

МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
РОССИЙСКОЙ ФЕДЕРАЦИИ
ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ
ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ
«СЕВЕРО-КАВКАЗСКАЯ ГОСУДАРСТВЕННАЯ АКАДЕМИЯ»

УТВЕРЖДАЮ:

Проректор по учебной работе,
к.п.н. доцент



/ Нагорная Г.Ю./
_____ 2022 г.

ПРОГРАММА

вступительного испытания по предмету «Химия (с включенным
английским)» для абитуриентов

**THE MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN
FEDERATION**
Federal State Budgetary Educational Institution of Higher Education
"North Caucasian State Academy"

APPROVED

Vice-rector for academic work

PhD in Pedagogy,

assistant professor

Nagornaya G.Y.



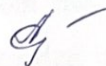
2022.

Program
of Chemistry Entrance Test
for Applicants entering based on
higher and secondary education

Cherkessk – 2022

Программа вступительного экзамена одобрена
На заседании кафедры «Химия»
Медицинского института ФГБОУ ВО «СКГА»
От 20 сентября 2022 г. Протокол № 2

Заведующий кафедрой «Химии»
Медицинского института ФГБОУ ВО «СКГА»



Асланукова М.М..

Программа вступительного экзамена одобрена
Советом Медицинского института ФГБОУ ВО «СКГА»
От 22 сентября 2022 Протокол №2

Директор Медицинского института
ФГБОУ ВО «СКГА», к.м.н., доцент



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Акбаева Ф.А.

NORTH CAUCASIAN STATE ACADEMY
CHEMISTRY ENTRANCE TEST PROGRAM FOR APPLICANTS

Applicants of North Caucasian State Academy, must show knowledge of the basic theoretical provisions of chemistry, know the methods of compiling redox reactions, the main classes of inorganic and organic compounds, mathematical relationships that describe chemical processes from the quantitative side, basic concepts and laws of chemistry, and also characterize chemical compounds in terms of their acid-base and redox properties. The characteristics of each class of organic compounds contain the features of the electronic and spatial structure of compounds of this class, the regularities of changes in the physical and chemical properties in the homologous series, the nomenclature, types of isomerism, the main types of chemical reactions and their mechanisms.

On the exam, you can use the tables: "Periodic system of elements of D.I. Mendeleev", "Solubility of bases, acids and salts in water", "Electrochemical series of voltages of metals".

Content of the entrance test

Part I. Fundamentals of Theoretical Chemistry

1. The subject of chemistry. Mass and energy. Basic concepts of chemistry. Substance. A molecule. Atomic structure. Electron. Ion. A chemical element. Chemical formula. Relative atomic and molecular masses. Mole. Molar mass.
2. Chemical transformations. The law of Conservation of Mass and Energy. The law of Constant of Composition. Stoichiometry.
3. The structure of the atom. The atomic nucleus. Isotopes. Stable and unstable cores.
4. The dual nature of the electron. The structure of the electron shells of atoms. Quantum numbers. Atomic orbitals. Electronic configurations of atoms in the ground and excited states, the Pauli principle, Hund's rule.

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5. Periodic law of D. I. Mendeleev and its justification from the point of view of the electronic structure of atoms. Periodic table of elements.
6. Chemical bond. Types of chemical bonds: covalent, ionic, metallic, hydrogen. Mechanisms of covalent bond formation: exchange and donor-acceptor. The binding energy. Ionization potential, electron affinity, electronegativity. The polarity, the Inductive Effect. Types of chemical bonding: double, triple. A model for hybridization of orbitals. Valence and degree of oxidation. Structural formulas. Isomerism. Types of isomerism, structural and spatial isomerism.
7. Aggregate states of matter and transitions between them depending on temperature and pressure. Gases. Gas laws. The Klayperomendeleev equation. Avogadro's law, molar volume. Liquids. Association of molecules in liquids. Solid bodies. The main types of crystallattices.
8. Classification and nomenclature of chemicals. Individual substances, mixtures, solutions. Simple substances, allotropy. Metals and non-metals. Complex substances. The main classes of inorganic substances: oxides, bases, acids, and salts. Complex compounds. The main classes of organic substances. Polymers and macromolecules.
9. Chemical reactions and their classification. Types of chemicalbond breaking. Homo-and heterolytic reactions. Redoxreactions.
10. Thermal effects of chemical reactions. Thermochemical equations. The heat of formation of chemical compounds. Hess ' law and its consequences.
11. The rate of chemical reaction. Introduction to the mechanisms of chemical reactions. The elementary stage of the reaction. Homogeneous and heterogeneous reactions. The dependence of the rate of homogeneous reactions on theconcentration (the law of active masses). Activation energy.
12. The phenomenon of catalysis. Catalysts. Examples of catalytic processes. Introduction to the mechanisms of homogeneous and heterogeneous catalysis.
13. Reversible reactions. Chemical equilibrium. The equilibrium constant, the degree of transformation. Displacement of the chemical equilibrium under the influence oftemperature and pressure (concentration). The Le Chatelier principle.

14. Dispersed systems. Colloidal systems. Solutions. The mechanism of solution formation. Solubility of substances and its dependence on the temperature and nature of the solvent. Ways to express concentration solutions: mass fraction, molar fraction, molar concentration, volume fraction. Alloys.

15. Electrolytes. Solutions of electrolytes. Electrolytic dissociation of acids, bases, and salts. Amphotericity. Dissociation constant. The degree of dissociation. The ionic product of water. The hydrogen index-pH. Hydrolysis of salts. The equilibrium between the ions in the solution and the solid phase. The product of solubility. Formation of the simplest complexes in solutions. Ionic equations of reactions.

16. Redox reactions in solutions. Definition stoichiometric coefficients in the equations of redox reactions. Electrolysis of solutions and melts.

Part II. Elements and their connections

Inorganic chemistry

On the basis of the periodic law applicants must give a comparative description of the elements in groups and periods. The characteristics of the elements include: electronic configurations of the atom; possible valences and oxidation states of an element in compounds; forms of simple substances and basic types of compounds, their physical and chemical properties, laboratory and industrial methods of obtaining; the abundance of the element and its compounds in nature, practical meaning and field of application of compounds. When describing chemical properties, reactions involving inorganic and organic compounds (acid-base and redox transformations), should be described as well as qualitative reactions.

1. Hydrogen. Isotopes of hydrogen. Compounds of hydrogen with metals and non-metals. Water. Hydrogen peroxide.
2. Halogens. Hydrogen halides. Halides. Oxygen-containing chlorine compounds.
3. Oxygen. Oxides and peroxides. Ozone.
4. Sulfur. Hydrogen sulfide, sulfides, polysulfides. Sulfur oxides (IV)

and (VI). Sulfurous and sulfuric acids and their salts.

5. Nitrogen. Ammonia, ammonium salts, metal amides, nitrides. Nitrogen oxides. Nitrogenous and nitric acids and their salts. Nitric acid esters.

6. Phosphorus. Phosphine, phosphides. Oxides of phosphorus (III) and (V). Ortho -, meta -, and diphosphoric acids. Orthophosphates.

7. Carbon. Carbon isotopes. The simplest hydrocarbons: methane, ethylene, acetylene. Calcium, aluminum, and iron carbides. Carbon oxides (II) and (IV). Carbonic acid and its salts.

8. Silicon. Silane. Silicides. Silicon (IV) oxide. Silicic acids, silicates.

9. Boron. Ortho- and tetraboric acids. Sodium tetraborate.

10. Noble gases. Examples of krypton and xenon compounds.

11. Alkali metals. Oxides, peroxides, hydroxides, and salts of alkali metals.

12. Alkaline earth metals, beryllium, magnesium: their oxides, hydroxides and salts.

13. Aluminum. Aluminum oxide, hydroxide, and salts. Comprehensive aluminum compounds. Ideas about aluminosilicates.

14. Copper, silver. Copper (I) and (II) oxides, silver (I) oxide.

Copper (II) hydroxide. Silver and copper salts. Complex compounds of silver and copper.

15. Zinc, hydrargyrum. Zinc and hydrargyrum oxides. Zinc hydroxide and its salts.

16. Chrome. Chromium (II), (III), and (VI) oxides. Hydroxides and salts of chromium (II) and (III). Chromates and dichromates (VI). Complex compounds of chromium (III).

17. Manganese. Oxides of manganese (II) and (IV). Hydroxide and salts of manganese (II). Potassium manganate and permanganate.

18. Iron, cobalt, nickel. Iron oxides (II), (II)-(III) and (III).

Hydroxides and salts of iron (II) and (III). Ferrates (III) and (VI). Complex iron compounds. Salts and complex compounds of cobalt (II) and nickel (II).

Organic chemistry

The characteristics of each class of organic compounds include: features of the electronic and spatial structure of compounds of this class, patterns of changes in physical and chemical properties in the homologous series, nomenclature, types of isomerism, main types of chemical reactions and their mechanisms.

Characterization of specific compounds includes physical and chemical properties, laboratory and industrial production methods, and applications. When describing chemical properties, it is necessary to take into account reactions involving both a radical and a functional group.

1. Structural theory as the basis of organic chemistry. Carbon skeleton. Functional group. Homological series. Isomerism: structural and spatial. The concept of optical isomerism. The mutual influence of atoms in a molecule. Classification of organic reactions by mechanism and charge of active particles.
2. Alkanes and cycloalkanes.
3. Alkenes and cycloalkenes.
4. Alkynes.
5. Aromatic hydrocarbons (arenes). Benzene and its homologues. Styrene. Reactions of the aromatic system and the hydrocarbon radical. Orienting action of substituents in the benzene ring (orientants I and II kind). The concept of condensed aromatic hydrocarbons.
6. Halogen-derived hydrocarbons. Substitution and cleavage reactions.
7. Alcohols are simple and polyatomic. Primary, secondary, and tertiary alcohols. Phenols. Simple ethers.
8. Carbonyl compounds: aldehydes and ketones. Saturated, unsaturated, and aromatic aldehydes.
9. Carboxylic acids. Saturated, unsaturated, and aromatic acids. Mono- and dicarboxylic acids. Derivatives of carboxylic acids: salts, anhydrides, haloanhydrides, esters, amides. Fats.
10. Nitro compounds: nitromethane, nitrobenzene.

11. Amines. Aliphatic and aromatic amines. Primary, secondary, and tertiary amines. Basicity of amines. Quaternary ammonium salts and bases.
12. Hydroxy acids: lactic, tartaric and salicylic acids. Amino acids: glycine, alanine, cysteine, serine, phenylalanine, tyrosine, lysine, glutamic acid. Peptides. Understanding the structure of proteins.
13. Carbohydrates. Monosaccharides: ribose, deoxyribose, glucose, fructose. Cyclic forms of monosaccharides. The concept of spatial isomers of carbohydrates. Disaccharides: maltose, sucrose. Polysaccharides: starch, cellulose.
14. Pyrrol. Pyridine. Pyrimidine and purine bases that are part of nucleic acids. An idea of the structure of nucleic acids.
15. Polymerization and polycondensation reactions. Certain types of high-molecular compounds: polyethylene, polypropylene, polystyrene, polyvinyl chloride, polytetrafluoroethylene, rubbers, copolymers, phenol-formaldehyde resins, artificial and synthetic fibers.