is called iodised salt. (Insufficient iodine in the diet leads to Goitre.

<u>GROUP 18</u>

Known as Noble gases as their valance shell orbitals are completely filled and react with a few elements under certain conditions.

He $1s^2$ **Ne $2s^22p^6$**	- **Atmospheric abundance of the noble gases in dry air ~1% by volume of which Ar is major constituent.**

Ar $3s^23p^6$ **Kr** $4s^24p^6$ **Xe** $5s^25p^6$ **Rn** $6s^26p^6$	• **Helium or Neon is also found in radioactive minerals, e.g. pitchblende, monazite, cleveite.** • **Natural gas is commercial source of helium.** • **Radon is obtained as decay product of ^{226}Ra.** **$^{226}Ra \rightarrow ^{222}Rn + ^{4}He$** **88862**

Electronic Configuration:
General electronic configuration is ns^2np^6 except He ($1s^2$). Due to fully filled configuration noble gases are inactive in nature.

IonizationEnthalpy:
Due to stable electronic configuration, they have high I.E. Decreases down the group due to increase in atomic size.

Atomic Radii:
Increases down the group due to increase in number of shells.

Electron Gain Enthalpy:
Noble gases have stable electronic configuration, so no tendency to accept electron and hence have large positive values of $\Delta_{eg}H$.

Physical Properties:

1. Monoatomic, colourless, odourless and tasteless.
2. Sparingly soluble in water.
3. Low m.p and b.p due to weak dispersion forces.
4. Can be liquefied at low temperature due to weak forces.

Chemical Properties:
Chemically inert due to:

1. Completely filled electronic config. ns^2np^6 in their valance shell.
2. High ionization enthalpy.
3. More positive electron gain enthalpy.

Uses of Noble Gases:

Helium:

- Non inflammable and light gas. Used in filling balloons for meteorological observations.
- Used in gas cooled nuclear reactors.
- Liquid He (b.p. 4.2K) is used as cryogenic agent for carrying out various experiments at low temperatures.
- Used to produce and sustain powerful superconducting magnets which form an essential part of modern NMR spectrometers and Magnetic Resonance Imaging (MRI) systems.

Neon:

- Used in discharge tubes.
- Used in fluorescent bulbs for advertisement display purpose.

Argon:
- Used to provide an inert atmosphere in high temperature metallurgical processes.
- Used for filling electric bulbs.
- Used in lab for handling substances that are air sensitive.

Kr, Xe:
- Used in light bulbs used for special purposes.

Energy of Compounds of Noble Gases:

In 1962, Neil Bartlett prepared a red compound $O_2^+PtF_6^-$. He realised that the first I.E of O_2=1175 kJmol^{-1} was almost identical to I.E of Xe=1170 k Jmol^{-1}. He prepared a similar red colour compound by mixing Xe and PtF_6.

$$Xe + PtF_6 \rightarrow Xe^+[PtF_6]^-$$

After this, a number of compounds of Xe with electronegative elements like fluorine and oxygen have been synthesised.

Xenon-fluorine compounds

Xenon forms three binary fluorides, XeF_2, XeF_4 and XeF_6 by the direct reaction of elements.

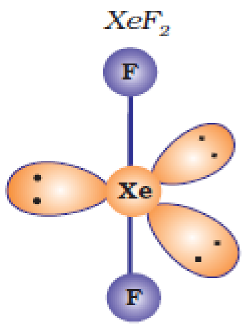
$$Xe\,(g) + F_2\,(g) \xrightarrow{673k,\ 1bar} XeF_2\,(s)$$
(Xe in excess)

$$Xe\,(g) + 2F_2\,(g) \xrightarrow{873k,\ 7bar} XeF_4\,(s)$$
(1:5 ratio)

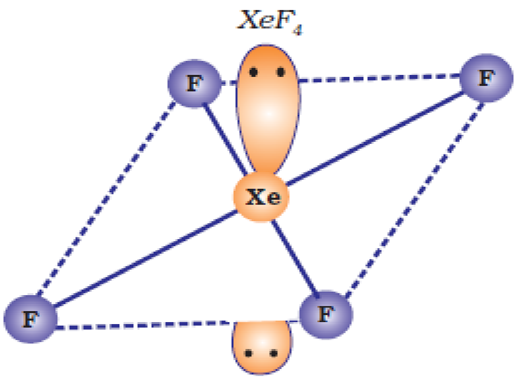
$$Xe\,(g) + 3F_2\,(g) \xrightarrow{573k,\ 60\text{-}70bar} XeF_6\,(s)$$
(1:20 ratio)

XeF_6 is also prepared as $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$ at 143K.

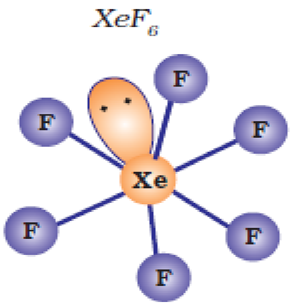
Structure:



Linear



Square planar



Distorted octahedral

Properties:

1. XeF_2, XeF_4 and XeF_6 are colourless crystalline solids.
2. Sublime readily at 298 K.
3. They are powerful fluorinating agents. They react with fluoride ion acceptors to form cationic species and fluoride ion donors to form fluoroanions.

   $XeF_2 + PF_5 \rightarrow [XeF]^+ [PF_6]^-$; $XeF_4 + SbF_5 \rightarrow [XeF_3]^+ [SbF_6]^-$

   $XeF_6 + MF \rightarrow M^+ [XeF_7]^-$ (M = Na, K, Rb or Cs)
4. They are readily hydrolysed even by traces of water.

   $2XeF_2 (s) + 2H_2O(l) \rightarrow 2Xe (g) + 4HF(aq) + O_2(g)$

Xenon-oxygen compounds:

Hydrolysis of XeF_4 and XeF_6 with water gives XeO_3.

$$6XeF_4 + 12H_2O \rightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$$

$$XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$$

Partial hydrolysis of XeF_6 gives oxyfluorides

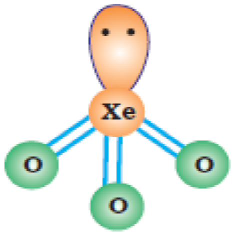
$$XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$$

$$XeF_6 + 2H_2O \rightarrow XeO_2F_2 + 4HF$$

Hydrolysis of XeF_6 is not a redox reaction as there is no change in oxidation state.

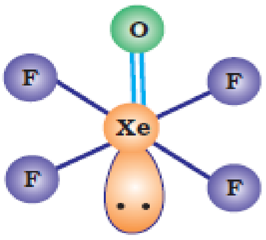
Structure:

XeO_3 (colourless explosive solid)



Pyramidal

$XeOF_4$ (colourless volatile liquid)



Square pyramidal

Assignment

Chapter 7: p -Block Elements

1. Assign appropriate reason for each of the following observations:
   a) SbF_5 is more stable than BiF_5 .
   b) Sulphur in vapour state exhibits some paramagnetic behaviour.
   c) H_2O is a liquid but H_2S is a gas.
   d) NH_3 is stronger base than phosphine.
   e) Hydrogen bonding in Hydrogen fluoride is much stronger than that in water, yet water has much higher boiling point.
   f) The majority of known noble gas compounds are those of Xenon.
   g) Halogens are strong oxidants.
   h) The value of electron gain enthalpy with negative sign for sulphur is higher than that for oxygen.
   i) ClF_3 molecule has a T-shaped structure and not a trigonal planar one.
   j) O_2 and F_2 both stabilize higher oxidation states of metals but O_2 exceeds F_2 in doing so.
   k) Structures of xenon fluorides cannot be explained by Valence Bond Approach.
   l) The chemical reactivity of nitrogen is much less than that of phosphorus.
   m) SF_6 is kinetically inert.
   n) All the bonds in SF_4 are not equivalent..
   o) ICl is more reactive than I_2.
   p) Despite lower value of its electron gain enthalpy with negative sign, F_2 is a stronger oxidizing agent than Cl_2.
   q) Bond dissociation enthalpy of F_2 is lower than that of Cl_2.
   r) PH_3 has a lower boiling point than NH_3.
   s) Ozone is thermodynamically unstable.
   t) Solid $PCl5$ is ionic in nature.
   u) Fluorine forms only one oxoacid HOF.

2. a)Write the reaction of preparation of XeF_4, XeF_6, XeO_3
   b) What happens when (i) PCl_5 is heated
   (ii) H_3PO_3 is heated

3. Draw the structures of the following:
   a) XeF_2 b). XeF_4 c) $XeOF_4$ d) BrF_3 e)XeO_3 f) $XeOF_4$ g) SF_4
   h) H_3PO_2 i) H_2SO_5 j) ClF_3 k) $H_2S_2O_7$ l) H_3PO_3 m) $(HPO_3)_3$ n) $H_2S_2O_8$ o) BrF_5

4. Complete the equations:
   a. $XeF_6 + H_2O \rightarrow$
   b. $XeF_2 + PF_5 \rightarrow$
   c. $HNO_3 + P_4O_{10} \rightarrow$
   d. $Ca_3P_2 + H_2O \rightarrow$
   e. Cl_2 + NaOH (cold and dil.) →
   f. $Pb(NO_3)_2 \xrightarrow{675K}$
   g. $Pb_3O_4 + HNO_3 \rightarrow$

h. Cu^{2+} (aq.) + NH_3(aq) (excess) $\longrightarrow$
i. F_2 (g) + H_2O (l) $\longrightarrow$
j. P_4(s) + NaOH(aq.) + H_2O(l) $\longrightarrow$
k. I^-(aq.) + H_2O(l) + O_3(g) $\longrightarrow$
l. P_4 + SO_2Cl_2 $\longrightarrow$
m. XeF_4 + O_2F_2 $\longrightarrow$
n. NaOH (hot & conc) + Cl_2 $\longrightarrow$
o. NH_4Cl(aq) + $NaNO_2$(aq) $\longrightarrow$
p. Xe(g) (excess)+ F_2(g) $\xrightarrow{673K,\ 1bar}$

5. (i) Compare the oxidizing action of F2 and C*l*2 by considering parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy.
   (ii) Write the conditions to maximize the yield of H2SO4 by contact process.
   (iii) Arrange the following in the increasing order of property mentioned :
      (a) H3PO3, H3PO4, H3PO2 (Reducing character)
   (b) NH3, PH3, AsH3, SbH3, BiH3 (Base strength)

6. How is SO_2 an air pollutant?

7. On adding NaOH to ammonium sulphate, a colourless gas with pungent odour is evolved which forms a blue coloured complex with Cu2+ ion. Identify the gas.

8. Draw the structures of white phosphorus and red phosphorus. Which one of these two types of phosphorus is more reactive and why?

9. Which one of PCl_4^+ and PCl_4^- is not likely to exist to exist and why?

10. Predict the shape and the asked angle(90^o or more or less) in each of the following cases:
   (a) SO_3^{2-} and the angle O-S-O.
   (b) XeF_2 and the angle F-Xe-F.

11. Which noble gas is used for filling balloons for meteorological observations?
12. How does supersonic jet aeroplanes responsible for depletion of ozone layers?

Practice Paper

Chapter 7: p -Block Elements

1. Assign appropriate reason for each of the followaing observations:
   1) Phosphinic acid behaves as a monoprotic acid.
   2) Nitric oxide becomes brown when released in air.
   3) PCl_5 is ionic in nature in solid state.
   4) White phosphorus is much more reactive than red phosphorus.
   5) Hydrogen fluoride is a much weaker acid than HCl in aqueous solution.
   6) BiH_3 is the strongest reducing agent amongst all the hydrides of Group 15 elements
   7) N and Bi do not form pentahalides while phosphorus does.
   8) $R_3P=O$ exists but $R_3N=O$ does not (R = alkyl group)
   9) SCl_6 is not known where as SF_6 is known
   10) Halogens are coloured .
   11) Dioxygen is a gas but sulphur is a solid.
   12) Fluorine forms only one oxoacid, HOF .
   13) Nitrogen shows catenation properties less than phosphorus.
   14) Sulphur has a greater tendency for catenation than oxygen.
   15)The lower oxidation statebecomes more stable with increasing atomic number in group 18.
   16) Fluorine exhibits only -1 oxidation state whereas halogens exhibit higher positive oxidation states also.
   17) On addition of ozone gas to KI solution, violet vapours are obtained.
   18) H_3PO_2 and H_3PO_3 act as good reducing agents while H_3PO_4 does not.
   19) Chlorine act as both oxidizing and bleaching properties.
   20) Chlorine loses its yellow colour on standing.
   21) Bond dissociation energy of F_2 is less than that of Cl_2.
   22) In the structure of HNO_3 molecule, the N-O bond (121 pm) is shorter than N-OH bond (140 pm).
   23) SF_4 is easily hydrolysed whereas SF_6 is not easily hydrolysed.
   24) XeF_2 has a straight linear structure and not a bent angular structure.
   25) Fluorine does not exhibit any positive oxidation state.
   26) Phosphorus is much more reactive than nitrogen.
   27) Bi(V) is stronger oxidizing agent than Sb(V) .
   28) NF_3 is an exothermic compound but NCl_3 is endothermic compound.
   29) Oxygen shows catenation property less than Sulphur.
   30) Helium is used in diving apparatus.

2. Illustrate how copper metal give different products on reaction with HNO_3

3. Describe the steps involved in the contact process for the manufacture of H_2SO_4.

4. Give Chemical reaction in support of each of the following statements:
   a) Bleaching of flowers by Cl_2 is permanent while by SO_2 is temporary.
   b) All the bonds in PCl_5 molecules are not equivalent.

c) Fluorine is a stronger oxidizing agent than chlorine.
d) Chlorine reacts with a cold and dilute solution of sodium hydroxide.
e) Orthophosohorous acid is heated.
f) PtF_6 and Xenon are mixed together.

5. Arrange the following in the decreasing order of the property indicated:

a. H_2O , H_2S, H_2Se , H_2Te boiling point
b. MF, MBr, MCl, MI Ionic character of the bond
c. NH_3, PH_3, AsH_3, SbH_3 Base strength
d. HF, HCl, HBr, HI Acid strength
e. H_2S, H_2O, H_2Se, H_2Te Thermal stability
f. $HClO_4$, $HClO_3$, $HClO_2$, HClO Oxidizing power
g. Cl_2 , Br_2 , F_2 , I_2 Oxidizing power
h. $HClO_4$, HIO_4, $HBrO_4$ Oxidising ability

6. With what neutral molecule ClO^- is isoelectronic? Also give the formula of a noble gas species isostructrual with ICl^-_4 and IBr^{--}.

7. How is ammonia manufactured industrially?

8. In which one of the two structures, $NO_2^t$and NO_2^-, the bond angle has a higher value?

9. Draw the structures of white phosphorus and red phosphorus. Which one of these two types of phosphorus is more reactive and why?

10. Which one of PCl_4^+ and PCl_4^- is not likely to exist to exist and why?

11. Predict the shape and the asked angle(90^o or more or less) in each of the following cases:
    (a) SO_3^{2-} and the angle O-S-O.
    (c) XeF_2 and the angle F-Xe-F.

12. Which noble gas is used for filling balloons for meteorological observations?
13. How does supersonic jet aeroplanes responsible for depletion of ozone layers?

d-and f-block elements

d-block of the periodic table contains elements of the groups 3-12 in which the orbitals are progressively filled in each of the four long periods. The elements constituting the *f*- block are those in which the 4*f* and 5*f* are progressively in the later two long periods; these elements are formal members of group 3 from which they have been taken outto form separate *f*-block of the periodic table.

The transition metals are those elements which have incompletely filled d-subshells in there ground stateor in any one of their oxidation state.

Cu,Ag and Au are transition metals because in their commonly occuring states, they have partly filled d-sub shells. Zn, Cd and Hg of group 12 do not have partly filled d-sub shell in their elementary state or commonly occuring oxidation state, and hence, are not considered as transition elements. However, being the end members their chemistry is studied with transition elements.

Electronic Configuration- $(n-1)d^{1-10}\ ns^{1-2}$
Transition series- The d-block elements are called transition elements as they represent change in properties from most electropositive s-block elements to least electropositive (or most electropositive) p-block elements.
Transition elements consist to of 4 rows: These series are called transition series.

First transition series- 3d series

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
21	22	23	24	25	26	27	28	29	30
$3d^{1}4s^{2}$	$3d\ ^{2}4s^{2}$	$3d^{3}4s^{2}$	$3d^{5}4s^{1}$	$3d^{5}4s^{2}$	$3d^{6}4s^{2}$	$3d^{7}4s^{2}$	$3d^{8}4s^{2}$	$3d^{10}4s^{1}$	$3d^{10}4s^{2}$

Second Transition series – 4d series

Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
39	40	41	42	43	44	45	46	47	48
$4d^{1}5s^{2}$	$4d^{2}5s^{2}$	$4d^{4}5s^{2}$	$4d^{5}s^{1}$	$4d^{6}5s^{1}$	$4d^{7}5s^{1}$	$4d^{8}5s^{1}$	$4d^{10}5s^{0}$	$4d^{10}5s^{1}$	$4d^{10}5s^{2}$

Third transition Series – 5d series

La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg
57	72	73	74	75	76	777	78	79	80

Fourth transition Series- 6d Series

Ac	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Uub
89	104	105	106	107	108	109	110	111	112

GENERAL POPERIES OF TRANSITION ELEMENTS

Atomic radii: The atomic radii is intermediate between those of s-and p- block elements. The

Following trends are observed:

a) The atomic radii of elements of a particular series decrease with increase in atomic number but this decrease in atomic radii become small after midway.

Reason- The atomic radii decreases in the beginning because of increase in atomic no., the nuclear charge goes on increasing progressively, but the electrons enter the penultimate shell and the added d-electrons screen the outermost s-electrons. The shielding effect is small so that net electrostatic attraction between the nuclear charge and outermost electrons increases. Consequently atomic radius decreases. As the no. of d-electrons increase the screening effect increases. This neutralizes the effect of increased nuclear charge due increase in atomic number and consequently atomic radius remains almost unchanged after chromium.

b) At the end of each period, there is slight increase in atomic number

Reason- This is because of increased electron-electron repulsions between the added electrons in the same orbital which exceeds the attractive forces due to increased nuclear charge. Therefore, electron cloud expands and size increase.

c) The atomic radii increase while going down the group.

Reason – The atomic radii of second transition series is larger than that of first transition series because of increase in no. of outermost shell.

The third transition series have nearly the same radii as metals of second transition series. This is because of lanthanide contraction. This is associated with the interventions of 4f- orbitals which are filled before 5d-series. 4f- orbital have poor screening effect, This results in regular decrease in atomic radii which compensates the expected increase in atomic size with increase in atomic no.

Ionic Radii- The ionic radii follows the same trend as atomic radii. Since metals exhibit different oxidation states, radii of ions also differ. The ionic radii decrease with increase in nuclear charge.

Metallic character- All transition elements are metals. They have high density, hardness, high m.p.& b.p. & high tensile strengths, ductility, high, thermal and electrical conductivity and lustre.

Reason – The metallic character is due to their relatively low ionization enthalpies and number of vacant orbitals in the outermost shell. The hardness of there metals suggests the presence of strong bonding due to overlap of unpaired electrons between different metal atoms. Therefore, they exhibit high enthalpy of atomization. Enthalpy of atomization is maximum in the middle indicates one unpaired electron is particularly favorable for strong atomic interaction. Hence, max enthalpy of atomization.

Density- All metals have high density. Within a period, the densities vary inversely with atomic radii, ie., densities increase along a period. Also densities increase upon descending down the group.

Reason – The atomic volumes of transition elements are low because electrons are added in (n-1)d sub shell and not in ns subshell . Therefore, increased nuclear charge is partly screened by the d-electrons and outer electrons are strongly attracted by the nucleus. Moveover, electrons are added in inner orbital. Conequently, densities of transition metals are high.

Melting and boiling points

The transition metals have high m.p. & b.p. The m.p. and b.p. of metals rise to a maximum value and then decrease with increase in atomic number. However, Mn and Tc have abnormally low m.p. & b.p.

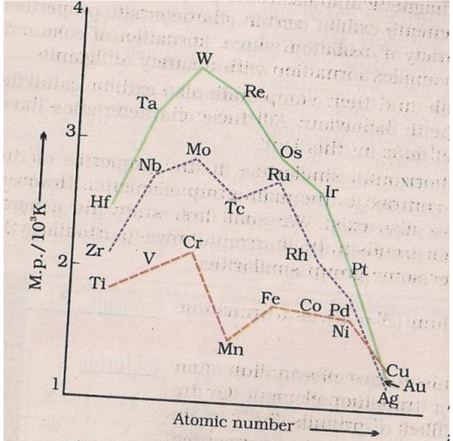


Fig. 8.1: *Trends in melting points of transition elements*

Reason – The high m.p. &b.p. is due to strong metallic bonds between the atoms of these elements. The metallic bond is formed due to interaction of electrons in the outermost orbital. The strength of bonding depends on the number of outer most electrons. Greater is the number of valance electrons, stronger is the metallic bonding and consequently, m.p. is high.

Therefore metallic strength increase up to the middle till d^5 confignation and then decreases with the decrease in availability of unpaired d- electrons(from Fe onwards) . Therefore, m.p. decrease after the middle because of increase an pairing of electrons.

<u>The dip in the curve in Mn and Tc</u> is due to the fact that Mn has stable electronic configuration ($3d^5\ 45^2$). As a result 3d electrons are more tightly held by Mn atomic nucleus and this reduces delocalization of electrons resulting in weaker metallic bonding.

Ionization Enthalpies- The following trend is observed in the ionization enthalpies of d- block elements.The ionization enthalpies of d-block elements are lower than those of p-block elements. The I.E. increase along a series.

Reason - The increase in ionization enthalpy is due to the effect of increasing nuclear charge which would tend to attract outer electron with greater force. Consequently, ionization enthalpy is expected to increase. But the addition of electrons take place in last but one d-sub shell and this increases the screening effect. With the increase in electrons in d-sub shell the outer electrons are shielded more & more. Thus, effect of increased nuclear charge is opposed by additional screening effect of the nucleus and ionization enthalpy increases but slowly.

The irregular trend in first I.E. of first transition series elements is due to the fact that removal of one electron alters the relatives energies of 4s and 3d orbitals. Therefore, there is reorganization energy which gains in exchange energy due to increase in no. of electrons in d^n configuration and from transference of s-electrons in d- orbital.

Some exceptions observed in ionization enthalpies are:-

a) Cr and Cu have high I.E. This is attributed to their half filled (d^5) and completely (d^{10}) electronic configuration .
b) The value of second I.E. for zinc is low because ionization involves removal of an electron resulting in stable $3d^{10}$ configuration.
c) The trend in third I.E. shows high value for Mn^{+2} and Zn^{+2} because of stable $3d^5$ and $3d^{10}$ electronic configuration.

Similarly, I.E$_3$ for Fe <I.E$_3$ for Mn because of stable $3d^5$ in Fe. In general, third I.E. values are very high because of filled 4*f*-orbitals which have poor shielding effect.

Oxidation States-

a) Transition metals exhibit a larger number of oxidation states in their compound.

Reason - This is because of participation of inner (n -1)d electrons in addition to outer ns-electrons because the energies of ns and (n -1)d electrons are almost equal.

The elements which gave the greatest number of oxidations states occur in or near the middle of the series. Eg.Mn ; oxidation states from + 2 & +7

The lesser number of oxidation states at the extreme ends is either due to too few electrons to lose or share or too many d electrons, hence fewer orbital are available in to available to share electrons with others, thus higher valence cannot be attained.
eg. Cu can have oxidation state of +1& +2
Zn can have oxidation state of +2 only

Oxidation state of first row transition elements

Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
21	22	23	24	25	26	27	28	29	30
$3d^{1}4s^{2}$	$3d\ ^{2}4s^{2}$	$3d^{3}4s^{2}$	$3d^{5}4s^{1}$	$3d^{5}4s^{2}$	$3d^{6}4s^{2}$	$3d^{7}4s^{2}$	$3d^{8}4s^{2}$	$3d^{10}4s^{1}$	$3d^{10}4s^{2}$
+3	+2 +3 +4	+2 +3 +4 +5	+2 +3 +4 +5 +6	+2 +3 +4 +5 +6 +7	+2 +3 +4 +6	+2 +3 +4	+2 +3 +4	+1 +2	+2

b) Except Sc, the most common oxidation state of first rose correlation elements is +2 which arises due to loss of 4s- electrons. This means Sc, 3d–orbitals are more stable and lower in energy than 4s- orbital. As a result electrons are first removed from 4s- orbital.
c) Zinc is +2 in which no d-electrons are involved.

d) Within a group, maximum oxidation state increases with atomic number. For e.g. in group 8 , Fe shows +2 and +3 but Rutheniun and Osmium form compounds in +4 , +6 and + 8 oxidation state .

e) In + 2 and + 3 oxidation state, bonds formed are ionic and in the compounds of higher oxidation state bonds are covalent.

Transition elements show low oxidation states in some compounds or complexes having ligands such as CO, for e.g. in $Ni(CO)_4$, Ni has zero oxidation state.

Standard electrode potential

The magnitude of ionization enthalpy gains the amount energy required to remove electrons from particular oxidation state of metal in compounds. Smaller the I.E. the metal, the stable is its compound.

$Ni \rightarrow Ni^{+2} + 2e^-$ I.E = 2.49×10^3 kJ/mol
$Pt \rightarrow Pt^{+2} + 2e^-$ I.E = 2.66×10^3 kJ/mol

Ni(II) compounds are thremodynamically more stable thaPt(II) compounds.

$Ni \rightarrow Ni^{+4} + 4e^-$ I.E = 8.80×10^3 kJ/mol
$Pt \rightarrow Pt^{+4} + 4e^-$ I.E = 6.70×10^3 kJ/mol

Pt(IV) compounds are relatively more stable than Ni(IV) compounds. Stability of the compounds depend on electrode.

In addition to ionization enthalpy, ΔH_{sub} , ΔH_{hyd} energy, explain the stability of a particular oxidation state.

$$\left.\begin{array}{ll} 1)\ M(s) \rightarrow M(g) & \Delta_{sub}H^0 \\ 2)\ M(g) \rightarrow M^+(g) + e^-\ 1.\ E & \\ 3)\ M^+(g) + nH_2O \rightarrow M^+(aq) & \Delta_{hyd}\ H \end{array}\right\} \Delta H = \Delta_{sub} H + 1.\ E + \Delta_{hyd} H$$

Smaller the value of total energy charge for a particular oxidation state in aqueous solution, greater will be the stability of that oxidation state. The electrode potential is a measure of total energy charge.

The lower the electrode potential, ie, more negative the standard reduction potential of the electrode, more stable is the oxidation state of the transition metal in aqueous solution.

More negative values of E^0 for Mn and Zn are due to the stability of half filled ($3d^5$) in Mn^{+2} and completely filled ($3d^{10}$) configuration in Zn^{+2} .

Trend in M^{3+}/M^{2+} standard electrode potential

Except copper and Zinc, all other elements of first transition series show +3 oxidation states to from M^{+3} in aqueous solution.

a) Low value of Sc reflects stability of Sc^{+3} which has a noble gas configuration.
b) High value for Mn shows that Mn^{+2} (d^5) is particularly stable.
c) Low value for Fe, shows extra stability for Fe^{+3} configuration.

Trends in stability of higher oxidation states-

The highest oxidation state is generally shown among halides and oxides.

a) Transition metals react with halogens at high temp as they have high activation energies. High temp is required to start the reaction but heat of reaction is sufficient to continue. The reaction.
Order of reactivity: F_2> Cl_2> Br_2> I_2

b) In general elements of I transition series react in low oxidation state.

c) Since fluorine is the most electronegative element, the transition elements show high oxidations states with fluorine.

d) The highest oxidation states are found in TiX_4, VF_5, CrF_6.

e) The +7 oxidation states are not shown by simple halides.

f) V(V)is shown by VFs only . Other halides undergoing hydrolysis form oxo halides OX_3.

g) Fluorides are unstable in their low oxidation state. Eg –V forms VX_2 (X = C1,Br or I) Cu can form CuX (X=Cl ,I) Cu (II) halides are known except the iodide.

h) The ability of oxygen to stabilize the highest oxidation state is exhibited in their oxides. The highest oxidation states in member of group number. Eg-Sc in Sc_2O_3 is +3 and is a member of group 3. Mn in group7 has +7 oxidation state in Mn_2O_7.Mangnese forms highest oxidation state fluorides as MnF_4 whereas the highest oxide is Mn_2O_7.Tthis is due to tendency of oxygen to form multiple bonds. In the covalent oxide Mn_2O_7 ,each Mn is tetrahedrally surrounded by oxygen atoms and has Mn-O-Mn bridge. Tetrahedral MnO_4^{-2} ions are also known for V(V),Cr(VI), Mn(VI) and Mn(VII).

Formation of colored ions-

Most of the compo undo of transition metals are colored in solid or solution form.

Reason- The colour is due to the presence of incomplete (n-1)d sub shell. Under the influence of approaching ions towards central metal ion, the d-ordinals of central metal split into different energy levels. This phenomenon is called crystal field splitting. For e.g. When six ions or molecules approach the metal ion (octahedral field) , the d-orbitals split into two sets:- One set consisting of two d-orbital of higher energy (dx^2-y^2, dz^2) end other set consisting of d-orbitals (dxy, dyz & dxz) of lower energy. The electrons are easily promoted from one to another energy level in the same d-sub shell. There are called d-d transition. The amount of energy required to excite some of the electrons to higher energy states within the same d-sub shell corresponds to energy of certain colours of visible light. Therefore, when white light falls on the compounds, some part of its energy corresponding to certain colour is absorbed and the electron gets raised from lower energy to higher energy & the excess colour is transmited. The observed colour is complementary of colour absorbed. Eg-Ti^{+3} (d^1) is purple.

Magnetic Properties-

Paramagnetism arises from the presence of unpaired electrons. Diamagnetic substances are repelled by the applied magnetic field while the paramagnetic substances are attracted whereas the ferromagnetic substances are attracted the most.

Each unpaired electron has a magnetic moment associated with its spin angular momentum and orbital angular momentum. For the compounds of the 1st transition series, the contribution of orbital angular momentum is effectively less and hence is of no significance. For these, the magnetic moment is determined by the number of unpaired electrons and can be calculated by 'spin only'

$\mu = \sqrt{n(n+2)}$ BM
N= no. of unpaired e-
μ = Magnetic moment in Bohr magnetron (μ_b) units
(μ_b =eh/ 4m = $9.27 x 10^{-24}$ Am^2 or Jt^{-1})
μ increase with the increasing number of unpaired electrons or in other words observed magnetic moment guise a useful indication about the number of unpaired electrons.
Eg- Calculate the magnetic moment of Mn^{2+} if the at no. =25 ,
Z=25 So, d^5 has 5 unpaired electrons , n=5
μ= 5(5+2) =5.92μ_b

Formations of complex compounds :- The transition metals form a large no. of complex compo undo due to

(i) the comparitively smaller sizes of the metal ions,
(ii) their high ionic charges and
(iii) the availability of d-orbital for bond formation

Eg .$[PtCl_4]^{2-}$, $[Cu(NH_3)_4]$, $[Fe(CN)_6]^{4-}$ etc.

Catalytic Properties-

a) Transition metals show catalytic property because of their ability to adopt multiple oxidation states. Catalysts at a solid surface involve the formation of bond between reactant molecules and atoms of the surface of the catalyst. This has the effect of increasing the concentration of the reactants at the catalyst surface and also weakening of the bonds in the reacting molecules & the activation energy is lowered, moreover transition metals can change their oxidation states.
   Eg- Fe^{3+} catalyses the reaction between I_2& persulphate ions.
b) The catalytic property of transition metals is due to their tendency to form reaction intermediates with suitable reactants. These intermediates give reaction paths of low activation energy and therefore increase the rate of reaction. The reaction intermediates decompose yielding products and regenerating the original substance. The transition metals form reaction intermediates due to the presence of vacant orbitals & tendency to form variable oxidation state.

Formation of interstitial compounds :-

Many of the transition metals form interstitial compounds which are formed when small atoms like B,H, N or C are trapped inside the crystal lattices of metals. They are usually non-stoichiomatric and are neither typically ionic nor covalent. There small atoms enter into the void sites, eg In, Ti. If C enters the void going the composition TiC or $TiH_{1.7}$, $VH_{0.56}$ etc.

Physical & Chemical characteristics of these compounds

(i) High m.pt, higher than pure metals.
(ii) Very hard , some borides approach diamond in hardness
(iii) Retain metallic conducting
(iv) Chemically inert

Alloy Formation:-

Alloys are homogenous solid solutions in which the atoms of one metal are distributed randomly among the atoms of the other but the metals should have similar metallic radii within 15% of each other.

The alloys formed have high m.pt & are hard.
Eg. Alloys of Cr, V, W, Mo, Mn etc, stainless steel is or alloys of Fe, Ni, Cr
Alloys of transition metals with non-transition metals, such as Brass (Cu-Zn), Bronze (Cu- Sn).

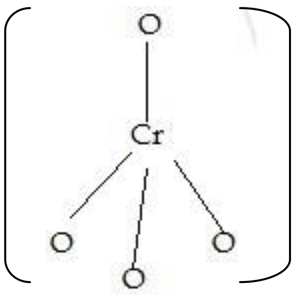
<u>Some important compounds of transition elements</u>

Oxides & oxo metals ions

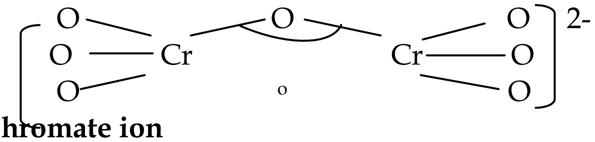
Metal + $O_2 \xrightarrow{high/\ temp} M_xO_y$
The higher oxidation state in the oxides coincides with the group no. eg, Sc_2O_3(Sc is +3), Mn_2O_7(Mn is +7).
Beyond group 7- no higher oxides. Eg- Fe_2O_3(Fe is +3)
Besides the oxides, oxocations, stabilize V(V) as VO_2^+, V(IV) as VO^{2+} and Ti(IV) as TiO^{2+}.
As the oxidation number of metal increases, ionic character decreases .
Mn_2O_7 is a covalent compound which is green oil.
Mn_2O_7 gives $HMnO_4$ } Acids in high oxidation state.
CrO_3 gives $H_2Cr_2O_7$
V_2O_5 is amphoteric, V_2O_3 is basic and V_2O_4 is less basic.
When dissolved in acidic salts it gives VO^{2+} salts.
CrO is basic and Cr_2O_3 is amphoteric. (High oxidation states are more covalent and more acidic).

<u>Potassium Dichromate , $K_2Cr_2O_7$ –</u>
***Preparation* - From Chromite ore**
Chromates in turn are formed by fusion of Chromite ore($FeCr_2O_4$) with Na_2CO_3 or K_2CO_3.
$4\ FeCr_2O_4 + Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$.
Excess
Na_2CrO_4 is filtered and treated with H_2SO_4 to obtain orange crystals of $Na_2CrO_7.2H_2O$
Sodium dichromate is more stable than pot. dichromate
$Na_2Cr_2O_7 + 2KCl \rightarrow K_2Cr_2O_7 + 2NaCl$
Chromates and dichromates are interchangeable in aqueous solution depending upon pH of the solution.
The O.S. of Cr in CrO_4^{2-} and $Cr_2O_7^{2-}$ is same.
$\underset{(+6)}{2CrO_4^{2-}} + 2H^+ \rightarrow \underset{(+6)}{Cr_2O_7^{2-}} + H_2O$
$Cr_2O_7^{2-} + 2OH^- \rightarrow 2CrO_4^{2-} + H_2O$

2-



Chromate ion



Dichromate ion

$Na_2Cr_2O_7$& $K_2Cr_2O_7$: Strong oxidizing agents

Used in Organic Chemistry

Used as a primary standard in volumetric analysis

Chemical properties of $K_2Cr_2O_7$:-

In acidic solution, its oxidizing action can be represented as follows –

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

Acidified $K_2Cr_2O_7$ oxidises iodides to iodine, sulphide to S, Sn(II) to Sn(IV), Fe(II) to Fe(II) to Fe(III)

$6I^- \rightarrow 3I_2 + 6e-$

$3 H_2S \rightarrow 6H^+ + 3S + 6e-$

$3Sn^{2+} \rightarrow 3Sn^{4+} + 6e-$

$6Fe^{2+} \rightarrow 6Fe^{3+}\ 6e-$

The full ionic equation can be obtained by adding half equation for potassium dichromate to half equation for the reducing agent, for eg.,

$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

Uses – In leather industry, preparation of azo dyes.

Potassium Permanganate ($KMnO_4$)

Preparation –

$$2MnO_2 + 4KOH + O_2 \xrightarrow{KNO_3} 2K_2MnO_4 + 2H_2O$$

Oxidizing agent

$$\underset{(+6)}{3MnO_4^{2-}} + 4H^+ \rightarrow \underset{(+7)}{2MnO_4^-} + \underset{(+4)}{MnO_2} + 2H_2O$$

Commercially prepared by alkaline oxidative fusion of MnO_2 followad by the electrolytic oxidation of Manganate (VI)

Fuse with KOH

$$MnO_2 \xrightarrow{\hspace{3cm}} MnO_4^{2-}$$

Oxidize with air or KNO_3

Electrolytic oxidation

$$MnO_4^{2-} \xrightarrow{\hspace{3cm}} MnO_4^-$$

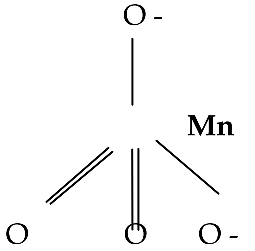
in alkaline solution

In the laboratory manganese (II) ion salt is oxidized by peroxodisulplate to permanganate

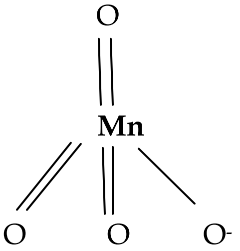
$$2Mn^{+2} + 5S_2O_8^{2-} + 8H_2O \rightarrow 2MnO_4^- + 10SO_4^{2-}\ 16H^+$$

Properties-

1. Forms dark purple crystals
2. Not very soluble in water
3. Decomposes when heated at 513K
   $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$

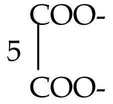


Tetrahedral manganese (green)ion



Tetrahedral Permanganate (purple) ion

MnO_4 is a strong oxidizing agent, both in neutral & acidic medium
Acidified $KMnO_4$ oxidises oxalates to CO_2, Iron(II) to iron (III), nitrites to nitrates and iodides to free iodine The half reaction of reductants are-



$$5\begin{matrix}COO-\\ |\\ COO-\end{matrix} \rightarrow 10CO_2 + 10e-$$

$Fe^{+2} \rightarrow 5Fe^{+3} + 5e-$

$5NO_2^- + 5H_2O \rightarrow 5NO_3^- + 10H^+ + 10e-$

$10I^- \rightarrow 5I_2 + 10e-$

Full reactions can be written by adding the half reactions of $KMnO_4$ to half reactions of the reducing agents and balancing them.

<u>Acidic solutions –</u>

$10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{+2} + 8H_2O + 5I_2$ (iodides to KI)

$5C_2O_4^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{+2} + 8H_2O + 10CO_2$ (oxalate ions to CO_2)

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{+2} + 4H_2O + 5Fe^{2+}$ (Fe^{2+}(green) to Fe^{3+} (yellow))

$5S^{2-} + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{+2} + 8H_2O + 5S$ (H_2S to S)

$5SO_3^{2-} + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{+2} + 3H_2O + 5SO_4^2$ (sulphites to sulphates)

$5NO_2^- + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{+2} + 3H_2O + 5NO_3^-$ (nitrites to nitrates)

<u>Neutral medium</u> -

$2MnO_4^- + H_2O + I^- \rightarrow MnO_2 + OH^- + IO_3^-$ (iodides to iodates)

$8MnO_4^- + H_2O + 3S_2O_3^{2-} \rightarrow 8MnO_2 + 2OH^- + 6SO_4^2$ (thiosulphates to sulphates)

$MnO_4^- + 2H_2O + 3Mn^{2+} \rightarrow 4H^+ + 5MnO_2$ (Manganese salt to Mn^{2+})

Uses- Used as uxidant, used for bleaching wool, cotton, silk and decolorization of oils.

<u>The Inner Transition elements (*f*- Block)</u>

Consists of two series:-

Lanthanoides (Ln; general Symbol)	Actinoides
(14elements following La)	(14 elements following Ac)

Lanthanoides :-

Electronic Configuration:-

Atomic No.	Name	Symbol	E.C.
57	Lanthanum	La	$5d^1 6s^2$
58	cerium	Ce	$4f^1 5d^1 6s^1$
59	praseodymium	Pr	$4f^3 6s^2$
60	Neodymium	Nd	$4f^4 6s^2$
61	Promethium	Pm	$4f^5 6s^2$
62	Samarium	Sm	$4f^6 6s^2$
63	Euroduim	Eu	$4f^7 6s^2$
64	Gadolinium	Gd	$4f^7 5d^1 6s^2$
65	Terbium	Tb	$4f^9 6s^2$
66	Dysprosium	Dy	$4f^{10} 6s^2$
67	Holmium	Ho	$4f^{11} 6s^2$
68	Erbium	Er	$4f^{12} 6s^2$
69	Thulium	Tm	$4f^{13} 6s^2$
70	Ytterbium	Yb	$4f^{14} 6s^2$
71	Lutetium	Lu	$4f^{14} 5d^1 6s^2$

Atomic & Ionic Series :- Decrease from La to Lu is due to Lanthanoid Contraction (The shielding of one 4*f* electron by another less than that by one d electron by another & the increase in nuclear charge along the series.

The almost identical radii of Zr (160pm.) and Hf (159), a consequence of the lanthanoid contraction, account their occurrence together in nature and for the difficulty faced in their separation.

Colour and Para magnetism

Ln^{3+} are coloured both in solid and in aqueous solution due to the presence of f electrons.
La^{3+} and Lu^{3+} do not show any colour. However absorption bands are narrow probably because of the excitants with in f level.
Ln^{3+} are paramagnetic except La^{3+}& Ce^{4+} (f^0 type) &f^{14} type (Yb^{2+}& Lu^{3+}). Paramagnetism rises to maximum in Neodymium .

Ionization enthalpies

I.E. depends on the degree of stability of empty, half filled and completely filled f-level.
This is indicated from the abnormally low values of the third ionization enthalpy of La, Gd, Lu.

Oxidation states.:-

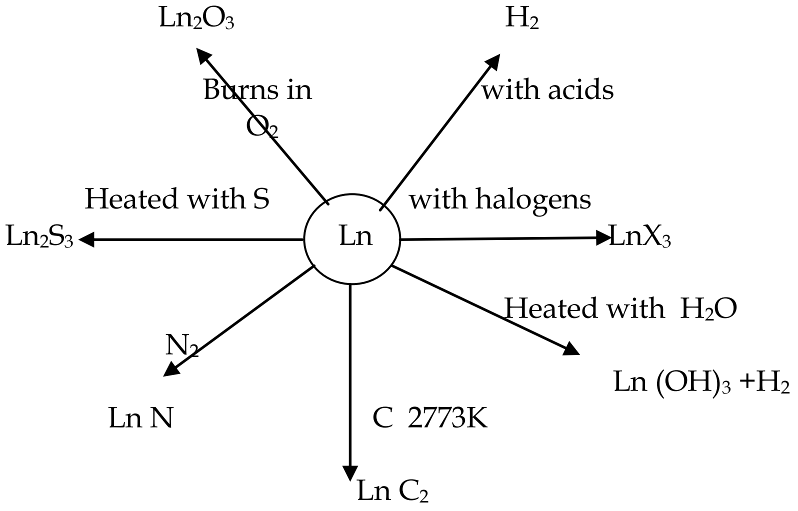
Ln^{3+} compounds are predominant species. +2 & +4 ions in solution or in solid compounds are also obtained occasionally.
Ce (IV) formation is favoured due to extra stability of noble gas configuration, but it is a strong oxidant reverting to the common +3 state .
Pr, Nd, Tb and Dy also exhibit +4 state but only in oxides, MO_2
Eu^{2+} is formed by losing the two s- electrons & its +7 configuration.

Properties and use :-

Ln are silvery white soft metals and tarnish rapidly in air. Hardness increases with increasing atomic number. M.pt. ranges from 1000K – 1200K
Sm is steel hard. (m.pt 1623K)

Chemical behavior

In general earlier members of the series are quite reactive similar to Ca, with increasing atomic number they behave more like aluminum.
$Ln^{3+}(aq) + 3e^- \rightarrow Ln(s)$



$$Ln + C \xrightarrow{\Delta} Ln_3C + Ln_2C_3 + LnC_2 \text{ (carbides)}$$

Use :- Used in the production of alloy steels for plates & pipes eg. Mischmetal is an alloy which consists of a lanthanoid metal (95%) and iron (5%) and trace of S, C, Ca and Al. A good amount of this allay is used in Mg-based alloy to produce bullets, shell & lighter flint.

- Mixed oxides of Ln are used as catalyst in petroleum cracking .
- Ln oxides are used as phosphors in television screens & similar fluorescing surfaces.

The Actinoids:-

Atomic no.	Name	Symbol	E.C.
89	Actinium	Ac	$6d^{1}7s^{2}$
90	Thorium	Th	$5f^{1}6d^{1}7s^{2}$
91	Protactinium	Pa	$5f^{2}6d^{1}7s^{2}$
92	Uranium	U	$5f^{3}6d^{1}7s^{2}$
93	Neptunium	Np	$5f^{4}6d^{1}7s^{2}$
94	Plutonium	Pu	$5f^{6}7s^{2}$
95	Americium	Am	$5f^{7}7s^{2}$
96	Curium	Cm	$5f^{7}6d^{1}7s^{2}$
97	Berkelium	Bk	$5f^{9}7s^{2}$
98	Californium	Cf	$5f^{10}7s^{2}$
99	Einsteinium	Es	$5f^{11}7s^{2}$
100	Fermium	Fm	$5f^{12}7s^{2}$
101	Mendelevium	Md	$5f^{13}7s^{2}$
102	Nobelium	No	$5f^{14}7s^{2}$
103	Lawrencium	Lr	$5f^{14}6d^{1}7s^{2}$

Although the naturally occurring elements & the earlier member have relatively long half lives, the latter members have values ranging from a day to 3 minutes for Lr (Z=103) These facts and high radioactivity renders their study more difficult.

Electronic Configuration

The irregularities in the electronic configurations of the actinoids like those of in the lanthanoids are related to the stability of f^0 ,f^7 and f^{14} occupancies of the 5*f* orloitals.
Eg.Am : [Rn] $5f^{7}7s^{2}$
Cm : [Rn] $5f^{7}6d^{1}7s^{2}$

5f orbital can & do participate in bonding.
Common oxidation state is +3
The maximum oxidation state increases from +4 in Th, +5 in Pa, +6 in U and +7 in Np but decreases in succeeding elements.

Magnetic Properties:- the variation of magnetic properties with the no. of unpaired 5*f* electrons is similar to that of Ln.

Ionic Sizes: Decrease in size due to increase in the effective nuclear charge on the outermost shell and poor shielding by 5f electrons. This is referred to as **actinoid contractions.**

Ionization Enthalpy :

The I.E. of early actinoids is lesser than that of early Ln as when 5f orbitals are beginning to be occupied, they will penetrate less into the inner core of electrons. The 5f electrons, will therefore, be more effectively shielded from the nuclear charge than are the 4f electrons of the corresponding Ln. Because the outer electrons are less firmly held, they are available for bonding in the actinoids.

Physical and Chemical Reactivity

The actinoids are highly reactive when they are finely divided.

Actinoid $\xrightarrow{\text{Boiling water}}$ $M_xO_y + MH_n$

moderate temp

Actinoid + Non metal $\longrightarrow$ Corresponding compound

Actinoid + HCl ➔ M_xO_y oxide layer

Actinoid + HNO_3 ➔ M_xO_y

Actinoid + Alkali ➔ No reaction

Metallic radii of actinoids is more as compared to lanthanoids.

Comparison With Lanthanoids

1. Structural variability in actinoids is obtained due to irregularities in metallic radii which are greater then lanthanoids.
2. Magnetic properties in actinoids are more complex than lanthanoids.
3. Ionization enthalpies of early actinoids, though not accurately known are lower than early lanthanoids. This is because 5f electrons penetrate less into the inner core and hence the outer electron are less firmly held, they are available for bonding in actinoids.

Applications of d-and f Block Elements

1 Iron and steel are important construction materials. Their production is based on reduction of iron oxides, removal of impurities, and addition of carbon and alloying metals such as Cr, Mn, and Ni.

2 TiO is used in pigment industry.

3 MnO_2 is used in battery cell. Also Zn and Ni/Cd.

4 Elements of group II are coinage metals.

5 V_2O_5 catalyses oxidation of SO_2 in contact process,

6 Iron catalyst is used in Haber's process.

7 $TiCl_4$ and $Al(CH_3)_3$ forms Ziegler-Natta Catalyst.

8 Ni complexes are used in polymerization of alkynes.

Assignment

Chapter 8: d -and f -Block Elements

1. Describe the general characteristics of transition elements with special reference to the following :
   - (i) Variable oxidation states
   - (ii) Complex formations.
   - (iii) Formations of coloured ions.

2. (i) What are interstitial compounds? Why are such compounds well known for transition elements?
   (ii) What are alloys? Name an alloy which contains a lanthanoid metal.

3. How is it that several transition metals act as catalysts? Give two examples of reactions catalyzed by them?

4. What is the effect of increasing the pH on a solution of potassium dichromate?

5. Complete the following reactions:
   $Cr_2O_7^{2-}(aq.) + I^-(aq.) + H^+ \longrightarrow$
   $MnO_4^-(aq.) + Fe^{2+}(aq.) + H^+(aq.) \longrightarrow$
   $MnO_4^-(aq.) + S_2O_3^{2-}(aq.) + H_2O(l) \longrightarrow$
   $5NO_2^-(aq.) + 2MnO_4^-(aq.) + 6H^+(aq.) \longrightarrow$
   $Cr_2O_7^{2-}(aq.) + H_2S(g) + H^+(aq.) \longrightarrow$
   $Cr_2O_7^{2-}(aq.) + Fe^{2+}(aq.) + H^+(aq.) \longrightarrow$
   $MnO_2(s) + KOH(aq.) + O_2 \longrightarrow$
   $2CrO_4^{2-} + 2H^+ \longrightarrow$
   $Cr_2O_7^{2-}(aq.) + 3Sn^{2+} + 14H^+ \longrightarrow$

6. Compare the chemistry of actinoids with that of lanthanoids with reference to
   (i) electronic configuration (ii) oxidation state
   (iii) atomic sizes (iv) chemical reactivity

7. When chromite ore FeCr2O4 is fused with NaOH in presence of air, a yellow coloured compound (A) is obtained which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KC*l* forms a orange coloured crystalline compound (C).
   (i) Write the formulae of the compounds (A), (B) and (C).
   (ii) Write one use of compound (C).

8. What may be the possible oxidation states of the transition metals with the following d electronic configurations in the ground state of their atoms:
   $3d^34s^2$, $3d^54s^2$ and $3d^64s^2$. Indicate relative stability of oxidation states in each case.

9. Calculate the number of unpaired electrons in following gaseous ions: Mn^{3+}, Cr^{3+}, V^{3+} and Ti^{3+}. Which one of these is the most stable in aqueous solution?

10. How would you account for the following:
    (a) The metallic radii of the third(5d) series of transition metals are virtually the same as those of corresponding group members of the second (4d) series.
    (b) Among lanthanoids, Ln(III) compounds are predominant. However, occasionally in solutions orin solid compounds,+2 and+4 ions are also obtained.
    (c) The $E^0_{M2+/M}$ for copper is positive (0.34V), copper is the only metal in the first series of transition elements showing this behavior.
    (d) The higher oxidation states are usually exhibited by the members in the middle of the series of transition elements.
    (e) Actinoid contraction is greater than lanthanoid contraction.
    (f) Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4.
    (g) Transition metals show variable oxidation states.
    (h) Actinoids show irregularities in their electronic configurations.

11. a) Which metal in the first transition series(3d series) exhibits +1 oxidation state most frequently and why?
    b) Which of the following cations are coloured in aqueous solution and why?
    Sc^{3+}, V^{3+}, Ti^{4+} , Mn^{2+}

12. In a terrorist activity in the Mumbai nearly ten persons were killed and 50injured due to continuous showering of bullets on them by terrorists. Agroup of persons rushed to the spot immediately and helped the injured toreach the nearby hospital.
    (i) Which kind of value is reflected by these persons by doing this?
    (ii) Which alloy is used in the preparation of bullet?

13. It is a general belief that we should not come out of the house to see "SolarEclipse" because it can have evil impact on life but nowadays educatedpeople allow their children to see solar eclipse, treating it as a natural sciencephenomenon, but children are advised to see them by U.V. protectedsun glasses (crooke's lenses) to avoid harmful impact of UV light on eyes.
    (i) Write the name of transition metal oxide used in making U.V protected lens.
    (ii) By allowing the children to see solar eclipse using U.V. protected lens whichvalue the educated people trying to inculcate in the children.
    (iii) Which rays are present in the light which can damage the eye while viewingsolar eclipse with naked eye?

Practice Assignment

Chapter 8: d -and f -Block Elements

1. What is Lanthanide contraction? What effect does it have on the chemistry of the elements which follow lanthanoids.

2. Why is HCl not used to acidify a permanganate solution in volumetric estimations of Fe^{2+} or $C_2O_4^{2-}$?

3. Why are Zn , Cd and Hg normally not regarded as transition metals ?

4. Which of the following ion is paramagnetic: Sc^{3+} (Z=21), Cu^{+} (Z=29).

5. Why is the third ionization energy of Manganese (Z=25) unexpectedly high?

6. Evaluate the magnetic moment of a divalent ion in aqueous solution if its atomic no. is 25.

7. Explain why:
   (1) Ce^{3+} can be easily oxidized to Ce^{4+} (At. no. of Ce =58).
   (2) Zr (Z=40) and Hf (Z=70) have very close value of atomic radii.
   (3) The lowest oxidation state of manganese is basic while the highest is acidic.
   (4) CrO_4^{2-} is a strong oxidizing agent while MnO_4^{2-} is not.

8. Predict which of the following will be coloured in aqueous solution?
   Ti^{3+},V^{3+},Cu^{+},Sc^{3+},Mn^{2+} ,Fe^{3+},Co^{2+}

9. Explain the following observations:
   (i) In general the atomic radii of transition elements decrease with atomic number in a given series.
   (ii) The E^{o} value for Mn^{3+}/Mn^{2+} couple is much more positive than for Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+} couple.
   (iii) Cu^{+} ion is unstable in aqueous solutions.
   (iv) Although Co^{2+} ion appears to be stable, it is easily oxidised to Co^{3+} ion in the presence of a strong ligand.
   (v) With the same d^4 d-orbital configuration Cr^{2+} ion is reducing while Mn^{3+} ion is oxidising.
   (vi) The enthalpies of atomisation of the transition elements are quite high.
   (vii) Transition metals form compounds which are usuallly coloured.
   (viii) Transition metals exhibit variable oxidation states.
   (ix) The actinoids exhibit a greater range of oxidation states than the lanthanoids.
   (x) There occurs much more frequent metal-metal bonding in compounds of heavy transition elements (3rd series).
   (xi) There is in general an increase in density of element from titanium (Z=22) to copper (Z=29).
   (xii) The gradual decrease in size (actinoid contraction) from element to element is

greater among the actinoids than that among the lanthnoids. (lanthanoid contraction).

(xiii) The greatest numbers of oxidation states are exhibited by the members in the middle of a transition series.

(xiv) With the same d-orbital configuration (d^4) Cr^{2+} ion is a reducing agent but Mn^{3+} ion is an oxidising agent.

10. What is meant by 'disproportionation' ? Give two examples.

11. Why $Ce^{4+}$is oxidizing and Sm^{2+}, Eu^{2+} are reducing in nature?

12. A mixed oxide of iron and chromium $FeOCr_2O_3$ is fused with sodium carbonate in the presence of air to form an yellow coloured compound (A) On acidification the compound the compound forms an orange coloured compound (B), which is a strong oxidizing agent .
(i) Identify the compounds (A) and (B)
(ii)Write balanced chemical equation for each step.

13. Explain the following facts:
(a) transition metals act as catalysts.
(b)Chromium group elements have the highest melting points in their respective series.
(c) The enthalpies of atomization of transition elements are high.
(d) From element to element the actinoid contraction is greater than the lanthanoid contraction.
(e) The E^o value for the Mn^{3+}/Mn^{2+} couple is much more positive than that for Cr^{3+}/Cr^{2+}
(f) Scandium (Z=21) does not exhibit variable oxidation states and yet it is regarded as a transition element.

14. An element 'A' exists as a yellow solid in standard state . It forms a volatile hydride 'B' which is a foul smelling gas and is extensively used in qualitative analysis of salts. When treated with oxygen ,'B' forms an oxide 'C' which is a colourless , pungent smelling gas.This gas when passed through acidified $KMnO_4$ solution , decolorizes it.'C' gets oxidized to another oxide'D' in the presence of a heterogenous catalyst . Identify A,B,C,D, and also give the chemical equation of reaction of 'C' with acidified $KMnO_4$ solution and for conversion of 'C' to 'D'.

15. (a) A blackish brown coloured solid 'A' when fused with alkali metal hydroxides in the presence of air, produces a dark green compound 'B', which on electrolytic oxidation in alkaline medium gives a dark purple coloured compound C. Identify A, B and C and write the reactions involved.
(b) What happens when acidic solution of green compound (B) is allowed to stand for some time? Give the equations involved .What is this type of reaction called?

Assignment

Chapter 9: Coordination Compounds

1. Write IUPAC name of the following:
   1) $[Pt(NH_3)_2Cl_2]$ 2) $[CoBr_2(en)_2]^+$ 3) $[Ni(NH_3)_6]Cl_2$
   4) $K_4[Fe(CN)_6]^{3+}$ 5) $[NiCl_4]^{2-}$ 6) $[CrCl_2(en)_2]Cl$

2. Write the formulas in the following cases.
   1) Tetrahydroxozincate(II), 2) Hexaamminecobalt(III) sulphate
   3) Hexaammineplatinum(IV), 4) Pentaamminenitrito-N-cobalt(III)

3. Give the formula of each of the following coordination entities:
   (a) Co^{3+} ion is bound to one Cl^-, one NH_3 molecule and two bidentate ethylene diamine(en) molecules.
   (b) Ni^{2+} ion is bound to two water molecules and two oxalate ions.

   Write the name and magnetic behavior of each of the above coordination entities.

4. When a co-ordination compound $CrCl_3.6H_2O$ is mixed with $AgNO_3$, 2 moles of $AgCl$ are precipitated per mole of the compound. Write
   (i) Structural formula of the complex.
   (ii) IUPAC name of the complex.

5. In the ring test for identification of nitrate ion, what is the formula of the compound responsible for the brown ring formed at the interface of two liquids?

6. a) For the complex [Fe(CN)6]3–, write the hybridization type, magnetic character and spin nature of the complex. (At. number : Fe = 26).
   b) Draw one of the geometrical isomers of the complex [Pt(en)2C*l*2]2+ which is optically active.

7. Show the possible isomers of the following coordination entities?
   (i) $[Cr(C_2O_4)_3]^{3-}$ (ii) $[Co(NH_3)_3Cl_3]$ (iii) $[Co(en)_2Cl_2]Cl$

8. Name the isomerism exhibited by the following pair of coordination compounds:
   $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$

   Give one chemical test to distinguish between these two compounds.

9. Using valence bond theory, predict the geometry and hybridization of $[Cr(NH_3)_6]^{3+}$ ion, $[Fe(CN)_6]^{3-}$ (paramagnetic due to single unpaired electron) and $[FeF_6]^{3-}$ (paramagnetic due to 5 unpaired electron) [Cr = 24, Fe=26].

10. How many ions are produced from the complex $[Co(NH_3)_6]Cl_2$ in aqueous phase.

11. What is spectrochemical series? Explain the difference between a weak field ligand and a strong field ligand.

12. (i) Draw a sketch to show the splitting of d- orbitals in an octahedral crystal field. State for a d^6 ion how the actual configuration of the split d- orbitals in an octahedral crystal field is decided by the relative values of Δ^o and P.
    (ii) On the basis of CFT, write the electronic configuration of d^4 ion if $\Delta_0 > P$.

13. Give reasons:
    1) $K_3[Fe(CN)_6]$ is weakly paramagnetic whereas $K_3[FeF_6]$ is highly paramagnetic.
    2) Though CO is a weak lewis base yet it forms a number of stable metal carbonyls . Explain.

14. Compare the following complexes with respect to their shape, magnetic behaviour and the hybrid orbitals involved: (i) $[CoF_4]^{2-}$, (ii)$[Cr(H_2O)_2(C_2O_4)_2]^-$
    (Atomic number Co = 27, Cr =24)

15. Discuss briefly giving an example in each case the role of coordination compounds in:
    (i) biological systems (ii) medicinal chemistry
    (iii) analytical chemistry (iv) metallurgy of metals.

16. (a) What is a ligand? Give an example of a bidentate ligand.
    (b) Explain as to how the two complexes of nickel, $[Ni(CN)_4]^{2-}$ and $Ni(CO)_4$, have different structures but do not differ in their magnetic behaviour. (Ni =28)

17. Explain the following:
    (a) The π-complexes are known for transition elements only.
    (b) Nickel(II) does not form low spin octahedral complexes.
    (c) $[Fe(CN)_6]^{4-}$ and $[Fe(H_2O)_6]^{2+}$ are of different colours in dilute solutions.

18. Hard water does not form leathers with soap. Rita uses a washing powdercontaining sodium metapolyphosphate and ethylenediamine tetracetate(EDTA) while Sita is using ordinary washing power.
    (a) Which washing powder is move effective for washing clothes in hard waterand why?
    (b) Name the values associated with the above passage.

19. A lot of children, working in a lead industry were rescued by NGO's activists.The children sent to the hospital and found to be excess exposure tolead so called lead poisoning.
    (i) Name the ligand (compound) used for treatment of Lead poisoning.
    (ii) During this rescue operation which values are shown by NGO's activists?
    (iii) Write the reaction involved for removal of lead from living organism.

20. Cancer is not a communicable disease. It occurs due to unlimited growth ofbody cells leading to tumours. We should shake hand, eat together withpeople suffering from cancer. These activities boost up the confidence inthem for living.
    (i) Write the name of coordination compound used as a chemotherapeutic agentto curb the growth of tumours.
    (ii) By showing such attitude to cancer patients, mention the values reflectedby us.

Practice Assignment

Chapter 9: Coordination Compounds

1. Write IUPAC name of the following:
   1) $[Pt(NH_3)_2Cl(NH_2CH_3)]Cl$
   2) linkage isomer of $[Co(NH_3)_5(ONO)]^{2+}$
   3) $[Co(NH_3)_6]Cl_3$
   4) $[Co(NH_3)_4Cl(NO_2)]Cl$
   5) $[Mn(H_2O)_6]^{2+}$
   6) $[Co)(en)_3]^{3+}$
   7) $[Cr(H_2O)_4Cl_2]Cl$
   8) $[Co(NH_3)_4(H_2O)_2]Cl_3$
   9) $[Pt(NH_3)_4][NiCl_4]$

2. Give the electronic configuration of the
   (a) d-orbitals of Ti in $[Ti(H_2O)_6]^{3+}$ ion in an octahedral crystal field.
   (b) Why is this complex coloured? Explain on the basis of distribution of electrons in the d-orbitals.
   (c) How does the colour change on heating $[Ti(H_2O)_6]^{3+}$ ion?

3. A metal ion M^{n+} having d^4 valence electronic configuration combines with three didentate ligands to form a complex compound. Assuming $\Delta o > P$
   a. draw the diagram showing d orbital splitting during this complex formation.
   b. Write the electronic configuration of the valence electrons of the metal M^{n+} ion in terms of t_{2g} and e_g.
   c. What type of hybridization will M^{n+} ion have?
   d. Name the type of isomerism exhibited by this complex.

4. Write the shape of $Fe(CO)_5$, $Mn_2(CO)_{10}$, $Co_2(CO)_8$, $Ni(CO)_4$ molecule

5. For the complex $[Fe(en)_2Cl_2]Cl$, (en = ethylene diamine), identify
   1) The oxidation number of iron.
   1) The hybrid orbitals and the shape of the complex
   2) The magnetic behaviour of the complex
   3) The number of geometrical isomers
   4) Whether there is an optical isomer
   5) Name of the complex. (At. No. of Fe =26)

6. Write the formulas in the following cases.
   1) Tetrabromidocuprate(II)
   2) Diamminedichloridoplatinum(II)
   3) Amminebromidochloridonitrito-N-platinate (II)
   4) Dichlorodobis (ethane-1,2-diamine) platinum (IV) nitrate

Chapter 10- Haloalkanes and Haloarenes

POLYHALOGEN COMPOUNDS

1. CH_2 CL_2 (Methylene Chloride) / (Dichloromethane)

Uses: Used as a solvent as a paint remover, propellant in aerosol, as a process solvent in the manufacture of drugs and as a metal cleaning and finishing solvent.
Harmful effects: Harms human central nervous system. Higher level in air causes dizziness, nausea, tingling and numbness in the fingers and toes. Direct contact with skin causes intense burning and can burn cornea of eyes.

2. $CHCl_3$ (chloroform/trichloromethene)

Uses: Solvents, fats, alkaloids, iodine and other substances, in production of Freon refrigerant R-22. Inhaling chloroform vapours depresses the central nervous system. Was used as an anesthetic but now has been replaced by less toxic anesthetics.

$$CHCl_3 \quad + \quad O_2 \xrightarrow{\text{Light}} \underset{\text{(Carbonyl chloride)}}{2COCl_2} \quad + \quad 2HCl$$

Chloroform is slowly oxidized by the presence of light to an extremely poisonous gas, phosgene which when inhaled may cause damage to liver, kidneys, and some people develop sores when the skin is immersed in closed dark coloured bottles completely filled so that air is kept out.

3. CHI_3(lodoform/ Triiodomethane)

It has strong unpleasant smell .It was used as an antiseptic but the antiseptic properties are due to the liberation of I_2 and not due to CHI_3. Due to its objectionable smell objectionable smell, other formulations containing I_2 are used.

4. **CCL_4(carbon tetrachloride/ Tetra chloromethane)**

Uses: Used in synthesis of chlorofluorocarbons, manufacture of refrigerants and propellants or aerosol cans, s a solvent, cleaning fluid, fire extinguishers.
Harmful effects: Exposure to CCl_4 may cause liver cancer, dizziness, lightheadedness, nausea and vomiting which can cause permanent damage to nerve cells. When CCl_4 is released into the air , it rises to the atmosphere and depletes the ozone layer which increases human exposure to UV rays, leading to increased skin cancer, eye diseases and disorders and possible disruptions to the immune system.

5. Freon (Chlorofluoro carbon compounds of CH_4 and C_2H_6)

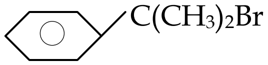
Freon is stable, unreactive, non toxic, non corrosive and easily liquefiable gases. Eg. Freon 12 (CCl_2F_2)
Preparation- $CCl_4 \quad + \quad 2\ AgF\ /\ SbF_2 \longrightarrow CCl_2F_2$ (Swartz reaction)
Uses- Aerosol propellants, refrigeration and air conditioning.
Freons, eventuall diffuse unchanged into the stratosphere here it initiates radical chain reaction that can upset O_3 balance.

6. **DDT (p,p′-Dichlorodiphenyltrichloromethane**) It is the first organic chlorinated nsecticide.
Uses- as used against mosquito that spreads malaria and lice that carry typhus. Later, many species of insects developed resistance to DDT, and it as also discovered to have toxicity towards fish. DDT is not metabolized very rapidly by animals; instead it is deposited and stored in fatty tissues.

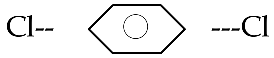
Assignment

Chapter 10: Haloalkanes and Haloarenes

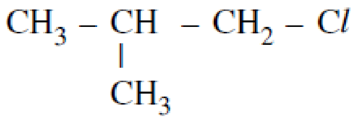
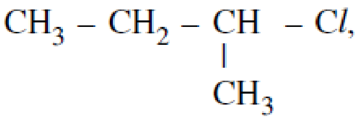
1. Name the following halides according to IUPAC system:

   (a) $CH_3CH(Br)CH=C(CH_3)CH_2Cl$ (b) 

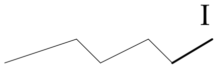
   (c) $CH_3CH(CH_3)CH(Br)CH_3$ (d) $ClCH_2C=CCH_2Br$

   (e) 

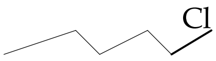
   (f) $CH_3CH \equiv C\text{-}I$

2. Out of  $CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2-Cl$ and  $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{CH}}-Cl$, which is more reactive towards S_N1 reaction and why ?
3. What happens when bromine attacks $CH_2=CH\text{-}CH_2\text{-}C \equiv CH$?
4. Write the structures of the following organic compounds:
   - (i) 2-Chloro-3-methylpentane
   - (ii) 1-Chloro-4-ethylcyclohexane
   - (iii) 2-(2-Chlorophenyl)-1-iodo octane
   - (iv) 4-tert-Butyl-3-iodoheptane

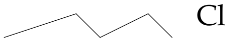
5. Answer the following questions:
   - (i) What is meant by chirality of the compound? Give an example.
   - (ii) Which of the following compounds is more easily hydrolysed by KOH and why?
     $CH_3CH(Cl)CH_2CH_3$ or $CH_3CH_2CH_2Cl$
   - (iii) Which one undergoes S_N2 faster and why?



Or



6. Which one of the following reacts faster in an S_N1 reaction and why?



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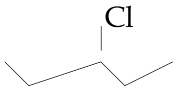


7. State one use of DDT and iodoform. Why chloroform is kept in dark coloured bottles completely filled?

8. What are ambident nucleophiles? Explain with the help of an example.

9. Write short notes on:
   (a) Fittig reaction (b) Swartz reaction

10. Account for the following:
    a) tert-Butyl chloride reacts with aqueous NaOH by S_N1 mechanism while n-butyl chloride

reacts by S_N2 mechanism.

b) Among HI, HBr and HCl, HI is most reactive.
c) Alkyl halides though polar, are immisible with water.
d) Chlorobenzene is extremely less reactive towards nucleophillic substitutionreaction.
e) C–C*l* bond length in chlorobenzene is shorter than C–C*l* bond length in CH3–C*l*.
f) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
g) SN1 reactions are accompanied by racemization in optically active alkyl halides.

11. Carry out the following conversions:
i) 1-Chlorobutane to n-octane
ii) Toluene to benzyl alcohol
iii) Benzyl chloride to benzyl alcohol

12. What will be the mechanism for the substitution of -Br by –OH in $(CH_3)_2C(Br)CH_2CH_3$?

13. Identify the following compounds from A to T:

(a) $CH_3CH_2CH_2Cl + NaI \xrightarrow[\text{heat}]{\text{acetone}} A$

(b) $(CH_3)_3CBr + KOH \xrightarrow{\text{Ethanol, heat}} B$

(c) $CH_3CH(Br)CH_2CH_3 + NaOH\ (aq) \longrightarrow C$

(d) $CH_3CH_2Br + KCN \xrightarrow{\text{ethanol}} D$

(e) $(CH_3)_3CBr + H_2O \xrightarrow{\text{heat}} E$

(f) $(CH_3)_2CHCH(Br)CH_2CH_3 \xrightarrow{C_2H_5ONa,\ \text{heat}} F$

(g) $CH_3CH_2Cl + SbF_3 \xrightarrow{\text{heat}} G$

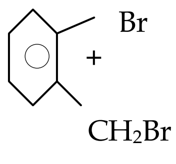
(h) $CH_2{=}CHCH_2Br + H_2O \longrightarrow H$

(i) $C_6H_4CH_2Cl + C_2H_5ONa \longrightarrow I$

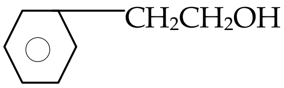
(j) $CH_3CH_2CH_2OH + SOCl_2 \longrightarrow J$

(k) $CH_3CH_2CH{=}CH_2 + HBr \xrightarrow{\text{peroxide}} K$

(l) $CH_3CH{=}C(CH_3)_2 + HBr \longrightarrow L$

(m)


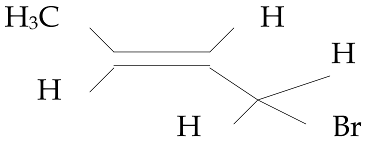
$+ \quad CH_3NH_2 \longrightarrow M$

(n)


$+ HBr \longrightarrow N$

Practice Assignment
Chapter 10: Haloalkanes and Haloarenes

1. Name the following halides according to IUPAC system:
   (i) $(CCl_3)_3CCl$
   (ii) $CH_3C(p\text{-}ClC_6H_4)_2CH(Br)CH_3$
   (iii) $(CH_3)_3CCH{=}C(Cl)C_6H_4I\text{-}p$
   (iv)



2. Arrange the following compounds in an increasing order of their acid strengths:
   $(CH_3)_2CHCOOH$, $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$

3. Write the structures of the following organic compounds:

4. Arrange the following compounds in increasing order of reactivity towards nucleophillic substitution reaction:
   1,4-Dichlorobenzene , 4-Methoxy chlorobenzene, benzene , 2,4,6- Trinitro chlorobenzene

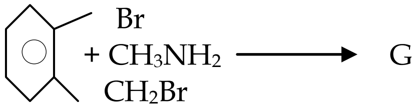
5. Account for the following:
   a) The dipole moment of chloro benzene is lower than that of cyclohexyl chloride.
   b) Vinyl chloride is unreactive towards nucleophillic substitution reactions.
   c) Grignard reagent should be prepared under anhydrous conditions.
   d) Haloarenes are much less reactive than haloalkanes towards nucleophilic substitution reactions.

6. Carry out the following conversions:
   (i) Propene to propyne
   (ii) Ethanol to but-1-yne

7. Identify the following compounds from A to K:

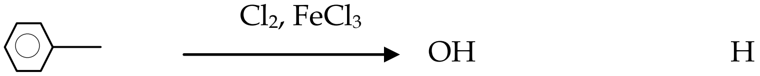
   (i) $(CH_3)_3CBr + H_2O \xrightarrow{heat}$ A
   C_2H_5ONa, heat
   (ii) $(CH_3)_2CHCH(Br)CH_2CH_3$B $\longrightarrow$

   (iii) $CH_2{=}CHCH_2Br + CH_3C \equiv CNa \xrightarrow{liq\ NH3}$ C
   (iv) $C_6H_4CH_2Cl + C_2H_5ONa$ D$\longrightarrow$
   (v) $CH_3CH_2CH_2OH + SOCl_2 \longrightarrow$ E
   (vi) $CH_3CH{=}C(CH_3)_2 + HBr \longrightarrow$ F
   (vii)



   $+ CH_3NH_2 \longrightarrow$ G

(viii)


Cl_2, $FeCl_3$
OH
H

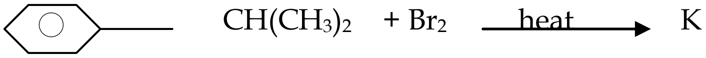
(ix)


CH_2CH_2OH
+ HBr
I

(x)


Cl
NO_2
NO_2
+
C_2H_5ONa
J

(xi)

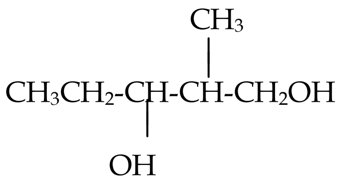

$CH(CH_3)_2$
+ Br_2
heat
K

Assignment

Chapter 11: Alcohols, Phenols and Ethers

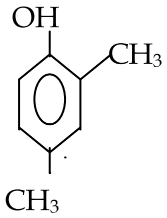
1 Give the I.U.P.A.C. name of the following:

(i)

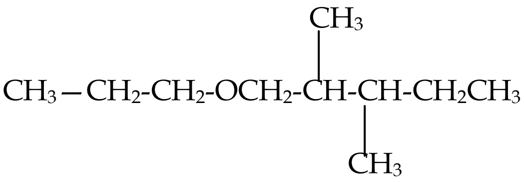


$CH_3CH_2-\underset{\substack{|\\OH}}{CH}-\overset{\substack{CH_3\\|}}{CH}-CH_2OH$

(ii)



(iii)

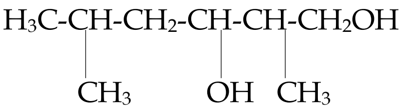


$CH_3-CH_2-CH_2-OCH_2-\overset{\substack{CH_3\\|}}{CH}-\underset{\substack{|\\CH_3}}{CH}-CH_2CH_3$

(iv)

$C_6H_5OCH_2CH_2CH_2CH_2\underset{\substack{|\\CH_3}}{CH}-CH_2CH_3$

(v)



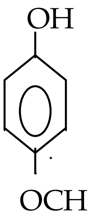
$H_3C-\underset{\substack{|\\CH_3}}{CH}-CH_2-\underset{\substack{|\\OH}}{CH}-\underset{\substack{|\\CH_3}}{CH}-CH_2OH$

2 **Arrange the following as**

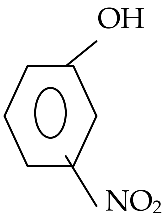
(i) Decreasing order of boiling points:
2-methyl-2-propanol, 1-butanol,2-methyl –1-propanol and 2-butanol.

(ii) Decreasing order of their acidic character:

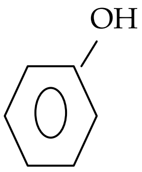
(a)



(b)



(c)



(iii) Increasing reactivity towards Lucas reagent:
1-butanol , 2-methyl-2- propanol , 2-butanol.

3 Write the chemical equation when 1-propanol react with
(i) excess of HBr (ii) H_2SO_4 at 410 K
(iii) H_2SO_4 at 443K (iv) acidified $KMnO_4$

4 How does phenol react with the following?
(i) Acetyl chloride.
(ii) Bromine in water.
(iii) Chloroform in presence of NaOH.

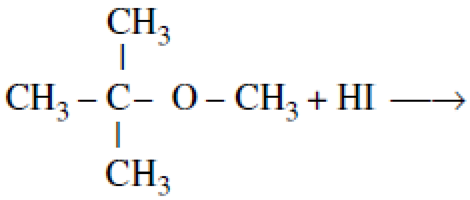
5 Convert
(1) Phenol to picric acid
(2) Cumene to phenol.
(3) Phenol to Salicyaldehyde
(4) Phenol to anisole
(5) Propan-2-ol to 2-Methylpropan-2-ol

6 Explain giving reasons:-
(i) Alcohols are generally soluble in water but alkyl halides are not.
(ii) Phenols exhibit an acidic character.
(iii) Phenols has a smaller dipole moment than methanol.
(iv) 2,3- dimethylbutanol has got lower boiling point than hexanol .
(v) 2-Nitrophenol is more volatile than 4-Nitrophenol.

7 Write the mechanism of the following reaction :

$$2CH_3CH_2OH \xrightarrow[413\ K]{Conc.\ H_2SO_4} CH_3CH_2-O-CH_2-CH_3$$

8 Write the main product(s) in each of the following reactions :

(i) 

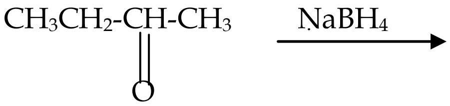
$$CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-O-CH_3+HI\longrightarrow$$

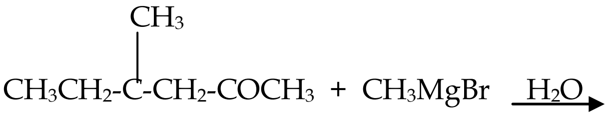
(ii) $CH_3-CH=CH_2 \xrightarrow[(ii)\ 3H_2O_2/OH^-]{(i)\ B_2H_6}$

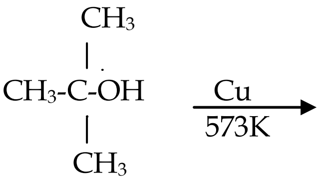
(iii) $C_6H_5-OH \xrightarrow[(ii)\ CO_2,\ H^+]{(i)\ aq.\ NaOH}$

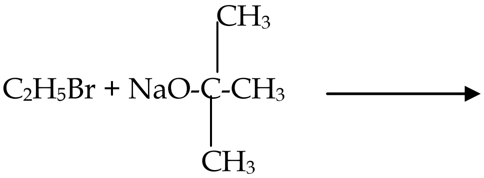
Practice Assignment
Chapter 11: Alcohols, Phenols and Ethers

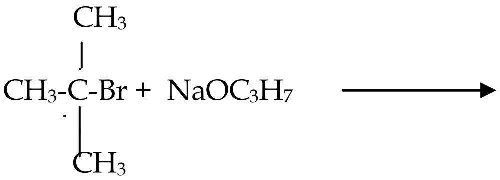
1. Complete the following reactions:

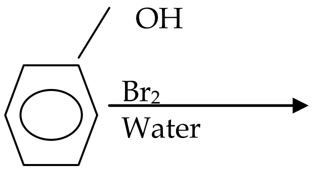
(a) 
$CH_3CH_2\text{-}\underset{\underset{O}{\|}}{C}H\text{-}CH_3 \xrightarrow{NaBH_4}$

(b) 
$CH_3CH_2\text{-}\overset{CH_3}{\overset{|}{C}}\text{-}CH_2\text{-}COCH_3 + CH_3MgBr \xrightarrow{H_2O}$

(c) 
$CH_3\text{-}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{-}OH \xrightarrow[573K]{Cu}$

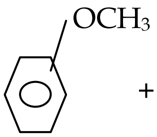
(d) 
$C_2H_5Br + NaO\text{-}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{-}CH_3 \longrightarrow$

(e) 
$CH_3\text{-}\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}\text{-}Br + NaOC_3H_7 \longrightarrow$

(a) 

$\xrightarrow[\text{Water}]{Br_2}$

(g) $CO + 2H_2 \xrightarrow[200\text{-}300\ \text{atm},\ 573\text{-}673\ K]{Cu\text{-}ZnO - Cr_2O_3}$

(h) 

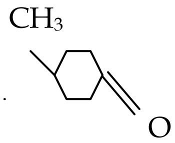
$+ \ CH_3COCl \xrightarrow{AlCl_3}$

2 Convert:
(i) Chlorobenzene to Phenol
(ii) Aniline to phenol
(iii) Propanone to Propene

Assignment

Chapter 12: Aldehydes, Ketones and Carboxylic Acids

1 Write IUPAC names for the following :



(b) $CH_2=CHCH_2CHO$
(c) $(CH_3)_2C=CHCOCH_2CH_3$

2
a) Arrange the following compounds as directed:
b) Acetaldehyde, acetone, Methyl tert-butyl ketone (reactivity towards HCN)
c) Benzoic acid, 3,4-Dinitrobenzoic acid, 4-methoxybenzoic acid
d) $CH_3CH_2CH(Br)COOH$, $CH_3CH(Br)CH_2COOH$, $(CH_3)_2CHCOOH$ (acid strength)
e) a) CH_3CHO, CH_3CH_2OH, CH_3OCH_3, $CH_3CH_2CH_3$(increasing order of their boiling point)
f) b) Ethanal, propanal, propanone , butanone (increasing order of their reactivity towards nucleophilic addition).

3 Give brief description with suitable example:
a) Cannizzaro Reaction
b) Hell-Volhard Zelinsky Reaction.
c) Clemmensen Reduction
d) Wolff-Kishner Reduction.
e) Cross aldol condensation

4 Account for the following:
a) Carboxylic acids have higher boiling points than alcohols of comparable molecular masses.
b) Electrophilic substitution in benzoic acid takes place at meta-position.
c) Monochloroethanoic acid has a higher pKa value than dichloroethanoic acid.
d) Ethanoic acid is a weaker acid than benzoic acid.
e) The boiling points of aldehydes and ketones are lower than of the corresponding acids.

5 How will you convert the following?
a) Acetaldehyde into 2-Butenal
b) Acetic acid to Acetic anhydride
c) Butanol to butanoic acid
d) 4-Methylacetophenone to benzene-1,4-dicarboxylic acid
e) Butan-2-one to butan-2-ol
f) Phenol to 2,4,6- tribromophenol

6 Distinguish between the following
a) CH_3CHO and C_6H_5CHO
b) C_2H_5OH and $CH_3CH_2COCH_2CH_3$
c) C_6H_5COOH and C_6H_5OH

d) $C_6H_5COCH_3$ and $C_6H_5COC_6H_5$
e) CH_3COCH_3 and C_2H_5OH
f) CH_3COCH_3 and C_3H_7OH

7 Complete the following reactions:

(a) $CH_3CO\,CH_3 + NH_2NH_2 \xrightarrow{KOH/glycol}$

(b) $C_6H_5COCH_3 + C_6H_5OH \xrightarrow{NaOH/\ I2}$

(c) $C_6H_5NH_2 \xrightarrow[\Delta]{NaOH/CaO}$

8 (a) Write the structures of A, B, C, D and E in the following reactions :

$$\begin{tikzcd}
C_6H_6 \arrow[r, "CH_3COCl", "Anhyd.AlCl_3"'] & A \arrow[r, "Zn\text{–}Hg/conc.HCl"] \arrow[d, "NaOI"] & B \arrow[r, "(i)\ KMnO_4 - KOH{,}\Delta", "(ii)\ H_3O^+"'] & C \\
 & D + E & &
\end{tikzcd}$$

9 (a) Write the chemical equation for the reaction involved in Cannizzaro reaction.

(b) Draw the structure of the semicarbazone of ethanal.

(c) Why pKa of F-CH_2-COOH is lower than that of $Cl - CH_2 - COOH$?

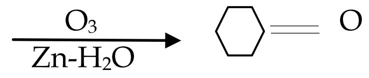
(d) Write the product in the following reaction :

$$CH_3 - CH = CH - CH_2CN \xrightarrow[(ii)\ H_2O]{(i)\ DIBAL\text{-}H}$$

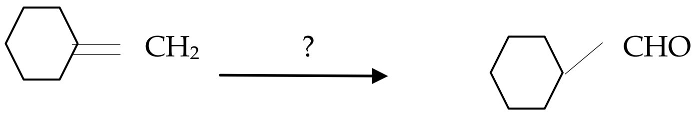
(e) How can you distinguish between propanal and propanone ?

10 Complete the following reaction statements by giving the missing starting material, reagent or product as required:

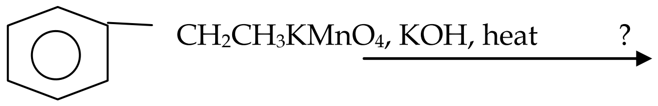
(i) ?



(ii)



(iii)



Practice Assignment

Chapter 12: Aldehydes, Ketones and Carboxylic Acids

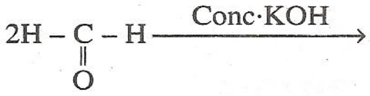
1 Account for the following:
   a) Formaldehyde gives Cannizzaro's reaction whereas acetaldehyde does not
   b) Carboxylic acids do not give the characteristic reactions of carbonyl group.
   c) Aldehydes are more reactive than ketones towards nucleophilic addition reactions.
   d) Chloroacetic acid has lower pKa value than acetic acid.
   e) The aldehydes an ketones undergo a number of addition reactions.
   f) Ethanoic acid is a weaker acid than benzoic acid.

2 How will you convert the following?
   i) Acetophenone to Ethyl benzene
   ii) Acetone to tert-butyl alcohol
   iii) Benzyl alcohol to phenyl ethanoic acid
   iv) Bromobenzene to benzoic acid
   v) p-methyl acetophenone to benzene 1,4 –dicarboxylic acid
   vi) Benzoic acid to benzyl amine
   vii) p-nitrobenzamide to p-nitroaniline
   viii) A primary alcohol to an aldehyde
   ix) Ethanol to acetone
   x) Benzene to acetophenone
   xi) Benzoic acid to benzaldehyde

3 (a) Although phenoxide ion has more number of resonating structures than Carboxylate ion, Carboxylic acid is a stronger acid than phenol. Give two reasons.

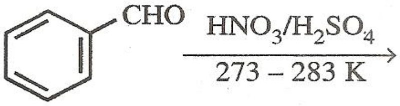
(b) How will you bring about the following conversions ?
   (i) Propanone to propane
   (ii) Benzoyl chloride to benzaldehyde
   (iii) Ethanal to but-2-enal

4 (a) Complete the following reactions :

(i) 

$$2H-\underset{\underset{O}{\|}}{C}-H \xrightarrow{Conc\cdot KOH}$$

(ii) $CH_3COOH \xrightarrow{Br_2/P}$

(iii) 

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

(i) Ethanal and Propanal

(ii) Benzoic acid and Phenol

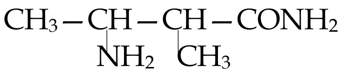
5 An organic compound contains 69.77% carbon, 11.63% hydrogen and the rest is oxygen. The molecular mass of the compound is 86. It does not reduce Tollen's reagent but forms an addition compound with sodium hydrogen sulphite and gives a positive iodoform test. On vigorous oxidation it gives ethanoic and propanoic acids. Deduce the possible structure of the organic compound.

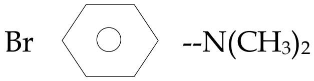
6 An organic compound with molecular formula C9H10O forms 2,4-DNP derivative, reduces Tollen's reagent and undergoes Cannizzaro's reaction. On vigorous oxidation it gives 1,2-benzenedicarboxylic acid. Identify the compound.

Assignment

Chapter 13: Organic Compounds containing Nitrogen

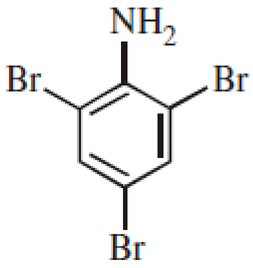
1 Write IUPAC names of the following:

a) 
$CH_3-\underset{NH_2}{\underset{|}{CH}}-\underset{CH_3}{\underset{|}{CH}}-CONH_2$

b) 

c) $O_2N-CH_2-CH_2-CH=CH-CHO$ d) $(CH_3)_3CCN$

e)



2 For an amine RNH_2, write the expression for K_b to indicate its basic strength

3 Describe the following processes giving suitable examples of each:
- i) Diazotization
- ii) Coupling reaction
- iii) Carbyl amine reaction
- iv) Hofmann's bromamide reaction

4 How will you carry out the following conversions:
- i) Nitrobenzene to acetanilide
- ii) Methyl amine to ethyl amine
- iii) Nitrobenzene to phenol
- iv) Toluene to m-nitro benzoic acid
- v) Acetic acid to ethyl amine

5 Write structures of the following:
- i) P- Toluidine
- ii) Picric acid
- iii) Sulphanilic acid

6 Write a chemical reaction in which the iodide ion replaces the diazonium group in a diazonium salt.

7 Write reactions for what happens when:
- a) Phenol is treated with benzene diazonium chloride in presence of NaOH
- b) Aniline is treated with benzaldehyde
- c) Ethyl amine is treated with excess of methyl iodide.

8 Arrange in increasing order of boiling point: $C_2H_5NH_2$, $C2H_5OH$, $(CH_3)_3N$

9 Complete the following reaction equations:

i) $C_6H_5N_2Cl + H_3PO_2 + H_2O \longrightarrow$

ii) $C_6H_5NH_2 + Br_2(aq) \longrightarrow$

10 Write the structures of A, B and C in the following :

(i) $C_6H_5 - CONH_2 \xrightarrow{Br_2/\text{aq. KOH}} A \xrightarrow[0\text{-}5\ ^\circ C]{NaNO_2 + HCl} B \xrightarrow{KI} C$

(ii) $CH_3 - Cl \xrightarrow{KCN} A \xrightarrow{LiAlH_4} B \xrightarrow[\Delta]{CHCl_3 + \text{alc. KOH}} C$

Practice Assignment

Chapter 13: Organic Compounds containing Nitrogen

1. Account for the following:
   a) Ammonolysis of alkyl halide does not give a corresponding pure amine
   b) pK_b for aniline is more than that for methylamine
   c) Boiling point of methylamine is less than that of methanoic acid
   d) Aniline cannot be prepared by Gabriel Pthalimide synthesis
   e) Nitration of toluene is easier compared to nitrobenzene
   f) Before nitration aniline is converted to acetanilide.
   g) Aniline does not undergo Friedel-Crafts reaction.
   h) Methylamine solution in water reacts with ferric chloride solution to give a precipitate of ferric hydroxide.

2. A compound X having molecular formula C_3H_7NO, reacts with Br_2 in presence of NaOH 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.

3. A compound A of the molecular formula $C_3H_7O_2N$ on reaction with Fe and conc. HCl gives a compound B of the molecular formula C_3H_9N. Compound B on treatment with $NaNO_2$ and HCl gives another compound C of the molecular formula C_3H_8O. The compound C gives effervescence with Na. On oxidation with CrO_3, the compound C gives a saturated aldehyde having 3 carbon atoms. Deduce the structures of A, B and C and write the reactions involved.

4. Describe a test to distinguish between each of the following pairs
   a) Ethyl amine and aniline
   b) N-methyl aniline and N,N-dimethyl aniline

5. How will you carry out the following conversions:
   i) Aniline to N-phenyl ethanamide
   ii) Aniline to benzoic acid
   iii) Benzene to m-dichlorobenzene
   iv) 2-nitropropane to acetone
   v) Benzonitrile to acetophenone

Assignment

Chapter 14: Biomolecules

1 State two main differences between globular proteins and fibrous proteins. Give one example of each.

2 a) Write the full forms of DNA and RNA. Write the names of the bases in them.
b) What are three types of RNA molecules which perform different functions?

3 Write chemical equations for the reactions of glucose with
(i)Acetic Anhydride (ii) NH_2OH (iii) HNO_3 (iv) HI

4 Define and classify vitamins. Name the main disease caused due to lack of vitamins and its sources in each of the following ;A , B_6, E ,D, B_{12} and K .

5 (a) Write any two reactions of glucose which cannot be explained by the open chain structure of glucose molecule.
(b) Write the structure of the product obtained when glucose is oxidized with nitric acid.

6 Define enzymes .State the activity of enzyme. How do enzymes differ from ordinary chemical catalysis? Comment on the specificity of enzyme action.

7 In what way is a nucleotide different from a nucleoside? Illustrate with examples?

8 What is essentially the difference between alpha-glucose and beta-glucose? What is meant by pyranose structure of glucose?

9 (a) Name some biological functions of nucleic acids.
(b) What is the name given to the linkage which holds together two nucleotides

10 Exlain what is meant by
(i) a peptide linkage
(ii) a glycosidic linkage

11 a) Write the name of two monosaccharides obtained on hydrolysis of lactose sugar.
b) Why Vitamin C cannot be stored in our body ?
c) What is the difference between a nucleoside and nucleotide ?

12 What is glycogen? How is it different from starch? How is starch structurally different from cellulose?

13 How do you explain amphoteric behaviour of amino acids

14 Define denaturation in proteins.

15 Which of the following is a disaccharide: Starch, Maltose, Fructose, Glucose?

16 Nita’s mother fell ill and the doctor diagnosed her with pernicious anemia.She felt lethargic

and did not have the energy to do work. Nita helped hermother in household work till she recovered.
(i) Name the vitamin whose deficiency caused pernicious anemia.
(ii) Name the sources which will provide this vitamin.
(iii) Mention the values shown by Nita.

17 In a school, lot of emphasis is given to the 3R principle of Reduce, refuseand Recycle. The students observe their teachers following it and they aremade to follow it in school. Rita also follows at home and always tries tosave paper. She also keeps waste paper and waste items separately sothat they be sent for recycling. She does not use plastic bags and takes ajute bag with her while going to the market.
(i) Mention the values shown by Rita.
(ii) If the jute bag is made of cellulose polymer, and name the monomer.
(iii) Name the chemical substance used in cotton, Jute and Rayon fibre.

18 After watching a programme on TV about the adverse effects of junk food and soft drinks on the health of school children, Sonali, a student of Class XII, discussed the issue with the school principal. Principal immediately instructed the canteen contractor to replace the fast food with the fibre and vitamins rch food like sprouts, salad, fruits etc. This decision was welcomed by the parents and the students.

After reading the above passage, answer the following questions:
a) What values are expressed by Sonali and the Principal of the school?
b) Give two examples of water-soluble vitamins.

Assignment

Chapter 15: Polymers

1. Write the names and molecular structures of the monomers of the following and classify them as addition or condensation polymers :
   (i) Natural rubber (ii) Glyptal (iii)) Buna-N (iv) Bakelite
   (v) PVC (vi) Nylon-6 (vii) Neoprene (viii) Polypropene

2. (i) What is the role of t-butyl peroxide in the polymerization of ethene ?
   (ii) Identify the monomers in the following polymer :
   [NH – (CH2)6 – NH – CO – (CH2)4 – CO–]n
   (iii) Arrange the following polymers in the increasing order of their intermolecular forces :
   Polystyrene, Terylene, Buna-S
   .
3. Write the mechanism of free radical polymerization of ethene
4. (a) Describe chain growth and step growth polymerization with the help of an example.
   (b) Classify the following as addition or condensation polymers:
   Nylon-66, Neoprene, Polythene
5. What are elastomers? Give an example of it.

6. (a) What is the difference between nylon-6 and nylon-66?
   (b) What does the part '6,6mean in the name nylon-6,6 ?

7. a) What is the role of Benzoyl peroxide in polymerization of ethane?
   (b) What are LDPE and HDPE? How are they prepared?

8. What is Teflon? What are its uses?

9. Differentiate the following pair of polymers based on the property mentioned against each.
   (i) Novolac and Bakelite (structure)
   (ii) Buna-S and Terylene (intermolecular forces of attraction)

10. What is the repeating unit in the condensation polymer obtained by combining $HO_2CCH_2CH_2CO_2H$ (succinic acid) and $H_2NCH_2CH_2NH_2$(ethylene diamine).

11. How is melamine polymer prepared? Give its two uses. What type of polymer is it?
12. Name the monomers of Nylon2-nylon6 polymer.

13. Two shopkeepers are using LDP (Low Density Polythene) and HDP (Highdensity Polythene) polymers for packing of materials.
    (i) Name the ploythene preferred for packaging.
    (ii) Name the catalyst used in the synthesis of HDP
14. PHBV (Poly-β-Hydroxybutyrate-co-β-hydroxy valerate) is a biodegradablepolymer. It is a copolymer of 3-hydroxy valerate acid and 3-hydroxy pentanicacid.
    (a) How PHBV has found utility in medicines as Capsule?
    (b) Write the name of polymer used in artificial limb popularly known as Jaipurfoot.

CHEMISTRY IN EVERYDAY LIFE

DRUGS

Drugs are chemicals of low molecular masses which interact with macromolecular targets and produce as biological response. When biological response is therapeutic and useful, these chemicals, are called medicines and if taken in higher doses, they behave as poisons. Use of chemicals for therapeutic effect is called Chemotherapy.

Classification of Drugs:

a) On the basis of pharmacological effect: It is useful for doctors because it provides them the whole range of drugs available for treatment of a particular problem. For e.g.: analgesics for pain killing effect, antiseptics kill or arrest growth of microorganisms.

b) On the basis of drug action: It is based on the action of a drug on a particular biochemical process. Eg- antihistamines which inhibit the action of histamines which causes inflammation in the body.

c) On the basis of Chemical structure: Some drugs share a common feature and often have similar Pharmacological activity. Eg; Sulphonamides have H_2N-C_6H_4-SO_2-NHR structural feature in common.

d) On the basis of molecular targets: Drugs usually interact with biomolecules such as carbohydrates, lipids, proteins & nucleic acid. These are called target molecules. Drugs possessing some common structural feature have the same mechanism of action on targets.

DRUG –TARGET INTERACTION

Macromolecules of biological origin perform various functions in the body. For eg- Proteins which perform role of biological catalyst in the body are called ENZYMES & those which are crucial to communication system are called RECEPTORS.

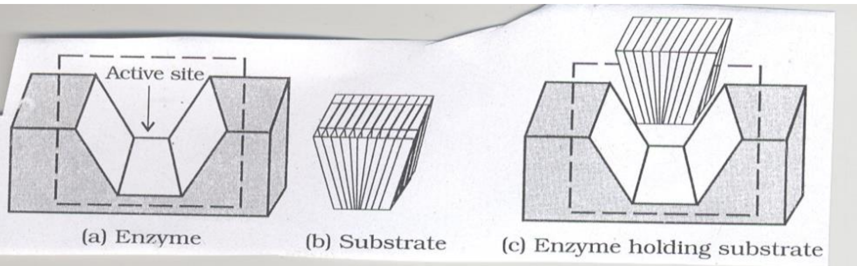
Hormones are biological chemical messengers secreted by endocrine glands. Example- Insulin, noradrenalin.

ENZYMES AS DRUG TARGETS:

a) Catalytic action of enzymes : For understanding interaction between drug and enzyme we first study the function of enzymes.

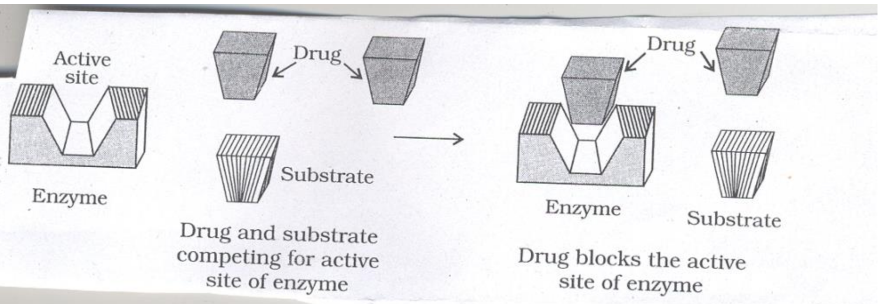
Enzymes hold the substrate for a chemical reaction. Active sites of enzymes hold substrate molecule in a suitable position, so that it can be attacked by the reagent effectively. Substrate binds themselves to the active sites by ionic bonding, hydrogen or by vanderwaals interaction.

(a) Active site of an enzyme (b) Substrate (c) Substrate held in active site of the enzyme



(a) Enzyme (b) Substrate (c) Enzyme holding substrate

Drug and substrate competing for active site

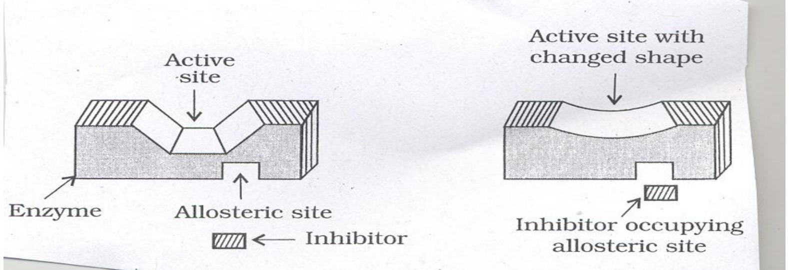


It provides functional groups that will attack the substrate and carry out chemical reaction.

b) Drug-enzyme interaction: Drugs inhibit any of the above mentioned activities of enzymes. These can block the binding site of enzyme and prevent the binding of substrate or can inhibit catalytic activity of enzyme. These are called enzyme inhibitor.
These can occur in two different ways---
   (i) Drugs compete with the natural substrate for their attachment on active sites of enzymes. These are called competitive inhibitors.

   (ii) Some drugs do not bind to the enzyme's active site. These bind to some different enzyme site called allosteric site. This binding of inhibitor at allosteric site changes the shape of the active site in such a way that substrate cannot recognize it.

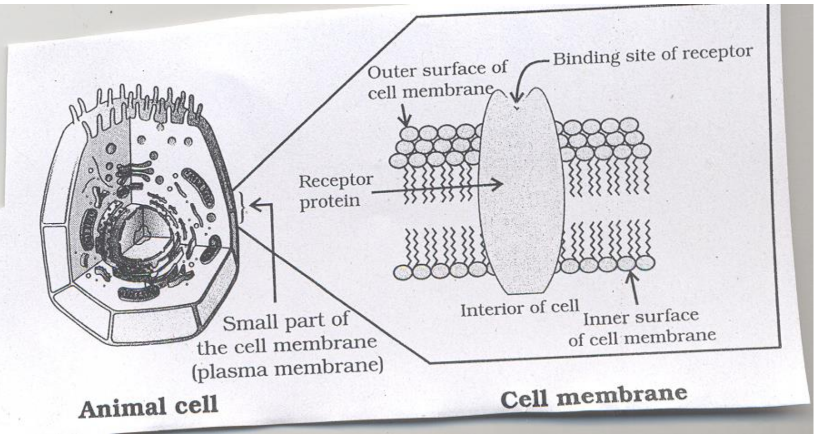
If the bond between an enzyme and inhibitor is a strong covalent bond and it cannot be easily broken, then the enzyme is blocked permanently. The body then degrades the enzyme-inhibitor complex and synthesizes the new enzyme.



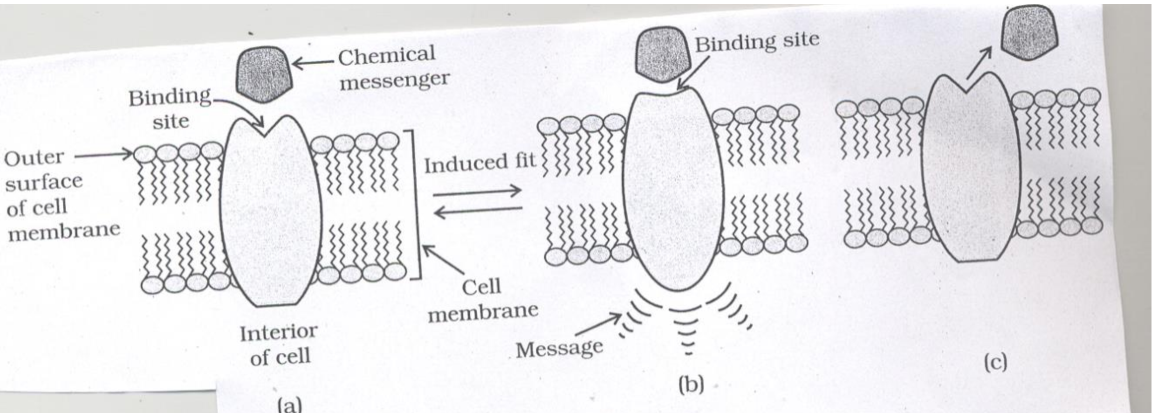
: Non-competitive inhibitor changes the active site of enzyme after binding at allosteric site.

RECEPTORS AS DRUG TARGETS

Receptors are proteins that are crucial to body’s communication process. Receptor proteins are embedded in cell membranes in such a way that their small part possessing active site projects out of the surface of the membrane and opens on the outside region of the cell membrane.



Receptor protein embedded in the cell membrane, the active site of the receptor opens on the outside region of the cell.



(a) Receptor receiving chemical messenger
(b) Shape of the receptor changed after attachment of messenger
removal of chemical messenger.
(c) Receptor regains structure after removal of chemical messenger

There are a large no. of different receptors in the body that interact with different chemical messengers. These receptors show selectivity for one chemical messenger over the other because their binding sites have different shape, structure and aminoacid composition.
Drugs that bind to the receptor site and inhibit its natural function are called antagonists. Drugs that mimic the natural messenger by switching on the receptors are called agonists. These are useful when there is lack of natural chemical messenger.

CHEMICALS IN MEDICINE

The chemical substances used for treatment of diseases and for reducing suffering from pain are called medincines or drugs.

Chemotherapy- is a science in which suitable chemicals are used for treatment of diseases.

1) **Antipyretics**- The chemicals use to lower body temperature in high fever are called antipyretics. Eg- Aspirin, paracetamol and phenacetin

2) **Analgesics**- The chemical substances used to relieve pains without causing impairment of consciousness, mental confusion, incoordination or paralysis or some other disturbances of nervous system are called analgesics. These are of two types.
    a) Non-narcotic drugs or non-addictive drugs- Eg- aspirin, analgin, novalgin, naproxen, ibuprofen & diclofenac sodium or potassium.
    Aspirin: Finds use as antipyretic, prevention of heart attack because of its anti-blood clotting action. Aspirin is supposed to be toxic to liver which gets hydrolysed in stomach giving salicylic acid which sometimes cause bleeding in stomach. Therefore, overdosage and its use in empty stomach should be avoided.
    b) Narcotic drugs or Addictive drugs- Which produce sleep and unconsciousness. These can also be used as analgesics. Eg- morphine, codeine, heroin, marijuana. When used in medicinal doses, they relieve pain and produce sleep. In excessive doses, they produce stupar coma, convulsions and ultimately leading to death. These narcotics are called opiates because they are obtained from opium poppy.

3) **Antiseptics and disinfectants**:
Antiseptics are chemical substances used either to kill or prevent the growth of micro-organisms. These are not harmful to living tissues and can be applied on wounds, ulcers, diseased skin surfaces. They are also used to reduce odours resulting from bacterial decomposition of the body or in the mouth. Eg- Soframycin, Bithional is added to medicated soaps, tincture of Iodine (2-3% soln of iodine in alcohol-water mixture), Iodoform, Boric acid in dilute aqueous solution is antiseptic for eyes etc.
Disinfectants are chemical substances which are used to kill micro-organisms but they cannot be applied on living tissues. They play a major role in water treatment and public health sanitation. These are commonly applied on inanimate objects like floors, drainage system etc. Eg- Cl_2 at a conc. of 0.2 to 0.4 ppm makes water fit for drinking, Phenol derivative, thymol.
Some substances act both as antiseptics and disinfectants. Eg- Dettol (a mixture of chloroxylenol and terpineol), 0.2% soln. of phenol acts as antiseptic & 1% soln acts as disinfectant.

4) **Tranquilizers**: The chemical substances used for treatment of stress, mild and severe mental diseases are called tranquilizers. They release mental tension and reduce anxiety. These are essential component of sleeping pills. These are also called psychotherapeutic drugs. Noradrenaline, a hormone which induces feeling of well being and helps in changing mood. If the level of nordrenaline is low for some reason, then signal sending activity becomes low, and the person suffers from depression. In such situations, antidepressant drugs are required.
Eg: iproniazid and phenalzine are antidepressant drugs. They inhibit the enzyme which catalyse the degradation of noradrenaline.
Chlordiazepoxide and meprobamate are used to relieve tension.
Equanil, diazepam,veronal and serotonin are used in controlling depression and hypertension

Barbiturates like veronal, amytal, membutal, seconal and luminal are hypotonic ie: sleep producing agents.

5) **Antimalarials**: These are chemical substances used for treatment of malaria. Eg- Chloroquine, paraquine etc.

6) **Antimicrobials**: are chemical substances used to cure infections due to micro-organisms. The disease in human beings may be caused due to variety of micro-organisms like virus, bacteria etc. which are called microbes. They can be seen only by microscope. The disease causing microbes are called pathogens. Our body possesses natural defense mechanism against the pathogenic microbes. Skin is impervious to microbes. Our body secretions kill the microbes or inhibit their growth. Some common examples are lysozyme in tears, nasal secretions, saliva, lactic acid in sweat etc. The pathogens reach the tissues due to breach in defence mechanism and cause infections.

The control of microbial diseases can be achieved by:

(i) Drugs which kill organisms in the body (bactericidal)
(ii) Drugs which inhibit or arrest the growth of organisms (bacteriostatic)
(iii) Increasing immunity and resistance to infections of the body (immunity)

Antimicrobial substances may be synthetic chemicals like sulphonamides or antibiotics- like tetracycline, penicillin, chloramphenicol etc. The common example of antimicrobial drug is sulphanilamides which are effective in wide range of micro-organisms.

7) **Antifertility Drugs**: These chemical substances control pregnancy. Their basic aim is to prevent conception or fertilization. The birth control pills are essentially a mixture of esterogen and progesterone derivative. Both of these compounds are hormones. Progesterone suppresses ovulation. Synthetic progesterone are more potent than progesterone.
The common pills used for a combination of progesterone, norethindrone and estrogen (ethynylestradiaol) is novestrol.

8) **Antacids**: The chemical substances which neutralize excess acid in the gastric juices and give relief from acid indigestion, acidity, heart burns, and gastric ulcers are called antacids. Baking soda in water is a common antacid. Other example are magnesium hydroxide, calcium carbonate, sodium bicarbonate, potassium bicarbonate, magnesium carbonate, potassium bicarbonate, aluminium phosphate. Magnesium oxide is also used as an antacid ingredient since it reacts with water to form $Mg(OH)_2$. The antacids are available in the form of liquids, gels or tablets. Generally, liquid antacids are more effective than tablets because of great surface area available for interaction and neutralization of acid. An advancement in treatment of hyperacidity came through the discovery that histamines stimulates the secretion of pepsin and hydrochloric acid. To prevent interaction of histamines with the receptors present in the stomach wall, the drug cimetidine has been designed. This resulted in release of lesser amount of acid. The drug is now replaced by ranitidine. A more effective new class of drugs is omeprazole and lansoprazole which prevents formation of acid in stomach.

9) **Antihistamines**: are chemical substances which diminish or abolish the main actions of histamines release in the body and hence prevent the allergic reactions caused by antigens. Histamines are responsible for nasal congestion associated with common colds, cough, allergic response to pollens etc. Synthetic drugs such as bromopheniramine (Dimetapp) and terfenadine (seldane) are used as antihistamines. Antihistamines are also called anti-allergic drugs. These are used to treat allergy, eg, skin rashes, conjunctivitis etc. These drugs relieve sneezing , nasal discharge, mild asthama, itching of eyes, nose and throat. The common antihistamine drugs are Benadryl, avil, zeet, bromethazine, actidil, anistine, foristal etc.

10) **Anaesthetics**: are chemical sunstances which produce general or local insensibility to pains and other sensations. Cocaine, novocaine are local anaesthetic chloroform, diethyl & vinyl ethers are general anaesthetics.

11) **Antibiotics**: are chemical substances which are produced by micro-organisms (bacteria, fungi and moulds) and can inhibit the growth or even destroy micro-organisms. Antibiotic refers to a substance (produced wholly or partly by chemical synthesis) which in low concentration inhibits growth or destroys micro-organisms by intervening in their metabolic processes.

    First antibiotic produced was penicillin by Alexander Fleming in 1929. Antibiotic can be either bactericidal or bacteriostatic.

    Bactericidal: Pencillin, Aminoglycosiders, Ofloxacin.

    Bacteriostatic: Erythromcin, Tetracycline, Chloramphenicol.

    Pencillin is narrow spectrum. These can be used for curing sore throat, reheumatic fever, local infections etc. Streptomycin, neomycin is used for treatment of tuberculosis, meningitis, pneumonia etc.

    Broad spectrum antibiotics are effective against several micr-organisms. Thereforem these are for curing a variety of diseases. Eg- thetracycline, chloromycetin and chloramphenicol. Eg- Chloramphenicol is a broad spectrum antibiotic which is used for curing typhoid, acute fever, dysentery, whooping cough, pneumonia, eye infections, certain urine infections etc. Sulphadrugs are used against pneumonia, tuberculosis, diphtheria etc. Some examples are sulphadiazine, sulphathiazole, sulphaacetamide etc.

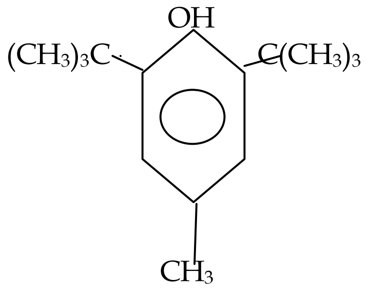
S.No.	**Type of Medicine**	**Used as**	**Examples**
1	Analgesics	Relieve Pain	Aspirin, Ibuprofen
2	Antipyretics	Lowers body temperature	Paracetamol, Phenacetin
3	Antiseptics & Disinfectants	Kill or prevent growth of microorganism	Phenol, Chlorine, dettol
4	Tranquilizers	Treatment of stress & mental diseases	Barbituric acid & its derivatives (Seconal, Luminal, Veronal etc)
5	Antimicrobials	Cure infections due to microorganisms	Sulphonamides
6	Antifertility drugs	Birth control	Novestrol (ethynylestradiol) & Progestrone

			(norethindrone), mifepristone
7	Antacids	Removes excess acid in stomach	Magnesium hydroxide, Magnesium trisilicate, aluminium hydroxide gel Ranitidine
8	Antihistamines	Treatment of hyperacidity, stimulates secretion of pepsin & HCl in the stomach. Also responsible for nasal congestion associated with common cold	Brompheniramine & terfenadine
9	Antibiotics	Produced by microorganisms & can inhibit the growth of other microbes	Pencillin, Tetracycline, Chloramphenicol

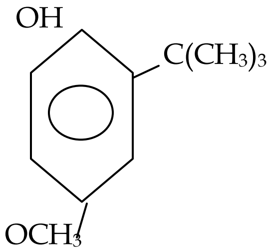
Chemicals in Food

Many chemicals are added to food for their preservation and enhancing their appeal. These include flavourings, sweetness, antioxidants, fortifiers, emulsifiers and antifoaming agents.

1. **Antioxidants**:
   Antioxidants are the important class of compounds which prevent oxidation of food materials. These compounds retard the action of oxygen on the food and thereby help in preservation. These act as sacrificial materials. i.e. they are more reactive towards oxygen than the materials they are protecting. They also reduce the rate of involvement of free radicals in the aging process. Most important antioxidants used are butylated hydroxy anisole (BHA) and butylated hydroxy toluene (BHT). The addition of BHA to butter increases its storage life.



BHT



BHA

   Sometimes BHT and BHA are added in combination with citric or ascorbic acid to produce a more active synergistic effect. SO_2 and sulphate are useful antioxidants for wine and beers, sugar syrups and cut peeled on dried fruits and vegetables.

2. **Preservatives:**

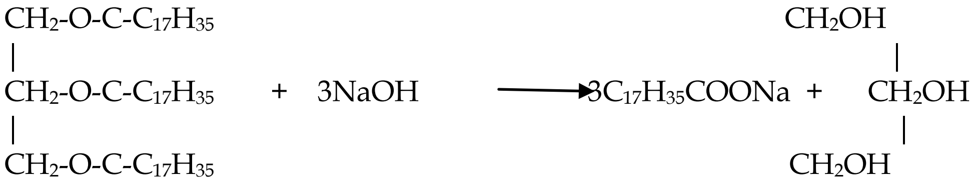
These are the chemical substances which are added to the food materials to prevent their spoilage and to retain their nutritive value for long periods. These preservatives prevent rancidity of food & inhibit the growth of microorganisms during storage. Example: Common salt, sugar, oils, Sodium benzoate, salts of propanoic acid and ascorbic acid.

3. **Artificial Sweetening agents:**
   The artificial sweetners are another type of food additives. Eg; Saccharin which is marketed as soluble of calcium salt. It is 300 times sweet than cane sugar. It is life saver for diabetic patients and is of great value to people who need to control intake of calories.
   Aspartame: Unstable at cooking temperature, therefore it is used as a sugar substitute to cold foods and soft drinks.
   Alitame: more stable during cooking than aspartame
   Sucralose: good artificial sweetener.

4. **Edible colors**:
   Edible colour that are used for food are dyes; ex- dyes are used to dye orange peels so hat oranges retain their colour. Colour is also added to fruit juices. Food colours do not have any nutritional value. The use of some of the azodyes are dangerous for young children and asthma patients.
   Terazime, a widely used dye is harmful
   Natural dyes like carotene are safe food edible colours.
   PFA {Prevention of food Adulteration Act}- govt. has passed it for the protection of consumer interests.

SOAPS AND DETERGENT

Soaps are sodium or potassium salts of long chain fattyacids. Soaps containing sodium salts are formed by heating fat (ie glyceryl ester of fatty acid) with aqueous sodium hydroxide solution and potassium salts are prepared by using potassium hydroxide. This reaction is known as saponification. Soap obtained remains in colloidal form and is precipitated from the solution by adding NaCl.



$$\begin{array}{l} CH_2\text{-}O\text{-}C\text{-}C_{17}H_{35} \\ | \\ CH_2\text{-}O\text{-}C\text{-}C_{17}H_{35} \\ | \\ CH_2\text{-}O\text{-}C\text{-}C_{17}H_{35} \end{array} + 3NaOH \longrightarrow 3C_{17}H_{35}COONa + \begin{array}{c} CH_2OH \\ | \\ CH_2OH \\ | \\ CH_2OH \end{array}$$

Soaps cannot be used in hard water as hard water contains certain metal ions such as Ca^{2+} and Mg^{2+} which form a curdy white precipitate of calcium and magnesium salt. This is called scum and is hinderance to good washing because this insoluble ppt. adheres onto the fibre of the cloth as gummy mass.

Synthetic detergents: They are sodium or potassium salts of sulphonic acid. Eg: sodium alkylbenzene sulphonate which have a general formula: $CH_3(CH_2)xC_6H_4SO_3Na^+$

Advantages of detergents:

Detergents can be work in hard water. The anions of synthetic detergent do not precipitate in the presence of Ca^{2+} and Mg^{2+}. They can work will even in acidic water.

Types of detergents;

There are three types of detergents;

(a) Anionic detergents are synthesized from long chain alcohol. The long chain alcohols are treated with conc. $H_2SO_4$to form alkyl hydrogen sulphate of high molecular mass and finally alkyl sulphate are neutralized with alkali to form salts. It is called anionic detergent because large part of the molecule is anion. The anionic detergent is largest in use as household detergents. E.g.- Alkylbenzenesulphonate . They are effective in acidic solutions to form an alkyl hydrogen sulphate which is soluble where as soap are not effective due to formation of insoluble fatty acids.
$CH_3(CH_2)_{11}OSO_3^-Na^+$, $CH_3(CH_2)_{11}C_6H_4SO_3^-Na^+$

(b) Cationic detergent: These are mostly acetates or chlorides of quaternary ammonium salt. They are more expensive therefore are used to limited extent. Such detergent possess germicidal properties and are extensively used as germicides. e.g $[CH_3(CH_2)_{11}N^+(CH_3)_3]Br^-$

(c) Non-Ionic detergent: Some of the detergent are non- ionic , like the esters of high molecular mass formed by reactions between polyethylene glycol and stearic acid. They do not possess any ion.

$$CH_3(CH_2)_{16}COOH+HO(CH_2CH_2O)_nCH_2CH_2OH \longrightarrow$$
$$CH_3(CH_2)_{16}COO(CH_2CH_2O)nCH_2CH_2OH$$

Some liquid dishwashing detergents are of non-ionic type branched hydrocarbon chain detergents are non-biodegradable and cause water pollution. The hydrocarbon side chain stops bacteria from attacking and breaking the chain. These molecules degrade slowly leading to water pollution.

Unbranched or linear alkyl chain detergents do not create pollution as they are more prone to attack by bacteria, thus can be biodegraded.

Assignment

Chapter 16: Chemistry in Everyday Life

1 Define the following and give one example of each -
(a) Artificial sweetening agents (b) Foodpreservatives

2 What type of medicines are omeprazole and lansoprazole?

3 Give an example of drug used in case of mental depression.

4 For which disease chloramphenicol is used?

5 Name the sweetening agent used in preparation of a sweet for a diabetic patient.

6 Name a broad spectrum antibiotic and diseases for which it is prescribed.

7 How are antiseptics distinguished from disinfectants? Give 2 examples of each.

8 Name a substance that can be used as an antiseptic as well as disinfectant.

9 Name the action of the following on the human body:
(i) Equanil (ii) Morphine (iii) Norethindrone (iv)Aspirin (v) Penicillin
(vi) Luminal (vii) Seconal

10 What are the essential components of dettol?

11 What are detergents? Give their scheme of classification. Why are detergents preferred over soaps?

12 Why is ethanol added to soaps?

13 What are biodegradable and non-biodegradable detergents? What are the consequences of using the latter kind? Give one example of each kind.

14 Why is use of aspartame limited to cold foods?

15 Why soaps do not act on hard water?

16 Explain the term 'chemotherapy'.

17 Describe the function of the following with one example for each :
a. Tranquilizers b. Antifertility drugs c. Antihistamines
d. Analgesics e. Antioxidants f. Antacids

18 What problem arises in using alitame as artificial sweeteners?

19 Explain the cleansing action of soaps.

20 Account for the following:

a) Aspirin drug helps in the prevention of heart attack.
b) Diabetic patients are advised to take artificial sweetener instead of natural sweeteners.
c) Detergents are non-biodegradable while soaps are biodegradable.

21 Except for vitamin B_{12}, all other vitamins of group B, should be supplied regularly in diet. Why?

22 In order to wash clothes with water containing dissolved calcium hydrogen carbonate which cleaning agent will you prefer and why, soaps or synthetic detergents? Give one advantage of soap over detergents

23 Due to hectic and busy schedule, Mr. Angad made his life full of tensions and anxiety. He started taking sleeping pills to overcome the depression without consulting the doctor. Mr. Deepak, a close friend of Mr. Angad, advised him to stop taking sleeping pills and suggested to change his lifestyle by doing Yoga, meditation and some physical exercise. Mr. Angad followed his friend's advice and after few days he started feeling better.

After reading the above passage, answer the following :

(i) What are the values (at least two) displayed by Mr. Deepak ?
(ii) Why is it not advisable to take sleeping pills without consulting doctor ?
(iii) What are tanquilizers ? Give two examples.

VALUE BASED QUESTIONS

1. Ravi went to a mall to pickup 'Ready to eat' food packets; noticed following labels on different food packets.
   Permitted Preservatives; Permitted anti-oxidants; Permitted preservatives added added anti-oxidants added.
   Packet : A Packet : B Packet : C
   a) Which packet would Ravi prefer, and why?
   b) What are the values associated with Ravi's selection?

2. Rita takes sugar while Renu prefers Aspartame in soft drinks for flavour.
   a) What is that Renu trying to avoid?
   b) What is the probable deficiency in Renu?
   c) What are the values that you notice in Renu's preference?

3. Raju was struggling from stomach ache because of hyper acidity condition. His friend, Ramesh offered him 'Soda water' (Aqueous $NaHCO3$), while Ratan wanted Raju to take 'Gelusil' (Aluminium hydroxide gel).
   a) Should Raju follow Ramesh's advice or Ratan's?
   b) What is the advantage of one medicine over the other?
   c) What are the values associated with the three friends' reactions?

4. Reetu wanted to buy milk cup for her son of 3-4 years of age; but was unable to decide between cup made of porcelain and melamine, since both looked colourful and decorative on the rack. She sought the opinion of her younger brother, a student of XII standard.
   a) Which cup would the young man select, and why?
   b) What are the values associated with his selection of the specific material?

5. Rajesh went to textile shop with his mother to purchase dress material for his school uniform. Rajesh wanted pure cotton fabric which looked bright, while mother insisted on blended fabric with 67% terylene.
   a) In your opinion, who is right?
   b) What are the monomers of Terylene?
   c) What are the values involved in the selection of the fabric?

6. The teacher fixed five cards on the flannel board that marked **A, T, C, U, G,** pick up cards that indicate bases that are not common to all nucleic acids.
   a) Which cards would Rakesh pick from the five?
   b) Of the nucleic acids picked by Rakesh, which does not form hydrogen bonding with other nucleic acids?
   c) What are the values involved in this exercise?

7. Mrs.Renuka was worried about her daughter not eating properly even though her favourite dishes are made, and shows very small growth in last six months.
   a) Which vitamin deficiency may be there in the girl child?
   b) Give chemical name of the vitamin deficient in the girl child.
   c) What are the values associated with this observation?

8. Ramesh noticed that chloroacetic acid [Cl-CH2-COOH] and Alanine [CH3-CH(NH2)-COOH] have comparable molar masses but exhibited different melting points and large difference of solubility levels in water.
   a) Which of the two would have shown higher melting point and better solubility in water, why?
   b) Identify the values associated with his observations.

9. CoCl3.4NH3 precipitates silver chloride with AgNO3(aq) reacting in equimolar amounts, though it has three moles of chlorides per mole. Further the compound was exhibiting different colours when prepared at different times – sometimes green and sometimes violet.
   a) Give IUPAC name of the compound.
   b) Why does it exhibit different colours?
   c) What are the values that can be attached with the observations?

10. Sudha's mother received a phone call on Monday morning from a close relative stating that three of them would be coming over for lunch. Sudha's mother noticed that she did not have enough curd to serve the guests. Sudha a class XII student suggested that her mother could warm the milk from the refrigerator or keep it under direct sunlight and curdle it.
    a) Why do you think Sudha suggested the above methods?
    b) Will it be helpful if her mother followed Sudha's suggestion?
    c) What values are associated with Sudha's suggestion?

11. Mohan was a regular late comer to School. His Class teacher found that his mother was cooking the traditional way in open vessels to prepare lunch for her family in the morning. Teacher suggested that his mother buys a pressure cooker that can be used for cooking.
    a) Why did the teacher suggest mohan to buy a pressure cooker?
    b) How would be helpful for Mohan's mother?
    c) What values are associated with the teacher's suggestion?

12. Teacher asked two Students 'A' and 'B' to demonstrate the reaction between Aluminium and dilute Sulphuric acid to the class. She provided Al foil, Al powder & dilute Sulphuric acid for the experiment:
    Student A chose Al foil & dilute Sulphuric acid. Student B chose Al powder & dilute Sulphuric acid.
    a) Who do you has made the correct choice of chemicals?
    b) Give a reason to justify the correct choice.
    c) What value do you associate with the above?

13. Geetha decided to make her bread at home. She bought four main and basic ingredients in the making of bread and they were yeast, flour, salt and water.
    a) Do you think she bought what was essential?
    b) What is the role of yeast here?
    c) What value do you associate with the above?

14. A child refused to take cold lemon jice with crystalline sugar but prefer to take with powdered sugar.

a) What is the effect of Temperature on solubility?
b) Why powdered sugar dissolve in water at a faster rate than crystalline sugar.
c) Which values were kept in mind in this activity?

15. Geetha has prepared homemade ice-cream, but her sister Swetha refused to take it after two days.
a) Mention state of dispersed phase and dispersed medium of ice-cream.
b) Why Swetha refused to take home made icecream after 2 days?
c) Mentio the value associated with the above process.

16. Ramesh went to Cinema theatre when it was raining heavily in a car and met with an accident due to unbalanced driving with hindered beam of light.
a) Define Tyndall effect.
b) Ramesh met with an accident. Give scientific reason?
c) Mention the value associated with the above situation.

17. Mohan and Rahul are good friends, they went to attend a marriage function with a neat dress. Unfortunately there, a sweet dish fell on their shirts and made an oil stain which Mohan washed with water but Rahul washed with soap.
a) What is CMC?
b) Why Rahul shirt looks neat but Mohan shirt looks dirt even after washing?
c) Write the value associated with above incident.

18. Gita regularly cleans her Artist father's Metal table with an Organic liquid given by her father due to this regular activity she had eye irritation. After few months she eventually losses vision in one of her eye.
a) What is the effect of chlorination in the presence of Sunlight on Methane?
b) Why did Gita lose her eye sight?
c) List the values associated with the above problem.

19. A farmer cultivating his land near the village pond was also drawing water from it for irrigation. He used insecticide excessively to protect his crops and improve the harvest, over a period of time his agricultural growth improved vastly. But the pond lost its aquatic life.
a) Draw the structure / IUPAC name of the compound used as an insecticide but not a pesticide.
b) Contrast the activity in plants and aquatic life with insecticide.
c) What value got expressed in students suggestions?

20. Sneha sitting behind her father in motor bike was studying with high concentration while her father was driving. She unknowingly put her foot into the silencer got burned. She was treated in a hospital with a yellow creamy antiseptic which eventually left violet colouration on the skin.
a) Identify the compound and give equation to identify Methyl Ketone.
b) What is the lesson learnt by Sneha after her accident?

21. An anesthetic bottle left on the window side of the operation theatre for a few days. It was exposed to Sun and rain. Another doctor used the same bottle on one of his patients and found the patient having severe vomiting and stomach poisoning.

a) Identify the compound. Give relevant equation as to its action.
b) What are the values to be kept in mind while using drugs?

22. A mother brought her 2 year old child to a clinic with a complaint that the child would not stop crying and was profusely vomiting. The doctor noticed the child shirt collar colour was faded.
a) Why dyes are coloured? Give 2 reasons?
b) What is coupling reaction? Give equation
c) What are the values involved in this?

23. Ram & Shyam are good friends, from 2 different localities. Ram used to go to cake point which used a colour light as insect attractants, but Shyam used to go to a way side XYZ bakery. Shyam was affected with poor health and ulcer in the stomach and admitted in the hospital. While Ram stayed healthy. The Doctor diagnosed and found Shyam's poor health due to poor quality of the food .
a) How do you distinguish primary and secondary amine?
b) Which organic compound is used as insect attractants?
c) What is the lesson learnt by Shyam from Ram?

24. A fruit seller bought oranges in the wholesale market and had emptied the sack full of it on his hand cart; the fruits were spread haphazardly all over the cart, some rolling off and some heaped up precariously.
a) As a student of chemistry, how will help him organize the fruits to make it attractive for the buyer as well as easy for him to handle without the fruits rolling off the cart?
b) What were the concepts you applied in this situation. What values do you learn?

25. Ram's dentist prescribed a fluoride tooth paste for his tooth decay; the same dentist asked Rani's father to send the water sample from their household for testing, to check if the fluoride content in it was excess, while treating her mottled teeth.
a) How would you explain this contradiction?
b) What is the value associated?

26. Reverse osmosis plants are becoming common in the coastal cities.
a) What do you think is its importance?
b) What values do you associate with your reasons?

27. In earlier days food items and products like cooking oil, sugar and biscuits were packed in tin containers. These containers were then used by housewives for storing grains and other kitchen items. Now exports / imports in tin containers are strictly prohibited; in spite of this we still seem to permit the tin containers for soft drinks!
a) What do you think is the reason for the prohibition?
b) Should we continue to use soft drink cans?
c) What values are involved in this paragraph of information?

28. Two iron plates, with dents were allotted to two students for plating and study of prevention of rusting. The first student selected tin for coating his plate, while the second chose zinc for the same purpose.

a) Who do you think made the right choice, and why?
b) Mention one value associated with the study of corrosion.

29. Automobiles fitted with catalytic convertors are more expensive and they become out of the reach for middle class population. The catalytic convertors help converting the unburnt particles in the fuel and CO into less harmful CO2 and let them out of exhausts.
a) Do you think it is necessary to fit in these catalytic convertors in automobiles? Justify.
b) Whar are the values involved in your decision?

30. Leather tanning is an important industry for our country's economy. Effluents from the leather industries contain a lot of toxic compounds and they are let into the water bodies causing pollution and foul smell. Local people in that area are most affected and this has lead to closing down of many tanneries.
a) What are the changes that occur during tanning of skin?
b) Which biomolecules make animal skin?
c) What are the values associated in closing of tanneries?

31. Few boys were playing next to a paddy field in a village, noticed a farmer bleeding profusely due to a deep cut on his leg because of wrong handling of the pick axe. One of the boys ran into the field and got wet clay and applied on the cut. The man was then taken to the nearby hospital.
a) The other boys asked the boy who applied the clay, why he did so?
b) What do you think was his answer?
c) What value did you learn from the incident?

32. Water for drinking purpose can be sterilized using ozone gas or chlorine gas.
a) Which is preferable over the other, why?
b) What are the values taken into consideration in sterilizing water?

33. Most of the villagers of a coastal village were found having swollen neck (affected by goiter.) When examined, they were using local salt, prepared by natural evaporation of back waters of sea.
a) As a student of chemistry how will you address this problem?
b) What value do you associate with it?

34. Due to scarcity of water, the residents of a colony decided to reuse their well which was not used for past six months. The secretary decided to clean the well by adding small amount of potassium permanganate in the well, and then loaded the well water with Aluminium alum crystal.
a) Why do you think he added potassium permanganate in the well?
b) How does loading with alum help?
c) What are the values involved in this process?

35. In an electroplating shop that the students visited as part of their industrial visit they observed that the plating of silver on cutlery is dull, even though the concentration AgNO3(aq) is good. The students suggested them to use K[Ag(CN)2](aq) instead of

AgNO3(aq). They could get good difference in the quality of the plating after changing the electrolyte.
a) Explain the reasons for obtaining bright and uniform plating.
b) What are the values attached with the students' approach?

36. Ram and Salim decided to do their chemistry project together, and both were fond of Organic chemistry; they chose an interesting topic which involves the usage of some organic solvents as well as aerosol propellants. When they approached their teacher to get her consent on the topic, she refused, and told them to choose some other topic but not this.
a) Why did the teacher denied?
b) What does this tell us about the teacher?

37. Abhishek decided to visit his village during summer holidays with his friends where his grandparents were staying. One day, while going for a walk they happened to hear the farmers discussing about how the pests have destroyed their crops, which caused a great loss, inspite of spraying pesticides. One of them suggested that they use DDT to have better control on pests and others agreed. On hearing this Abhishek and his friends were worried and they convinced the farmers against the usage of DDT.
a) Write expansion of DDT, and its structure.
b) Why were the friends worried about use of DDT?
c) What are the values that can be leant from the action of friends?

38. Ramu had drunk from a local wine shop. He complained of blurred vision, started losing his eyesight slowly and died in a couple of days.
a) What could be the reason for his death?
b) Give IUPAC name of main component of wine.
c) What values can be derived from the sad incident?

39. Ram's mother always followed very traditional way of cooking using earthen wares, copper utensil. Her daughter replaced all the kitchen utensils with Teflon coated ones.
a) In your opinion who is correct in the present life situation?
b) What is the monomer of Teflon? What is its structure?
c) What are the values involved?

40. The Government order directs the shop keepers to charge their customers bags, to take the items that they purchase.
a) Name the different types of polythene available.
b) Why does the Government impose such an order?
c) What are the values involved in the Government order?

41. Shyam's grandma complained of irritation and pain in her stomach. He called the family doctor, but got an appointment only in the evening. Meanwhile he gave her ranitidine tablet for an immediate relief.
a) In your opinion, is Shyam's action justifiable?
b) What type of drug is 'Ranitidine?'
c) What are the values associated with Shyam's action?

42. Neeta’s grandmother diabetic patient, wished to have homemade sweets. Neeta went to a nearby super market to buy artificial sweeteners to make sweets. She noted two brands of sweeteners, one containing aspartame and the other containing sucrolose. Neeta chose the brand having sucrolose
a) Why did Neeta choose this brand?
b) Is ‘Aspartame’ a disaccharide? How is ‘Sucrolose’ different from ‘Sucrose?’
c) What are the values that Neeta brings out through her action?

43. According to a report from Harvard’s school of Public Health published in ‘Change= the magazine of Higher Learning” in 1996, a study conducted by Henry Weshler& Associates found that as the number of drinks (alcohol) per week increased, academic performance decreased.
a) How is ethyl alcohol made unfit for consumption?
b) How is Ethyl alcohol manufactured from molasses?
c) What values can be derived from this information?

44. Ram was travelling in a car with his driver. They were stopped by a policeman and the driver was asked to take the breath analyzer test for alcohol. He was asked to blow air into the device which contained a pink solution. The solution faded in colour.
a) What is the pink coloured solution? Why does it fade?
b) Why are such tests conducted on drivers?
c) What are the values involved in the action of policeman?

45. Brazil is the world's second largest producer of ethanol fuel and the world's largest exporter. Together, Brazil and the United States lead the industrial production of ethanol fuel. Brazil’s sugarcane ethanol is "the most successful alternative fuel to date." There are no longer any light vehicles in Brazil running on pure gasoline. Since 1976 the government made it mandatory to blend anhydrous ethanol with gasoline. Since July 1, 2007 the mandatory blend is 25% of anhydrous ethanol and 75% gasoline or E25 blend.
a) Why do you think Brazil has made it mandatory to blend gasoline with ethanol?
b) What could be the reason for Brazil being the second largest producer of ethanol?
c) What are the values involved in use of ethanol substitute for gasoline?

46. A group of students were given to study the properties of aldehydes and ketones in the lab. They recorded a few observation of their physical properties.
PROPERTY ALDEHYDE KETONE
SOLUBILTY HIGH LOW
VOLATALITY MODERATE HIGH
REACTIVITY HIGH LOW
a) Why are aldehydes more reactive and more soluble than ketones?
b) What values can be learnt from behavior of aldehydes?

47. A group of students were allotted a project to determine the molar mass of Benzoic acid in a non-polar solvent (benzene) by Rast Method. But the students observed the value of the molar mass of benzoic acid was double the formula wt., this led them to confusion.
a) Why was the molar mass double the theoretical mass?
b) What type of property is useful in determination of molar mass of a
non-volatile substance?

c) What values can be derived from the behaviour of Benzoic acid.

48. Ramesh went to Cinema theatre driving his car under foggy weather and met with an accident due to unbalanced driving with hindered beam of light.
    a) Define Tyndall effect.
    b) Which type of colloid is the fog?
    c) Mention the value associated with the above situation.

49. Mohan and Rahul are good friends, they went to attend a marriage function neatly dressed. There unfortunately a boy splashed some eatable on their shirts which left oil stain, which Mohan washed with plain water but Rahul washed with soap water.
    a) What is CMC?
    b) Why Rahul's shirt looks neat but Mohan's shirt still carried oil stain?
    c) Write the value associated with above incident.

50. Ram was playing football. He fell down and had a bad cut in his knee and he startedbleeding. The Chemistry lab was situated very close to the football court. Shyam immediately brought a bottle of ferric chloride while Sundar brought a bottle of potassium chloride. After debating for a few seconds, a spatula of ferric chloride was applied to the wound and the bleeding was arrested.
    Contextual question: Why is ferric chloride preferred over potassium chloride in case of a cut leading to bleeding?
    Value: What value does the behaviour of Ram's friends reflect?

51. A factory was situated very close to the Residential area where Rita lived . The factory worked round the clock and the smoke coming out of the chimneys was causing a lot of health problems to people living in the area. Rita and few others decided to meet the top officials of the factory and give them the idea of installing the Cottrell's Smoke Precipitator.
    Contextual question: What is the purpose of having the Cottrell's Precipitator installed ?
    Value: What value do you attribute to Rita's concern?

52. Reena was admiring the clear blue sky and was talking to her friend about the beautiful clear sky in the evening as they were taking a walk in the beach. She looked at the sky and exclaimed –" look at the sky. It looks red now". Reena asked her friend Rita if she could explain why the clear blue sky in the morning looked red at dusk.
    Contextual question: Explain why the sky appears blue in the morning and the sun looks red at the time of setting?
    Value: What value does Reena's explanation reflect?

53. Shakthi's village was facing a lot of problem with the sewage disposal.The environment was became unhealthy and unhygienic .Shakthi and her friends decided to talk to the village chief and find a solution for this problem. She came out with the idea of allowing the sewage water to pass through the tunnel fitted with metallic electrode maintained at high potential difference. This method will not only provide water from irrigation but also manure for the fields.
    Contextual question: Why did Shakthi insist on the sewage water being passed

through electrode fitted tunnels?
Value: What value does the attitude of Shakthi and her friend's reflect?

54. Babu was suffering from stomach disorder. The doctor prescribed Milk of Magnesia as remedy and it would be effective since it is an emulsion. Babu went home and asked his mother what an emulsion was and why emulsions are more effective?
Contextual Question: What is an emulsion? Why are medicines in emulsion form more effective?
Value: What value does Babu's question reflect?

55. Asha gives an induction stove to her friend Nish as a gift. Nisha immediately places a curved base copper cooker to cook but it failed to work. Thinking that the piece is defective she gets annoyed and wants to call up the service center. Her son beside her reads the catalogue and instructs her to use Al and steam flat based cooker.
a. What is the chemistry behind it and what are the values derived from this incident?
b. What are the Values associated with the above?

56. Two group or students are provided with 50 lemons each and a small circular plate. They are asked to arrange them in an orderly manner in 5 minutes. One team successfully arranges the lemons while other team was not able to complete the task.
a. What is the mode of packing had the team adopted?
b. What are the Values offered?

57. Bunty a chemist, during the construction of his house advised the civil engineer to leave a gap in wooden fittings of glass window panes to avoid cracks.
a. What is the chemistry involved in advising the civil engineer?
b. What values can be imbibed from this?

58. Ajay had managed to purchase large quantities of iron scrape from the corporation, with an intention of starting a factory for making screws and bolts. But his friend suggested an alternative idea of using this in electromagnets. What would you think was his decision and what were the values inculcated?

59. Sonia was punctual to school while Aditi was not punctual. The teacher wanted to analyse why Aditi was late to school while Sonia was punctual while both of them came from the same place. Aditi expressed that her mother took longer time to provide breakfast and lunch so she was late to school. The teacher concluded that the methodology og cooking was different. Aditi's mother used conventional methods of cooking while Sonia's mother used pressure cooker. Why is cooking with pressure cooker more preferred? What values are included from the above happening?

60. Asha and Meena bought meat from butcher. She salted the meat forpreservation while Meera refrigerated meat. Which meat can last longer?

61. Rahul sees his grandfather's swollen leg and advices him to take less salt in his food and ensures that the food cooked at home contains less salt. Why did the child insist to reduce the intake of salt and what are the values that can be developed?

62. Students went to Kashmir for excursion in winter and saw the roads covered with snow. It was being cleared by shoveling it. One group of students advised sprinkling of salt and another group advised use of calcium chloride. The first suggestion was taken to clear the snow. Why was the first suggestion adopted? What are the values derived from he above incident?

63. At a site, low grade copper ores are available and zinc and iron scrapes are also available. As a student of chemistry, which of the two scrapes will you suggest for reducing the leached copper and why? What are the values associated with the above decision?

64. Shyam wanted to take a good picture of his grandmother but Shyam had only an ordinary camera. His friend Ram suggested him to make use of Aluminium powder. How is Al powder helpful? What value did Ram give to Shyam?

65. Wrought iron is preferred over cast iron for making anchors and railway carriage couplings. Why? What are the values associated with above?

66. Suresh who runs a school canteen decided to replace the Al containers used for storing water by steel container even though steel is costlier. Why? What is the value associated with this decision?

67. Vishal and Anurag were arguing about the ban on supersonic jets. Vishal was against the use of it. Anurag supported it as it is fast and saves time. Why do you think Vishal is right and what is the value you gain?

68. Chlorine gas is the very useful gas. At the same time it can be used for the manufacture of certain poisonous gases. Name two useful and poisonous gases manufactured from chlorine? The teacher while teaching made the student aware of both merits and de – merits of chemicals. What value based education she tried to impart?

69. While taking the class on noble gases the teacher related the story about how Neil Barlett tried many experiments before he manufactured Xe compounds. Which compound was this? What inspiration do you get from him?

70. While analyzing a salt Rina reported acid radical as nitrate as it gave brown gas with conc. Sulphuric acid. But the teacher disagreed. Her friend Rupa helped her and suggested another test. What other radical it could be? Suggest the test for the radical. What moral value do you take from Rupa's action?

71. Mohan while diluting concentrated acid added water to it. This caused splashes and he suffered minor burns on his hands. Dinesh came to his help, took him to the medical room for first aid and also explained the right way to dilute sulphuric acid Explain why Mohan's method of dilution caused splashes?What moral value is highlighted by Dinesh action?

72. The metals used in application such as mobile phones, nuclear reactors, batteries etc are so rare that these critical metals will be unavailable for use in modern technology.

a. What measures would you suggest to overcome this situation?
b. What value would be promoted by the measure you adopt?
c. Name any two rare transition metals.

73. A Poster suggests the following life style on the part of families/individuals.
a. Use organic food products.
b. Use KMnO4 for bleaching purpose instead of using chlorine based bleaching agents.
c. Use alloy steel to furnish home needs than wood.
d. Use bicycle for travelling short distances than petrol/diesel vehicles.

Questions:
I. Which environmental values are promoted through these life style.
II. Suggest one additional life style action for promotion of greenchemistry.
III. Give reason for the bleaching action of KMnO4

74. For automotive catalytic converters, transition metals like Pt, Pd, Rd, Fe, Cr etc used in industry are expensive while ceramic cores are inexpensive.
i. Which property of transition metal makes them useful as catalyst?
ii. Which value is promoted through the use of catalytic converters in industry?
As a student of chemistry would you suggest the use of expensive & rare metals like Pt, Pd & Rh give reasons.

75. Sam and his neighbor Ram have got their home fenced with iron rods. Sam saw the next day that Ram was painting the iron fence. Ram suggested Sam to do the same to increase the longevity of iron rods by preventing corrosion. Sam argues that its waste of time & the iron rods are quite strong.
After reading the above passage, answer the following question.
i. Whose opinion is correct according to you? What values are promoted here?
ii. Why do iron objects found near the sea get corroded faster?
iii. Are there any other ways to prevent corrosion other than painting?

76. An element X has low melting point and high density, It is used in thermometers and barometers and its oxide is used in batteries.
i. Name the element X
ii. Why is the use of the element X in skin lightening creams not recommended?
iii. Should we advocate the use of metal free cosmetics? Which value is reflected in this approach?

77. A junior scientist reports the use of silver amalgam to control tooth decay can result in getting a deadly disease and recommends the use of biocompatible resins.
i. Why the use of silver amalgam in dentistry is banned in many countries?
ii. Which value is reflected in this ban?
iii. What is the advantage of biocompatible products?

78. An NGO decided to supply KMnO4 in villages in monsoon to be added to water bodies. Why? What is the value behind this decision?

Practice paper (Summer Vacation)

(Electrochemistry, Chemical Kinetics, Solutions, Solid state, p-block elements, Salt Analysis)

Time: 1 hr 45 min *Max. Marks –50*

No. of printed pages: 2

General Instructions:

(i) All questions are compulsory.
(ii) This paper has two parts.
(iii) Part A is theory from question nos. 1 to 14 carrying 35 marks.
(iv) Part B is practical related questions numbering 15 to 19 carrying 15 marks.
(v) Use log tables if necessary, use of calculators is not permitted.

PART A

1 For a reaction, $A + B \rightarrow P$, the reaction is of first order in reactant A and second order in reactant B. 1

i) How is the rate of this reaction affected when the concentration of B doubled.
(ii) What is the overall order of rection if A is present in large excess.

2 Write the anode and cathode reactions occurring in a mercury cell. 1

3 Why ZnO turns yellow and shows enhanced conductivity on heating? 1

4 Draw the structural formulae of molecules of following compounds: 1

a) ClF_5b)XeF_4

5 Complete the following chemical equations: 2

a) NaOH(aq) (Hot and Conc) + $Cl_2(g) \rightarrow$
b) $XeF_6(s) + H_2O(l) \rightarrow$

6 How many grams of chlorine can be produced by the electrolysis of molten NaCl with a current of 1A for 15 minutes? 2

(given atomic mass of Cl=35.5u, 1F=96500 C/mol)

7 State Kohlrausch law of independent migration of ions. Write and expression for the molar conductivity of acetic acid at infinite dilution according to Kohlrausch law. 2

8 Non ideal solutions exhibit either positive or negative deviations from Raoult's law. 2

What are these deviations and why are they caused? Explain with one example for each type.

9 (i) Why is the freezing point depression of 0.1M sodium chloride solution nearly twice that of 0.1M glucose solution? 2

(ii) A solution containing 8g of a substance in 100g of diethyl ether boils at 36.86^0C , whereas pure ether boils at 35.6^0C. Determine molecular mass of solute. [For ether, $K_b = 2.02$ K Kg mol^{-1}]

10 The decomposition of phosphine, PH_3, proceeds according to the following equation: 2

$4PH_3\ (g) \rightarrow 3P_4\ (g) + 6H_2(g)$

It is found that the reaction follows the following rate equation: Rate = $k[PH_3]$

The half-life of PH_3 is 37.9s at 120^0C. How much time is required for 3/4th of PH_3 to decompose? [log2=0.3010]

11 a) What is meant by the 'rate constant, k' of a reaction? If the concentration be expressed in mol L^{-1} units and time in seconds, what would be the units for k (i) for a zero order reaction and (ii) for a first order reaction? 2

b) What type of collisions is known to be effective?

12 A well known mineral fluorite is chemically calcium fluoride. It is known that in one unit cell of this mineral there are $4Ca^{2+}$ ions and $8F^-$ ions and that Ca^{2+} ions are arranged in a fcc lattice. The F^- ions fill all the tetrahedral holes in the face centered cubic lattice of Ca^{2+} ions. The edge of the unit cell is 5.46×10^{-8} cm in length. The density of the solid is 3.18 g/cm^3. Use this information to calculate Avogadro's number. 3

(Molar mass of CaF_2 = 78.08 $gmol^{-1}$)

13 Write the Nernst equation and calculate the e.m.f of the following cell at 298K 3

$Zn(s)\,|\,Zn^{2+}(0.1\ M)\ ||\ Cd^{+2}(0.01M)\,|\,Cd(s)$

($E^0_{Zn^{2+}/Zn}$= -0.761V, $E^0_{Cd^{2+}/Cd}$ = 0.40V) . Furthur show:

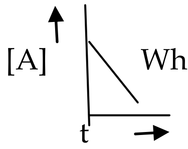
(i) The carriers of current within the cell.

(ii) E^0 values for the electrode 2 Zn^{+2}/2Zn .

(iii) Which electrode is negatively charged?

(iv) Individual reactions at each electrode.

14 a) From the graph: 3



What is the order of the reaction?

b) A first order decomposition reaction takes 40 min for 30% decomposition. Calculate its $t_{1/2}$ value. (log10=1, log7=0.8451)

15 a) 2g each of two solutes A and B (molar mass of A > B) are dissolved separately in 200g each of the same solvent. Which will show greater elevation in boiling point? 3

b) The molal elevation constant for H_2O is 0.52 K/m. Calculate the boiling point of solution made by dissolving 6 g of urea (NH_2CONH_2) in 200 g of H_2O.

16 a) Complete the following chemical reaction equations: 5

i. $P_4 + SOCl_2 \rightarrow$

ii. $XeF_4 (s) + H_2O (l) \rightarrow$

b) Explain the following observations giving appropriate reasons:

i. Solid phosphorus pentachloride behaves as an ionic compound.

ii. Halogens are strong oxidizing agents.

iii. H_3PO_3 is diprotic acid.

PART B

17 Why is it that tests for Barium, Strontium and Calcium to be done in order? 2

18 Explain one confirmatory test for Ni^{2+}. 2

19 (a) Give the formula of reddish yellow vapours evolved during chromyl chloride test? 1,2

(b) Explain the Cl_2 water test for iodide with equation.

20 Explain the indicatory and confirmatory tests for sulphide. 3

21 (a) How can one distinguish between sulphite and sulphate using $BaCl_2$ test. 5

(b) What is the colour seen in flame for strontium salt.

(c) What is the yellow ppt. in K_2CrO_4 test for lead due to?

(d) What is the canary yellow ppt. in Ammonium Molybdate test for Phosphate due to?

(e) What is the formula for brown ring?

Academic Session 2015-16
First Term Examination
Subject – Chemistry
M/2/1

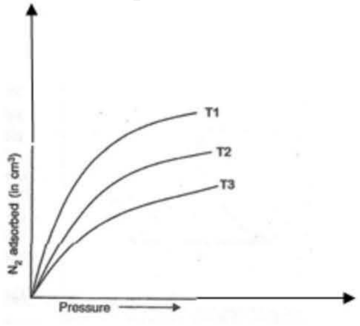
Time :3hrs *Max. Marks – 70*

No. of printed pages: 4

General Instructions:

(i) All questions are compulsory.
(ii) Questions nos. 1 to 5 are very short answer questions and carry 1 mark each.
(iii) Questions nos. 6 to 10 are short answer questions and carries 2 marks each.
(iv) Questions nos. 11 to 22arealso short answer questions and carry 3 marks each.
(v) Questions no. 23is a value based question and carry 4 marks.
(vi) Question nos. 24 to 26are long answer questions and carry 5 marks each.
(vii) Use log tables if necessary, use of calculators is not permitted.

1 The following figure shows the variation of adsorption of N_2 on charcoal with pressure at different constant temperatures: 1



Arrange the temperatures T1, T2 and T3 in the increasing order.

2 Out of $BaCl_2$ and KCl, which one is more effective in causing coagulation of a negatively charged colloidal Sol? Give reason. 1

3 What is the formula of a compound in which the element Y forms ccp lattice and atoms of X occupy 1/3rd of tetrahedral voids? 1

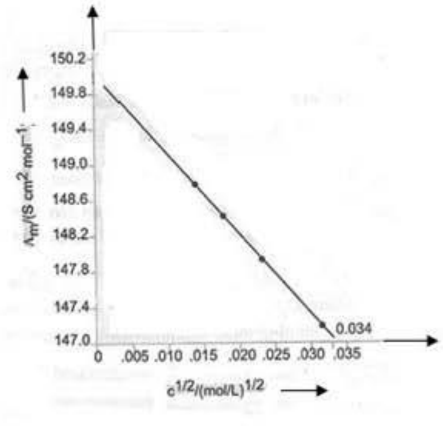
4 Which would undergo S_N2 reaction faster in the following pair and why? 1
CH_3CH_2 Br and $(CH_3)_3C$-Br

5 Give the formula of a noble gas compound which is isostructural with $\mathbf{IBr_2^-}$ 1

6 Aluminum crystallizes in anfcc structure. Atomic radius of the metal is 125 pm. What is the length of the side of the unit cell of the metal? 2

7 Draw the structure of the following compounds: 2
(i) $H_2S_2O_7$ (ii) $XeOF_4$

8 The molar conductivity (λm) of KCl solutions at different concentrations at 298 K is plotted asshown in the figure given below: 2



Determine the value of λ^0_m and A (approx..) for KCl.

9 Name the crystal defect which reduces the density of an ionic solid? What type of ionic substances show this defect? 2

10 2
(i) Which allotrope of phosphorus is more reactive and why?
(ii) Which noble gas is used in filling balloons for meteorological observations? Why the compounds of this gas not known.

11 3.9 g of benzoic acid dissolved in 49 g of benzene shows a depression in freezing point of 1.62 K. Calculate the van't Hoff factor and predict the nature of solute (associated or dissociated).[Molar mass of benzoic acid = 122 u, K_f for benzene = $5.12^0C\ kg\ mol^{-1}$] 3

12 Give reasons for the following observations: 3
(i) Leather gets hardened after tanning
(ii) It is necessary to remove CO when ammonia is prepared by Haber's process
(iii) Lyophilic sol is more stable than lyophobic sol

13 3
(i) What kind of lattice do the 'ABABAB…. type of sequence lead to? What is the coordination number of such lattice.
(ii) What type of magnetic behavior is shown by solid having following arrangement of dipole? Give an example.

↑↑↑↑↑↑

(iii) ZnO is white at low temperature but yellow at high temperature. Give reason.

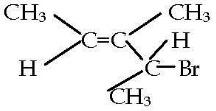
14 Henry's law constant for CO_2 in H_2O at 298 K is 1.67×10^8 Pa. Calculate the quantity (in grams) of CO_2 in 500 ml of soda water when placed under 2.5 atm CO_2 pressure at 298 K. 3

15 Explain what is observed when 3
(i) Silver nitrate solution is added to potassium iodide solution.
(ii) The size of the finest gold sol particles increases in the gold sol.
(iii) Two oppositely charged sols are mixed in almost equal proportions

16 Write balanced chemical equations for the following: 3
(i) Reaction of chlorine with hot and concentrated NaOH.
(ii) Sulphur dioxide is passed through an aqueous solution of Fe (III) salt.
(iii) Supersonic jet aeroplanes are responsible for the depletion of ozone layers?

17 Write the Nernst equationand calculate the emffor the following cell at 298 K: 3
Mg(s) | Mg^{2+} (0.001 M) | | Cu^{2+} (0.0001 M) | Cu(s)
How does **Ecell**vary with the concentration of both Mg^{2+} and Cu^{2+} ions?
(Given**E^{o}cell**= 2.71 V)

18 (i) Give the IUPAC name: 3



(ii) Amongst the isomeric dihalobenzenes which isomer has the highest melting point and why?
(iii) Arrange the following haloalkanes in the increasing order of density. Justify your answer.

CCl_4, CH_2Cl_2 and $CHCl_3$.

19 During nuclear explosion , one of the products is ^{90}Sr with half-life of 3.01 years. If 10 μg of ^{90}Sr was absorbed in the bones of a newly born baby instead of Calcium. How old shall the baby become if ^{90}Sr found is 1 μg. 3

20 Explain the following named reaction: 3
(i) Fittig reaction
(ii) Sandmeyer reaction
(iii)Swarts reaction

21 a) How will you bring about the following conversion: 3
i) 1-bromopropane to 2-bromopropane
ii) Chlorobenzene to p-nitrophenol
b) Write the mechanism for:
n BuBr + KCN $\xrightarrow{\text{EtOH-H2O}}$ nBuCN

22 Define the following: 3
Order of a reaction ii) Activation energy of a reaction iii) Rate constant

23 Sam and his neighbor Ram have got their home fenced with iron rods. Sam saw the next day that Ram was painting the iron fence. Ram suggested Sam to do the same to increase the longevity of iron rods by preventing corrosion. Sam argues that its waste of time and the iron rods are quite strong. 4
After reading the above passage, answer the following question
(i) Whose opinion is correct according to you? What values are promoted here?
(ii) Why do iron objects found near the sea get corroded faster?
(iii)Are there any other ways to prevent corrosion other than painting.
(iv) Write the chemical reaction happening during rusting.

24 Account for the following: 5

(i) Chlorobenzene is difficult to hydrolyse than chloroethane.

(ii) Presence of NO_2 group increases the reactivity of aryl halides towards nucleophilic substitution reaction.

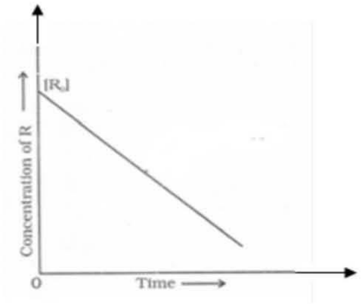
(iii) Chloroethane on reaction with ethanolic KCN gives ethyl cyanide but with ethanolicAgCN gives ethyl isocyanide.

(iv) Chlorobenzene on reaction with Cl_2/ $FeCl_3$ gives ortho and para dichlorobenzene.

(v) Alkyl halides, though polar, have low solubility in water.

25 In the reaction 'Q + R → Products' 5

The time taken for 99% reaction of Q is twice the time taken for 90% reaction of Q. The concentration of R varies with time as shown in the figure below:



(i) What is the overall order of the reaction? Give the units of the rate constant for the same. Write the rate expression for the above reaction.

(ii) Rate constant for a first order reaction has been found to be $2.54 \times 10^{-3} s^{-1}$. Calculate its three-fourth life.

26 Account for the following: 5

(i) Acidic character increases from HF to HI

(ii) Sulphur is paramagnetic in vapour state.

(iii) The HEH bond angle of the hydrides of group 15 elements decrease as we move down the group.

(iv) Bleaching effect of chlorine is permanent.

(v) F_2 is a better oxidizing agent than Cl_2.

Academic Session 2016-17
First term Examination
Subject – Chemistry
M/2/1

Time : 3 hrs **MM – 70 marks**

No. of printed pages: 4

Q1. Physisorption is reversible while chemisorption is irreversible. Why? 1

Q2. Why ortho - nitrophenol is more acidic than ortho – methoxyphenol? 1

Q3. Write a short note on Reimer- Tiemann reaction. 1

Q4. Why nitrogen dioxide (NO_2) is paramagnetic in gaseous state but the solid obtained on cooling is diamagnetic? 1

Q5. $CH_3 – CH (CH_3) – CH_2 – Cl$ and $CH_3 – CH_2 – CH (CH_3) – Cl$, which is more reactive towards S_N1 reaction and why? 1

Q6. In the ring test of NO_3^- ion, Fe^{2+} ion reduces nitrate ion to nitric oxide, which combines with Fe^{2+} (aq) ion to form brown complex. Write the reactions involved in the formation of brown ring. 2

Q7. (i) What mass of Zinc (II) ion will be obtained by passing 1F of electricity. (Atomic mass of Zn = 65u) 2
(ii) State Kohlrausch law of independent migration of ions.

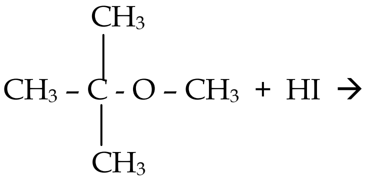
Q8. An electrolyte AB is 50% ionised in aqueous solution. Calculate the freezing point of 1 molal aqueous solution? (K_f for water is 1.86 K kg/mol) 2

Q9. Draw the structures of the following molecules: 2
(i) $XeOF_4$ (ii) $HOClO_2$

Q10. A first order reaction takes 10 minutes for 25% decomposition. Calculate $t_{1/2}$ for the reaction. (Given: log2 = 0.3010, log3 = 0.4771, log4 = 0.6021) 2

Q11. Write the main product(s) in each of the following reactions: 3

(i)



$$CH_3 - \underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}} - O - CH_3 + HI \rightarrow$$

(ii) $CH_3 - CH = CH_2 \xrightarrow[\text{(ii) } 3H_2O_2/OH^-]{\text{(i) } B_2H_6}$

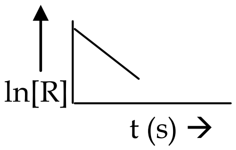
(iii) $C_6H_5 - OH \xrightarrow[\text{(ii) } CO_2, H^+]{\text{(i) aq. NaOH}}$

Q12. (i) What is cause of anoxia? 3

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

Q13. (i) For a chemical reaction R → P, the variation in the concentration, ln[R] vs time (s) plot is given as shown in figure. 3

a. Predict the order of the reaction
b. What is the slope of the curve?
c. Write the unit of rate constant for this reaction



(ii) Show that the time required for 99% completion is double of the time required for the completion of 90% reaction.

Q14. (i) Why does alkaline medium inhibit rusting of iron? 3

(ii) The standard electrode potential (E°) for Daniel cell is +1.1 V. Calculate the ΔG° for the reaction:

$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$ (1F = 96500C)

(iii) Predict the product of electrolysis of an aqueous solution of $CuCl_2$ with platinum electrodes.

Q15. (i) Give IUPAC name of following compound: 3

$CH_3CH=CH-C(CH_3)_2Br$

(ii) Complete the following reactions:

a. $C_6H_5-CH_2OH + PCl_5 \rightarrow$
b. $C_6H_5-CH_2CH=CH_2 + HBr \rightarrow$

Q16. (i) An alloy of gold and cadmium crystallizes with a cubic structure in which gold atoms occupy the corners and cadmium atoms fit into the face centre. Give the ratio of Gold and Cadmium present in the alloy. 3

(ii) An element with density 2.8 gcm^{-3} forms fcc unit cell with edge length 4×10^{-8} cm. Calculate the molar mass of the element.

(Given: $N_A = 6.022 \times 10^{23}\ mol^{-1}$)

Q17. Give reasons: 3

(i) C-Cl bond length in chlorobenzene is shorter than C-Cl bond length in CH_3-Cl.
(ii) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.
(iii) S_N1 reactions are accompanied by racemization in optically active alkyl halides.

Q18. A strip of nickel metal is placed in a 1 molar solution of $Ni(NO_3)_2$ and a strip of silver metal is placed in a 1 molar solution of $AgNO_3$. An electrochemical cell is created when the two solutions are connected by a salt bridge and the two strips are connected by wire to a voltmeter. 3

(i) Write the balanced equation for the overall reaction occurring in the cell
(ii) Calculate the cell potential, E_{cell} at 25°C for the cell if the initial concentration of $Ni(NO_3)_2$ is 0.100 molar and the initial concentration of $AgNO_3$ is 1.00 molar. $[E^\circ_{Ni^{2+}|Ni} = -0.25\ V;\ E^\circ_{Ag^{+}|Ag} = 0.80\ V]$

Q19. How would you convert the following: 3

(i) Prop-1-ene to 1-fluoropropane
(ii) Chloro Benzene to 4-Chloro toluene
(iii) Ethanol to Propane isonitrile

Q20. (i) Which will absorb more gas, a lump of charcoal or its powder and why? 3

(ii) Give the principle/equation involved in preparation of each of the following sol:
   a. Silver sol
   b. Sulphur sol

Q21. (i) Define Molal boiling point elevation constant (Ebullioscopic constant) K_b. 3

(ii) A solution containing 15g of urea (molar mass = 60 g mol^{-1}) per litre of solution in water is isotonic with the solution of glucose (molar mass = 180 g mol^{-1}) in water. Calculate the mass of glucose present in one litre of its solution.

Q22. In a pseudo first order hydrolysis of ester in water, the following results were obtained: 3

t/s	0	30	60	90
[Ester]/mol L^{-1}	0.55	0.31	0.17	0.085

(i) Calculate the average rate of reaction between the time interval 30 to 60 seconds.
(ii) Calculate the pseudo first order rate constant for the hydrolysis of ester. (log 55= 1.7404, log 31=1.4914, log17=1.2304, log8.5=0.9294)

Q23. Few boys were playing next to a paddy field in a village, noticed a farmer bleeding profusely due to deep cut on his leg because of wrong handling of the pick axe. One of the boys ran into the field and got wet clay and applied on the cut and the bleeding stopped. The man was then taken to the nearby hospital. 4

(i) Give reason as to why bleeding stopped on application of the clay?
(ii) Why deltas are formed when river water meets the sea?
(iii) State Hardy-Schulze rule.
(iv) What value did you learn from the incident?

Q24. (i) Write the mechanism of hydration of ethene to yield ethanol. 5

(ii) Carry out the following conversions:

a) Phenol to picric acid

b) Propanone to 2-methylpropan-2-ol

(iii) Write the structure of aspirin.

Q25. (i) What are molecular solids? Which one of the following is an example of molecular solid: CO_2 or SiO_2. 5

(ii) Refractive index of a solid is observed to have the same value along all directions. Comment on the nature of this solid and name this property.

(iii) On the basis of band theory, give a point of difference between insulator and a semiconductor.

(iv) If NaCl is doped with 10^{-3} mol% of $SrCl_2$. What is the concentration of cation vacancies?

Q26. (i) Complete the following chemical equations: 5

(a) $Cu + HNO_3$ (dilute) $\rightarrow$

(b) $XeF_4 + O_2F_2 \rightarrow$

(ii) Explain the following observations:

(a) ICl is more reactive than I_2.

(b) Oxygen is a gas but sulphur a solid.

(c) F_2 is better oxidizing agent than Cl_2

Academic Session: 2015-16
Second Term Examination

Q1. Arrange the following in increasing order of basic strength: (1)
$C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$, $C_6H_5NH_2$, NH_3

Q2. Free energies of formation(Δ_fG^0) of MgO(s) and CO(g) at 2273 K are given below: (1)
Δ_fG^0 (MgO(s)) = -344kJ/mol at 2273 K
Δ_fG^0 (CO(g)) = -628kJ/mol at 2273 K
On the basis of above data, predict whether carbon can be used as a reducing agent for MgO(s) at 2273 K. Report ΔG^0 of the reaction.

Q3. Why is the use of aspartame restricted to cold foods and drinks? (1)

Q4. Outline the principle of the method used for refining of Nickel. (1)

Q5. Why aniline does not undergo Friedal Craft's reaction? (1)

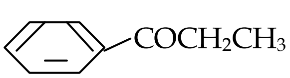
Q6. Explain why $[NiCl_4]^{2-}$ is paramagnetic but $[Ni(CO)_4]$ is diamagnetic in nature although both form tetrahedral complexes. (2)

Q7. (a)Arrange the following in increasing order of boiling points (2)
$C_2H_5OC_2H_5$, C_3H_7COOH, C_4H_9OH, C_3H_7CHO
(b) What are ambident nucleophiles? Give an example.

Q8. Write Short note on the following reactions: (2)
(a) Hell-Volhard-Zelinsky reaction
(b) Tollen's test

Q9. Give the mechanism for nucleophillic addition of HCN on ethanal. (2)

Q10. Give IUPAC name of the following: (2)
(i) $CH_3CH(Cl)CH(CH_3)CH(NH_2)CH(C_2H_5)CH_2COOH$

(ii) 

Q11. (a) Carry out the following conversions: (3)
(i) Nitrobenzene to phenol
(ii) Benzoic acid to aniline
(b) Why aromatic amines cannot be prepared by Gabriel phthalimide synthesis?

Q12. (a) Extraction of Au by leaching with NaCN involves both oxidation and reduction. Justify by giving equations for the reactions involved? (3)

(b) Why is froth floatation method selected for the concentration of sulphide ores?

Q13. $CoSO_4Cl.5NH_3$ exists in two isomeric forms 'A' and 'B'. Isomer 'A' reacts with $AgNO_3$ solution to give white precipitate but does not react with $BaCl_2$ solution. Isomer 'B' gives white precipitate with $BaCl_2$ solution but does not react with $AgNO_3$ solution. Answer the following questions: (3)

(a) Identify 'A' and 'B' by writing their structural formulae.
(b) Name the type of isomerism involved.
(c) Give the IUPAC names of 'A' and 'B'

Q14. (a) Differentiate between the following pairs of polymers based on the property mentioned against each: (3)

(i) HDP and LDP(Structure)
(ii) Buna-N and Nylon6 (Intermolecular forces)
(b) What is the main purpose of vulcanization of rubber?

Q15. Distinguish between the following with a chemical test: (3)

(i) $CH_3CH_2CH_2OH$ and CH_3COOH
(ii) $C_2H_5NH_2$ and $(C_2H_5)_2NH$
(iii) CH_3COCH_3 and $CH_3CH_2COCH_2CH_3$

Q16. Give equations for the following chemical reactions: (3)

(a) Reaction of bromine in water with phenol.
(b) Action of Zn dust on phenol.
(c) Treating phenol with chloroform in the presence of aqueous NaOH and heat.

Q17. Complete the following reactions: (3)

(a) $C_6H_5NH_2 + (CH_3CO)_2O \longrightarrow$
(b) $C_6H_5N_2^+Cl^- + C_6H_5OH \xrightarrow{OH^-}$
(c) $C_6H_5NH_2 \xrightarrow{HNO_3/H_2SO_4}$

Q18. (a) Identify A and B from the following: (3)

Cl2/heat
(i) $C_6H_5CH_3 \xrightarrow{KCN} [A] \longrightarrow [B]$

NaOH/623K
(ii) $C_6H_5Cl \xrightarrow{} [A] \xrightarrow{H_2O/H^+} [B]$
High Pressure

(b) Although Chlorine is an electron withdrawing group, yet it is ortho and para directing in electrophillic substitution reactions. Explain.

Q19. (a)Complete the following equations: (3)

(i) $Cr_2O_7^{2-}(aq) + H_2S(g) + H^+(aq)$ ----->

(ii) $MnO_4^-(aq) + I^-(aq) + H^+(aq)$ -------->

OR

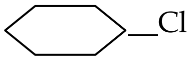
Assign reasons for the following:
(i) Transition elements act as good catalysts.
(ii) Among the lanthanides, Ce(III) is easily oxidized to Ce(IV).

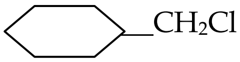
(b) Why Cu^+ is colourless and Cu^{2+} is coloured?

Q20. (a) Write the names of the monomers of polymer used for making unbreakable crockery. (3)
(b) Write the reaction involved in the preparation of neoprene.
(c) What is step growth polymerization? Give an example.

Q21. (a) Give equations to synthesise: (3)
(i) 1-Phenyl ethanol from a suitable alkene.
(ii) Cyclohexylmethanol using an alkyl halide .
(b) Write the reactants for the preparation of 2-Methoxy-2methylpropane by Williamson's synthesis.

Q22. (a) In the following pair of halogen compounds, which will undergo S_N2 reaction faster and why? (3)



or


(b) Out of S_N1 and S_N2, which occurs with (i) inversion of configuration and (ii) racemization ?
(c) How will you convert methyl bromide into methyl iodide?

Q23. Naresh works in a multi-national company. He is stressed due to his hectic schedule. Amit, his friend comes to know that he has started taking sleeping pills without consulting the doctor. Amit requests Naresh to stop this practice and takes him to a yoga centre. With regular Yoga sessions, Naresh is now a happy and a relaxed man. (4)
After reading the above passage, answer the following questions:
(a) Write the values shown by Amit.
(b) Which class of drugs is used in sleeping pills? How do they help in reducing stress?
(c) Why is it not advisable to take sleeping pills without consultation with the doctor?

Q24. (a) How will you bring about the following conversions in not more than two steps: (5)
(i)Butanol to butanoyl chloride
(ii) Acetaldehyde to But-2-enal.
(b) Predict the product when cyclo hexane carbaldehyde reacts with following reagents:
(i) Semicarbazide in weakly acidic medium
(ii) Zinc amalgam and dilute HCl
(c) Draw the structure of Sulphanilic acid.

Q25. (a) Predict the hybridization and number of unpaired electrons of Mn ion (5) in the tetrahedral $[MnBr_4]^{2-}$

(b) Draw the geometrical isomers of $[Cr(NH_3)_4Cl_2]^+$

(c) Write the formula of the following coordination compound:
Amminebromidochloridonitrito-N-platinate(II)

(d) What is the effect of synergic bonding interactions in the metal carbonyl complex?

(e) On the basis of crystal field theory, state whether $[Fe(CN)_6]^{4-}$ will form high spin or low spin complex.

Q26. (a) When an oxide of manganese [A] is fused with KOH in the presence of an oxidizing agent and dissolved in water, it gives a dark green solution of compound [B]. Compound [B] disproportionate in acidic solution to give a purple compound [C]. An alkaline solution of compound [C] oxidizes KI solution to a compound [D] and compound [A] is also formed. Identify compounds A to D and also explain the reactions involved. (5)

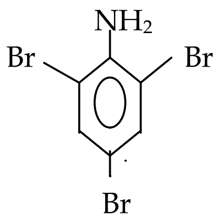
(b) Name an important alloy which contains some of the lanthanoid metals. Mention its use.

Academic session- 2016-17
Second term Examination
Subject – Chemistry
M/2/1

Time: 3 hrs ***Max. Marks – 70***

No. of printed pages: 4

1 Write IUPAC name of



2 Out of C and CO, which is a better reducing agent at 673K and why?

3 Name the different types of RNA found in a cell.

4 What is misch metal? Give one use of it.

5 Write equation for the preparation of phenol from cumene.

6 Write name and structure of monomers of the polymer used for making electric switches. 2
Give an example of biodegradable aliphatic polyester. Write the names of its monomers also.

7 Write the names associated with the following reactions: 2

(i) $RCONH_2 + Br_2 + 4NaOH \longrightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O$

(ii) $C_6H_5N_2^+X^- + C_6H_5NH_2 \xrightarrow{^-OH} C_6H_5N{=}NC_6H_4NH_2 + X^- + H_2O$

(iii) $RNH_2 + CHCl_3 + 3KOH \xrightarrow{Heat} RNC + 3KCl + 3H_2O$

(iv) $ArN_2^+X^- \xrightarrow{Cu/HCl} ArCl + N_2 + CuX$

8 Which one of the two compounds, CH_3Br and CH_3I, will react faster in an S_N2 reaction with Aqueous NaOH? Explain giving mechanism for the reaction. 2

9 (i) How will you distinguish between propanal and propanone? 2
(ii) An aromatic compound 'A'(molecular formula C_8H_8O) gives positive 2,4-DNP test. It gives a yellow precipitate of iodoform on treatment with iodine and NaOH. Compound 'A' does not give Tollen's or Fehling's test. Identify the compound 'A'.

10 When mixed oxide of iron and chromium $FeCr_2O_4$ is fused with NaOH in the presence of air, a yellow coloured compound (A) is obtained which on acidification with dilute sulphuric acid gives a compound (B). Compound (B) on reaction with KCl forms an orange coloured compound (C). 2
(a) Identify compounds (A), (B) and (C).
(b) Write one use of compound (C).

11 (i) Write the names of the two monosaccharides obtained on hydrolysis of lactose sugar. 3
(ii) Why vitamin C cannot be stored in our body?
(iii) What is the difference between nucleoside and nucleotide?

12 (i) Name the method used for refining of Zr. What is the principle involved? 3
(ii) In extraction of A*l*, impure A*l* is dissolved in conc. NaOH to form sodium aluminate and leaving behind impurities. What is the name of this process.
(iii) What is the role of coke in the extraction of iron from its oxides.

13 (i) Write the products obtained when benzyl phenylether is treated with HI. 3
(ii) How will you convert: Phenol to Salicyaldehyde.
(iii) How will you distinguish between phenol and Cyclohexanol?

14 (i) Draw one geometrical isomer of the complex $[Pt(en)_2Cl_2]^{2+}$ which is optically active. 3
(ii) When a coordination compound $CrCl_3.6H_2O$ is mixed with $AgNO_3$, 2 moles of AgCl are precipitated per mole of the compound. Write
a) Formula of the complex.
b) IUPAC name of the complex.

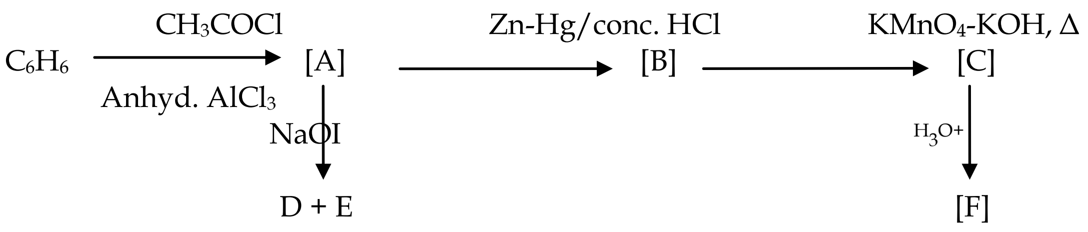
15 (i) What are Antioxidants. Give one example. 3
(ii) Name one substance which
a) which can act as both antiseptic and disinfectant
b) which is a biodegradable detergent
(iii) Mention the class of drug to which Chloramphenicol belongs.
(iv) Name a sweetening agent used in preparation of sweets for a diabetic patient.

16 (i) What happens when D- Glucose is treated with Bromine water? Write equation. 3
(ii) What type of linkage is present between monomers of nucleic acids?
(iii) An optically active compound having molecular formula $C_6H_{12}O_6$ is found in two isomeric forms (A) and (B) in nature. When (A) and (B) are dissolved in water, they show the following equilibrium.

$$\begin{matrix} (A) & \Longrightarrow & \text{Equilibrium mixture} & \Longleftarrow & (B) \\ (\alpha)_D = 111^0 & & 52.2^0 & & (\beta)_D = 19.2^0 \end{matrix}$$

(a) What are these isomers called?
(b) Draw Haworth structure of isomer (A) .

17 Write structures of A, B, C, D and E in the following reactions: 3



18 (i) Write the chemical equation for the reaction involved in Cannizzaro reaction. 3
(ii) Draw the structure semicarbazone of ethanal.
(iii) Why pKa of F-CH_2COOH is lower than that of Cl-CH_2COOH?

19 Account for the following facts: 3
(i) The reduction of a metaloxide is easier if the metal formed is in the liquid state at the temperature of reduction.
(ii) Pine oil is used in froth floatation process used to concentrate sulphide ores.
(iii) Silica is used in extraction of copper.

20 (i) Write the mechanism of free radical polymerization of ethene. 3
(ii) Is $[\!\!-\ CH_2 - CHCl\ -\!\!]_n$ a homopolymer or copolymer? Give one use of it.

21 (i) What is the main purpose of vulcanization of rubber? 3
(ii) Identify he monomers in the following polymer:

$$-[\!\!-NH - (CH_2)_6 - NH - CO - (CH_2)_4 - CO\ -\!\!]_n$$

(iii) Arrange the following in decreasing order of intermolecular forces:
Nylon 6,6, Polythene, Buna-S .

22 (i) What happens when 3
(a) Ethyl chloride is treated with KNO_2 .
(b) n-Butyl bromide is treated with alcoholic KOH.
(ii) Explain why: 3-Bromocyclehexene is more reactive than 4-Bromocyclohexene in hydrolysis with aqueous NaOH.

23 Due to hectic and busy schedule, Mr. Angad made his life full of tensions and anxiety. He started taking sleeping pills to overcome the depression without consulting the doctor. Mr. Deepak, a close friend of Mr. Angad advised him to stop taking sleeping pills and suggested to change his life style by doing yoga, meditation and some physical exercise. Mr. Angad followed his friend's advice and after few days he started feeling better. 4

After reading the above passage, answer the following:
(i) What are the values (at least two) displayed by Mr. Deepak?
(ii) Why is it not advisable to take sleeping pills without consulting doctor?
(iii) Low level of noradrenaline is the cause of depression. What types of drugs are needed to cure this problem? Give an example.
(iv) Why are cimetidine and ranitidine better than sodium hydrogen carbonate or magnesium or aluminium hydroxide in treatment of acidity?

24 (i) Complete the following chemical equations: 5
(a) $Cr_2O_7^{2-} + 3Sn^{2+} + 14H^+ \rightarrow$
(b) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow$
(ii) Give reason:
(a) Mn shows the highest oxidation state of +7 with oxygen but with fluorine it shows the highest oxidation state of +4.
(b) Transition metals generally form coloured compounds.
(c) Actinoids show large number of oxidation states.

25 (i) Write the structures of A, B and C in the following: 5

(a) $C_6H_5NO_2 \xrightarrow{Fe/HCl} [A] \xrightarrow[0\text{-}5^0C]{NaNO_2+HCl} [B] \xrightarrow{KI} [C]$

(b) $CH_3\text{-}Cl \xrightarrow{KCN} [A] \xrightarrow{LiAlH4} [B] \xrightarrow[0^0C]{HNO_2} [C]$

(ii) Arrange in increasing order of basic strength:
CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$, $C_6H_5NH_2$, $C_6H_5CH_2NH_2$.

(iii) Convert Aniline to p-Bromoaniline.

26 (i) On the basis of Valence bond theory, show that complex, $[Fe(CN)_6]^{4-}$ is a diamagnetic complex. Also write the hybridization and spin nature of the complex. (At. number : Fe=26) 5

(ii) On the basis of crystal field theory, write the electronic configuration of d^4 ion if $\Delta_0 < P$.

(iii) What is synergic bonding? Explain in reference to bonding in metal carbonyls .

Academic Session 2015-16
Preboard Examination
Subject – Chemistry
M/2/1

Time :3hrs *Max. Marks – 70*

No. of printed pages: 4

General Instructions:

(i) All questions are compulsory.
(ii) Questions nos. 1 to 5 are very short answer questions and carry 1 mark each.
(iii) Questions nos. 6 to 10 are short answer questions and carries 2 marks each.
(iv) Questions nos. 11 to 22arealso short answer questions and carry 3 marks each.
(v) Questions no. 23is a value based question and carry 4 marks.
(vi) Question nos. 24 to 26are long answer questions and carry 5 marks each.
(vii) Use log tables if necessary, use of calculators is not permitted.

1 What makes the crystal of KCl appear sometimes violet when heated with excess of potassium vapour? 1

2 What happens to the freezing point of water when in aqueous solution no. of moles of glucose decreases. 1

3 Why are aquatic species more comfortable in cold water in comparison to warm water? 1

4 Which of the following is more effective electrolyte in coagulation of $Fe(OH)_3$ sol? 1
$AlCl_3$, K_3PO_4, $K_4[Fe(CN)_6]$, $MgCl_2$.

5 Why is smoke from chimneys of industries passed through Cottrell precipitator? 1

6 Write the mechanism of the following reaction: 2
$2\,CH_3CH_2OH \xrightarrow[413\,K]{H^+} CH_3CH_2-O---CH_2CH_3$

7 (i) What is the effect of temperature on adsorption of N_2 gas on charcoal at constant pressure and why? 2
(ii) What happens when silver nitrate solution is added to potassium iodide solution

8 Give reasons 2
(i) Transition metals form alloys
(ii) Mn_2O_7 is acidic but MnO is basic

9 Complete the following equation: 2
(a) $Cr_2O_7^{2-} + OH^- \longrightarrow$
(b) $KMnO_4 \xrightarrow{heat}$

10 (a) Why does the rate of reaction become double for every 10^0C rise in temperature? 2
(b) In –dx/dt , what is the meaning of negative sign?

OR

Consider the following reaction of NO_2 (g) with CO (g)

$$NO_2(g) + NO_2(g) \longrightarrow NO(g) + NO_3(g) \; [slow]$$
$$NO_3(g) + CO(g) \longrightarrow NO_2(g) + CO_2(g) \; [fast]$$

(a) Derive the rate law on the basis of mechanism.
(b) What is molecularity of the each elementary reactions?

11 (a) Draw optical isomer of $[Pt(en)_2Cl_2]^{2+}$ 3
(b) Write electronic configuration in terms of crystal field theory of d^6 if $\Delta_o < P$.
(c) Write hybridization and magnetic behaviour of tetrahedral $[NiCl_4]^{2-}$.
{Atomic number of Ni is 28}

12 Calculate the mole fraction of benzene in solution containing 30% by mass in carbon tetrachloride. (atomic weight of C= 12 u, H= 1u, Cl = 35.5 u) 3

13 (a) Indicate the principle of method used for refining of Germanium. 3
(b) What is the role of NaCN in froth floatation.
(c) Give the principle of refining of copper metal.

14 (a) What type of semiconductor is formed when Si is doped with Indium. 3
(b) Silver crystallizes in fcc lattice. If edge length of the cell is 4.07×10^{-8} cm and density is 10.5 g cm^{-3}, calculate the atomic mass of silver. ($N_A = 6.02 \times 10^{23}$ mol^{-1})

15 (a) For M^{2+}/M systems, the E^0 values for some metals are as follows: 3
Cr^{2+}/Cr = -0.9 V, Mn^{2+}/Mn = -1.2 V, Fe^{2+}/Fe = -0.4 V
Use the data to comment upon the ease with which iron can be oxidized as compared to the similar process for either Cr or Mn metals.
(b) Give reasons:
(i) Cu^+ ion is unstable in aqueous solution.
(ii) In the series from Sc to Zn , the zinc has lowest enthalpy of atomization.

16 (a) Write the structure of 2- Hydoxycyclopentanecarbaldehyde 3
(b) Illustrate the following name reactions giving a chemical equation in each case:
(i) Clemmensen reaction
(ii) Kolbe's reaction

17 Give chemical tests to distinguish between 3
(i) Acetaldehyde and propanone
(ii) Benzaldehyde and Acetophenone
(iii) Benzoic acid and ethyl benzoate

18 An aliphatic compound 'A' with the molecular formula of C_3H_6O reacts with phenylhydrazine to give compound 'B'. Reaction of 'A' with I_2 in alkaline medium on warming gives a yellow precipitate 'C'. Identify the compounds A ,B and C and write the corresponding equations. 3

19 Classify detergents giving an example in each case. 3

20 (a) How does Thionyl chloride react with benzoic acid. Give equation. 3
(b) Convert the following:
- (i) Propan-2-ol to 2-methylpropan-2-ol
- (ii) Aniline to phenol

21 At 380^{0}C , the half-life period for first order decomposition of H_2O_2 is 360 min. The activation energy of the reaction is 200 KJ mol^{-1}. Calculate the rate constant at 450^{0}C. 3
[R = 8.314 J/mol/K, Antilog (1.5487) = 35.38]

OR

The activation energy for a hypothetical reaction A $\rightarrow$ Product , is 12.49 K cal/ mol. If temperature is raised from 295 to 305 K, by what factor does the rate will increase?
[R = 2 Cal/mol/K, Antilog (0.3013) = 2]

22 3
- (i) Which one of the following is a disaccharide: starch, Maltose, Fructose, Glucose?
- (ii) What is the difference between fibrous protein and globular protein ?
- (iii) Write the name of vitamin whose deficiency causes bone deformaties in children.

23 Students of a school decided to create awareness among the people about harmful effects of plastic bags. They made paper bags and distributed to vegetable vendors, shopkeepers and departmental stores. All students pledged not to use plastic bags in future. 4
After reading the passage, answer the following questions:
- (i) What values are shown by students?
- (ii) What are natural polymers? Give one example.
- (iii) Name a monomer which will lead to formation of Neoprene.
- (iv) Is polystyrene homopolymer or copolymer? Write the structure of the polymer.

24 5
- (i) Why does PCl_3 fume in moist air?
- (ii) Fluorine shows -1 whereas other halogens show +1, +3, +5, +7 oxidation states. Why?
- (iii) Why is $PbCl_4$ more covalent than $PbCl_2$?
- (iv) Why are halogens coloured?
- (v) Write the reaction of thermal decomposition of Barium azide.

OR

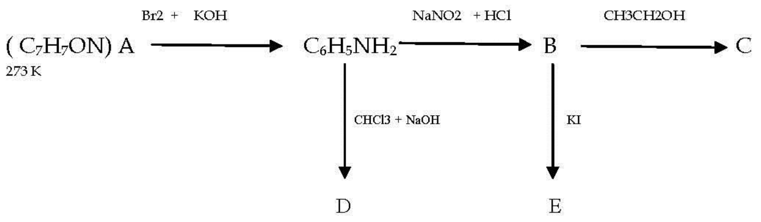
Complete the following reactions:
- (i) $CaF_2 + H_2SO_4 \longrightarrow$
- (ii) $SO_3 + H_2O \longrightarrow$
- (iii) $F_2 + H_2O \longrightarrow$
- (iv) $XeF_2 + PF_5 \longrightarrow$
- (v) $P_4 + NaOH + H_2O \longrightarrow$

25 Calculate the cell emf at 25°C for the following cell:
$Zn(s)\ |Zn^{2+}(0.1\ M)\ ||\ Pb^{2+}(0.02M)|Pb(s)$ 5
Given $E^0_{Zn2+/Zn}$ = -0.76 V, $E^0_{Pb2+/Pb}$= -0.13 V, 1F = 96500 $Cmol^{-1}$}. Calculate the maximum work that can be accomplished by the operation of this cell.

OR

(a) Calculate the electrode potential of silver electrode dipped in a 0.1 M solution of silver nitrate at 298 K assuming silver nitrate to be completed dissociated. The standard electrode potential of Ag^+/ Ag is 0.80 V at 298 K.
(b) At 18⁰C, the $\Lambda^0 NH_4Cl$, $\Lambda^0 NaOH$ and $\Lambda^0 NaCl$ are 129.8, 217.4 and 108.9 S cm^2 mol^{-1} respectively. If Λ_m of 0.01 M NH_4OH is 9.93 S cm^2 mol^{-1}, Calculate degree of dissociation.

26 An aromatic compound 'A' of molecular formula C_7H_7ON undergoes a series of reactions as shown below. Write the structures of A, B, C, D and E in the following reactions: 5



OR

(a) Write the structures of main products when aniline reacts with the following reagents:
(i) Br_2 water
(ii) HCl
(iii)$(CH_3CO)_2O$/ pyridine

(b) Arrange the following in the increasing order of their boiling point:
$C_2H_5NH_2$, C_2H_5OH, $(CH_3)_3N$

(c) Give a simple chemical test to distinguish between the following pair of compounds:
$(CH_3)_2NH$ and $(CH_3)_3N$

Academic Session: 2016-17
Pre board Examination
Subject: Chemistry
M/2/1

Time : 3 Hrs **Max marks : 70**

General Instructions:

- All questions are compulsory.
- Question nos. 1 – 5 are very short answer questions and carry 1 mark each.
- Question nos. 6 – 10 are short answer questions and carry 2 mark each.
- Question nos.11 – 22 are also short answer questions and carry 3 mark each.
- Question no. 23 is a value based question and carry 4 marks.
- Question nos.24 – 26 are long answer questions and carry 5 mark each.
- Use of calculators is not permitted.
- This paper has 5 printed sides.

Q1. What is meant by positive deviation from Raoult's law? Give an example. (1)

Q2. Why is adsorption always exothermic? (1)

Q3. What is flux? (1)

Q4. $CuSO_4.5H_2O$ is blue in colour while anhydrous $CuSO_4$ is white, why? (1)

Q5. Give one use of DDT. (1)

Q6. (a) Name the type of: (2)
(i) semiconductor obtained when silicon is doped with boron?
(ii) magnetism shown in the following alignment of magnetic moments:
⇧ ⇧ ⇩ ⇧ ⇩ ⇧

(b) In an ionic compound, the anion (N^-) form cubic close type of packing, while the cation (M^+) ions occupy one third of the tetrahedral voids. Deduce the empirical formula of the compound and the coordination number of M^+ ions.

Q7. (a)Arrange the following compounds in decreasing order of pK_b values : (2)
$C_2H_5NH_2$, $C_6H_5NHCH_3$, $(C_2H_5)_2NH$ and $C_6H_5NH_2$
(b) Although amino group is ortho and para directing in aromatic electrophilic substitution reaction, aniline on nitration gives substantial amount of m-nitro aniline. Why?

Q8. Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10. (2)

Q9. (a) Arrange the following compounds in decreasing order of reactivity towards S_N2 displacement reaction: (2)
$(CH_3)_3CBr$, $CH_3CH_2CHBrCH_3$, $CH_3CH_2CH_2CH_2Br$
(b) What happens when ethyl chloride is treated with $AgNO_2$?

OR

An alkyl halide 'A' when heated with magnesium in presence of dry ether gave 'B'. 'B' on treatment with ethanal followed by acid hydrolysis gave 2-propanol. Identify the compound "A". What is "B" known as?

Q10. Write the structures of A, B,C,D in the following reactions: (2)

$$CH_3COOH \xrightarrow{SOCl_2} A \xrightarrow{NH_3\text{ (excess)}} B \xrightarrow{Br_2/KOH} C \xrightarrow[\text{(ii) } H_2O]{\text{(i) } HNO_2} D$$

Q11. An element X with an atomic mass of 60 g/mol has density of 6.23 g/cm^3. If the edge length of its cubic unit cell is 400 pm, identify the type of cubic unit cell. Calculate the radius of an atom of this element? (3)

Q12. KI and sucrose solution are with 0.1 M concentration each and both at temperature T have osmotic pressure of 0.465 atm and 0.245 atm respectively. Find the van't Hoff factor of KI and its degree of dissociation? (3)

Q13. (a) Write the chemical reactions involved in the extraction of gold by cyanide process. Also give the role of Zinc in the extraction. (3)
(b) What is the role of depressants in froth floatation process?

Q14. (a) Complete the following equations: (3)
(i) $XeF_2(s) + H_2O(l) \longrightarrow$
(ii) NaOH (cold and dilute) + $Cl_2 \longrightarrow$
(b) Draw the structure of H_2SO_5

Q15. An optically active compound having molecular formula $C_7H_{15}Br$ reacts with aqueous KOH to give a racemic mixture of products. Write the mechanism involved for this reaction. (3)

Q16. (a) How much electricity is required in coulomb for the oxidation of 1 mol of H_2O to O_2? (3)
(b) Predict the products of electrolysis of an aqueous solution of $CuCl_2$ with Pt electrodes.
(c) State Kohlrausch law of independent migration of ions. Why does conductivity of a solution decrease with dilution?

Q17. Arrange the following in the order of the property indicated for each set: (3)

(a) F_2, Cl_2, Br_2, I_2- Increasing bond dissociation enthalpy.
(b) HF, HCl, HBr, HI- Increasing acid strength.
(c) NH_3, PH_3, AsH_3, SbH_3, BiH_3- Increasing base strength.

Q18. What is observed when: (3)

(a) an electric current is passed through a sol.
(b) a beam of light is passed through a sol.
(c) an electrolyte (say NaCl) is added to ferric hydroxide sol.

OR

Give reasons for the following observations:
(a) Peptizing agent is added to convert precipitate into colloidal solution.
(b) Cottrell's smoke precipitator is fitted at the mouth of chimney used in factories.
(c) Colloidal gold is used for intra muscular injections

Q19. For the complex $[Fe(en)_2Cl_2]Cl$, identify the following: (3)

(a) oxidation number of iron.
(b) shape of the complex.
(c) magnetic behavior of the complex.
(d) number of its geometric isomers.
(e) geometric isomer which is optically active.
(f) name of the complex.

Q20. (a) Write the structure of 3-Cyclohexylpentan-3-ol (3)

(b) Write the equation for the preparation of ethoxy benzene by Williamson's Synthesis.
(c) Write a short note on Kolbe's reaction.

Q21. (a) What products would be formed when a nucleotide from DNA containing Thymine is hydrolyzed? (3)

(b) What are the products of hydrolysis of Lactose?
(c) Draw the structure of α- Glucopyranose.

Q22. (a) What are anti oxidants? Give an example. (3)

(b) How do antiseptics differ from disinfectants? Give an example of each.
(c) Which category of the synthetic detergent is used in toothpastes?

Q23. After the ban on plastic bags, students of one school decided to make the people aware of the harmful effects of plastic bags on environment and Yamuna river. To make the awareness more impactful, they organized rally by joining hands with other schools and distributed paper bags to vegetable vendors, shopkeepers, and departmental stores. All students pledged not to use polythene bags in future to save Yamuna river. (4)

After reading the above passage, answer to following questions:
(a) What values are shown by the students?

(b) What are bio degradable polymers? Give an example.
(c) Give one point of difference and one use each of LDPE and HDPE.

Q24. (a) Define rate constant of a reaction. (5)
(b) For a first order reaction, show the time required for 99% completion is twice the time required for the completion of 90% of the reaction.
(c) Rate constant 'k' of a reaction varies with temperature 'T' according to the equation: log k= log A- $E_a/2.303RT$, where E_a is the activation energy. When a graph is plotted for log k vs 1/T, a straight line with a slope of -4250K is obtained. Calculate E_a for the reaction. (R=8.314J/K/mol)

OR

(a) The following data were obtained during the first order thermal decomposition of N_2O_5 (g) at constant volume:

$$2\,N_2O_5(g) \longrightarrow 2\,N_2O_4(g) + O_2\,(g)$$

S.No.	Time/s	Total pressure/atm
1	0	0.5
2	100	0.512

Calculate the rate constant. (log 5=0.6990, log 4.76= 0.6776)
(b) Give one point of difference between order and molecularity.
(c) Define pseudo first order reaction.

Q25. (a) Give a chemical test to distinguish between acetophenone and benzophenone (5)
(b) How will you convert ethanal to 3-hydroxybutanal?
(c) There are two $-NH_2$ groups in semicarbazide. However, only one is involved in the formation of semicarbazones. Explain.
(d) Write the IUPAC name of $CH_3COCH_2CH(Cl)CH_3$.
(e) Name the reagent used in the following reaction:

$$CH_3COOH \xrightarrow{?} CH_3COCl$$

OR

(a) Write one chemical reaction each to exemplify the following:
(i) Rosenmund reduction
(ii) Fehling's test
(b) An organic compound 'A'gives a positive Tollen's test. On treatment with concentrated NaOH, it forms compounds 'B' and 'C'. Compound 'B' has molecular formula C_7H_8O which on oxidation with PCC gives back 'A'. The compound 'C' is a sodium salt of an acid. When 'C' is treated with soda lime, it yields an aromatic compound 'D'. Deduce the structures of 'A', 'B', 'C' and 'D'. Write the sequence of the reactions involved.

Q26. (a) Complete the following chemical equations: (5)

(i) $2MnO_4^- (aq) + 10I^- (aq) + 16 H^+ (aq) \longrightarrow$

(ii) $Cr_2O_7^{2-} (aq) + 6Fe^{2+} + 14 H^+ (aq) \longrightarrow$

(b) Give an explanation for each of the following observations:

(i) The gradual decrease in size (actinoid contraction) from element to element is greater among actinoids than that among the lanthanoids (Lanthanoid contraction)

(ii) The greatest number of oxidation states are exhibited by the members in the middle of a transition series.

(iii) With the same d-orbital, configuration(d^4), Cr^{2+} ion is a reducing agent but Mn^{3+} ion is an oxidizing agent.

OR

(a) Complete the following chemical equations:

(i) $2MnO_4^- (aq) + 5NO_2^- (aq) + 6H^+(aq) \longrightarrow$

(ii) $Cr_2O_7^{2-} (aq) + 2OH^-(aq) \longrightarrow$

(b) How will you prepare K_2MnO_4 from MnO_2?

(c) Account for the following:

(i) The enthalpy of atomization is lowest for Zn in 3d series of the transition elements.

(ii) Actinoid elements show wide range of oxidation states.

SAMPLE QUESTION PAPER

CHEMISTRY

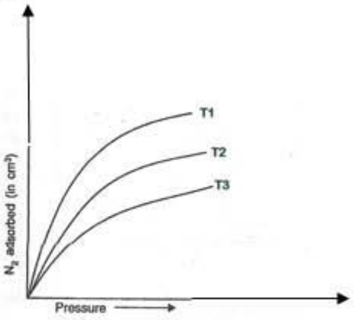
CLASS – XII (2014 – 2015)

Time Allowed: 3 hr **Maximum marks: 70**

General Instructions:

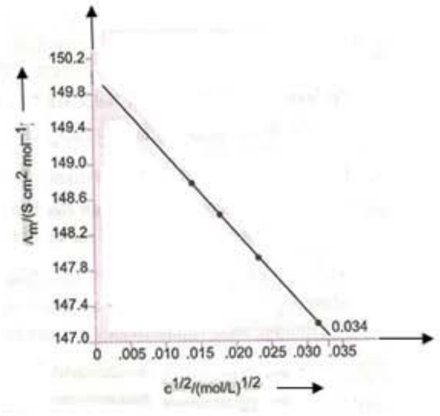
- *(a) All questions are compulsory.*
- *(b) Q.no. 1 to 5 are very short answer questions and carry 1 mark each.*
- *(c) Q.no. 6 to 10 are short answer questions and carry 2 marks each.*
- *(d) Q.no. 11 to 22 are also short answer questions and carry 3 marks each*
- *(e) Q.no. 23 is a value based question and carry 4 marks.*
- *(f) Q.no. 24 to 26 are long answer questions and carry 5 marks each*
- *(g) Use log tables if necessary, use of calculators is not allowed.*

1. The following figure shows the variation of adsorption of N_2 on charcoal with pressure at different constant temperatures:



Arrange the temperatures T1, T2 and T3 in the increasing order.

2. Give the formula of a noble gas species which is isostructural with $\mathbf{IBr_2^-}$.
3. What is the effect of synergic bonding interactions in a metal carbonyl complex?
4. PCl_5 acts as an oxidizing agent. Justify.
5. Write the name of the product formed when benzenediazonium chloride solution is treated with potassium iodide.
6. Name the crystal defect which reduces the density of an ionic solid? What type of ionic substances show this defect?
7. The molar conductivity (λ_m) of KCl solutions at different concentrations at 298 K is plotted as shown in the figure given below.



Determine the value of λ_m^0 and A for KCl.

8. Aluminum crystallizes in anfcc structure. Atomic radius of the metal is 125 pm. What is the length of the side of the unit cell of the metal?
9. Draw the structure of the following compounds:
   (i) $H_2S_2O_7$
   (ii) $XeOF_4$

OR

Write balanced chemical equations for the following:

(i) Reaction of chlorine with hot and concentrated NaOH.

(ii) Sulphur dioxide is passed through an aqueous solution of Fe (III) salt.

10. 0.5 g of KCl was dissolved in 100 g of water and the solution originally at 20^0C, froze at -0.24^0C. Calculate the percentage dissociation of the salt.

(Given :K_f for water = 1.86 K kg /mol, Atomic mass: K = 39 u, Cl= 35.5 u)

11. State briefly the principles involved in the following operations in metallurgy. Give an example.
    (i) Hydraulic washing.
    (ii) Zone refining.

12.
    i) What type of deviation from Raoult's law is observed, when two volatile liquids A and B on mixing produce a warm solution? Explain with the help of a well labeled vapour pressure graph.
    ii) Consider separate solutions of 0.5 M CH_3OH, 0.250 M KCl (aq) and 0.125 M Na_3PO_4 (aq). Arrange the above solutions in the increasing order of their Van't Hoff factor.

13. Write the Nernst equationand calculate the emffor the following cell at 298 K:

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

How does $\mathbf{E}_{\mathbf{cell}}$vary with the concentration of both Mg^{2+} and Cu^{2+} ions?

(Given$\mathbf{E}^{\mathbf{o}}_{\mathbf{cell}}$= 2.71 V)

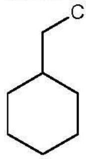
14. Explain the following observations giving appropriate reasons:
    (i) Ozone is thermodynamically unstable with respect to oxygen. .
    (ii) The HEH bond angle of the hydrides of group 15 elements decrease as we move down the group.
    (iii) Bleaching effect of chlorine is permanent.

15.
    (i) Predict the number of unpaired electrons in the tetrahedral $[MnBr_4]^{2-}$ ion.
    (ii) Draw structures of geometrical isomers of $[Co(NH_3)_4Cl_2]^+$.
    (iii) Write the formula for the following coordinate compound: Amminebromidochloridonitrito-N-platinate(II)

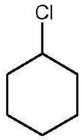
16. Explain what is observed when
    (i) Silver nitrate solution is added to potassium iodide solution.
    (ii) The size of the finest gold sol particles increases in the gold sol.
    (iii) Two oppositely charged sols are mixed in almost equal proportions.

17.

(i) In the following pairs of halogen compounds, which would undergo S_N1 reaction faster? Explain.



and



(ii) Amongst the isomeric dihalobenzenes which isomer has the highest melting point and why?

(iii) Arrange the following haloalkanes in the increasing order of density. Justify your answer.

CCl_4, CH_2Cl_2 and $CHCl_3$.

18. An organic compound (A) has characteristic odour. On treatment with NaOH, it forms compounds (B) and (C). Compound (B) has molecular formula C_7H_8Owhich on oxidation gives back (A). The compound (C) is a sodium salt of an acid. When (C) is treated with soda-lime, it yields an aromatic compound (D). Deduce the structures of (A), (B), (C) and (D). Write the sequence of reactions involved.

19. (a) Give one chemical test to distinguish between the following pairs of compounds:
   - (i) Methylamine and dimethylamine.
   - (ii) Aniline and benzylamine

(b) Write the structures of different isomers corresponding to the molecular formula C_3H_9N, which will liberate nitrogen gas on treatment with nitrous acid.

20. (a) Exemplify the following reactions:
   - (i) Rosenmund reduction reaction.
   - (ii) Kolbe electrolysis reaction.

(b) Arrange the following compounds in increasing order of their reactivity towards HCN: Acetaldehyde, Acetone, Di-tert-butyl ketone.

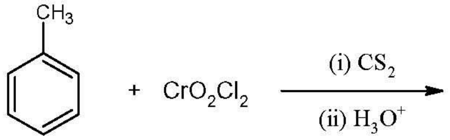
OR

(a) Predict the products of the following reactions:

(i)

$$CH_3\text{-}CH_2\text{-}COOH \xrightarrow[\text{(ii) } H_2O]{\text{(i) } Cl_2 \text{ / Red phosphorous}}$$

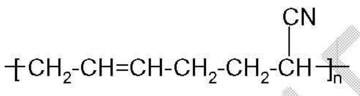
(ii)



(b) Arrange the following compounds in increasing order of acid strength:
Benzoic acid, 4-Nitrobenzoic acid, 4-Methoxybenzoic acid.

21.

(i) Identify the monomer in the following polymeric structure:



$$\left[CH_2\text{-}CH{=}CH\text{-}CH_2\text{-}CH_2\text{-}\underset{}{\overset{CN}{\overset{|}{C}}}H \right]_n$$

(ii) On the basis of forces between their molecules in a polymer to which class does neoprene belong?

(iii) Can both addition and condensation polymerization result in the formation of a co-polymer?

22.

(i) Which of the following biomolecule is insoluble in water? Justify.
Insulin, Haemoglobin, Keratin.

(ii) Draw the Haworth structure for α-D-Glucopyranose.

(iii) Write chemical reaction to show that glucose contains aldehyde as carbonyl group.

23. John had gone with his mother to the doctor as he was down with fever. He then went to the chemist shop with his mother to purchase medicines prescribed by the doctor. There he observed a young man pleading with the chemist to give him medicines as he had nasal congestion. The chemist gave him cimetidine. John advised and also explained to the young man that he should only take the medicines prescribed by the doctor.

Answer the following questions:

a) Did the chemist give an appropriate medicine? Justify your answer.

b) John's action was appreciated by his mother. List any two reasons.

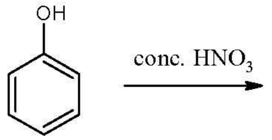
24. (a) Write the mechanism of hydration of ethene to form ethanol.

(b) How are the following conversions carried out?

(i) Propanol to propan-2-ol.

(ii) Propanol to 1-propoxypropane.

(c) Give the structure and the IUPAC name of the major product obtained in the following reaction:

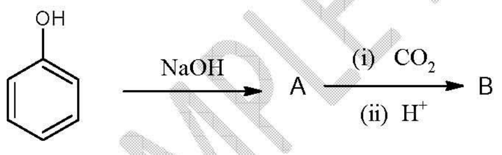


OR

(a) Write the mechanism of the reaction of HI with methoxymethane.

(b) Identify A and B in the following reactions:

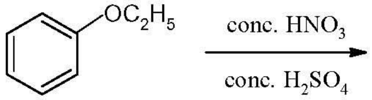
(i)



(ii)

$$C_2H_5OH \xrightarrow{\text{Cu, 573 K}} A \xrightarrow[H_2O\,/\,H^+]{CH_3MgBr} B$$

(c) Give the structure and the IUPAC name of the major product obtained in the following reaction:



25. (a) A blackish brown coloured solid (A) which is an oxide of manganese, when fused with alkali metal hydroxide and an oxidizing agent like KNO_3, produces a dark green coloured

compound (B). Compound (B) on disproportionation in neutral and acidic solution gives a purple coloured compound (C). Identify A, B and C and write the reaction involved when compound (C) is heated to 513 K.

(b)

(i) E^0 M^{3+} / M^{2+}values for the first series of transitionelements are given below. Answer the question that follows:

E^0 (V)	Ti	V	Cr	Mn	Fe	Co
M^{3+} / M^{2+}	-0.37	-0.26	-0.41	+1.57	+0.77	+1.97

Identify the two strongest oxidizing agents in the aqueous solution from the above data.

ii) Copper (I) ion is not known in aqueous solution

iii) The highest oxidation state of a metal is exhibited in its oxide.

OR

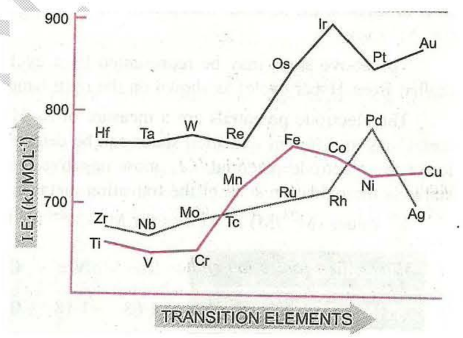
(a) Write balanced equations to represent what happens when

(i) Cu^{2+} is treated with KI.

(ii) Acidified potassium dichromate solution is reacted with iron (II) solution. (ionic equation)

(b)

i) The figure given below illustrates the first ionization enthalpies of first, second and third series of transition elements. Answer the question that follows



Which series amongst the first, second and third series of transition elements have the highest first ionization enthalpy and why?

ii) Separation of lanthanide elements is difficult. Explain.

iii) Sm^{2+}, Eu^{2+} and Yb^{2+} ions in solutions are good reducing agents but an aqueous solution of Ce^{4+} is a good oxidizing agent. Why?

26.

i) Graphically explain the effect of temperature on the rate constant of reaction? How can this temperature effect on rate constant be represented quantitatively?

ii) The decomposition of a hydrocarbon follows the equation

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

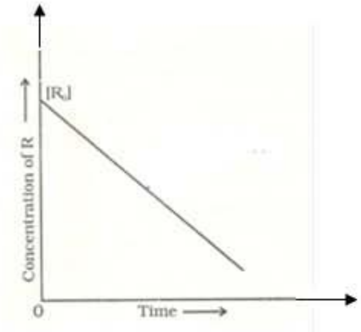
Calculate E_a

OR

i) In the reaction

$Q + R \rightarrow$ Products

The time taken for 99% reaction of Q is twice the time taken for 90% reaction of Q. The concentration of R varies with time as shown in the figure below.



What is the overall order of the reaction? Give the units of the rate constant for the same. Write the rate expression for the above reaction.

ii) Rate constant for a first order reaction has been found to be $2.54 \times 10^{-3} s$-1. Calculate its three-fourth life.

SAMPLE QUESTION PAPER
CLASS XII
CHEMISTRY

Time: 3 hrs **MM: 70**

GENERAL INSTRUCTIONS:

1. *All the questions are compulsory.*
2. *Q. No. 1 to 5 are very short answer type, carrying 1mark each.*
3. *Q. No. 6 to 10 are short answer type, carrying 2 marks each.*
4. *Q. No. 11 to 22 are short answer type, carrying 3 marks each.*
5. *Q.No.23 is a value based question carrying 4 marks.*
6. *Q. No. 24 to 26 are long answer type, carrying 5 marks each.*
7. *Use of calculators is not allowed, use log tables wherever required.*

1. Name the non stoichiometric point defect responsible for colour in alkali metal halides.

2. What is shape selective catalysis?

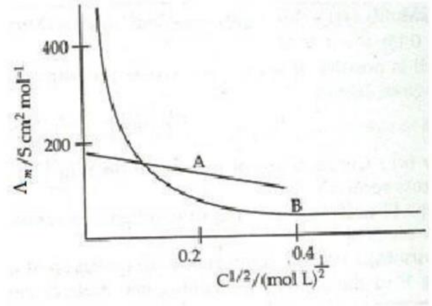
3. Amongst the isomeric alkanes of molecular formula C_5H_{12}, identify the one that on photochemical chlorination yields a single monochloride.

4. Give the IUPAC name and structure of the amine obtained when 3-chlorobutanamide undergoes Hoffmann –bromamide reaction.

5. How many ions are produced from the complex, $[Co(NH_3)_6]Cl_2$ in solution?

6. Will the elevation in boiling point be same if 0.1 mol of Sodium chloride or 0.1 mol of sugar is dissolved in 1L of water? Explain.

7. The following curve is obtained when molar conductivity (Λ_m) is plotted against the square root of concentration, $c^{1/2}$ for two electrolytes A and B



(a) How do you account for the increase in the molar conductivity of the electrolyte A on dilution.

(b) As seen from the graph, the value of limiting molar conductivity (Λ^o_m) for electrolyte B cannot be obtained graphically. How can this value be obtained?

8. Name the following:
   (a) A transition metal which does not exhibit variation in oxidation state in its compounds.
   (b) A compound where the transition metal is in the +7 oxidation state.
   (c) A member of the lanthanoid series which is well known to exhibit +4 oxidation state.
   (d) Ore used in the preparation of Potassium dichromate.

9. Arrange the following in order of property indicated for each set:
   (a) F_2, Cl_2, Br_2, I_2 – increasing bond dissociation enthalpy
   (b) PH_3, AsH_3, BiH_3, SbH_3, NH_3 – increasing base strength

10. (a) Predict the major product of acid catalysed dehydration of 1-Methylcyclohexanol.
    (b) You are given benzene, conc.H_2SO_4, NaOH and dil.HCl. Write the preparation of phenol using these reagents.

OR

Draw the structures of any two isomeric alcohols (other than 1° alcohols) having molecular formula $C_5H_{12}O$ and give their IUPAC names.

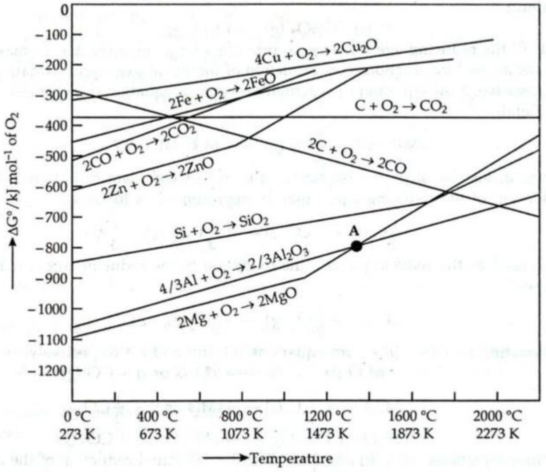
11. An element occurs in the bcc structure with cell edge of 288 pm. The density of the element is 7.2 g cm^{-3}. How many atoms of the element does 208g of the element contain?

12. Calculate the boiling point of a 1M aqueous solution (density 1.04 g mL^{-1}) of Potassium chloride (K_b for water = 0.52 K kg mol^{-1}, Atomic masses: K=39u, Cl=39.9u)
    Assume, Potassium chloride is completely dissociated in solution

13. A galvanic cell consists of a metallic zinc plate immersed in 0.1M $Zn(NO_3)_2$ solution and metallic plate of lead in 0.02M $Pb(NO_3)_2$ solution. Calculate the emf of the cell. Write the chemical equation for the electrode reactions and represent the cell.
    (Given: $E^o_{Zn^{2+}/Zn} = -0.76V$; $E^o_{Pb^{2+}/Pb} = -0.13V$)

14. Answer the following questions:
    (a) What happens when a freshly precipitated Fe $(OH)_3$ is shaken with a little amount of dilute solution of $FeCl_3$?
    (b) Why are lyophilic colloidal sols more stable than lyophobic colloidal sols?
    (c) What form Freundlich adsorption equation will take at high pressure?

15. What chemical principle is involved in choosing a reducing agent for getting the metal from its oxide ore? Consider the metal oxides, Al_2O_3 and FeO and justify the choice of reducing agent in each case.



OR

Account for the following facts:

(a) the reduction of a metal oxide is easier if the metal formed is in the liquid state at the temperature of reduction.
(b) Limestone is used in the manufacture of pig iron from haematite.
(c) Pine oil is used in the froth floatation process used to concentrate sulphide ores.

16. (i) For M^{2+}/M and M^{3+}/M^{2+} systems, E° values for some metals are as follows:

$Cr^{2+}/Cr = -0.9V$ $Cr^{3+}/Cr^{2+} = -0.4V$
$Mn^{2+}/Mn = -1.2V$ $Mn^{3+}/Mn^{2+} = +1.5V$
$Fe^{2+}/Fe = -0.4V$ $Fe^{3+}/Fe^{2+} = +0.8V$

Use this data to comment upon

(a) the stability of Fe^{3+} in acid solution as compared to that of Cr^{3+} and Mn^{3+}
(b) the ease with which iron can be oxidised as compared to the similar process for either Cr or Mn metals

(ii) What can be inferred from the magnetic moment of the complex $K_4[Mn(CN)_6]$ Magnetic moment: 2.2 BM?

17. (i) Describe the type of hybridisation for the complex ion $[Fe(H_2O)_6]^{2+}$.

(ii) Write the IUPAC name of the ionisation isomer of the coordination compound $[Co(NH_3)_5Br]SO_4$. Give one chemical test to distinguish between the two compounds.

18. (a) Explain why the dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.

(b) An optically active compound having molecular formula $C_7H_{15}Br$ reacts with aqueous KOH to give a racemic mixture of products. Write the mechanism involved in this reaction.

19. Give the structures of A, B and C in the following reactions:

(a) $C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow{HNO_2;273\,K} B \xrightarrow{C_6H_5OH} C$

(b) $C_6H_5N_2Cl \xrightarrow{CuCN} A \xrightarrow{H_2O/H^+} B \xrightarrow{NH_3;\Delta} C$

20. (a) A non reducing disaccharide 'A' on hydrolysis with dilute acid gives an equimolar mixture of D-(+)-glucose and D-(-)-Fructose.

$$A + H_2O \xrightarrow{HCl} C_6H_{12}O_6 + C_6H_{12}O_6$$

$[\alpha]_D = +66.5^0$ $\quad + 52.5^\circ \quad -92.4^\circ$

Identify A. What is the mixture of D-(+)- glucose and D-(-)-Fructose known as? Name the linkage that holds the two units in the disaccharide.

(b) α-amino acids have relatively higher melting points than the corresponding halo acids. Explain.

21. (a) Pick out the odd one from among the following on the basis of their medicinal properties mentioning the reason: Luminal, Seconal, Phenacetin, Equanil.

(b) Give an example of a substance that can act as a disinfectant as well as antiseptic depending upon its concentration. (Specify concentration)

(c) Name any two macromolecules chosen as drug targets.

22. The following is not an appropriate reaction for the preparation of tert.-butyl ethyl ether:

$$C_2H_5ONa + (CH_3)_3C-Cl \rightarrow (CH_3)_3C-OC_2H_5$$

(i) What would be the major product of the given reaction?

(ii) Write a suitable reaction for the preparation of tert.-butyl ethyl ether, specifying the names of reagents used.

Justify your answer in both cases.

23. Study the given passage carefully and answer the questions that follow:

Shalini studied a chapter on Polymers in school and came across the following paragraph:

The durability, strength, low cost, water and chemicals resistance, welding properties, lesser energy, fewer atmosphere emissions and light weight are advantages of plastic bags.

Shalini is confused as she has been reading in the newspaper about the ban on the usage of plastic substances.

She further finds that despite the durability, the use of these materials has presented mankind with serious waste disposal problem as these materials do not disintegrate by themselves. In view of this, certain polymers are being developed which are broken down rapidly by microorganisms. Shalini feels relaxed that such kinds of biomaterials are being developed.

(a) Name the class of these useful polymers which do not harm the environment.
(b) Give any one example of these polymers and name its monomers.
(c) Comment on the qualities of Shalini.

24. (a) Give a plausible explanation for each one of the following:
    (i) Although phenoxide ion has more number of resonating structures than carboxylate ion, carboxylic acid is a stronger acid than phenol.
    (ii) There are two -NH_2 groups in semicarbazide. However, only one is involved in the formation of semicarbazones.
  (b) Carry out the following conversions in not more than two steps:
    (i) Phenyl magnesium bromide to benzoic acid.
    (ii) Acetaldehyde to But-2-enal.
    (iii) Benzene to m-Nitroacetophenone

OR

(a) Give a simple chemical test to distinguish between the pair of organic compounds: Ethanal and Propanal
(b) Name and complete the following chemical reaction:
$RCH_2COOH \xrightarrow{(i)\, X_2 / red P (ii)\, H_2O}$
(c) Draw the structures of the following derivatives:
    (i) The 2,4-Dinitrophenylhydrazone of benzaldehyde
    (ii) Acetaldehydedimethyl acetal
    (iii) Cyclopropanone oxime

25. (a) Write the rate law for a first order reaction. Justify the statement that half life for a first order reaction is independent of the initial concentration of the reactant.

  (b) For a first order reaction, show that the time required for 99% completion of a first order reaction is twice the time required for the completion of 90%.

OR

(a) For the reaction A→B, the rate of reaction becomes twenty seven times when the concentration of A is increased three times. What is the order of the reaction?

(b) The activation energy of a reaction is 75.2 kJmol^{-1} in the absence of a catalyst and it lowers to 50.14 kJmol^{-1} with a catalyst. How many times will the rate of reaction grow in the presence of a catalyst if the reaction proceeds at 25°C?

26. (a) Write balanced chemical equations for the following:
   (i) Complete hydrolysis of XeF_6.
   (ii) Disproportionation reaction of orthophosphorus acid.
   (b) Draw the structure of a noble gas species which is isostructural with BrO_3^-.
   (c) Considering the parameters such as bond dissociation enthalpy, electron gain enthalpy and hydration enthalpy, compare the oxidising power of F_2 and Cl_2.
   (d) Why is $K_{a_2} << K_{a_1}$ for H_2SO_4 in water?

OR

Explain the following:
(a) Hydrogen fluoride is a weaker acid than hydrogen chloride in aqueous solution..
(b) PCl_5 is ionic in nature in the solid state.
(c) SF_6 is inert towards hydrolysis.
(d) H_3PO_3 is diprotic.
(e) Out of noble gases only Xenon is known to form established chemical compounds.

CBSE SAMPLE PAPER -2016-17

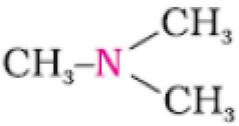
NAME OF THE UNIT	TOTAL WEIGHTAGE	VSA (1 mark)	SA (2 marks)	SA (3 marks)	VBQ (4marks)	LA (5 marks)	WEIGHTAGE
Solid State	23	1 (1) Remembering		3 (1) Understanding			4 (2)
Solutions			2 (1) Remembering	3 (1) Evaluation			5 (2)
Electrochemistry						5 (1) Application	5 (1)
Chemical Kinetics			2 (1) Application	3 (1) Application			5 (2)
Surface Chemistry		1 (1) Remembering		3 (1) Evaluation			4 (2)
General Principles and Processes of Isolation of Elements	19			3 (1) Application			3 (1)
p - Block Elements			2 (1) Understanding	3 (1) Application			5 (2)
d - and f - Block Elements		1 (1) HOTS				5 (1) Understanding	6 (2)
Coordination Compounds			2 (1) Application	3 (1) HOTS			5 (2)
Haloalkanes and Haloarenes	28	1 (1) Evaluation		3 (1) Understanding			4 (2)
Alcohols, Phenols and Ethers		1 (1) HOTS		3 (1) understanding			4 (2)
Aldehydes, Ketones and Carboxylic acids						5 (1) HOTS	5 (1)
Amines			2 (1) Understanding	3 (1) Application			5 (2)
Biomolecules				3 (1) Remembering			3 (1)
Polymers				3 (1) Understanding			3 (1)
Chemistry in Everyday Life					4 (1)* Value based question		4 (1)
TOTAL		5 (5)	10 (5)	36 (12)	4 (1)	15 (3)	70 (26)

* Value based question

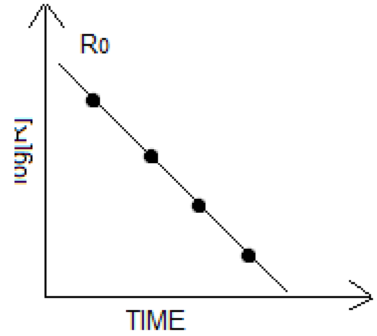
A(B) WHERE; A = NUMBER OF QUESTIONS; B= MARKS

HENCE 26 (70)

Sample Question Paper Chemistry class XII 2016-17 , MM:70 TIME 3 HRS

1.	Define Kraft temperature.	1
2.	The electronic configuration of a transition element in +3 oxidation state is [Ar]3d7. Find out its atomic number.	1
3.	Draw the structure of 4-tertbutyl-3-iodoheptane.	1
4.	Give the equation of reaction for the preparation of phenol from cumene.	1
5.	Name the type of semiconductor obtained when silicon is doped with boron.	1
6.	The two complexes of nickel, [Ni(CN)4]2- and [Ni(CO)4], have different structures but possess same magnetic behaviour. Explain. **OR** A chloride of fourth group cation in qualitative analysis gives a green coloured complex [A] in aqueous solution which when treated with ethane –1, 2 – diamine (en) gives pale - yellow solution [B] which on subsequent addition of ethane –1, 2 – diamine turns to blue/purple [C] and finally to violet [D]. Write the structures of complexes [A], [B], [C] and [D].	2
7.	Account for the following : (i) XeF2 is linear molecule without a bend. (ii) The electron gain enthalpy with negative sign for fluorine is less than that of chlorine, still fluorine is a stronger oxidizing agent than chlorine.	2
8.	Derive the relationship between relative lowering of vapour pressure and mole fraction of the volatile liquid.	2
9.	After 24 hrs, only 0.125 gm out of the initial quantity of 1 gm of a radioactive isotope remains behind. What is its half life period?	2
10.	Write the IUPAC names of the following: $C_6H_5CH_2NH_2$ · 	2
11.	The edge length of a unit cell of a metal having molecular mass 75 g/mol is 5 A◦ which crystallises in a cubic lattice. If the density is 2g/cc, then find the radius of the metal atom.	3
12.	(i) A mixture of X and Y was loaded in the column of silica. It was eluted by alcohol water mixture. Compound Y eluted in preference to compound X. Compare the extent of	3

	adsorption of X and Y on column. (ii) Why copper matte is put in silica lined converter? Write reactions involved (iii)Name the method used for the refining of Zr.	
13.	(i) Complete the following chemical equations. (a) NH4Cl (aq.)+ NaNO2 (aq.) → (b) P4 + 3NaOH + 3H2O→ (ii) Why is Ka2 << Ka1 for H2SO4 in water?	3
14.	Write the correct formulae for the following coordination compounds: (i) CrCl3.6H2O (violet with 3 chloride ions precipitated as AgCl) (ii) CrCl3.6H2O (light green colour, with 2 chloride ions precipitated as AgCl) (iii)CrCl3.6H2O (dark green colour, with 1 chloride ion precipitated as AgCl)	3
15.	Give reasons for the following observations: (i) p-dichlorobenzene has higher melting point than those of o and m –isomers. (ii) Haloarenes are less reactive than haloalkanes towards nucleophillic substitution reaction. (iii) The treatment of alkyl chloride with aqueous KOH leads to the formation of alcohol but in the presence of alcoholic KOH, alkene is the major product,	3
16.	(i) Why does leather get hardened after tanning? (ii) On the basis of Hardy-Schulze rule explain why the coagulating power of phosphate is higher than chloride. (iii)Do the vital functions of the body such as digestion get affected during fever? Explain your answer.	3
17.	Calculate the mass of a non-volatile solute (molar mass40 g/mol) which should be dissolved in 114 g octane to reduce its vapour pressure to 80%. OR At 300 K, 36 g of glucose, $C_6H_{12}O_6$ present per litre in its solution has an osmotic pressure of 4.98 bar. If the osmotic pressure of another glucose solution is 1.52 bar at the same temperature, calculate the concentration of the other solution.	3
18.	Carry out the following conversions : i) Phenol to benzoquinone. ii) Propanone to 2-Methylpropan-2-ol. iii) Propene to propan-2-ol.	3
19.	(i) Illustrate the following reactions: a) Hoffmann bromamide degradation reaction. b) Coupling reaction. (ii) Write a chemical test to distinguish between aniline and methylamine.	3
20.	(i) Name the common types of secondary structure of proteins and give one point of difference. (ii) Give one structural difference between amylose and amylopectin	3
21.	Observe the graph in diagram and answer the following questions.	3

	 (i) If slope is equal to -2.0x10-6 sec-1, what will be the value of rate constant? (ii) How does the half-life of zero order reaction relate to its rate constant?	
22.	(i) Classify the following as addition and condensation polymers: Terylene, Bakelite, Polyvinyl chloride, Polythene. (ii) Explain the difference between Buna – N and Buna – S.	3
23.	Ali's brother likes taking medicines. He sometimes even takes cough syrups even when he is not ill. One such day, he took cough syrup when he was healthy. After some time he started feeling nausea, headache and his body started itching. Ali's father did not take him to the doctor and wanted to give medicine on his own. Ali insisted that his father should not give medicine to his brother on his own but should take him to a doctor. After reading the above passage, answer the following questions: (i) Mention the values shown by Ali. (ii) Why did his body start itching and what kind of medicine will doctor prescribe him? (iii) Why medicines should not be taken without consulting doctor? (iv) Give one point of difference between agonist and antagonist.	4
24.	(i) State the relationship amongst cell constant of a cell, resistance of the solution in the cell and conductivity of the solution. How is molar conductivity of a solution related to conductivity of its solution? (ii) A voltaic cell is set up at 25◦C with the following half cell; Al / Al 3+ (0.001 M) and Ni /Ni 2+ (0.50 M) Calculate the cell voltage. [E◦ Ni2+/Ni = - 0.25V, E◦Al3+/Al = -1.66V] **OR** (i) Calculate the potential of hydrogen electrode in contact with a solution whose pH is 10. (ii) State Faraday's laws of electrolysis. How much charge in terms of Faraday is required for reduction of 1 mol of Cr2O72- to Cr 3+ ?	5

25. (i) Is the variability in oxidation number of transition elements different from that of non – transition elements? Illustrate with examples. 5

(ii) Give reasons:

(a) d- block elements exhibit more oxidation states than f-block elements.

(b) Orange solution of potassium dichromate turns yellow on adding sodium hydroxide to it.

(c) Zirconium (Z= 40) and Hafnium (Z = 72) have almost similar atomic radii.

OR

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

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

26. (i) A ketone A which undergoes haloform reaction gives compound B on reduction. B on heating with sulphuric acid gives compound C, which forms mono-ozonide D. The compound D on hydrolysis in presence of zinc dust gives only acetaldehyde. Write the structures and IUPAC names of A, B and C. Write down the reactions involved. 5

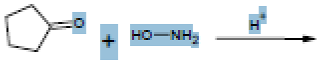
(ii) Predict the products formed when cyclohexanecarbaldehyde reacts with following reagents.

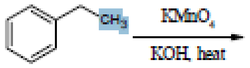
(a) PhMgBr and then H3O+.

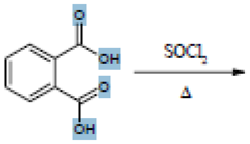
(b) Tollens' reagent.

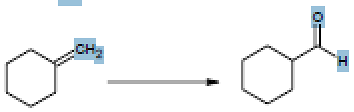
OR

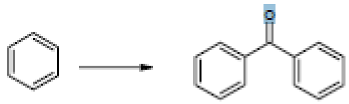
(i) Complete each synthesis by giving missing starting material, reagent or products:











COMMON LOGARITHMIC TABLES $\log_{10} x$

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
10	0.0000	0043	0086	0128	0170	0212					42	4	8	13	17	21	25	29	34	38
							0253	0294	0334	0374	40	4	8	12	16	20	24	28	32	36
11	0.0414	0453	0492	0531	0569	0607					39	4	8	12	16	20	23	27	31	35
							0645	0682	0719	0755	37	4	7	11	15	19	22	26	30	33
12	0.0792	0828	0864	0899	0934	0969					35	4	7	11	14	18	21	25	28	32
							1004	1038	1072	1106	34	3	7	10	14	17	20	24	27	31
13	0.1139	1173	1206	1239	1271	1303					33	3	7	10	13	17	20	23	26	30
							1335	1367	1399	1430	32	3	6	10	13	16	19	22	26	29
14	0.1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	30	3	6	9	12	15	18	21	24	27
15	0.1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	28	3	6	8	11	14	17	20	22	25
16	0.2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	26	3	5	8	10	13	16	18	21	23
17	0.2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	25	3	5	8	10	13	15	18	20	23
18	0.2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	24	2	5	7	10	12	14	17	19	22
19	0.2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	22	2	4	7	9	11	13	15	18	20
20	0.3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	21	2	4	6	8	11	13	15	17	19
21	0.3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	20	2	4	6	8	10	12	14	16	18
22	0.3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	19	2	4	6	8	10	11	13	15	17
23	0.3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	18	2	4	5	7	9	11	13	14	16
24	0.3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	18	2	4	5	7	9	11	13	14	16
25	0.3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	17	2	3	5	7	9	10	12	14	15
26	0.4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	16	2	3	5	6	8	10	11	13	14
27	0.4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	16	2	3	5	6	8	10	11	13	14
28	0.4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	15	2	3	5	6	8	9	11	12	14
29	0.4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	15	2	3	5	6	8	9	11	12	14
30	0.4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	14	1	3	4	6	7	8	10	11	13
31	0.4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	14	1	3	4	6	7	8	10	11	13
32	0.5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	13	1	3	4	5	7	8	9	10	12
33	0.5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	13	1	3	4	5	7	8	9	10	12
34	0.5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	13	1	3	4	5	7	8	9	10	12
35	0.5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	12	1	2	4	5	6	7	8	10	11
36	0.5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	12	1	2	4	5	6	7	8	10	11
37	0.5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	12	1	2	4	5	6	7	8	10	11
38	0.5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	11	1	2	3	4	6	7	8	9	10
39	0.5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	11	1	2	3	4	6	7	8	9	10
40	0.6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	11	1	2	3	4	6	7	8	9	10
41	0.6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	10	1	2	3	4	5	6	7	8	9
42	0.6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	10	1	2	3	4	5	6	7	8	9
43	0.6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	10	1	2	3	4	5	6	7	8	9
44	0.6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	10	1	2	3	4	5	6	7	8	9
45	0.6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	10	1	2	3	4	5	6	7	8	9
46	0.6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	9	1	2	3	4	5	5	6	7	8
47	0.6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	9	1	2	3	4	5	5	6	7	8
48	0.6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	9	1	2	3	4	5	5	6	7	8
49	0.6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	9	1	2	3	4	5	5	6	7	8
50	0.6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	9	1	2	3	4	5	5	6	7	8
51	0.7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	8	1	2	2	3	4	5	6	6	7
52	0.7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	8	1	2	2	3	4	5	6	6	7

COMMON LOGARITHMIC TABLES $\log_{10} x$

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
53	0.7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	8	1	2	2	3	4	5	6	6	7
54	0.7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	8	1	2	2	3	4	5	6	6	7
55	0.7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	8	1	2	2	3	4	5	6	6	7
56	0.7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	8	1	2	2	3	4	5	6	6	7
57	0.7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	8	1	2	2	3	4	5	6	6	7
58	0.7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	8	1	2	2	3	4	5	6	6	7
59	0.7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	7	1	1	2	3	4	4	5	6	6
60	0.7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	7	1	1	2	3	4	4	5	6	6
61	0.7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	7	1	1	2	3	4	4	5	6	6
62	0.7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	7	1	1	2	3	4	4	5	6	6
63	0.7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	7	1	1	2	3	4	4	5	6	6
64	0.8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	7	1	1	2	3	4	4	5	6	6
65	0.8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	7	1	1	2	3	4	4	5	6	6
66	0.8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	7	1	1	2	3	4	4	5	6	6
67	0.8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	6	1	1	2	2	3	4	4	5	5
68	0.8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	6	1	1	2	2	3	4	4	5	5
69	0.8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	6	1	1	2	2	3	4	4	5	5
70	0.8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	6	1	1	2	2	3	4	4	5	5
71	0.8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	6	1	1	2	2	3	4	4	5	5
72	0.8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	6	1	1	2	2	3	4	4	5	5
73	0.8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	6	1	1	2	2	3	4	4	5	5
74	0.8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	6	1	1	2	2	3	4	4	5	5
75	0.8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	6	1	1	2	2	3	4	4	5	5
76	0.8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	6	1	1	2	2	3	4	4	5	5
77	0.8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	6	1	1	2	2	3	4	4	5	5
78	0.8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	6	1	1	2	2	3	4	4	5	5
79	0.8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	6	1	1	2	2	3	4	4	5	5
80	0.9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	5	1	1	2	2	3	3	4	4	5
81	0.9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	5	1	1	2	2	3	3	4	4	5
82	0.9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	5	1	1	2	2	3	3	4	4	5
83	0.9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	5	1	1	2	2	3	3	4	4	5
84	0.9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	5	1	1	2	2	3	3	4	4	5
85	0.9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	5	1	1	2	2	3	3	4	4	5
86	0.9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	5	1	1	2	2	3	3	4	4	5
87	0.9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	5	1	1	2	2	3	3	4	4	5
88	0.9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	5	1	1	2	2	3	3	4	4	5
89	0.9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	5	1	1	2	2	3	3	4	4	5
90	0.9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	5	1	1	2	2	3	3	4	4	5
91	0.9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	5	1	1	2	2	3	3	4	4	5
92	0.9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	5	1	1	2	2	3	3	4	4	5
93	0.9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	5	1	1	2	2	3	3	4	4	5
94	0.9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	5	1	1	2	2	3	3	4	4	5
95	0.9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	5	1	1	2	2	3	3	4	4	5
96	0.9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	4	0	1	1	2	2	2	3	3	4
97	0.9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	4	0	1	1	2	2	2	3	3	4
98	0.9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	4	0	1	1	2	2	2	3	3	4
99	0.9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	4	0	1	1	2	2	2	3	3	4

ANTILOGARITHMS 10^x

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
0.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	2	0	0	1	1	1	1	1	2	2
0.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	2	0	0	1	1	1	1	1	2	2
0.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	2	0	0	1	1	1	1	1	2	2
0.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	2	0	0	1	1	1	1	1	2	2
0.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	3	0	1	1	1	2	2	2	2	3
0.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	3	0	1	1	1	2	2	2	2	3
0.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	3	0	1	1	1	2	2	2	2	3
0.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	3	0	1	1	1	2	2	2	2	3
0.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	3	0	1	1	1	2	2	2	2	3
0.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	3	0	1	1	1	2	2	2	2	3
0.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	3	0	1	1	1	2	2	2	2	3
0.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	3	0	1	1	1	2	2	2	2	3
0.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	3	0	1	1	1	2	2	2	2	3
0.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	3	0	1	1	1	2	2	2	2	3
0.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	3	0	1	1	1	2	2	2	2	3
0.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	3	0	1	1	1	2	2	2	2	3
0.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	3	0	1	1	1	2	2	2	2	3
0.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	4	0	1	1	2	2	2	3	3	4
0.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	4	0	1	1	2	2	2	3	3	4
0.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	4	0	1	1	2	2	2	3	3	4
0.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	4	0	1	1	2	2	2	3	3	4
0.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	4	0	1	1	2	2	2	3	3	4
0.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	4	0	1	1	2	2	2	3	3	4
0.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	4	0	1	1	2	2	2	3	3	4
0.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	4	0	1	1	2	2	2	3	3	4
0.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	4	0	1	1	2	2	2	3	3	4
0.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	4	0	1	1	2	2	2	3	3	4
0.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	4	0	1	1	2	2	2	3	3	4
0.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	4	0	1	1	2	2	2	3	3	4
0.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	4	0	1	1	2	2	2	3	3	4
0.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	5	1	1	2	2	3	3	4	4	5
0.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	5	1	1	2	2	3	3	4	4	5
0.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	5	1	1	2	2	3	3	4	4	5
0.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	5	1	1	2	2	3	3	4	4	5
0.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	5	1	1	2	2	3	3	4	4	5
0.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	5	1	1	2	2	3	3	4	4	5
0.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	5	1	1	2	2	3	3	4	4	5
0.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	6	1	1	2	2	3	4	4	5	5
0.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	6	1	1	2	2	3	4	4	5	5
0.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	6	1	1	2	2	3	4	4	5	5
0.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	6	1	1	2	2	3	4	4	5	5
0.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	6	1	1	2	2	3	4	4	5	5
0.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	6	1	1	2	2	3	4	4	5	5
0.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	6	1	1	2	2	3	4	4	5	5
0.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	6	1	1	2	2	3	4	4	5	5
0.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	7	1	1	2	3	4	4	5	6	6
0.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	7	1	1	2	3	4	4	5	6	6
0.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	7	1	1	2	3	4	4	5	6	6
0.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	7	1	1	2	3	4	4	5	6	6
0.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	7	1	1	2	3	4	4	5	6	6

ANTILOGARITHMS 10^x

x	0	1	2	3	4	5	6	7	8	9	Δ	1	2	3	4	5	6	7	8	9
											+				A	D	D			
0.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	7	1	1	2	3	4	4	5	6	6
0.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	8	1	2	2	3	4	5	6	6	7
0.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	8	1	2	2	3	4	5	6	6	7
0.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	8	1	2	2	3	4	5	6	6	7
0.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	8	1	2	2	3	4	5	6	6	7
0.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	8	1	2	2	3	4	5	6	6	7
0.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	8	1	2	2	3	4	5	6	6	7
0.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	9	1	2	3	4	5	5	6	7	8
0.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	9	1	2	3	4	5	5	6	7	8
0.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	9	1	2	3	4	5	5	6	7	8
0.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	9	1	2	3	4	5	5	6	7	8
0.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	10	1	2	3	4	5	6	7	8	9
0.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	10	1	2	3	4	5	6	7	8	9
0.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	10	1	2	3	4	5	6	7	8	9
0.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	10	1	2	3	4	5	6	7	8	9
0.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	10	1	2	3	4	5	6	7	8	9
0.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	11	1	2	3	4	6	7	8	9	10
0.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	11	1	2	3	4	6	7	8	9	10
0.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	11	1	2	3	4	6	7	8	9	10
0.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	11	1	2	3	4	6	7	8	9	10
0.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	12	1	2	4	5	6	7	8	10	11
0.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	12	1	2	4	5	6	7	8	10	11
0.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	12	1	2	4	5	6	7	8	10	11
0.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	12	1	2	4	5	6	7	8	10	11
0.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	13	1	3	4	5	7	8	9	10	12
0.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	13	1	3	4	5	7	8	9	10	12
0.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	13	1	3	4	5	7	8	9	10	12
0.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	14	1	3	4	6	7	8	10	11	13
0.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	14	1	3	4	6	7	8	10	11	13
0.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	14	1	3	4	6	7	8	10	11	13
0.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	15	2	3	5	6	8	9	11	12	14
0.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	15	2	3	5	6	8	9	11	12	14
0.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	15	2	3	5	6	8	9	11	12	14
0.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	16	2	3	5	6	8	10	11	13	14
0.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	16	2	3	5	6	8	10	11	13	14
0.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	16	2	3	5	6	8	10	11	13	14
0.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	17	2	3	5	7	9	10	12	14	15
0.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	17	2	3	5	7	9	10	12	14	15
0.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	18	2	4	5	7	9	11	13	14	16
0.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	18	2	4	5	7	9	11	13	14	16
0.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	18	2	4	5	7	9	11	13	14	16
0.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	19	2	4	6	8	10	11	13	15	17
0.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	19	2	4	6	8	10	11	13	15	17
0.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	20	2	4	6	8	10	12	14	16	18
0.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	20	2	4	6	8	10	12	14	16	18
0.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	21	2	4	6	8	11	13	15	17	19
0.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	21	2	4	6	8	11	13	15	17	19
0.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	22	2	4	7	9	11	13	15	18	20
0.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	22	2	4	7	9	11	13	15	18	20
0.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	23	2	5	7	9	12	14	16	18	21