

CTOM -21 ИИ

**FEDERAL STATE BUDGET EDUCATIONAL INSTITUTION OF HIGHER
EDUCATION
"NORTH OSSETIAN STATE MEDICAL ACADEMY"
OF THE MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION**

The Department of Chemistry and Physics

Approved by
the protocol of the meeting of the Central
Coordination Educational and Methodical
Council No 5 in 23 May, 2023

EVALUATION MATERIALS

«CHEMISTRY»

**The main professional educational program of higher education-specialty program
in the specialty 31.05.03 Dentistry**

For the first year students

Considered and approved at the meeting of the Department of Chemistry and
Physics of «22» May, 2023, protocol No 9.

Head of the Department of Chemistry and Physics

R.V. Kalagova

THE STRUCTURE OF THE EM

1. The title page.
2. The structure of the EM.
3. Review of the EM.
4. Passport EM.
5. Set of evaluation tools:
 - questions to offset;
 - modular issues;
 - benchmarks of test tasks;
 - the ticket to offset.

**ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ ОБРАЗОВАТЕЛЬНОЕ
УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ
«СЕВЕРО-ОСЕТИНСКАЯ ГОСУДАРСТВЕННАЯ МЕДИЦИНСКАЯ АКАДЕМИЯ»
МИНИСТЕРСТВА ЗДРАВООХРАНЕНИЯ РОССИЙСКОЙ ФЕДЕРАЦИИ**

**РЕЦЕНЗИЯ
на оценочные материалы**

**по дисциплине «Химия»
для студентов 1 курса
по специальности - 31.05.03 Стоматология (образовательная программа, частично реализуемая на английском языке)**

Оценочные материалы составлены на кафедре химии и физики на основании рабочей программы дисциплины «Химия», утвержденной ученым Советом ФГБОУ ВО СОГМА Минздрава России 24 мая 2023 г., протокол № 8 и соответствует требованиям ФГОС ВО 3⁺⁺ по специальности **31.05.03 Стоматология**.

Оценочные материалы включает в себя:

- вопросы к модулю,
- вопросы к зачету,
- эталоны тестовых заданий (с титульным листом и оглавлением),
- билеты к зачету.

Эталоны тестовых заданий включают в себя следующие элементы: тестовые задания, шаблоны ответов. Все задания соответствуют рабочей программе дисциплины «Химия» (образовательная программа, частично реализуемая на английском языке) формируемым при ее изучении компетенциям, и охватывают все её разделы. Сложность заданий варьируется. Количество заданий по каждому разделу дисциплины достаточно для проведения контроля знаний и исключает многократное повторение одного и того же вопроса в различных вариантах. Эталоны содержат ответы ко всем тестовым заданиям.

Количество билетов к зачету достаточно для проведения зачета и исключает неоднократное использование одного и того же билета во время зачета в течение одного дня. Билеты к зачету выполнены на бланках единого образца по стандартной форме, на бумаге одного цвета и качества. Билет к зачету включает в себя 3 вопроса. Формулировки вопросов совпадают с формулировками перечня вопросов, выносимых на зачет.

Содержание вопросов одного билета относится к различным разделам рабочей программы дисциплины, позволяющее более полно охватить материал дисциплины. Сложность вопросов в билетах распределена равномерно.

Замечаний к рецензируемым оценочным материалам нет.

В целом, оценочные материалы по дисциплине «Химия» (образовательная программа, частично реализуемая на английском языке) способствуют качественной оценке уровня владения обучающимися универсальными компетенциями.

Рецензируемые оценочные материалы по дисциплине «Химия» (образовательная программа, частично реализуемая на английском языке) могут быть рекомендованы к использованию для текущего контроля успеваемости и промежуточной аттестации на **стоматологическом факультете** у обучающихся 1 курса/года обучения.

Рецензент:

*Председатель ЦУМК по естественнонаучным и
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Н.И. Боцьева

РЕЦЕНЗИЯ

на оценочные материалы

Рецензируемые оценочные материалы по дисциплине **«Химия» (образовательная программа, частично реализуемая на английском языке)** могут быть рекомендованы к использованию для текущего контроля успеваемости и промежуточной аттестации на **стоматологическом факультете** у обучающихся **1 курса/года** обучения.

А.Э. Калоева

Passport of assessment materials for the discipline
on the academic discipline
" Chemistry " specialty 31.05.03 Dentistry (specialty) (educational program, partially
implemented in English)

№п/п	Name controlled section (topics) of the discipline/module	Code of the formed competence (stage)	Name of the evaluation tool
1	2	3	4
Type of Attestation	Operating Intermediate		
Credit	Fundamentals of General Chemistry: Solutions and their physical and chemical properties. The main types of chemical reactions and processes in the functioning of living systems. Types of chemical equilibrium (protolytic, heterogeneous, red/ox, complexation). Basic concepts of chemical kinetics. Classification of reactions in kinetics. Buffer solutions.	GPC-8	Test control Questions for the module Offset tests Examination cards
	Fundamentals of Physical Chemistry: Basic concepts of thermodynamics. The first and second principles of thermodynamics. Basic concepts of chemical kinetics. Classification of reactions in kinetics.	GPC-8	Test control Questions for the module Offset tests Examination cards
	Fundamentals of colloid chemistry: Physical chemistry of surface phenomena. Adsorption.	GPC-8	Test control Questions for the module Offset tests Examination cards
	Organic chemistry: biologically active high-molecular substances (structure, properties, participation in the functioning of living systems) Classification of organic compounds and reactions. Conjugated and aromatic compounds. Biologically active poly- and hetero functional organic compounds. Biologically active high-molecular substances.	GPC-8	Test control Questions for the module Offset tests Examination cards

Questions to offset

on the subject " CHEMISTRY " for students of the 1-st course for specialty 31.05.03 DENTISTRY

GENERAL CHEMISTRY

1. The concept of chemistry as a science.
2. Importance of chemistry for physicians.
3. The role of H₂O and solutions in life.
4. Physicochemical properties of water, which determine its unique role as the sole biosolvent.
5. Homogeneous and heterogeneous systems.
6. Determination and classification of solutions.
7. The concept of concentration.
8. Methods of expressing the concentration of solutions. The value of solutions in the life of organisms?
9. Classification of solutions: solutions of electrolytes, non-electrolytes, solutions of ampholytes, solutions of polyelectrolytes.
10. Concentration of solutions and ways of expressing it.
11. Diffusion in solutions. Fick's Law. The Einstein-Smoluchowski equation.
12. Factors affecting the rate of diffusion. The role of diffusion in the processes of transport of substances in biological systems.
13. Colligative properties of dilute solutions of electrolytes.
14. Raoult's law and its consequences: a decrease in the freezing temperature of the solvent, an increase in the boiling point, and osmosis.
15. Osmosis. Osmotic pressure. The Van't Hoff law. Does the osmotic pressure depend on the nature of the dissolved substance?
16. Hypo-, hyper- and isotonic solutions. Isotonic coefficient.
17. The role of osmosis in biological systems. Plasmolysis and lysis.
18. The concept of the rate of chemical reaction. On what parameters does the rate of chemical reaction depend?
19. What is the difference between homogeneous and heterogeneous chemical processes?
20. How is the average and true rate of chemical reactions expressed?
21. What factors affect the rate of chemical reaction?
22. The law of action of the masses.
23. What is the rate constant of a chemical reaction? On what factors does it depend?
24. How does the rate of chemical reaction depend on temperature? Formulate the rule of Van't Hoff. The Arrhenius equation.
25. The order and molecular nature of the reaction.
26. What phenomenon is called catalysis? How does heterogeneous catalysis differ from homogeneous? What are the characteristics of enzyme catalysis?
27. Electrolytic dissociation of substances in solutions. Basic provisions of the Arrhenius theory. Strong and weak electrolytes.
28. Degree of dissociation. Factors affecting the degree of dissociation.
29. The dissociation constant and the factors on which it depends.
30. Formulate the Ostwald breeding law.
31. What is meant by the activity coefficient? What is meant by the activity of the electrolyte?
32. What is called the ionic strength of the solution? The Debye-Hückel law. Calculate the ionic strength of 0.01 molar salt solution of Na₃PO₄.
33. The main provisions of the protolytic theory of acids and bases of Bronsted and Lowry.
34. Fundamentals of the Lewis electron theory.

35. Processes of solvation and hydration. Solvolysis and hydrolysis.
36. Hydrolysis of salts. Define hydrolysis. Hydrolysis from the point of view of the protolytic theory.
37. What types of salts undergo hydrolysis? Types of hydrolysis.
38. The role of hydrolysis of bioorganic compounds in life processes.
39. Write the equation of hydrolysis of ATP. What is the role of this process in the human body?
40. How is the hydrolysis constant expressed for different cases of hydrolysis? What is the constant of hydrolysis? What does the salt hydrolysis constant depend on?
41. How is the degree of hydrolysis determined, the factors affecting the degree of hydrolysis.
42. What does the pH of the solution mean?
43. What does the pH of the solution depend on and on what formula is calculated?
44. What solutions are called buffer? What is the reason for the buffer effect from the point of view of the proton theory?
45. Classification of acid-base buffer systems. What types of buffer systems are known? What determines the pH of the buffer system?
46. The capacity of buffer systems. What determines the buffer capacity of the system?
47. Calculation of the Henderson-Hasselbach equation for the I type of buffer systems.
48. Calculation of the Henderson-Hasselbach equation for the II type buffer system.
49. General characteristics of *d*-elements. The most stable oxidation states of cations of *d*-elements.
50. What features of electronic structures determine the difference in chemical properties of *s*- and *p*-elements?
51. The concept of hybridization of orbitals, types of hybridization.
52. What is double salt and how does it differ from a complex compound?
53. Donor-acceptor mechanism of chemical bonding.
54. Nature and types of chemical bonds in complex compounds.
55. Calculation of the general and stepwise constants of instability (stability)?
56. Dissociation of complex compounds.
57. Definition of the concepts-chelator and ligand.
58. The meaning of the concepts of dentateness and lability of ligands.
59. Chelate complex compounds and their application.
60. Conformational states of complex ions.
61. Classification of sorption processes.
62. The essence of the adsorption process? How does the concept of "absorption" differ from the concept of "adsorption"? What is adsorption and desorption?
63. What is the adsorption equilibrium and how is it characterized? How can we shift the adsorption equilibrium?
64. The formulation of the Duclos-Traube rule.
65. The theory of Langmuir monomolecular adsorption.
66. Freundlich equation. Shilov's rule.

BIOORGANIC CHEMISTRY

1. Basic theses of the theory of the structure of organic compounds Butlerov. Isomerism as a specific phenomenon of organic chemistry.
2. Classification features of organic compounds: the structure of the carbon skeleton and the nature of the functional group. Functional group. Structural formula. Structural isomers.
3. Basic rules for the preparation of names for the nomenclature of IUPAC for organic compounds; substitutive and radical-functional nomenclature.
4. Ancestral structure, substitutes, characteristic groups. Show on specific examples.
5. The main classes of biologically important organic compounds: alcohols, phenols, thiols, amines, ethers, sulfides, aldehydes, ketones, carboxylic acids. Organic radicals.
6. The main methods of the YUPAK nomenclature of compounds.
7. Atomic orbitals and their hybridization.
8. Structural and spatial isomerism.
9. Configuration and conformation.
10. Acidity and basicity of organic compounds.
11. Definition of acids and bases according to the Bronsted theory.
12. What factors determine the strength of acids? List them.
13. How does acidity depend on the nature of the atom in the acid center? How does it change in groups, in periods? Why?
14. Describe the effect of donor and acceptor substituents on the strength of acids and bases.
15. How does the acidity depend on the nature of the solvent?
16. The essence of the principle of hard and soft acids and bases. Describe hard and soft acids and bases. Acidity of body fluid systems.
17. Stereoisomerism. Optical isomerism of molecules and its medico-biological significance. Elements of symmetry of molecules.
18. Optical activity. Enantiomeria. Diastereometry.
19. General characteristics of the reactivity of heterofunctional compounds. Acid-base properties
20. Heterofunctional substituent as a factor influencing the chemical properties of the reaction center. Specific reactions of heterofunctional compounds.
21. Biologically important classes of hetero-functional compounds and their properties. Unsaturated carboxylic acids. Oxyacids (hydroxy acids). Amino acids. Oxoacids. Write a diagram of the interaction of acetoacetic ether with dilute sulfuric acid.
25. Biologically important heterocyclic systems. Five-membered heterocycles with one heteroatom. Pyrrole, furan, thiophene. The concept of the structure of tetrapyrrene compounds (porphin, gemm). Linear tetrapyrrene compounds.
26. Indole (benzopyrrole). Structure, properties. Biologically active derivatives of indole.
27. Five-membered heterocycles with two or more heteroatoms. Imidazole, properties; medico-biological significance of the derivatives.
28. Pyrazole, oxazole, thiazole. Structure, properties, biological functions of derivatives. Pyrazolone-3 is the structural basis of non-narcotic analgesics (analgin).

29. Six-membered heterocycles with one heteroatom. Pyridine, nicotinic acid and nicotinamide. Isonicotinic (γ -pyridinecarboxylic acid), medico-biological functions of derivatives.
30. Six-membered heterocycles with one heteroatom: pyrimidine, pyrazine. Hydroxy- and amino-derivatives of pyrimidine are components of nucleic acids. Barbituric acid and its derivatives.
31. Bicyclic heterocycles. Purin. Hydroxy- and aminopurines. Uric acid. Lactim-lactam tautomerism. Adenine; medico-biological significance of derivatives, tautomeric forms.
32. The concept of alkaloids. Hygrene, nicotine. Derivatives of tropane are atropine and cocaine. Methylated xanthines - caffeine, theophylline, theobromine.
33. Classification of α -amino acids and their nomenclature. Isomerism of amino acids.
34. Properties of α -amino acids. Why are α -amino acids capable of interacting with acids and alkalis?
35. Methods of obtaining amino acids.
36. Primary structure of peptides and proteins. Composition and amino acid sequence. Enzymatic hydrolysis of proteins.
37. Chemical methods for determining the primary structure of peptides and proteins: the dinitrophenylation method, the Edman method, the dansyl method.
38. Nucleic acids. Composition and structure of the nucleotide.
39. Structure of N-glycosides: adenosine, uridine, deoxycytidine
40. Monosaccharides. Structure and stereoisomerism.
41. The phenomenon of mutarotation. Projection formulas of Fisher, Hevors formula (on the example of glucose and fructose).
42. Chemical properties of monosaccharides: a) complexation reactions; b) electrophilic-nucleophilic properties (alkylation, acylation reactions); c) oxidation-reduction properties - epimerization reactions, oxidation and reduction reactions of monosaccharides.
43. Disaccharides. Their structure, α - and β -glycosidic bonds.
44. Restoring disaccharides. The way in which they form a glycosidic bond. Lactose and maltose, their biological significance.
45. Non-reducing disaccharides, the principle of the formation of a glycosidic bond in them. Sucrose.
46. Biological fragments of natural glycosides on the example of geniciobiosis. Aminoglycosides (or carbohydrate antibiotics) - on the example of streptomycin.
47. Polysaccharides, the structure of starch, glycogen, dextrans, cellulose.
48. Heteropolysaccharides and mixed biopolymers: chondroitin sulfates, hyaluronic acid, proteoglycans, peptidoglycans, glycoproteins.
49. Primary structure of peptides and proteins. Composition and amino acid sequence. Enzymatic hydrolysis of proteins.
50. Chemical methods for determining the primary structure of peptides and proteins: the dinitrophenylation method, the Edman method, the dansyl method.
51. Structure and synthesis of peptides. Method for protecting the amino group, activation of the carboxyl group.
52. Simple and complex lipids.
53. Common reactions to terpenes.
54. Features of corticosteroids. Detection of keto group, keto-alcohol group and double bonds in them. Which of the reactions to corticosteroids are characteristic of other steroids?
55. The general reaction to steroids is the Lieberman-Burkhard reaction.

MODULAR ISSUES

"Fundamentals of Chemical Thermodynamics and Bioenergy"

1. Thermodynamics studies
2. The system is ...
3. Homogeneous systems are called ...
4. Heterogeneous systems are called ...
5. The phase is part of a heterogeneous system, ...
6. Depending on the nature of the interaction with the external environment, the systems are distinguished.
7. Isolated systems are characterized by ...
8. Closed systems are characterized by ...
9. Open systems are characterized by ...
10. Extensive parameters - this These include:
11. Intensive parameters are These are:
12. The internal energy of the system is ...
13. Energy exchange between the system and the external environment can take the form of
14. Work is ... Heat is
15. In living systems, work is done at the expense of energy
16. Work done in living organisms can be ...
17. Entropy is a thermodynamic function ...
18. Information is Entropy and information are related ...
19. Thermodynamic process is ... There areprocesses.
20. Formulation I law of thermodynamics:
21. Formulation I law of thermodynamics for isolated systems:
22. Formulation I law of thermodynamics for closed systems:
23. Enthalpy is a thermodynamic function, ...
24. Standard enthalpy of the formation of simple substances in their thermodynamically stable aggregate and allotropic state
25. The standard enthalpy of the formation of a complex substance is ... For example, ...
26. The Law of Hess: ...
27. The caloric content of nutrients is called ...
28. Caloric content of fats, proteins and carbohydrates is ..., ..., ... kcal / g, respectively.
29. The daily requirement for fats, proteins and carbohydrates for an adult is ..., ..., ..., respectively.
30. The daily need of man for energy

"The Second Law of Thermodynamics"

1. The second law of thermodynamics for isolated systems: ...
2. Gibbs energy is
3. Gibbs energy can be calculated through enthalpy and entropy according to the formula:
4. The change in Gibbs energy as a result of the chemical reaction under standard conditions is equal to ...
5. Statement II of the law of thermodynamics for any system:
6. All exothermic reactions can spontaneously occur, if ...
7. Exergonic are biochemical reactions that ...
8. Endergonic are biochemical reactions that ...
9. The principle of energy conjugation of biochemical reactions is that ...
10. Macroergic refers to the connection
11. ATP is acompound.
12. Chemical kinetics studies ...

13. In general, the rate of a chemical reaction is defined as ...
14. The true speed of a chemical reaction is ...
15. Complicated reactions are ... They are divided into ...
16. The rate of homogeneous reaction depends on ...
17. For a reaction of the type $aA + bB = cC + dD$, the law of acting masses can be written in the form:
18. If the values of the reaction order for the reagents coincide with the stoichiometric coefficients, this means that ...
19. According to the rule of Van't-Hoff ...
20. According to the Arrhenius equation ...

"Ionic Equilibria in Electrolyte Solutions"

1. Electrolytic dissociation of substances in solutions. Basic provisions of the Arrhenius theory.
2. The process of electrolytic dissociation in water of substances with ionic and covalent bond type.
3. Degree of dissociation. Factors affecting the degree of dissociation.
4. The dissociation constant and the factors on which it depends. Give examples of electrolytes exposed in solutions of stepwise dissociation.
5. Relationship between the degree and the dissociation constant of weak electrolytes.
6. Formulate the Ostwald breeding law.
7. What is meant by the activity coefficient? What is meant by the activity of the electrolyte?
8. What is called the ionic strength of the solution? The Debye-Hückel law.
9. Give examples of strong electrolytes. Why is the term "apparent degree of dissociation" used for strong electrolytes?
10. Why does the dissociation constant lose its meaning in solutions of strong electrolytes?
11. Which characteristic of the electrolyte, which does not depend on concentration, will determine its strength?
12. What characterizes the dissociation constant? Write sequential reactions of detachment of a proton from molecules of sulfuric, hydrogen sulfide, carbonic acids.
13. Explain the concepts of "acid" and "ground" from the point of view of the Arrhenius theory. Give examples.
14. Explain the concepts of "acid" and "ground" from the point of view of the Bronsted-Lowry theory. Give examples.
15. Indicate the pH value of acidic, alkaline and neutral solutions. Specify the change in the color of litmus, phenolphthalein, methylorange in acidic and neutral medium.
16. Ionic product of water, its meaning, on what does it depend on?
17. What is the hydrogen index? What is the pH value in different media?
18. What is the relationship between the type of chemical bond and the degree of electrolytic dissociation?
19. Which characteristic of the electrolyte, which does not depend on concentration, will determine its strength?
20. What characterizes the dissociation constant? Write sequential reactions of detachment of a proton from molecules of sulfuric, hydrogen sulfide, carbonic acids.
21. Explain the concepts of "acid" and "ground" in terms of the theory of Arrhenius and Bronsted-Lowry. Give examples.
22. Indicate the pH value of the acidic, alkaline and neutral solutions. Specify the change in the color of litmus, phenolphthalein, methylorange in acidic and neutral medium.
23. Explain which of the acids is stronger: HNO_2 or HNO_3 ? H_2SO_4 or H_2SiO_4 ? HPO_3 or H_3PO_4 ? Write down the dissociation schemes for these acids. Explain the change in the strength of the bases in the series: LiOH - NaOH - KOH - RbOH - CsOH ?

Hydrolysis of salts

1. Processes of solvation and hydration.
2. Hydrolysis of salts. Hydrolysis from the point of view of the protolytic theory.
3. The role of H₂O and solutions in life. Physico-chemical properties of water, which determine its unique role as the sole biosolvent.
4. What types of salts are hydrolyzed? Types of hydrolysis.
5. The role of hydrolysis of bioorganic compounds in life processes?
6. Write the equation for the hydrolysis of ATP. What is the role of this process in the human body?
7. How is the hydrolysis constant expressed for different cases of hydrolysis?
8. How is the degree of hydrolysis determined, the factors affecting the degree of hydrolysis.
9. What is the constant of hydrolysis? What does the salt hydrolysis constant depend on?
10. Write the equilibrium constant for a weak acid, using the law of acting masses.
11. What are the patterns of hydrolysis of salts?

"Colligative properties of solutions"

1. What are called solutions? The value of solutions in the life of organisms?
2. Classification of solutions: solutions of electrolytes, non-electrolytes, solutions of ampholytes, solutions of polyelectrolytes.
3. Concentration of solutions and ways of expressing it.
4. Diffusion in solutions. Fick's Law. The Einstein-Smoluchowski equation.
5. Factors affecting the rate of diffusion. The role of diffusion in the processes of transport of substances in biological systems.
6. Colligative properties of dilute solutions of electrolytes.
7. Raoult's law and its consequences: a decrease in the freezing temperature of the solvent, an increase in the boiling point, and osmosis.
8. Osmosis. Osmotic pressure. The Van't Hoff law. Does the osmotic pressure depend on the nature of the dissolved substance?
9. Hypo-, hyper- and isotonic solutions. Isotonic coefficient.
10. The role of osmosis in biological systems. Plasmolysis and lysis.

"Buffer systems"

1. What are called buffer solutions?
2. What determines the buffer effect from the point of view of the proton theory?
3. Classification of acid-base buffer systems. What types of buffer systems are known?
4. Calculation of the pH of buffer systems. The Henderson-Hasselbach equation.
5. What determines the pH of the buffer system?
6. What is the buffer capacity of the system? What determines the buffer capacity of the system?
7. Explain why most of the body's buffer systems have an acid buffer capacity greater than the base.
8. Pathological phenomena: acidosis and alkalosis.
9. What chemical balance is maintained in the body by buffer systems?
10. Which buffer system makes the maximum relative contribution to the maintenance of protolytic homeostasis in the internal environment of red blood cells?
11. Buffer solutions play a significant role in maintaining the constancy of biological liquids, tissues and organs.

CTOM -21 ИИ

Federal State Budget Educational Institution of Higher Education "North Ossetian State Medical Academy" of the Ministry of Health of the Russian Federation

The Department of Chemistry and Physics

COLLECTIONS OF PROBLEMS/PRACTICAL TASKS

«Biology» the main professional educational program of higher education - specialty program in the specialty 31.05.03 Dentistry For the first year students who study in English

**Chemistry for the first year students of the
General medicine Faculty**

Vladikavkaz, 2023

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№	Name of the controlled section (topic) of the discipline/module	Code of competence being formed (stage)	Number of tests (total)	p. from __ to __
1	2	3	4	5
Вид контроля	Текущий контроль успеваемости/Промежуточная аттестация			
	<i>Test input control</i>	GPC-8	24	14-18
1.	General chemistry	GPC-8	144	19
1.1	Fundamentals of Chemical Thermodynamics and Bioenergy	GPC-8	30	19
1.2	The Second Law of Thermodynamics	GPC-8	20	19-20
1.3	Ionic Equilibria in Electrolyte Solutions	GPC-8	7	20
1.4	Hydrolysis of salts	GPC-8	10	20
1.5	Colligative properties of solutions	GPC-8	22	21
1.6	Buffer systems	GPC-8	25	21-23
1.7	Chemical equilibrium	GPC-8	10	23
1.8	Complex compounds	GPC-8	10	24-25
1.9	Superficial phenomena	GPC-8	10	25-27
2.	Basic concepts in bioorganic chemistry	GPC-8	110	27-42
2.1	Isomerism of organic compounds	GPC-8	10	27-28
2.2	Acidity and basicity of organic compounds	GPC-8	10	28-29
2.3	Poly- and hetero-functional compounds	GPC-8	15	29-32
2.4	Biologically active heterocyclic compounds	GPC-8	11	32-35
2.5	α-amino acids	GPC-8	8	35-36
2.6	Peptides. Proteins	GPC-8	14	36-38
2.7	Nucleic acids	GPC-8	12	38-39
2.8	Carbohydrates	GPC-8	10	40-41
2.9	Lipides	GPC-8	20	41-42

Test input control

1. Which of the following substances has the equivalence factor (f_e) equal to one?

- 1) Na_2SO_4
- 2) NaNO_3
- 3) CaCl_2
- 4) Na_2CO_3
- 5) Na_3PO_4

2. Which of the following substances has the equivalence factor (f_e) equal to 1/3?

- 1) Na_2CO_3
- 2) Na_3PO_4
- 3) NaNO_3
- 4) $\text{Ca}(\text{OH})_2$
- 5) $\text{Al}_2(\text{SO}_4)_3$

3. Which of the following has the units mol / kg?

- 1) molarity
- 2) normality
- 3) molality
- 4) mass fraction
- 5) mole fraction

4. Which of these formulae is used to calculation of molar concentration?

- 1) $\frac{m(x)}{m(\text{solution})} \cdot 100\%$
- 2) $\frac{m(x)}{M(x) \cdot V(\text{solution})}$
- 3) $\frac{m(x)}{M_e(x) \cdot V(\text{solution})}$
- 4) $\frac{m(x)}{V(\text{solution}) \cdot \rho(\text{solution})} \cdot 100\%$
- 5) $\frac{n_e(x)}{V(\text{solution})}$

5. Which of the following is used to calculate molar concentration of equivalent?

- 1) $\frac{m(x)}{m(\text{solution})} \cdot 100\%$
- 2) $\frac{m(x)}{M(x) \cdot V(\text{solution})}$
- 3) $\frac{m(x)}{M_e(x) \cdot V(\text{solution})}$
- 4) $\frac{n(x)}{V(\text{solution})}$
- 5) $\frac{m(x)}{V(\text{solution}) \cdot \rho(\text{solution})} \cdot 100\%$

6. Which of the following formulas is used to calculate mass fraction of solution?

- 1) $C_e(x) = \frac{n_e(x)}{V(solution)}$
- 2) $\omega = \frac{m(solution)}{m(x)} \cdot 100\%$
- 3) $\omega(x) = \frac{n(x)}{V(solution)}$
- 4) $\omega = \frac{m(x)}{m(x) + m(solvent)} \cdot 100\%$
- 5) $\omega = \frac{m(x)}{m(x) \cdot m(solvent)} \cdot 100\%$

7. 1 liter of solution contains 3.65 g of hydrogen chloride. What is the molar concentration of the solution?

- 1) 1 mol / l
- 2) 0.5 mol / l
- 3) 0.1 mol / l
- 4) 0.05 mol / l
- 5) 0.01 mol / L

8. Hypertensive gauze bandages soaked in 10% water's solution of sodium chloride are used in surgery. How many grams of salt and water do you need to take to prepare 500 g of this solution?

- 1) 5 and 495
- 2) 10 and 490
- 3) 25 and 475
- 4) 50 and 450
- 5) 75 and 425

9. 5 g of glucose is dissolved in 95 grams of water. What is the mass fraction of glucose (%) of the resulting solution?

- 1) 5,00
- 2) 5,26
- 3) 5,56
- 4) 5,88
- 5) 6,00

10. What is the relation between boiling point elevation with boiling point of pure solvent?

- 1) is equal to zero
- 2) Directly proportional to the mass fraction of dissolved material
- 3) Is directly proportional to the mole fraction of the dissolved substance
- 4) Is directly proportional to molality of the solution
- 5) Does not depend on the concentration of solute

11. Which of the following forms 3% H₂O₂ solution?

- 1) 1 liter of solution containing 3 g of hydrogen peroxide
- 2) 1000 g of a solution containing 3 g of hydrogen peroxide
- 3) 100 g of a solution containing 3 g of hydrogen peroxide
- 4) 100 g of solution containing 3 moles of hydrogen peroxide
- 5) 1000 g of solvent and 3 g of hydrogen peroxide

12. Ebullioscopic constant of water (E) is $0,52^\circ$. What is the boiling point of water solution containing glucose of molal concentration equal to 1 mol / kg?

- 1) 100°C
- 2) 100.52°C
- 3) 101.04°C
- 4) 99.48°C
- 5) 98.96°C

13. Which of the following substances has the highest temperature of freezing, if the equivalent molar concentrations of these water solutions are the same?

- 1) $\text{C}_6\text{H}_{12}\text{O}_6$
- 2) NaNO_3
- 3) $\text{Ca}(\text{NO}_3)_2$
- 4) $\text{Al}(\text{NO}_3)_3$
- 5) $\text{Al}_2(\text{SO}_4)_3$

14. Which of the following substances has the lowest freezing temperature, if the equivalent molar concentrations of these water solutions are the same?

- 1) $\text{C}_6\text{H}_{12}\text{O}_6$
- 2) KNO_3
- 3) $\text{Mg}(\text{NO}_3)_2$
- 4) $\text{Fe}(\text{NO}_3)_3$
- 5) $\text{Al}_2(\text{SO}_4)_3$

15. Which pair of solutions from below are isotonic to each other when their concentrations are 0.1 mol/l and the temperatures are also the same?

- 1) Fructose and sodium chloride
- 2) Sodium chloride and sodium sulfate
- 3) Sucrose, and magnesium chloride
- 4) Calcium nitrate and sodium sulfate
- 5) potassium chloride and potassium sulfate

16. What is the name of part of the osmotic pressure indicated to the presence of high-molecular components in solution?

- 1) The saturated vapor pressure of pure solvent
- 2) Saturated vapor pressure of the solvent over a solution
- 3) Systolic blood pressure
- 4) Diastolic pressure
- 5) Oncotic pressure

17. How do you call a solution that contains osmotic pressure more than the standard values?

- 1) hypotonic solution
- 2) isotonic solution
- 3) physiological solution
- 4) saturated solution
- 5) hypertonic solution

18. The adding of RBC in a 10% solution of sodium chloride result in the phenomenon?

- 1) hemolysis
- 2) plasmolysis
- 3) deplasmolysis
- 4) ultrafiltration

5) endosmosis

19. What is the phenomenon observed when the RBC are added to 0.1% solution of sodium chloride?

- 1) hemolysis
- 2) plasmolysis
- 3) deplazmolysis
- 4) ultrafiltration
- 5) endosmosis

20. Salt solutions have the same molar concentration of 0.01 mol / l. Which pair of the following solutions contain the same number of particles in 1 liter of solution?

- 1) Na_2SO_4 and NaCl
- 2) Na_2CO_3 and NaBr
- 3) NaBr and K_2SO_4
- 4) NaCl and KBr
- 5) NaCl and Na_3PO_4

21. Equivalent amount of substance, can be calculated as the ratio?

- 1) the molar mass of the substance to its mass
- 2) The mass of a substance to its molar mass
- 3) the molar mass of the substance for its equivalent weight
- 4) The mass of a substance to its molar mass equivalent
- 5) The mass of the substance to the weight of the solution

22. What value can be calculated as the product of the equivalence factor and molar mass of the substance?

- 1) the mass fraction
- 2) the molar concentration
- 3) the molar equivalent concentration
- 4) molar equivalent mass
- 5) the mole fraction

23. Which property of the following represents the ratio of the equivalents to the volume of the solution?

- 1) molarity
- 2) normality
- 3) mass fraction
- 4) mole fraction
- 5) molality

24. Which property of the following represents the ratio of the equivalents of the solute to the weight of the solvent?

- 1) molarity
- 2) normality
- 3) mass fraction
- 4) mole fraction
- 5) molality

"Fundamentals of Chemical Thermodynamics and Bioenergy"

1. Thermodynamics studies
2. The system is ...
3. Homogeneous systems are called ...
4. Heterogeneous systems are called ...
5. The phase is part of a heterogeneous system, ...
6. Depending on the nature of the interaction with the external environment, the systems are distinguished.
7. Isolated systems are characterized by ...
8. Closed systems are characterized by ...
9. Open systems are characterized by ...
10. Extensive parameters - this These include:
11. Intensive parameters are These are:
12. The internal energy of the system is ...
13. Energy exchange between the system and the external environment can take the form of
14. Work is ... Heat is
15. In living systems, work is done at the expense of energy
16. Work done in living organisms can be ...
17. Entropy is a thermodynamic function ...
18. Information is Entropy and information are related ...
19. Thermodynamic process is ... There areprocesses.
20. Formulation I law of thermodynamics:
21. Formulation I law of thermodynamics for isolated systems:
22. Formulation I law of thermodynamics for closed systems:
23. Enthalpy is a thermodynamic function, ...
24. Standard enthalpy of the formation of simple substances in their thermodynamically stable aggregate and allotropic state
25. The standard enthalpy of the formation of a complex substance is ... For example, ...
26. The Law of Hess: ...
27. The caloric content of nutrients is called ...
28. Caloric content of fats, proteins and carbohydrates is ..., ..., ... kcal / g, respectively.
29. The daily requirement for fats, proteins and carbohydrates for an adult is ..., ..., ..., respectively.
30. The daily need of man for energy

"The Second Law of Thermodynamics"

1. The second law of thermodynamics for isolated systems: ...
2. Gibbs energy is
3. Gibbs energy can be calculated through enthalpy and entropy according to the formula:
4. The change in Gibbs energy as a result of the chemical reaction under standard conditions is equal to ...
5. Statement II of the law of thermodynamics for any system:
6. All exothermic reactions can spontaneously occur, if ...
7. Exergonic are biochemical reactions that ...
8. Endergonic are biochemical reactions that ...
9. The principle of energy conjugation of biochemical reactions is that ...
10. Macroergic refers to the connection
11. ATP is acompound.
12. Chemical kinetics studies ...
13. In general, the rate of a chemical reaction is defined as ...
14. The true speed of a chemical reaction is ...

15. Complicated reactions are ... They are divided into ...
16. The rate of homogeneous reaction depends on ...
17. For a reaction of the type $aA + bB = cC + dD$, the law of acting masses can be written in the form:
18. If the values of the reaction order for the reagents coincide with the stoichiometric coefficients, this means that ...
19. According to the rule of Van't-Hoff ...
20. According to the Arrhenius equation ...

"Ionic Equilibria in Electrolyte Solutions"

1. Strong and weak electrolytes. The dissociation of the electrolyte K_nA_n can be represented as
2. According to Ostwald's law, the relationship between the constant and the degree of dissociation of a weak electrolyte is expressed by the relation (give the formula and give the formulation of the law)
3. Debye and Hückel suggested that the main reason for the sharp difference in the properties of strong and weak electrolytes is
4. The apparent degree of dissociation is The higher the concentration of the solution, the apparent degree of dissociation
5. According to the Debye-Hückel law "In dilute solutions of strong electrolytes with the same ionic strength, the activity coefficients of cations and"
6. The precipitate of aluminum hydroxide dissolves in acids and alkalis according to the equations
7. The ionic strength of the solution is (to give a mathematical expression for the calculation of I).

Hydrolysis of salts

1. $[H^+]$ for salts formed by a strong acid and a weak base is (Give the formula for calculation).
2. $[H^+]$ for salts formed by a weak acid and a weak base is (Give the formula for calculation).
3. $[H^+]$ for salts formed by a weak acid and a strong base is (Give the formula for calculation).
4. Molecular and ionic equations of the reactions of the stepwise hydrolysis of sodium sulfite have the form
5. Molecular and ionic equations of the reactions of the stepwise hydrolysis of sodium carbonate have the form
6. Molecular and ionic equations of the reactions of hydrolysis of ammonium acetate have the form
7. The reaction of the medium in a solution of aluminum sulphate, because Write the equation of salt hydrolysis.
8. The reaction of the medium in the solution of copper (II) sulphate, because
9. The reaction of the medium in a solution of ammonium chloride because
10. With the gradual addition of a solution of sodium carbonate to the solution of aluminum sulfate, a precipitate precipitates, since (give the reaction equations).

"Colligative properties of solutions"

1. Solutions are of special interest for biology, medicine and physiology, since
2. In terms of the size of dissolved particles and homogeneity, the solutions are divided into
3. Water has a number of unique properties, due to which it is not only a medium, but also an active metabolite for living organisms:
4. Diluted solutions are characterized by the absence of, therefore the properties of such solutions do not depend on, But depend only on
5. The colligative properties are those solutions that These include
6. Diffusion is From the point of view of thermodynamics, diffusion is explained
7. The diffusion rate is directly proportional to and inversely proportional to (bring the Einstein-Smoluchowski equation).
8. Osmosis is called
9. The osmotic pressure is called (illustrated by the figure).
10. According to the law of Van't Hoff, Π for nonelectrolytes can be calculated by the formula, and for electrolytes by the formula
11. The isotonic coefficient shows the ratio, it is related to the degree of dissociation by the formula
12. The isotonic coefficient can take different values, for example,
13. Two solutions are called isotonic, if When the cell is placed in a hypotonic solution,
14. If the cell is placed in a hypertonic solution, then
15. Oncotic pressure is called With a decrease in oncotic pressure, which is observed when, occurs
16. In medical practice, isotonic solutions are used
17. Hypertensive solutions or gauze dressings, moistened with hypertonic solution of NaCl or ethanol, are used for, since
18. Raoult's law, in terms of the molar fraction of the solvent, is formulated as follows (Give the formula).
19. Raoult's law, in terms of the molar fraction of the solute, is formulated as follows (Give the formula).
20. Consequences from the law of Raul
21. Increasing the boiling point of solutions and lowering the freezing point of solutions is directly proportional to (give formulas for calculation).
22. The molar mass of the nonelectrolyte can be expressed in terms of the cryoscopic and ebullioscopic constants by the formulas

"Buffer systems"

1. Buffer solutions are (Give examples)
2. Buffer solutions in composition are of two main types:
 - a)
 - b)(Give examples)
3. Each of the buffer mixtures is characterized by a certain concentration of hydrogen ions, which the buffer system tends to preserve by adding or, as well as when
4. Derivation of the Hendersson-Hasselbach equation for Type I buffer systems (weak acid and its salt (conjugate base):

5. Derivation of the Hendersson-Hasselbach equation for type II buffer systems (weak base and its salt (proton donor):
6. The pH of the buffer solutions depends on, and practically does not depend on
7. The mechanism of buffer action of the acetate buffer system: (Write reaction equations)
8. Mechanism of buffer action of ammonium buffer system: (Write the reaction equations)
9. The mechanism of the buffer action of the phosphate buffer system: (Write reaction equations)
10. Mechanism of buffer action of bicarbonate buffer system:.. (Write the reaction equations)
11. The mechanism of the buffer action of the protein buffer system: (Write reaction equations)
12. When hydrochloric acid is added to the acetate buffer, the reaction occurs: (Write the reaction equation)
13. When alkali is added to the acetate buffer, the reaction is: (Write the reaction equation)
14. When hydrochloric acid is added to the ammonium buffer, the reaction occurs: (Write the reaction equation)
15. When alkali is added to the ammonium buffer, the reaction occurs: (Write the reaction equation)
16. When hydrochloric acid is added to the phosphate buffer, the reaction occurs: (Write the reaction equation)
17. Mathematically, the acid buffer capacity is defined as follows: , where
18. Mathematically, the buffer capacity for alkali is defined as follows: , where
19. The buffer capacity depends on,
20. Unlike the pH value, the buffer capacity depends on
21. List the main buffer systems of a living organism:
A... B... C... D ...
22. Acid-base balance in blood plasma is provided by the following buffer systems (Choose the correct answers):
a) hemoglobin
b) acetate
c) hydroxycarbonate
d) protein
e) Hydroxyphosphate
f) ammonium
23. Buffer systems of erythrocytes are (choose the correct answers):
1) hemoglobin
2) acetate
3) hydroxycarbonate
4) protein
5) hydroxyphosphate
6) ammonium.
24. Select those statements that correctly describe the biological role of the bicarbonate buffer system

- a) With an excess of CO_2 dissolved in the blood plasma there is acidosis
- b) With an excess of CO_2 dissolved in the blood plasma, alkalosis
- c) The buffer capacity of the bicarbonate buffer system is higher in acid than in alkali
- d) The buffer capacity of the bicarbonate buffer system is higher in alkali than in acid
- e) The bicarbonate buffer system is an effective physiological buffer near pH of 7.4
- e) Bicarbonate buffer system is most significant in blood plasma
- g) The bicarbonate buffer system takes precedence over the cellular sector.

25. Select those statements that correctly describe the biological role of the phosphate buffer system:

- a) Phosphate buffer system is of primary importance in the cellular sector
- b) Phosphate buffer system is most significant in blood plasma
- c) Buffer bases are mainly represented by potassium salts of phosphoric acid
- d) In the blood, the role of phosphate buffer is reduced mainly to maintaining the constancy and reproduction of bicarbonate buffer
- e) In the blood, the role of the phosphate buffer is reduced mainly to maintaining the consistency and reproduction of the protein buffer
- e) Phosphate buffer is of greatest importance in such biological fluids as urine and juices of digestive glands.

"Chemical equilibrium"

1. The speed of any chemical reaction depends on:

- a) pressure
- b) temperature
- c) areas of contact of reacting substances
- d) all of the above factors

2. How many times will the reaction rate change: $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$ when the pressure in the system is increased 3 times?

- a) will increase 9 times
- b) will increase 6 times
- c) will increase by 27 times
- d) will increase 18 times

3. Unit of measurement of homogeneous reaction rate:

- a) $\text{mol} / (\text{n} \cdot \text{s})$
- b) $(\text{kmol} \cdot \text{m}^3) / \text{h}$
- c) $(\text{mol} \cdot \text{s}) / \text{ml}$
- d) $(\text{n} \cdot \text{s}) / \text{mole}$

4. In the reaction, the scheme of which $2\text{A}(\text{g}) + \text{B}(\text{g}) \rightarrow \text{C} + \text{D}$ the concentration of substance A was increased 2 times, and substance B - 3 times.

The reaction speed will increase:

- a) 12 times
- b) 6 times
- c) by a factor of 1.5
- d) 3 times

5. To increase the rate of chemical reaction $\text{Mg}(\text{s}) + 2\text{H}^+ \rightarrow \text{Mg}^{2+} + \text{H}_2$ is necessary:

- a) add a few pieces of magnesium
- b) increase the concentration of hydrogen ions

- c) reduce the temperature
- d) increase the concentration of magnesium ions

6. To increase the reaction rate of $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2 + \text{Q}$, it is necessary:

- a) increase the concentration of CO
- b) reduce the concentration of O_2
- c) lower the pressure
- d) lower the temperature

7. The speed of the chemical reaction between a solution of sulfuric acid and iron has no effect:

- a) concentration of acid
- b) grinding of iron
- c) reaction temperature
- d) increase in pressure

8. The temperature coefficient of the reaction is 2. How many degrees it is necessary to reduce the temperature, so that the reaction rate decreases 16 times:

- a) by 20°C
- b) at 30°C
- c) at 40°C
- d) at 50°C

9. The rate constant of the chemical reaction does not depend:

- a) on the nature of the reactants
- b) on the concentration of reactants
- c) on the temperature
- d) on the presence of a catalyst

10. In any chemical reaction, the equilibrium shifts when:

- a) temperature change
- b) with a change in pressure
- c) under the action of catalysts
- d) when the contact area of the reacting substances changes.

«Complex compounds »

1. Specify the metal complexing agent in the complex $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$:

- a) Cl^-
- b) $[\text{Ag}(\text{NH}_3)_2]^+$
- c) Ag^+
- d) NH_3

2. Specify the coordination number of the central atom in the complex $\text{K}_4[\text{Fe}(\text{CN})_6]$:

- a) 3
- b) 4
- c) 5
- d) 6

3. What is the formula for compounds with a complexing agent Cr^{III} (coordination number 6), ligands OH^- , H_2O and the external sphere Cl^-

- a) $[\text{Cr}(\text{OH})_2(\text{H}_2\text{O})_4]\text{Cl}_2$
- b) $[\text{Cr}(\text{H}_2\text{O})_4(\text{OH})_2]\text{Cl}$

- c) $\text{K}[\text{Cr}(\text{OH})_4(\text{H}_2\text{O})_2]$
- d) $[\text{Cr}(\text{H}_2\text{O})_5(\text{OH})_2]\text{Cl}$

4. Indicate the inner sphere of the complex $\text{Na}_2\text{Pb}[\text{Cu}(\text{NO}_2)_6]$:

- a) Cu^{2+}
- b) Na^+
- c) $[\text{Cu}(\text{NO}_2)_6]^{4-}$
- d) NO_2^-

5. What is the electronic formula of the *d*-sublevel of the atom Fe^{III} :

- a) $3d^5$
- b) $3d^6$
- c) $3d^8$
- d) $3d^3$

6. Determine the charge of the complex dicyanodiamcooper (II):

- a) 2^-
- b) 1^-
- c) 0
- d) 2^+

7. Determine the complex compound among the chromium compounds (III)

- a) CrCl_3
- b) $\text{KCr}(\text{SO}_4)_2$
- c) $[\text{Cr}(\text{H}_2\text{O})_2(\text{NH}_3)_4]\text{Cl}_3$
- d) $\text{Cr}_2(\text{SO}_4)_3$

8. Which molecule corresponds to the name tetraiodopalladate (II) sodium?

- a) PdI_2
- b) $\text{Pd}(\text{NO}_2)$
- c) NaI
- d) $\text{Na}_2[\text{PdI}_4]$

9. Which molecule corresponds to the name tetraiodomercurate (II) of potassium?

- a) $\text{K}_2[\text{HgI}_4]$
- b) HgI_2
- c) $\text{Hg}(\text{NH}_3)_4]\text{SO}_4$
- d) HgSO_4

10. What is the charge of a complex ion $[\text{Zn}(\text{OH})_4]$?

- a) +3
- b) +4
- c) -2
- d) -3

"Superficial phenomena"

1. Choose the correct statement:

- a) atoms or molecules at the phase boundary have a high energy in comparison with atoms or molecules in the depth of the phase
- b) atoms or molecules at the phase boundary have a lower energy compared to atoms or molecules in the depth of the phase

- c) atoms or molecules on the interface and in the depth of the phase have the same energy
- d) there is no correct statement.

2. Indicate which substances, whose formulas are listed below, have a negative adsorption on the surface of the aqueous solution?

- a) NH_4OH
- b) $\text{C}_3\text{H}_7\text{NH}_2$
- c) $\text{C}_3\text{H}_{13}\text{SO}_3$
- d) Na_2SO_3

3. With increasing temperature, the surface tension value:

- a) decreases
- b) increases
- c) does not change.

4. Absorption of the substance with the whole mass of the adsorbent is called:

- a) by adsorption
- b) absorption
- c) sorption
- d) desorption.

5. Indicate in which series the adsorption of substances from aqueous solutions on activated carbon increases?

- a) CH_3COOH , CH_3COOH ; $\text{C}_2\text{H}_5\text{OH}$; $\text{C}_3\text{H}_7\text{OH}$
- b) $\text{C}_3\text{H}_7\text{OH}$, $\text{C}_2\text{H}_5\text{OH}$, CH_3COOH , CH_3COOH
- c) CH_3COOH , CH_3COOH , $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_3\text{H}_7\text{OH}$
- d) CH_3COONa , $\text{C}_3\text{H}_7\text{OH}$, CH_3COOH , $\text{C}_2\text{H}_5\text{OH}$.

6. The better the adsorbate dissolves in a given solvent, the more it is adsorbed from this solvent:

- a) worse
- b) better
- c) the solubility of the adsorbate does not affect adsorption

7. Adsorption of gases on a solid adsorbent depends on:

- a) on the pressure
- b) temperature
- c) the nature of the adsorbent and adsorbate
- d) from the specific surface of the adsorbent.

8. Molecular adsorption depends on:

- a) the nature of the adsorbent
- b) the nature of the solvent
- c) the nature of the adsorbate
- d) solution concentration
- e) temperature?

1) a, b, c; 2) a, c, d, q; 3) a, b, c, d, d; 4) a, b, d, d.

9. Indicate units of measurement of surface tension in the SI system:

- a) $\text{N} \cdot \text{m}^2 \cdot \text{mol}^{-1}$
- b) $\text{J} \cdot \text{m} / \text{mol}^{-1}$
- c) J / m^2

d) $\text{N} \cdot \text{m}$.

10. The value of the surface energy decreases when:

- a) increasing the surface
- b) reducing the surface
- c) increase in surface tension
- d) decrease in surface tension

1) b, d; 2) b, c; 3) a, c; 4) a, d.

BASIC CONCEPTS IN BIOORGANIC CHEMISTRY. ISOMERISM OF ORGANIC COMPOUNDS

1. Correspondence of hydrocarbon and type of hybridization of atomic orbitals carbon in the molecule:

- | | |
|--------------|--------------------------|
| 1) ethane | a) sp |
| 2) ethylene | b) sp^2 |
| 3) acetylene | c) sp^3 |
| | d) sp^2d |

Answer: 1 ..., 2 ..., 3 ...

2. Compounds that are among themselves isomers:

- a) hexane
- b) 2,3-dimethylpentane
- c) 2,3-Dimethylbutane
- d) 2,2-dimethylpropane

3. The general formula of the homologous series of compound $\text{CH}_3\text{-CH=CH-CH=CH}_2 \dots$

- a) $\text{C}_n\text{H}_{2n-2}$
- b) $\text{C}_n\text{H}_{2n+2}$
- c) C_nH_{2n}
- d) $\text{C}_n\text{H}_{2n-6}$

4. Compounds for which geometric isomers are possible:

- a) 1,2 dichlorobutane
- b) 3-hexene
- c) ethynyl chloride
- d) 1,2-Dimethylcyclobutane

5. Correspondence of formulas and names of compounds:

- | | |
|---|------------|
| 1) C_6H_6 | a) styrene |
| 2) $\text{C}_6\text{H}_5\text{CH}_3$ | b) xylene |
| 3) $\text{CH}_3\text{C}_6\text{H}_4\text{CH}_3$ | c) toluene |
| | d) benzene |

Answer: 1 ..., 2 ..., 3

6. Substances, isomeric butylene ...

- a) butane
- b) Butyne

- c) cyclobutane
- d) butadiene-1,2

7. Name of the compound $\text{HC} \equiv \text{C}-\overset{\text{CH}_3}{\underset{|}{\text{C}}}-\text{CH} = \text{CH}_2$ according to the systematic nomenclature

...



- a) 3,3-dimethylpentene-1-yn-4
- b) 3,3-Dimethyl-pentyn-1-en-4
- c) 3-methyl-3-ethynyl-butene-2
- d) 3-Vinyl-3-methylbutyn-1

8. The name of the acid, which is the homologue of acetic acid:

- a) ant
- b) benzoic acid
- c) oleic
- d) oxalic

9. Names of pentanone-2 isomers according to the rational nomenclature:

- a) diethyl ketone
- b) methyl ethyl ketone
- c) methylbutyl ketone
- d) ethyl acetic aldehyde

10. Compounds whose molecules include a carbonyl group:

- a) aldehydes
- b) phenols
- c) ethers
- d) ketones

ACIDITY AND BASICITY OF ORGANIC COMPOUNDS

1. A number of compounds whose acidity increases:

- a) glycerin; phenol; water
- b) ethanol; water; phenol
- c) phenol; ethylene glycol; methanol
- d) ethanol, methanol, phenol

2. Alcohol interacting with a freshly precipitated solution of copper (II) hydroxide:

- a) CH_3OH
- b) $\text{C}_6\text{H}_{11}\text{OH}$
- c) $\text{CH}_2(\text{OH})-\text{CH}(\text{OH})-\text{CH}_2\text{OH}$
- d) $\text{CH}_2(\text{OH})-\text{CH}_2-\text{CH}_2-\text{CH}_3$

3. A compound that reacts chemically with sodium hydroxide:

- a) $\text{C}_6\text{H}_5\text{OH}$
- b) $\text{CH}_3\text{CH}_2\text{OH}$
- c) $\text{C}_6\text{H}_{13}\text{OH}$
- d) $\text{C}_6\text{H}_5-\text{CH}_2\text{OH}$

4. Solubility of alcohols in water series $C_3H_7OH \rightarrow C_4H_9OH \rightarrow C_5H_{11}OH \dots$
- decreases
 - does not change
 - decreases, and then increases
 - increases
5. Reagent, which forms a violet staining of the solution in the interaction with phenol:
- bromine water
 - sodium hydroxide
 - copper (II) hydroxide
 - ferric chloride (III)
6. The sequence of compounds in order of increasing their acid properties:
- glycerin
 - hexanol
 - ethanol
 - phenol
7. Conformity of compounds and solutions of reagents for their qualitative determination:
- | | |
|--------------------|-----------------------------|
| 1) phenol | a) iron (III) chloride |
| 2) ethylene glycol | b) copper (II) hydroxide |
| 3) acetylene | c) sodium hydroxide |
| | e) Chloride diammine silver |
- Answer: 1- ..., 2- ..., 3-
8. In the substance CH_3-CH_2-OH , the bond between carbon and oxygen atoms:
- covalent nonpolar
 - covalent polar
 - ionic
 - hydrogen
9. Arrange the substances in order of increasing acidity:
- H-OH
 - C_2H_5OH
 - CH_3COOH
 - C_6H_5OH
10. Polyatomic are called alcohols, in the molecule of which
- many oxygen atoms
 - many carbon atoms
 - two or more hydroxyl groups
 - two or more carboxyl groups

POLY- AND HETERO-FUNCTIONAL COMPOUNDS

1. Select representatives (2) of multifunctional connections:
- ethanediol
 - lactic acid
 - glycerin
 - butanoic acid
 - ethanol

2. Which of the compounds forms acidic and middle salts:

- a) methanal
- b) ethanol
- c) succinic acid
- d) propanoic acid
- e) lactic acid

3. Name the compound: $\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{COOH}$

- a) glycerin
- b) pentanoic acid
- c) glutaric acid
- d) ethanediol
- e) succinic acid

4. Indicate the functional groups of amino alcohols:

- a) $-\text{OH}$; $-\text{COOH}$
- b) $-\text{OH}$; $-\text{NH}_2$
- c) $-\text{C}=\text{O}$; $-\text{COOH}$

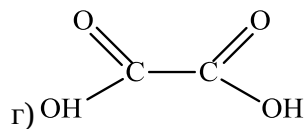
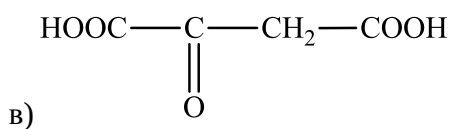
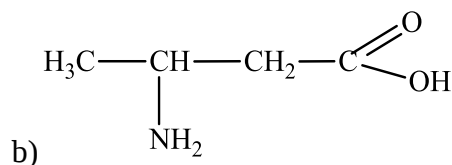
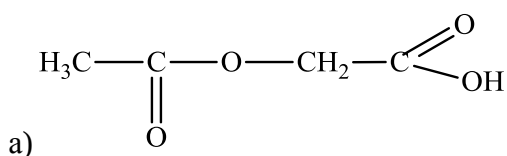
5. What groups in the molecule are responsible for the amphoteric properties of the compound?

- a) $-\text{OH}$ and $-\text{NH}_2$
- b) $-\text{OH}$ and $-\text{COOH}$
- c) $-\text{NH}_2$ and $-\text{COOH}$
- d) $-\text{C}=\text{O}$ and $-\text{COOH}$

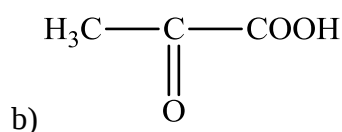
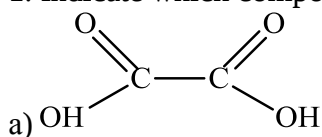
6. Which of the statements does not correspond to the molecule of paracetamol

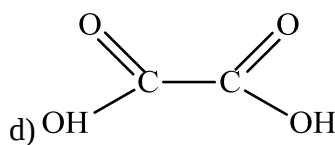
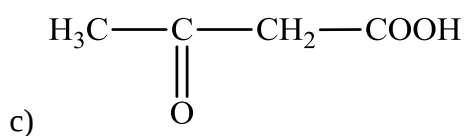
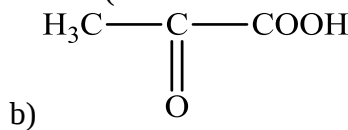
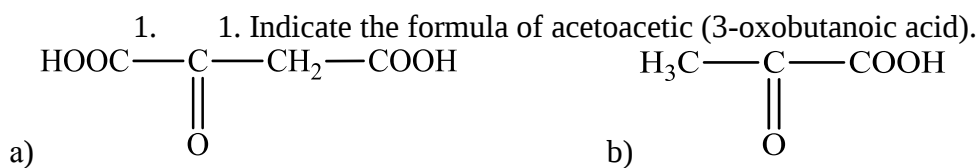
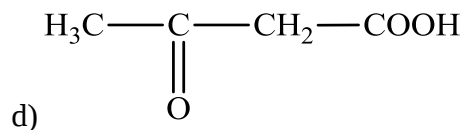
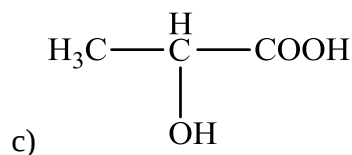
- a) contains an amino group
- b) contains only the same functional groups
- c) all carbon atoms are in the second valence state
- d) contains a phenolic moiety

1. Indicate the formula of oxaloacetic acid.

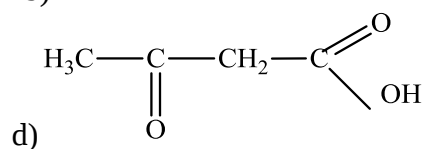
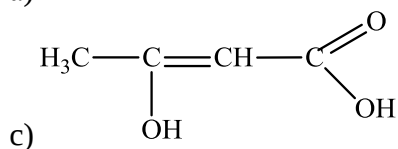
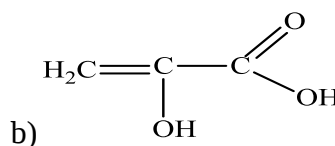
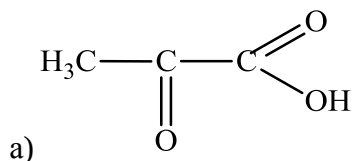


1. Indicate which compound is related to ketoacids

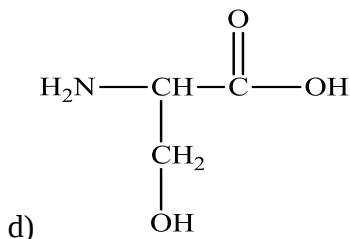
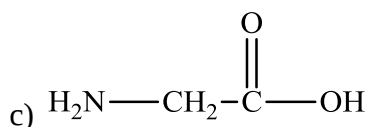
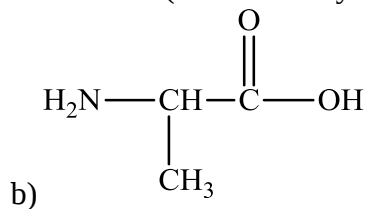
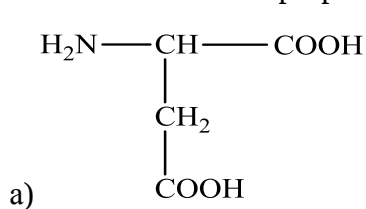




10. Indicate the enol form of pyruvic (2-oxopropanoic) acid



11. Choose from the proposed formulas serine (2-amino-3-hydroxypropanoic acid).



12. With the intramolecular dehydration of which compound, lactones are obtained:

- a) α -hydroxypropanoic acid
- b) γ -aminobutyric acid
- c) γ -aminopropanoic acid
- d) γ -hydroxybutyric acid

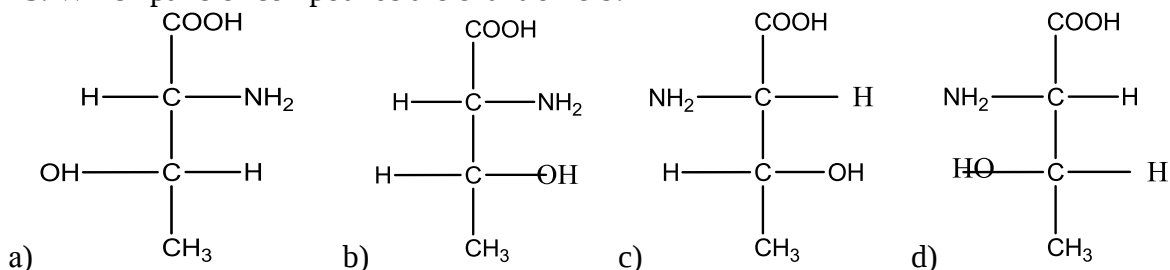
13. Which compound is related to hydroxy acids?

- a) milk
- b) Butter
- c) pyruvic
- d) glutaric

14. To dicarboxylic hydroxy acids refers to

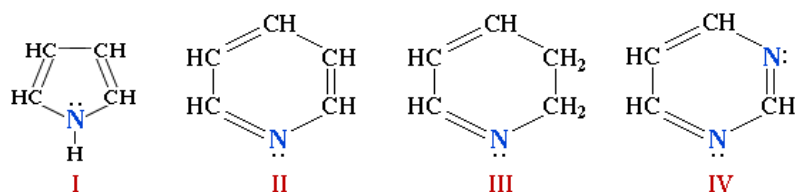
- a) malic acid
- b) tartaric acid
- c) fumaric acid
- d) maleic acid

15. Which pairs of compounds are enantiomers?



BIOLOGICALLY ACTIVE HETEROCYCLIC COMPOUNDS

1. Which heterocycles are aromatic?



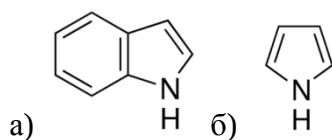
3. Specify the correct order of increasing the properties of the base for the following nitrogen-containing compounds:

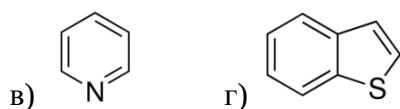
- a) pyrrole < pyridine < dimethylamine < ammonia
- b) ammonia < pyrrole < pyridine < dimethylamine
- c) dimethylamine < ammonia < pyridine < pyrrole
- d) pyrrole < pyridine < ammonia < dimethylamine

4. In what order is the ease of electrophilic substitution reactions increasing for the following compounds?

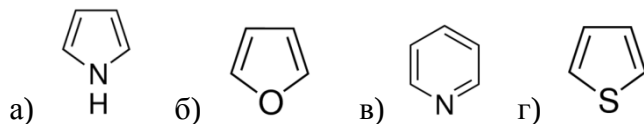
- a) pyridine < benzene < pyrrole
- b) pyrrole < benzene < pyridine
- c) benzene < pyridine < pyrrole
- d) benzene < pyrrole < pyridine

5. Among the heterocycles represented, the base properties are:





6. The unpaired electron pair of the heteroatom does not participate in conjugation with the p-electrons of the carbon atoms of the ring in the molecule ...



7. The composition of nucleic acids includes heterocyclic bases, which are ...

- а) derivatives of thiophene
- б) pyrrole derivatives
- в) derivatives of purine
- г) derivatives of furan

8. Nicotinic acid is a derivative of:

- а) pyridine
- б) indole
- в) imidazole
- г) pyrimidine
- д) pyrazole

1. Piperidine is a derivative:

- а) pyridine
- б) pyrrole
- в) pyrimidine
- г) pyrazine
- д) pyridazine

2. Diazines include:

- а) pyridine
- б) piperidine
- в) pyrimidine
- г) pyrrole
- д) pyrroline

3. Six-membered heterocyclic compounds include:

- а) pyrazole
- б) pyran
- в) pyrrole
- г) pyrroline
- д) Thiazole.

4. The six-membered heterocyclic compounds include:

- а) thiazole
- б) thiophene

- c) imidazole
- d) pyridine
- e) pyrrole

5. For qualitative determination of the antipyrine, use:

- a) sodium nitrite
- b) bromine water
- c) potassium permanganate
- d) sodium hydroxide
- e) sulfuric acid

6. Dibazol is a derivative:

- a) benzopyrrole
- b) furan
- c) benzimidazole
- d) indole
- e) pyrazole

7. Pyridine has the following properties:

- a) the main
- b) Acidic
- c) amphoteric
- d) oxidative
- e) Rehabilitation

8. Five-membered heterocyclic compounds with one heteroatom include:

- a) xanthine
- b) pyrimidine
- c) furan
- d) quinoline
- e) pyridine

9. Five-membered heterocyclic compounds include:

- a) Purine
- b) imidazole
- c) pyridine
- d) quinoline
- e) Thiazole

10. Condensed heterocycles include:

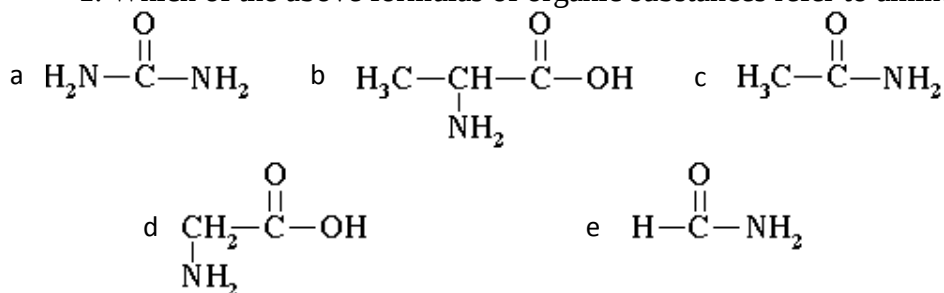
- a) Purine
- b) Thymine
- c) piperidine
- d) imidazole
- e) pyrrolidine

11. The pyrazolone-3 derivatives are:

- a) porphin
- b) analgin
- c) pyridine
- d) furacilin
- e) pyrrole

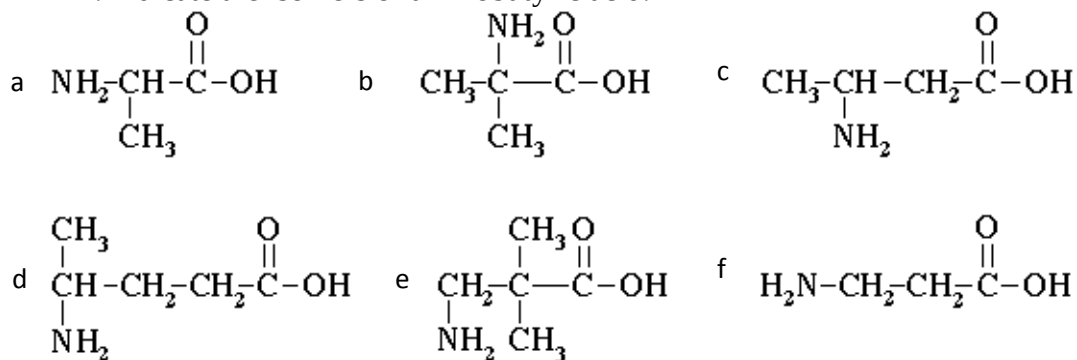
α -AMINO ACIDS

1. Which of the above formulas of organic substances refer to amino acids?



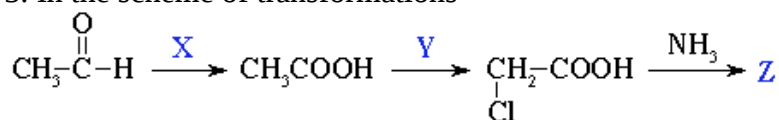
- 1) a, c
- 2) a, e
- 3) b, d
- 4) c, e

2. Indicate the isomers of aminobutyric acid.



- 1) a, d
- 2) b, c
- 3) d, e
- 4) e, f

3. In the scheme of transformations



substances X, Y and Z can be:

- a) X - [O]; Y is Cl₂; Z-aminobutyric acid
- b) X is H₂; Y is Cl₂; Z-aminobutyric acid
- c) X - [O]; Y = HCl; Z-amide of acetic acid
- d) X is H₂; Y = HCl; Z-amide of acetic acid

4. The ester is formed by the reaction of aminoacetic acid. . .

- a) with sodium hydroxide

- b) with a solution of sulfuric acid
- c) with aminoacetic acid
- d) with ethanol

5. As a result of the intermolecular cyclization reaction of α -amino acids,

- a) lactams
- b) lactones
- c) cyclic anhydrides
- d) lactides
- e) diketopiperazines

6. During the decarboxylation reactions of amino acids, the following are formed:

- a) hydroxy acids
- b) unsaturated carboxylic acids
- c) oxo acids
- d) biogenic amines

7. When intermolecular dehydration of α -amino acids is formed:

- a) lactams
- b) lactims
- c) diketopiperazines
- d) lactides

8. Is it possible to distinguish glycine from proline by:

- a) ninhydrin reaction
- b) Van Slyck reaction?

PEPTIDES. PROTEINS

1. The coiling of a spiral into a tangle-"globule" characterizes:

- a) the primary structure of the protein
- b) secondary structure of the protein
- c) tertiary structure of the protein
- d) quaternary structure of the protein

2. When burning proteins, there is a smell:

- a) rotten eggs
- b) ammonia
- c) burnt feathers (horns)
- d) burnt rubber

3. The appearance of a yellow color when the protein solution interacts with concentrated nitric acid indicates the presence in the protein of amino acid residues containing:

- a) -SH
- b) hydroxyl group
- c) benzene ring
- d) an aldehyde group

4. Proteins that protect against bacteria entering the cell:

- a) hemoglobin
- b) antibodies
- c) Enzymes

d) antitoxins

5. Proteins can be found:

- a) xantoprotein reaction d) with potassium permanganate
- b) the effect of the indicator e) with the help of a biuret reaction
- c) by the appearance of an odor when burning e) by the reaction of a "silver mirror"

6. What statements about proteins are correct?

- a) the proteins are hydrolyzed to amines
- b) Peptide bonds are present in the macromolecule of the protein
- c) during the hydrolysis of proteins amino acids are formed
- d) hydrogen bonds are present in the macromolecule of proteins
- e) with nitric acid, the proteins give a black color
- e) the main function of proteins in the body - energy

7. The spatial configuration of a protein molecule resembling a spiral (secondary structure of the protein) is formed due to numerous:

- a) disulfide bonds
- b) peptide bonds
- c) hydrogen bonds
- d) ester bridges

8. The process of irreversible clotting of proteins is called:

- a) Denaturation
- b) polymerization
- c) polycondensation
- d) hybridization

9. Structural feature of molecules of amino acids, distinguishing them from each other:

- a) the radical
- b) amino group
- c) carboxyl group
- d) nitro group

10. In the primary structure of protein molecules, the amino acid residues are linked together by the following chemical bond:

- a) disulphide
- b) Peptide
- c) hydrogen
- d) ionic

11. The synthesis of proteins occurs in the cell organelles, called:

- a) chloroplasts
- b) ribosomes
- c) mitochondria
- d) Golgi apparatus

12. The first protein, which managed to decipher the primary structure (in 1954), was:

- a) casein
- b) insulin
- c) gliadin
- d) keratin

13. When concentrated nitric acid acts on proteins (xantoprotein reaction), the following appears:

- a) yellow color
- b) red-violet coloring
- c) black precipitate
- d) a blue precipitate

14. Renaturation is a process:

- a) a violation of the natural structure of the protein
- b) restoration of the natural structure of the protein

15. Choose a protein that performs a predominantly structural function

- a) collagen
- b) catalase
- c) actin
- d) gamma globulin

NUCLEIC ACIDS

1. Nucleotide that is not part of RNA:

- a) CMF
- b) UMF
- c) AMF
- d) GMF
- e) TMF

2. A nucleotide that is not part of the DNA:

- a) dCMF
- b) UMF
- c) d AMF
- d) dGMP
- e) TMF

3. In nucleic acids, the phosphodiester bond is formed between the atoms of the pentose residue:

- a) $1^1 - 2^1$
- b) $1^1 - 3^1$
- c) $1^1 - 5^1$
- d) $2^1 - 5^1$
- e) $3^1 - 5^1$

4. A compound formed from a nitrogenous base and ribofuranose:

- a) ribonucleoside
- b) deoxyribonucleoside
- c) Ribonucleotide
- d) deoxyribonucleotide
- e) nucleotide

5. A compound formed from uracil and ribofuranose:

- a) adenosine
- b) thymidine
- c) cytidine

- d) uridine
- e) guanosine

6. A compound formed from cytosine and ribofuranose:

- a) adenosine
- b) thymidine
- c) cytidine
- d) uridine
- e) guanosine

7. A compound formed from guanine and ribofuranose:

- a) adenosine
- b) thymidine
- c) cytidine
- d) uridine
- e) guanosine

8. The DNA molecule is:

- a) deoxyribonucleic acid
- b) dinucleic acids
- c) d-nucleic acids
- d) 2-nucleic acids
- e) nucleic acids

9. Nucleoside can be obtained from the nucleotide by cleavage:

- a) hydrochloric acid
- b) phosphoric acid
- c) acetic acid
- d) oxalic acid
- e) Ethyl alcohol

10. RNA monomer.

- a) adenosine monophosphate
- b) nucleoside diphosphates
- c) nucleic bases
- d) nicotinic acid
- e) thymidine monophosphate

11. Monomer DNA:

- a) nucleosides
- b) nucleoside diphosphates
- c) nucleic bases
- d) deoxyguanosine monophosphate
- e) Purine

12. It has anhydride bond:

- a) nucleoside polyphosphates
- b) nucleosides
- c) adenosine triphosphoric acid
- d) nucleoside cyclophosphates
- e) thymidylic acid

CARBOHYDRATES

1. Glucose in the industry receive ...
 - a) synthesis from formaldehyde
 - b) cracking of oil products
 - c) hydrolysis of starch
 - d) synthesis from carbon dioxide and water

2. Among the listed disaccharides, non-reducing ones are:
 - a) sucrose
 - b) maltose
 - c) cellobiose
 - d) lactose

3. Macromolecules of starch and cellulose are formed from individual glucose molecules by the reaction:
 - a) esterification
 - b) polycondensation
 - c) polymerization
 - d) oxidation

4. Cellulose forms esters, interacting with ... (2 correct answers)
 - a) nitric acid
 - b) hydrochloric acid
 - c) acetic anhydride
 - d) oxygen

3. What substances are natural polymers (2 correct answers)?
 - a) starch
 - b) lactose
 - c) cellulose
 - d) fructose

4. Starch from cellulose can be distinguished ...
 - a) by reaction with copper (II) hydroxide
 - b) reaction with iodine
 - c) reaction by etirification
 - d) hydrolysis followed by the reaction of the "silver mirror"

7. Monosaccharides include:
 - a) maltose
 - b) fructose
 - c) lactose
 - d) heparin
 - e) glycogen.

8. Glucose is:
 - a) ketohexose
 - b) ketopentose
 - c) aldohexose
 - d) aldopentose
 - e) disaccharide.

9. The composition of sucrose includes residues:
- a) two glucose molecules
 - b) two molecules of fructose
 - c) glucose and fructose
 - d) galactose and glucose.
10. A physiologically important homopolysaccharide is:
- a) hyaluronic acid
 - b) chondroitin sulfate
 - c) glycogen
 - d) cellulose.

LIPIDES

1. Lipids dissolve in all substances listed below except:
- a) ether
 - b) water
 - c) benzene
 - d) chloroform
2. Structurally, all lipids are:
- a) with ethers
 - b) higher alcohols
 - c) esters
 - d) polycyclic alcohols
3. Structural lipids include all of the following:
- a) phospholipids
 - b) glycolipids
 - c) triglycerides
 - d) sterols
4. The composition of triglycerides includes all of the elements listed below except:
- a) H
 - b) O
 - c) S
 - d) C
5. The main lipids of membranes are:
- a) triglycerides
 - b) glycolipids
 - c) Waxes
 - d) phospholipids
6. Esters of higher fatty acids and polycyclic alcohols are called:
- a) Waxes
 - b) sterols
 - c) sterols
7. The most common saturated higher fatty acids, which are part of lipids:
- a) palmitic
 - b) acetic acid
 - c) stearic acid
 - d) ant
8. How many isoprene fragments contain diterpenes:
- a) 2
 - b) 3
 - c) 4
 - d) 6
9. Camphor refers to
- a) to monoterpenes

- b) diterpenes
- c) sesquiterpenes
- d) triterpenes

10. Provitamin A of vitamin A is:

- a) γ - carotene b) β - carotene c) α - carotene

11. How many isoprene fragments contain triterpenes:

- a) 2 b) 3 c) 4 d) 6

12. The main component of turpentine is:

- a) limonene b) terpinene
- c) α -pinene d) camphene

13. Acyclic terpenes include:

- a) geraniol b) citronellol
- c) Nerol d) Citronellal
- e) limonene e) terpinenes

14. Monocyclic monoterpenes include:

- a) geraniol b) citronellol
- c) pinene d) citronellal
- e) limonene e) terpinenes

15. Bicyclic monoterpenes include:

- a) geraniol b) citronellol
- c) pineny d) camphor
- e) limonene e) terpinenes

16. The following applies to sesquiterpenes:

- a) kicking b) Camphor
- c) limonene d) farnesol

17. Diterpenes include:

- a) phytol b) Camphor
- d) cis- and tansretinal e) farnesol

18. Triterpenes include:

- a) phytol
- b) Camphor
- c) squalane
- d) borneol

19. The structural features of cardiac glycosides include:

- a) the aromatic nature of ring A
- b) the presence of phenolic OH at the C-3 atom
- c) the presence of an unsaturated lactone ring in position 17 of the gonane system;
- d) the β -hydroxyl group at the C11 atom
- e) the presence of a branched C8-C10 alkyl radical at position C17

20. How many isoprene fragments contain sesquiterpenes:

- a) 2 b) 3 c) 4 d) 5 e) 6