

Entrance Examination Topics

Biology

1. Cell Biology

- Types and function of lipids
- Biologically important carbohydrates
- Primary, secondary, tertiary and quaternary protein structure
- The structure of DNA and RNA
- Types and function of RNA molecules
- What are the enzymes and how are enzymes regulated?
- Glycolysis
- The citric acid cycle
- Mechanism of ATP production in the mitochondria
- Replication
- Transcription
- Translation
- The nucleus
- Chromosomes
- Endoplasmic reticulum
- The Golgi apparatus
- Ribosomes
- Cytoskeleton
- Exocytosis, endocytosis
- The cell membrane
- Mitosis
- Meiosis
- Structure of the bacterial cells
- Transformation, conjugation and transduction
- Structure of the viruses
- Membrane transport

2. Physiology

- Parts of the digestive system
- Digestive enzymes, absorption of food and water
- Parts of the respiratory system, mechanism of inhalation and exhalation
- Oxygen and carbon dioxide exchange in the lungs
- Parts of the excretory system
- Water and ion transport in the kidneys
- Parts of the circulatory system
- Structure and function of the heart
- Blood, composition, cell types
- The cellular immune response

- The humoral immune response
- Muscles, bones, joints
- Muscle contraction
- Parts of the male reproductive system
- Parts of the female reproductive system
- The ovarian cycle and the uterine cycle
- Hormonal control of the reproductive system
- The pituitary gland and its hormones
- The adrenal gland and its hormones
- The thyroid gland and its hormones
- The pancreas and its hormones
- The autonomic nervous system
- The spinal cord, spinal reflexes
- Parts of the human brain, function of the brain lobes
- Nerve cell structure, resting and action potential
- Neurotransmitters and synaptic transmission
- The structure of the human eye
- Mechanism of vision
- The structure of the human auditory system and the mechanism of hearing
- The olfactory system
- Hormonal regulation of blood glucose level
- Hormonal regulation of stress

3. **Genetics**

- The Laws of Mendel
 - Structure of the genes
 - Levels of gene expression
 - Mutations: types and consequences
 - Human chromosome number aberrations, genetic diseases
 - Dominant-recessive inheritance
 - Sex-linked inheritance
 - The genetic code
 - The lactose operon
- ### 4. Evolution
- Darwin's theory
 - Origin of life

Recommended reading:

Life, The science of biology (last edition)

Chemistry

1. General and Inorganic Chemistry

- Elements and compounds. The mole concept, Avogadro's number
- Basic structure of atoms and the quantum numbers
- Periodic table. Periodic properties
- Types of chemical bonding
- Lewis structure. Geometry of molecules
- Intermolecular forces. Types of solids
- Chemical equilibrium. LeChatelier's principle. Examples for chemical equilibrium
- Acid-base theories
- Definition of pH, the pH scale. Examples for strong and weak acids and bases
- Solutions. Ways of expressing composition of solutions
- Definition of oxidation and reduction. Examples for redox reactions.
- Carbon and its inorganic compounds
- Nitrogen and its compounds
- Phosphorous and its compounds
- Sulfur and its compounds

2. Organic Chemistry

- Functional groups. Types of organic chemical reactions
- Isomerism in organic compounds. Types and examples
- Alkanes. Nomenclature, physical and chemical properties
- Alkenes and alkynes. Nomenclature, physical and chemical properties
- Aromatic hydrocarbons: examples, chemical reactions
- Alcohols: classification, preparation, physical properties
- Alcohols: chemical properties and most important representatives
- Ethers and phenols
- Oxo compounds: classification and oxidation-reduction reactions
- Carboxylic acids. Nomenclature, physical and chemical properties
- Carboxylic acid derivatives: esters and amides
- Amines: classification, nomenclature, examples for their chemical reactions
- Proteinogenic amino acids: examples. The peptide bond
- Carbohydrates: definition, classification, most important representatives
- Components of nucleic acids

Recommended reading:

John E. McMurry, Fay, Robert C. Fay: Chemistry, 6th edition Pearson Education, Inc., Upper Saddle River, NJ 07458.

Physics (upon request instead of Chemistry)

- Speed and velocity. Acceleration. Free fall.
- Heat capacity and specific heat. Change of phase and latent heat
- Newton's laws. Force and the principle of superposition
- The ideal gas law. Isothermic, isobaric, isochoric processes
- Mass and weight. Universal law of gravitation
- Kinetic theory of gases. The first law of thermodynamics
- Work and kinetic energy. Work-energy theorem
- Electric charges and Coulomb's law
- Potential energy. Law of conservation of energy
- Electric field: electric field lines, electric flux, Gauss's law. Electrical potential, equipotential surfaces
- Linear momentum
- Capacitance, capacitor, energy stored in a capacitor
- Torque and lever arm. Conditions of equilibrium
- Electrical current, resistance, Ohm's law
- Uniform circular motion. Centripetal acceleration and centripetal force
- Kirchhoff's rules
- Forces of friction; Hooke's law
- Magnetic field, magnetic force. The force on acting on a current-carrying wire in a magnetic field.
- Simple harmonic motion: main characteristics: displacement, velocity and acceleration, period, amplitude, frequency, angular velocity
- Magnetic induction: Faraday's law, Lenz's law
- Mechanical waves, interference, diffraction and standing waves, resonance; Sound; Doppler-effect
- Alternating current, effective values; R, L, C in an alternating circuit, resonance
- Pressure in fluids: Pascal's principle, pressure-depth relation. The hydraulic press
- Light as an electromagnetic wave. Reflection, refraction of light, dispersion and colors of light
- Archimedes' principle, buoyancy
- Optical instruments, optical lenses, mirrors
- Concept of temperature, temperature scales. Thermal expansion
- The structure of atom: electron shell structure, excitation and relaxation, ionization

Recommended reading:

Steven Holzner: Physics essentials for dummies. Hoboken: Wiley, 2010
R.A. Serway, J. W. Jewett Physics for scientists and engineers. Thomson Brooks/Cole (latest edition)
Arfken G. B., Griffing D. F., Kelly D. C. and Priest J.: University Physics. Orlando, 1984
Tipler, Paul A. College Physics. New York: Worth Pub, 1987