PRIVATE HIGHER EDUCATIONAL ESTABLISHMENT
"KYIV MEDICAL UNIVERSITY"

«APPROVED»
Vice-Rector for Clinical Work
Education and International Relations
Vice-Rector _____ V.P. Mehed
«05» січня 2021

THE PROGRAM

of the admission examination (writing test) in Chemistry
for foreign citizens and stateless persons
holders of secondary education certificate
aimed at obtaining the master's degree
in the fields of science 22 "Health care"
in the following specialties
222 «Medicine», 221 «Dentistry»,
226 "Pharmacy, Industrial Pharmacy"

Kyiv 2021

EXPLANATORY NOTE

The program of entrance examination (writing test) on the discipline "Chemistry" for foreigners and stateless persons who plan further study at the Private higher educational institution "Kyiv Medical University" aimed at obtaining the master's degree in the field of science 22 "Health care" majors 221 Dentistry, 222 Medicine and 226 Pharmacy, industrial pharmacy, designed concerning the content and scope of basic curricula and requirements for the graduates of general secondary education level.

PROGRAM CONTENT

The program materials on the discipline "Chemistry" include the following sections:

General Chemistry

- Basic chemical concepts. Substance.
- Chemical reactions.
- Atoms and simple ions organization.
- Periodic law and periodic system of chemical elements.
- Chemical bond.
- Mixtures of substances. Solutions.

Inorganic Chemistry

- Inorganic substances and their properties.
- General information about non-metallic elements and non-metals.
- General information about metallic elements and metals.
- Main types of inorganic compounds: oxides, bases, acids, salts, amphoteric compounds.
- Genetic relationships between classes of inorganic compounds.

Organic chemistry

- Theoretical foundations of organic chemistry.
- Hydrocarbons: alkanes, alkenes, alkynes, aromatic hydrocarbons, benzene. Natural sources of hydrocarbons and their processing.
- Oxygen-containing organic compounds: alcohols, phenol, aldehydes, ketones, carboxylic acids, esters, carbohydrates.
- Nitrogen-containing organic compounds: amines, amino acids, proteins.
- Synthetic macromolecular substances and polymeric materials based on them.

Calculations in Chemistry

- Solving problems using chemical formulas and deriving the compound formula.
- Expression of the quantitative composition of the solution (mixture).
- Problem solving by reaction equations.

Table 1. Program content

The name of the section	Content of the material	Requirements to the entrants training level
1	2	3
General chemistry.		
Basic chemical concepts. Substance.	Concepts: chemical element, atom, molecule, ion (cation, anion), substance, physical body, material, simple substance (metal, non-metal), complex substance. Physical and chemical properties of the substance. The composition of the substance (qualitative, quantitative). The valence of the chemical element. Chemical (simplest, true) and graphical (structural) formulas. Physical and chemical phenomena. Chemical reaction. Relative atomic and molecular masses, molar mass, amount of matter. Units of quantity of substance, molar mass, molar volume; values of temperature and pressure that meet normal conditions; molar volume of gas. Avogadro Law; Avogadro number. The average relative molecular weight of air. The mass fraction of the element in the compound.	- To write chemical formulas of substances, graphical (structural) formulas of molecules. - To distinguish between physical bodies and substances; simple and complex substances; elements and simple substances; metals and non-metals; atoms, molecules and ions (cations, anions); physical and chemical properties of the substance; physical phenomena and chemical reactions. - To form the formulas of the binary compounds by the element's valence. - To analyze the qualitative (elemental) and quantitative composition of a substance by its chemical formula. - To determine the valence of elements by formulas of binary compounds. - To calculate the average relative molecular weight of air, the mass fraction of an element in a compound, the mass of an element in a complex substance by its mass fraction.
Chemical reaction.	Chemical reaction, reaction scheme, chemical equation. The law of conservation of mass of substances during a chemical reaction, the volume ratios of gases in a chemical reaction. External effects accompanying chemical reactions. Types of chemical reactions. Classification of chemical reactions in organic chemistry. Thermal effect of chemical reactions, thermochemical equation. The concept of oxidant, reducing agent, oxidation processes, reduction. Electroplating element. The rate of the chemical reaction. Catalyst. Influence of various factors on the rate of chemical	- To write the reaction schemes, chemical and thermochemical equations. - To distinguish reaction types by mechanism (coupling reactions, decomposition, exchange, substitution), change of oxidation of elements (reactions of oxidation-reduction and without change of oxidation degree), thermal effect (exothermic, endothermic reactions), the direction of flow (reactions reversible, irreversible); involving organic compounds (substitution, addition, elimination, isomerization). - To analyze the influence of the nature of the reagents, their concentration, the magnitude of their contact surface, the temperature, the catalyst on the rate of chemical reaction. Processes that occur when a galvanic element is operating.

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	reaction. Chemical equilibrium, Le Chatelier principle.	- To determine in the redox reaction oxidant and reducing agent, the processes of oxidation and reduction, the degree of oxidation of atoms. - To use the electronic balance method to convert the redox scheme to a chemical equation. - To apply the law of conservation of mass of a substance for a chemical equation, Le Chatelier's principle for determining the direction of displacement of a chemical equilibrium.
Atoms and simple ions organization.	The atom organization (nucleus, electron shell). Concepts of nucleons, nuclides, isotopes, proton number, nucleon number, orbital, energy level and sublayer, coupled and unpaired electrons; the radius of the atom, the excited and excited states of the atom. Forms of s- and p-orbitals, placement of p-orbitals in space. The sequence of electron filling of energy levels and sublevels in the atoms of elements №1-20 and 26, electronic formulas of atoms and simple ions of elements №1-20 and №26 and their graphical representations. Valence states of elements. The degree of oxidation of the element in the substance. The degree of oxidation of non-metallic elements of small periods is possible.	- To write and to recognize electronic formulas of atoms and simple ions of elements №1-20 and №26 and their graphical images, atoms of non-metallic elements of small periods in their ground and excited states. - To determine the valence and oxidation degree of the element. - To formulate compound formulas by the oxidation degrees of the elements. - To compare the possible oxidation rates of non-metallic elements of small periods in one group based on their electronic structure. - To analyze changes in the radii of atoms in periods and subgroups, the relationship of the number of electrons at the outer level with the nature of the element (metallic, non-metallic), the type of a simple substance (metal, non-metal), the acid-base nature of the oxides and hydroxide. Differences of electronic structure of atoms of s- p-, d-elements (Ferum), 1-4 periods. - To determine the composition of nuclei (number of protons and neutrons) and electronic shells (energy levels and sublevels) in the atoms of elements №1-20 and №26, the total number of electrons and the number of electrons at the external energy level of the atoms of elements №1-20 and №26.
The Periodic Law and Periodic System of chemical elements.	The Periodic law modern formulation. Structure of short and long variants of the periodic system; periods, groups, subgroups: main (A), indirect (B). Proton number (ordinal, atomic	- To distinguish between periods, groups, main (A) and side (B) subgroups; metallic and non-metallic elements in their place in the periodic system; alkaline, inert elements, halogens. - To use information contained in periodic

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	element number), place of metallic and non-metallic elements in the periodic system, periods and groups; alkaline, inert elements, halogens. The periodicity of changes in the properties of elements and their compounds based on ideas about the structure of atoms.	table to determine the properties of an element (metallic or non-metallic element), the maximum value of its valence, the properties of a simple substance (metal or non-metal), the chemical nature of oxides, hydroxides. - To analyze changes in the properties of simple substances and the acid-base character of oxides and hydroxides depending on the location of the elements in periods, subgroups, in the transition from one period to another.
Chemical bond.	The main types of chemical bonding (ionic, covalent, hydrogen, metallic). Exchange and donor-acceptor mechanisms of covalent bond formation. Simple, double, triple, polar and non-polar covalent bonds. Electronegativity of the element. Electronic molecule formula. Substances of atomic, molecular, ionic structure. Crystalline and amorphous states of solids. Types of crystal lattices (atomic, molecular, ionic, metallic). Dependence of physical properties of substances on their structure.	- To give examples of substances with different types of chemical bonding; amorphous and crystalline substances. - To explain the differences in the mechanisms of covalent bond formation in the ammonia molecule and the ammonium ion; between amorphous and crystalline substances. - To distinguish between exchange and donor-acceptor (ammonium cation) mechanisms of covalent bond formation. - To make electronic formulas of molecules, chemical formulas of compounds on charge of ions. - To determine the types of chemical bonding in substances by their formulas. - To determine simple, double, triple, polar, and nonpolar covalent bonds between atoms. - To predict the possibility of hydrogen bonding between molecules, the physical properties of substances based on their structure, and the structure of substances based on their physical properties (such as crystalline lattices). - To evaluate the possibility of hydrogen bond formation on the basis of the structure of water molecules and alcohols molecules.
Mixtures of substances. Solutions.	Homogeneous (solutions) and non-homogeneous mixtures. The concept of disperse systems. Colloidal and true solutions. Suspensions, emulsions, aerosols. Mass and volume (for gas) particles of a substance in the mixture. Methods of separation of	-To give examples of colloidal and true solutions, solvents, suspensions, emulsions, aerosols, electrolytes and non-electrolytes, strong and weak electrolytes, crystalline hydrates. - To distinguish between homogeneous and heterogeneous mixtures of different types; diluted, concentrated,. saturated, unsaturated solutions; electrolytes and non-electrolytes,

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	mixtures (settling, filtration, centrifugation, evaporation, distillation). Structure of a water molecule. Concept of a solution, solvent, dissolved substance, crystalline hydrate. Solubility of substances, its dependence on various factors. Saturated and unsaturated, concentrated and diluted. Mass fraction of solute in solution. Electrolyte, non-electrolyte. Electrolytic dissociation, degree of. Electrolytic dissociation. Ion-molecular equation. "Exchange reactions between electrolytes in solution. Hydrogen index (pH). arvlennya indicators (universal phenolphthalein, methyl orange) in acidic, neutral and alkaline environments, pH of each medium. Hydrolysis of salts. Qualitative responses to certain ions.	strong and weak electrolytes. - To choose a method of separation of homogeneous or non-homogeneous mixture of substances; Detection of hydroxide, chloride, sulfate, carbonate, silicate and orthophosphate ions, hydrogen ions, ammonium, barium ions, as well as alkali ions of Ferum (2+) and Ferum (3+) in solution. - To write schemes of electrolytic dissociation of bases, acids, salts; ion-molecular equations by molecular equations and molecular equations by ion-molecular equations, equation of hydrolysis reactions of salts; equation of qualitative reactions for determination in chloride solutions. sulfate-, carbonate-, silicate- and orthophosphate ions, ammonium ions, Ferum (2+), Ferum (3+), (precipitated with alkalis), Barium in molecular and ionic forms. - To analyze the influence of the structure of substances, temperature, pressure (for gases) on their solubility in water; mechanisms of ion formation upon dissolution of ionic and molecular structure electrolytes in water. - To determine the possibility of an exchange reaction between electrolytes in solution, hydrolysis of salts, medium of salt solution.
Inorganic Chemistry. Inorganic substances and their properties. General information about non-metallic elements and non-metals.	Non-metals. General characteristics of non-metallic elements (place in the periodic system, features of the electronic structure of atoms). Physical properties of non-metals. Allotropy. Allotropic modifications of non-metallic elements. The phenomenon of adsorption (for example, activated carbon). Oxidative and reducing properties of non-metals. The use of non-metals. Oxygen. Prevalence of Oxygen in nature. Oxygen, its molecule composition, distribution in nature. Physical properties of oxygen. Oxygen production in the laboratory (with hydrogen	- To name the most common non-metallic elements in nature; qualitative and quantitative composition of air. - To explain the essence of the phenomenon of allotropy; differences in the properties of allotropic modifications of Oxygen, Sulfur, Carbon, Phosphorus composition of their molecules or structure; the essence of the phenomenon of adsorption (on the example of activated carbon); anthropogenic and natural causes of occurrence in the atmosphere., oxides of non-metallic elements, oxidation processes, oxygen cycle. - To give examples of allotropic modifications of Oxygen (oxygen and ozone), Sulfur (rhombic and monoclinic sulfur), Carbon (graphite, diamond and fullerene), Phosphorus (white and red
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	peroxide and water) and industry. Methods of oxygen collection. Proof of oxygen. Chemical properties of oxygen: interaction with simple and complex substances. Oxygen cycle in nature. Ozone. The use and biological role of oxygen. Oxidation (burning, slow oxidation, respiration). Conditions of occurrence and termination of combustion. Compounds. non-metallic elements with hydrogen. Properties of aqueous solutions of these compounds, their use. Oxides of non-metallic elements, their content in the atmosphere.	phosphorus); compounds of non-metallic elements with hydrogen (hydrogen chloride, hydrogen sulfide, ammonia). - To compile chemical equations that confirm the oxidizing properties of non-metals in reactions with hydrogen and metals; the reducing properties of hydrogen and carbon in reactions with oxides of metallic elements; reactions characterizing the properties of aqueous solutions of hydrogen chloride (with bases), hydrogen sulfide (with alkali), ammonia (with acids); reactions of nitric and concentrated sulfuric acids with magnesium, zinc, copper, reactions: obtaining oxygen from hydrogen peroxide and water; oxygen with hydrogen, carbon, sulfur, magnesium, iron, copper, methane, hydrogen sulfide. - To compare physical and chemical properties of non-metals, oxides of non-metallic elements; properties of aqueous solutions of hydrogen chloride, hydrogen sulphide, ammonia. - To characterize non-metals, their physical properties and applications; use of hydrogen chloride, hydrogen sulphide, ammonia; physical and chemical properties of nitric and concentrated sulfuric acids (interaction with magnesium, zinc, copper); chemical properties of oxygen. - To evaluate the biological significance of the most important non-metallic (Oxygen, Nitrogen, Carbon, Phosphorus, halogens) elements; the value of oxygen in the life of organisms; of ozone in the atmosphere. - To make judgments regarding the use of ozone, the environmental effects of carbon, Nitrogen, and Sulfur oxides; acid rain, greenhouse effect.
General information about metal elements and metals.	General characteristics of metallic elements (place in the periodic system, features of the electronic structure of atoms). Physical properties of metals, dependence on their structure. Aluminum and iron: physical and chemical properties. The most important compounds are Aluminum and Ferum. Application of metals and their alloys. The range of activity of metals. Modern silicate	- To name the most common metal elements in nature. - To write equations confirming the reducing properties of metals, in particular aluminum and iron (reactions with non-metals, acids and salts in solutions). - To compare physical and chemical properties of metals (aluminum and iron), oxides of metal elements; bases (sodium and calcium hydroxides). - To characterize metals, their physical properties and applications (including metal
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	materials. Mineral fertilizers. The concept of acid and alkaline soils: The biological meaning of metallic and non-metallic elements.	alloys); use of sodium and calcium hydroxides. - To assess the biological significance of metallic (Calcium, Potassium, Sodium, Magnesium, Ferum) elements. - To prove the practical importance of metals and compounds of metallic elements.
The main classes of inorganic compounds. Oxides.	Definition, composition and nomenclature, classification of oxides, chemical properties of salt-forming oxides, methods of the oxides producing.	- To name the oxides using the modern nomenclature according to their chemical formulas. Distinguish insoluble (CO, N2O, NO, SiO) and salt forming oxides (acidic, basic, amphoteric). - To form chemical formulas of oxides; equation of reactions, characterizing the chemical properties of salt forming oxides (interaction with water, oxides, acids, alkalis); methods of oxides producing (interaction of simple and complex substances with oxygen, decomposition of insoluble bases, some acids and salts during heating). - To compare the chemical properties of basic, acid and amphoteric (for example, Zinc and Aluminum oxides) oxides. - To characterize the physical properties of oxides. - Define formulas of oxides among formulas of compounds of other studied classes.
Hydroxides.	Definition (general and in terms of electrolytic dissociation), composition and nomenclature, classification, chemical properties of alkalis and insoluble bases, methods of bases obtaining.	- To name the basics using the modern nomenclature. - To distinguish between soluble (alkali) and insoluble bases. - To form the chemical formulas of bases; equations of reactions characterizing the chemical properties of alkalis (interaction with acid oxides, acids and salts in solution) and insoluble bases (interaction with acids, decomposition during heating), methods of alkalis producing (interaction between metals with water, basic oxides with water) and insoluble bases (interaction of salts with alkalis in solution). - To compare the chemical properties of soluble (alkali) and insoluble bases. - To characterize the physical properties of the bases. - To define base formulas among compound formulas of other classes of substances.

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Acids/	Definition (general and in terms of electrolytic dissociation), composition and nomenclature, classification, chemical properties, methods of acids obtaining.	- To name acids according to modern nomenclature. - To distinguish acids by the composition (oxygen-containing, non-oxygen-based), basicity (one-, two-, three-basic), ability to electrolytic dissociation (strong, weak). - To make chemical formulas of acids; equations of reactions characterizing the chemical properties of acids (interaction with metals, basic and amphoteric, oxides, bases and amphoteric hydroxides, salts) and methods for their preparation (interaction of acid oxides with water, some non-metals with hydrogen, salts with acids). - To characterize the physical properties of acids. - To determine the formulas of acids among the formulas of compounds of other studied classes, the valence of the acid residue by the formula of acids. - To predict the possibility of chemical reactions of acids with metals, using a number of metal activities.
Salts.	Definition (general and in terms of electrolytic dissociation), composition and nomenclature, classification, chemical properties, methods of salts obtaining, their distribution in nature. The water hardness and ways of it's elimination.	- To name salts according to the modern nomenclature. - To differentiate between medium and acidic salts. - To write chemical formulas of salts; equations of reactions characterizing the chemical properties of medium salts (interaction with metals, acids, alkalis, other salts in solution) and acidic (interaction with acids, alkalis, thermal decomposition of carbonates and hydrogencarbons) methods of obtaining (interaction of acids with metals, basic oxides with acids, acid oxides with alkalis, bases with acids, salts with acids, salts with alkalis, acid oxides with basic oxides, salts with salts, salts with metals). - To characterize the physical properties of salts. - To determine the formulas of medium and acidic salts among the formulas of compounds of other classes studied. - To predict the possibility of chemical reactions of salts with metals using a range of metal activities.

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Amphoteric compounds.	The phenomenon of amphoterism. Chemical properties, methods for amphoteric oxides and hydroxides producing.	- To name amphoteric oxides and hydroxides according to the modern nomenclature. - To distinguish amphoteric oxides and hydroxides from other inorganic compounds by their properties. - To write the chemical formulas of oxides and hydroxides of Aluminum and Zinc, equations of reactions characterizing their chemical properties (interaction with acids, alkalis (in solution and during fusion) and methods of preparation (interaction of salts of these elements with alkalis in solution). - To characterize the concept of amphoteric properties, physical properties of aluminum and zinc oxides and hydroxides.
The genetic relationships between classes of inorganic compounds.	The genetic relationships between classes of inorganic compounds	- To make the equation of reactions between inorganic compounds of different classes. - To compare chemical properties of oxides, bases, acids, amphoteric hydroxides, salts. - To establish relationships between the composition and chemical properties of oxides, acids, bases, amphoteric hydroxides, salts; genetic relationships between simple and complex substances, oxides, bases, acids, amphoteric hydroxides, salts. - To explain the dependence between the composition, properties and use of oxides, bases, acids, amphoteric hydroxides, salts.
Organic chemistry.		
Theoretical foundations of organic chemistry.	The most important elements-organogens, organic compounds; natural and synthetic organic compounds. Molecular structure of organic compounds. Covalent Carbon-Carbon Bonds in Organic Compounds: Simple, Double, and Triple. The theory of structure of organic compounds. Nomenclature of organic compounds. Classification by the structure of the carbon chain and the presence of characteristic (functional) groups. The phenomenon of homology; homologs, homologous series, homologous difference. Classes of	- To name organic compounds by structural formulas using the IUPAC systematic nomenclature. - To give examples of organic compounds with simple, double, triple Carbon-Carbon bonds; homologues of different homologous series of hydrocarbons and oxygen and nitrogen-containing organic compounds of different classes; structural isomers of representatives of different homologous series of hydrocarbons and oxygen- and nitrogen-containing organic compounds of different classes. - To distinguish by characteristic features inorganic and organic compounds, natural and synthetic organic compounds; organic compounds of qualitative composition:

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	organic compounds. General formulas for homologous series and classes of organic compounds. Isomerism phenomenon, isomers, structural isomerism. The interaction of atoms or groups of atoms in molecules of organic compounds.	hydrocarbons, oxygen and nitrogen-containing substances; simple, double, triple Carbon-Carbon bonds; homologous series and classes of organic compounds; structural isomers of a particular substance. - To compare covalent Carbon-Carbon bonds in organic compound molecules: simple, double, triple. - To classify organic compounds by the structure of the carbon chain into saturated hydrocarbons (alkanes), unsaturated hydrocarbons (alkenes, alkynes), aromatic hydrocarbons; the presence of characteristic (functional) groups of alcohols, phenol, aldehydes, carboxylic acids, esters, amines, amino acids. - To identify the most important elements-organogens (C, H, O, N, S, P); homologs of hydrocarbons and their derivatives; isomers according to structural formulas. - To write structural formulas of organic compounds by name according to the systematic nomenclature. - To explain the dependence of the properties of substances on the composition and structure of their molecules based on the provisions of the theory of structure of organic compounds; the essence of structural isomerism. - To understand the essence of the theory of structure of organic compounds. - To analyze the reactivity of organic compounds with different types of bonds; chemical structure of organic compounds, using the basic principles of the theory of structure of organic substances. - To predict the reactivity of organic compounds using the concept of the interaction of atoms or groups of atoms in molecules. - To make conclusions about the properties of substances based on their structure and the structure of substances based on their properties, as well as on the diversity of organic compounds based on the theory of chemical structure.
Hydro-carbons. Alkanes.	General formula of alkanes, nomenclature, structural isomerism, structure of molecules, methods of obtaining, application.	- To know the names of alkanes, representatives of the homologous number of CH4-C10H22 composition by systematic nomenclature.

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	physical and chemical properties,	- To name alkanes according to a systematic nomenclature IUPAC based on their structural formula. - To form molecular, structural formulas of alkanes and their isomers by the name of the compound; equation of reactions characterizing the chemical properties of alkanes (combustion, thermal decomposition, isomerization, halogenation, nitrification), alkanes obtaining (hydrogenation of alkenes, alkynes). - To recognize the structural isomers of representatives of homologous series of alkanes. - To compare the structure and properties of methane and its homologs. - To justify the dependence between the aggregate state (at 20-25 ° C), the melting and boiling temperatures of alkanes and their relative molecular masses and the structure of molecules; the ability of alkanes to substitution reactions; use of alkanes (fuel, fuel, solvents, soot, hydrogen, halogenoalkanes) by their properties. - To establish relationships between the composition, structure, properties and use of alkanes, their environmental impact.
Alkenes	The general formula of alkenes, nomenclature, structural and geometrical isomerism, structure of molecules, chemical properties and methods of ethene obtaining, application of alkenes.	- To name alkenes according to a systematic nomenclature IUPAC based on their structural formula. - To determine the structural isomers of alkenes by the structure of the carbon chain, the location of the double bond. - To explain the essence of the structural isomerism of alkenes. - To recognize the structural isomers of representatives of a homologous series of alkenes. - To form molecular, structural formulas of alkenes on the basis of the general formula; equation of reactions characterizing the chemical properties of ethene (partial and complete oxidation, addition of hydrogen, halogens, hydrogen halides, water; polymerization) and the preparation of ethene (ethane dehydration, ethanol hydrogenation, ethanol dehydration). - To apply knowledge to choose the method of alkenes detection. - To establish links between the structure and the ability of alkenes to attach reactions.

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Alkynes	The general formula of alkynes, nomenclature, structural isomerism, structure of molecules. Chemical properties and methods of ethine obtaining, application.	- To name alkynes according to systematic nomenclature IUPAC based on their structural formulas. -To determine the structural isomers of alkynes by the structure of the hydrocarbon chain, the location of the triple bond. - To explain the nature of the structural isomerism of alkynes. - To make molecular, structural formulas of alkynes; equation of reactions characterizing the chemical properties of ethyne (addition of hydrogen, halogens, hydrogen halides, water; ethylene trimerization, partial oxidation and complete oxidation of alkynes); industrial and laboratory methods for the ethyne production: dehydrogenation of ethane, ethene, hydrolysis of calcium acetylene, thermal decomposition of methane. - To apply knowledge to choose how to detect alkynes. Compare the reactivity of ethene and ethyne in additional reactions. - To establish a link between ethyn's structure and ability to react in the additional reactions. - To substantiate the use of ethine (gas cutting and welding of metals), due to its properties.
Aromatic hydrocarbons Benzene	The general formula of arenas homologous of benzene. Molecular structure, properties, methods of benzene obtaining.	- To name aromatic hydrocarbons based on their structural formula according to the IUPAC nomenclature. -To distinguish between unsaturated and aromatic hydrocarbons. - To compare the bonds between Carbon atoms in benzene molecules and alkanes and alkenes, reactivity of benzene, alkanes, alkenes and alkynes in substitution and oxidation reactions; of benzene, alkenes and alkynes in addition reactions. - To prove the aromaticity of benzene. - To wrire molecular and structural formulas of benzene; equation of reactions characterizing the chemical properties of benzene (halogenation, hydrogenation, combustion), the production of benzene in industry (catalytic dehydrogenation of n-hexane, ethylene trimerization).

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Natural sources of hydrocarbons and their processing	Distribution of hydrocarbons in the nature. Natural gas, oil, coal are natural sources of hydrocarbons. Distillation of oil. Hydrocarbons and environmental protection. Use of hydrocarbons.	To explain the essence of the oil distillation process. - To make equations of reactions that occur during natural gas combustion. - To distinguish the reactions that occur during the thermal decomposition of hydrocarbons. - To establish links between the composition, structure, properties and use of hydrocarbons.
Oxygen-containing organic compounds. Alcohols	Functional group of alcohols. Saturated monoatomic alcohols: general and structural formulas, structural isomerism, systematic nomenclature, chemical properties. Hydrogen bonding, its effect on the physical properties of alcohols. Preparation of ethanol. Glycerol as a representative of polyatomic alcohols: chemical properties, qualitative reaction of polyhydric alcohols.	- To name monatomic, diatomic and triatomic saturated alcohols according to a systematic nomenclature IUPAC based on their structural formula. - To distinguish monatomic alcohols from other oxygen-containing organic compounds by the structural formula. - To determine the structural isomers of monatomic saturated alcohols by the structure of the hydrocarbon chain, the location of the hydroxyl group. Classify alcohols by number of hydroxyl groups. - To form molecular, structural formulas of alcohols; equation of reactions describing the chemical properties of saturated monatomic alcohols (complete and partial oxidation, dehydration, interaction with alkali metals, hydrogen halides, esterification), glycerol (complete oxidation, interaction with alkali metals, higher saturated and unsaturated); glycerol obtaining by alkaline hydrolysis (saponification) of fats; methods for ethanol production (ethene hydration, glucose fermentation). - To characterize the composition and structure of monoatomic saturated alcohol molecules, chemical properties of monatomic alcohols and glycerol, methods for ethanol production. - To compare the physical properties (boiling point, water solubility) of monatomic alcohols and the corresponding alkanes, methanol and ethanol; the activity of monatomic alcohols, water and inorganic acids in reactions with alkali metals; structure and properties of monatomic alcohols and. - To apply knowledge to choose the method for detecting polyatomic alcohols (interaction with cuprum (II) hydroxide).

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		- To predict the chemical properties of monohydric alcohols and glycerol based on knowledge of the properties of the characteristic (functional) groups. - To justify t ussng of ethanol (ethanoic acid) and methanol (methanal (formaldehyde)) by their properties. - To establish causal relationships between the composition, structure, properties, use of monohydric alcohols and glycerol. - To make conclusions about the properties of monoatomic alcohols and glycerol based on their structure and on the structure of monohydric alcohols and glycerol based on their properties and on the basis of the results of observations. - To be aware of the relationship of composition, structure, properties, use of monohydric alcohols and glycerol.
Phenol	The phenol formula. The composition and structure of the phenol molecule; application properties.	- To make molecular, structural formulas of phenol; equation of reactions, which reflect the chemical properties of phenol (reactions involving the hydroxyl group - interaction with alkali metals, alkalis); reactions involving benzene ring - interaction with bromine water). - To compare the structure and properties of monohydric alcohols and phenol; the ability of benzene and phenol to substitution reactions. - To establish causal relationships between the composition, structure, properties, use of phenol. - To apply knowledge to choose how to detect phenol (interaction with bromine water). - To predict chemical properties of phenol based on knowledge of the properties of characteristic (functional) groups. - To make conclusions about the properties of phenol based on its structure and on the structure of phenol based on its properties and based on the results of observations.
Aldehydes and ketones	General and structural formulas of aldehydes and ketones. The composition, structure of aldehyde molecules. The aldehyde characteristic (functional) group, its detection. Systematic nomenclature and physical properties of aldehydes. Chemical	- To name the functional groups of aldehydes and ketones; to name aldehydes and ketones according to a systematic nomenclature IUPAC based on their structural formula. - To distinguish aldehydes and ketones among other oxygen-containing organic compounds by general and structural

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	properties of ethanol, its production.	formulas. - To explain the effect of the functional group on the physical and chemical properties of the ketones and aldehydes, the physical properties of ethanal in comparison with ethanol. - To give examples of aldehydes; the use of ethanol (obtaining acetic acid). - To form molecular and structural formulas of aldehydes and ketones by systematic names. - To characterize the chemical properties of ethanal; methods of ethanol production (catalytic hydration of ethine and ethanol oxidation). - To apply knowledge to choose the method of detection of aldehydes by qualitative reactions: interaction with ammonia solution of argentum (I) oxide, freshly precipitated cuprum (II) hydroxide. - To establish causal relationships between composition, structure, properties, use of aldehydes. - To predict the chemical properties of aldehydes and ketones based on knowledge of the properties of functional groups.
Carboxylic acids	Functional group of carboxylic acids. Composition, structure of molecules of monocarboxylic acids, general and structural formulas, systematic nomenclature, structural. isomerism. Classification, properties, use of carboxylic acids. Methods of ethanoic acid producing. Distribution of carboxylic acids in nature.	- To name the functional group of carboxylic acids; to name monocarboxylic saturated c acids according to the systematic nomenclature IUPAC, to know the trivial names of methanoic and ethanoic acids. - To explain the effect of the carboxyl group on the physical and chemical properties of carboxylic acids, the formation of hydrogen bonds between carboxylic acid molecules on the physical properties of carboxylic acids. - To classify carboxylic acids by structure of hydrocarbon chain (saturated, unsaturated), quantity of carboxyl groups and the number of Carbon atoms in their molecules. - To determine the structural isomers of saturated monocarboxylic acids. - To make molecular and structural formulas of saturated monocarboxylic acids by name and general formula; formulas of structural isomers of saturated monocarboxylic acids - To characterize the chemical properties,

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		to write the reactions of saturated monocarboxylic acids, methods of ethanoic acid obtaining (oxidation of ethanol, ethanol). - To substantiate the ability of lower saturated monocarboxylic acids to electrolytical dissociation and acting on the indicators in solutions. - To compare the physical properties (boiling point, solubility in water) of saturated monocarboxylic acids and the corresponding aldehydes and monoatomic alcohols; acidic properties of carboxylic acids within homologous as well as in comparison with alcohols, phenol and inorganic acids. - To explain the chemical properties of methanoic acid (ability to oxidize - interaction with ammonia solution of argentum (I) oxide, freshly precipitated cuprum (I) hydroxide).
Esters.	General and structural formulas of esters, structure of its molecules, systematic nomenclature, structural isomerism, physical properties. Hydrolysis of esters. The use of esters.	- To name esters according to systematic nomenclature IUPAC based on their structural formula. - To give examples of esters; distribution of esters in nature and food. - To make the equation of ester formation reactions (esterification reaction) and their hydrolysis.
Carbo-hydrates.	Classification of carbohydrates. The composition, molecular and structural formulas of glucose, sucrose, molecular formulas of starch and cellulose. Forms of monosaccharides: open, pyranose and furanose. Chemical properties of glucose. Formation of glucose in nature. Starch and cellulose are natural polymers. Sucrose, starch and cellulose hydrolysis. Qualitative reactions for the determination of glucose and starch. The use of carbohydrates, their biological role.	- To distinguish between mono-, di- and polysaccharides. - To explain the influence of functional groups on the physical and chemical properties of monosaccharides. - To give examples of carbohydrates and their trivial names; use of glucose, starch, distribution of carbohydrates in nature and food. - To make molecular and structural formula of open, pyranose and furanose form of glucose, molecular formulas of sucrose, starch and cellulose; equation of reactions that reflect the chemical properties of glucose (complete and partial oxidation, reduction with hydrogen); sucrose, starch and cellulose (molecular equations of hydrolysis). - To compare starch and cellulose in composition and properties. - To apply knowledge to choose the method for glucose detecting (interaction with

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		ammonia solution of argentum (I) oxide, reaction with freshly precipitated cuprum (II) hydroxide) and starch (interaction with iodine).
Nitrogen-containing organic compounds. Amines.	Functional group of amines, its structure. Classification of amines. Structure of amine molecules. Systematic nomenclature of the simplest compounds. Amines as organic bases. Chemical properties of methylamine, aniline. Obtaining of aniline.	- To name the functional group of amines; primary amines according to systematic nomenclature IUPAC based on their structural formulas. - To give examples of amines. - To classify amines by structure of the hydrocarbon chain (saturated, aromatic). - To compare the basic properties of ammonia, methylamine and aniline. - To make equations of reactions that describe the chemical properties of methylamine (combustion, interaction with water and hydrochloric acid), aniline (interaction with hydrochloric acid, bromine water) and aniline production (reduction of nitrobenzene). - To establish causal relationships between the composition, structure, properties of saturated and aromatic amines. - To substantiate the basic properties of saturated amines and aniline; weakening the basic properties and increasing the reactivity of aniline in substitution reactions. - To draw conclusions about the properties of amines based on the structure of their molecules and on the structure of amine molecules based on their properties and the results of observations.
Amino acids.	Composition and structure of molecules, general and structural formulas, functional groups, systematic nomenclature. The concept of amphoteric amino acids. Chemical properties of amino ethanoic acid. The biological role of amino acids. Peptides. Peptide group.	- To name the functional groups of amino acids; to name amino acids according to systematic nomenclature, to form structural formulas of amino acids by names. - To explain why amino acids are amphoteric compounds. - To make equations of reactions that describe the chemical properties of amino ethanoic acid (interaction with sodium hydroxide, hydrochloric acid, formation of dipeptide). - To compare the structure of molecules and chemical properties of amino acids with carboxylic acids and amines. - To predict the chemical properties of amino acids due to the peculiarities of the structure of their molecules.

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		- To establish cause and effect relationships between the composition, structure, properties of amino acids. - To make conclusions about the properties of amino acids based on the structure of their molecules and on the structure of amino acids based on their properties. - To explain the meaning of concepts: peptide group, dipeptide, polypeptide.
Proteins.	Proteins as macromolecular compounds, their structure, use. Denaturation and hydrolysis of proteins. Color reactions for proteins.	- To characterize the processes of hydrolysis, denaturation of proteins. Apply knowledge to choose the method of protein detection (xanthoprotein and biuret reactions). - To establish cause and effect relationships between composition, structure, properties of proteins. - To make conclusions about the properties of proteins based on the structure of their molecules and the structure of proteins based on their properties and the results of observations.
Synthetic high molecular weight substances and polymeric materials based on them.	Synthetic macromolecular substances. Polymers. Polymerization and polycondensation reactions. Plastics. Rubbers, rubber. Synthetic fibers: physical properties and applications. The most common polymers and their applications. Values of natural and synthetic polymeric organic compounds.	- To explain the essence of the term polymer; polymerization and poly-condensation reactions as methods of producing polymers. - To classify polymers by production method: natural, artificial, synthetic. - To give examples of synthetic macro-molecular substances and polymeric materials based on them; equations of polymerization and polycondensation reactions. - To write the equation of polymerization reactions with the formation of the most important polymers (polyethylene, polypropylene, polychlorovinyl); polycondensation reactions with the formation of di- and tripeptides. - To apply knowledge about the properties of polyethylene: relation to heating, acid solutions, alkalis in the context of its importance in public economy, everyday life. - To establish cause and effect relationships between the composition, structure, properties and use of polymers. - Tomake conclusions about the properties of polymers based on the structure of their molecules.

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Generaliza-tion of knowledge about organic compounds.	Establish genetic relationsheeps between different classes of organic compounds.	- To explain the causes of the diversity of organic matter. - To give examples of homologs and isomers; compounds with simple and multiple bonds; with different functional groups. - To distinguish organic compounds according to their respective homologous series. - To make the equation of reactions - interactions of organic compounds of different classes. - To compare the chemical properties of organic compounds of different classes. - To establish relationships between the composition and chemical properties of organic compounds of different classes; between the structure of molecules of organic compounds and their ability to react in a certain type; between classes of organic compounds. - To justify the use of organic compounds depending on their properties; the importance of organic matter in the creation of new materials.
Calculations in Chemistry. Solving problems using chemical formulas and deriving the compound formula.	Formulas for calculating the amount of a substance, the number of particles in a given, the amount of a substance, the mass fraction of an element in a compound, the relative density of gas, the derivation of the compound formula, by the mass fraction of the elements.	- To establish the chemical formula of a compound by mass fraction of the elements that make up its composition; according to the general formula of homologous series and density or relative density. - To calculate the relative molecular and molar masses of the substance; the number of particles (atoms, molecules, ions) in a given amount of substance, mass of substance, volume of gas; the mass and volume of a given quantity of a substance and the quantity of a substance by a known mass and volume; the volume of a given mass or amount of a substance of gas per n. in.; the relative density of the gas over the other gas.
The expression of the quantitative composition of the solution (mixture).	Formulas for calculating the mass (volume) fraction of a component in a mixture, the mass fraction of solute.	- To calculate the mass and volume (for gases) particles of substances in the mixture; the mass fraction of the element in the compound by its formula; the mass of an element in a complex substance by its mass fraction; mass fraction of solute in solution; mass (volume) of solution and solvent; mass of solute.

1	2	3
Problem solving by reaction equations.	Algorithms for solving the equation of reaction problems; the relative yield of the reaction product.	- To establish the chemical formula of a substance by weight, volume or amount of substance of reagents or reaction products. - To calculate by chemical equation the amount of substance, mass and volume of gas or the amount of substance of the reagent / product by the known amount of substance, weight, volume (for gas) of another of the reagents / products; by reaction equations using solutions with a specific mass fraction of solute; the relative yield of the reaction product; the amount of substance, weight or volume of the product by chemical equation if one of the reagents is taken in excess; volume ratios of gases by chemical equations; the amount of substance, weight or volume by amount of substance, weight or volume of reagent containing a certain proportion of impurities. - To solve combined problems (no more than two algorithms combined

REQUIREMENTS FOR KNOWLEDGE AND SKILLS OF THE ENTERANTS GENERAL TRAINING LEVEL

The knowledge:

- to know the basic chemical symbols and concepts;
- to understand the periodic law and the periodic table of elements, describe, explain and predict the properties of chemical elements and compounds based on periodic law;
- to understand the facts, laws, principles and concepts of chemistry;
- to understand the connection between composition, structure, physical and chemical properties of substances, methods of their obtaining, fields of application;
- to have knowledge about the most important natural and synthetic substances, their structure, methods of obtaining and applications.

Skills:

- to use chemical terms, concepts, symbols, scientific terminology and nomenclature;
- to justify the course and conditions of chemical experiments;
- to apply spatial imagination to compose structural formulas and models of substances;
- to compose chemical formulas and to write equations of chemical reactions;
- to solve calculation and experimental problems;
- to distinguish between the main classes of inorganic and organic compounds;
- to use the acquired knowledge to reflect and model chemical processes;
- determine the reactivity of compounds based on their chemical structure.

EVALUATION CRITERIA, THE STRUCTURE OF EVALUATION AND THE ORDER OF EVALUATION OF KNOWLEDGE AND SKILLS OF APPLICANTS

The exam consists of 2 parts, each of which has its level of difficulty and is assessed by a certain number of points. The evaluation uses a 200-point scale (Table 2).

The exam consists of 2 parts, which reveal the theoretical knowledge and practical skills of the entrant in the discipline "Chemistry":

Part 1. Test task. It reveals the level and scope of the applicant's theoretical knowledge. Minimum and medium difficulty levels. The maximum score is 120 points.

Consists of 40 questions. Each question has four answer options, of which only one is correct. The task is considered completed if the entrant has selected and marked the correct answer (letter) in the answer sheet.

The score for the answer to the test question can have two marks: 3 points for each correct answer; 0 points if the answer is incorrect, or answer is given with two or more options.

Part 2. Practical task. High level of complexity. The maximum score is 80 points.

Consists of 5 practical tasks (shown in Table 2). In four tasks, it is necessary to write the equations of reactions, including the complete and net ionic equation, and the scheme of chemical transformations, as well as to apply the electronic balance method to determine the stoichiometric coefficients. There is a computation problem among the practical task.

Practical tasks provide an opportunity to evaluate the practical skills of applicants and their ability to use theoretical knowledge.

Points for answer are distributed unevenly depending on the complexity of the practical task (shown in Table 2).

The knowledge, skills and competences that are necessary for further mastering of the disciplines of the master's degree in the field of preparation 22 Health care, specialties 221 Dentistry, 222 Medicine, 226 Pharmacy, industrial pharmacy are subject to testing.

Table 2. Examination test structure and assessment principles.

Part number	The structure and content of the task	Response evaluation criteria	The maximum score (points)
1	2	3	4
Part 1	Test task – multiple choice questions In each test question, only one of the four suggested answers is correct. The correct answer is indicated by the letter in the answer sheet.	3 points for the correct answer. No answer is rated as the wrong answer (ie 0 points).	120
Part 2	Practical task 1) To write the molecular reaction of hydrolysis, to adduce complete and net ionic equation	15 points (5 points for each reaction type)	15

1	2	3	4
	2) To write the electronic balance of the chemical equation and determine the stoichiometric coefficients	15 points	15
	3) To write the scheme of chemical transformations of inorganic substances	15 points	15
	4) To write a scheme of chemical transformations of organic substances	10 points	10
	5) To solve the problem of determining mass fraction or concentration	25 points (provided coverage of the solving problem course)	25

The entrance exam is 120 minutes long. 2 minutes is given for each test question. It takes 40 minutes to complete practical tasks.

LIST OF REFERENCES TO PREPARE FOR THE ENTERANCE EXAMINATION ON CHEMISTRY

1. General and inorganic chemistry: Textbook for students of higher schools / Ye. Ya. Levitin, I.A. Vedernikova, 2009 – 360 p.

2. Inorganic Chemistry by Catherine E. Housecroft, Alan G. Sharpe Publisher: Prentice Hall. – 832 p.

3. Descriptive Inorganic Chemistry by Kathleen A. House, James E. House Publisher: Brooks Cole. – 515 p.

4. Educational portal https://chem.libretexts.org/Organic Chemistry libretexts

5. Educational portal http://www.4college.co.uk/as/index.php / Salters Chemistry

6. Educational portal https://study.com/academy/course/index.html / High school Chemistry

CREATED:
Head of examination
commission on chemistry S.O. Vlasenko

The program of entrance test, test structure, assessment criteria, assessment structure and procedure for assessment of knowledge and skills for foreigners and stateless persons, discussed and approved at the meeting of the Admissions Committee of the Kyiv Medical University.
Protocol № 2 «05» 01 2021.