

KERALA PUBLIC SERVICE COMMISSION

SYLLABUS FOR THE POST OF
RANGE FOREST OFFICER IN
KERALA FOREST & WILDLIFE DEPARTMENT

Optional subject- Chemistry

Module 1: Fundamentals of Chemistry (20 Marks)

Atomic Structure

- Discovery of electron, proton, neutron
- Rutherford and Bohr models of atom
- Quantum mechanical model of atom
- Quantum numbers and electronic configuration
- Aufbau principle, Pauli exclusion principle, Hund's rule

Mole Concept

- Avogadro's number, molar mass
- Empirical and molecular formulas
- Stoichiometry and calculations involving chemical reactions

Chemical Bonding

- Ionic, covalent, and metallic bonds
- VSEPR theory and molecular shapes
- Hybridization and molecular orbital theory
- Bond energy, bond length, and bond order

Module 2: Physical Chemistry (40 Marks)

Thermodynamics

- First law of thermodynamics, internal energy, enthalpy
- Second law of thermodynamics, entropy, Gibbs free energy
- Third law of thermodynamics
- Applications to chemical reactions (Hess's law, standard enthalpies)

Chemical Equilibrium

- Dynamic nature of equilibrium, equilibrium constant
- Le Chatelier's principle and its applications

Calculations involving equilibrium constants (K_c , K_p)

Solutions

Concentration terms (molarity, molality, normality, mole fraction)

Raoult's law and ideal solutions

Colligative properties (boiling point elevation, freezing point depression, osmotic pressure)

Electrochemistry

Electrolytes and non-electrolytes, conductance in electrolytic solutions

Electrochemical cells, standard electrode potentials

Nernst equation, electrochemical series

Applications of electrochemistry (batteries, fuel cells, corrosion)

Chemical Kinetics

Rate of a reaction, factors affecting reaction rates

Rate laws, order of reaction, molecularity

Arrhenius equation, activation energy

Mechanisms of complex reactions

Surface Chemistry

Adsorption and absorption, types of adsorption

Freundlich and Langmuir adsorption isotherms

Colloids and emulsions, properties and applications

Module 3: Inorganic Chemistry (40 Marks)

Coordination Chemistry

Nomenclature and isomerism in coordination compounds

Werner's theory, Valence Bond Theory (VBT), Crystal Field Theory (CFT)

Stability of coordination compounds, applications in bioinorganic chemistry

Solid State

Classification of solids (crystalline and amorphous)

Crystal lattices and unit cells, Bravais lattices

Packing efficiency, voids, and density calculations

Bragg's law and X-ray diffraction

Nuclear Chemistry

Radioactivity, types of radioactive decay

Half-life, nuclear reactions, and stability of nuclei

Applications of radioisotopes (medical, industrial, archaeological)

Inorganic Qualitative Analysis Principles

Solubility product, common ion effect
Qualitative analysis of cations and anions
Spot tests and group separation techniques

Chemical Bonding in Inorganic Compounds

Bonding in ionic and covalent compounds
Shapes of molecules and ions (VSEPR theory)
Hybridization and shapes of molecules (sp, sp², sp³, etc.)

Module 4: Organic Chemistry (50 Marks)

Basic Principles and Concepts

Hybridization, resonance, inductive effect, hyperconjugation
Acid-base concepts in organic chemistry
Nomenclature of organic compounds (IUPAC system)

Stereochemistry

Optical isomerism, chirality, enantiomers, diastereomers
Geometric isomerism, E/Z notation
Conformational analysis of alkanes and cycloalkanes

Alcohols, Phenols, Aldehydes, and Ketones

Structure, nomenclature, physical properties
Methods of preparation and reactions (oxidation, reduction, nucleophilic addition)
Special reactions (Aldol condensation, Cannizzaro reaction, Reimer-Tiemann reaction)

Carboxylic Acids and Amines

Structure, nomenclature, physical properties
Methods of preparation and reactions (acid-base properties, substitution, decarboxylation)
Amines: Basicity, preparation, and reactions (Hofmann rearrangement, Gabriel synthesis)

Benzene and its Derivatives

Structure and stability of benzene, aromaticity
Electrophilic aromatic substitution (nitration, sulfonation, halogenation, Friedel-Crafts reactions)

Diazonium Salts

Preparation and reactions (Sandmeyer reaction, Gattermann reaction)
Applications in organic synthesis

Module 5: Biochemistry (20 Marks)

Carbohydrates

Classification (monosaccharides, disaccharides, polysaccharides)

Structure and properties, reactions of glucose and fructose

Glycosidic linkage and polysaccharides (starch, cellulose, glycogen)

Amino Acids and Proteins

Structure, classification, and properties of amino acids

Peptide bond formation, primary, secondary, tertiary, and quaternary structure of proteins

Enzyme catalysis and mechanism of enzyme action

Nucleic Acids

Structure and function of DNA and RNA

Replication, transcription, and translation

Mutations and genetic code

Biochemical Techniques

Chromatography (paper, thin-layer, column)

Electrophoresis (gel electrophoresis, SDS-PAGE)

Module 6: Applied Chemistry (20 Marks)

Photochemistry

Laws of photochemistry (Grotthuss-Draper law, Stark-Einstein law)

Quantum yield, photochemical reactions (photosynthesis, vision)

Jablonski diagram, fluorescence, and phosphorescence

Catalysis

Types of catalysis (homogeneous, heterogeneous, enzyme catalysis)

Mechanism of catalytic action, characteristics of catalysts

Industrial applications of catalysis (Haber process, Contact process)

Gaseous State

Gas laws (Boyle's law, Charles's law, Avogadro's law)

Ideal gas equation, kinetic molecular theory of gases

Real gases and deviations from ideal behavior, Van der Waals equation

Module 7: Advanced Topics in Chemistry (10 Marks)

Green Chemistry

Principles of green chemistry

Green synthesis and sustainable processes

Nanochemistry

Synthesis and properties of nanomaterials

Applications of nanotechnology in chemistry

Environmental Chemistry

Chemical principles in environmental science

Pollution (air, water, soil), greenhouse gases, and climate change

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.