THE रसायनम् ™

A UNIT OF RASAYANAM INSTITUTE PVT. LTD.

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UP PGT Chemistry Syllabus

Physical Chemistry

Gaseous state - molecular kinetic theory of gases, derivation of kinetic equations and verification of Gas laws, details of molecular velocities, heat absorption of gases, energy distribution rules, molecular collision and transport phenomena, mean free path, collision diameter, non-ideal gases van der Waals equation and other state equations. The corresponding state law of liquefaction of gases,

Liquid state - molecular force in liquids, vapour pressure of liquids and effect of temperature on vapor pressure, the surface tension and viscosity of liquids and the effect of temperature on them.

Solid state - crystal shape and symmetry space conductor and unit cell. Miller Indices, different crystal system, Bragg-equation, NaCl- structure, bonding of atoms in cubic bodies, arrangement of atom in cubic crystal system and crystal defects.

Colloidal state- hydrophilic and hydrophobic colloids, formation and properties of colloids, charge on colloidal particles, emulsions, preservation and use of colloids aerosols, foams and emulsions.

Molecular Structure and Spectroscopy -Dipole moment and its application in molecular structure representation, infrared and Raman spectroscopy and its application in structure representation of molecules, nuclear magnetic resonance and electron spin resonance spectroscopy and its application in structure representation of molecules.

Thermodynamics and Thermochemistry - The zero and first laws of thermodynamics enthalpy ,internal energy, first law of thermodynamics and its application, the work done by an ideal gas in isothermal reversible expansion, Joule Thomson coefficient, reaction enthalpy (heat of combustion , Heat of transmission , enthalpy of nutrilization, enthalpy of atomisation and heat exchange, etc.) Hess's law of constant heat addition and its applications, bond energy, second law of thermodynamics- Carnot cycle, entropy change, physical interpretation of entropy, entropy change in isothermal reversible expansion of ideal gas, Entropy change in irreversible processes. Free energy (Gibbs and Helmholtz) Maxwell relationship. Partial molar quantities (chemical potentials) Gibbs Duhem relation, Clausius-Clapeyron Equation and Gibbs–Helmholtz equation.

Molecular/Statistical Thermodynamics - Partition Functions and their Significance, Relation between partition Function and Thermodynamic Function: Translational, Rotational, Vibrational and Electronic

partition Functions, derivation of Thermodynamic Properties Translational, Rotational, Vibrational and Electronic for Ideal Gases.

Surface chemistry/Adsorption - physical and chemical adsorption, Langmuir adsorption isotherm, isothermal curves, BET equation and its uses

Physical photochemistry - primary and secondary processes, Einstein's law of photochemical equivalence. Phosphoresence and fluorescence. Photochemical decomposition of hydrogen iodide, principles of chemical laser, catalytic-homogeneous and heterogeneous catalysis, enzyme catalysis.

Solution - Ideal and Non-ideal Solution, Molecular Properties of Roult's-Law, Colligative properties of Solutions (osmotic pressure, relative lowering in vapor pressure, elevation in boiling point and depression in freezing point). Determination of molecular weight of insoluble solute in a solution. abnormal colligative properties.

Nuclear Chemistry - Basic Particles and Their Classification, Nuclear Force, Fluid of Atomic Nuclei, Droplet and Base Model, Nuclear Stability, Energy Transformation in Nuclear Reactions, Concept of Nuclear Fragmentation. Nuclear Fission and Fusion Reactions.

Chemical Kinetics – Order and Molecularity of Chemical Reactions And derivation of rate constants for first and second order reaction and its unit, effect of temperature on rate constants (Arrhenius equation), methods of determining the order of reaction. Factors affecting rate of chemical reactions and active-hybrid theory.

Chemical Equilibrium – Relationship between KP And KC. law of mass action and its application for Dissociation of PCl5, formation of HI and NH_3, and dissociation of $CaCO_3$, Le Chatelier's Principle - its application in chemical and physical equilibrium. Vant's hoff equation,

Phase equilibrium - phase rule, phase diagram for one component system and its applications.

Electrochemistry - Electrolytic conductance, Arrhenius theory of electrolysis. Ostwald dilution law, the theory of strong electrolytes. Debye-Falkenhagen and Wien effects. Accessibility and its determination, Kohlrausch law of independent migration of ions, Applicability of conductivity measurement, mobility and ionic strength, mean ionic activity coefficient, Debye- Huckel limiting law. Electrochemical cell, Electromotive force for reversible and irreversible electrode in a single compartment, Nernst Equation, Standard Electrode Potential. Applications of Electromotive force, Oxygen Hydrogen Fuel cell.

Ionic Equilibrium – solubility product. Water dissociation of salts. pH, pOH and pK (pKa and pKb) of Buffer solutions. Theory of indicators.

Inorganic Chemistry

Atomic structure - wave-particle dualism, Heisenberg's uncertainty principle, Schrödinger wave equation, atomic orbitals, quantum numbers, linear and angular potential distribution curves. s, p and the shape of d orbitals. Aufbau's rule and the exclusion principle of Pauli. The electronic configuration of the Hund's law elements, the study of the long form of the periodic table - characteristic features, Periodic properties – atomic and ionic radii, ionization energies, electron affinity and electronegativity and their tendency in the periodic table.

Chemical bonding - Ionic bonding - lattice energy, Born – Haber cycle, solvation energy, solubility of ionic solids, covalent nature of ionic bonding (Fajans' Rule) Covalent bonding - valence bonding and molecular orbital theory of covalency. Molecular orbital analysis, hybridization and morphology of simple inorganic molecules and ions of homogeneous nuclear and heterogeneous nuclear molecules (CO, HFNO only). Valence shell electron pair repulsion theory (VSEPR) and its application in NH_3, H_3O^+, SF_6 and IF_7.

Elements of S-block - general characteristics, chemistry of Lithium and beryllium, exceptional behaviour and diagonal relationships.

Elements of P-block - electronic configuration and general trend of periodic properties. Composition and structure of nitrogen phosphorus and sulphur oxides and their oxy acids. Chemistry of phosphagens silicates, silicones, diboranes, inter halogens, and poly halides. Formation, properties and uses of the following compounds: - Heavy water, microcosmic salts, plaster of paris, potassium dichromate, potassium permanganate, sodium thiosulphate, hydrogen, hydroxyl amine, albumen and bleaching powder.

Elements of D-Lock - Characteristic properties of elements of 3d block, Comparison of elements of 4d and 5d block with elements of 3d block.

Chemistry of coordination compounds - Werner theory, IUPAC Naming. Coordination isomerism. Principles of metal-ligand bonding in transition metal complexes. Effective Atomic Number (EAN) rules and valence bond theory. Crystal field theory. Crystal field splitting in tetrahedron and octahedral complexes. Crystal field stabilization energy (CFSE) only for $d1 - d9$ configurations (magnetic behavior of transition metal complexes), L-coupling and orbital contribution to magnetic moment, a brief thermodynamic profile of the stability of metal complexes, substitution reactions in square planar

complexes. Electronic spectrum, types of electronic transition, selection rules for d-d transition. spectroscopic ground state and spectrochemical range. Orgel energy level diagram for $d1$ and $d9$ states.

F-Block Elements - Lanthanides electronic configuration, Oxidation states Comparative study in terms of atomic and ionic radii and complex formation. The principle of separation of lanthanides. Magnetic and spectroscopic properties of lanthanide compounds, actinides-general characteristics and chemistry of actinides. Chemistry of Separation of Np, Pu, Am, Fm and U.

Organometallic Chemistry - Definition - Nomenclature and Classification,

Bio Inorganic Chemistry - Biological Role of Alkali and Alkaline earth Metal Ions ($Ca2+$ with special reference), Metal-porphyrin complex - haemoglobin and myoglobin.

Organic Chemistry

General Organic Chemistry - Orbital diagram of general organic molecules - methane, ethane, ethene, ethyne and benzene. Inductive effect, hyperconjugation effect, mesomeric effect, resonance, and their effect on the acidity and basicity of organic compounds, classification and nomenclature of organic compounds - (both aliphatic and aromatic)

Reaction Mechanism - methods of organic reactions - homogeneous and heterogeneous cleavages, electrophile, nucleophile and free radical. Mechanism of aliphatic substitution, addition and elimination reactions

Stereochemistry – Structural isomer and stereoisomers. Conformational analysis of isomerism (ethane and n-butane only),

Organic synthesis - properties and synthesis of Alkyl, alkene, alkyne, alkyl halide, alcohols, aldehydes, ketone and carboxylic acids and their derivative. Methodology should also be given at the appropriate place.). Method of preparation of Grignard reagent and its application, active methylene compounds - aceto acetic ester and malonic ester and keto-enol tautomerism.

Carbohydrate - Classification of ring structure and configuration of glucose and fructose, muta-rotation, carbohydrate, interconversion of functional groups,

Aromatic Compounds - common methods of synthesis of aromatic compounds - aromatic hydrocarbons, electrophilic aromatic substitution-nitration, halogenation, sulfonation, Friedel-Crafts reactions (alkylation and acylation reactions). Formation and properties of chlorobenzene, nitrobenzene, aniline, phenol benzaldehyde, benzoic acid, benzene sulfonic acid thallic acid, salicylic acid and cinnamic acid organic compounds.

Heterocyclic - Asymmetric cyclic compounds - synthesis, furan, pyrol, thiophene, pyridine, quinoline and Aromatic Characteristics of Isoquinoline, poly-nuclear Aromatic Compounds-Naphthalene, Anthracene and phenanthracene,

Alicyclic Compounds-Cycloalkanes-Normal Synthesis Bayer's Deformation. Cyclohexane: Boat and Chair form.

Reactive Intermediate – Preparation, structure and reaction of carbocation, carbanion, free radical, carbene, nitrene and Benzynes. basicity of general organic compounds, Hoffman Methylation. Structure and Synthesis of Nicotine and Piperine, Amino Acids, Peptides and Protein Formation and its Properties.

Polymer-type of polymers and polymerization process, manufacture and use of the following polymers, natural and synthetic rubber, teflon, fricyan and polystyrene, palamidrush synthesized fiber-polyesters, polyacylates and rayon, dyes-color , modern ideas malachite green , Synthesis of chlorencin and methylarenchose, composition and synthesis of indigo (indigo) and alizarin,

Chemistry in everyday life (Drugs and Medicines) - classification of drugs, antibiotics and agrochemicals, aspirin, paracetamol, phenylbutazone, sulphanilamide, sulphagunidine, sulphapyridine, sulphathiazole, chloroquine, primaquine P.A.S., Chlorapamycin and streptomycin, parathion, malathion, gamaxine, DDT Synthesis and and its use.

Vitamins and hormone-chemical composition and animal-botanical work of vitamin A, B and C and thyroxine and estrone and their biological importance.