

1. Working program of the discipline

1.1. Explanatory note

- **The mission of MSM MUC** is to train competent specialists in the field of medicine, conforming to international standards and traditions of medical ethics, ready for continuous professional growth using modern achievements of science and practice to solve public health problems.
- **Abstract**

The program on the subject of "Chemistry" is included in the mandatory scope of the subjects being studied, included in the State Higher Educational Institution, and is compiled for students of the Faculty of Medicine. It includes all the theoretical material on the chemistry course required to pass the entrance exam. The program, compiled within the framework of the requirements of the State Higher Educational Institution, includes 2 main sections - "General Chemistry" and "Organic Chemistry". Training in each of these sections provides for listening to lectures on individual topics, seminars aimed at discussing and consolidating the theoretical material passed, solving problems and exercises on lecture topics (practical classes), as well as passing modules on the material passed, in accordance with the criteria and requirements of the admission exams.

- **The purpose and objectives of mastering the discipline**
- **The purpose of the discipline:**

The formation of students' holistic physico-chemical, natural science approach to the study of the human body, as well as the substantiation of chemical and physico-chemical aspects of the most important biochemical processes and various types of equilibria occurring in a living organism.

- **Tasks of the discipline:**

- To help students master knowledge the basic laws of physical chemistry for the characterization of living organisms and the description of biochemical processes occurring in the body, as well as for solving situational problems,
- the relationship between the chemical composition, structure, properties and biological activity of substances, including organic components of living organisms and medicines
- on the influence of the structure of the main classes of natural organic compounds and biopolymers on their chemical properties;

To form theoretical foundations and practical skills

- in the field of chemical systems, thermodynamics, chemical kinetics and reactivity, chemical identification;

Master execution skills

- basic chemical laboratory operations;

Master methods and tools

- synthesis of inorganic and simplest organic compounds.
- determine the basic physical characteristics of organic substances

- **The place of discipline in the structure of the main professional educational program of the Higher educational institution.**

This discipline is elective (by choice of students) of the mathematical and natural science cycle of the curriculum.

Prerequisites: physics, mathematics, biology.

Post-requirements: molecular biology, biochemistry, pharmacology, physiology, clinical disciplines.

- **Formed competencies, as well as a list of planned learning outcomes in the discipline (knowledge, skills, proficiency), formulated in a competent format.**

As a result of mastering this discipline, the student acquires the following professional competencies: OK1, OK3, IK1

- OK-1 - is able and ready to analyze socially significant problems and processes, use methods in natural sciences, mathematics and humanities in various types of professional and social activities;
- OK-3 - is able and ready to collect, process and interpret with the use of modern information technologies the data necessary to form judgments on relevant social, scientific and ethical issues;

After mastering the discipline "Chemistry", the student:

will know:

- safety regulations and work in biochemical laboratories with reagents, devices;
- the physico-chemical essence of the processes occurring in a living organism;
- structure and chemical properties of the main classes of biologically important organic compounds;
- basic chemical properties of carbohydrates, lipids, amino acids, nucleic acids;
- structure and functions of the most important chemical compounds (nucleic acids, steroids, lipids);
- physico-chemical methods of analysis in medicine (chromatography, spectrophotometry, etc.)•

- using the capabilities of modern chemical methods in laboratory diagnostics of diseases;
- the main methods used in chemistry.

will be able to:

- use educational, scientific, popular science literature, the Internet and an educational portal for professional activities;
- use the IUPAC nomenclature to compile names according to formulas of typical representatives of biologically important substances;
- use physical, chemical equipment;
- to make calculations based on the results of the experiment, to carry out elementary statistical processing of experimental data;
- classify chemical compounds based on their structural formulas;
- predict the direction and result of physico-chemical processes and chemical transformations of biologically important substances;
- to select the optimal chemical and other methods for conducting research;
- evaluate the results of research methods in chemistry;
- formulate corrective measures when identifying inconsistencies in goals, objectives and results obtained;

will be proficient in:

- chemical terminology;
- basic technologies of information search and transformation, including the use of educational educational resources;
- modern methods of research in chemistry;
- skills in planning experimental research work;
- skills of conducting research on chemical analyzers;
- skills in preparing bulk solutions for chemical research;
- skills of translating various concentrations of substances into the SI system of units for chemical research;

will understand

- classification and nomenclature of organic compounds, the most important classes of organic compounds;
- structure, methods of preparation, physical and chemical properties, basic theoretical concepts in organic chemistry, mutual transformations of classes of organic compounds;

will be able to synthesize

- isolate and purify organic compounds, determine the basic constants of organic compounds, conduct qualitative analysis of organic compounds;

- draw up a scheme for the synthesis of the desired drug, synthesize it according to literary methods,

will be able to

- apply the acquired knowledge in practice;
- plan the experiment;
- create experimental models;
- use reference, review and monographic literature in the field of organic chemistry;

will be able to analyze

- the obtained results of the conducted research;
- the effectiveness of the conducted research, to identify inconsistencies in the results of the tasks.

1.2. Recommended educational technologies

The following educational technologies are used to master the students of the discipline "Chemistry", gain knowledge and form professional competencies:

- lecture-electronic presentation,
- problem lecture,
- class-conference,
- training,
- brainstorming,
- small group method,
- participation in scientific and practical conferences, congresses, symposiums,
- student's research work,
- written analytical papers
- preparation and defense of abstracts,
- distance learning technologies.

1.3. Scope of discipline and types of academic work

According to the curriculum of 2021	1 sem.	Total	
		in hours	in credits
Total labor intensity	60	60	2
Classroom work	36	36	
Lectures	18	18	
Practical exercises			
Seminars			
Laboratory work	18	18	
Independent work	16	16	
SRSP	8	8	
Type of final control exam	exam		

1.4. Structure of the discipline in general chemistry

1.4.1. Thematic plan for the study of the discipline (by semesters)

№	The name of the sections and topics of the discipline (lectures and practical classes)	Classroom classes				Total hours for classroom work	SRSP	Independent work of the student	Formed competencies	Used educational	Forms of current and boundary control of academic
		lectures	seminars	practical. classes	laboratory work						
	Module 1										T
1	Topic 1. Fundamentals of thermodynamics and kinetics of chemical reactions	2			2				OK-1, OK-3	LV,PL,LC ,P	Pr, CW, P
	<i>Topic 2. Kinetics and catalysis. Solutions.</i>	2			2					LV,PL,LC ,P	
	Topic 3. Theory of electrolytic dissociation.	2			2					LV,PL,LC ,P	
	Topic 4. Chemistry of elements	2			2					LV,PL,LC ,P	
	Module 2										T
6	Тема 5. Углеводы	2			2					LV,PL,LC ,P	
	Topic 6. Biologically important properties of α -amino acids	2			2					LV,PL,LC ,P	

Topic 7. Proteins	2									
Topic 8. Nucleosides, nucleotides. The primary structure of nucleic acids	2			2					LV,PL,LC ,P	
Topic 9. Saponified lipids. Sterols, sterides, steroids and their derivatives. Reactions to fats. Reactions of the discovery of unsaturated higher fatty acids	2			2					LV,PL,LC ,P	
Total hours by discipline:	18			18	24	8	16			

Abbreviations of educational technologies, methods and methods of teaching: traditional lecture (L), lecture-visualization (LV), problem lecture (PL), lecture–press conference (LPC), lesson-conference (LC), training (T), debate (D), brainstorming (MS), master class (MC), "round table" (CS), activation of creative activity (ATD), regulated discussion (RD), forum–type discussion (F), business and role-playing educational game (DI, RI), small group method (MG), classes using simulators, simulators (TR), computer simulation (CS), analysis of clinical cases (CS), preparation and protection of medical history (IB), use of computer training programs (CPC), interactive atlases (IA), attendance of medical conferences, consultations (VC), participation in scientific and practical conferences (NPC), congresses, symposiums (SIM), student's educational and research work (UIRS), conducting subject Olympiads (O), preparation of written analytical papers (AR), preparation and protection of abstracts (P), project technology (PT), excursions (E), distance educational technologies (DOT).

Abbreviations of the forms of current and boundary control of academic performance: T - testing, Pr - assessment of the development of practical skills (abilities), , CW – control work, , P – writing and defending an abstract.

№	Topics of students' independent work:	Assignment for SRS	Recommended Literature	deadlines (weeks)	maximum score
1.	Quantitative characteristics of the composition of solutions and their colligative properties. Hypo-, hyper- and isotonic solutions. Osmosis, hemolysis, plasmolysis	REPORT	1. Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.	2	10
2.	Calculation of pH in aqueous solutions of strong and weak electrolytes. Buffer systems of the body: composition, mechanism of action. Acidosis. Alcoholosis	ABSTRACT	Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.	4	10
3.	Medico-biological significance of c-, p-, d-elements and their compounds	REPORT	Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.	6	10
4.	Classification, isomerism and nomenclature of organic compounds. Reactivity of hydrocarbons.	PRESENTATION	Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.	8	10
5.	Homo- and heteropolysaccharides: structure, biological role	REPORTING	Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.	10	10

6.	α -AMINO acids: classification, structure, nomenclature	PRESENT ATION	Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.	12	10
7.	The structure of heme, nucleosides, nucleotides.	PRESENT ATION	Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.	14	10

1.4.3. Assessment tools for monitoring academic performance

- Current (summative) and boundary (modular) (formative) control

The current control of students' knowledge can be:

- oral interview;
- testing on the topic,
- verification of laboratory work,
- verification of practical tasks,
- verification of control works,
- checking the completion of written homework;
- review of abstracts, essays, reports;

Examples of control works

1-option

1.Saturated monatomic alcohols do NOT react:

1. Dehydration 3. esterification

2. Hydrogenation 4. Oxidation

2 As a result of heating CH_3COOH and $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ in the presence of sulfuric acid, the following are obtained:

1. ethylpropanoate 3.ethylethanoate

2. propylethanoate 4. propylpropanoate

3.The number of substances proposed - formic acid, methane, sodium, sodium carbonate solution, copper (II) hydroxide, hydrogen bromide - that react with glycerin:

1. 5 3. 4

2. 2

4. 3

4. A substance whose structure is $\text{CH}_3\text{-CCCH-CH}_2\text{-CH=O}$ is called



1) 2-methyl-5-oxopentene-2 2) 2-methylpentene-2-al-5

3) 5-methylhexene-4-al 4) 4-methylpentene-3-al

5. The number of σ -bonds in the acetaldehyde molecule is

1) 2

2) 3

3) 5

4) 6

6. When acetaldehyde is heated with freshly precipitated copper(II) hydroxide, it is observed

1) the appearance of yellow and then red sediment

2) transformation of the blue precipitate of copper(II) hydroxide into black

3) dissolution of the precipitate and formation of a blue solution

4) dissolution of sediment and formation of cornflower blue solution

7. In the chain of transformations X $\text{CH}_3\text{-CH=}$ About Y

substances X and Y, respectively, are

1) ethylene and ethanol 2) ethanol and acetic acid

3) acetylene and ethanol 3) acetylene and acetic acid

8. A substance whose structure is $\text{CH}_3\text{-CH-CH}_2\text{-CH}_2\text{-COON}$ is called



1) 2-methylpentenic acid 2) 4-methylpentenic acid

3) 2-methylpentanoic acid 4) 4-methylpentanoic acid

9. Acetic acid reacts with

1) sodium bicarbonate 2) copper(II) hydroxide 3) sodium chloride

4) hydrogen chloride 5) chlorine

10. Establish a correspondence between the starting substances and the main product of the reaction

STARTING SUBSTANCES REACTION PRODUCT

1) $\text{CH}_3\text{-CH}_2\text{-CH=}$ About A) $\text{CH}\equiv\text{C-CH}_3 + \text{H}_2\text{O}$

2) $\text{CH}_3\text{-CO-CH}_3$ B) $\text{CH}_3\text{-CH}_2\text{-CH=O} + \text{Cu(OH)}_2$

3) $\text{CH}_3\text{-CH}_3\text{-CH}_3$ B) $\text{CH}_3\text{-CH}_2\text{-CH=O} + \text{H}_2$

4) $\text{CH}_3\text{-CH}_2\text{-COON}$ D) $\text{CH}_3\text{-SNON-CH}_3 + \text{CuO}$

5) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{ON}$

11. A molecule of acrylic (propenic) acid contains

1) one oxygen atom and one π bond 2) two oxygen atoms and two π bonds

3) one oxygen atom and two π bonds 4) two oxygen atoms and one π bond

12. What is formed as a result of glucose fermentation?

a) 1-propanol b) ethanol c) 2-propanol d) acetone

13. The products of the interaction of glucose with copper(II) hydroxide during heating are

a) sorbitol and Si_2O b) lactic acid and Si_2O c)
d) gluconic acid and Si_2O d) fructose and Si

14. Glucose isomer - fructose - is

a) acid b) ester c) aldehyde alcohol d) ketospirt

15. Kpurinovymosnovaniyam are

a) Adenine c) Cytosine

b) Uracil d) Thymine

16 Match the amine formula and its name

FORMULA NAME

A) $\text{C}_2\text{H}_5\text{NHCH}_3$ 1) ethylamine

B) $\text{CH}_3\text{NH}(\text{C}_2\text{H}_5)_2$ 2) propylethylamine

C) $\text{C}_2\text{H}_5\text{NH}_2$ 3) methylethylamine

D) $\text{C}_6\text{H}_5\text{NH}_2$ 4) aniline

5) methyldiethylamine

17. Write the equation of reactions by which the following transformations can be carried out:

Ethane ethyl alcohol acetic aldehyde acetic acid chloroacetic acid aminoacetic acid polypeptide.

18. We make up mRNA triplets complementary to DNA codons and write them down in the line below:

DNA: TAA-ATG-HCA-ACC

mRNA:

19. Calculate the mass of ethylene formed during the dehydration of 9.2 g of ethyl alcohol.

20. Calculate the amount of chlorine that will be required for the complete chlorination of 1.5 mol acetylene

Examples of laboratory work

Determination of the osmotic pressure value for the state of cells by the preservation of erythrocytes in solution

The purpose of the work: To master the preparation of solutions with a different mass fraction of the dissolved substance by dilution. To demonstrate the value of the concentration of dissolved substances for the normal state of cellular elements.

Course of work: Prepare a sodium chloride solution with a mass fraction of NaCl 3.4%. Prepare 5 test tubes, pour 2 ml of water into the tubes from the 2nd to the 5th pipette. Next, 2 ml of the prepared sodium chloride solution are poured into the 1st and 2nd test tubes. The solution in the 2nd tube is mixed and 2 ml of it is transferred to the next 3rd tube. The solution in the 3rd tube is also mixed and 2 ml of it is transferred to the 4th tube. The solution is mixed in the 4th tube and 2 ml of it is transferred to the 5th tube. From the last 5th tube, 2 ml of the solution is taken and poured. Each tube contains 2 ml of electrolyte solutions diluted in comparison with the initial solution in the following number of times: 1st □ 1, 2nd □ 2, 3rd □ 4, 4th □ 8 and 5th - 16 times. Thus, solutions with a mass fraction of sodium chloride are obtained 3,4%, 1,7%, 0,85%, 0,425%, 0,2125%. Then, 1 drop of a solution containing red blood cells is injected into each tube with a pharmacy pipette. The solutions are mixed and kept for 10 minutes. One drop of solution from each tube is applied to a slide with a glass rod and examined under a microscope at magnification (40×15).

The order of execution of the work: Give the calculation of the mass fraction of NaCl to obtain the initial solution. Record the color changes of solutions in test tubes after adding red blood cells and draw the pictures observed in the microscope. Explain the results obtained and draw conclusions about the osmotic pressure in the sodium chloride solutions used.

Topics of abstracts (essays, reports):

- Expression of genetic material in pro- and eukaryotes.
- Protein synthesis.
- Regulation of ontogenesis.
- Human genetics and hereditary diseases.
- Hereditary syndromes.
- Population-specific level of organization of the living. Features of evolutionary processes in human populations.
- Biogeocenotic level of life organization. The influence of environmental factors on humans.
- X-ray radiation and its use in engineering and medicine.
- Plasma is the fourth state of matter.
- Amorphous substances in nature, technology, everyday life.
- Environmental protection from chemical pollution. Quantitative characteristics of environmental pollution.
- Application of solid and gaseous carbon monoxide (IV).
- Protection of the ozone shield from chemical pollution.

- Coarse-dispersed systems, their classification and use in professional activities.
- Cosmetic gels.
- Solutions are all around us. Types of solutions.
- The history of gypsum.
- Table salt as a chemical raw material.
- Virtual modeling of chemical processes.
- The history of the origin and development of organic chemistry.
- Modern ideas about the theory of chemical structure.
- Environmental aspects of the use of hydrocarbon raw materials.

Sample questions for boundary (modular) control

ON INORGANIC, PHYSICAL AND COLLOIDAL CHEMISTRY

The doctrine of solutions

1. For any substance, the factor of equivalence ($f_{\text{э}}$) equal to one?
2. For some substances the factor of equivalence ($f_{\text{э}}$) is equal to 1/2?
3. For any substance, the factor of equivalence ($f_{\text{э}}$) is equal to 1/3?
4. For some substances the factor of equivalence ($f_{\text{э}}$) is equal to 1/6?
5. What concentration is measured in mol/kg?
6. What ratio is calculated molar concentration?
7. By what ratio is the molar concentration of the equivalent calculated?
8. By what formula is the mass fraction of the solution calculated?
9. 1 liter contains 3.65 g of hydrogen chloride. What is the molar concentration of this solution?
10. Hypertonic gauze bandages impregnated with a 10% aqueous solution of sodium chloride are used in surgery. How many grams of salt and water should be taken to prepare 500 g of such a solution?
11. 5 g of glucose was dissolved in 95 g of water. What is the mass fraction of glucose (%) in the resulting solution?
12. An increase in the boiling point of the solution compared to the boiling point of a pure solvent
13. What does the entry "3% H₂O₂ solution" mean?
14. The ebullioscopic constant of water is 0.52 O. What is the boiling point of an aqueous glucose solution, the molal concentration of which is 1 mol / kg?
15. Which solutions are hypertonic in relation to blood plasma?
16. Which solutions are isotonic with respect to blood plasma?
17. Which solutions are hypotonic in relation to blood plasma?
18. An aqueous solution of which of the substances listed below has the highest freezing point, provided that the molar concentrations of the equivalent of these solutions are the same?

19. An aqueous solution of which of the substances listed below has the lowest freezing point, provided that the molar concentrations of the equivalent of these solutions are the same?
20. At the same temperature, solutions with a molar concentration of 0.1 mol/l are isotonic to each other. For which pair of solutions will this condition be met?
21. What is the name of the part of the osmotic pressure due to the presence of high-molecular components in the solution?
22. What is the name of a solution with an osmotic pressure greater than in the standard?
23. What phenomenon is observed when red blood cells are placed in a 10% sodium chloride solution?
24. What phenomenon is observed when red blood cells are placed in a 0.1% sodium chloride solution?
25. Solutions of the salts listed below have the same molar concentration of 0.01 mol/l. Which pair of solutions contains the same number of particles in 1 liter of solution?
26. The amount of substance equivalent can be calculated as the ratio
27. What value can be calculated as the product of the equivalence factor and the molar mass of a substance?
28. What is the ratio of the amount of dissolved substance to the volume of the solution?
29. What is the ratio of the amount of solute to the mass of the solvent?

Buffer solutions

1. Which statement is true for a neutral solution?
2. Which component of the bicarbonate buffer solution will react when a small amount of hydrochloric acid is added to it?
3. By what equation can the concentration of hydrogen ions in an acetate buffer solution be calculated?
4. What compounds are part of the bicarbonate buffer solution?
5. What compounds are part of the phosphate buffer solution?
6. What compounds are part of the ammonia buffer solution?
7. In which aqueous solutions is the ratio $[H^+] < [OH^-]$ observed?
8. In which aqueous solutions is the ratio $[H^+] > [OH^-]$ observed?
10. What is the concentration of $[H^+]$ ions in pure water at 25 ° C (mol/L)?
11. What is the concentration of SO_4^{2-} if $C_{H^+} = 10^{-4}$?
12. What is the sum of pH and pOH for dilute aqueous solutions?
13. What is the name of the shift of the reaction of the environment in the body to the acidic side?

14. What is the name of the shift of the reaction of the environment in the body to the alkaline side?
15. What is the concentration of hydrogen ions (mol / l) in an aqueous solution with $RH = 11$?
16. What is the reaction of the medium if $RH = 13$?
17. What is the pH of a solution of sodium hydroxide with $C_{NaOH} = 0,001$ mol/l?
17. What ratios are true for HCl solution with concentration of 0.1 mol/l?
18. For aqueous solutions of some substances the condition $[H^+] > [OH^-]$?
19. What is the formula to calculate the concentration of hydrogen ions in a solution of acetic acid?
20. By what formula can the concentration of hydrogen ions in an ammonium hydroxide solution be calculated?
21. For a KOH solution with a concentration of 0.01 mol/l, it is true
22. What is the ionization constant K_b for a solution Odnokolenko weak base with a concentration of 0.1 mol/l and the degree of ionization $\alpha = 0,001$?
23. What is the degree of ionization α for Odnokolenko solution of a weak base with a concentration of 0.1 mol/l and the ionization constant K_b equal to 10^{-7} ?
24. How is the volume fraction of the chemically bound CO_2 in 100 ml of blood plasma?

The structure of the atom. Biogenic elements

1. How many electrons have particle Ba^{2+} , if the serial number of barium is 56?
2. How many electrons have particle I-if the sequence number of iodine is 53?
3. How many electrons have particle Fe^{3+} , if the atomic number of iron is 26?
4. What substances to form compounds that are toxic to humans?
5. Which element is the basis of bone tissue compounds?
6. Solutions of which substances are used in medicine as antiseptics?
7. What substance solution is used in medicine to increase the acidity of gastric juice?
8. What substance is used in medicine for increased acidity of gastric juice and heartburn?
9. Which ion is the main intracellular ion?
10. Which ion is the main extracellular ion?
11. What elements are macronutrients?
12. Which elements are organogens?
13. What elements are microelements?
14. When there is a lack of what element in the body, the disease "endemic goiter" occurs?
15. Which ion is the complexing agent in hemoglobin?
16. With a lack of what element in the body does osteoporosis develop?

17. When there is an excess of fluoride,
18. As a result of systematic inhalation of coal dust develops
19. With systematic inhalation of aluminum dust and its oxide, a disease develops:

Chemical thermodynamics

1. What thermodynamic system is the system "0.9% NaCl solution in a sealed ampoule"?
2. Which thermodynamic systems are homogeneous?
3. Which thermodynamic systems are heterogeneous?
4. Which thermodynamic system exchanges mass (matter) and energy with the environment?
5. Which of the following thermodynamic systems are closed?
6. Which thermodynamic system (with an equal amount of matter) will have the lowest entropy value?
7. What thermodynamic quantity is a measure of the reactivity of a chemical system?
8. How do heat and enthalpy change during an endothermic reaction?
9. How do heat and enthalpy change during an exothermic reaction?
10. During the course of which chemical reaction going on in the gas phase, the entropy of the thermodynamic system does not change?
11. During the course of which chemical reaction going on in the gas phase, the entropy of the thermodynamic system increases?
12. What kind of thermodynamic system is a person?
13. What biochemical processes take place in the cells of a living organism?
14. The heats of formation of which substances are zero?
15. What is the value equal to the amount of heat released or absorbed during the formation of 1 mole of a complex substance from simple substances under standard conditions?
16. "The heat of decomposition of any chemical compound is equal in absolute magnitude and opposite in sign to the heat of its formation" is the formulation
17. Which formula corresponds to the mathematical expression of the Lavoisier-Laplace law?
18. What will be the enthalpy of the decomposition reaction of two moles of water, if the enthalpy of the reaction of the formation of one mole of water is -241.6 kJ?
19. "The thermal effect of chemical reactions does not depend on the number of intermediate stages, but is determined only by the initial and final appearance and state of the system" is the formulation
20. The heats of formation of which of the above substances are not equal to zero?
21. How does the entropy change when the aggregate state changes in the crystal-liquid-gas series?

Kinetics of chemical reactions

1. What is the rate of chemical reaction?
2. What equation expresses the dependence of the rate of direct reaction $2\text{NO} + \text{O}_2 = 2\text{NO}_2$ on the concentration of reagents?
3. Which equation expresses the dependence of the rate of the reverse reaction $2\text{NO} + \text{O}_2 = 2\text{NO}_2$ on the concentration of reagents?
4. Which equation corresponds to the law of acting masses for the direct reaction $\text{A} + \text{B} \rightleftharpoons \text{AB}$?
5. What are the features of the catalytic action of enzymes?
6. What equation expresses the reaction rate of the first order?
7. What is the function of enzymes in a living organism?
8. For which reactions does the expression for velocity have the form $w = kC(\text{O}_2)$?
9. How will the rate of direct chemical reaction $\text{CaCO}_3(\text{s}) = \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$ change if the pressure in the system is increased by 5 times?
10. Which reaction is trimolecular?
11. What formula corresponds to the equilibrium constant of the reaction $2\text{NO}(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons 2\text{NOCl}(\text{g})$?
12. Which formula corresponds to the expression of the law of acting masses for the direct reaction $\text{CaCO}_3(\text{s}) = \text{CO}_2(\text{g}) + \text{CaO}(\text{s})$?
13. The temperature coefficient of the reaction $\gamma = 2$. How will the rate of chemical reaction change when the temperature increases from 35°C to 65°C?
14. What is the rate constant of a chemical reaction?
15. How is the influence of the concentration of reacting substances on the rate of a chemical reaction quantified?
16. How can the dependence of the rate constant of a chemical reaction on temperature be described quantitatively?
17. What statements characterize the enzymatic reaction?
18. Which of the listed reactions are homogeneous?
19. Which of the listed reactions are heterogeneous?

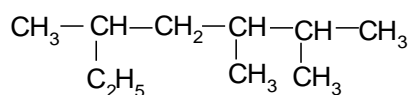
• Final (formative) control

The *final control* at the end of the study of the discipline is carried out in the form of a credit, which is set based on the results of the boundary (modular) control of the discipline.

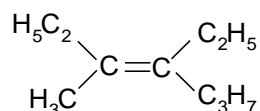
EXAMINATION QUESTIONS IN ORGANIC CHEMISTRY

Theoretical foundations of organic chemistry. Reactivity of hydrocarbons.

1. What is the name of the compound according to the substitution nomenclature?

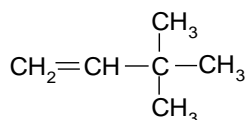


2. What is the name of the compound according to the IUPAC substitution nomenclature?

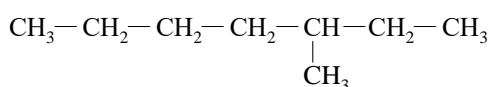


3. What is the name of the compound $(\text{CH}_3)_2\text{CN} - \text{S}(\text{CH}_3)_2 - \text{CH}_2 - \text{CH}_3$ by substitutive nomenclature?

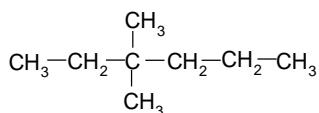
4. What is the name of the following compound by substitutive nomenclature?



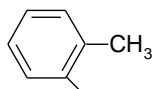
5. What is the name of the compound according to rational nomenclature?



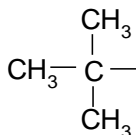
6. What is the name of the following compound according to rational nomenclature?



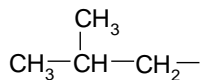
7. What name corresponds to the hydrocarbon radical?



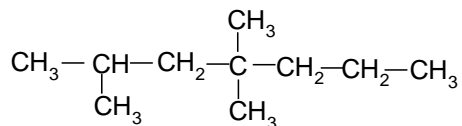
8. What name corresponds to the hydrocarbon radical?



9. What name corresponds to the hydrocarbon radical?

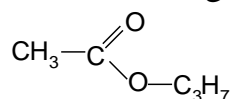


10. How many secondary carbon atoms are in the compound?

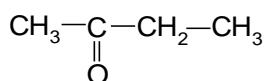


11. What is the number of primary carbon atoms in a 2,2-dimethylbutane molecule?

12. What class of organic substances does the compound belong to?



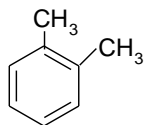
13. What class of organic substances does the compound belong to?



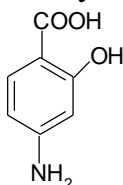
14. What class of organic substances does the compound belong to?

15. Which class of organic substances does the compound $\text{CH}_3-\text{CH}_2-\text{O}-\text{CH}_2-\text{CH}_3$ belong to?

16. What name corresponds to the formula?



17. What is the name of the replacement nomenclature corresponds to p-aminosalicylic acid (PASC), used as an antituberculous agent?



18. The following compounds are given: C_7H_{14} , C_8H_{18} , C_2H_2 , C_6H_6 , $\text{C}_{10}\text{H}_{22}$. What is the amount of compounds that are marginal hydrocarbons?

19. The hydrocarbon radical $\text{CH}_2 \square \text{CH} - \text{CH}_2 -$ is given. Which hydrocarbon does it correspond to?

20. The hydrocarbon radical $\text{C}_6\text{H}_5 -$ is given. Which hydrocarbon does it correspond to?

21. Which of the available functional groups in the serine molecule $\text{NO}-\text{CH}_2-\text{CH}(\text{NH}_2)-\text{COON}$ are reflected in the name according to the rules of the IUPAC substitution nomenclature in the form of an ending?

22. What is the name of the hydrocarbon radical $\text{C}_6\text{H}_5\text{CN}_2 -$?

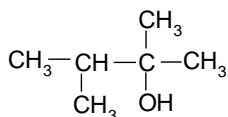
23. What is the name of the hydrocarbon residue $\text{CH}_2 \square \text{CH} -$?

24. Which of the above compounds are the isomer of butene-1?

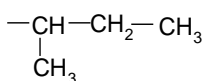
25. What is the name of the benzene radical?

26. What are the toluene radicals called?

27. What class of organic substances does the compound belong to?

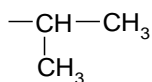


28. What name corresponds to the hydrocarbon radical?



29. What names correspond to the structural formulas of compounds?

30. What name corresponds to the hydrocarbon radical?



31. Structural isomers

32. Functional groups

33. Hydrocarbon radicals

1. What product is formed as a result of toluene reduction?

2. Is the reaction $\text{CH}_3\text{—CH}_2\text{—CH}_3 + \text{Br}_2$ given?

What is the type, mechanism and final product of the bromination reaction?

3. What electronic effects does the carboxyl group exhibit in benzoic acid?

4. What electronic effects does the nitro group exhibit in the $\text{CH}_2 = \text{CH} - \text{NO}_2$ molecule?

5. What kind and sign of electronic effects in the aniline molecule does the NH_2 group affect the benzene ring?

6. What kind and sign of electronic effects in the $\text{CH}_2 = \text{CH} - \text{NH}_2$ molecule is influenced by the amino group?

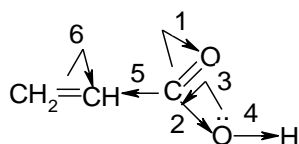
7. The hydroxyl group in phenol exhibits electron-donor properties. What electronic effects does the hydroxyl group in phenol exhibit?

8. The aldehyde group in benzaldehyde exhibits electron-acceptor properties. What electronic effects does the aldehyde group exhibit in benzaldehyde?

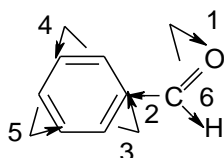
9. The reaction $\text{CH}_2 = \text{CH} - \text{CH}_3 + \text{HCl} \rightarrow$ is given? What product is formed as a result of the reaction?

10. Is the hydration reaction of isobutylene in an acidic medium given? What kind of alcohol is formed as a result of the reaction?

11. Which electronic effects in the acrylic acid molecule are marked correctly?



12. Which electronic effects in the benzaldehyde molecule are marked correctly?



13. Four test tubes contain alkene, alkane, diene, and alkyne. In three of them, a mild oxidation reaction with this reagent occurred.

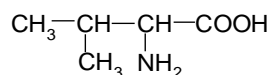
Solutions of which reagents should be added to the test substance to prove the presence of double bonds?

14. A hydrocarbon with the general formula C_8H_8 discolors bromine water, forms aromatic acid during oxidation. What is the name of this connection?

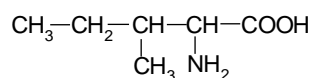
15. Two test tubes contain the compounds under study. In one of the test tubes, after the addition of the reagent $[Ag(NH_3)_2]OH$, a silver plaque formation reaction occurred. Which pair of compounds can be distinguished from each other using this reagent?
16. What is the type, mechanism and final product of the propene reduction reaction?
17. What is the type, mechanism and products of phenol bromination?
18. What compound is formed as a result of the oxidation reaction of butene-2 with an aqueous solution of $KMnO_4$?
19. Which of the above reactions follows the S_N mechanism?
20. Which of the above reactions follows the S_E mechanism?
21. Which of the above reactions follows the A_E mechanism?
22. In which of the above compounds does the π, π - conjugation take place?
23. In which of the above compounds does p, π - conjugation take place?
24. Which of the above substituents in the benzene ring exhibits a positive inductive effect?
25. In which of the above compounds is conjugation present?
26. Which of the above substituents in the benzene ring exhibit negative inductive and negative mesomeric effects ($-I, -M$)?
- NH_2

Heterofunctional connections. Carbohydrates

1. What is the formula of glycine?
2. Which of the following formulas corresponds to glutamic acid (2-aminopentanedioic) in the form of a bipolar ion?
3. How many asymmetric carbon atoms in the compound $(CH_3)_2SN-SN(Br)-CH(Br)-COOH$?
4. What formula is alanine?
5. What is the name of an amino acid?



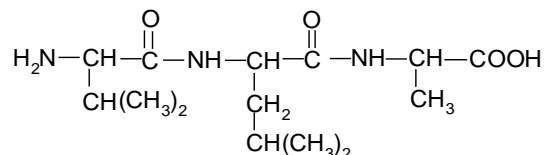
6. What name corresponds to the following amino acid?



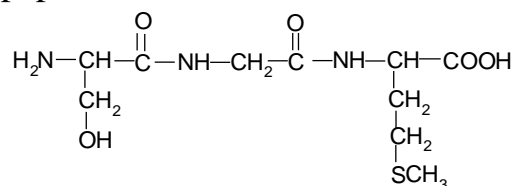
7. Which α - amino acid forms a disulfide bond during oxidation?
8. What product is formed by the interaction of glyoxalic acid $O = CH-COON$ with an ammonia solution of silver hydroxide?
9. What is the structure of the product formed as a result of the deamination reaction of valine (α -aminoisovaleric acid) with nitric acid?

10. What is the structure of the product formed by deamination of alanine (α -aminopropionic acid) with nitric acid:

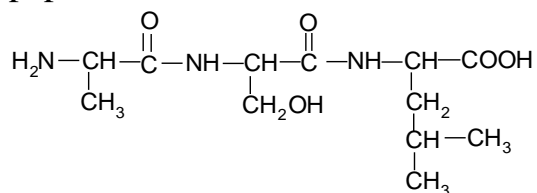
11. The formula of the tripeptide is given. What amino acids are formed during acid hydrolysis of such a peptide?



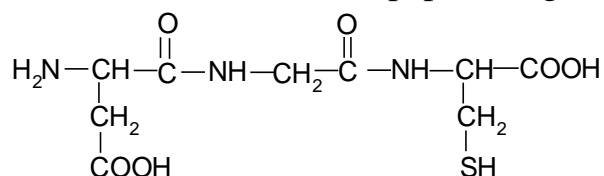
12. The formula of the tripeptide is given. What amino acids are included in such a peptide?



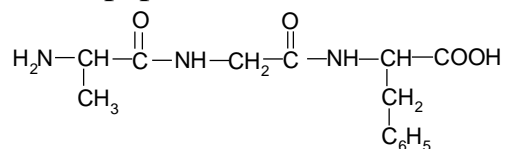
13. The formula of the tripeptide is given. What amino acids are included in such a peptide?



14. The formula of the tripeptide is given. What name corresponds to this peptide?



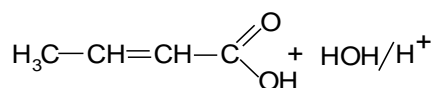
15. The formula of the tripeptide is given. What amino acids are formed during acid hydrolysis of such a peptide?



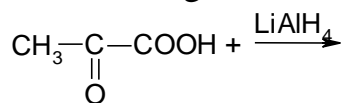
16. Which α -amino acid forms butenedioic acid $\text{HOOC}-\text{CH}=\text{CH}-\text{COOH}$ as a result of non-oxidative deamination?

17. Which α -amino acid forms pyruvic acid (2-oxopropanoic acid) as a result of oxidative deamination?

18. The reaction is given. What product is formed as a result of the reaction?



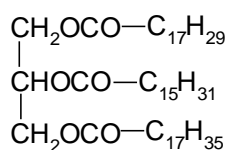
19. The following reaction is given. What reaction product is formed?



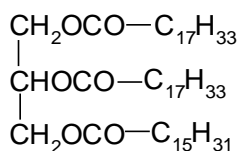
20. Which of the above forms of alanine will prevail at pH = 12?
21. Which of the above forms of valine will prevail at pH = 2?
22. Tyrosine enters into an acylation reaction. With the help of what reagent can this reaction be carried out?
23. Threonine reacts with the formation of an ester. With the help of what reagents can this reaction be carried out?
24. The liquid under study becomes purple when heated with ninhydrin. What substance is contained in the test tube?
25. Methionine in the form of oral dosage forms is used to prevent and treat liver diseases. In what ionic form does methionine (isoelectric point - 5,8) predominantly exist in a dissolved state in a biological fluid - saliva (saliva pH - 6,35)?
26. γ -aminobutyric acid in the body acts as an inhibitor of nerve impulses. From which α -amino acid is formed by decarboxylation of γ -aminobutyric acid?
27. What name corresponds to the compound $\text{CH}_3\text{SN}(\text{OH})\text{SOON}$?
28. What acid when heated to form a dipeptide?
29. Which statements correspond to the structure and properties of serine?
30. Which of the following α -amino acids are essential α -amino acids?
31. Which statements correspond to the structure and properties of phenylalanine?
32. How many chiral carbon atoms in glucose?
33. What is the number of spatial isomers has ketohexose?
34. What stereoisomers are ephemeralum glucose?
35. What is the oxidizing agent aldose turns into pieroway acid?
36. What product is formed when glucose is oxidized with bromine water?
37. What name corresponds to the formula?

Lipids. Heterocyclic compounds

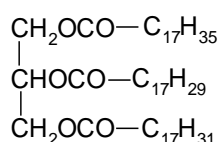
1. What name corresponds to the following compound?



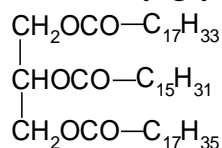
2. What name corresponds to the following compound?



3. Which amino alcohol contains phosphatidylethanolamine?
4. What is the name of a complex saponified lipid formed by phosphatidic acid and choline?
5. What is the structure of the amino alcohol that is part of phosphatidylcholine?
6. What is the structure of the amino alcohol that is part of phosphatidylserine?
7. With which compound does cholic acid interact to form glycocholic acid?
8. When interacting with which compound does cholic acid form taurocholic acid?
9. What reagents can be used to distinguish tripalmitin from triolein?
10. Which of the above compounds are formed as a result of acid hydrolysis of triacylglycerin?

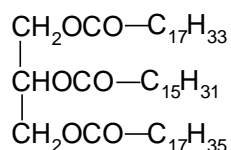


11. Which of the above compounds are formed as a result of the saponification reaction of triacylglycerin?



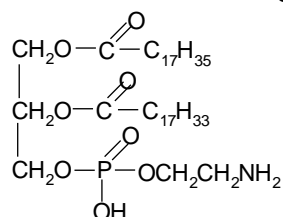
12. The reaction is given: L-phosphatidic acid + ethanolamine \rightarrow ?
What is the name of the reaction product?

13. Which of the above compounds are formed as a result of acid hydrolysis of triacylglycerin?

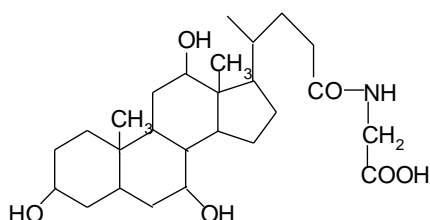


14. What is the type, mechanism and final product of the reaction of interaction of cholic acid with taurine?

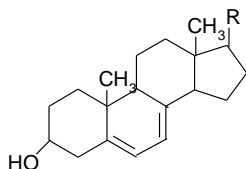
15. Which bond undergoes hydrolysis in phosphatidylethanolamine?



16. Which bond undergoes hydrolysis in glycocholic acid?



17. Which of the above compounds corresponds to the name 1-oleoyl-2-palmitoyl-3-stearoyl glycerin?
18. Which of the listed lipids will be solid in consistency?
19. Which of the listed lipids will be liquid in consistency?
20. Which of the listed higher fatty acids is irreplaceable?
21. Which of the listed higher fatty acids is irreplaceable?
22. What statements are true in relation to linolenic acid?
23. What statements about the properties and structure of 1-oleoyl-2-palmitoyl-3-stearoyl glycerin are true?
24. What statement about the structure and properties of ergosterol is true?



25. What statement is true about the structure and properties of cholesterol?

1.4.4. Course Policy and evaluation criteria

The control of students' knowledge is carried out according to the point-rating system in accordance with the standard "Regulation on the modular point-rating system for assessing students' knowledge in the NOU of the UNPC "International University of Kyrgyzstan".

The discipline "Chemistry" includes 2 modules, each module is evaluated on a 100-point system:

The maximum score is 100, of which:

- attendance - 20 points;
- current control - 40 points (20 points - for classroom work, 20 points - for independent work),
- boundary control (module delivery) - 40 points.

The results of the 2 modules are added together and the average score is displayed.

Scoring policy	Module1	Module 2 e.t.c.
Attendance	20 points	20 points
Classroom work (activity in discussions, during oral questioning, working with the glossary, etc.)	20 points	20 points
Independent work: abstract, report	20 points	20 points
Total module (testing)	40 points	40 points
Total by discipline:	More than 60 points	

Test	
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The final control in the form of a set-off is carried out based on the results of attendance, current and boundary (modular) control.

The form of final control is a set-off.

To assess the student's academic performance, the following scale of correspondence of grades and points is used:

The scale of conformity of grades and points				
Maximum Score	Intervals			
	«unsatisfactory»	«satisfactory»	«good»	«excellent»
20	0-11	12-15	16-17	18-20
40	0-23	24-30	31-35	36-40
60	0-35	36-45	46-53	54-60
100	0-59	60-75	76-89	90-100

1.4.5. Educational, methodological and informational support of the discipline

List of sources and literature

Main:

1. Morris Hein, Scott Pattison, Susan Arena. Introduction to General, Organic, and Biochemistry [Text]: Book / 10th Edition.-USA: John Wiley&Sons, Inc, 2012.-1091 p.
2. Tyukavkina, N. A., A. baukov, Y. I. Bioorganic chemistry [Text]: Textbook /.- Ed.5th ed. - M.: Drofa, 2006.- 542 p.
3. Verentsova L.G., Nechepurenko E.V. Inorganic, physical and colloidal chemistry. [Text]: Textbook/ Almaty: Evero, 2009.- 214 p.

Additional:

1. Verentsova L.G., Nechepurenko E.V. Inorganic, physical and colloidal chemistry [Text]:: Verification tests / Asfendiyarov KazNMU.- Almaty: Evero, 2009. -222 p.
2. Almabekova, A.A. Collection of tasks in a test form on organic chemistry. [Text]: textbook. / A.A. Almabekova.- Almaty.: Evero, 2009.- 306 p.
3. Verentsova L.G., Nechepurenko E.V. Inorganic, physical and colloidal chemistry [Text]:: Collection of tasks and exercises / Asfendiyarov KazNMU.- Almaty: Evero, 2013.-304 p.
4. Ravich-Shcherbo, Novikov M. I. Physical and colloid chemistry [Text] /.- Ed.3-e, ISPR. and extra - M., 2001.- 255c.
5. Asanbayeva, R. D. textbook of Bioorganic chemistry for independent work of students of 1 course of medical doctor., San.-hygienic., stomatol. fac-in [text]: Part 1. / R.D. Asanbayeva; KazNMU named after S.D.Asfendiyarov.- Almaty, 2004.- 128s.

6. Asanbayeva, R.D. Educational and methodical manual of bioorganic chemistry for independent work of a student-in the 1st course of medical, pediatrician., san.-hygienic., stomatol. fac-in [text]: Part 1. / R.D. Asanbayeva; KazNMU named after S.D.Asfendiyarov.- Almaty, 2004.- 128s.

1.4.6. Material and technical support of the discipline

Lectures

When teaching students, he applies modern methods and forms of teaching using the latest information technologies, electronic learning resources and other information systems necessary for the successful implementation of educational and scientific activities.

The classrooms of the course are equipped with modern and innovative means to provide quality education for students. Lecture halls are equipped with computers, video projectors and sound systems, allowing lectures to be held at a high professional level. There is also portable equipment for teaching staff in the form of laptops and projectors for convenient provision of educational material in electronic format

LABORATORIES

№ п/п	№ Name (educational laboratories, equipment) Audience, number of installations	Audience, number of installations
1	Installation for thermal decomposition of crystallohydrates (electric stove, sand bath)	Morphocorpus, room 402
2.	Titration unit (burette, glasses, standard solutions of acids and alkalis, indicators)	Morphocorpus, room 402
3	Installation for determining the equivalent mass of metal (burette, Wurtz flask, equalizing vessel, rubber or silicone tube, thermostat or water bath, pipettes, tripod)	Morphocorpus, room 402
4	Installation for determining the heat of dissolution	Morphocorpus, room 402
5	Installation for determining the heat capacity and entropy of solid	Morphocorpus, room 402
6	Installation for the study of electrolysis (rectifiers, glasses, sets of electrodes, millivoltmeter, milliammeter)	Morphocorpus, room 402
7	Photoelectrocolorimeters	Morphocorpus, room 402
8	Drying cabinets	Morphocorpus, room 402

9	Muffle furnaces	Morphocorpus, room 402
10	pH – meters	Morphocorpus, room 402

1.4.7. Student's research work

Research in the discipline "Chemistry" is aimed at solving the following tasks:

- □ development of skills of perception and analysis of professional information;
- развитие development and improvement of decision-making abilities and their implementation;
- development and improvement of creative abilities in the independent study of professional problems.

To solve the first problem, students are invited to read and analyze scientific monographs and articles on various public health issues contained in the list of resources of the Internet information and telecommunications network:

<https://www.euro.who.int/en/health-topics/Health-systems/public-health-services/public-health-services>

<https://www.cdcfoundation.org/what-public-health>

<https://www.researchgate.net/journal/Public-Health-Monograph-0079-7596>

<https://www.journals.elsevier.com/public-health>

The results of work with scientific monographs and articles are discussed in practical classes.

For the development and improvement of students' communicative abilities, special training sessions are organized in the form of work in small groups, brainstorming, discussions, presentations, or, in preparation for which students are divided in advance into groups defending a particular point of view on the problem under discussion.