

Federal State Budgetary Educational Institution of Higher Education
"Privolzhsky Research Medical University"
Ministry of Health of the Russian Federation

BANK OF ASSESSMENT TOOLS FOR DISCIPLINE

BIOCHEMISTRY

Training program (specialty): 31.05.01 General Medicine
code, name

Department: Biochemistry named after G.Ya. Gorodisskaya

Mode of study: full-time
(full-time/mixed attendance mode/extramural)

Nizhniy Novgorod
202_

1. Bank of assessment tools for the current monitoring of academic performance, mid-term assessment of students in the discipline Biochemistry.

This Bank of Assessment Tools (BAT) for the discipline "Biochemistry" is an integral appendix to the working program of the discipline "Biochemistry". All the details of the approval submitted in the WPD for this discipline apply to this BAT.

2. List of assessment tools

The following assessment tools are used to determine the quality of mastering the academic material by students in the discipline/ practice:

No.	Assessment tool	Brief description of the assessment tool	Presentation of the assessment tool in the BAT
1	Test №1 Test №2	A system of standardized tasks that allows you to automate the procedure of measuring the level of knowledge and skills of a student	Bank of test tasks
2	Control work	A tool of checking the ability to apply acquired knowledge for solving problems of a certain type by topic or section	Set of control tasks in variants
3	Case - task	A problem task in which the student is offered to comprehend a real professionally-oriented situation necessary to solve this problem.	Tasks for solving cases
4	Colloquium	A tool of controlling the mastering of study materials of a topic, section or sections of a discipline, organized as a class in the form of an interview between a teacher and students.	Questions on topics/sections of the discipline
5	Situational tasks	A method of control that allows you to assess the criticality of thinking and the degree of the material comprehension, the ability to apply theoretical knowledge in practice.	List of tasks

3. A list of competencies indicating the stages of their formation in the process of mastering the educational program and the types of evaluation tools

Code and formulation of competence*	Stage of competence formation	Controlled sections of the discipline	Assessment tools
UC-1 Able to carry out critical analysis of problem situations based on a systematic approach, develop an	Current, Mid-term	Section 1 Structure, properties and functions of proteins. Enzymes.	1, 2, 3, 4. 5
		Section 2 Introduction to the metabolism. Biological oxidation.	1, 2, 3, 4. 5
		Section 3 Protein and amino acid metabolism.	1, 2, 3, 4. 5
		Section 4. Nucleotide metabolism	1, 2, 3, 5
		Section 5. Hormones.	1, 2, 3, 4. 5
		Section 6. Carbohydrate metabolism.	1, 2, 3, 4. 5
		Section 7. Lipid metabolism.	1, 2, 3, 4. 5

action strategy.		<p>Section 8. Biochemistry of connective tissue.</p> <p>Section 9. Biochemistry of muscle tissue.</p> <p>Section 10. Biochemistry of the liver.</p> <p>Section 11. Biochemistry of nervous tissue.</p> <p>Section 12. Biochemistry of blood and urine.</p>	<p>1, 2, 3, 5</p> <p>1, 2, 3, 5</p> <p>1, 2, 3, 5</p> <p>1</p> <p>1, 2, 3, 5</p>
<p>GPC-5</p> <p>Able to assess morphofunctional, physiological conditions and pathological processes in the human body to solve professional problems</p>	<p>Current, Mid-term</p>	<p>Section 1 Structure, properties and functions of proteins. Enzymes.</p> <p>Section 2 Introduction to the metabolism. Biological oxidation.</p> <p>Section 3 Protein and amino acid metabolism.</p> <p>Section 4. Nucleotide metabolism</p> <p>Section 5. Hormones.</p> <p>Section 6. Carbohydrate metabolism.</p> <p>Section 7. Lipid metabolism.</p> <p>Section 8. Biochemistry of connective tissue.</p> <p>Section 9. Biochemistry of muscle tissue.</p> <p>Section 10. Biochemistry of the liver.</p> <p>Section 11. Biochemistry of nervous tissue.</p> <p>Section 12. Biochemistry of blood and urine.</p>	<p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 5</p> <p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 5</p> <p>1, 2, 3, 5</p> <p>1</p> <p>1, 2, 3, 5</p>
<p>GPC-10</p> <p>Able to understand the principles of modern information technologies and use them to solve the tasks of professional activity</p>	<p>Current, Mid-term</p>	<p>Section 1 Structure, properties and functions of proteins. Enzymes.</p> <p>Section 2 Introduction to the metabolism. Biological oxidation.</p> <p>Section 3 Protein and amino acid metabolism.</p> <p>Section 4. Nucleotide metabolism</p> <p>Section 5. Hormones.</p> <p>Section 6. Carbohydrate metabolism.</p> <p>Section 7. Lipid metabolism.</p> <p>Section 8. Biochemistry of connective tissue.</p> <p>Section 9. Biochemistry of muscle tissue.</p> <p>Section 10. Biochemistry of the liver.</p> <p>Section 11. Biochemistry of nervous tissue.</p> <p>Section 12. Biochemistry of blood and urine.</p>	<p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 5</p> <p>1, 2, 3, 4, 5</p> <p>1, 2, 3, 5</p> <p>1, 2, 3, 5</p> <p>1</p> <p>1, 2, 3, 5</p>

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* - not provided for postgraduate programs

4. The content of the assessment tools of entry, current control

Entry /current control is carried out by the discipline teacher when conducting classes in the form of: assessment tool 1, assessment tool 2, etc. (*list the forms, for example, control work, organization of a discussion, round table, abstract, etc.*)

Assessment tools for current control.

4.1. Assessment tool 1. Tests for the assessment of competence “UC-1, GPC-5, GPC-10”.

I. BIOCHEMISTRY OF CONNECTIVE TISSUE.

1. AMINO ACID RESIDUES INVOLVED IN THE FORMATION OF DESMOSIN ARE:

1. oxyproline
2. alanine
3. arginine
4. lysine

2. HYDROXYLATION OF PROLINE IN COLLAGEN SYNTHESIS REQUIRES:

1. NADPH
2. NAD
3. ascorbic acid
4. alkaline phosphatase

3. CHOOSE THE POSTULATES CHARACTERIZING PROTEOGLYCANS:

1. Protein makes up 40-60% of the total weight
2. carbohydrate component is monosaccharide
3. carbohydrate component are heterogeneous oligosaccharide units of GAG
4. localization in the blood plasma

II. BIOCHEMISTRY OF MUSCLE TISSUE.

1. ATP HYDROLYSIS:

1. triggers muscle contraction
2. starts the cycle of association and dissociation of actin and myosin
3. activates the troponin system
4. causes conformational changes in myosin heads

2. TROPONIN CONSISTS OF THE FOLLOWING SUBUNITS:

1. kinase, phosphatase, decarboxylating
2. intestinal, gastric, hepatic
3. Ca-binding, inhibitory, tropomyosin-binding
4. globular, fibrillar, amorphous

3. WHAT STATEMENT CHARACTERIZES TROPONIN PROTEIN:

1. globular protein
2. consists of 7 globules
3. the length corresponds to 7 globules of actin
4. fibrillar protein

III. BIOCHEMISTRY OF BLOOD AND URINE

1. ARRANGE THE HEME SYNTHESIS REACTIONS IN THE CORRECT SEQUENCE IN THE BODY:

1. formation of porphobilinogen
2. formation of δ -aminolevulinic acid
3. formation of protoporphyrin IX
4. iron binding

2. INDICATE POSSIBLE CAUSES OF HYPERPROTEINEMIA:

1. nephrotic syndrome
2. copious vomiting

3. extensive burns
4. acute infections
3. HEMOGLOBIN TRANSPORTS IN THE BLOOD:

1. nitrogen
2. carbon dioxide
3. oxygen
4. ammonia

IV. BIOCHEMISTRY OF NERVOUS TISSUE.

1. THE FOLLOWING LIPIDS ARE ABSENT IN THE NERVOUS TISSUE:

1. glycerophospholipids
2. triacylglycerols
3. cerebrosides
4. cholesterol

2. THE FUNCTION OF THE DELTA SLEEP INDUCING PEPTIDE IS:

1. maintaining a good mood
2. regulation of eating behavior
3. sleep regulation
4. stabilization of cell membranes.

3. NERVOUS TISSUE IS CHARACTERIZED BY:

1. very low oxygen consumption rate
2. preference of glucose as an oxidation substrate
3. high content of creatine phosphate
4. low glucose content

V. BIOCHEMISTRY OF THE LIVER.

1. THE LIVER IS CHARACTERIZED BY THIS FUNCTION:

1. metabolic
2. transport
3. vitamin C synthesis
4. immune

2. CHOOSE A PROCESS THAT TAKES PLACE ONLY IN THE LIVER:

1. synthesis of lipoproteins
2. synthesis of fatty acids
3. oxidation of ketone bodies
4. synthesis of ketone bodies

3. BILE ACIDS IN THE LIVER CONJUGATE WITH:

1. glycogen
2. proteases
3. amino acids
4. ethanol

4.2. Assessment tool 2. A set of control tasks for the assessment of competence UC-1, GPC-5, GPC-10.

I. SECTION "PROTEINS. ENZYMES".

Card 1.

Question 1. The concept of enzymes. Enzymes as catalysts. Differences between enzymes and inorganic catalysts. Simple and complex enzymes.

Question 2. The active center of enzymes, its structure, areas of the active center. Features of the bonds involved in the formation of an active center.

Card 2.

Question 1. Specificity of enzyme action, types of specificity, significance for the body.

Question 2. Theories of the interaction between enzyme active center and substrate (Fischer and Koshland theories).

II. SECTION "INTRODUCTION TO METABOLISM".

Card 1.

Question 1. The significance of the formation of NADH in the cycle of tricarboxylic acids..

Write reactions, specify enzymes, name vitamins included in the structure of cofactors.

Question 2. Substrate level phosphorylation in the Krebs cycle. Define, write a reaction, name an enzyme. Explain the mechanism of substrate level phosphorylation.

Card 2.

Question 1. Succinate dehydrogenase, its non-protein component. Write a structural formula for the part of the cofactor that transmits e⁻ and H⁺. Which vitamin is involved in the formation of the cofactor? Donor and acceptor of e⁻ and H⁺ for succinate dehydrogenase.

Question 2. Distribute the redox pairs listed below according to the decrease in redox potential:

NAD⁺/NADH₂, fumarate/succinate, cyt. C Fe³⁺/Fe²⁺, Co/ KoQH₂, FMN/FMNH₂, cyt. a Fe³⁺/Fe²⁺.

III. SECTION "PROTEIN AND AMINO ACID METABOLISM".

Card 1.

Question 1. Enzymes of pancreatic juice, pro-enzymes, their activation. Place and specificity of action, hydrolysis products.

Question 2. The biological role of free HCl (hydrochloric acid).

Card 2.

Question 1. Characteristics of amino acids oxidative deamination, characteristics of oxidases.. Chemistry of oxidative deamination of glutamic acid. Characteristics of glutamate dehydrogenase.

Question 2. Decarboxylation of amino acids in animal tissues. The name and characteristics of the enzyme. What are the decarboxylation products called? Write the reactions of histamine, serotonin and gamma-aminobutyric acid (GABA) formation and indicate their role in the regulation of body functions. The role of MAO and DAO in the inactivation of biogenic amines.

Card 3.

Question 1. The participation of glutamic and aspartic acids in the reactions of temporary neutralization of ammonia in the cell. Products, their future fate.

Question 2. List the compounds of residual blood nitrogen, indicate their origin. The value of residual nitrogen determination for the clinic. Causes of azotemia.

IV. SECTION "HORMONES".

Question 1. Hormones: concept of hormones, general characteristics of hormone action. Synthesis and transport of hormones. Characteristics of the receptors.

Question 2. Classification of hormones by chemical nature, examples.

Card 2.

Question 1. The membrane type of hormone action, cascade effect. Characteristics of the receptors. Mediators with membrane mechanism of action, examples of hormones.

Question 2. Hormones with intracellular type of reception: physico-chemical properties, production sites, characteristics of receptors, mechanism of action, examples.

4.3. Assessment tool 5. Tasks for the assessment of competence " UC-1, GPC-5, GPC-10".

Task 1. Severe viral hepatitis may be accompanied by the development of hepatic coma, caused, in particular, by the toxic action of ammonia on the brain cells. What is the reason of a significant accumulation of ammonia in the blood? To answer, remember metabolism of ammonia in the liver in a healthy person. Write a diagram of this process.

Task 2. A patient complains of recurring acute inflammatory pain paroxysms of joints (small mainly). A few tophaceous nodules were revealed under patient skin and some urine calculi were found in the patient's excretory tract.

What is possible cause of the symptoms? What is the name of the disease? What biochemical parameters should be determined to make a precise diagnosis? What approaches can be used to correct metabolic disorders in this pathological state?

Task 3. The enzyme isocitrate dehydrogenase catalyzes the reaction of isocitrate transforming into alpha-ketoglutarate. ATP is a negative allosteric effector of the enzyme, ADP is a positive one. Explain the mechanism of the enzyme regulation. Draw a graph demonstrating the ATP inhibitory action (the dependence of the reaction velocity on a substrate concentration).

4.4. **Assessment tool 3.** Case – tasks for the assessment of competence " UC-1, GPC-5, GPC-10".

1. SECTION "CARBOHYDRATE METABOLISM".

Case 1.

The pentose phosphate pathway of glucose oxidation is extremely active in adipose tissue, liver, adrenal cortex, erythrocytes, lactating mammary gland. Explain why. To answer:

1. Give a general description of the pentose phosphate pathway of glucose oxidation (definition, localization, stages).

2. Write the reactions of the oxidative stage of this process, name the enzymes, explain the regulation.

3. Specify the ways of using the reduced form of coenzyme, the value of other products.

4. Using points 1-3, answer the general question.

Case 2. The patient went to the doctor with symptoms of increased hunger, fatigue, weakness. An examination of the pancreas revealed an insulinoma - a tumor of the beta cells of the islets. In the blood the glucose level was below normal. Explain the described symptoms. To answer:

1. Describe the structure of the insulin receptor and the mechanism of its action. Explain the regulation of membrane glucose transport and the main metabolic pathways of carbohydrate metabolism under the action of insulin, name the key enzymes of the processes.

2. What biochemical tests should be prescribed to confirm the diagnosis?

3. Will there be brain disorders in the future? Why?

4. Using points 1-3, answer general question.

2. SECTION "LIPID METABOLISM".

Case 1. After 16-24 hours' keeping in a fridge a cream-like layer appears on the surface of patient's blood. Biochemical analysis showed triglycerides concentration to be greatly elevated, cholesterol level being slightly increased. Clinical manifestations of atherosclerosis were not found. What type of hyperlipoproteinemia was found in the patient? What is the mechanism of lipid metabolism disorder development? To answer:

1. Define "dyslipoproteinemia".

2. What type of hyperlipoproteinemia is described in the case? What are the causes of this type of hyperlipoproteinemia?

3. Describe the structure of blood lipoproteins, types and functions of lipoproteins.

4. Which lipoproteins transport TAG in the blood? Write the reaction catalyzed by lipoprotein lipase. Which protein activates lipoprotein lipase?

Case 2. A 64-year-old man was admitted to the hospital due to complaints of pain in the heart area. The examination revealed atherosclerotic plaques in the coronary arteries and large cerebral vessels. The content of cholesterol in the blood, LDL and HDL in the blood plasma exceeds the norm by several times.

1. Write the equations of reactions of cholesterol synthesis. Specify the localization, regulation of the process.

2. Define and give examples of atherogenic and antiatherogenic lipoproteins. Name their functions.

3. SECTION "INTRODUCTION TO THE METABOLISM".

Case 1.

Oxygen does not participate directly in the reactions of the tricarboxylic acid cycle (TCA). However, TCA is aerobic process. Explain what happens to the cycle speed in hypoxia conditions. To answer:

1. Specify which enzyme complex of the mitochondrial respiratory chain uses oxygen as a substrate? How will hypoxia conditions affect mitochondrial respiratory chain enzymes? Will the substrates of these enzymes accumulate in hypoxia?

2. Which metabolites are supplied to the respiratory chain by TCA? How will the accumulation of these metabolites affect the rate of TCA dehydrogenases?
3. Specify the limiting enzymes of TCA and the mechanism of their regulation. Write reactions, specify all the activators and inhibitors of the enzymes.

Case 2.

Under physiological conditions, the human body temperature is higher than the ambient temperature (36.6 C versus 20 C). Explain what caused this difference?

1. Define uncoupling of respiration and oxidative phosphorylation.
2. Give examples of physiological uncouplers, indicating the mechanism of their action.
3. What role does the protein thermogenin play in the body? Which group of uncouplers does it belong to?

4.5. **Assessment tool 4.** Colloquium for the assessment of competence " UC-1, GPC-5, GPC-10".

I. SECTION "PROTEINS. ENZYMES". QUESTIONS.

1. Amino acids as structural protein molecules. Their structure, properties. Classification of amino acids, examples. Nonessential and essential amino acids. The role of amino acids in the formation of native protein and the formation of intramolecular bonds.
2. Levels of structural organization of globular protein.
3. Enzymes, their molecular organization. Apoenzyme and cofactor (coenzyme and prosthetic group). Nomenclature and classification of enzymes. Vitamins and metal ions as cofactors of enzymes.
4. Fundamentals of enzymatic kinetics. Dependence of the enzymatic reaction rate on the substrate and enzyme concentration. Michaelis-Menten equation. Michaelis constant, its physical meaning. Substrate inhibition.

II. SECTION "INTRODUCTION TO METABOLISM". QUESTIONS.

1. Modern understanding of biological oxidation. Characteristics of oxidoreductases involved in this process. Mitochondria as the center of tissue respiration, their role in the regulation of cell metabolism.
2. Structural organization of the respiratory chain. Redox potential is the factor determining the movement of electrons along the respiratory chain and energy formation.
3. Biological significance of tricarboxylic acid cycle, confirm by the reactions. Write reactions replenishing the citrate cycle.
4. Energy effect of pyruvic acid total oxidation to CO₂ and H₂O (confirm by chemical reactions).

III. SECTION "NUCLEOTIDE EXCHANGE". QUESTIONS.

1. Compounds that are sources of nitrogen and carbon atoms in the synthesis of purine and pyrimidine rings. Enzymes of ribonucleotides and deoxyribonucleotides synthesis as targets for the action of antiviral and antitumor drugs.
2. Ways of adenine and guanine reutilization in the process of nucleotide biosynthesis. Features of deoxyribonucleotide biosynthesis.

IV. SECTION "CONNECTIVE AND MUSCULAR TISSUE". QUESTIONS.

1. General information about the structure of collagen proteins. Fibrillating collagens are specific proteins of connective tissue. Features of the chemical composition. Structural organization. Participation of vitamin C in the maturation of collagen. Oxyproline excretion is an indicator of the rate of collagen breakdown.
2. Elastin, its properties, chemical composition and molecular structure.
3. Proteoglycans are the main proteins of the intercellular substance of connective tissue, significance, structural organization. Glycosaminoglycans, structure and function. Metabolism of glycosaminoglycans.
4. Myofibrillary, sarcoplasmic proteins and muscle tissue stroma proteins; their significance. Characteristics of myosin, actin, troponin, tropomyosin. Features of the structure and molecular organization.

5. Biochemical mechanism of muscle contraction and relaxation. The role of calcium ions and ATP in the regulation of muscle contraction.

5. The content of the assessment tools of mid-term assessment

Mid-term assessment is carried out in the form of exam.

The content of the assessment tool (questions, topics of abstracts, round tables, etc.)

If the bank of assessment tools for conducting current control and mid-term assessment of students in this discipline is presented on the Educational Portal of the PRMU, specify a link to this electronic resource.

6. Criteria for evaluating learning outcomes

For the credit (example)

Learning outcomes	Evaluation criteria	
	Not passed	Passed
Completeness of knowledge	The level of knowledge is below the minimum requirements. There were bad mistakes.	The level of knowledge in the volume corresponding to the training program. Minor mistakes may be made
Availability of skills	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes.	Basic skills are demonstrated. Typical tasks have been solved, all tasks have been completed. Minor mistakes may be made.
Availability of skills (possession of experience)	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes.	Basic skills in solving standard tasks are demonstrated. Minor mistakes may be made.
Motivation (personal attitude)	Educational activity and motivation are poorly expressed, there is no willingness to solve the tasks qualitatively	Educational activity and motivation are manifested, readiness to perform assigned tasks is demonstrated.
Characteristics of competence formation*	The competence is not fully formed. The available knowledge and skills are not enough to solve practical (professional) tasks. Repeated training is required	The competence developed meets the requirements. The available knowledge, skills and motivation are generally sufficient to solve practical (professional) tasks.
The level of competence formation*	Low	Medium/High

** - not provided for postgraduate programs*

For the exam (example)

Learning outcomes	Assessment of competence developed			
	unsatisfactory	satisfactory	good	excellent
Completeness of knowledge	The level of knowledge is below the minimum requirements. There were bad mistakes	The minimum acceptable level of knowledge. A lot of light mistakes were made	The level of knowledge in the volume corresponding to the training program. A	The level of knowledge in the volume corresponding to the training program, without

Learning outcomes	Assessment of competence developed			
	unsatisfactory	satisfactory	good	excellent
			few light mistakes were made	errors
Availability of skills	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes	Basic skills are demonstrated. Typical problems with light mistakes have been solved. All tasks have been completed, but not in full.	All basic skills are demonstrated. All the main tasks have been solved with light mistakes. All tasks have been completed, in full, but some of them with shortcomings	All the basic skills were demonstrated, all the main tasks were solved with some minor shortcomings, all the tasks were completed in full
Availability of skills (possession of experience)	Basic skills are not demonstrated when solving standard tasks. There were bad mistakes	There is a minimal set of skills for solving standard tasks with some shortcomings	Basic skills in solving standard tasks with some shortcomings are demonstrated	Skills in solving non-standard tasks without mistakes and shortcomings are demonstrated
Characteristics of competence formation*	The competence is not fully formed. The available knowledge and skills are not enough to solve professional tasks. Repeated training is required	The formation of competence meets the minimum requirements. The available knowledge and abilities are generally sufficient to solve professional tasks, but additional practice is required for most practical tasks	The formation of competence generally meets the requirements, but there are shortcomings. The available knowledge, skills and motivation are generally sufficient to solve professional tasks, but additional practice is required for some professional tasks	The formation of competence fully meets the requirements. The available knowledge, skills and motivation are fully sufficient to solve complex professional tasks
The level of competence formation*	Low	Below average	Intermediate	High

For testing:

Mark "5" (Excellent) - points (100-90%)

Mark "4" (Good) - points (89-80%)

Mark "3" (Satisfactory) - points (79-70%)

Less than 70% – Unsatisfactory – Mark "2"

Developer(s):
Full name, position, academic degree, academic title

Date " _____ " _____ 202__