

MINISTRY OF HEALTH OF UKRAINE
ODESSA NATIONAL MEDICAL UNIVERSITY



Rector of ONMedU

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2023

PROGRAM
INTRODUCTORY TEST IN CHEMISTRY
FOR FOREIGNERS AND STATELESS PERSONS

Odesa

2023

The chemistry program has been developed taking into account the current chemistry programs for secondary school students. The material of the program is divided into the following sections: "Inorganic Chemistry", "Organic Chemistry", "General Chemistry", "Calculations in Chemistry".

The program was discussed and approved at the meeting of the Admissions Committee of Odesa National Medical University (Minutes __ __ from _____20__)

The program was approved by the order of the rector of Odesa National Medical University (protocol № _____ from _____20__)

The main purpose of the test is an objective and impartial assessment of the level of academic achievement of persons who graduated from high school and expressed a desire to enter the Odesa National Medical University.

The task of assessment in chemistry is to assess the knowledge and skills of participants: students' knowledge of the most important laws and theories of chemistry; knowledge of chemical language, the ability to use the names and symbols of chemical elements, the names of simple and complex substances; ability to compose chemical formulas and equations of chemical reactions, to solve computational and experimental problems; understanding the relationship between the composition, structure, physical and chemical properties of substances, methods of their extraction, areas of application; knowledge of the most important natural and artificial substances, their structure, methods of extraction and areas of application; understanding the scientific basis of certain chemical industries; awareness of some environmental issues related to chemistry; understanding the role of chemistry in solving global problems of mankind.

GENERAL DESCRIPTION OF THE MAIN COMPONENTS OF THE CHEMISTRY EXAM

The chemistry exam includes 2 types of tasks from the specified sections of the discipline. The answers require in-depth knowledge of chemistry to the extent determined by the secondary school program and the chemistry program for foreign students of the preparatory department.

Task I.

Tasks with several answer options. The entrant must read the questions and fill in the table with the correct answers (5 questions) - the time of the task is 15 minutes (2-3 minutes for each question).

Task II.

Tasks with a detailed answer. The entrant must give a written answer to the question (2 separate questions) - the time of the task is 20 minutes.

CHEMISTRY INTRODUCTORY TEST PROGRAM

n / a	Name topics	Content of educational material
1. GENERAL CHEMISTRY		

1.1	Basic concepts	Atoms. Molecules. Relative atomic and relative molecular mass. The law of conservation of mass of matter. Molar mass. Mole - a measure of the amount of substance.
1.2	Chemical element. Chemical formula. Avogadro's law. Relative density of gases	Chemical element. Signs of chemical elements. Chemical formula. The law of constancy of composition. Mass hour of the element. Avogadro's law and its consequences. Relative density of gases. Molar volume.
1.3	The structure of the atom	Modern model of atomic structure. Isotopes. Structure of electronic shells of atoms.
1.4	Periodic law of DI Mendeleev. PSE	Opening of the periodic law. Its formulation by DI Mendeleev and modern, based on the structure of the atom. Periodic system of elements. The meaning of the periodic law. Periods, groups, insert decades, blocks. Dependence of properties of chemical elements on their presence in PSE.
1.5	Chemical bond	Quantum-mechanical theory of communication. Types of chemical bonds and parameters. Electronegativity of atoms, polarity and polarization of chemical bonds, the mechanism of its formation.
1.6	Classification of chemical reactions	Classification of chemical reactions on various grounds. Reactions of coupling, decomposition, exchange, substitution.
1.7	Rate of chemical reactions. Chemical equilibrium. Catalysis	The concept of the rate of chemical reactions. Dimensionality and definition of the concentration of components. Dependence of reaction rate on concentration. Kinetic equation of reaction. Influence of temperature and pressure on the rate of reactions. Vant-Goff's rule. Catalysis and catalysts. Catalytic reactions. Reversible reactions. Displacement of equilibrium according to the JIe Chatelier principle.
1.8	Solutions. General characteristics. Electrolyte solutions	The concept of solutions. Classification of solutions. Means of expressing the concentration of solutions. The concept of electrolytes. Strong and weak electrolytes. Degree and constant of dissociation. Ionic equations.
1.9	Redox reactions	The degree of oxidation of the elements. Redox reactions. Intermolecular, intramolecular, disproportionation. Compilation of equations by electronic balance. The most important oxidants and reducing agents.

2. INORGANIC CHEMISTRY

2.1	Oxides. Hydroxides	Classification of oxides. Means of production and properties of acid, basic and amphoteric oxides. Soluble and insoluble hydroxides, their production and properties.
2.2	Acids	Classification of acids. Obtaining oxygen-free and oxygen-containing acids. Chemical properties and applications of acids.
2.3	Salt. Genetic connection between the main classes of inorganic compounds.	Composition, types, nomenclature of salts. Chemical properties and means of obtaining salts. Hydrolysis of salts.
2.4	Hydrogen. Oxygen. Water	The position of hydrogen in PSE. Physical and chemical properties. Obtaining in the laboratory and industry. Allotropy. Physical and chemical properties of oxygen and ozone. Receiving. The structure of the water molecule. Physical and chemical properties. Biological role of water.
2.5	Halogens and their compounds	Provisions in the PSE. The structure of atoms. Physical and chemical properties. Obtaining in the laboratory and industry. Participation in OVR.
2.6	Sulfur and its compounds	The structure of the sulfur atom. Physical and chemical properties. Hydrogen sulfide. Oxides of sulfur (IV) and (VI). Obtaining properties. Sulfuric acid, properties, chemical bases of production of contact methods. Participation in OVR.
2.7	Elements of the main subgroup of the PSE group. Nitrogen and its compounds. Phosphorus and its compounds	General characteristics of the elements of the nitrogen subgroup. Nitrogen. Physical and chemical properties. Ammonia. Industrial production, properties. Ammonium salts. Nitric acid. Features of chemical properties of nitric acid, its production. Participation in OVR. Allotropic forms of phosphorus. Physical and chemical properties of phosphorus. Phosphorus oxide (V). Orthophosphate acid and its salts.
2.8	Elements of the carbon subgroup. Carbon and its compounds. Silicon	Carbon, its allotropic forms. Physical and chemical properties. Oxides of carbon (II) and (IV), carboxylic acid and its salts. Silicon, physical and chemical properties. Silica (IV) oxide, silicate acid. Silicon compounds in nature, its use in technology.

2.9	Alkali and alkaline earth metals	General characteristics of elements of subgroups of lithium and beryllium. Alkali and alkaline earth metals and their properties. Receiving. Compounds of sodium, potassium, calcium in nature.
2.10	Aluminum and its compounds	Position of aluminum in PSE. Forms of its compounds. Aluminum oxide and hydroxide, their amphotericity. Aluminum compounds in nature, application in engineering
2.11	Iron. Iron alloys	Characteristics of iron by position in PSE. The degree of oxidation of iron and the form of its compounds. Oxides and hydroxides of iron (II) and (III).
2.12	General characteristics of metals	Position of metal elements in PSE. Electronic structure. Methods of obtaining. A number of activities of metals. Corrosion.

3. ORGANIC CHEMISTRY

3.1	Theory of chemical structure. Nomenclature and classification of organic compounds	The subject of organic chemistry. AM Butlerov's theory of chemical structure of organic compounds. Types of bonds in molecules of organic compounds. Mechanisms of their formation and ways of rupture. Classification of organic compounds. Nomenclature. The concept of isomerism.
3.2	Saturated hydrocarbons	Homologous series of alkanes. The concept of hybridization. Spatial and electronic structure of saturated hydrocarbons. Their chemical and physical properties. Receipt and use.
3.3	Unsaturated hydrocarbons	Homologous series of alkenes, alkynes. The concept of hybridization. Spatial and electronic structure of unsaturated hydrocarbons. Their chemical and physical properties. Receipt and use.
3.4	Aromatic carbohydrates. Benzene and its homologues	Electronic structure and chemical properties of benzene. Industrial methods of obtaining benzene. The mutual influence of atoms on the example of toluene. Orientation rules in the benzene nucleus.
3.5	Hydro compounds. Monoatomic and polyhydric alcohols. Phenols	General formula, nomenclature, isomerism of saturated monohydric alcohols, their properties and methods of production. Polyhydric alcohols. Chemical properties of ethylene glycol and glycerol. The structure of the phenol molecule. Electronic effects and interaction of atoms in the phenol molecule. Chemical properties of phenol in comparison with the properties of alcohols.

3.6	Aldehydes	General formula of aldehydes. Electronic structure of aldehyde group. Nomenclature and isomerism of aldehydes. Chemical properties.
3.7	Carboxylic acids	Nomenclature and isomerism of carboxylic acids. The structure of the carboxyl group. Physical and chemical properties of monobasic carboxylic acids, methods of their production.
3.8	Esther, jury	Ester communication. Nomenclature of esters. Esterification reaction and conditions of its course. Esters of low molecular weight monobasic carboxylic acids and low molecular weight monobasic alcohols. General formula of fats. Fats as a source of glycerol, VZhK, salts of VZhK-soap. Synthetic and natural fat. Chemical properties of fats.
3.9	Carbohydrates	General characteristics of carbohydrates and their classification. Monoses, bioses, polyoses. Carbohydrates as poly functional compounds. Carbohydrate isomerism. D- and L-genetic series
3.10	Nitrogen-containing organic compounds. Amines	Nomenclature. Isomerism of amines. Chemical properties of fatty amines. Structure of amines. Comparison of the main properties of aniline as an aromatic amine with fatty amines. Industrial and laboratory methods of obtaining amines.
3.11	Amino acids. Proteins	Isomerism and nomenclature of amino acids. Chemical properties of amino acids. Alpha amino acids as structural units of proteins. Formation of peptic bond. Levels of protein structure. Types of chemical bonds in protein molecules.
3.12	Genetic connection between the main classes of organic compounds	Chains of transformation of the basic classes of connections among themselves.

4. CALCULATION IN CHEMISTRY

4.1	Solving problems to determine the formula of a substance and chemical formulas	Formulas for calculating the amount of a substance, the number of particles in a certain amount of a substance, the mass fraction of an element in a compound, the relative density of a gas, the mass (volume) fraction of a component in a mixture, the derivation of a compound formula.
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4.2	Expression of the quantitative composition of the solution	Mass fraction of solute.
4.3	Solving problems by chemical equations	Algorithms for solving problems by the reaction equation, the relative yield of the reaction product, impurities, mixtures.

CRITERIA FOR EVALUATION OF THE ADMISSION TEST

1. Number of tasks in the ticket of the entrance test - 7.
2. The minimum number of points required for compilation is 100. The maximum number of points is 200.
3. The ticket (Appendix №1) contains 5 test tasks with the definition of the correct answer from 4 proposed options (each correct answer is evaluated in 20 points), 2 tasks with an open answer form (each correct answer is evaluated in 50 points).
4. The answers must be entered in the answer sheet (Appendix №2).

LITERATURE

1. Richard Post. Chemistry: Concepts and Problems / Richard Post, Chad Snyder, Clifford C. Houk // A Self-Teaching Guide, Jossey-Bass, 2020. – 432 p. – (3rd Edition). ISBN 9781119632627.
2. Darrell D. Ebbing. General Chemistry / Darrell D. Ebbing, Steven D. Gammon. – Boston: Cengage Learnin, 2017. – 1190 c. – (Eleventh Edition). ISBN: 978-1-305-58034-3
3. William H. Brown. Introduction to Organic Chemistry / William H. Brown, Thomas Poon. – Hoboken, NJ: Wiley, 2016. – 723 c. – (6th edition). ISBN: 111887580X,9781118875803.
4. Paula Yurkanis Bruic. Organic Chemistry / Paula Yurkanis Bruic. – Santa Barbara: Pearson, 2017. – 1340 c. – (8th edition). (ISBN: 978-0134074580)
5. General chemistry : principles and modern applications / Ralph H. Petrucci, F. Geoffrey Herring, Jeffrey D. Madura, Carey Bissonnette. – Toronto: Pearson, 2016. – 1496 c. – (11th edition). (ISBN 978-0-13-293128-1)

The Executive Secretary
of the admission board of ONMedU –

Henadii STEPANOV

Examination task № 1

1. Specify the element 2 of the period that exhibits the strongest metallic properties
A. Beryllium
B. Lithium
B. Nitrogen
G. Fluor
2. Specify the type of bond between atoms in the CH₄ molecule
A. Ionic
B. Polar covalent
B. Nonpolar covalent
G. Hydrogen
3. Indicate the degree of oxidation of Cl in compounds with metals
A. +7
B. +1
B. -1
G. +5
4. Specify the propane formula
A. CH₄
B. C₂H₂
B. C₃H₈
G. C₄H₁₀
5. Specify the substance with which methanol reacts
A. KOH
B. HCl
B. Cu
G. NaCl
6. Determine and indicate the mass of 5 mol of sulfuric acid.
7. Write what is formed during the oxidation of butane.

ANSWER SHEET

NAME OF THE APPLICANT	Examination task №

Give answers to test tasks

	A	B	C	D
1				
2				
3				
4				
5				

Give a short answer to the question (please write in block letters)

6. _____

7. _____

EVALUATION:

Tasks 1-5 (number of points)	Tasks 6,7(number of points)	Total score

SNP of the examiner

Signature
