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Chemistry Syllabus for Uttarakhand State Civil Services Main Exam-2011

CHEMISTRY

PAPER-I

Atomic Structure: Bohr's model and its limitations, De-broglie equation, Heisenberg uncertainity principle, quantum mechanical operators and the Schrodinger wave equation, physica significance of wave function and its characteristics (normalized, orthogonal), radial distributior and shapes of s, p, d and f-orbitals, particle in a one-dimensional box, quantisation of electronic energies (qualitative treatment of hydrogen atom).

Pauli's Exclusion principle, Hund's rule of maximum multiplicity, Aufbau principle. Electronic configuration of atoms, Long form of Periodic table including transuranium elements. Periodicity ir properties of the elements such as atomic and ionic radii, ionization potential, electron affinity electronegativity and hydration energy.

Nuclear and Radiation Chemistry: Structure of nucleus (shell model), nuclear forces, nuclear stability-N/P ratio, nuclear binding energy. Kinetics, detection and measurement of radioactivity, Artificial transmutation of elements and nuclear reactions, nuclear fission & fusion, radioactive isotopes and their applications.

Chemical Bonding: Valence bond theory (Heitler-London and Pauling-Slater theories), hybridization VESPR theory and shapes of simple inorganic molecules. Molecular orbital theory, bonding, non-bonding and antibonding molecular orbitals, molecular orbital energy level diagrams for homo and hetero nuclear diatomic molecules, bond order, bond length and bond strength, sigma-and pi-bonds, hydrogen bond, characteristics of covalent bond.

Chemistry of s-and p-Block Elements: General properties of s-and p-block elements, chemical reactivity of elements and group trends, chemical behaviour with respect to their hydrides, halides and oxides.

Chemistry of Transition Elements: General characteristics, variable oxidation states, complex formation, colour, magnetic and catalytic properties. Comparative study of 4d- and 5d- transition elements with their 3d analogues with respect to their ionic raddi, oxidation states and magnetic properties.

Chemistry of Lanthanides and Actinides: Lanthanide contraction, oxidation states, Principles of separation of lanthanides and actinides. Magnetic and spectral properties of their compounds.

Coordination Chemistry: Werner's theory of coordination compounds, IUPAC system of nomenclature, Effective Atomic Number (EAN), Isomerism in coordination compounds. Valence bond theory and its limitations, Crystal field theory, Crystal field splitting of d-orbitals in octahedral, tetrahedral and square planar complexes. Dq and factors affecting its magnitude, Calculation of Crystal field Stabilisation Energies (CPSE) for d^1 to d^9 weak and strong field octahedral tetrahedral and square planar complexes. Dq and factors affecting its magnitude, Calculation of Crystal field Stabilisation Energies (CPSE) for d^1 to d^9 weak and strong field octahedral complexes, spectrochemical series. Electronic spectra of 3d-transition metal complexes, type of electronic transitions, selection rules for electronic transitions, spectroscopic ground states for d^1 to d^{10} systems.

Preparation, Properties and Uses of the following Inorganic Compounds: Heavy water, boric acid, diborane, hydrazine, hydrozylamine, potassium dichromate, potassium permagnate, Ce (IV) sulphate and titanium (III) sulphate.

Polymers: Molecular weight of polymers by sedimentation, light scattering, viscosity and osmotic pressure. Number average and weight average molecular weights, elasticity and crystallinity of polymers. Borazines, silicones and phosphonitrilic halide polymers.

Chemical Thermodynamics: Thermodynamic functions, Laws of thermodynamic and their application to various physico-chemical processes. Concept of chemical potential, Gibbs Duhem equation, Classius-Clapeyron equation, thermodynamic treatment of Colligative properties.

Chemical Kinetics: Order and molecularity of a reaction. Rate laws, methods for determining the order of a reaction, Energy of activation, Collision theory of reaction rate, Steady state approximations, Transition state theory of reaction rates, consecutive and side reactions.

Phase Equilibria: Phases, components degrees of freedom, phase diagram of one and two component systems, Nernst distribution law, Applications of distribution law.

Electrochemistry: Theory of strong electrolytes, Debye-Huckel theory of activity coefficients, laws of electrolytic condition, transport number, determination of transport number (Hittorf's and moving boundry method). Applications of conductance for determining the solubility and solubility products, ionic equilibria, ionic product of water, pH, acid-base indicators, common ion effect, buffer solutions, buffer index, buffer capacity, solubility product and applications in analysis.

Solid State Chemistry: Classification of solids, seven crystal systems, elements of symmetry in crystals, space lattice and unit cell,. classification of crystals on the basis of bond types-ionic solids, metallic solids, covalent solids, and molecular solids. The close packing of sph. es-hexagonal close packing, cubic close packing and body centered cubic packing, coordination number and radius ratio effect. Bragg's law of X-ray diffraction, powder pattern method, crystal structure of NaCl and KCl.

Surface Chemistry: Stability of and origin of charge on colloids, Electrokinetic potential. Physical and chemical adsorption, various types of adsorption isotherms. Homogeneous and heterogeneous catalysis, enzyme catalysis (Michelis-Menton) equation.

Molecular Spectra: Rotational Spectra: Rigid and non-rigid rotator models, Determination of bond distance of diatomic molecules, linear triatomic molecules, isotopic substitution.

Vibrational-Rotational Spectra: Harmonic and anharmonic vibrations, vibrational energies of diatomic molecules, zeropoint energy, evaluation of force constant. Fundamental frequencies, overtones, hot bands, degrees of freedom of polyatomic molecules. Concept of group frequencies.

Raman Spectra: Raman effect, stokes, and antistokes lines and their intensity difference, Rule of mutual exclusion.

Electronic spectra: Electronic transitions. Frank-Condon principle, phosphorescence and fluorescence.

PAPER-II

General Organic Chemistry: Electronic displacement-inductive, electromeric and mesomeric effects. Conjugation and hyperconjugation. Resonance and its application to organic compounds. Electrophiles, nucleophiles, carbocations carbanious and free radicals. Organic acids and bases. Effects of structure on the strength of organic acids and bases. Hydrogen bond and its effect on the properties of organic compounds.

Concept of Organic Reaction Mechanism: Mechanism of addition, substitution, elimination reactions and molecular re-arrangements. Mechanism of electophilic and nucleophilic aromatic substitution. Mechanism of the following reactions: Aldol condensation, Claisen condensation, Beckmann re-arrangement, Perking reaction, Reimer-Tiemann reaction, Cannizzaro's reaction, Friedel-Craft's reaction, Reformatisky's reaction and Wagner-Meerwain re-arrangement.

Aliphatic Compounds: Chemistry of simple organic compounds belonging to following classes with special reference to the mechanisms of the reactions involved therein: alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, thiols, aldehydes, ketones, α,β unsaturated cabonyl compounds, acids and their derivatives, amines, aminoacids, hydroxy acids, unsaturated acids and dibasic acids.

Synthetic uses of malonic ester, acetoacetic ester, Grignard's reagent, carbene, diazomethane and phosphoranes.

Carbohydrates: Classification, configuration and general reactions of simple monosaccharides. Osazone formation, mutarotation, pyranose and furanose structures. Chain lengthening and chain shortening in aldoses and ketoses. Interconversion of glucose and fructose.

Stereochemistry and Conformations: Elements of symmetry, optical and geometrical insomerism in simpleorganic compounds. Absolute configurations (R&S), Configurations of geometrical isomers, E&Z notations. Conformations of mono and disubstituted cyclohexanes. Boat and chair forms.

Aromatic Compounds: Modern structure of benzene; concept of aromaticity. Huckel rule and its simple application to non-benzenoid aromatic compounds. Activating and deactivating effect of substitutent groups, directive influence. Study of the compounds containing following groups attached to the alkyl and benzene ring: halogen, hydroxy, nitro and amino groups. Sulphonic acids, benzaldehyde, salicyldehyde, acetophenone. Benzoic, salicylic, phthalic, cinnamic and mandelic acids.

Naphthalene & Pyridine : Synthesis, structure and important reactions.

Alkaloids: General methods of structure elucidation of alkaloids, chemistry of nicotine.

Organic Polymers: Mechanism of polymerization, polymers of industrial importance, synthetic fibers.

Chemistry of Living Cells: A brief introduction, chemical constituents, cell membrane, acid-base balance. Diffusion and active transport. Donnan membrance equilibria.

Enzymes and Coenzymes: Nomenclature and characteristics, factors which affect enzymes activity.

NMR Spectroscopy: Principle of PMR, chemical shift, spin-spin coupling, interpretation of PMR spectra of simple organic molecules.

Evaluation of Analytical Data: Errors, Accuracy and precision, Relative and standard deviation, rejection of doubtful observations, t-test, Q-test.

Solvent Extraction: Distribution law, Craigs concept of counter-current distribution, important solvent extraction systems.

Chromatography: Classification of chromatographic techniques, general principles of absorption, partition ion exchange, paper and thin layer chromatography.

Environmental Chemistry: Air pollutants and their toxic effect, depletion of ozone layer. Effects of oxides of nitrogen, fluorochlorocarbons and their effect on ozone layer. Greenhouse effect, Acid rain.