

TRIPURA CHEMICAL SOCIETY

SYLLABUS FOR CHEMISTRY APTITUDE TEST

STAGE - III

(Effective from 2017)

Unit I : Some Basic Concepts of Chemistry

Laws of chemical combination. Dalton's atomic theory : concept of elements, atoms and molecules. Atomic and molecular masses, Mole concept and molar mass; percentage composition, empirical and molecular formula; chemical reactions, stoichiometry and calculations based on stoichiometry.

Unit II: Structure of Atom

Discovery of electron, proton and neutron; atomic number, atomic mass, isotopes, isobars and isotones. Rutherford's and Bohr's atomic model and their limitations, electronic shells and subshells, concept of orbitals, quantum numbers, shapes of s,p. and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli exclusion principle and Hund's rule, electronic configuration of atoms, stability of half filled and completely filled orbitals. Heisenberg's uncertainty principle, dual nature of matter and light and De Broglie's relationship.

Unit III: Classification of Elements and Periodicity in Properties

Significance of classification, modern periodic law and the present form of periodic table, periodic trends in properties of elements-atomic radii, ionic radii. ionization enthalpy, electron gain enthalpy, electro negativity, valency. Nomenclature of elements with atomic number greater than 100.

Unit IV: Chemical Bonding and Molecular Structure

Valence electrons, ionic bond, covalent bond and bond parameters, Hydrogen bond and its importance. Born Haber Cycle and its importance. Lewis structure, polar character of covalent bond, covalent character of ionic-bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization involving s, p and d orbitals; shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules, bond orders, magnetic properties.

Unit V: States of Matter

Three states of matter and intermolecular bonding interactions, melting and boiling points, gas laws- Boyle's law, Charles' law, Gay Lussac's law, Avogadro's law. Ideal behaviour of gases, derivation of gas equation, Avogadro's number. Ideal gas equation, Derivation from ideal behaviour, liquefaction of gases, critical temperature, kinetic energy and molecular speeds (elementary idea). Liquid State: vapour pressure, viscosity and surface tension.

Unit VI: Chemical Thermodynamics

Concepts of System, types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics, internal energy and enthalpy, state function, enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transformation, ionization, and solution. Hess's law of constant heat summation, entropy, Gibbs energy, spontaneous and nonspontaneous processes, criteria for equilibrium. Second and third laws of thermodynamics.

Unit VII : Equilibrium

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium -Le Chatelier's principle; ionic equilibrium - ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polybasic acids, acid strength, concept of pH, Henderson Equation, hydrolysis of salts. Buffer solutions, solubility product, common ion effect .

Unit VIII: Redox Reactions

Concept of oxidation and reduction, redox reactions, oxidation number, balancing Redox reactions in terms of electron transfer and change in oxidation number.

Unit IX : Hydrogen

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides – ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxide-preparation, properties, structure and use; hydrogen as a fuel.

Unit X : s-Block Elements (Alkali and Alkaline earth metals)

Electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of, properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens; uses. Preparation and properties of sodium carbonate, sodium hydroxide and sodium hydrogen carbonate, CaO, CaCO₃ and industrial use of lime and limestone, biological importance of Na, K, Mg and Ca.

Unit XI : Some p-Block Elements

Group 13 elements: electronic configurations, occurrence. variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group; **Boron-** physical and chemical properties, some important compounds- borax, boric acid, boron hydrides, **Aluminium-** reactions with acids & alkalies and uses.

Group 14 elements : electronic configurations, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first element, **Carbon-**catenation, allotropic forms, physical and chemical properties; uses of some important compounds. Oxides of carbon. Important compounds of silicon and uses - silicon tetrachloride, silicones, silicates and zeolites, structure of silicates.

Unit XII: Organic Chemistry – Introduction

Organic compounds - methods of qualitative and quantitative analysis, classification and IUPAC nomenclature. Electronic displacements in a covalent bond - inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond, free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions.

Unit XIII : Hydrocarbons

Classification of hydrocarbons. **Alkanes**: nomenclature, isomerism, conformations (ethane only), physical properties & chemical reactions. **Alkenes**- nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation, chemical reactions - addition, Markovnikov's rule, ozonolysis, oxidation, mechanism of electrophilic addition. **Alkynes** – Nomenclature, structure of triple bond (ethyne), physical properties. Methods of preparation, chemical reactions; acidic character of alkynes, addition reaction of- hydrogen, halogens hydrogen halides and water.

Aromatic hydrocarbons: introduction, IUPAC nomenclature; Benzene: resonance Aromaticity; chemical properties: mechanism of electrophilic substitution- nitration sulphonation, halogenation, Friedel Craft's alkylation and acylation carcinogenicity and toxicity.

Unit XIV : Environmental Chemistry

Environmental pollution – air, water and soil pollution, chemical reactions in atmosphere, smog, major atmospheric pollutants; acid rain, ozone layer and its importance, effects of depletion of ozone layer, greenhouse effect and global warming- pollution due to industrial wastes; green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.

Unit XIV : Chemistry Practical

Basic principle of preparation of standard solution, determination of strength of a given acid/base solution. Methods of determination of melting or boiling point of an organic compound. pH Comparison of strong and weak acid solutions of same concentration. pH changes by common ion effect in the case of a weak acid or a weak base. Shift in equilibrium by increasing/decreasing the concentration of constituent ions of an equilibrium system. Detection of Nitrogen/Chlorine/Sulphur in organic compounds. Methods of crystallization of impure sample. Tests for identification of Pb^{2+} , Cu^{2+} , Al^{3+} , Fe^{3+} , Mn^{2+} , Ni^{2+} , Zn^{2+} , Co^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+ , CO_3^{2-} , S^{2-} , SO_3^{2-} , SO_4^{2-} , NO_2^- , NO_3^- , Cl^- , Br^- , I^- , CH_3COO^-