Topics for the entrance examination – degree subject 'General Medicine'

B I O L O G Y

- General characteristics of living systems (General characteristics of organisms. Material composition of living systems. Characteristics of unicellular and multicellular organisms. Non-cellular organisms. Hierarchy of organisms by level of complexity.
- Overview of living organisms (Systematic categories of organisms. Biological species. Bacteria. Cyanobacteria. Protozoa. Moulds. Yeasts and higher fungi. Overview and characteristics of plants. Overview and characteristics of animals. Worms and arthropods. Chordates. Vertebrates. Mammals.)
- Cells (Characteristics of prokaryotic and eukaryotic cells. Biomembranes. The cytoskeleton. Cell organelles. Chemical composition – nucleic acids, proteins, saccharides. Cell metabolism. Energy conversion. Cell division. Chromosomes. Cell reproduction.)
- Vital functions of higher plants, animals (Photosynthesis, anaerobic glycolysis, oxidative phosphorylation, ATP cycle. Plant reproduction and movement. Animal temperature. Respiratory systems of animals. Cardiovascular systems of animals. Bodily fluids of animals. Excretory systems of animals. Nervous systems of animals. Hormonal regulation. Homeostasis. Sensory functions. Locomotive functions. Reproduction of animals. Ontogenetic development and ageing of animals.)
- Genetics (Heredity and variation. Sexual and asexual reproduction. Basic concepts in genetics. Genetic information and the genetic code. Genes and their expression. Storage of genes in chromosomes. Prokaryotic chromosomes. Eukaryotic chromosomes. Karyotypes. Diploid and haploid chromosome number. Meiosis. Segregation and combination of chromosomes. Determination of sex by chromosomes. Crossbreeding. Dominance and recessivity. Mendel's laws. Autosomal inheritance. Gonosomal inheritance. Mutation. Mutagenic factors in the human environment. Genetic structure of the population. The medical importance of genetics. Examples from genetics: molecular basis of heredity, cells and heredity, heredity in multicellular organisms, genetic variation. Examples from human genetics. Heredity of blood groups, eye colour, left-handedness, disorders of finger development, hemophilia, colourblindness. Heredity in organism populations.)
- Evolution (Basic notions of the origins of life. Geological development of the Earth and the development of life. The oldest forms of life. Darwin's theory of evolution. Basic paleoanthropological discoveries. The line of development of humans.)
- Human biology (The skeletal and locomotive systems. The internal environment of the organism. Blood. Defence reactions of the organism. Blood groups. Blood transfusion. The circulatory system and its functions. Lymph and the lymphatic system. The respiratory system and its functions. The digestive system and its functions. The excretory system. Conversion of substances and energy in the human organism. The functions of the liver. Body temperature and its maintenance. Hormonal control of organism activity. Control of internal organ activity. The nervous system. Nervous control of organism activity. Sensory systems. Higher nervous activity. Male and female reproductive systems. Ontogenesis and intrauterine development of humans. Pregnancy. Hereditary diseases. Genetic consultancy.)
- Ecology (Basic concepts in ecology. Relationships between organisms and the environment. Abiotic and biotic elements of the environment. Solar radiation, the atmosphere, the hydrosphere, life. Population. Mutual relations among populations. Parasitism, predation. Positive relations in populations. Communities of organisms. The ecosystem and its changes. The biosphere. The human population and the environment. The population explosion.)

Recommended literature:

- Biology textbooks covering the secondary school curriculum
- Chiras, D.D.: Human Biology. Jones and Bartlett Publishers, Sudburry, USA, 2002, ISBN 0-7637-1880-7
- Mader S. S.: Human Biology. McGraw-Hill Publishing Company, New York, 2010. ISBN10: 0077280113

C H E M I S T R Y

- General chemistry and inorganic chemistry (Basic characteristics of substances – mass and relative mass of atoms and molecules, amount of substance, the Avogadro constant, molar mass, normal molar volume of gases. Names and chemical formulas of inorganic compounds. Calculations from chemical formulas. Chemical equations. Calculations of mass, amount of substance. Atomic structure. Valence electrons. The periodic system of elements; s-block, p-block, d-block elements. Electronegativity of elements. Ionic and covalent chemical bonds, bond polarity. Covalent bonds. Coordinate bonds. Directionality of bonds, hybridization of atomic orbitals, molecule polarity. Intermolecular bond forces. Solutions – expressing the composition of a solution via mass fraction, mass concentration and molar concentration, calculations. Equivalent amount of substance in neutralization reactions (neutralization titration). Nonelectrolytes and electrolytes, electrolytic dissociation, strong and weak electrolytes. Ionic concentration in strong electrolyte solutions. Types of chemical reactions. Protolytic reactions. Strong acids and bases, dissociation constant of weak acids and bases. Autoprotolysis of water and ionic product of water. Concentration of hydrogen ions and pH. Solutions of strong acids and bases – calculations. Hydrolysis of salts. Oxidation-reduction reactions, agents, numbers of exchanged electrons and coefficients in chemical equations. Thermochemical equations and reaction energy equilibrium, reaction heat. Influence of reaction conditions on the speed of chemical reactions. Chemical equilibrium and the equilibrium constant, factors causing non-equilibrium states. Groups of elements in the periodic table (main group elements, transition elements, distribution of metals and non-metals). Hydrogen and oxygen, covalent hybrids, ionic and covalent oxides, acidic oxides, basic oxides, amphoteric oxides. Water.)
- Organic chemistry (Molecular bonds in organic compounds. Properties of organic compounds, basic types of reactions. Terminology – principles. Isomerism. Hydrocarbons (names of hydrocarbon radicals, unsaturated hydrocarbons, arenes. Haloalkanes, nitro compounds, amines – various types). Alcohols and phenols, quinones, ethers. Aldehydes and ketones. Carboxylic acids. Overview of names and structures of biologically important acids (mono- and dicarboxylic unsubstituted saturated and unsaturated, substitution derivatives – hydroxy acids and keto acids). Optical isomerism. Urine. Heterocyclic compounds. Uric acid.)
- Biochemistry (Saccharides – classification, importance, structure of the most important monosaccharides (acyclic forms, derivation of hemiacetal cyclic forms, anomerism), sucrose esters, formation of glycosidic bonds. Reducing and non-reducing disaccharides, polysaccharides. Lipids – fatty acids bound in lipids, acylglycerols, hydrolysis of fats and oils, soaps, rancidification, main components of phospholipids. Steroids – structure of sterane, biologically important steroids. Purine and pyrimidine bases of nucleic acids, structure and names of nucleosides and nucleotides, basic structural features of nucleic acids, their types and functions in the transcription and translation processes. Amino acids and proteins: names and structures of all 20 standard amino acids, polarity of side chains, ionization. Peptide bond formation, peptide name formation. Protein structure – primary/quaternary structure, stabilization of secondary, tertiary and quaternary structure. Denaturing of proteins. Basic types of proteins. Functions of enzymes, main classes of enzymes. Important enzymes in the digestive system. Functions of vitamins, chemical names. Anabolic and catabolic character of metabolic pathways, importance of oxidation reactions, macroergic compounds and metabolism energy effect. The role of the citrate cycle and the respiratory chain. End products of aerobic and anaerobic glucose breakdown, beta-oxidation of higher carboxylic acids and nitrous substances. Hormones – basic characteristics and functions.)

Recommended literature:

- Chemistry textbooks covering the secondary school curriculum

P H Y S I C S

- Physical quantities, units (SI system of units. Fractional or multiple units. Scalar and vector quantities. Conversion of units).
- Mechanics (Kinematics of a material point (types and configurations of movements, velocity and acceleration, even and uneven movements, circular movement of a material point, centripetal acceleration). Dynamics of a material point (mutual effects of bodies, Newton's laws of motion, momentum of bodies and impulse of force, law of conservation of momentum, centripetal and centrifugal force). Energy of a material point (work, power, mechanical energy, kinetic energy, potential energy, laws of conservation of energy in mechanics). Mechanics of solid bodies (solid bodies, moment of force, centre of gravity, couple moment, displacement and rotary movement of solid bodies, efficiency of machines). Mechanics of liquids and gases (pressure in liquids and gases, hydrostatic pressure, Pascal's law, Archimedes' principle, atmospheric pressure, constant flow of ideal liquids, continuity equations, the Bernoulli equation, flow of real liquids). Gravitational fields (law of gravity, the Earth's gravitational field, movement of bodies in the Earth's homogeneous and radial gravitational field).
- Thermodynamics and molecular physics (Kinetic theory of the structure of substances, unordered movement of particles in substances, state-structure models, thermodynamic temperature). Internal energy, work and heat (changes in the internal energy of a body during heat exchange, heat, specific heat capacity, calorimetry, first law of thermodynamics). Structure and properties of gases (classification of gas molecules according to velocity, equation of state for an ideal gas, isothermic, isobaric and adiabatic processes in ideal gases, the cyclic process, second law of thermodynamics). Structure and properties of solids (crystalline and amorphous solids, ideal crystal lattices, main bond types, deformation of solid bodies, thermal expansion of solids). Structure and properties of liquids (surface layer of liquids, surface tension, solid/liquid state boundary phenomena, capillarity, liquid volume thermal expansion). Changes of state (melting, solidification, sublimation, evaporation and boiling, condensation, phase diagram, steam in the atmosphere).
- Acoustics (Oscillation (harmonic oscillation, phases, oscillator energy, eigen oscillation, forced oscillation, resonance). Waves (classification of wave types, reflection and refraction, interference, standing waves, spatial propagation of waves, Huygens principle). Sound waves (sound and its properties, volume of sound, intensity and velocity of sound, ultrasound, infrasound).
- Electricity and magnetism (Electrical fields (electric current, force effects, Coulomb's law, electrical field intensity, voltage, conductor and condenser capacity, conductors and insulators in an electrical field, electrical power source). Electric current in metals (electron conductivity, Ohm's law, electrical resistance. Kirchoff's laws, work, power). Electric current in semiconductors (diodes and transistors, the thermoelectric effect). Electric current in electrolytes (electrolytic dissociation, Faraday's laws, electrolysis, galvanic cells). Electric current in gases, vacuums (gas ionization, cathode radiation, electron thermal emissions). Magnetic fields (origin, magnetic fields and force effects of conductors with current, force effects, magnetic induction, magnetic properties of substances, production and measurement of alternating voltage and current, inductance, capacitance, impedance, Thomson formula, electromagnetic induction).
- Optics (Electromagnetic radiation and its energy (basic concepts, basic radiometric quantities, thermal radiation). Light speed, total reflection, light reflection and refraction, refraction index, separation of light through a prism, spectroscopy, light interference, light bending, light polarization. Optical systems – lenses, the eye, microscopes, telescopes).
- Atomic physics (The photoelectric effect, the Compton effect, particle and wave properties of photons, spontaneous and stimulated radiation emission – lasers, wave properties of particles. Electron shells of atoms (atomic spectra, quantum energy, quantum mechanical model of a hydrogen atom, quantum numbers). Structure of the atomic nucleus (nuclear reactions, natural radioactivity, law of radioactive transformation, nuclear fission and fusion, production and use of radionuclides, detection of nuclear radiation).

Recommended literature:

- Physics textbooks covering the secondary school curriculum - Physics for Secondary Schools Years I – IV.