MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
ODESA STATE AGRARIAN UNIVERSITY

«APPROVED»
Rector of Odesa State Agrarian University
Professor Mykhailo BROSHKOV
_____ 2021

PROGRAMME
OF THE ENTRANCE TEST
IN CHEMISTRY
FOR APPLICANTS AIMING TO OBTAIN
A BACHELOR'S DEGREE
(A MASTER'S DEGREE IN VETERINARY MEDICINE)
ON THE BASIS OF THEIR COMPLETE
GENERAL SECONDARY EDUCATION

ODESA 2021

The program of the entrance examination in Chemistry for applicants aiming to obtain a bachelor's degree (a master's degree in veterinary medicine) on the basis of their complete general secondary education.

Developed by:

Head of the Committee _____ Associate Professor, PhD in Chemistry
Oleksandr POZHARYTSKYI

Member of the Committee _____ Associate Professor, PhD in Chemistry
Olena PIESAROHLO

Considered and approved
at a meeting of the Academic Council
Agrobiotechnology Faculty
min. № 7 as of 11.02, 2021
Head of the Council, Faculty Dean
_____ H. Balan

CONTENTS

1. BASIC PART OF THE PROGRAMME..... 4
2. . ASSESSMENT CRITERIA..... 26
3. RECOMMENDED LITERATURE LIST 27

1. BASIC PART OF THE PROGRAMME

Chapter / Topic	The applicant should know	Subject skills and methods of educational activity (The applicant should know how to...)
	Section 1: General Chemistry	
Basic chemical concepts. Substance.	Subject and tasks of chemistry. The place of chemistry among the natural sciences. The role of chemistry in environmental protection. Substances, physical bodies, materials; pure substances, mixtures of substances, separation of mixtures; physical and chemical phenomena; atomic-molecular theory, molecules, atoms, stability of the composition of substances; relative atomic and relative molecular mass. Chemical equations, the law of conservation of mass, its significance in chemistry. Chemical element, simple and complex substances; chemical compounds and mechanical mixtures, symbols of chemical elements and chemical formulas; valence and degree of oxidation, compilation of formulas of binary compounds by valence of atoms of elements, determination of valence of atoms by formulas of binary compounds; calculations of the mass fraction of a chemical element in a substance according to a formula, establishment of the chemical formula of a substance according to the mass fractions of elements, relative density for another gas; amount of substance, mole, molar mass, Avogadro's law and molar volume of gas (nc), volume ratios of gases in reactions (nu); values of temperature and pressure that correspond to n.c .; calculations by chemical equations.	Draw formulas of compounds according to the values of valence of elements. Write chemical and graphical structural formulas of substances. 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 and chemical properties of the substance; physical phenomena, chemical reactions; the simplest and true formula of the compound. Determine the valence in binary compounds. Analyze the qualitative (elemental) and quantitative composition of the substance according to its chemical formula.
Chemical reactions	Classification of chemical reactions: coupling, decomposition, substitution, exchange; signs of chemical reactions, conditions of occurrence and course of reactions; exothermic and endothermic; reversible and irreversible, factors influencing the state of chemical equilibrium, the principle of Le Chatelier; redox reactions, oxidation and reduction processes, their significance in nature and technology.	Write reaction schemes, chemical equations. Distinguish types of reactions by the number of reagents and products (coupling, decomposition, substitution reactions), changes in the degree of oxidation of elements (redox reactions and non-redox reactions), thermal effect (endo- and exothermic reactions), direction of flow (reversible

	Speed of chemical reactions, factors influencing the speed of chemical processes; catalysis and catalysts.	reactions and irreversible). Determine in redox reactions the processes of oxidation and reduction, reducing agent and oxidant. To analyze the influence of the nature of reactants, their concentration, the size of their contact surface, temperature, gas pressure, catalyst and inhibitor on the rate of chemical reaction. Apply the law of conservation of mass of substances to convert the reaction scheme to a chemical equation. Use the electronic balance method to convert the redox reaction scheme to a chemical equation.
Periodic law and periodic table of chemical elements D.I. Mendeleev.	The discovery of DI Mendeleev's periodic law and the creation of a periodic system of elements. Modern formulation of the periodic law. The structure of the long and short versions of the periodic table. Large and small periods, groups (A) and subgroups (B). Ordinal (atomic) element number. Dependence of the properties of elements on their position in the periodic table, placement of metallic and non-metallic elements in the periodic table, periods and groups; alkali and alkaline earth metals, inert elements, halogens. Periodicity of change of properties of simple substances and compounds of elements. The meaning of the periodic law.	Distinguish in the periodic table periods, groups, main (A) and secondary (B) subgroups; metallic and non-metallic elements according to their position and periodic table; alkaline, alkaline earth, inert elements, halogens. Use the information contained in the periodic table to determine the type of element (metallic or non-metallic element), the maximum value of its valence, the type of simple substance (metal or non-metal), the chemical nature of oxides, hydroxides, compounds of elements with hydrogen. Analyze changes in the properties of simple substances and the acid-base nature of oxides and hydroxides depending on the location of elements in periods, subgroups, in the transition from one period to another.
Atom Structure	The composition of atomic nuclei (protons and neutrons). Isotopes, the concept of a chemical element based on knowledge of isotopes, nucleon, nuclide, proton number, nucleon number, orbital, energy level, sublevel, paired and unpaired electron, atomic radius (simple ion), ground and excited state of the atom. The essence of the phenomenon of radioactivity. Forms of s- and p-orbitals. Sequence of electron filling of energy levels and sublevels in atoms of chemical elements of small periods (atoms №1-20). Features of the structure of atoms of elements of large periods (on the example of	Compose electronic formulas of molecules, chemical formulas of compounds according to the degrees of oxidation of elements, ion charges. Distinguish between valence and oxidation state of an element in a compound. Determine the multiplicity, polarity or non-polarity of the covalent bond between atoms. Predict the type of chemical bond in the compound, the physical properties of the substance, taking into account the type of crystal lattice.

Chemical Bonds	the element №26), the sequence of filling the s- and p- and d-orbitals with electrons. Electronic and graphical formulas of atoms and simple ions of elements №1-20. Basic types of chemical bonds Covalent bonds (polar and non-polar), its characteristics. Donor-acceptor mechanism of covalent bond formation. Ionic bond, its difference from covalent. Hydrogen bond. Structure of substances: molecular and non-molecular structure, types of crystal lattices. Electronegativity of chemical elements and chemical bonding.	Compose electronic formulas of molecules, chemical formulas of compounds according to the degrees of oxidation of elements, ion charges. Distinguish between valence and oxidation state of the element. Calculate the degree of oxidation of the element in the compound. Determine the multiplicity, polarity or non-polarity of the covalent bond between atoms. Predict the type of chemical bond in the compound, the physical properties of the substance, taking into account the type of crystal lattice.
Solutions	Mixtures are homogeneous (solutions) and inhomogeneous (suspension, emulsion, foam, aerosol, gel). Methods of separation of mixtures (settling, filtration, centrifugation, evaporation, distillation) The concept of solution, solvent, solute, crystal hydrate. Mass and volume fraction (for gases.) Solubility of substances, mechanism of dissolution, dependence of solubility of substances on their nature, temperature and pressure, thermal effects during dissolution. Quantitative expression of the composition of solutions: mass fraction of solute. Preparation of aqueous solutions of substances with a certain mass fraction of solute. The role of water as a solvent, the structure of its molecule. Saturated and unsaturated, concentrated and diluted solutions. Electrolytic dissociation, electrolytes and non-electrolytes, degree of dissociation, strong and weak electrolytes, ion exchange reactions occurring to the end. Ionic equations of reactions. Compilation of reaction equations in full and reduced ionic forms. Properties of bases, acids and salts in the light of the theory of electrolytic dissociation. Coloring of indicators (universal, litmus, phenolphthalein, methyl orange) in acidic, alkaline and neutral environments. Degree of electrolytic dissociation (without calculations).	To make schemes of electrolytic dissociation of bases, acids, salts; ionic-molecular equations by molecular equations and molecular equations by ionic-molecular equations. Distinguish between homogeneous and inhomogeneous mixtures of different types; diluted, concentrated, saturated, unsaturated solutions; electrolytes and non-electrolytes, strong and weak electrolytes. Determine the possibility of the exchange reaction between electrolytes in solution. Analyze the influence of the structure of matter, temperature, pressure (for gases) on their solubility in water; mechanisms of ion formation when electrolytes of ionic and molecular structure are dissolved in water. Apply knowledge to separate a homogeneous or inhomogeneous mixture of substances.

Section 2: Inorganic Chemistry		
2.1. Main Classes of Inorganic Compounds		
Oxides	Oxides, classification and nomenclature of oxides, methods of extraction, properties and application of oxides.	Draw up chemical formulas of oxides, reaction equations that characterize the chemical properties of salt-forming oxides (interaction with water, oxides, acids, alkalis), methods of extracting oxides, interaction of simple and complex substances with oxygen, decomposition of insoluble bases, some acids and salts during heating. Name oxides by their chemical formulas. Determine the formulas of oxides among the formulas of compounds of other studied classes. Distinguish non-salt-forming (CO, NO, N2O, SiO) and salt-forming oxides (acid, basic, amphoteric). Compare the chemical properties of basic, acid and amphoteric (for example, oxides of Zinc and Aluminum) oxides. Determine the dependence of the properties of oxides of the element type and the chemical bond in the compound.
Alkalis (Bases)	Bases, their composition and names. Hydro group. Insoluble bases and alkalis, their chemical properties. Neutralization reaction. Amphoteric hydroxides, their properties. Extraction of bases.	To make chemical formulas of bases; equations of reactions that characterize 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 obtaining alkalis (interaction of alkali and alkaline earth (except magnesium) metals with water and insoluble bases (interaction of salts with alkalis in solution). Name the bases by their chemical formulas. Determine the formulas of bases among the formulas of compounds of other classes. Distinguish between soluble (alkalis) and insoluble bases. Compare the chemical properties of soluble and insoluble bases, their effect on indicators.

Acids	Acids, their composition and names, classification of acids. Physical and chemical properties, methods of acid extraction. The effect of acids and alkalis on indicators.	Compile chemical formulas of acids; equations of reactions that characterize the chemical properties of acids (effect on indicators, interaction with metals, basic oxides, bases and salts in solution) and methods of their production (interaction of acid oxides with water, non-metals with hydrogen, salts with acids). Name acids by their chemical formulas. Determine the formulas of acids among the formulas of compounds of other classes, the valence of the acid residue by the formula of the acid. Distinguish acids by composition (oxygen-containing, oxygen-free), ability to electrolytic dissociation (strong, weak) and basicity (single and many basic), stability (stable and unstable), volatility (volatile and non-volatile).
Salts	Salts, their composition and names, classification of salts. Physical and chemical properties, methods of salt extraction. Genetic bond between oxides, bases, acids and salts.	Compose chemical formulas of medium and acid salts; equations of reactions that characterize the chemical properties of medium salts (interaction with metals, acids - chloride, sulfate, nitrate, alkalis, salts in solution) and methods of their production (interaction of acids with metals, basic oxides with acids, salts with alkalis and acids, acid oxides with basic oxides, salts with salts, salts with metals (reactions are carried out in solutions), metals with nonmetals). Name medium and acid salts according to their chemical formulas. Determine the formulas of medium and acid salts among the formulas of compounds of other classes. Distinguish between medium and acid salts.
Amphoteric Compounds	The phenomenon of amphotericity (on the examples of oxides and hydroxides); chemical properties, methods of extraction of amphoteric hydroxides.	Compose reaction equations that characterize the chemical properties of oxides and hydroxides of Aluminum and Zinc (interaction with acids, alkalis) and methods of obtaining hydroxides of Aluminum and Zinc (interaction of salts of these elements with alkalis in

		solution, aluminates and zinc with acids).
	2.2. Metal Elements	
General Characteristics of Metals	Metal elements, their position in the periodic table, features of the structure of atoms. Metal connection. Electrochemical series of metal stresses. Physical and chemical properties of metals. The concept of corrosion and means to prevent it. Metals in modern technology. The main methods of industrial extraction of metals: reduction with coal, carbon monoxide, hydrogen, aluminothermy. The concept of alloys.	Determine the position of metal elements in the periodic table. Describe the metal bond, metal crystal lattices, physical properties of metals. Distinguish between metallic and non-metallic elements by the electronic structure of atoms. To compose electronic formulas of atoms of metal elements - Lithium, Sodium, Magnesium, Aluminum, Calcium, Iron; equations of reactions that characterize the chemical properties of metals (interaction with oxygen, m, halogens, sulfur, water, solutions of acids, alkalis and salts) and methods of their production (reduction of oxides with coke, carbon (II) oxide, hydrogen, metallothermy (aluminothermy)) ; equations of reactions that occur during the production of iron and steel. Explain the dependence of the chemical activity of metals on the electronic structure of their atoms; the essence of metal corrosion; chemical transformations during the production of cast iron and steel. Predict the possibility of chemical reactions of metals with water, solutions of acids, salts, alkalis.
Alkaline and alkaline earth elements	Alkali metals, their characteristics by position in the periodic table and the structure of atoms. Sodium and potassium compounds in nature. Potash fertilizers. Sodium, Potassium, Magnesium, Calcium hydroxides, their chemical properties, extraction, application. Calcium, its compounds in nature. Calcium oxide and hydroxide, their chemical properties, extraction, application. Water hardness. Qualitative reactions to ions of Calcium, Sodium, Potassium, Magnesium.	Characterize the position of Sodium, Potassium, Magnesium, Calcium in the periodic table; physical properties of sodium and potassium, types of water hardness - temporary or carbonate; constant, general; the use of oxides of Magnesium and Calcium, hydroxides of Sodium, Potassium, Magnesium and Calcium; qualitative detection of ions of Sodium, Potassium, Magnesium, Calcium. Compose electronic formulas of atoms and ions of Sodium, Potassium, Magnesium and Calcium; equations of reactions that characterize the chemical properties of

		sodium, potassium, magnesium, calcium (interaction with oxygen, halogens, sulfur, water) oxides and hydroxides of Sodium, Potassium, Magnesium Calcium; reaction equations used to reduce or eliminate the hardness of water (by boiling, adding soda or lime).
Aluminum	Aluminum, characteristics of the element and its compounds by position in the periodic table. Amphotericity of alumina and hydroxide. Aluminum compounds in nature, its role in technology.	Characterize the position of aluminum in the periodic table, the physical properties of aluminum, oxide and hydroxide of aluminum, the use of aluminum. Compose electronic formulas of the atom and ion of aluminum; equations of reactions that characterize the chemical properties of aluminum (interaction with oxygen, halogens, sulfur, solutions of acids, alkalis, salts), amphoteric oxide and hydroxide of aluminum (interaction with basic and acid oxides, acids, alkalis).
Ferum	Ferum (iron), its oxides and hydroxides, the dependence of their properties on the degree of oxidation of iron. Chemical reactions on which the production of cast iron and steel is based. The role of iron and its alloys in engineering.	Describe the position of iron in the periodic table, the physical properties of iron, oxides and hydroxides of Ferum (II) and (III); use of Ferum and Ferum compounds (II) and (III); physiological role of Ferum ions (Fe2 + and Fe3 +). Write the electronic formula of the Ferum atom; equations of reactions that characterize the chemical properties of Ferum (interaction with oxygen, chlorine, sulfur, water vapor, solutions of acids and salts, rust), oxides and hydroxides of Ferum (II) and (III) (interaction with acids), salts of Ferum (II) and (III) (interaction with solutions of alkalis, acids, salts) interconversion of compounds of Ferum (II) and Ferum (III).
Section 2.3: Non-metal Elements and Their Compounds. Non-Metals		
Halogenes	Chemical formulas of fluorine, chlorine, bromine, iodine. Chemical formulas, names and physical properties of the most important halogen compounds (hydrogen chloride, halides of metallic elements; methods of laboratory production and chemical properties of chlorine, hydrogen chloride and hydrochloric acid; the most	Compose the equations of reactions characteristic of chlorine (interaction with metals, nonmetals, water), hydrogen chloride and hydrochloric acid (interaction with metals, basic oxides, bases, amphoteric compounds, salts) equations of reactions for the production of hydrogen

	important applications of chlorine, hydrogen chloride, hydrochloric acid; qualitative reaction for detection -ions.	chloride in the laboratory.
Oxygen and Sulfur	Chemical formulas of oxygen, ozone, sulfur and the most important compounds Oxygen and Sulfur; physical and chemical properties of oxygen, ozone, sulfur, oxides of sulfur, sulfuric acid, sulfates; methods of oxygen extraction in the laboratory; the most important applications of oxygen, ozone, sulfur, sulfuric acid and sulfates; qualitative reaction for the detection of sulfate ions.	Compose the equations of reactions characteristic of oxygen (interaction with metals, nonmetals, compounds of nonmetallic elements with hydrogen), sulfur (interaction with metals, some nonmetals), sulfur oxides (interaction with water, basic oxides, bases), sulfuric acid (interaction with metals) , basic oxides, bases, amphoteric compounds, salts); equations of reactions of oxygen extraction in the laboratory, formation and decomposition of ozone. Compare the composition, chemical activity of oxygen and ozone. Describe the most important sources of oxygen (as an oxidant), ozone (water disinfection), srki (extraction of sulfuric acid; production of rubber, matches, anti-inflammatory drugs, cosmetics), sulfuric acid (production of fertilizers, fibers) and sulfates (gypsum - in buildings , medicine, copper sulphate - to control plant pests, wood pickling). Apply knowledge to detect oxygen and sulfate ions (in solution), methods of collecting oxygen (displacement of air or water).
Nitrogen and Phosphorus	Chemical formulas of nitrogen, white and red phosphorus, the most important compounds of Nitrogen and Phosphorus; physical and chemical properties of nitrogen, white and red phosphorus, nitrogen (II) oxide, nitrogen (IV) oxide, phosphorus (V) oxide, ammonia, ammonium salts, nitric acid, nitrates, orthophosphate acid, orthophosphates; methods of obtaining ammonia, nitric and orthophosphate acids in the laboratory; the most important industries use of nitrogen, ammonia, nitric acid, nitrates, orthophosphate, orthophosphates; qualitative reactions for the detection of ammonium ions and orthophosphate ions. Methods of production of ammonia),	Compose the equations of reactions characteristic of nitrogen and phosphorus (interaction with metals, some nonmetals), ammonia (interaction with oxygen, water, acids), ammonium salts (interaction with alkalis, salts), nitric acid (interaction with metals, basic oxides, bases) , amphoteric compounds, salts), nitrogen (IV) oxide and phosphorus (V) oxide (interaction with water, basic oxides, bases), orthophosphate acid (interaction with metals, basic oxides, bases, salts); equations of reactions that

	nitric acid (production of fertilizers, explosives, nitrogen-containing organic compounds), nitrates (production of fertilizers, explosives), orthophosphate acid and orthophosphates (production of fertilizers).	characterize the interconversion of medium and acid orthophosphates; equations of reactions of thermal decomposition of ammonium salts (chloride, nitrate, carbonate and w. formaldehyde) and nitrates; equations of reactions of extraction of ammonia, nitric and orthophosphate acids in the laboratory. Characterize the composition and structure of simple substances Phosphorus (red and white phosphorus), the most important applications of nitrogen (ammonia production, low temperatures), ammonia (nitric acid production, fertilizer production) Compare the activity of red and white phosphorus. Apply knowledge to detect orthophosphate ions, ammonium ions.
Carbon and Silicium	Simple Carbon substances; adsorption, adsorption properties of activated carbon; chemical formulas of the most important Carbon and Silicon compounds; physical and chemical properties of carbon, silicon, carbon oxides, carbonates, silicon (IV) oxide, silicate acid, silicates; methods of extracting carbon oxides in the laboratory; the most important industries application of diamond, graphite, activated carbon, carbon oxides, carbonates, W. formaldehyde, silicon (IV) oxide, silicates; qualitative reactions for the detection of carbonate and silicate ions.	Compose the equations of reactions characteristic of carbon and silicon (interaction with active metals and nonmetals, oxides of metallic elements), carbon (II) oxide (interaction with oxygen, oxides of metallic elements), carbon (IV) oxide (interaction with water, basic oxides, alkalis, carbon), silicon (IV) oxide (interaction with basic oxides, alkalis); equations of reactions of interconversion of medium and acid carbonates, thermal decomposition of carbonates and W. formaldehyde, extraction of carbon oxides in the laboratory. Describe the composition, structure and physical properties of simple substances Carbon (graphite, diamond, carbine), the most important applications of diamond (in cutting and grinding tools), graphite (in the manufacture of pencils, electrodes), activated carbon (in medicine, gas masks, for cleaning water), carbon oxides (CO as a reducing agent, CO2 - in the production of soda, sugar, carbonated beverages, extinguisher filler), sodium W. formaldehyde, Calcium and Sodium carbonates,

		silicon (IV) oxide (production of glass, building materials), silicates (components of cement, ceramics, porcelain, liquid glass). Apply knowledge to choose the method of detection of carbon (IV) oxide, carbonate and silicate ions (in solution).
Section 3: Organic Chemistry		
3.1. Hydrocarbons		
Theoretical Foundations of Organic Chemistry	The most important elements are organogens, organic compounds; natural and synthetic organic compounds. Single, multiple (double, triple), aromatic bonds according to the method of formation. Molecular structure of organic compounds. Chemical bonding in molecules of organic compounds. The phenomenon of homology; homologues, homologous series, homologous difference. Classes of organic compounds. General formulas of homologous series and classes of organic compounds. The concept of primary (secondary, tertiary, Quaternary) carbon atom. Hybridization of electronic watts. atomic forms Carbon; sp3-, sp2-, sp-hybridization. Nomenclature of organic compounds. Name organic compounds according to structural formulas, using the IUPAC nomenclature. The phenomenon of isomerism, isomers, structural and spatial (geometric, or cis-trans-) isomerism. Interaction of atoms or groups of atoms in molecules of organic compounds. Classification of organic compounds by the structure of the carbon chain and the presence of characteristic (functional) groups Classification of chemical reactions in organic chemistry (addition, substitution, isomerization reactions).	Identify the most important elements-organogens (C, H, O, N, S, P). Distinguish by characteristic features inorganic and organic compounds, natural and synthetic organic compounds. Characterize the multiplicity, polarity or non-polarity of a covalent bond in molecules of organic compounds, □- and □-bonds. Compare single, double, triple and aromatic bonds by energy and length and spatial orientation. Analyze the reactivity of organic compounds with different types of bonds. Determine the types of hybridization and spatial orientation of hybrid electronic watts. forms of carbon atoms in molecules of organic compounds. Classify organic compounds according to the structure of the carbon chain into saturated hydrocarbons of acyclic structure - alkanes, unsaturated hydrocarbons of acyclic structure - alkenes, alkynes; cyclic hydrocarbons - cycloalkanes and arenas; in the presence of characteristic (functional) groups for alcohols, phenol, haloalkanes, aldehydes, carboxylic acids, esters, amines, amino acids. Determine homologues of hydrocarbons and their derivatives. Distinguish homologous series and classes of organic

		compounds. Establish correspondences between representatives of homologous series and their general formulas, classes of organic compounds and their characteristic (functional) groups. Compile structural formulas of organic compounds by name according to IUPAC nomenclature. Determine isomers by structural formulas. Distinguish between structural and spatial (geometric, or cis- and trans-) isomers. To establish differences between isomers and homologues by: qualitative and quantitative composition, structure of molecules. Determine the molecules of organic compounds of different structure of primary, secondary, tertiary, Quaternary carbon atoms. Establish a relationship between the structure and properties of organic compounds, taking into account the redistribution of electron density on the examples of propene (addition of W. formalde and water according to V. Markovnikov's rule); alcohols (similarity to acids); phenol (acidic properties, the ability to substitution reactions in the gasoline ring); saturated monobasic carboxylic acids (acidic properties), amines (basic properties, the ability of aniline to substitution reactions in W. ring form). Analyze the chemical structure of organic compounds, using the basic provisions of the theory of O. Butlerov. Predict the reactivity of organic compounds using the concept of the interaction of atoms or groups of atoms in molecules. Classify reactions involving organic compounds (substitution, addition, cleavage, isomerization).

		Establish links between the structure of molecules of organic compounds and their ability to react in a certain type.
Alkanes	General formula of alkanes, their nomenclature, isomerism, structure of molecules, physical and chemical properties, methods of extraction, application.	Name the first 10 representatives of the homologous series of alkanes according to the IUPAC nomenclature. Compile molecular and structural formulas of alkanes; equations of reactions characterizing the chemical properties of alkanes (substitution reaction on the example of methane chlorination, complete oxidation of alkanes or partial oxidation of methane, thermal decomposition of methane, cracking, isomerization of alkanes), laboratory method of methane extraction. Explain the phenomenon of sp3-hybridization of electronic watts. forms of carbon atoms in alkane molecules. Compare the physical properties of alkanes on the example of their boiling and melting points. Justify the relationship between the physical state under normal conditions, melting and boiling points of alkanes and their relative molecular weight; the ability of alkanes to substitution reactions by electronic structure of molecules, the use of alkanes (fuel, fuel, solvents, extraction of soot, hydrogen, halogenated alkanes) by their properties. Establish links between the structure of molecules and the properties of alkanes.
Alkenes	The general formula of alkenes, their nomenclature, isomerism, structure of molecules, chemical properties, methods of extraction, application; qualitative reactions to the double bond.	Determine the structural isomers of alkenes by the structure of the carbon chain, the location of the double bond; vt. form (alkenes and cycloalkanes) and spatial (geometric or cis-trans-) isomers. Name alkenes according to the IUPAC nomenclature. Compose molecular, structural formulas of alkenes; equations of reactions characterizing the chemical

		properties of ethene and propene (reactions addition of hydrogen, halogens, W. formalde, water; polymerization, partial oxidation of ethene and complete oxidation of alkenes), industrial and laboratory methods of alkene production (thermal cracking alkanes, dehydrogenation of alkanes, dehydration of saturated monohydric alcohols, interaction of haloalkanes with an alcoholic solution of alkali, reactions of alkynes with hydrogen), extraction of ethene in the laboratory. Explain the phenomenon of sp2-hybridization of electronic watts. forms of carbon atoms in alkene molecules. Apply knowledge to choose the method of detection of ethene (interaction with bromine water, aqueous solution of potassium permanganate), alkenes (interaction with bromine water). Justify the use of alkenes (production of polyethylene, polypropylene, ethanol, 1,2-dichloroethane) by their properties. Establish links between the structure and the ability of alkenes to join reactions. Analyze the connection of vt. formalde and water to propene according to the redistribution of electron density in the molecule (V. Markovnikov's rule).
Alkines (Alkynes)	General formula of alkynes, their nomenclature, isomerism, structure of molecules; chemical properties and methods of ethine extraction, application; qualitative reactions to the triple bond.	Determine the structural isomers of alkynes by the structure of the carbon chain, the location of the triple bond. Name alkynes according to the IUPAC nomenclature. Compile molecular and structural formulas of alkynes; equations of reactions characterizing the chemical properties of acetylene (reactions of addition of hydrogen, halogens, formaldehyde, water (reaction of M. Kucherov; substitution reactions - interaction with sodium, ammonia solution of vt (I) oxide; trimerization of acetylene,

		complete oxidation of alkynes and partial oxidation of acetylene), industrial and laboratory methods of acetylene production (thermal decomposition of methane, interaction of calcium with formal water, reaction of 1,2-dichloroethane with an alcoholic solution of alkali). Justify the use of acetylene (gas cutting and welding of metals; extraction of vinyl chloride, polyvinyl chloride, acetaldehyde), due to its properties. Explain the phenomenon of sp-hybridization of electronic watts. forms of carbon atoms in alkyne molecules. Apply knowledge to choose the method of detection of acetylene (interaction with bromine water, aqueous solution of potassium permanganate, ammonia solution of vt (I) oxide), alkynes containing in the composition of molecules CH bonds (interaction with bromine water, ammonia solution v fo (I) oxide). Compare the reactivity of ethene and ethyne in addition reactions. Establish a link between the structure and the ability of acetylene to join, substitution reactions.
Aromatic hydrocarbons	Benzene. The general formula of homologous arenas a number of vt. f. Structure, properties, methods of extraction; the concept of aromatic bonds, 6π-electronic system.	Compose the molecular and structural formulas; formaldehyde, which characterize the chemical properties (substitution reactions involving halogens, addition reactions - hydrogenation and chlorination (hv), oxidation), extraction in industry (catalytic dehydrogenation of hexane, cyclohexane, trimerization of acetylene). Distinguish between unsaturated and aromatic hydrocarbons. Explain the phenomenon of sp2-hybridization of electronic watts. forms of carbon atoms in the molecule, the stability to the action of oxidants and its ability to substitution reactions.

		Compare the bonds between carbon atoms in molecules, alkanes and alkenes, the reactivity, alkanes and alkenes in the substitution and oxidation reactions
Natural sources hydrocarbons and their processing	Oil, natural and related petroleum gases, coal, their composition; cracking and aromatization of oil and oil products, detonation resistance of gasoline, octane numeric; coal processing; problems of extraction of liquid fuel from coal and alternative sources.	Name the products of oil and coal refining. Give examples of the use of natural hydrocarbons as sources of organic compounds. Compose the equations of reactions that occur during the combustion of natural gas. Distinguish the reactions that occur during cracking and aromatization of hydrocarbons. Compare the detonation resistance of gasolines taking into account their octane numbers.
3.2. Oxygen-Containing Compounds		
Alcohols	Characteristic (functional) group of alcohols. Classification of alcohols. General formula of monohydric saturated alcohols. Structure, nomenclature, isomerism, properties, methods of extraction and application. The concept of hydrogen bonding.	Determine the structural isomers of monohydric saturated alcohols by the structure of the carbon chain, the location of the hydroxyl group and W. form isomers (ethers). Name monohydric saturated alcohols, as well as ethylene glycol and glycerol according to the IUPAC nomenclature. To classify alcohols according to the structure of the carbon chain - saturated, unsaturated, by the number of hydroxyl groups - mono- and polyhydric, by the nature of the carbon atoms to which the hydroxyl group is connected - primary, secondary, tertiary alcohols. Compose molecular, structural formulas of alcohols; equations of reactions that reflect the chemical properties of saturated monohydric alcohols and W. for (substitution reactions - interaction with active metals, w. formaldehyde, w. formal, intermolecular dehydration, w. formaldehyde dehydration, partial and complete oxidation), industrial methods of extraction of methanol (from synthesis gas), ethanol (hydration of ethene, enzymatic fermentation of glucose, ethanol reduction) and

		laboratory methods of alcohol production (hydrolysis of haloalkanes). Characterize the composition and structure of molecules of monohydric saturated alcohols. Justify the use of ethanol (extraction of acetic acid, diethyl ether) and methanol (extraction of formaldehyde) by their properties. Compare the physical properties (boiling point, solubility in water) of monohydric saturated alcohols and the corresponding alkanes, methanol, ethanol, ethylene glycol; activity monohydric saturated alcohols, water and inorganic acids in reactions with alkali metals. Establish links between the electronic structure of molecules of monohydric saturated alcohols and their physical and chemical properties. Ethylene glycol and Tues. pho as representatives of polyhydric alcohols; qualitative reaction to polyhydric alcohols. Compose reaction equations that reflect the chemical properties of ethylene glycol and W. for (interaction with sodium, copper (II) hydroxide (without recording the reaction equation), complete oxidation), (interaction with nitric acid, higher saturated and unsaturated carboxylic acids); extraction of glyceryl (saponification of fats). Establish links between the structure of molecules of polyhydric alcohols and their properties. Apply knowledge to select a method for detecting polyhydric alcohols (interaction with copper (II) hydroxide).
Phenol	Phenol formula. The structure of the phenol molecule, the characteristic (functional) group in it; properties, extraction, application; qualitative reactions to phenol.	Make molecular, structural formulas of phenol; equations of reactions that reflect the chemical properties of phenol (reactions involving a hydroxyl group - interaction with

		sodium, sodium hydroxide; reactions involving W. ring shape - interaction with bromine water, nitric acid), its extraction in industry (hydrolysis of chlorobenzene). Justify the mutual influence of the hydroxyl group and the benzene ring in the phenol molecule. Compare the acidic properties of alcohols, phenol and carboxylic acid; ability w. f and phenol to substitution reactions. Establish links between the structure of the phenol molecule and its properties. Apply knowledge to choose the method of detection of phenol (interaction with iron (III) chloride, bromine water).
Aldehydes	General formula of aldehydes. Structure of aldehyde molecules, characteristic (functional) group, nomenclature, isomerism, properties, extraction, application; qualitative reactions to the aldehyde group.	Determine the structural isomers of aldehydes by the structure of the carbon chain. Name aldehydes according to the IUPAC nomenclature. Give examples of the use of ethanal (extraction of acetic acid, ethyl alcohol) and methanol (extraction of formalin, urotropin) by their properties. To compose structural formulas of aldehyde molecules and their structural isomers; equations of reactions that reflect the chemical properties of aldehydes (reduction, partial oxidation), ethanol production in industry (hydration of acetylene by the reaction of M. Kucherov) and laboratory (oxidation of ethanol). Apply knowledge to choose the method of detection of aldehydes by qualitative reactions - interaction with ammonia solution of argentum (I) oxide, copper (II) hydroxide.
Carbon acids	Characteristic (functional) group of carboxylic acids. Classification of carboxylic acids. The general formula of saturated monobasic carboxylic acids. Structure, nomenclature, isomerism of monobasic	Determine the structural isomers of saturated monobasic carboxylic acids by the structure of the carbon chain, W. form isomers (esters).

	carboxylic acids, properties, extraction, application.	To name saturated monobasic carboxylic acids according to the IUPAC nomenclature, to give trivial names to the first three monobasic carboxylic acids. Classify carboxylic acids according to the structure of the carbon chain (saturated, unsaturated), the number of carboxyl groups (one-, two- basic) and the number of carbon atoms in their molecules (lower, higher). To formulate structural isomers of saturated monobasic carboxylic acids; equations of reactions that reflect the chemical properties of carboxylic acids (interaction with active metals, basic oxides, bases, salts of carboxylic acid, alcohols); equation of methane acid extraction reactions (methane oxidation, interaction of carbon (II) oxide with sodium hydroxide with subsequent action of hydrochloric acid) and ethanoic acid (oxidation of butane, ethanol, ethanol). To substantiate the ability of lower carboxylic acids to electrolytic dissociation, and their solutions - to change the color of indicators; special chemical properties of methane acid (ability to oxidize - interaction with ammonia solution (I) oxide, copper (II) hydroxide). Compare the physical properties (boiling point, solubility in water) of saturated monobasic carboxylic acids and monohydric saturated alcohols; acidic properties of carboxylic acids within homologous series, as well as with alcohols, phenol and inorganic acids. Establish links between the electronic structure of molecules and the physical and chemical properties of carboxylic acids.
Esthers, Oils	General formula of carboxylic acid esthers. Structure, nomenclature, isomerism, properties, extraction, application. Oils - esthers. for and higher carboxylic acids. Classification of fats/oils, properties, extraction, application. Honey	Determine the structural isomers of carboxylic acid esters by the structure of the carbon chain, W. form isomers (carboxylic acids); structural formulas of fats - Tue. forms, Tue. formal; salt formulas

	and synthetic detergents.	palmitic and stearic acids. Name esters according to the IUPAC nomenclature. Classify fats into animal and vegetable; solid and liquid. Make the equations of reactions of formation of esters (vt. Formal) and their hydrolysis; equations of reactions that reflect the properties of fats (saponification, hydrogenation). Establish links between the composition, structure of molecules, properties and uses of fats. Apply knowledge to choose how to detect unsaturated liquid fats (interaction with bromine water).
	3.3. Carbohydrates	
Carbohydrates	Classification of carbohydrates; composition, molecular formulas of glucose, fructose, sucrose, starch and cellulose; structural formula of the open form of the glucose molecule; properties of glucose, sucrose, starch and cellulose; glucose extraction, production of sucrose and starch; qualitative reactions for the determination of glucose and starch; use of glucose, starch, cellulose.	Distinguish between mono-, di- and polysaccharides. Give examples of the use of glucose, starch (ethanol production) and cellulose (extraction of artificial acetate silk) by their properties. Compose equations of reactions that reflect the chemical properties of glucose (complete and partial oxidation, reduction, alcohol and lactic acid fermentation, VT formal, interaction with copper (II) hydroxide without heating (without writing the reaction equation) and with heating), sucrose (complete oxidation) , hydrolysis, formation of sugars), starch (acid and enzymatic hydrolysis) and cellulose (complete oxidation, hydrolysis, formal formation of triacetate and cellulose trinitrate), photosynthesis .. Establish the similarities and differences between starch and cellulose in composition, structure of molecules and properties. Apply knowledge to choose the method of detecting glucose (interaction with ammonia solution of argentum (I) oxide, reaction with copper (II) hydroxide) and starch (interaction with iodine).

3.4. Nitrogen-containing compounds		
Amenes	Characteristic (functional) group of amines. Classification of amines. Nomenclature, isomerism, structure, properties, methods of extraction and application.	Determine the structural formulas of isomeric amines by the structure of the carbon chain, the position of the amino group and interspecific isomers (primary, secondary, tertiary amines). Name amines according to the IUPAC nomenclature. Classify amines as ammonia derivatives (primary, secondary and tertiary) and by the structure of the carbon chain (saturated, aromatic). Compose equations of reactions that reflect the chemical properties of saturated amines as organic bases (interaction with water, inorganic acids; combustion); aniline (interaction with inorganic acids, bromine water); aniline extraction (reduction of nitrobenzene - reaction of M. Zinin). Substantiate the main properties of saturated amines and aniline; reducing the basic properties and increasing the reactivity of aniline in substitution reactions. Compare the main properties of ammonia, primary, secondary, tertiary saturated amines and aniline.
Amino Acids	Composition and structure of molecules, nomenclature, properties, extraction, application of amino acids. The concept of amphoteric amino acids, bipolar ion; di-, tri-, polypeptides, peptide bonds (peptide group of atoms).	Name the amino acids according to the IUPAC nomenclature. Make structural formulas of the simplest amino acids - glycine (aminoethane), alanine (2-aminopropanoic); reaction equations that reflect the chemical properties of amino acids on the example of the interaction of aminoethanoic acid and 2-aminopropanoic acid with inorganic acids, bases; formation of di-, tri-, polypeptides. Justify the amphotericity of amino acids, the formation of bipolar ions. Compare the structure of molecules and chemical properties of amino acids with carboxylic acids and amines.

Proteins	The structure of proteins, their properties, applications, color reactions to proteins.	Structure of proteins, their properties characterize the processes of hydrolysis, denaturation of proteins. Apply knowledge to choose the method of protein detection (xanthoprotein and biuret reactions).
Synthetic macromolecular substances and polymeric materials based on them	Synthetic macromolecular substances and polymers materials based on them. The concept of polymer, monomer, elementary unit, the degree of polymerization. Classification of macromolecular substances; methods for the synthesis of macromolecular substances; structure and properties of polymers; thermoplastic polymers and plastics based on them; the concept of natural and synthetic rubbers, synthetic fibers; the importance of polymers in the public economy and everyday life. Distinguish ways of formation of macromolecular compounds (polymerization and polycondensation reactions). Compare the properties of natural (cotton, linen, silk, wool), artificial (artificial acetate and viscose silk) and synthetic fibers (kapron, mylar). Establish relationships between properties and applications polymers.	Classify polymers by production (natural, artificial, synthetic); relation to heating (thermoplastic, thermoreactive); structure (linear, branched, mesh). Write the equations of polymerization reactions with the formation of the most important polymers (polyethylene, polypropylene, polystyrene, polyvinyl chloride, Teflon, Formaldehyde resins, polyisoprene, polybutadiene, kapron, mylar). Distinguish ways of formation of macromolecular compounds (polymerization and polycondensation reactions). Compare the properties of natural (cotton, linen, silk, wool), artificial (artificial acetate and viscose silk) and synthetic fibers (kapron, mylar). Establish links between the properties and applications of polymers.
3.5. Generalization of Knowledge about Organic Compounds		
Generalization of knowledge about organic compounds	Establishing genetic links between different classes of organic compounds, between organic and inorganic compounds	Compare the chemical properties of organic compounds of different classes. Establish links between the composition and chemical properties of organic compounds of different classes, between organic and inorganic compounds; genetic links between organic and inorganic compounds. Compose the equations of reactions - interconversions of organic compounds of different classes.
Section: 4. Calculations in Chemistry		
Solving chemical problems	Formulas for calculating quantity substance, the number of particles in a certain amount of substance, the mass fraction of the element in the compound, the relative density of the	Calculate the relative molecular and molar mass of the substance; the number of particles in a certain amount of substance, mass of substance, volume of gas; the volume of a given mass or quantity of a gas substance per n. in.; the relative density of a gas over another gas; mass and volume (for gases) particles of substances in the mixture; the average molar mass of the gas mixture; mass fraction of the element in the compound according

	gas, the mass (volume) fraction of the component in the mixture, derivation of the compound formula by mass fractions of elements	to its formula. Determine the chemical formula of a compound by the mass fractions of its constituent elements.
Expression of the quantitative composition of a solution (mixture)	Mass fraction of solute	Calculate the mass fraction of solute in solution, mass (volume) of solution and solvent, mass of solute. Perform calculations to prepare solutions from crystal hydrates.
Solving problems by reaction equations	Algorithms for solving problems by the reaction equation; the relative yield of the reaction product.	Calculate mass, volume (for gas) or by chemical reaction equation the amount of the substance of the reagent or product by a known mass, volume (for gas) or quantity of the substance of another reagent or product; the relative yield of the reaction product. Establish the chemical formula of a substance based on quantitative data about reagents and reaction products. Perform calculations if substances contain impurities or are present in excess. Solve combined problems (combination of no more than two algorithms).

II. ASSESSMENT CRITERIA

The list of questions for the entrance test is based on the programme of the external independent assessment in "Chemistry", which is developed in accordance with the current program in chemistry for secondary schools.
The entrance test aims at checking up the applicant's knowledge, skills, abilities and competence necessary for studying Chemistry.
During the entrance test, the applicant prepares answers to the tasks in writing. The applicant is given an hour to prepare his/her answers.
The entrance test is evaluated on a 200 - point scale. The final grade is determined by the number of correct answers to the 50 test questions according to the assessment criteria of the entrance exam.

Number of correct answers to 50 questions	Assessment on a 200-point scale	Number of correct answers to 50 questions	Assessment on a 200-point scale
0	0	26	104
1	4	27	108
2	8	28	112
3	12	29	116
4	16	30	120
5	20	31	124
6	24	32	128
7	28	33	132
8	32	34	136
9	36	35	140
10	40	36	144
11	44	37	148
12	48	38	152
13	52	39	156
14	56	40	160
15	60	41	164
16	64	42	168
17	68	43	172
18	72	44	176
19	76	45	180
20	80	46	184
21	84	47	188
22	88	48	192
23	92	49	196
24	96	50	200
25	100		

RECOMMENDED LITERATURE LIST

1. Brown L., LeMay H. & E., Bruce, Bursten E., Murphy C., Woodward P. Chemistry: The Central Science. (Chemistry: The Central Science in SI Units.
2. Tro N. Chemistry: A Molecular Approach.
3. Petrucci Ralph, Herring F., Madura Jeffry, Bissonnette Carey General Chemistry: Principles and Modern Applications
4. Tro N. Introductory Chemistry Essentials (MasteringChemistry)
5. Moore J.T. Chemistry For Dummies (For Dummies (Lifestyle)
6. Підручник «Хімія. 7 клас» / вт.. Попель П.П., Крикля Л.С./ К: Академія, 2007.
7. Підручник «Хімія. 7 клас» / вт.. Ярошенко О.Г./ К: Станіца, 2008.
8. Підручник «Хімія. 7 клас» / вт.. Буринська Н.М./ К: Перун, 2007.
9. Підручник «Хімія. 7 клас» / вт.. Лашевська Г.А./ К: Генеза, 2007.
10. Підручник «Хімія. 8 клас» / вт.. Попель П.П., Крикля Л.С./ К: Академія, 2008.
11. Підручник «Хімія. 8 клас» / вт.. Ярошенко О.Г./ К: Освіта, 2008.
12. Підручник «Хімія. 8 клас» / вт.. Буринська Н.М./ К: Перун, 2008.
13. Підручник «Хімія. 9 клас» / вт.. Буринська Н.М., Величко Л.П./ К: Перун, 2009.
14. Підручник «Хімія. 9 клас» / вт.. Лашевська Г.А./ К: Генеза, 2009.
15. Підручник «Хімія. 9 клас» / вт.. Попель П.П., Крикля Л.С./ К: Академія, 2009.
16. Підручник «Хімія. 9 клас» / вт.. Ярошенко О.Г./ К: Освіта, 2009.
17. Підручник «Хімія. 10 клас (рівень стандарту, академічний рівень)» / вт.. Ярошенко О.Г./ К: Грамота, 2010.
18. Підручник «Хімія. 10 клас (рівень стандарту, академічний рівень)» / вт.. Попель П.П., Крикля Л.С./ К: Академія, 2010.
19. Підручник «Хімія. 10 клас (профільний рівень)» /авт. Буринська Н.М. та вт./ К: Педагогічна думка, 2010
20. Підручник «Хімія. 11 клас (рівень стандарту)» / вт.. Лашевська Г.А., Лашевська А.А./ К: Генеза, 2011.
21. Підручник «Хімія. 11 клас (рівень стандарту)» / вт.. Ярошенко О.Г./ К: Грамота, 2011.
22. Підручник «Хімія. 11 клас (академічний рівень)» / вт.. Попель П.П., Крикля Л.С./ К: Академія, 2011.
23. Підручник «Хімія. 11 клас (академічний рівень)» / вт.. Величко Л.П./ К: Освіта, 2011.
24. Сучасна термінологія і номенклатура органічних сполук / вт.. Толмачова В.С., Ковтун О.М., Корнілов М.Ю., Гордієнко О.В., Василенко
25. С.В./ Тернопіль: Навчальна книга – Богдан, 2008.
26. Номенклатура органічних сполук / вт.. Толмачова В.С., Ковтун О.М., Дубовик О.А., Фіцайло С.С./ Тернопіль: Мандрівець, 2011.