

The Entrance Exam Topics

Biology – The Entrance Exam Topics

Principles of biology

- Basic attributes of living systems
- Biological disciplines, biotechnology, biomedicine, main branches of medicine
- Biological terminology
- Key discoveries in biology and medicine
- Chemical elements and molecules of living systems
- Basic metabolic pathways

Molecular genetics

- Central dogma of molecular biology
- Structure and function of nucleic acids and proteins
- DNA replication, transcription, translation and genetic code
- Genome, chromosome, and gene structure
- Regulation of gene expression
- Mutations and their consequences
- Basic molecular genetic methods

Cell biology

- Structure and organization of cells (prokaryotic, eukaryotic, plant, animal)
- Origin, structure, and function of mitochondria
- Origin, structure, and function of chloroplasts, photosynthesis
- Structure and function of ribosomes
- Nucleus and chromatin, human karyotype
- Cell cycle, mitosis, their regulation and errors
- Meiosis, crossing over, oogenesis and spermatogenesis, gametes, fertilization

Genetics

- Genotype and phenotype
- Mendel laws and Mendelian and non-Mendelian modes of inheritance
- Gene linkage and gene interactions
- Population genetics and Hardy-Weinberg equilibrium
- Clinical genetics, genetic counselling and prevention of genetic disorders, prenatal examination
- Medically important autosomal recessive, dominant, sex-linked and multifactorial traits
- Medically important chromosomal abnormalities
- Germline and somatic genetic defects in cancer

Virology, bacteriology, protistology, zoology, botany, and mycology

- Classification, basic characteristics, structure and reproduction of viruses
- Retroviruses and reverse transcription
- Viral diseases
- Viroids, prions and associated diseases
- Eubacteria and Archea, their reproduction and importance
- Bacterial infections and their therapy
- Protists, their taxonomy and classification

- Parasitic protists and associated diseases
- Taxonomy and evolution of animals
- Classification, reproduction, ontogenesis and body structure of invertebrates
- Parasitic invertebrates (helminths, arthropods), their life cycle and associated diseases
- Classification, reproduction, ontogenesis and body structure of chordates
- Taxonomy, evolution and reproduction of plants and fungi
- Medically important fungi (parasitic, producing antibiotics or toxic compounds)

Basic human biology

- Basic anatomy and physiology of the human body, tissues and organ systems
- Skeleton, structure and development of bones, disorders of the musculoskeletal system
- Most important muscles and the mechanism of muscular contraction
- Basic components and function of blood, blood groups and transfusion
- Heart and circulatory system, blood vessels, blood pressure, heart rate, cardiovascular diseases
- Immunity, lymphatic system, antibodies, vaccination and transplantation, disorders of the immune system
- Respiration, respiratory system and its disorders
- Digestive system and basic nutrients, vitamins, their sources and importance, eating disorders, obesity
- Excretion, urinary system, production and composition of urine, diseases of the urinary system
- Skin, its structure and importance, skin diseases
- Central and peripheral nervous system, its anatomy and function, sensory organs and receptors
- Disorders and injuries of the nervous system, stress, psychiatric diseases, addiction
- Exocrine and endocrine glands, endocrine system and its disorders, hormones
- Reproductive system and human reproduction, embryogenesis, organogenesis, prenatal care, inborn defects
- Disorders of human reproduction, assisted reproduction, sexually transmitted diseases
- Cancer, its origin, carcinogens, cancer prevention

Evolution

- Evolutionary theories, Darwin's concept of evolution, neodarwinism, selfish gene theory
- Evolutionary factors: variability, mutation, selection, genetic drift, gene flow
- Origin of life, prebiotic evolution, evolution of cellular organisms, fossils
- Evolution of *Homo sapiens*, its ancestors and related species

Ecology

- Biotic and abiotic factors, population, community, ecosystem, biome, species diversity
- Food web, food chain, producers, consumers, decomposers
- Interspecific and intraspecific relationships
- Toxic, mutagenic and carcinogenic factors of the human environment, genotoxicity testing
- Global environmental issues and environmental protection

Chemistry – The Entrance Exam Topics

General and inorganic chemistry

SI units. Atomic structure. Subatomic particles. Electron configurations. Symbols of the elements. Periodic properties of the elements. Stoichiometry. Weight relationships (atomic number, atomic mass number, molecular weight...). Mole concept. Writing balanced chemical equations. Calculations based on balanced equations. Concentrations (expressing and calculating concentration, weight, volume percent, molarity). Nomenclature and formula writing. Thermochemistry. Reaction heat. Chemical bonding. Ionic bonding. Polar and nonpolar covalent bonding. Intermolecular forces in solids, liquids and gases. Kinetics. Activation energy and catalysis. Equilibria. Acid-base equilibria. Electrolytic dissociation. Dissociation constant. Strong and weak electrolytes. pH. Hydrolysis. Solubility product. Oxidation-reduction. Dispersion systems (diffusion, osmosis). Chemical properties of main biogenic elements. Coordination compounds.

Organic chemistry

Structure, nomenclature and reactions of alkanes, alkenes, alkynes, alkylhalides, thiols, alcohols, phenols, aldehydes, ketones and carboxylic acids. Aromatic compounds – structure, nomenclature and reactions. Carboxylic acids and derivatives. Amines and other nitrogen functions. Heterocyclic compounds.

Biochemistry

Structure features of amino acids, classification and reactions. Proteins – structure, properties and function. Saccharides – classification, structure, stereochemistry, biological significance. Lipids – classification – structure and properties. Fatty acids. Enzyme and enzyme activity. Macroergic compounds, ATP. Citric acid cycle, the respiratory chain. Ureosynthetic cycle. Glycolysis. Purine and pyrimidine nucleotides. Structure of DNA and RNA.

Physics – The Entrance Exam Topics

Generally

SI units. Scalar and vector quantities.

Mechanics

The Newton's laws. The Energy conservation law. Force, Momentum. Gravity.

Hydrostatics: Pressure. Pascal's and Archimed's laws, Buoyant force.

Hydrodynamics: The Continuity and Bernoulli's equations.

Acoustics

Frequency, wavelength, phase velocity. Sound intensity, intensity level, hearing. Ultrasound.

Thermodynamics

Temperature, Celsius and absolute temperature scales. Heat, specific heat. The 1st and 2nd principles of thermodynamics.

Aggregation state changes, saturated vapor curve, humidity.

Electricity & Magnetism

Electric charge, Coulomb's law. Electric field intensity and potential. Tension, Current, Resistance, Ohm's law, Joule's heat, power. Connecting resistors.

Magnetic field, Ampère's rule. Electromagnetic induction, Faraday's law.

Optics

Light reflection and refraction, refraction index, Snell's law. Mirrors and lenses. Light as elmg. wave, light velocity, spectrum, visible light.

Atom physics

The structure of atom, main elementary particles. The nucleus, isotopes, radioactivity. Radioactive decay.

Examples of the Entrance Test

The thymus:

- A. is an organ of the human immune system
- B. is located in front of the heart and behind the sternum
- C. provides an inductive environment for the development of B-lymphocytes
- D. plays an important role in the induction of central immunological tolerance

Which of the following statements about gene, allele and DNA sequence is/are correct?

- A. a gene can have more alleles which differ in their DNA sequence
- B. one allele can have more genes which differ in their DNA sequence
- C. a person having two different alleles of a specific gene is a heterozygote
- D. a person having two identical alleles of a specific gene is a homozygote

The basic laws of heredity were postulated after 1850 by:

- A. Johann Gregor Mendel
- B. Rudolf Virchow
- C. Francis Galton
- D. Charles Darwin

An alpha particle:

- A. is composed of two protons and two neutrons
- B. has the number of nucleons equal to the number of protons ($A = Z$)
- C. for the number of nucleons and protons holds $A + Z = 4$
- D. is not deflected by a magnetic field

A body with a mass of 10 kg moves with a constant velocity of 36 km/h. Its kinetic energy is:

- A. 360 J
- B. 1000 J
- C. 500 J
- D. about 6.5 kJ

Various components are based on physical principles or phenomena. Mark the correct relations:

- A. a bimetallic thermometer – thermal expansion of solids
- B. a thermistor – semiconductor conductivity dependence on the temperature
- C. a thermocouple – metal conductivity dependence on temperature
- D. a resistance thermometer – conductor's resistivity dependence on the temperature

The blood glucose level of a fasting patient drops to 65 mg/dL. What is the number of grams of glucose in 1.0 L of blood?

- A. 6.5 g
- B. 0.065 g
- C. 65 g

D. 0.65 g

Indicate the functional groups in a molecule of serine:

A. –SH

B. –COOH

C. –NH₂

D. –OH

Indicate the saturated fatty acids:

A. linoleic acid

B. stearic acid

C. palmitic acid

D. oleic acid

Which pattern requires the longest wire in order to be formed?

A. B. C. D.

There are an equal number of boys and girls playing beach volleyball. They can be grouped into four different mixed pairs. Is the number of children:

A. lower than 5

B. equal to 4

C. higher than 4

Determine the percentage of the squared area that is shaded.

A. less than 50 %

B. equal to 50 %

C. more than 50 %