«Затверджую»
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PROGRAM ON CHEMISTRY
for entrants to the Bukovinian State Medical University, who use the special conditions of admission in 2021.

1. General chemistry

1.1. Basic of chemical concepts. Substance.

To know. Concept of matter, physical body, material, simple substance (metal, nonmetal), complex substance, chemical element; the smallest particles of matter - atom, molecule, ion (cation, anion). Physical and chemical properties of the substance. Composition of a substance (qualitative, quantitative). Valence of a chemical element. Chemical (simplest, true) and graphic (structural) formulas. Physical phenomenon and chemical reaction. Relative atomic and molecular (formula) mass, molar mass, amount of matter. Units for measuring the amount of substance, molar mass, molar volume; values of temperature and pressure that correspond to normal conditions (n. c.): molar volume of gas (in n. c.). Avogadro's Law; Number Avogadro; average relative molecular mass of gas mixture, air. The mass fraction of the element in the compound.

To be able to compile formula formulas based on valence values of elements. Record chemical and graphic (structural) formulas of substances. 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; the simplest and true formula of the compound.

Determine the valence of elements in binary compounds. Analyze the qualitative (elemental) and quantitative composition of matter according to its chemical formula.

1.2. Chemical reaction

To know. Chemical reaction, reaction scheme, chemical equation. Laws of preserving the mass of substances during the chemical reaction, the volume ratio of gases in the chemical reaction. External effects that accompany chemical reactions. The notion of an oxidizer. reductant, oxidation, recovery. Types of chemical reactions. The speed of the chemical reaction. Catalyst.

To be able to write reaction schemes, chemical equations; distinguish types of reactions by the number of reagents and products (reaction of combination, decomposition, exchange, substitution), change in the degree of oxidation of the elements (oxidation-reduction and non-oxidation-reduction reactions), thermal effects (reactions exothermic, endothermic), direction of flow (reversible reactions, irreversible); determine oxidizing and reducing agent oxidation-reduction reactions, oxidation and reduction processes; analyze the influence of the nature of the reactants, their concentration, the contact surface, temperature, gas pressure, catalyst and inhibitor on the rate of chemical reaction. Apply the law of preserving the mass of substances to convert the reaction scheme to the chemical equation. Use the electronic balance method to convert the oxidation-reduction reaction scheme to the chemical equation.

1.3. Periodic law and periodic system of chemical elements D. I. Mendeleev

To know. Periodic law (modern formulation). Structure of short and long variants of the periodic system: periods, groups, subgroups (main (A), sideways (B)). Ordinal (atomic) element number, placement of metallic and nonmetallic elements in the periodic system, periods and groups; alkaline, alkaline earth, inert elements, halogens.

To be able to. Distinguish in periodic system periods, groups, main (A) and secondary (B) subgroups; metallic and nonmetallic elements according to their position in the periodic system; alkaline, alkaline earth, inert gases, halogens. Use information contained in the periodic system to determine the type of element (metallic or nonmetallic element), the maximum value of its valency, the type of simple substance (metal or nonmetal), the chemical nature of oxides, hydroxides, compounds of elements with the Hydrogen. Analyze changes in the properties of simple substances and the acid-base nature of oxides and hydroxides depending on the placement of elements in periods, subgroups, during the transition from one period to another.

1.4. The structure of the atom

To know. The composition of the atom (nucleus, electron shell). Concept of nucleon, nuclide, isotopes, proton number, nucleon number, orbital, energy level and sublevel, coupled and unpaired electrons, radius of atom (simple ion); the main and excited states of the atom. The essence of the phenomenon of radioactivity. Forms s- and p-orbitals, placement of p-orbitals in space. Sequence of electron filling of energy levels and sublevels in atoms of elements № 1-20, № 26 electronic and graphic formulas of atoms and simple ions of elements № 1-20, № 26.

To be able to. Record and recognize the electronic and graphic formulas of atoms and simple ions of elements № 1-20, № 26 of the atoms of non-metallic elements

of the 2nd and 3rd periods in the excited state. Determine the composition of the nuclei (the number of protons and neutrons in the nuclide) and the electron shells (energy levels and sublevels) of the atoms of elements number 1-20. Compare the radii of atoms and simple ions. Analyze changes in the radii of atoms in periods and subgroups, the relationship between the radii of atoms and the number of electrons at the external energy level with the nature of the element (metallic or nonmetallic) properties of simple substances (metal or nonmetal) and the acid-base character of oxides and hydroxides.

1.5. Chemical bond.

To know. The main types of chemical bond (ionic, covalent, hydrogen, metallic). Characteristics of covalent bond - multiplicity, energy, polarity, length. Types of crystalline lattices (atomic, molecular, ionic, metallic); dependence of physical properties of a substance on the type of crystal lattices. The electronic formula of the molecule. Elemental electronegativity. The degree of oxidation of an element in a substance.

To be able to. Form electronic formulas of molecules, chemical formulas of compounds according to the stages of oxidation of elements, charges of ions. Distinguish the valence and degree of oxidation of the element. Calculate the degree of oxidation of the element in the compound. Determine the multiplicity, polarity or nonpolarity 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 crystalline lattice.

1.6. Mixture of substances. Solutions.

To know. Mixtures are homogeneous (solutions) and inhomogeneous (suspension, emulsion, foam, aerosols, gel). Mass and volumetric (for gas) particles of matter in the mixture. Methods of separation of mixtures (settling, filtration, centrifugation, evaporation, distillation). Concept solution, solvent, soluble substance, crystalline hydrate, electrolytic dissociation, electrolyte, nonelectrolyte, degree of electrolytic dissociation (without computation), ion-molecular equation. Mass fraction of dissolved substance in solution. Structure of the water molecule; hydrogen bond in water. Coloring of indicators (universal, litmus, phenolphthalein, methylorange) in acidic, alkaline and central media. Reactions of exchange between electrolytes in a solution.

To be able to. Draw up the schemes of electrolytic dissociation of bases, acids, salts; ion-molecular equations for molecular equations and molecular equations for ion-molecular equations. Distinguish homogeneous and heterogeneous mixtures of different types; dilute, concentrated, saturated, unsaturated solutions: electrolytes and non-electrolytes. strong and weak electrolytes. Determine the possibility of an exchange reaction between electrolytes in a solution. Analyze the influence of the structure of substances, temperature, pressure (for gases) on their solubility in water; Mechanisms of formation of ions at dissolution in water of electrolytes of ionic and molecular structure. Apply knowledge to choose the method of separating a homogeneous or heterogeneous mixture of substances.

2. Inorganic chemistry

2.1. Basic classes of inorganic compounds

2.1.1. Oxides

To know. Definition of the name, classification of oxides, chemical properties of saltforming oxides, methods of obtaining oxides.

To be able to. Formulate chemical formulas of oxides; equations of reactions that characterize the chemical properties of solvent oxides (interaction with water, oxides, acids, alkalis), methods of obtaining oxides (the interaction of simple and complex substances with oxygen, the decomposition of insoluble bases, some acids and salts during heating). Call oxides according to their chemical formulas. Determine the formulas of oxides among the formulas of compounds of other classes studied. Distinguish non-volatile (CO, N_2O, NO, SiO_2) and saltforming oxides (acidic, basic, amphoteric). Compare the chemical, basic, acid and amphoteric (based on examples of zinc and aluminum oxides) oxides. Establish the dependence of the properties of oxides on the type of element and the chemical bond in the compound.

2.1.2. Hydroxides (bases)

To know. Definitions (general and in terms of electrolytic dissociation), names, classification, chemical properties, methods of obtaining bases.

To be able to. Formulate the chemical formulas of the bases: the equation of reactions that characterize the chemical properties of alkalis (interaction with acidic oxides, acids and salts in solution) and insoluble bases (interaction with acids, decomposition during heating), methods of extraction of alkalis (interaction of alkaline and alkaline earths (except for magnesium)) metals with water, the main oxides of alkaline and alkaline earth elements with water) and insoluble bases (the interaction of salts with alkalis in solution). Call the bases according to their chemical formulas. Define formula formulas among formulas of compounds of other classes. Distinguish between soluble (alkali) and insoluble bases. Compare the chemical properties of soluble (alkali) and insoluble bases, their effect on the indicators.

2.1.3. Acids

To know. Definitions (general and in terms of electrolytic dissociation), names, classification, chemical properties, methods of obtaining acids.

To be able to. Form chemical acids formulas; equations of reactions characterizing the chemical properties of acids (action on indicators, interaction with metals, basic oxides, bases and salts in solution) and methods of their extraction (interaction of acid oxides with water, nonmetals with hydrogen, salts with acids). Call acids according to their chemical formulas. Determine the formula of acids among the formulas of compounds of other classes studied, the valency of the acid residue by the acid formula. Distinguish acid in composition (oxygene-containing, nonoxygenic), the ability to electrolytic dissociation (strong, weak) and basicity (single and multi-basic), stability (stable and unstable), and volatility (volatile and non-volatile).

2.1.4. Salt

To know. Definitions (general and in terms of electrolytic dissociation), names,

classification, chemical properties, methods of obtaining salts.

To be able to. Form chemical formulas of medium and acid salts; equations of reagents that characterize the chemical properties of middle salts (interaction with metals, acids - chloride, sulfate, nitrate, alkali, salts in solution) and methods of their extraction (interaction of acids with metals, basic oxides with acids, acid oxides from alkalis, alkali acids, acids salts, salts with alkalis, acid oxides with basic oxides, salts with salts, salts with metals (reactions are made in solutions), metals with nonmetals). Call average and sour salts according to their chemical formulas. Determine the formulas of medium and acid salts among formulas of compounds of other studied classes. Distinguish the composition of medium and sour salts.

2.1.5. Amphoteric compounds.

To know. The phenomenon of amphotericity (on examples of oxides and hydroxides); chemical properties, methods of obtaining amphoteric hydroxides.

To be able to. Formulate reaction equations that characterize the chemical properties of oxides and hydroxides of Aluminum and Zinc (interaction with acids, alkalis) and methods for the production of hydroxides of Aluminum and Zinc (interaction of salts of these elements with alkalis in solution, aluminates and zincates with acids).

2.1.6. Genetic links between classes of inorganic compounds

To be able to. Formulate the equation of reaction between inorganic compounds of different classes. Compare the chemical properties of oxides, bases, acids, amphoteric hydroxides, salts. Establish connections between the composition and chemical properties of oxides, acids, bases, amphoteric hydroxides, salts; genetic links between simple substances, oxides, bases, acids, amphoteric hydroxides, salts

2.2. Metal elements and their compounds. Metals

2.2.1. General information about metal elements and metals.

To know. The position of metal elements in the periodic system; features of the electronic structure of atoms of metal elements; features of the metal connection; general physical and chemical properties of metals, general methods of their extraction; series of activity of metals; the phenomenon of corrosion, methods of protecting metals from corrosion; Alloys based on iron (cast iron, steel).

To be able to. Determine the position of the metallic elements in the periodic system. Describe a metallic bond, metallic crystalline lattices, physical properties of metals. Distinguish between metallic and nonmetallic elements according to the electronic structure of atoms.

Form electronic formulas of atoms of metal elements - Lithium, Sodium, Magnesium, Aluminum, Potassium, Calcium, Ferum; the equations of reactions that characterize the chemical properties of metals (interaction with oxygen, halogens, sulfur, water, solutions of acids, alkalis and salts) and methods of their extraction (reduction of oxides of coke, carbon (II) oxide, hydrogen, metalothermia (aluminothermia)); equations of reaction occurring during the production of cast iron and steel. Explain the dependence of the chemical activity of metals on the electronic structure of their atoms; the essence of corrosion of metals; chemical transformations during the production of cast iron and steel. Predict the possibility

of chemical reaction of metals with water, solutions of acids, salts, alkalis.

2.2.2. Alkaline and alkaline earth elements

To know. Chemical properties of sodium, potassium, magnesium, calcium; names and formulas of the most important compounds of alkaline and alkaline earth elements; application of sodium, potassium, magnesium, calcium compounds; chemical formulas and names of the most important potassium fertilizers; hardness of water. Qualitative detection of sodium ions, potassium, magnesium, calcium.

To be able to. Characterize the position of sodium, potassium, magnesium, calcium in the periodic system, physical properties of sodium and potassium, magnesium and calcium, types of water hardness - temporary, or carbonate; permanent, general; the use of magnesium oxide and calcium, sodium hydroxide, potassium, magnesium and calcium. Qualitative detection of sodium ions, potassium, magnesium, calcium. Form electronic formulas of atoms and ions of sodium, potassium, magnesium, 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; equations of reactions used to reduce or eliminate the hardness of water (boiling, adding soda or lime).

2.2.3. Aluminum

To know. Chemical Properties, Extraction and Use of Aluminum: Names and Formulas of the Most Important Aluminum Compounds.

To be able to. Characterize the position of aluminum in the periodic system, the physical properties of aluminum, oxide and hydroxide Aluminum, the use of aluminum. Form electronic formulas of the atom and ion of aluminum; equations of reactions characterizing the chemical properties of aluminum (interaction with oxygen, halogens, sulfur, acid solutions, alkalis and salts), amphotericity of oxide and hydroxide Aluminum (interaction with basic and acid oxides, acids and alkalis).

2.2.4. Ferum

To know. Chemical properties and iron extraction; names and formulas of the most important compounds of the Ferum; application of iron and ferrum compounds.

To be able to. Characterize the position of the Ferrum in the periodic system, the physical properties of iron, oxides and hydroxides of the Ferum; application of iron and compounds of the Ferrum (II) and (III); Physiological role of Ferrum ions (Fe^{2+}, Fe^{3+}). To form the electronic formula of the Ferum atom; the equations of reactions that characterize the chemical properties of iron (interaction with oxygen, chlorine, sulfur, water vapor, solutions of acids and salts, rust), oxides and hydroxides of Ferrum (II) and (III) (interaction with acids), Ferum salts (II) and (III) (interaction with solutions of alkalis, acids, salts), interconversion of the compounds of Ferum (II) and Ferum (III).

2.3. Non-metallic elements and their compounds. Nonmetals

2.3.1. Halogens

To know. Chemical formulas of fluorine, chlorine, bromine, iodine; chemical formulas, names and physical properties of the most important compounds of halogens (hydrogen chloride, halides of metallic elements); methods of obtaining

in the laboratory and chemical properties of chlorine, hydrogen chloride and hydrochloric acid; the most important branches of chlorine application, hydrogen chloride, chloride acid; qualitative reaction for the detection of chloride ions.

To be able to. Formulate 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); the equation, the reaction of obtaining hydrogen chloride in the laboratory. Compare the chemical activity of halogens. Characterize the most important branches of chlorine (as an oxidant, in the production of organic and inorganic substances), hydrogen chloride, chloride acid (in the production of plastics, for the production of chlorides), chlorides (sodium chloride - food condiments for the production of chlorine, sodium, sodium hydroxide, soda) Apply knowledge to detect chloride ions in solution.

2.3.2. Oxygen and Sulfur.

To know. Chemical formulas for oxygen, ozone, sulfur and the most important compounds of Oxygen and Sulfur; physical and chemical properties of oxygen, ozone, sulfur, sulfur oxides, sulfate acid, sulfates; methods of obtaining oxygen in the laboratory; the most important branches of oxygen, ozone, sulfur, sulphate and sulphate use; qualitative reaction for the detection of sulfate ions.

To be able to. Formulate the equations of reactions characteristic of oxygen (interaction with metals, nonmetals, compounds of nonmetallic elements with Hydrogen), sulfur (interaction with metals, some nonmetals), sulfurous oxides (interaction with water, basic oxides, bases), sulfate acid (interaction with metals , basic oxides, bases, amphoteric compounds, salts); the equation of oxygen extraction reactions in the laboratory, the formation and expansion of ozone. Compare composition, chemical activity of oxygen and ozone. Characterize the most important branches of the use of oxygen (as an oxidizer), ozone (disinfection of water), sulfur (sulfate production, production of rubber, matches, anti-inflammatory drugs, cosmetics), sulfate acid (production of mineral fertilizers, fibers) and sulfates (gypsum - in construction) , medicine; copper sulfate - for the control of plant pests, etching of wood). Apply knowledge to choose the method of detecting oxygen and sulfate ions (in solution), methods of collecting oxygen (displacement of air or water).

2.3.3. Nitrogen and Phosphorus

To know. Chemical formulas for 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, orthophosphoric acid, orthophosphates; methods of obtaining ammonia, nitrate and orthophosphate acids in the laboratory; the most important fields of application of nitrogen, ammonia, nitric acid, nitrates, orthophosphoric acid, orthophosphates; qualitative reactions for the detection of ammonium ions and orthophosphate ions.

To be able to. Formulate 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 characterize the interconversion of medium and acidic ortho-phosphates; The equation of the reactions of the thermal decomposition of ammonium salts (chloride, nitrate, carbonate and hydrogen carbonate) and nitrates: the equation of the ammonia extraction, nitrate and orthophosphate extraction reactions in the laboratory. Characterize the composition and structure of simple substances of phosphorus (red and white phosphorus), the most important branches of nitrogen use (production of ammonia, the creation of low temperatures), ammonia (production of nitric acid, fertilizer production, ammonia), nitric acid (fertilizer production, explosives, nitrogen-containing organic compounds), nitrates (production of fertilizers, explosives), orthophosphate acid and orthophosphates (fertilizer production). Compare the chemical activity of nitrogen, red and white phosphorus. Apply knowledge to choose how to detect ammonia, ammonium ions and orthophosphate ions (in solution).

2.3.4. Carbon and Silicon

To know. Simple substances Carbon; adsorption, adsorption properties of activated carbon; chemical formulas of the most important compounds of Carbon and Silicon; physical and chemical properties of carbon, silicon, oxides of carbon, carbonates, silicides (IV) oxide; silicate acid, silicates; ways to extract Carbon oxides, in the laboratory; the most important branches of diamond, graphite, activated carbon, oxide use.

3. Organic Chemistry

3.1. Theoretical Foundations of Organic Chemistry

To know. The most important elements are organogens, natural and synthetic organic compounds. Molecular structure of organic compounds. Chemical bond in molecules of organic compounds: energy, length, spatial orientation, polarity. σ-connection and π-connection. Single, multiple (double, triple), aromatic ligaments. Hybridization of the electron orbitals of the Carbon atom; sp^3, sp^2, sp hybridization. Classification of organic compounds in the structure of the carbon chain and the presence of characteristic (functional) groups. The phenomenon of homology: homologues, homologous series, homologous difference. Classes of organic compounds. General formulas of homologous series and classes of organic compounds. The notion of primary (secondary, tertiary, quaternary) atom Carbon. Nomenclature of organic compounds. The phenomenon of isomerism, isomers, structural and spatial (geometric, or cis-, trans-) isomerism. Mutual influence of atoms or groups of atoms in organic molecules. Classification of chemical reactions in organic chemistry (reactions of addition, substitution, isomerization).

To be able to. Determine the most important elemental organogens (C, H, O, N, S, P). Distinguish the characteristic features of inorganic and organic compounds, natural and synthetic organic compounds. Characterize by the multiplicity, polarity or nonpolarity of covalent bond in organic molecules, σ-bond and π-bond by way of formation. Compare single, double, triple and aromatic bonds for 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 the hybrid electronic orbitals of Carbon atoms in organic molecules. Classify organic compounds based on the structure of the carbon chain on saturated hydrocarbons acyclic structure - alkanes, unsaturated hydrocarbons acyclic structure - alkenes, alkenes; cyclic hydrocarbons - cycloalkanes and arenes; by the presence of characteristic (functional) groups on alcohols, phenol, halogenoalkanes, aldehydes, carboxylic acids, esters, amines, amino acids. Determine homologues of hydrocarbons and their derivatives. Separate homologous rows 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. Determine in the molecules of organic compounds of different structure the primary, secondary, tertiary, quaternary atoms of Carbon. Call organic compounds according to the structural formulas, using the nomenclature of IUPAC. Formulate organic formulas of organic compounds by name in accordance with the nomenclature IUPAC. Determine isomers by structural formulas. Distinguish between structural and spatial (geometric, or cis- and trans-) isomers. Establish the differences between isomers and homologues in terms of qualitative and quantitative composition, structure of molecules. Establish a connection between the structure and properties of organic compounds, taking into account the redistribution of electron density on examples of propane (addition of halogens and water in accordance with V. Markovnikov's rule); alcohols (similar to acids); phenol (acidic properties, the ability to substitute reactions in the benzene ring); saturated

monobasic carboxylic acids (acidic properties), amines (basic properties, aniline's ability to substitute reactions in the benzene ring). Analyze the chemical structure of organic compounds, using the main provisions of the theory of A. Butlerov. Predict the reactivity of organic compounds using the notion of the mutual influence of atoms or groups of atoms in molecules. Classify reactions involving organic compounds (substitution, addition, cleavage, isomerization). Establish connections between the structure of organic molecules and their ability to react in a certain type.

3.2. Hydrocarbones 3.2.1. Alkanes

To know. General formula of alkanes, their nomenclature, isomerism, structure of molecules, physical and chemical properties, methods of extraction, application.

To be able to. Call the first 10 representatives of the homologous series of alkanes in the nomenclature IUPAC. Formulate molecular and structural formulas of alkanes; the equation of reactions characterizing the chemical properties of alkanes (the substitution reaction by the example of chlorination of methane, the complete oxidation of alkanes or partial oxidation of methane, the thermal decomposition of methane, cracking, isomerization of alkanes), the laboratory method for producing methane (from sodium acetate, aluminum carbide). Explain the phenomenon of sp^3 hybridization of the electron orbitals of Carbon atoms in alkanes molecules. Compare the physical properties of alkanes by their boiling and melting temperatures.

Substantiate the relationship between the aggregate state under normal conditions, the melting and boiling point of alkanes, and their relative molecular weight; the ability of alkanes to substitution reactions by the electronic structure of molecules, the use of alkanes (fuel, solvents, soot, hydrogen, halogenoalkanes) by their properties. Establish connections between the structure of molecules and the properties of alkanes.

3.2.2. Alkenes

To know. General formula, alkenes, their nomenclature, isomerism, structure of molecules, chemical properties, methods of extraction, application; qualitative reactions to double bond.

To be able to. Determine the structural isomers of the alkenes and the structure of the carbon chain, the location of the double bond; intergroup (alkenes and cycloalkanes) and spatial (geometric, or cis, trans-) isomers. Denominate alkenes with the IUPAC nomenclature. Formulate molecular, structural alkene formulas; reaction equations characterizing the chemical properties of ethane and propane (reactions with hydrogen, halogens, halogens, water, polymerization, partial oxidation of ethene and total oxidation of alkenes), industrial and laboratory methods for the extraction of alkenes (thermal cracking of alkanes, dehydrogenation of alkanes, dehydration of saturated the interaction of halogenoalkanes with alcoholic solution of alkali, reactions of alkins with hydrogen), the production of ethane in the laboratory (dehydration of alcohols, alkaline hydrolysis of halogen derivatives of alkanes). Explain the phenomenon of sp^2-hybridization of the electron orbitals of Carbon atoms in alkene molecules.

Apply knowledge to choose a method for detecting ethen (interaction with bromine water, aqueous solution of potassium permanganate), alkenes (interaction with bromine water).

Substantiate the use of alkenes (production of polyethylene, polypropylene, ethanol, 1,2-dichloroethane) by their properties. Establish connections between the structure and the ability of alkenes to addition reactions. Analyze the addition of halohydrides and water to propene in accordance with the redistribution of electron density in a molecule (Marlikovikov's rule).

3.2.3. Alkines

To know. General formula of alkines, their nomenclature, isomerism, structure of molecules; chemical properties and methods of obtaining ethane, qualitative triple bond reactions.

To be able to. Determine the structural isomers of alkenes in the structure of the carbon chain, the location of the triple bond. Call alkins under the nomenclature IURAC. Formulate molecular and structural alkynes; the reaction equation of the reactions characterizing the chemical properties of acetylene (the reaction of the addition with hydrogen, halogens, halides, water (reaction M. Kucherova), the substitution reaction - the interaction with sodium, ammonium solution of argentum (I) oxide, acetylene trimerization, complete oxidation of alkenes and partial oxidation of acetylene), industrial and laboratory methods of acetylene extraction (thermal decomposition of methane, interaction of calcium acetylenide with water, reaction of 1,2-dichloroethane with alcoholic solution of alkali, to substantiate the use of acetylene (gas cutting and welding of metals). Extraction of vinyl chloride, polyvinyl chloride, acetic aldehyde) due to its properties. Explain the phenomenon of sp-hybridization of the electron orbitals of the Carbon atoms in the molecules of alkenes. Apply knowledge to select the method for detecting acetylene (interaction with bromine water, aqueous solution of potassium permanganate, ammonium solution of argentum (I) oxide), alkenes containing CH bonds (interaction with bromine water, ammonium solution of argentum (I) oxide). Compare the reactivity of ethane and ethin in the addition reactions. Establish a connection between the structure and the ability of acetylene to addition, substitution reactions.

3.2.4. Aromatic hydrocarbons. Benzen

To know. The general formulas of the arenas of the homologous series of benzene. Structure, properties, methods of obtaining benzene, the concept of aromatic bonds, 6π-electronic system).

To be able to. Form the molecular and structural formulas of benzene, the equation of reactions characterizing the chemical properties of benzene (the reaction of substitution with the participation of halogens (in the presence of different catalysts), the addition reaction - hydrogenation and chlorination (hν), oxidation), the extraction of benzene in the industry (catalytic dehydrogenation of hexane , cyclohexane, trimerization with acetylene). Distinguish unsaturated and aromatic hydrocarbons. Explain the phenomenon of sp^2-hybridization

3.3. Oxygen-containing organic compounds.

3.3.1. Alcohols

To know. Characteristic (functional) group of alcohols. Classification of alcohols. The general formula of monoatomic saturated alcohols. Structure, nomenclature, isomerism, properties, methods of extraction and application. The notion of hydrogen bond. Ethylene glycol and glycerol as representatives of polyhydric alcohols; qualitative reaction to polyhydric alcohols.

To be able to. Determine the structural isomers of monoatomic saturated alcohols based on the structure of the carbon chain, the location of the hydroxyl group, and interclass isomers (ethers). Name monoatomic saturated alcohols, as well as

ethylene glycol and glycerol in the nomenclature IUPAC. Classify alcohols in the structure of the carbon chain - saturated, unsaturated, in the number of hydroxyl groups - single- and multi-atomic, by nature Carbon atoms, with which the hydroxyl group is combined, primary, secondary, tertiary alcohols. Formulate molecular, structural alcohols, reaction equations reflecting the chemical properties of saturated monoatomic alcohols and glycerol (substitution reactions, interaction with active metals, halogenhidrides, esterification, intermolecular dehydration, intramolecular dehydration, partial and complete oxidation), industrial methods of methanol production (from synthesis gas), ethanol (ethanol hydration, enzymatic fermentation of glucose, ethanal reduction) and laboratory methods for obtaining alcohols (hydrolysis of halogenoalkanes). Characterize the composition and structure of molecules of monoatomic saturated alcohols. Substantiate application of ethanol (production of acetic acid, diethyl ether) and methanol (extraction of formaldehyde) by their properties. Compare physical properties (boiling point, solubility in water) of monoatomic saturated alcohols and corresponding alkanes, methanol, ethanol, ethylene glycol and glycerol; the activity of monatomic saturated alcohols, water and inorganic acids in reactions with alkali metals. To establish connections between the electronic structure of molecules of monatomic saturated alcohols and their physical and chemical properties. Formulate reaction equations reflecting the chemical properties of ethylene glycol and glycerol (interaction with sodium, cuprom (II) hydroxide (without recording the equation of reaction), complete oxidation); and glycerol (interaction with nitric acid, higher saturated and unsaturated carboxylic acids): the production of glycerol (saponification of fats). Establish connections between the structure of molecules of polyhydric alcohols and their properties. Apply knowledge to choose a method for detecting polyhydric alcohols (interaction with coper (II) hydroxide).

3.3.2. Phenol.

To know. Formula phenol. The structure of the phenol molecule, the characteristic (functional) group in it; properties, extraction, application; qualitative reactions to phenol.

To be able to. Formulate molecular, structural formula for phenol; equations of reactions reflecting the chemical properties of phenol (reactions involving the hydroxyl group - interaction with sodium, sodium hydroxide, reactions involving the benzene ring - interaction with bromine water, nitric acid), its extraction in industry (hydrolysis chlorobenzene). Substantiate the mutual influence of the hydroxyl group and the benzene ring in the phenol molecule. Compare the acidic properties of alcohols, phenol and carbonate acid; the ability of benzene and phenol to the substitution reactions. Establish connections between the structure of the phenol molecule and its properties. Apply knowledge to choose a method for detecting phenol (interaction with iorn (III) chloride, bromine water).

3.3.3. Aldehydes

To know. General formula of aldehydes. Structure of aldehyde molecules, characteristic (functional) group, nomenclature, isomerism, properties, extraction, application; qualitative reactions to the aldehyde group.

To be able to. Determine the structural isomers of aldehydes in the structure of the

carbon chain. To call aldehydes with the nomenclature IUPAC. Give examples of the use of ethanal (the production of acetic acid, ethyl alcohol) and methanal (extraction of formalin, urotropinum) by their properties. Formulate the structural formulas of the aldehyde molecules and their structural isomers; equations of reactions reflecting the chemical properties of aldehydes (reduction, partial oxidation), ethanal extraction in industry (acetylene hydration by the reaction of M. Kucherov) and laboratory (by oxidation of ethanol); Apply knowledge to choose a method for detecting aldehydes by qualitative reactions - interaction with an ammonium solution of the argentum (I) oxide, coper (II) hydroxide.

3.3.4. Carboxylic acids

To know. Characteristic (functional) group of carboxylic acids. Classification of carboxylic acids. The general formula of saturated monobasic carboxylic acids. Structure, nomenclature, isomerism of monobasic carboxylic acids, properties, extraction, application.

To be able to. Determine the structural isomers of saturated monobasic carboxylic acids based on the structure of the carbon chain, interclass isomers (esters). To name the IUPAC range of saturated monobasic carboxylic acids, to give trivial names to the first three monobasic carboxylic acids. Classify carboxylic acids in the structure of the carbon chain (saturated, unsaturated), the number of carboxyl groups (one-, two-base) and the number of carbon atoms in their molecules (lower, higher). Formulas of structural isomers of saturated monobasic carboxylic acids; equations of reactions reflecting the chemical properties of carboxylic acids (interaction with active metals, basic oxides, bases, salts of carbonacetic acid, alcohols); the methanolic acid extraction reaction equation (methane oxidation, carbon dioxide (II) oxide interaction with sodium hydroxide followed by the effect of chloride acid) and ethanic acid (oxidation of butane, ethanol, ethanal). Substantiate the ability of lower carboxylic acids to electrolytic dissociation, and their solutions - to change the color of the indicators; special chemical properties of methane acid (the ability to oxidation - the interaction with an ammonium solution of argentum (I) oxide, cuprom (II) hydroxide).

Compare physical properties (boiling point, solubility in water) of saturated monobasic carboxylic acids and monoatomic saturated alcohols; acidic properties of carboxylic acids within the homologous range, as well as with alcohols, phenol and inorganic acids. Establish connections between the electronic structure of molecules and the physical and chemical properties of carboxylic acids.

3.3.5. Esthers. Fast

To know. The general formula of esters of carboxylic acids. Structure, nomenclature, isomerism, properties, extraction, application. Fats are esters of glycerol and higher carboxylic acids. Classification of fats, properties, extraction, application. Soaps and synthetic detergents.

To be able to. Determine the structural isomers of the carboxylic ester by the structure of the carbon chain, interclass isomers (carboxylic acids); structural formulas of fats - trioleine, tristearin, salt formulas of palmitic and stearic acids. Name esters in the IUPAC nomenclature. Classify fats on animal and plant, solid and liquid. Formulate the equation of formation of esters (esterification) and their

hydrolysis: equation of reactions that reflect the properties of fats (sapling, hydrogenation). Establish connections between composition, structure of molecules, properties and application of fats. Apply knowledge to choose how to detect unsaturated liquid fats (interaction with bromine water).

3.3.6. Carbohydrates

To know. Classification of carbohydrates, composition, molecular formulas of glucose, fructose, sucrose, starch and cellulose; structural formula of the open form of the molecule - glucose; properties of glucose, sucrose, starch and cellulose; extraction of glucose, production of sucrose and starch; qualitative reactions for determination of glucose and starch; application of glucose, starch, cellulose.

To be able to. Distinguish between mono-, di- and polysaccharides. Provide examples of the use of glucose, starch (ethanol production) and cellulose (the production of artificial acetate silk) by their properties.

Formulate reaction equations reflecting the chemical properties of glucose (complete and partial oxidation, reduction, alcoholic and lactic acid fermentation, esterification, interaction with coper (II) with hydroxide without heating (without recording the equation of reaction) and with heating), sucrose (complete oxidation, hydrolysis , formation of saccharates), starch (acid and enzymatic hydrolysis) and cellulose (complete oxidation, hydrolysis, esterification - formation of triacetate and trinitrate of cellulose), photosynthesis. Establish the similarity and difference of starch and cellulose in composition, structure of molecules and properties. Apply knowledge to choose a method for detecting glucose (interaction with ammonium solution of argentum (I) oxide, reaction with cuprum (II) hydroxide) and starch (interaction with iodine).

3.4. Nitrogen-containing organic compounds

3.4.1. Amines

To know. Characteristic (functional) group of amines. Classification of amines. Nomenclature, isomerism, structure, properties, methods of extraction and application.

To be able to. Determine the structural formulas of isomeric amines in the structure of the carbon chain, the position of the amino group and interspecific isomers (primary, secondary, tertiary amines). Name amines in the IUPAC nomenclature. Classify amines as ammonia derivatives (primary, secondary and tertiary) and in the structure of the carbon chain (saturated, aromatic). Formulate reaction equations reflecting the chemical properties of saturated amines as organic bases (interaction with water, inorganic acids, combustion); Aniline (interaction with inorganic acids, bromine water, extraction of aniline (reduction of nitrobenzene - M. Zinin's reaction), to substantiate the basic properties of saturated amines and aniline, to reduce the basic properties and increase the reactivity of aniline in substitution reactions, to compare the basic properties of ammonia, primary, secondary , tertiary saturated amines and aniline.

3.4.2. Amino acids

To know. Composition and structure of molecules, nomenclature, properties, extraction, application and amino acids. The notion of amphoteric amino acids, bipolar ion; di-, polypeptides, peptide bond (peptide group of atoms)

To be able to. Name the aminoacids in the nomenclature IUPAC. Formulate the structural formulas of the simplest amino acids - glycine (aminothian), alanine (2-aminopropane); equations of reactions reflecting the chemical properties of amino acids on the example of the interaction of aminothic acid and 2-aminopropanoic acid with inorganic acids, bases; the formation of di-, tri-, polypeptides. Substantiate the amphotericity of amino acids, the formation of bipolar ions. Compare the structure of molecules and the chemical properties of amino acids with carboxylic acids and amines.

3.4.3. Proteins

To know. The structure of proteins, their properties, application, color reactions to proteins.

To be able to. Characterize the processes of hydrolysis, denaturation of proteins. Apply knowledge to choose a way to detect proteins (xanthropoin and biuret reactions).

3.5. Synthetic high molecular substances and polymeric materials on their basis.

To know. The concept of polymer, monomer, elemental link, degree of polymerization. Classification of macromolecular substances; methods of synthesizing high-molecular substances; structure and properties of polymers; thermoplastic polymers and plastics on their basis; the concept of natural and synthetic rubbers, synthetic fibers; the importance of polymers in the social economy and everyday life.

To be able to. Classify polymers by way of obtaining (natural, artificial, synthetic); the ratio to heating (thermoplastic, thermosetting); structure (linear, branched, mesh). Formulate the equation of polymerization reactions to the formation of the most important polymers (polyethylene, polypropylene, polystyrene, polyvinyl chloride, teflon, phenol formaldehyde resins, polyisoprene, polybutadiene, nylon, lavsane).

Distinguish between methods for the formation of macromolecular compounds (polymerization and polycondensation reactions). Compare the properties of natural (cotton, flax, silk, wool), artificial (artificial acetate and viscose silk) and synthetic fibers (capron, lavsan). Establish connections between properties and the use of polymers.

3.6. Generalization of knowledge about organic compounds

To know. Establishing genetic links between different classes of organic compounds, between organic and inorganic compounds.

To be able to. Compare the chemical properties of organic compounds of different classes. Establish connections between the composition and chemical properties of organic compounds of different classes, between organic and inorganic compounds; genetic links between organic and inorganic compounds. Formulate reaction equations - interconversions of organic compounds of different classes.

4. Calculations in chemistry

4.1. Problem solving by chemical formulas and for the derivation of the formula of the compound

To know. Formulas for calculating the amount of substance, the number of particles in a certain amount of matter, the mass fraction of the element in the

compound, the relative density of gas, the mass (volume) of the component of the component in the mixture, the derivation of the formula of the compound by the mass fraction of elements.

To be able to. Calculate the relative molecular and molar mass of matter; number of particles in a certain amount of substance, mass of matter, volume of gas; the volume of this mass or amount of gas substance per n. in.; relative gas density by another gas; mass and volumetric (for gas) particles of substances in the mixture; average molar mass of gas mixture; the mass fraction of an element in the compound according to its formula. Establish the chemical formula of the compound in terms of the mass fraction of the elements included in its composition.

4.2. Expression of the quantitative composition of the solution (mixture)

To know. Mass fraction of dissolved substance.

Calculate the mass fraction of the dissolved substance in the solution, the mass (volume) of the solution and the solvent, the mass of the dissolved substance. Perform calculations to prepare solutions from crystalline hydrates.

4.3. Solving problems by reaction equations

To know. Algorithms for solving problems by the equation of reaction; relative yield of the product of the reaction.

To be able to. Calculate the chemical reaction of the mass, the volume (for gas) or the amount of the substance of the reagent or product by known mass, volume (for gas) or the amount of substance of another reagent or product; relative yield of the product of the reaction. Establish a chemical formula of a substance on the basis of quantitative data on reagents and reaction products. Perform calculations if the substances contain impurities or are present in excess. Solve composite tasks (combining no more than two algorithms).

The chemistry program was developed on the basis of the current program for conducting external independent chemistry assessment in 2020 (order of the Ministry of Education and Science of Ukraine dated 26.06.2018, №696)