

Curriculum for entrance exam

BIOLOGY

1-73

1. arteries, veins, capillaries – comparison
2. ATP as high-energy substrate
3. autonomic nervous system – structure and role
4. basic elements of a virus
5. basic metabolic changes in animal and plant cell
6. basic terminology of classic genetics (allele, recessive, dominant, locus, homozygote, heterozygote, genotype, phenotype)
7. carbohydrate metabolism – glycolysis and the catabolism of hexoses
8. cell membranes – structure and role
9. cell movement
10. characteristics specific for fishes, amphibians, reptiles, birds, and mammals
11. chromosome and characteristics of diploid organism
12. citric acid (Krebs) cycle
13. coding amino acids in DNA
14. comparison of aerobic respiration and fermentation – energetic values
15. comparison of anabolism and catabolism
16. comparison of DNA and RNA
17. comparison of eukaryotic and prokaryotic cell
18. description of photosynthesis
19. diversity of bacteria – structure, mobility, nutrition (phototrophism, chemotrophism, heterotrophism)
20. DNA organization in genome
21. double helix and its role in DNA replication
22. ear structure and function
23. elements of the cell
24. endocrine glands and types of hormones
25. examples of adaptation of selected species to its living environment
26. eye structure and function
27. factors influencing enzymatic activity (temperature, pH, salt concentration)
28. fertilization in humans
29. fungi: basic characteristic differentiating them from other organisms
30. gastrointestinal system – general processes of digestion and absorption
31. immune system – general mechanism of immunity and cells of the immune system
32. major bacterial diseases in humans (tuberculosis, dysentery, typhoid, cholera, anthrax, tetanus, Lyme disease)
33. major energetic compounds in the cell
34. major protista diseases in humans (malaria, trichomoniasis, giardiasis, toxoplasmosis, amoebiasis)
35. major viral diseases in human (flu, measles, chickenpox, AIDS, hepatitis, rabies, rubella, mumps, polio) – pathways of infection and prevention methods
36. mechanism of water and minerals transport in plants
37. Mendel's laws of inheritance (dominance, segregation, independent assortment)
38. menstrual cycle of human female
39. methods of regulation of enzymatic activity (competitive and non-competitive inhibition, phosphorylation/dephosphorylation, activation of proenzymes)
40. mitosis and meiosis – comparison
41. mutations (point, insertion, deletion)
42. osmosis – mechanism of water transport
43. parasite flatworms and roundworms – examples of their life cycle
44. phases of cell cycle
45. plasmolysis in plant cell
46. population – basic characteristics
47. prokaryotic and eukaryotic genome – comparison
48. pulmonary circulation
49. reproduction and development of various vertebrate groups
50. respiratory chain and ATP synthesis
51. respiratory system – gas exchange and transport
52. role of bacteria in human life and in natural world

- 53.** role of brain in control and integration of body functions
- 54.** route of enzymatic catalysis
- 55.** sex inheritance
- 56.** sex-conjugated genes
- 57.** skeleto-muscular system – major structures and functions
- 58.** smell and taste
- 59.** structure and functioning of the heart
- 60.** structure and functions of the blood
- 61.** structure and role of cell organelles (nucleus, mitochondria, chloroplasts, vacuole, endoplasmic reticulum, cytoskeleton)
- 62.** structure of brain, spinal cord and nerves
- 63.** structure of male and female sex organs
- 64.** structure of protein enzyme
- 65.** systemic and pulmonary circulation – comparison
- 66.** tissues, organs, systems of human body
- 67.** transcription and translation
- 68.** transmission of genetic material in conjugation process
- 69.** trophic levels (producers, consumers – herbivores and carnivores, destruents)
- 70.** types of RNA present in cell
- 71.** types of sensation in humans
- 72.** types, structure and functions of muscles
- 73.** urinary tract – structure and mechanism of action

Curriculum for entrance exam

CHEMISTRY

1-52

- acidic, basic, and neutral examples of oxides
- acids, bases and salts – acid-base theories (according to Arrhenius, according to Brønsted and Lowry);
- alcohols – the general formula, (primary, secondary and tertiary alcohols)
- alcohols and phenols, structure and chemical reactions
- amino acids – structure and function
- aromatic and aliphatic hydrocarbons, the general formulas and reactions
- atomic orbital model (electron cloud)
- characteristics of metals
- definitions of the enthalpy change; exothermic and endothermic reactions, activation energy
- basic terms for organic compounds: homologous series, functional group, isomerism
- carbohydrates – classification and structure
- carboxylic acids and esters – structure and reactions
- characteristics of acids – reactions with metals, metal oxides, hydroxides, and weaker acid salts
- chemical characteristics of aliphatic hydrocarbons – burning, substitution, addition, elimination, polymerization
- chemical characteristics of aromatic hydrocarbons – burning, reactions with halogens, nitration
- chemical characteristics of nonmetals – reactions with oxygen, hydrogen, and metals
- chemical reactions – products and substrates stoichiometry
- chemical reactions of aldehydes and ketones (Tollens reaction, Trommer reaction, reaction with alcohols)
- polysaccharides - comparison of starch and cellulose
- configurations of valence electrons
- definitions and examples of oxidation and reduction: oxidation number, oxidizer, reducer, oxidation, reduction
- differences between aldehydes and ketones
- electron balance – redox stoichiometry
- example reaction of metals with oxygen and acids
- factors influencing reaction rate (temperature, substrate concentration and granularity, catalyst)
- families of organic compounds, functional groups
- fatty acids and lipids – saturated and unsaturated
- monosaccharides – division and examples
- hydrolysis of polysaccharides
- comparison of inorganic acids and carboxylic acids
- mole and Avogadro number
- monosaccharides, disaccharides, and polysaccharides – examples
- nomenclature of hydrocarbons
- obtaining of carboxylic acids from alcohols and aldehydes
- obtaining of salts
- pH and its indicators
- pH of weak acid and bases; dissociation constant
- primary and secondary alcohols – examples
- protein denaturation by temperature, acids, salts
- proteins – peptide bonds
- reactions of neutralization and hydrolysis
- saturated and unsaturated fatty acids
- saturated and unsaturated hydrocarbons – structure and reactions,
- secondary structure (α -, β -) of proteins and hydrogen bonds importance
- solution concentration – molar and percent
- solution, colloid, and suspension – definitions
- structure of the atom
- structure and reactions of ester and ester bond
- structure of hydrocarbons – aliphatic and aromatic, saturated and unsaturated
- structure of proteins
- types of bonds (ionic, covalent – polar and nonpolar, coordinate)
- structure of nucleotides

Curriculum for entrance exam

PHYSICS

1-50

1. behavior of electric charges
2. buoyant force and Archimedes principle
3. capillary action
4. cohesion and adhesion forces
5. concentration and dispersion of light rays in convex and concave lenses
6. conductors, insulators, resistors, and capacitors
7. connection between kinetic energy and temperature
8. convection of liquids and gases
9. crystal structure
10. differences in the structure of solids, liquids, and gases
11. different forms of mechanical energy
12. diffusion
13. electric charge and interactions of charges
14. electrolytic dissociation
15. electromagnet – solenoid and core
16. factors determining loudness and pitch
17. first law of thermodynamics (adiabatic process)
18. flow of current
19. focus, focal length
20. force, work, and power
21. gravity
22. heat transfer – convection, evaporation,
23. Heisenberg uncertainty principle
24. ideal gas: nature and laws
25. images: real, virtual, upright, inverted, magnified, reduced
26. inertia and resistance
27. isobaric, isochoric, and isothermal processes
28. kinetic and potential energy
29. law of conservation of energy
30. mass, weight, density
31. melting, solidification, condensation, sublimation, resublimation
32. Newton's laws of motion
33. Pascal's law
34. permanent magnets and their poles
35. phase transition on the example of water
36. pressure and hydrostatic pressure
37. quantum number and Pauli exclusion principle
38. reflection, dispersion, and refraction of light
39. resistance and Ohm's law
40. the second law of thermodynamics (entropy)
41. simple machines: lever, pulley, wheel, and axle
42. sound as a wave, its velocity of traveling in different media
43. specific heat, melting point, and heat of vaporization
44. spreading of electromagnetic waves – comparison with mechanical waves
45. surface tension
46. types of electromagnetic waves (radio, micro, infrared, visible light, ultraviolet, X-rays), examples of applications
47. velocity and speed
48. velocity of light
49. voltage and amperage
50. waves – amplitude, period and frequency, velocity and length