Assessment tools for conducting attestation
in discipline «Chemistry»
for students of 2025 year of admission
under the educational programme
31.05.01 General medicine,
specialisation (profile) General medicine
(Specialist's degree),
form of study full-time correspondence
for the 2025 - 2026 academic year

1. Assessment tools for conducting current attestation in discipline «Chemistry».

The current attestation includes the following types of tasks: testing, control work, interview on control questions

1.1. Examples of test

Verifiable indicators of competence achievement:: UC-1.1.1, GPC-10.1.1, GPC-10.1.2

Choose just one correct answer

1. How many moles of HNO3 are needed to prepare 5.0 liters of a 2.0 M solution of HNO3?
   A 2.5
   B 5
   C 10
   D 20
2. Find the pH of the following solution 0.0815 M NaOH
   A. 1.08
   B. - 1.08
   C. 12.9
   D. – 12.9
3. Find the pOH of the following solution 0.0115 M HCl
   A. – 1.9
   B. 12.1
   C. 1.9
   D. – 12.1
4. 23.45 mL of 0.275 M sodium hydroxide was used to titrate against 15 mL of acetic acid. What was the normality of acetic acid?
   A. 0.430 N
   B. 0.176 N
   C. 0.275 N
   D. 0.152 N
5. Which of the following combinations define a process that is always spontaneous?
   A. $\Delta H < 0, \Delta S > 0$
   B. $\Delta H < 0, \Delta S < 0$
   C. $\Delta H = 0, \Delta S < 0$
   D. $\Delta H > 0, \Delta S > 0$
   E. $\Delta H > 0, \Delta S < 0$
6. The first law of thermodynamics is a restatement of which law?
   A. conservation of energy

B. second law of thermodynamics
C. kinetic-molecular law
D. gravity

19. Which of the following inorganic substances is a metabolic waste product?
A. Oxygen
B. carbon dioxide
C. inorganic salts
D. all of the above

20. Which of the following elements is found only in proteins and nucleic acids in the body?
A. Carbon
B. Nitrogen
C. Hydrogen
D. oxygen

21. The bond that contributes to maintaining the special shape of a protein is a(n)
A. hydrogen bond
B. electrovalent bond
C. ionic bond
D. peptide bond

22. A phospholipid typically has
A. phosphorus atoms substituted for carbon atoms
B. no glycerol portion
C. two fatty acid chains and a phosphate group
D. three fatty acids each of which contain phosphate groups

23. Which of the following elements is not one of the six most abundant elements found in all living cells? oxygen
A. nitrogen
B. sulfur
C. potassium
D. carbon

24. More than 95% of the atoms in your body are these four elements

A. oxygen, carbon, hydrogen, and nitrogen
B. iron, phosphorus, carbon, and hydrogen
C. oxygen, hydrogen, calcium, and carbon
D. hydrogen, iron, silicon, and oxygen

25. _____ function as biological catalysts, make up your muscles and tendons, and help transport substances in your blood.

A. Carbohydrates
B. Esters
C. Proteins
D. Sugars

26. Proteins are polymers made up of these monomers

A. amino acids
B. alkenes
C. hexoses
D. vitamins

27. In proteins, these structures are held together by hydrogen bonds, ionic bonds, and disulfide cross-link

A. amino acids
B. carbon atoms
C. monomers
D. polypeptides

28. Carbohydrates are made up of these three elements

A. carbon, hydrogen, and oxygencarbon, calcium, and hydrogen
C. carbon, phosphorus, and hydrogen
D. carbon, nitrogen, and oxygen

29. Animals store energy in their livers and muscles as _____.

A. glycogen
B. starch
C. glucose
D. sucrose

Glucose, fructose, and ribose are _____.disaccharides

B. monosaccharides
C. polymers
D. proteins

31. These are biological compounds that contain a large proportion of C-H bonds and less oxygen than carbohydrates

A. boneslipids
C. sugars
D. substrates

32. An _____ atom is at the center of the hemoglobin molecule

A. carbon
B. copper
C. iron
D. nitrogen

33. Which of the following inorganic substances is a metabolic waste product?

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B. carbon dioxide
C. inorganic salts
D. all of the above

1.2. An example of a test case.

Verifiable indicators of competence achievement: UC-1.1.1, GPC-10.1.1, GPC-10.1.2

1. The specific gravity of 48 % HNO_3 solution equals 1.25. Calculate molarity and molality of this solution.

2. How much glucose ($C_6H_{12}O_6$) per liter should be used for an intravenous solution to match the 780 kPa at 37 °C osmotic pressure of blood?

3. Two processes flow with the same rates at 25^0C. The temperature coefficient of the first reaction is equal to 3.2 and the second reaction 1.7. Find the ratio between rates of these reactions at 55^0C.

4. 500 mL of 1 M citric acid has 0.1 mole of sodium citrate added to it. What is the pH of this buffer? ($K_a = 6.58 \cdot 10^{-4}$).

1.3. Examples of control questions for the interview.

Verifiable indicators of competence achievement: UC-1.1.1, GPC-10.1.1, GPC-10.1.2

1. What is the thermodynamic system? How can we classify the systems? Give some examples.
2. How do the buffer solutions work (if add a strong acid or a strong base)? Buffer capacity.
3. Find the molarity of OH^- ions in the solution in which the concentration of H^+ ions is equal to: a) 1.4 10^{-10}mol/L, b) 2.3 10^{-2}mol/L.
4. How many grams of magnesium sulfate do you need to make 250 ml of 1.6% MgSO4 solution (p=1.16)?
5. Calculate ΔG^o and equilibrium constant of the reaction: $C_{(S)} + CO_{2(G)} \Leftrightarrow 2CO_{(G)}$ at 500^oC.
6. Describe the osmosis process. Van't Hoff's Law. What are plasmolysis, hemolysis, lysis? What happens to red blood cells that are placed in the following solutions: 2% NaCl, pure water, 0.9% NaCl?
7. 15.0g of calcium carbonate is dissolved in 250g of water. If the water has a temperature of 30°C, what is the resulting vapor pressure of the water in solution? (The vapor pressure of pure water at 30^0C is 53.196 kPa)

1.4 Assessment tools for students' independent work

The evaluation of independent work includes testing.

1.4.1. Examples of test tasks with a single answer

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E. $\Delta H > 0, \Delta S < 0$

1.4.2. Examples of multiple choice test tasks and/or matching and/or sequencing

1. Thermodynamic systems are classified as:

a) Isolated

b) Open

c) Closed

d) Different

2. Living organisms are

a) open systems

b) systems which exchange mass only

c) isolated systems

d) closed systems

e) systems which exchange mass and energy with environment.

2. Assessment tools for conducting intermediate attestation in a discipline «Chemistry». Intermediate attestation is carried out in the form of an exam. The intermediate attestation includes the following type of tasks: interview on control issues.

List of questions to prepare for the intermediate attestation:

№	EXAMINATION QUESTIONS IN CHEMISTRY	Verifiable general professional competencies
1.	Solutions and types. The methods of expressing concentrations (mass (percentage) concentration, molar concentration, molal concentration, normal (equivalent) concentration)	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
2.	Chemical equivalent and calculation. The Law of equivalent weight.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
3.	The subject of chemical thermodynamics. The main definitions: the system, the parameters of the condition, the functions of the condition	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
4.	The Ist Law of Thermodynamics. Internal energy. Enthalpy. The Hess's Law and its effects.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
5.	The IInd Law of Thermodynamics. Entropy. Gibbs free energy.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
6.	Spontaneous processes. The criteria and directions of spontaneous processes.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
7.	Caloricity of food. Caloric intake	UC-1.1.1, GPC-10.1.1, GPC-10.1.2

8.	Strong and weak acids. Strong and weak bases. Ionization degree and ionization constant. The calculation of pH for strong and weak acids/bases.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
9.	Ionic product of water. pH and pOH: definition and calculations for strong and weak acids and bases	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
10.	Buffer solutions. Their classification and mechanism of their action.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
11.	Calculation of pH of buffer solutions	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
12.	Buffer capacity and its determination	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
13.	Buffer systems in a human body. Regulation of acid-base balance in the organism. Alkalosis and acidosis	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
14.	The vapour pressure lowering. The Raoult's Law	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
15.	Effects of the Raoult’s Law. Ebullioscopy and cryoscopy.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
16.	Osmosis, its mechanism. Osmotic pressure of the solution. The Van't Hoff’s Law. Dialysis	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
17.	The isotonic, hypo- and hypertonic solutions. Plasmolysis. Hemolysis. Dialysis. Their practical use in medicine	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
18.	The structure of coordination compounds. The Werner’s theory.	UC-1.1.1, GPC-10.1.1,

		GPC-10.1.2
19.	Classification of complexes. Naming with examples. Types of isomerism in complexes (examples).	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
20.	Bonding in complex ions, types of hydridization	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
21.	Ionization of complexes and their stability of complexes. Stability constant	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
22.	Importance of complex compounds in nature. Their use in medicine.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
23.	Redox reactions. Oxidation and reduction processes. Main oxidants and reductants. EMF.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
24.	Main definitions and subject of chemical kinetics. Rate of chemical reaction. Average and Instantaneous rate.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
25.	Effect the concentration on the rate. The Law of mass action. Molecularity and order of chemical reactions. Kinetic equations of the zero, first, and second order reactions. Effect of the temperature on the rate. The Van't Hoff's Rule. Activation energy. Activation theory of Arrhenius.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
26.	The collision theory and theory of transition complex. Complicated reactions and their types.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
27.	Catalysis. Catalyst and its properties. Enzyme catalysis. Theories of catalysis.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
28.	The structural theory of organic chemistry of A.M.Butlerov. Hybridization of carbon atomic orbitals (sp, sp2, sp3).	UC-1.1.1, GPC-10.1.1,

	Classification of organic compounds according to molecular framework, to the nature and number of functional group. Homologous series of alkanes, alkenes, alkynes.	GPC-10.1.2
29.	Isomerism and isomers. Types of structural (constitutional) isomerism. Optical isomerism of Organic compounds. Asymmetric carbon. Chiral molecules. Configurations and their types. Fischer projections. Conformations. Newman projections. Conformations of cyclic compounds (cyclopropane, cyclobutane, cyclohexane).	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
30.	Heterofunctional compounds: amino alcohols, hydroxyl acids, oxo acids	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
31.	Structure of alpha amino acids and acid-base properties. Alpha amino acids: essential, semi essential, non essential. A dipolar ion structure of amino acids and chelation reaction.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
32.	Chemical properties of amino acids, specific reactions of α, β, γ–amino acids. Structure of the peptide bond. Lactim-lactam tautomerism. The structure of proteins and their biological importance. Reactions for detecting amino acids and peptides (proteins).	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
33.	Definitions and classification of carbohydrates. Chirality in monosaccharides. Fischer projection formulas and D–, L–sugars. Family of D-aldoses. The cyclic hemiacetal structures of monosaccharides. Pyranose and furanose structures. Anomeric carbon atom (α–, β–forms). Mutarotation. Cyclic forms of D-glucose, D-ribose and D-fructose. Chemical properties of monosaccharides.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
34.	Disaccharides. Reducing and nonreducing sugars. Maltose, cellobiose, lactose, sucrose. Chemical properties of reducing sugars. Test reactions. Polysaccharides. Homopolysugars (starch, glycogen, cellulose, chitin) and heteropolysugars (hyaluronic acid, chondroitin). Primary structure and their hydrolysis. Usage	UC-1.1.1, GPC-10.1.1, GPC-10.1.2

	in medicine	
35.	Heterocyclic bases (pyrimidine derivatives and purine derivatives). Tautomerism. Nucleosides: structure and naming deoxyribonucleosides and ribonucleosides. Nucleotides: structure and nomenclature.	UC-1.1.1, GPC-10.1.1, GPC-10.1.2
36.	Nucleic acids: structure and biological role. Structure of nucleosides mono-, di- and triphosphates. ATP. Deoxyribonucleic acid (DNA). The primary and secondary structures. The double helix and its complementary nature. Ribonucleic acid and its primary and secondary structures. Biological importance of DNA and RNA in biochemical processes	UC-1.1.1, GPC-10.1.1, GPC-10.1.2

The full fund of assessment tools for the discipline is available in the VolgSMU Electronic Information and Educational System at the links:

https://elearning.volgmed.ru/course/view.php?id=10807

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Head of the Department of Chemistry, professor  A.K. Brel