



Entrance examination topics

Medical Biotechnology MSc

Biology

1. Origin of life on Earth. Organization of cells. Chemo- and photosynthesis, respiration.
2. DNA, gene, chromosomes, genome. Replication and cell division.
3. Genetics of prokaryotes. Mendel's laws, gene linkage, genetic maps. Transcription in pro- and eukaryotes
4. Translation and the genetic code. The ribosome. Mutation and repair. Mutagens and carcinogens.
5. Regulation of gene expression in pro- and eukaryotes. Genetic engineering.
6. Cytoskeleton and cellular movements, intracellular transport. Structure and function of biological membranes.
7. Outline of the nervous system and its function in living organisms.
8. Cellular information uptake, processing, storing and response
9. Characterization of the cell types found in nervous tissue, common and distinctive traits compared to the structure and function of other somatic cells
10. The electrical activity of neurons, action potential, EPSP and IPSP
11. Types of nerve fibers, conduction of nerve impulses in the central and peripheral nervous system
12. Types and functions of glial cells
13. Morphological and functional description of neuron-neuron interactions. Comparison of chemical and electric synapses.
14. Morphological and functional description of neuron-glia interactions. Role of glial cells in synaptic transmission
15. Types of neurotransmitters, their synthesis, use and degradation, amines and peptide type neurotransmitters
16. Non-synaptic interneuronal contacts and retrograde signal transmission
17. Types and function of receptors. The structure and role of the muscle spindle.
18. Types and mechanisms of effectors, structure and role of the motor endplate

Recommended literature:

Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick: *Lewin's genes X*. Jones & Bartlett Learning, 2011.

Eric R. Kandel et al. (eds): *Principles of Neural Science*. Fifth edition, McGraw-Hill, 2013.

Chemistry

1. The periodic table of the elements. Properties of nuclei, isotopes, electronic structure, quantum numbers, the Bohr-Sommerfeld model
2. Properties of atoms, electronegativity, atomic radius, ionization energy, formation of bonds, bonding models, valence, molecular orbital theory, hybridization, VSEPR theory, features of chemical bonds, primary and secondary bonds
3. Compounds, stoichiometry, classification of compounds, important compounds of the abundant elements, case studies
4. States of matter, gases, kinetic gas theory, gas laws, fluids, surface tension, cohesive forces. Solid state, crystal structures, changes in states, phase diagrams
5. Chemical equilibria, acid-base reactions and theories: Arrhenius-Ostwald, Bønsted-Lowry, Lewis, HSAB
6. Solutions and mixtures. Mixtures of gases, fluids, mixing, phase equilibria in mixtures: fluid-gas, solid-fluid. Colligative properties of dilute solutions
7. Thermodynamics: main laws, heat, entropy, enthalpy (reaction enthalpy), Gibbs free energy (equilibrium processes), electrochemistry (reactions on a boundary surface)
8. Classification and nomenclature of organic compounds
9. Aliphatic hydrocarbons: alkanes and derivatives, stereoisomers, the Cahn-Ingold-Prelog convention. Newman- and Fischer-projection, aromatic hydrocarbons, aromaticity
10. Classification of organic reactions, acidity and basicity of organic compounds, nucleophilicity and electrophilicity, energy profile of reactions, kinetic and thermodynamic control. Factors determining reactivity: inductive, steric and mesomeric effects
11. Mechanisms of reactions: kinetic overview, first and second-order reactions, parallel reactions, nucleophilic and electrophilic substitutions, radicals. Additions and eliminations.
12. Oxo compounds: aldehydes and ketones, tautomerism, carboxylic acids and their derivatives, carbohydrates and heterocyclic compounds.
13. Amino acids and proteins, protein folding, primary, secondary and tertiary structure, cooperativity



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14. Nucleosides, nucleotides and nucleic acids, their structure and biological function
15. Enzymes: fundamentals of enzyme catalysis, basic mechanisms, examples
16. Bioenergetics: role and production of ATP, completion of energetically unfavorable reactions in the cells
17. Lipids, biological membranes and transport mechanisms

Recommended literature:

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

Leroy G. Wade, Jan W. Simek: *Organic Chemistry*. Pearson, 2016.

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