Assessment tools for conducting attestation in discipline «Biochemistry» 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 for the 2025 - 2026 academic year

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

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

1.1. Examples of test tasks

Verifiable indicators of competence achievement: GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

1. Diastasis in urine is determined by:

1) heart attack

2) viral hepatitis

3) stroke

4) pancreatitis

2. The maximum activity of the MB creatine kinase isoform is observed:

1) 24 hours after a heart attack

2) 48 hours after a heart attack

3) a heart attack does not lead to a change in the activity of CC MV

4) 2-3 days after a heart attack

3. The effect of a competitive inhibitor can be eliminated:

1) by adding the reaction product

2) heavy metal ions

3) by adding excess substrate

4) temperature rise

4. In the postabsorptive period, the liver occurs:

1) acceleration of glycolytic reactions

2) activation of the pyruvate dehydrogenase complex

3) the use of acetyl-CoA for the synthesis of fatty acids

4) the breakdown of glycogen.

5. Lactate entering the bloodstream can be converted back into glucose in: 1)adipose tissue

2) the heart muscle

3) red blood cells

4) liver

6. The regulatory enzyme of cholesterol synthesis is:

1) HMG-CoA synthetase

2) Acetyl-CoA carboxylase

3) HMG-CoA-lyase

4) HMG-CoA reductase

7. Protein kinases, as opposed to protein phosphatases:

1) Catalyze the reaction: Protein-OH + ATP → Protein-OP03H2 + ADP

2) affect the amount of phosphorylated proteins in the cell

3) change the activity of enzymes in response to the action of the hormone

4) Catalyze the reaction: Protein-OP03H2 + H2O → Protein-OH + H3PO4

8. Cyclic adenosine monophosphate (cAMP):

1) is formed from AMP

2) regulates the activity of adenylate cyclase

3) reduces phosphodiesterase activity

4) increases the activity of protein kinase A

9. The mechanism of action of adrenaline on liver cells includes:

1)interaction with cytoplasmic receptors

2) decrease in cAMP concentration in the cell

3) dephosphorylation of glycogen synthase

4) phosphorylation of glycogen phosphorylase

10. Essential fatty acid:

1) Stearic acid

2) Linoleum

3) palmitic acid

4) oleic acid

1.2. An example of a test case.

Verifiable indicators of competence achievement: GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

1) Write the structure, abbreviated numbers of the number of C atoms, the number and position of double bonds of linolenic acid.

2) Write the structure, abbreviated numbers of the number of C atoms, the number and position of double bonds of palmitoleic acid.

3) Write the structure, specify the biorole of monoacylglycerol.

4) Write the structure and specify the biorole of phosphatidylinositol. 5)Write the structure and specify the biovalue of glycocholic acid.

1.3. Examples of control questions for the interview.

Verifiable indicators of competence achievement: GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

1) Functional features of oligomeric proteins. Cooperativity. Evolutionary advantages of oligomeric proteins over monomeric proteins (comparison of hemoglobin and myoglobin). Regulation of hemoglobin functioning.

2) Principles of qualitative and quantitative determination of enzymes. Units of measurement of enzyme activity.

3) Inhibition of enzyme activity. Types of inhibition: reversible and irreversible, competitive, noncompetitive and uncompetitive. The inhibition constant.

4) The biochemical mechanism of ketonemia and ketonuria development. Formation of acetone.

5) Regulation of cholesterol biosynthesis. Natural and synthetic hydroxymethylglutaryl-CoA reductase inhibitors.

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

Verifiable indicators of competence achievement: GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

1. In type I glycogenosis (Gierke's disease), an enzyme defect is observed:

1) glycogen phosphorylase;

2) hexokinases;

3) Glycogen synthase;

4) Glucose-1-phosphaturidyltransferase;

5) glucose-6-phosphatase.

2. In McArdle's disease, there is a defect in the enzyme:

1) liver phosphorylase;

2) glucose-6-phosphatase;

3) glucokinases;

4) Glucose-6-phosphate dehydrogenase;

5) Muscle phosphorylase.

3.Galactosemia has an enzyme defect.:

1) Galactose-1-phosphaturidyltransferase;

2) lactase;

3) isomaltase;

4) glucose-6-phosphatase;

5) sucrase.

4. Specify the defective enzyme that causes fructose intolerance:

1) glucose-6-phosphatase;

2) phosphofructokinase;

3) galactose-1-phosphaturidyltransferase;

4) fructose-1-phosphataldolase;

5) fructokinase.

5. The cause of cataract development in patients with galactosemia is the accumulation of:

1) sorbitol in the lens of the eye;

2) glucose;

3) galactol;

4) glycerol;

5) fructose.

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

Verifiable indicators of competence achievement: GTP-5.1.1, GTP-5.2.1, GTP-5.3.1, GTP-10.1.1, GTP-10.2.1.

1. Lipids are substances that perform the following functions:

1) Energy source

2) endogenous water source

3) protect vital organs from damage

4) limit heat transfer

5) participate in the transmission of hereditary information

2. Phospholipids include:

1) phosphatidylinositol

2) kefalin

3) ceramide

4) phosphatidil serine

5) lecithin

3. Establish the sequence of processes occurring during the assimilation of lipids in the human body:

1) the supply of lipids to the lymph

2) the intake of glycerin and fatty acids into the cells of the intestinal villi

3) the intake of lipids into the stomach

4) oxidation of lipids by liver cells

5) cleavage of lipids by pancreatic lipase

2. Assessment tools for conducting intermediate attestation in a discipline «Biochemistry».

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 BIOCHEMISTRY**	**verifiable general professional competencies**

1	The subject and tasks of biological chemistry. Biochemistry as a molecular level of the structural organization studying, anabolism and catabolism of living matter. The importance of biochemistry in the doctor's training.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
2	Standard amino acids, their structure and properties. Peptides. The biological role of amino acids and peptides.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
3	The primary structure of proteins. The peptide bond, its characteristics. The dependence of the biological properties of proteins on the primary structure. Violation of the primary structure and function of hemoglobin A (on example of hemoglobin S).	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
4	The secondary structure of proteins. Types of the secondary structures. Bonds that stabilize the secondary structure.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
5	Tertiary structure of proteins. Types of chemical bonds involved in the formation of the tertiary structure. Supersecondary structures. Domain structure and its role in the functioning of proteins. The role of chaperones (heat shock proteins) in the formation of the tertiary structure of proteins in vivo.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
6	The active center of proteins and its specific interaction with the ligand, as the basis of the biological function of proteins. Conformational lability of proteins. Complementarity of the interaction of proteins with ligands. The reversibility of binding.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.2, GPC-10.2.1.
7	Quaternary structure of proteins. Features of the structure and functioning of oligomeric proteins on the example of hemoglobin. Cooperative changes in the conformation of protomers. The possibility of regulating the biological function of oligomeric proteins by allosteric ligands.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
8	Physico-chemical properties of proteins. Molecular weight, size and shape, solubility, ionization and hydration. Denaturation, signs and factors causing it.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
9	Methods of protein fractionation. The principles underlying fractionation. Methods of quantitative determination of protein (refractometric and biuretic). Electrophoresis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
10	Principles of protein classification. Protein families. Classification by composition and biological functions, examples of representatives of individual classes.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
11	Immunoglobulins, classes of immunoglobulins, features of the domain structure and functioning.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

12	Enzymes, definition. Features of enzymatic catalysis. The specificity of the enzymes action, types.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
13	Classification and nomenclature of enzymes, examples.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
14	The structure of enzymes. Catalytic and regulatory centers. Interaction of enzymes with ligands. The mechanism of action of enzymes. Formation of an enzyme-substrate complex. The "key lock" hypothesis and the "induced fit" hypothesis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
15	Kinetics of enzymatic reactions. The dependence of the rate of enzymatic reactions on the temperature, pH, concentration of the enzyme and substrate. The Michaelis-Menten equation, Km.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
16	Enzyme cofactors: metal ions and their role in enzymatic catalysis. Coenzymes as derivatives of vitamins. Coenzyme functions of vitamins B_6, PP and B_2 on the example of transaminases and dehydrogenases.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
17	Inhibition of enzyme activity: reversible (competitive, non-competitive, uncompetitive) and irreversible. Drugs as enzyme inhibitors.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
18	Allosteric regulation of enzyme activity. The role of allosteric enzymes in cell metabolism. Allosteric effectors. Features of the structure and functioning of allosteric enzymes and their localization in metabolic pathways. Regulation of enzyme activity according to the principle of negative feedback.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
19	Regulation of the catalytic activity of enzymes by covalent modification (phosphorylation and dephosphorylation) on the example of enzymes involved in glycogen metabolism.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
20	Association and dissociation of protomers by the example of protein kinase A and limited proteolysis during activation of proteolytic enzymes as ways to regulate the catalytic activity of enzymes.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
21	Isoenzymes: origin, biological significance, examples. Determination of enzymes and the isoenzyme spectrum of blood plasma in order to diagnose diseases.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
22	Enzymopathies are hereditary (phenylketonuria) and	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1,

	acquired (enzyme deficiency in diseases of the gastrointestinal tract). The use of enzymes for the treatment of diseases (enzyme therapy).	GPC-10.2.1.
23	The general scheme of synthesis and degradation of pyrimidine nucleotides. Regulation. Orotaciduria.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
24	The general scheme of synthesis and degradation of purine nucleotides. Regulation. Gout.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.2, GPC-10.2.1.
25	Synthesis of deoxyribonucleotides. Ribonucleotide reductase complex. Biosynthesis of thymidyl nucleotides, the role of folic acid and folate reductase. Antitumor, antiviral and antibacterial drugs as inhibitors of the synthesis of ribonucleotides and deoxyribonucleotides.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
26	The primary structure of nucleic acids. DNA and RNA. The secondary structure of DNA (Watson and Crick model). Bonds that stabilize the secondary structure of DNA. Complementarity. Chargaff's rule. Polarity. Antiparallelism.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
27	Hybridization of nucleic acids. Denaturation and renaturation of DNA. Hybridization (DNA-DNA, DNA RNA). Laboratory diagnostic methods based on nucleic acid hybridization (PCR).	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
28	The tertiary structure of DNA. The role of histone and non-histone proteins in organization of eukaryotic DNA structure in the form of chromatin and chromosomes. Covalent histone modification and its role in the regulation of chromatin structure and activity.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
29	Replication. Principles of DNA replication. Stages of replication. Initiation. Proteins and enzymes involved in the formation of the replicative fork.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
30	Elongation and termination of replication. Enzymes. Asymmetric DNA synthesis. Fragments of Okazaki. The role of DNA ligase in the formation of a leading and lagging strands.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
31	DNA damage and repair. Types of damage. Methods of reparation. Defects of repair systems and hereditary diseases.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
32	Transcription. Characteristics of the components of the RNA synthesis system. The structure of DNA-dependent RNA polymerase: the role of subunits (ααββ'). Initiation of the process. Elongation and termination of transcription.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
33	The primary transcript and its processing. Ribozymes as an example of the catalytic activity of nucleic acids. Biological role.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

34	The genetic code and its properties. Requirement of the components: amino acids, aminoacyl-t-RNA synthetases, t-RNA, ribosomes, energy sources, protein factors, enzymes.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
35	Assembly of a polypeptide chain on a ribosome. Formation of the initiator complex. Elongation: formation of a peptide bond (transpeptidation reaction). Translocation. Termination.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
36	Features of synthesis and processing of secreted proteins (for example, collagen and insulin).	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
37	Biochemistry of nutrition. The main components of food, their biological role, the daily requirements. Essential components of food.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
38	Nutritional importance of proteins. Biological value and functions of proteins. Nitrogen balance. Assessment of nutritive value of proteins, requirement of proteins, the norms of protein in the diet, protein deficiency.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
39	Protein digestion. Specificity and action of proteases, optimum pH and products. Formation and role of hydrochloric acid in the stomach. Protection of cells from the action of proteases.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
40	Absorption of proteins digestion products. Transport of amino acids into intestinal cells. Features of amino acid transport in hepatocytes. ɤ-glutamyl cycle. Disorders of protein digestion and amino acid transport.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
41	Vitamins. Classification, nomenclature. Provitamins. Hypo-, hyper- and vitamin deficiency, causes of occurrence. Vitamin-dependent and vitamin-resistant conditions.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
42	Minerals of food, macro- and microelements, biological role. Regional pathologies associated with a lack of trace elements (J_2, Se).	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
43	Biological membranes, structure, functions and general properties: fluidity, transverse asymmetry, selective permeability.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
44	Lipid composition of membranes - phospholipids, glycolipids, cholesterol. Membrane proteins: integral, peripheral, "anchored". The role of individual membrane components in the formation of structure and performance	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

	of functions.	
45	Mechanisms of transport across membranes: simple diffusion, uniport, symport and antiport, active transport, regulated channels. Membrane receptors.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
46	Endergonic and exergonic reactions in a living cell. High-energy compounds, definition, examples. Dehydrogenation of substrates and hydrogen oxidation as the main energy source for ATP synthesis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
47	The structure of mitochondria and the structural organization of the respiratory chain: NADH-CoQ reductase, succinate CoQ reductase, CoQ-cytochrome C reductase, cytochrome oxidase. Features of composition, structure and functions.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
48	Oxidative phosphorylation, the essence of the process, scheme, substrates, P/O coefficient. Transmembrane electrochemical potential as an intermediate form of energy during oxidative phosphorylation. Mitchell's theory. H+-ATP synthase: role, localization, structure, mechanism of ATP synthesis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
49	Regulation of the electron transport chain (respiratory control). Uncoupling of respiration from oxidative phosphorylation. Thermoregulatory function of brown adipose tissue. Thermogenin.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
50	Formation of reactive oxygen species (ROS): superoxide radical, hydrogen peroxide, hydroxyl radical, singlet oxygen. Sources and generation of free radicals. The physiological role of reactive oxygen species: generation of ROS by macrophages.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
51	Harmful effects of free radicals: lipid peroxidation, oxidation of carbohydrates, proteins and nucleic acids). Examples of reactions.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
52	Catabolism of the main nutrients in the cell - carbohydrates, fats, amino acids. The concept of specific and general pathways of catabolism. Oxidative decarboxylation of pyruvic acid, pyruvate dehydrogenase complex (PDH). Reactions of PDH complex. Regulation.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
53	Citric acid cycle (TCA cycle): reactions of TCA cycle, characteristics of enzymes. The role of the cycle in metabolism.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
54	Citric acid cycle, scheme of process. The connection of the cycle with the electron transport chain (ETC). Regulation of TCA cycle. Amphibolic nature of the citric acid cycle, anaplerotic reactions.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

55	Basic carbohydrates of animals, biological role. Carbohydrates of food, digestion of carbohydrates. Absorption of monosaccharides.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
56	Glucose as an important metabolite of carbohydrate metabolism: a general scheme of sources and ways of glucose consumption in the body. Maintaining a constant blood glucose level, Quantitative determination blood glucose. The role of insulin, glucagon, and adrenaline in the regulation of glucose levels.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
57	Aerobic glycolysis. The sequence of reactions before the formation of pyruvate. Physiological significance of aerobic glycolysis. The use of glucose for the synthesis of fats. The energy yield of aerobic glycolysis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
58	Anaerobic glycolysis. Reactions of glycolytic oxido-reduction (regeneration of cytosolic NAD^+). Distribution and physiological significance of anaerobic glycolysis. Energy yield of anaerobic glycolysis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
59	Glucose biosynthesis (gluconeogenesis) from amino acids, glycerol and lactic acid; regulation of gluconeogenesis. Biotin, role in the formation of oxaloacetate. The relationship of glycolysis in muscles and gluconeogenesis in the liver (Cori cycle).	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
60	Glycogen, biological significance. Biosynthesis and mobilization of glycogen. Regulation of glycogenesis and glycogenolysis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
61	Hereditary metabolic disorders of monosaccharides and disaccharides: galactosemia, intolerance to fructose and disaccharides. Glycogen storage diseases.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
62	Lipids. General characteristics. Biological role. Classification of lipids. Fatty acids, structural features. Saturated and unsaturated fatty acids Triacylglycerols.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
63	Digestion of dietary lipids. Absorption of digestion products. Disorders of digestion and absorption of lipids. Resynthesis of triacylglycerols in enterocytes. Formation of chylomicrons and transport of fats. Lipoprotein lipase, its role.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
64	Plasma lipoproteins (LP), classification by density and electrophoretic mobility. Features of the structure and lipid composition. The main apolipoproteins, their functions. The functions of LP blood plasma. The place of formation and transformation of various types of LP.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

	Hyperlipoproteinemia. Dyslipoproteinemia. Diagnostic value of determining the lipid spectrum of blood plasma.	
65	Deposition and mobilization of fats in adipose tissue, the physiological role of these processes. The role of insulin, adrenaline and glucagon in the regulation of fat metabolism.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
66	Oxidation of fatty acids in the cell. Activation and transport of acyl CoA into mitochondria. Sequence of reactions β-oxidation of fatty acids, regulation, energy yield.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
67	Biosynthesis of fatty acids (FA) in the cell. Synthesis of palmitic acid. Fatty acid synthase complex: structure, regulation. Elongation of the FA, formation of double bonds in the radicals of the FA.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
68	Biosynthesis and utilization of ketone bodies. Overproduction of ketone bodies. Causes of ketonemia and ketonuria during fasting and diabetes mellitus.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
69	Cholesterol. Ways of admission, use and excretion from the body. The level of cholesterol in the blood serum. Cholesterol biosynthesis, its stages. Regulation of cholesterol synthesis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
70	The role of low and high density lipoproteins (LDL and HDL) in cholesterol metabolism. Biochemical bases of atherosclerosis development. Quantitative determination of total cholesterol in blood serum. Biomedical importance.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
71	The general scheme of sources that contribute (input) and the metabolic pathways that utilize (output) the amino acids. Dynamic state of proteins in the body. The reasons for constant updating of body proteins. "Essential" amino acids.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
72	Catabolism of amino acids. Common ways of amino acid degradation. Transamination of amino acids. The scheme of reactions, enzymes, the role of vitamin B_6. The biological significance of transamination. Diagnostic value of determination of transaminases in blood serum.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
73	Deamination of amino acids: direct, indirect. Types of direct deamination. Oxidative deamination. Oxidases of L-amino acids. Glutamate dehydrogenase. Reaction, cofactor, regulation.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
74	Indirect deamination of amino acids. Scheme of the process, substrates, enzymes, cofactors.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
75	The main sources of ammonia in the human body. Toxicity	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1,

	of ammonia. The role of glutamine and asparagine in ammonia neutralization. Kidneys glutaminase, formation and excretion of ammonium salts.	GPC-10.2.1.
76	Synthesis of urea. Reactions of urea cycle. Arrangement of urea cycle enzymes, the energy yield of the process, its regulation. Blood urea estimation, clinical significance.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
77	Decarboxylation of amino acids. Biogenic amines: histamine, serotonin, GABA, putrescine. Reactions of their synthesis, enzymes, cofactor. Biological role of biogenic amines. Deamination and methylation of amines as ways of their neutralization.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
78	Metabolism of phenylalanine and tyrosine. Features of tyrosine metabolism in different tissues. Synthesis of catecholamines, melanins, and iodothyronines. Hereditary biochemical blocks and disorder's in the metabolism of phenylalanine and tyrosine: phenylketonuria, alkaptonuria, albinism, parkinsonism. Diagnostics and treatment.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
79	Endocrine, paracrine and autocrine systems of intercellular communication. The role of hormones in the regulation of metabolism. Regulation of hormone synthesis according to the feedback principle.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
80	Classification of hormones by chemical structure and biological functions.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
81	Target cells and cellular hormone receptors. Cytoplasmic membrane receptors, receptors localized in the cytoplasm. Regulation of the number and activity of receptors. Mechanisms of signal transduction by membrane receptors, G-protein.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
82	Cyclic AMP and GMP as secondary messengers. Activation of protein kinases and phosphorylation of proteins responsible for the hormonal effect.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
83	Phosphatidylinositol cycle as a mechanism of intracellular communication. Inositol 1,4,5 triphosphate and diacylglycerol are secondary messengers of signal transmission. Calcium ions as secondary intermediaries, calmodulin.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
84	Transmission of signals through intracellular receptors. Formation of the hormone-receptor complex and its interaction with DNA, hormone responsible elements (HRE). Transmission of signals through receptors coupled with ion channels. The structure of the acetylcholine	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

	receptor.	
85	Hormones of the hypothalamus and anterior pituitary gland, chemical nature and biological role.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
86	Regulation of water-salt metabolism. Structure, mechanism of action and functions of aldosterone and vasopressin. The role of the renin-angiotensin-aldosterone system. Atrial natriuretic factor.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
87	Regulation of calcium and phosphate ion metabolism. Structure, biosynthesis and mechanism of action of parathyroid hormone, calcitonin and calcitriol. Causes and manifestations of rickets, hypo- and hyperparathyroidism.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
88	Insulin - structure, synthesis and secretion. Regulation of insulin synthesis and secretion. The mechanism of action of insulin. The role of insulin and counterregulatary hormones (adrenaline and glucagon) in the regulation of metabolism. Changes in hormonal status and metabolism in diabetes mellitus. Diabetic coma.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
89	Thyroid hormones. Regulation of synthesis and secretion of iodothyronines and their effect on metabolism and body functions. Changes in metabolism in hypo and hyperthyroidism. Causes and manifestations of endemic goiter.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
90	Hormones of the adrenal cortex (corticosteroids). Their effect on cell metabolism. Changes in metabolism in hypo- and hyperfunction of the adrenal cortex.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
91	Hormones of the adrenal medulla. Secretion of catecholamines. Mechanism of action and biological functions of catecholamines. Pathology of the adrenal medulla.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
92	Metabolism of endogenous and foreign toxic substances. The main stages of neutralization of xenobiotics. Scheme microsomal oxidation. The role of cytochrome P_{450}. Induction of cytochrome P_{450} by drugs.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
93	Degradation of heme to bile pigments. The scheme of the process, localization. The concepts of "direct" and "indirect" bilirubin. Diagnostic value of determination of bilirubin in blood and urine.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
94	Disorders of heme metabolism. Jaundice: hemolytic, hepatocellular (parenchymal), obstructive, neonatal-physiologic jaundice. Causes of the syndrome, differential diagnosis.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
95	Metabolism of endogenous and foreign toxic substances.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1,

	The main stages of neutralization of xenobiotics. Conjugation phase. Schemes of conjugation reactions with PAPS and UDP-glucuronic acid. Neutralization of putrefaction products of amino acids in the intestine.	GPC-10.2.1.
96	Human hemoglobins, structure. Transport of oxygen and carbon dioxide. Fetal hemoglobin and its physiological significance. Hemoglobinopathies.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
97	Heme biosynthesis. The scheme of the process, the chemistry of the first two reactions, localization. Regulation of the activity of enzymes ALK-synthase and ALK-dehydratase. Sources of iron for heme synthesis, iron absorption, transport in the blood, deposition.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
98	Serum proteins, the biological role of the main protein fractions, the importance of their determination for the diagnosis of diseases. Plasma enzymes, enzyme diagnostics. Quantitative determination of the activity of aminotransferases (AlAt, AsAt).	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
99	Collagen: features of amino acid composition, primary and spatial structure. Features of collagen biosynthesis and maturation. The role of ascorbic acid in the maturation of collagen.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
100	Structural organization of the intercellular matrix. Adhesive proteins of the intercellular matrix: fibronectin and laminin, their structure and functions. The structure and functions of glycosaminoglycans (hyaluronic acid, chondroitin sulfates, heparin). The structure of proteoglycans.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
101	The molecular structure of myofibrils. Structure and function of the main proteins of myofibrils myosin, actin, tropomyosin, troponin.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
102	Biochemical mechanisms of muscle contraction and relaxation. The role of calcium ions and other ions in the regulation of muscle contraction. Features of energy metabolism in muscles; the role of creatine phosphate.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
103	Chemical composition of nervous tissue. Myelin membranes: composition and structural features. Energy metabolism in the nervous tissue. The value of aerobic glucose degradation. Neurotransmitters of the nervous system. Physiologically active brain peptides.	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.
104	The importance of water for the vital activity of the body. Distribution of water in tissues, the concept of intracellular and extracellular fluids. Water balance, regulation of water	GPC-5.1.1, GPC-5.2.1, GPC-5.3.1, GPC-10.1.1, GPC-10.2.1.

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