Chemistry Syllabus

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

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

Part II (50 marks) is divided into 3 Sections, A, B and C. You are required to answer two out of three questions from Section A (each carrying 10 marks), two out of three questions from Section B (each carrying 5 marks) and two out of three questions from Section C (each carrying 10 marks). Therefore, a total of six questions are to be answered in Part II.

SECTION A

1. Relative Molecular Mass and Mole

(i) Normality, molality, molarity, mole fraction, as 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.
- (c) Elevation in boiling point method.
- (d) Osmotic pressure and its application in the determination of relative molecular mass.
- (e) van’t Hoff 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.

2. States of Matter: 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.

3. Chemical Kinetics

Qualitative meaning of chemical kinetics, comparison with chemical dynamics; slow and fast reactions; rate of reactions; factors affecting the rate of reaction such as: concentration, temperature, nature of reactants and products, surface area of reactants, presence of catalyst and radiation; Rate constant; Rate law; Law of Mass Action; concept of energy barrier; threshold energy, activation energy; formation of activated complex; exothermic and endothermic reactions; collision theory for a chemical change; order of a reaction; rate equation of zero and first order reaction; half life period; molecularity of a reaction; mechanism of elementary and overall reaction; variation of rate constant with temperature; Arrhenius equation – $K=Ae^{-Ea/RT}$; related graphs; catalyst.

4. Chemical Equilibria

(i) Reversible reactions and dynamic equilibrium. The concept of equilibrium constant in terms of concentration or partial pressure to indicate the composition of the equilibrium mixture. The following are the examples: the dissociation of dinitrogen tetroxide, hydrolysis of simple esters, the Contact Process for the manufacture of sulphuric acid, the synthesis of ammonia by Haber's process.

(ii) Le Chatelier's Principle and its applications to chemical equilibria.

5. Ionic Equilibria

(i) Ostwald's dilution law and its derivation. Strength of acids and bases based on their dissociation constant.

(ii) Arrhenius, Brönsted-Lowry and Lewis concept of acids and bases, Multistage ionization of acids and bases with examples.

(iii) Ionic product of water, pH of solutions and pH indicators.

(iv) Common ion effect.

(v) Salt hydrolysis.

(vi) Buffer solutions.

(vii) Solubility product and its applications.

6. 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).

(iii) Galvanic cells, mechanism of current production in a galvanic cell; and electrode potential, standard hydrogen electrode, electrochemical series, Nernst equation.

(iv) Electrolytic conductance: specific conductance. Measuring of molar and equivalent conductance; Kohlrausch's law.

(v) Corrosion.

(vi) Batteries.

SECTION B

7. 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 and crystal field theory. Stability constant; uses of coordination compounds in different fields.

8. 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 states, (f) Electronegative character, (g) Ionisation enthalpy, (h) Oxidising nature, (i) Nature of oxides, hydroxides, hydrides, carbonates, nitrates, chlorides, sulphates, wherever applicable.

9. Preparation/ Manufacture, Properties and Uses of Compounds of Groups 16, 17

Ozone, Hydrogen peroxide, Sulphur Dioxide, Sulphuric Acid, Hydrochloric Acid

10. 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, oxidisation states, variable valency, formation of coloured compounds, formation of complexes, alloy formation.

Lanthanoids: Lanthanoid contraction, shielding effect, radioactive nature.

Actinoids - general electronic configuration, oxidation state, comparison with lanthanoids and uses.

Metallurgy of Al, Zn, Fe, Cu and Ag in terms of equations, thermodynamics and electrochemical principles involved in the extraction of metals; 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

11. Alkyl and Aryl Halides

(i) The nomenclature of aliphatic compounds containing halogen atom.

(ii) Preparation, properties, uses of haloalkanes.

(iii) Preparation, properties, and uses of the following: ethyl bromide, chloroform, iodoform, haloform reaction.

(iv) Chlorobenzene.

(v) Organometallic compounds.

12. 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.

13. 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.

14. 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.

15. Cyanides, Isocyanides, Nitro compounds, Amines and Diazonium Salts

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

16. Polymers

Polymerisation: the principle of addition and condensation polymerisation illustrated by reference to natural and synthetic polymers e.g. proteins, polyolefins 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.

17. Biomolecules

carbohydrates, proteins, enzymes, vitamins and nucleic acids.