
Aims

1. To foster acquisition of knowledge and understanding of terms, concepts, facts, processes, techniques and principles relating to the subject of Chemistry.
2. To develop the ability to apply the knowledge of contents and principles of Chemistry in new or unfamiliar situations.
3. To develop skills in proper handling of apparatus and chemicals.
4. To develop an ability to appreciate achievements in the field of Chemistry and its role in nature and society.
5. To develop an interest in activities involving usage of the knowledge of Chemistry.
6. To develop a scientific attitude through the study of Physical Sciences.
7. To acquaint students with the emerging frontiers and interdisciplinary aspects of the subject.
8. To develop skills relevant to the discipline.
9. To apprise students with interface of Chemistry with other disciplines of Science, such as, Physics, Biology, Geology, Engineering, etc.

There will be 2 papers in the subject.

Paper I: Theory: 3 hours (70 marks)

Paper II: Practical: 3 hours (20 marks)

Project Work: 10 marks

PAPER I -THEORY - 70 Marks

There will be one paper of 3 hours duration divided into 2 parts.

Part I (20 marks) will consist of compulsory short answer questions, testing knowledge, application and skills relating to elementary/fundamental aspects of the entire syllabus.

Part II (50 marks) will be divided into 3 Sections, A, B and C. Candidates are required to answer two out of three questions from Section A (each carrying 9 marks), two out of three questions from Section B (each carrying 7 marks) and two out of three questions from Section C (each carrying 9 marks). Therefore, a total of six questions are to be answered in Part II.

SECTION A

Relative molecular mass and mole

(i) Molality, molarity, mole fraction measures of concentration. (ii) Raoult's law and colligative properties, (iii) Nonvolatile non electrolytic solute, (iv) Dissociation- Electrolytic solute. (v) Association. . (vi) Relative molecular mass of non-volatile substances: (a) By relative lowering of vapour pressure. (b) Depression in freezing point method- Beckmann's method. (c) Elevation in boiling point method- Cottrell's method. (d) Osmotic pressure and its application in the determination of relative molecular mass. (e) Van'tHoff factor. (f) Van't Hoff equation and its

interpretation. (g) Simple numerical problems on different methods mentioned above for the determination of molecular masses. Abnormal molecular masses in case of electrolytes and in case of solutes which associate.

Chemical bonding

(i) Co-ordinate or dative covalent bond, e.g. formation of oxy-acids of chlorine. (ii) Hydrogen bonding: its essential requirements, the examples of hydrogen fluoride, water (ice), alcohol, etc may be considered. (iii) Metallic bonding, Van der Waals' forces. (iv) Valence Shell Electron Pair Repulsion Theory; Hybridisation and shapes of molecules: hybridisation involving s, p and d orbitals only; sigma and pi bonds. (v) Molecular orbital theory, Qualitative treatment of homonuclear diatomic molecules of first two periods. Energy level diagrams, bonding, antibonding molecular orbitals, bond order, paramagnetism of O₂ molecule. Relative stabilities of O₂, O₂⁻, O₂²⁻, O₂⁺, O₂²⁺

States of matters: structure and properties

Solid state

Crystalline and amorphous substances; lattice; unit cell; 3-D packing of atoms in a crystal lattice; relation between radius, edge length and nearest neighbour distance of atoms in a unit cell; density of a unit cell; interstitial void; imperfections in solids, ionic, metallic and atomic solids, electrical and magnetic properties

Chemical energetics

(i) Introduction. (ii) First law of Thermodynamics and its mathematical statement. (iii) Ideas about Heat, Work and Energy. (iv) Second law of thermodynamics – Entropy, Free Energy. Spontaneity of a chemical change. $\Delta G^{\circ} = -2.303 RT \log K_{eq}$; reversible and irreversible changes, isobaric, isochoric adiabatic processes. (v) Thermochemistry: (a) Definitions. (b) Constancy in the heat of neutralisation. (c) Calorific value of a fuel. (d) Hess's law of constant heat summation - simple problems based on the above definitions and concepts.

Chemical kinetics (including numericals)

Detailed study of - (i) Collision theory. (iii) Effect of concentration of the reactants on - (a) The rate of the reaction. (b) The rate constant. (iv) Molecularity and order of the reaction. (a) Meaning of the order of reaction. (b) Meaning of molecularity. (v) Mechanisms of the reactions. (vi) Variation of rate constant with temperature. Arrhenius equation $K = Ae^{-E_A/RT}$ and related graphs. (vii) Catalyst - Catalysis: types of catalysts, theories of catalysts, characteristics of catalyst.

Ionic equilibria

(i) Ostwald's dilution law and its derivation. Strength of acids and bases based on their dissociation constant. (ii) Brønsted-Lowry and Lewis concept of acids and bases. (iii) Ionic product of water, pH of solutions and pH indicators, problems. (iv) Common ion effect. (v) Salt hydrolysis. (vi) Buffer solutions. (vii) Solubility product and its applications.

Electrochemistry

(i) Faraday's laws of Electrolysis, Coulometer.
(ii) Relation between Faraday, Avogadro's number and charge on an electron. $F = Nae$ should be given (no details of Millikan's experiment are required).

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- (iii) Galvanic cells, mechanism of current production in a galvanic cell; and electrode potential, standard hydrogen electrode, electrochemical series, Nernst equation. (a) Standard electrode potential, measurement of standard electrode potential. (b) Idea of heterogeneous equilibria on the surface of the electrode. (c) Factors affecting electrode potential. (d) Electrochemical series and its explanation on the basis of standard electrode potential. (e) Numericals based on calculation of emf of a cell from the values of standard electrode potential. (f) Nernst equation (correlation with the free energy of the reaction in thermodynamics derivation of the equation).
- (iv) Electrolytic conductance: specific conductance. Measuring of molar and equivalent conductance; Kohlrausch's law.
- (v) Corrosion.
- (vi) Batteries.

SECTION B

Coordination compounds

Concept of complexes; definition of ligands; classification of ligands, coordination number, coordination sphere; IUPAC nomenclature of coordination compounds; isomerism; magnetic characteristics of coordination compounds on the basis of valence bond theory. Stability constant; uses of coordination compounds in different fields.

Chemistry of p-block elements: Group 16, 17, 18

The following should be included: (a) Occurrence, (b) Physical State, (c) Electronic configuration, (d) Atomic and ionic radii, (e) Common oxidation state, (f) Electronegative character, (g) Ionisation enthalpy, (h) Oxidising nature, (i) Nature of oxides, hydroxides, hydrides, carbonates, nitrates, chlorides, sulphates, wherever applicable.

Preparation / manufacture, properties and uses of compounds of groups 16, 17, – Ozone, Sulphur dioxide, Sulphuric acid, Hydrochloric acid

Chemistry of transition and inner-transition elements: - d-Block: 3d, 4d and 5d series f-Block: 4f and 5f series

Study in terms of metallic character, atomic and ionic radii, ionisation enthalpy, oxidation states, variable valency, formation of coloured compounds, formation of complexes, alloy formation. Lanthanoid contraction, shielding effect, radioactive nature. Metallurgy of Fe, Cu, Zn and Ag in terms of equations; electrolytic refining and uses. Compounds – 1. Silver nitrate: equation of preparation, use in laboratory and in photography. 2. Potassium permanganate: structure, shape, equation of extraction from pyrolusite ore, its oxidising nature in acidic, basic and neutral medium, use in redox titration. 3. Potassium dichromate: equation of extraction from chromite ore, structure and shape of molecule and its use in titration.

SECTION C

(Note: Aliphatic compounds containing upto 5 carbon atoms to be taught)

Alcohols and Phenols

(i) Classification, general formulae, structure and nomenclature. (ii) Methods of preparation, manufacture, properties and uses. (iii) Preparation, properties and uses of ethane- 1,2 diol,

propane-1,2,3 triol (outline – no details). (iv) Conversion of one alcohol into another. (v) Distinction between primary, secondary and tertiary alcohols.

Ethers, Carbonyl compounds

(i) Ethers: general formula and structure. Nomenclature; preparation, properties and uses of ether (outline, no detail), with reference to diethyl ether. (ii) Carbonyl compounds: methods of preparation, properties and uses of aldehydes and ketones.

Carboxylic acids and Acid derivatives

(i) Carboxylic acids: classification, general formulae, structure and nomenclature: monocarboxylic acids, general methods of preparation, properties and uses of acids. (ii) Acid derivatives: laboratory preparation, properties and uses of acetyl chloride, acetic anhydride, acetamide, ethylacetate; urea preparation (by Wohler's synthesis), properties and uses of urea, manufacture of urea from ammonia and by cyanamide process.

Cyanide, Isocyanide, Nitro compounds and Amines

Their nomenclature, general methods of preparation, correlation of physical properties, their structure, chemical properties, their uses.

Polymers

Polymerisation: the principle of addition and condensation polymerisation illustrated by reference to natural and synthetic polymers e.g. proteins, polyolefines and synthetic fibres; thermoplastics, thermosetting plastics, chemotrophs; reference should also be made to the effect of chain-length and cross-linking on physical properties of polymers.

Isomerism

Definition. Classification of isomerism. (i) Structural Isomerism. (ii) Stereo Isomerism. (a) Geometric isomerism (cis and trans only). (b) Optical isomerism

Biomolecules

Carbohydrates, proteins, enzymes, vitamins and nucleic acids.