

Master's program Entrance examination topics

Chemistry

1. The periodic table of the elements. Isotopes, electronic structure, the Bohr-Sommerfeld model. Bonding models, properties of chemical bonds, primary and secondary bonds.
2. States of matter, gases, kinetic gas theory, diffusion, gas laws, fluids, surface tension, cohesive forces. Solid state, crystal structures, changes in states, phase diagrams.
3. Chemical equilibria, acid-base reactions and theories. Thermodynamics: laws, heat, entropy, enthalpy (reaction enthalpy), Gibbs free energy (in equilibrium processes), electrochemistry (reactions on a boundary surface).
4. Classification of organic reactions, nucleophilicity and electrophilicity, energy profile of reactions. Mechanisms of reactions. Substitutions, additions and eliminations.
5. Aliphatic hydrocarbons: alkanes and derivatives, stereoisomers, the Cahn-Ingold-Prelog convention. Newman- and Fischer-projection, aromatic hydrocarbons, aromaticity.
6. Oxo compounds: aldehydes and ketones, tautomerism, carboxylic acids and their derivatives, carbohydrates and heterocyclic compounds.
7. Amino acids and proteins, protein folding, primary, secondary and tertiary structure, cooperativity.
8. Nucleosides, nucleotides and nucleic acids, their structure and biological function.
9. Enzymes: fundamentals of enzyme catalysis, basic mechanisms, examples.
10. Bioenergetics: role and production of ATP, completion of energetically unfavorable reactions in the cells.
11. Lipids, biological membranes and transport mechanisms.

Recommended literature:

James E. House: *Inorganic chemistry*. Elsevier, 2008.

Leroy G. Wade, Jan W. Simek: *Organic Chemistry*. Pearson, 2022.

Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto, Jr., Lubert Stryer: *Biochemistry*. MacMillan, 2015.