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of the Academic Council
of the federal state budgetary
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of higher education
"Dagestan State Medical University"
of the Ministry of healthcare
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The program of entrance examination in Chemistry

which is held by the federal state budgetary educational institution of higher education "Dagestan State Medical University" of the Ministry of healthcare of the Russian Federation individually in 2020/21 academic year.

Part I.
Theoretical foundations of Chemistry

1. Basic concepts and laws of Chemistry.

Atomic and molecular teaching. A matter, a substance (simple, complex, mixtures of substances), a chemical element, an allotropy, a molecule, an atom, an ion, a chemical formula, a valency, a structural formulas. Physical and chemical phenomenas.

Relative atomic and molecular weight. Mol is a unit of quantity of a substance. The molar mass of a substance. The calculation of the mass fraction of an element in a substance by using the formula. The relative density of gases.

The law of conservation of mass and energy. The law of constancy of the composition, the equivalent of the substance and methods of determining the equivalent mass of the substance. The law of equivalents. A. Avogadro's law and its consequences.

2. Atomic structure.

The structure of atomic nuclei. The isotopes. The dual nature of the electron. The structure of electronic shells of atoms of chemical elements of periods 1, 2, 3 and 4 of D. I. Mendeleev’s periodic system. The energetical characteristic of electrons (main and side quantum numbers). Electronic configurations of atoms.

The characteristics of atoms: a size, an electron affinity, an ionization potential, an electronegativity.

3. The periodic law of D. I. Mendeleev.

The distribution of electrons in the atoms of elements of the first four periods. The characteristics of small and large periods, groups and subgroups. The periodic law. The structure of the periodic system of D. I. Mendeleev. The Characteristic of individual elements and their most important compounds which are based on the position of elements in the periodic table and the structure of atoms.

4. The chemical bond.

The types of chemical bonds: a covalent, an ionic, a hydrogen, a metallic. The mechanism of covalent non-polar and polar bond formation (exchange and donor-acceptor). The covalent bond's characteristics: an energy, a length, a multiplicity, a saturation, a polarity, a directivity. The examples of connections with different types of bonds. Ways of breaking a chemical bond. Types of crystal lattices. Oxidation degree.

5. Chemical reactions.

The classification of reactions: compounds, decompositions, substitutions, exchanges, reversible and irreversible. Exo- and endothermic reactions. Thermal effects of chemical reactions. Oxidation-reduction reactions, their classification (intermolecular, intramolecular, the reaction of disproportionation). The most important oxidizing agents, reducing agents, and substances with redox duality. Drawing up the equations of redox reactions by using the electronic balance method.

6. The main regularities of chemical reactions.

The rate of chemical reactions, the rate's constant and its determining factors. The dependence of chemical reactions' rate on concentration (kinetic equations), pressure, temperature (Van't-Goff rule), the degree of dispersion and the nature of the reacting substances. Chemical equilibrium and its displacement conditions – Le Chatelier principle.The equilibrium's constant. Catalysis. Catalysts positive and negative (inhibitors), characteristic of biological catalysts. Types and examples of catalysis.

7. Solutions.

The classification of solutions. The mechanism of dissolution of substances depending on the type of chemical bond of the soluble substance. The solubility of substances, its dependence on temperature, pressure and nature. Thermal effect during dissolution. The value of solutions in the chemical industry, medicine and everyday life. Methods for expressing the concentration of solutions: mass fraction, volume fraction of the solute, molar concentration.

8. Electrolytic dissociation.

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

The hydrolysis of salts, cases of hydrolysis. The concept of indicators.

The electrolysis of solutions and molten salts with inert electrodes.

Part II.
Inorganic Chemistry

1. The main classes of inorganic compounds.

Acidic, basic, amphoteric oxides, their physical and chemical characteristics and methods of obtaining.

Bases, their classification, methods of obtaining and properties.

The features of chemical characteristics of amphoteric bases.

Acids, their classification, characteristics and methods of obtaining. Neutralization's reaction.

Salts, their classification, characteristics and methods of obtaining. Crystallohydrates, their structure and application.

2. Hydrogen and its compounds.

Hydrogen's isotopes. Methods of obtaining, interaction of hydrogen with simple, complex and organic substances. The use of hydrogen as an ecologically pure, raw material for the chemical industry. Water, physical and chemical characteristics. Hydrogen's peroxide, its characteristics. The role of water in nature, medicine, chemical industry, and everyday life.

3. Halogens and their compounds.

Halogens' natural compounds. Halogens' physical and chemical characteristics, oxygen compounds, methods of obtaining and practical application in the chemical industry, medicine, and everyday life. Hydrogen chloride, hydrochloric acid, its characteristics, preparation, practical application.

4. Characteristics of the oxygen's subgroup.

The allotropy of oxygen, features of the structure and characteristics of ozone, the oxygen's cycle in nature. Physical and chemical characteristics, methods of obtaining and practical application. The role of oxygen in nature, human life and medicine.

The sulfur. The allotropy of sulfur. Characteristics of the features of sulfur's oxides (IV) and (VI). Sulphurous and sulphuric acids and their salts. The hydrogen sulfide and its characteristics.

5. Characteristic of the nitrogen's subgroup.

The nitrogen and its compounds' characteristics: ammonia, nitrogen's oxides, nitrous and nitric acids. The obtaining and practical application of nitrogen and its compounds. The decomposition of nitric acid's salts during heating.

The phosphorus. The allotropy of phosphorus. Physical and chemical characteristics of phosphorus, of its oxides, phosphoric acids and orthophosphoric acid's salts. Medical and biological significance of phosphorus compounds.

6. The characteristic of carbon's subgroup. The carbon, its allotropy and natural compounds. Physical and chemical characteristics of carbon, of its oxides and carbonic acid. The characteristics of carbonic acid's salts.

Silicon, the natural compounds of silicon. Silicon and its compounds' characteristics: oxides, hydride, silicic acids, silicates.

7. General characteristics of metals.

The position of metals in the periodic table, their atoms structure's special features. The most important physical and chemical characteristics of metals of groups I, II and III of D. I. Mendeleev's periodic system. Electrochemical series of metals' stress. The most important characteristics of zinc, copper, chromium, manganese and of their compounds. The corrosion of metals.

Alkaline metals: sodium and potassium, their natural compounds, characteristics and methods of obtaining these metals, their oxides, hydroxides and salts. Medical and biological significance of these metals' compounds.

Alkaline earth metals: magnesium and calcium, their natural compounds. . The most important characteristics of metals, of their oxides, hydroxides and salts. Medical and biological significance of these metals' compounds . The hardness of water and ways of its elimination.

Aluminum. The characteristics of aluminum and its compounds. The amphotericity of aluminum oxide and hydroxide.

Iron, natural compounds, characteristics of iron's features, its oxides, hydroxides and salts.

Part III.
Organic chemistry.

1. A. M. Butlerov's theory of chemical structure. The dependence of substances' characteristics on their chemical structure. Structural and spatial isomerism. Nomenclature. The homologous series. Types of hybridization of carbon atom's electronic orbitals.

2. Saturated hydrocarbons.

Alkanes, cycloalkanes. Homological series of alkanes, an isomerism, a nomenclature. Physical and chemical characteristics. The methods of obtaining. Finding in nature.

3. Unsaturated hydrocarbon.

Alkenes, alkadienes, alkynes. Isomerism. Chemical and physical characteristics. Polymerization. The methods of obtaining. Qualitative reactions.

4. Aromatic hydrocarbons (arenas).

Benzene, its homologs and derivatives. Chemical characteristics. The methods of obtaining. Orienting action of substituents in the benzene ring (substituents of the kind I and II). The relation of the ultimate, unsaturated and aromatic hydrocarbons.

5. Alcohols, simple esters, phenols.

The classification, structure. Acidic characteristics of alcohols and phenols. Polyhydric alcohols. Chemical characteristics. The methods of obtaining. Qualitative reactions of alcohols and phenols. Medical and biological significance.

6. Carbonyl compounds.

Aldehydes and ketones. The structure of the carbonyl group. Chemical characteristics. Oxidation and reduction reactions of "silver" and "copper" mirrors. The methods of obtaining.

7. Carboxylic acids and their functional derivatives.

The classification and characteristics of carboxylic acids (aliphatic, aromatic, saturated, unsaturated). Trivial names. Chemical characteristics. The reaction of esterification. Features of the structure and properties of formic acid. Derivatives of carboxylic acids: salts, anhydrides, amides, esters.

8. Fats.

Classification, structure and characteristics. Higher fatty carboxylic acids. Synthesis and hydrolysis of fats (acid and alkaline). The value of synthetic detergents, the protection of the environment from them.

9. Nitrogen-containing organic compounds.

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

Amino acids, chemical features. α-amino acids: a glycine, an alanine, a serine, a cysteine, a phenylalanine, an aspartic acid.

Synthesis, structure and hydrolysis of peptides. **Structure, structure** and characteristics of proteins.

Heterocyclic nitrogen-containing compounds: a pyridine, a pyrrol, a pyrimidine, an imidazole, a purine. The structure of purine and pyrimidine bases: uracil, cytosine, thymine, adenine and guanine.

Nucleic acids, structure and characteristics. The principle of complementarity in the construction of DNA's secondary structure. The differences in the structure and characteristics of DNA and RNA.

10. Carbohydrates.

Monosaccharides: a glucose, a fructose, a ribose, a deoxyribose. The cyclic forms of monosaccharides. Structure, characteristics and biomedical role.

Reducing and non-reducing disaccharides: a sucrose, a maltose, a lactose, a cellobiose. The structure, characteristics.

Polysaccharides: a starch and cellulose. The structure, characteristics. Medical and biological value of carbohydrates.

12 High-molecular compounds.

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

Typical calculation tasks:

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

- calculations on the equations of reactions: heat of reaction; mass (volume, amount of substance) products or starting materials, if one of the substances is given in excess (has impurities) in the form of a solution with a certain mass fraction of the dissolved substance; mass or volume fraction of the reaction's product from the theoretically possible yield; mass fraction (mass) of the chemical compound in the mixture; a derivation of the molecular formula of the substance.