**The program of the entrance test in chemistry**

conducted independently by the federal state budgetary educational institution of higher education "Dagestan State Medical University" of the Ministry of Health of the Russian Federation in 2024/25 academic year

**Part I.**

**Theoretical foundations of chemistry**

**1. Basic concepts and laws of chemistry.**

Atomic-molecular teaching. Substance (simple, complex, mixtures of substances), chemical element, allotropy, molecule, atom, ion, chemical formula, valence, structural formulas. Physical and chemical phenomena. Relative atomic and molecular weight. A mole is a unit of the amount of a substance. The molar mass of the substance. Calculation of the mass fraction of an element in a substance by the formula. The relative density of gases.

**2. The structure of the atom. Periodic law of D. I. Mendeleev.**

The structure of the atom. Isotopes. The structure of the electron shells of the atoms of the elements of the first four periods: s -, p-and d-elements. The electronic configuration of atoms and ions. The ground and excited state of the atoms. Properties of atoms: size, electron affinity, ionization potential, electronegativity. The degree of oxidation and valence of chemical elements. Characteristics of small and large periods, groups and subgroups. Periodic law. Characteristics of individual elements and their most important compounds based on the position of the elements in the periodic table and the structure of the atoms.

**3. Chemical bond.**

Types of chemical bonds: covalent, ionic, hydrogen, metal. The mechanism of formation of covalent nonpolar and polar bonds (exchange and donor-acceptor). Properties of a covalent bond: energy, length, multiplicity, polarity, directivity. Types of crystal lattices. Substances of molecular and non-molecular structure. The dependence of the properties of substances on their composition and structure.

**4. Chemical reactions.**

Classification of reactions: compounds, decompositions, substitution, exchange reactions, reversible and irreversible. Exo-and endothermic reactions. Thermal effects of chemical reactions. Redox reactions, their classification (intermolecular, intramolecular, disproportionation reactions). The most important oxidizing agents, reducing agents and substances with redox duality. Compilation of equations of redox reactions by the electronic balance method.

**5. The main regularities of the course of chemical reactions.**

The rate of chemical reactions, the rate constant and its determining factors. The dependence of the rate of chemical reactions on the concentration (kinetic equations), pressure, temperature (Van't-Hoff rule), the degree of dispersion and the nature of the reacting substances. The catalysts are positive and negative (inhibitors). Chemical equilibrium. The displacement of the chemical equilibrium under the influence of various factors - the Le Chatelier principle.

**6. Solutions.**

Classification of solutions. Solubility of substances, its dependence on temperature, pressure and nature. The importance of solutions in the chemical industry, medicine and everyday life. Methods of expressing the concentration of solutions: mass fraction, volume fraction of the dissolved substance, molar concentration.

**7. Electrolytic dissociation.**

Strong and weak electrolytes. Electrolytic dissociation of acids, bases, and salts. The mechanism of dissociation of substances with an ionic and covalent polar type of chemical bond. The degree of dissociation. Ion exchange reactions, their flow conditions.

Hydrolysis of salts, cases of hydrolysis. The medium of aqueous solutions: acidic, neutral, alkaline. The concept of indicators.

Electrolysis of solutions and melts of salts with inert electrodes.

**Part II.**

**Inorganic Chemistry**

1. **The main classes of inorganic compounds.**

Classification of inorganic substances. Nomenclature of inorganic substances (trivial and international).

Acidic, basic, amphoteric oxides, their physical and chemical properties and methods of preparation.

Bases, their classification, methods of obtaining and characteristic properties. Features of the chemical properties of amphoteric bases.

Acids, their classification, characteristic properties and methods of preparation.

Salts, their classification, characteristic properties and methods of preparation. Crystal hydrates, their structure and application.

The interaction of different classes of inorganic substances.

**2. Non-metals.**

Characteristic chemical properties of simple substances-non-metals: hydrogen, halogens, oxygen, sulfur, nitrogen, phosphorus, carbon, silicon. Hydrogen, methods of production, interaction with simple, complex and organic substances. Hydrogen peroxide, its properties.

Natural halogen compounds. Physical and chemical properties, oxygen compounds of halogens, methods of production and application in the chemical industry, medicine, and everyday life. Hydrogen chloride, hydrochloric acid, its properties, preparation, application.

Oxygen allotropy. Physical and chemical properties, methods of preparation and application.

Sulfur, interaction with simple and complex substances. Characteristics of the properties of sulfur oxides (IV) and (VI). Sulfurous and sulfuric acids and their salts. Hydrogen sulfide and its properties.

Properties of nitrogen and its compounds: ammonia, nitrogen oxides, nitrous and nitric acids. Production and application of nitrogen and its compounds. Decomposition of nitric acid salts during heating.

Phosphorus. Allotropy of phosphorus. Physical and chemical properties of phosphorus, its oxides, phosphoric acids and orthophosphoric acid salts.

Carbon, its allotropy and natural compounds. Physical and chemical properties of carbon, its oxides and carbonic acid. Properties of carbonic acid salts.

Silicon, natural silicon compounds. Properties of silicon and its compounds.

**3. Metals.**

The position of metals in the periodic table, the features of the structure of their atoms. The most important physical and chemical properties of metals of groups I, II and III of the periodic system of D. I. Mendeleev. Electrochemical series of metal tension. The most important properties of zinc, aluminum, iron, copper, chromium, manganese and their compounds. General methods of obtaining metals.

Alkali metals: sodium and potassium, their natural compounds, properties and methods of obtaining these metals, their oxides, hydroxides and salts.

Alkaline earth metals: magnesium and calcium, their natural compounds. The most important properties of metals, their oxides, hydroxides and salts.

**Part III.**

**Organic Chemistry**

**1. The theory of the chemical structure of A.M. Butlerov.**

The dependence of the properties of substances on their chemical structure. The isomerism is structural and spatial. Nomenclature (international and trivial). Homological series. Types of hybridization of electronic orbitals of the carbon atom. Types of bonds in organic matter molecules. A radical.

**2. The main classes of hydrocarbons.**

Alkanes, cycloalkanes. Homological series of alkanes, isomerism, nomenclature. Physical and chemical properties. Methods of obtaining. Being in nature.

Alkenes, alkadienes, alkynes. Isomerism. Chemical and physical properties. Polymerization. Methods of obtaining. Qualitative reactions.

Benzene, its homologues and derivatives. Chemical properties. Methods of obtaining. Orienting action of substituents in the benzene ring (substituents of the I and II kind). The relationship of marginal, unsaturated and aromatic hydrocarbons.

**3. Oxygen-containing organic compounds.**

Classification, structure. Acidic properties of alcohols and phenols. Polyatomic alcohols. Chemical properties. Methods of obtaining. Qualitative reactions of alcohols and phenols. Medical and biological significance.

Aldehydes and ketones. The structure of the carbonyl group. Chemical properties. Oxidation and reduction reactions, "silver" and "copper" mirrors. Methods of obtaining.

Classification and properties of carboxylic acids (aliphatic, aromatic, saturated, unsaturated). Trivial names. Chemical properties. Esterification reaction. Features of the structure and properties of formic acid. Derivatives of carboxylic acids: salts, anhydrides, amides, esters. Fats. Classification, structure and properties. Higher fatty carboxylic acids. Synthesis and hydrolysis of fats (acid and alkaline). The importance of synthetic detergents, the protection of the environment from them.

**4. Nitrogen-containing organic compounds.**

Amines as organic bases, classification of amines (primary, secondary, tertiary, aromatic). Aniline. Chemical properties.

Amino acids, chemical features. α-amino acids: glycine, alanine, serine, cysteine, phenylalanine, aspartic acid. Synthesis, structure and hydrolysis of peptides. The most important ways to obtain amines and amino acids.

**5. Carbohydrates.**

Monosaccharides: glucose, fructose, ribose, deoxyribose. Structure, properties and medico-biological role.

Reducing and non-reducing disaccharides: sucrose, maltose, lactose, cellobiose. Structure, properties.

Polysaccharides: starch and cellulose. Structure, properties. The medical and biological significance of carbohydrates.

**6. High-molecular compounds**.

Basic concepts of the chemistry of high-molecular compounds: monomer, polymer, structural link, degree of polymerization. Polymerization and polycondensation reactions. The structure of polyethylene, polypropylene, polystyrene, polyvinyl chloride, polytetrafluoroethylene, rubbers, phenol-formaldehyde resins, artificial and synthetic fibers. The dependence of the properties of polymers on their structure.

**Typical calculation tasks:**

- calculation of the mass fraction, volume fraction, molar concentration of the substance;

- calculations according to the reaction equations: the thermal effect of the reaction; the mass (volume, amount of substance) of the products or starting substances, if one of the substances is given in excess (has impurities), given in the form of a solution with a certain mass fraction of the dissolved substance; the mass or volume fraction of the reaction product from the theoretically possible outcome ; the mass fraction (mass) the chemical compound in the mixture; the derivation of the molecular formula of the substance.