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Частное образовательное учреждение высшего образования
«Санкт-Петербургский медико-социальный институт»

Утверждаю

Председатель Приемной
комиссии, ректор, к.м.н., доцент

_____ С.Б. Мальцев

«17» января 2025 года

**ПРОГРАММА ВСТУПИТЕЛЬНОГО ИСПЫТАНИЯ ПО ПРЕДМЕТУ
«ХИМИЯ»**

Санкт-Петербург

2025

Chemistry

Evaluation criteria

In total, the test contains 60 tasks of two difficulty levels.

Questions from Part A:

Each correct answer is worth 1 points (40 tasks, 40 points)

Questions from Part B:

Each correct answer is worth 3 points (20 tasks, 60 points)

The total points can reach 100 if all answers are correct. The minimum score determining successful completion of the entrance test is 40

PROGRAM OF ENTRANCE EXAMINATIONS IN "Chemistry".

Subject and tasks of chemistry. The place of chemistry among the natural sciences. Atomic-molecular science. Molecules. Atoms. Constancy of the composition of the substance. Relative atomic and relative molecular mass. The law of conservation of mass, its significance in chemistry. A mole is a unit of quantity of a substance. Molar mass. Avogadro's number.

The structure of the nuclei of atoms of chemical elements and the electronic shells of atoms using the example of elements of the 1st, 2nd, 3rd and 4th periods of the periodic system. Isotopes.

Periodic law of chemical elements D.I. Mendeleev. Distribution of electrons in atoms of elements of the first four periods. Small and large periods, groups and subgroups. Characteristics of individual chemical elements of the main subgroups based on position in the periodic table and atomic structure. The importance of the periodic law for understanding the scientific picture of the world, the development of science and technology.

Chemical element, simple substance, complex substance. Signs of chemical elements and chemical formulas. Calculation of the mass fraction of a chemical element in a substance using its formula.

Types of chemical bonds: covalent (polar and non-polar), ionic, hydrogen, metallic. Examples of connections with connections of different types. Valency and oxidation state.

Types of chemical reactions: reactions of combination, decomposition, substitution, exchange. Redox reaction. Thermal effect of chemical reactions.

The rate of chemical reactions. Dependence of speed on the nature of the reacting substances, concentration, temperature. Catalysis. Reversibility of chemical reactions. Chemical equilibrium and conditions for its displacement.

Solutions. Solubility of substances. The dependence of the solubility of substances on their nature, temperature, pressure. Thermal effect during dissolution. Concentration of solutions. The importance of solutions in industry, agriculture, and everyday life.

Electrolytic dissociation. Degree of dissociation. Strong and weak electrolytes. Ion exchange reactions. Electrical dissociation of acids, alkalis and salts. Oxides are acidic, basic, amphoteric. Methods for obtaining and properties of oxides. Bases, methods of their preparation and properties. Alkalis, their preparation, properties and application.

Acids, properties, methods of production. Neutralization reaction. Salt. Composition and properties. Hydrolysis of salts.

Hydrogen. Chemical, physical properties. Interaction with oxygen, metal oxides, and organic substances. The use of hydrogen as an environmentally friendly fuel and raw material for the chemical industry.

Oxygen. Chemical, physical properties. Allotropy. Use of oxygen. Oxygen cycle in nature.

Water. Physical and chemical properties. Crystal hydrates. The importance of water in industry, agriculture, everyday life, nature. Protection of water bodies from pollution.

Chlorine. Physical, chemical properties. Reactions with inorganic and organic substances. Production of chlorine in industry. Chlorine compounds. Use of chlorine and its compounds.

Halogens. General characteristics of halogens. Halogen compounds in nature and their uses.

Subgroup of carbon. General characteristics of elements of group IV of the main subgroup. Physical and chemical properties. Carbon, its allotropic forms. Carbon compounds: oxides (II, IV), carbonic acid and its salts. Silicon. Silicon compounds in nature, their use in technology.

Oxygen subgroup. General characteristics of the elements of the main subgroup of group VI. Sulfur, its physical and chemical properties. Sulfur compounds: hydrogen sulfide, sulfur oxides. Sulfuric acid, its properties, chemical bases of production.

General characteristics of the elements of the main subgroup of group V. Nitrogen. Physical and chemical properties. Nitrogen compounds: ammonia, ammonium salts, nitrogen oxides, nitric acid, nitric acid salts (physical and chemical properties). Ammonia production. Application of

ammonia, nitric acid and its salts. Phosphorus, its allotropic forms, physical and chemical properties. Phosphorus (V) oxides, phosphoric acid and its salts. Phosphorus fertilizers.

Metals. Position in the periodic table. Features of the structure of their atoms. Metal connection. Characteristic physical and chemical properties. Corrosion of metals.

Alkali metals. General characteristics based on position in the periodic table D.I. Mendeleev. Sodium and potassium compounds in nature, their use. Potash fertilizers.

General characteristics of the elements of the main subgroups of groups II and III of the periodic system D.I. Mendeleev. Calcium, its compounds in nature. Water hardness and ways to eliminate it.

Aluminum. Characteristics of aluminum and its compounds. Amphotericity of aluminum oxide. Application of aluminum and its alloys. Iron. Characteristics of iron, oxides, hydroxides, salts of iron (II) and (III). Natural iron compounds. Iron alloys - cast iron and steel. Application of iron alloys and compounds.

Metallurgy. Metals in modern technology. The main methods of industrial production of metals. Blast furnace production of cast iron. Steel production methods. The problem of low-waste production in metallurgy and environmental protection. Development of domestic metallurgy and its importance for the development of other industries.

Basic principles of the theory of chemical structure of A.M. Butlerov. Dependence of the properties of substances on the chemical structure. Isomerism. The electronic nature of chemical bonds in molecules of organic compounds, methods of breaking bonds, the concept of free radicals.

Homologous series of saturated hydrocarbons (alkanes), their electronic and spatial structure (sp^3 hybridization). Methane. Nomenclature of alkanes, their physical and chemical properties. Cycloparaffins. Saturated hydrocarbons in nature.

Ethylene hydrocarbons (alkenes). Homologous series of alkenes. Double bond, σ - and π -bonds, sp^2 - hybridization. Physical properties. Isomerism of the carbon skeleton and the position of the double bond. Nomenclature. Chemical properties. Production of hydrocarbons by dehydrogenation reaction. Application of ethylene hydrocarbons. Natural rubber, its structure and properties.

Acetylene. Triple bond, sp - hybridization. Homologous series of acetylene. Physical and chemical properties, use of acetylene. Obtaining it using the carbide method from methane.

Benzene, its electronic structure, chemical properties. Industrial production and use of benzene. The concept of pesticides, the conditions for their use in agriculture based on environmental protection requirements.

The relationship between saturated, unsaturated and aromatic hydrocarbons.

Natural sources of hydrocarbons: oil, natural and associated petroleum gases, coal. Fractional distillation of oil. Cracking. Flavoring of petroleum products. Environmental protection during oil refining.

Alcohols, their structure, chemical properties. Isomerism. Nomenclature of alcohols. Chemical properties of alcohols. The use of methyl and ethyl alcohols. The toxicity of alcohols, their destructive effect on the human body.

Genetic relationship between hydrocarbons and alcohols.

Phenol, structure, physical properties. Chemical properties of phenol. Application of phenol. Environmental protection from industrial waste containing phenol.

Aldehydes, their structure, chemical properties. Preparation and use of formic acetaldehyde.

Carboxylic acids. Homologous series of saturated monobasic acids, their structure. Carboxyl group, mutual influence of the carboxyl group and hydrocarbon radical. Physical and chemical properties of carboxylic acids. Acetic, palmitic, stearic, oleic acids. Preparation and use of carboxylic acids.

Esters. Structure, preparation of esterification reactions. Chemical properties. Fats in nature, their structure and properties. Synthetic detergents, their meaning. Protecting the environment from pollution by synthetic detergents.

Glucose, its structure, chemical properties, role in nature. Sucrose and its hydrolysis. Starch and cellulose, their structure, chemical properties, role in nature. Application of cellulose and its derivatives. The concept of artificial fibers. Amines as organic bases. Structure, amino group. Interaction of amines with water and acids. Aniline. Preparation of aniline from nitrobenzene, practical significance of aniline.

Amino acids. Structure, chemical features, isomerism of amino acids. Amino acids, their meaning in nature and application. Synthesis of peptides, their structure. The concept of nitrogen-containing heterocyclic compounds using the example of pyridine and pyrrole.

Proteins. Structure, structure and properties of proteins. Advances in the study and synthesis of proteins. Importance of the microbiological industry. Nucleic acids, structure of nucleotides. The principle of complementarity in the construction of the DNA double helix. The role of nucleic acids in cell life.

General concepts of the chemistry of high molecular weight compounds: monomer, polymer, structural unit, degree of polymerization, average molecular weight. Polymerization, polycondensation. Linear branched structure of polymers. Dependence of the properties of polymers on their structure.