

# Entrance Examination Topics

## I. 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

### 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

### **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)

## **II. Chemistry**

### **1. GENERAL AND INORGANIC CHEMISTRY**

- Elements and compounds. The mole concept, Avogadro's number.
- Basic structure of atoms, subatomic particles, atomic and mass numbers, isotopes.
- Quantum numbers and electron configuration of atoms.
- Periodic table. Periodic properties.
- Types of chemical bonding.
- Lewis structure. Geometry of molecules.
- Intermolecular forces.
- States of matter. Types of solids.
- Chemical reactions: exothermic or endothermic processes, reaction rate, catalysts.
- 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.
- Metathesis (double-replacement) reactions: types and examples.
- Alkali metals, alkaline-earth metals and some important compounds of them.
- Properties and compounds of some d-transition metals: iron, copper, zinc and mercury.
- Carbon and its inorganic compounds.
- Nitrogen and its compounds (e.g. oxides, acids).
- Phosphorous and its compounds (e.g. oxides, acids).
- Oxygen and its inorganic compounds (e.g. water, hydrogen peroxide, nonmetal and metal oxides).
- Sulfur and its compounds (e.g. oxides, acids).
- Halogens and some important compounds of them.

### **2. ORGANIC CHEMISTRY**

- Classification of organic compounds based on their structure (skeleton). Examples.
- Functional group. Classification of organic compounds based on functional groups. Examples.
- Types of organic chemical reactions. Examples.
- Isomerism in organic compounds: types and examples.
- Alkanes: nomenclature, physical and chemical properties.
- Cycloalkanes: nomenclature, structure, representatives, chemical properties.
- Alkenes: nomenclature, physical and chemical properties.
- 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, nomenclature and physical properties.
- Oxo compounds: chemical properties and most important representatives.
- Carboxylic acids: nomenclature and physical properties.
- Carboxylic acids: chemical properties and some representatives.
- Carboxylic acid derivatives: esters and amides.
- Amines: classification, nomenclature and physical properties.
- Amines: chemical properties and some representatives.
- Carbohydrates: definition, classification, most important representatives.

- Proteinogenic amino acids: examples. The peptide bond.
- Proteins: building blocks, bonds, levels of protein structure.
- Components of nucleic acids.

### **III. Physics (only in Szeged)**

- 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 colours 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, ionisation

#### **Recommended reading:**

- Holzner, Steven. *Physics essentials for dummies*. Hoboken: Wiley, 2010
- Serway R A, Jewett J W. *Physics for scientists and engineers*. Thomson Brooks/Cole, 2004
- Arfken G B, Griffing D F, Kelly D C And Priest J. *University Physics*. Orlando: Academic Press, 1984
- Tipler, Paul A. *College Physics*. New York: Worth Publishers, 1987