

Syllabus of Chemistry for Premedical Course (entrance exam requirements)

General Chemistry

1. Atoms. Atomic number. Mass number. Protons and neutrons. Electron configuration. Orbitals. Pauli exclusion principle. Hund's rule. Aufbau principle. Chemical symbols.
2. Nomenclature of inorganic compounds.
3. Physical quantities: mass, volume, temperature, time and quantity of chemical substance. Density, specific gravity.
4. Kinetic and Potential energy. (Chemical energy as a form of potential energy. Law of Conversion of Energy). Heat. Specific heat and Heat capacity. Melting point of solids. Boiling point of liquid. Exothermic and endothermic reactions.
5. Periodic Table. Periodic law. Representative elements, transition elements, inner transition elements. Metals and nonmetals. Biologically important elements (macroelements, inorganic ions, trace elements). Ionic compounds. Shapes, sizes and radii of ions. Octet rule.
6. Molecules. Chemical bonds. Covalent, Polar covalent and Ionic bonds, Intermolecular attractive forces. Inorganic Chemical Compounds.
7. States of Matter: Gaseous state. Pressure. The pressure-volume-temperature relationships for a fixed amount of gas. The general gas law. Avogadro's principle. Dalton's law of partial pressures.
8. States of Matter : Liquid state. Dynamic equilibrium. Vapor pressure. Water and Hydrogen bonds. Boiling point. Surface tension. Surfactants.
9. Solid state. Melting point. Sublimation.
10. Heterogeneous and homogeneous mixtures (Solutions. Colloidal Dispersions. Suspensions). Aqueous solutions. Product of solubility. Solubilities of Gases. Henry's law. Gas tension. Diffusion. Osmosis and Dialysis.
11. Quantitative Relationships in Chemical Reactions. Reactions in solution. (the mole concept, percentage concentration, molar concentration, mutual conversion of different concentration, preparing dilute solutions from concentrated solutions). Balanced Chemical Equations and Stoichiometry.
12. Chemical reactions. Equilibrium. Shifting of equilibrium. Le Chatelier's principle
13. Electrolytes, Acids and Bases. Arrhenius and Brønsted theories, and ionic compounds. Salts. Product of solubility.
14. The pH concept. Ionic product of water. Acid ionization constants. Buffers. Acid-Base titration.
15. Reaction Kinetics and Chemical Equilibria. Guldberg-Waage law. Catalyst. Rate of reaction. Acid-Base Equilibria
16. Oxidation-Reduction Equilibria. The oxidation number. Balancing equations of redox reactions. Reduction potentials.

Organic chemistry and biochemistry

1. Classification of Organic Compounds (hydrocarbons, derivatives of hydrocarbons), Physical Properties
2. Important Terms of Organic Chemistry (valence of C, O, H, N, S, halogens; alkyl, aryl, aromatic compound, constitution, conformation, configuration, saturated and unsaturated hydrocarbon, functional group, cyclic hydrocarbon, single and multiple bonds, sigma and pi electrons, primary, secondary, and tertiary carbon)
3. Chemical Formulas (molecular, empirical, and structural formula)
4. Isomerism (structural isomers, stereoisomers: optical and geometrical isomerism)
5. Reaction Types (substitution, addition, elimination, rearrangement)
6. Nomenclature of Organic Compounds (important prefixes and suffixes, systematic and common names, general rules of naming compounds, priority of functional groups and their structures)
7. Alkanes, Alkenes, and Alkynes (physical and biological properties, occurrence, reactivity: oxidation, halogenation, reduction, addition, polymerization; important common names: ethylene, acetylene, chloroform, vinylchloride)
8. Arenes (structure, physical and biological properties; important common names: benzene, phenyl-, toluene, benzyl-, o-, m-, and p-xylene, naphthalene, anthracene, phenanthrene, pyrene, biphenyl, styrene)
9. Alcohols and Phenols (naming, structure, classification: primary, secondary, and tertiary alcohols, monofunctional and polyfunctional alcohols; physical and biological properties, reactivity: dehydration, oxidation, esterification; important common names: glycerol, phenol, cresols, hydroquinone, pyrocatechol, benzylalcohol)
10. Ethers and Epoxides (naming, structure, physical and biological properties)
11. Thiols, Sulfides, and Disulfides (naming, structure, physical and biological properties)
12. Carbonyl Compounds: Aldehydes and Ketones (naming, structure, physical and biological properties, reactivity: oxidation, reduction, addition of water, alcohol, and nitrogen compounds; keto-enol tautomers, aldol condensation; important common names: formaldehyde, acetaldehyde, benzaldehyde, glyceraldehyde, acetone, dihydroxyacetone, quinones, phenones)
13. Carboxylic Acids (naming, structure, classification: saturated, unsaturated, monocarboxylic, dicarboxylic; terms: acyl, anion, alpha-carbon, omega-carbon; physical and biological properties; important common names: monocarboxylic acids C1-C4, C16, C18, dicarboxylic acids C2-C5, fumaric and maleic acid, oleic, linoleic, linolenic, arachidonic acid, benzoic acid)
14. Derivatives of Carboxylic Acids: Substitutional Derivatives (halogen, hydroxy, oxo = keto, and amino derivatives; naming, structure, important common names: lactic acid, malic acid, pyruvic acid, oxaloacetic acid, 2-oxoglutaric acid, citric acid, salicylic acid), and Functional Derivatives (salts, anhydrides, esters, amides, halides, and nitriles; naming, structure, properties)
15. Sulfonic Acids (naming, structure, properties)
16. Carbonic Acid Derivatives (urea, phosgene, guanidine)
17. Heterocyclic Compounds (structure, pyrrole, indole, pyridine, pyrimidine, purine, imidazole, furan, pyran)

18. Amines (naming, structure, classification: primary, secondary, tertiary amines, quaternary ammonium cations; physical and biological properties; reactivity: diazotation; important common names: aniline, choline)
19. Nitrocompounds (naming, structure, properties)
20. Structure of Nucleic Acids (purine and pyrimidine bases, nucleosides, nucleotides; keto-enol tautomerism; complementary base pairing, bonds in nucleic acids: H-bond, N-glycosidic bond, phosphoester bond, phosphodiester bond; structure of DNA and RNA, types of RNA)
21. Proteins (proteinogenic amino acids: classification, properties, isoelectric point; structure of proteins: primary, secondary, tertiary, and quaternary one; bonds in proteins, properties, denaturation, classification, and functions of proteins)
22. Lipids (classification: fatty acids, neutral lipids - triacylglycerols, phospholipids, sphingolipids, steroids - cholesterol; structure, properties, and functions) and Terpenes (structure, classification; isoprene)
23. Saccharides (classification: mono-, oligo-, and polysaccharides; structure: Fischer, Tollens, and Haworth projection, properties; reactivity: oxidation, reduction, esterification, glycosylation, isomerization: ketose-aldose, pyran-furan, alpha-beta anomer, epimers, D- and L- enantiomers; important saccharides: glucose, fructose, galactose, mannose, ribose, deoxyribose, sucrose, lactose, maltose, starch, glycogen, cellulose)

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