End-of-course exam questions
«Biological chemistry»
General medicine 31.05.01

№	Questions
1.	The primary structure of proteins. Species specificity of proteins. Hereditary changes in the primary structure. Protein polymorphism. Hereditary proteinopathies: sickle cell anemia, other examples.
2.	Conformation of protein molecules (secondary and tertiary structures). Types of intramolecular bonds in proteins. The role of the spatial organization of the peptide chain in the formation of active sites. Conformational changes during the functioning of proteins.
3.	Quaternary structure of proteins. Cooperative changes in protomer conformation. Examples of the structure and functioning of oligomeric proteins: hemoglobin (in comparison with myoglobin, allosteric enzymes).
4.	The concept of enzymes. The specificity of the action of enzymes. enzyme cofactors. Dependence of the rate of enzymatic reactions on the concentration of the substrate, enzyme, temperature and pH. Principles of quantitative determination of enzymes. Activity units.
5.	The concept of the active site of the enzyme. The mechanism of action of enzymes. Enzyme inhibitors: reversible and irreversible, competitive. The using of inhibitors in medicine
6.	Regulation of enzyme action: allosteric mechanisms, chemical (covalent) modification. Protein-protein interactions. Examples of metabolic pathways regulated by these mechanisms. Physiological significance of the regulation of the action of enzymes.
7.	The functions of enzymes in metabolism. variety of enzymes. Nomenclature and classification of enzymes. Hereditary primary enzymopathies: phenylketonuria, alkaptonuria. Other examples of hereditary enzymopathies. Secondary enzymopathies. Importance of enzymes in medicine.
8.	The concept of catabolism and anabolism and their relationship. Endorgonic and exergonic reactions in metabolism. Methods of electron transfer. Features of the course of oxidative reactions in the body. Stages of catabolism.
9.	Oxidoreductases. Classification. Characteristics of subclasses. NAD-dependent dehydrogenases. The structure of the oxidized and reduced forms. The most important substrates of NAD-dependent dehydrogenases. FAD-dependent dehydrogenases: succinate dehydrogenase and acyl-CoA dehydrogenase.
10.	Oxidative decarboxylation of pyruvate and the Krebs cycle: sequence of reactions, connection with the electron transport chain, regulation, significance.
11.	Electron transport chain, components, structural organization. Electrochemical potential, its significance.
12.	Oxidative phosphorylation of ADP. Mechanism. Coupling and uncoupling of oxidation and phosphorylation in the electron transport chain. Regulation of the electron transport chain.
13.	Substrate phosphorylation of ADP. Differences from oxidative phosphorylation. The main ways of using ATP. ADP-ATP cycle. The concept of free oxidation and its significance. Tissue features of redox processes.
14.	Classification of carbohydrates: mono-, di-, oligo- and polysaccharides. Functions of carbohydrates. . Digestion of carbohydrates. Disorders of digestion and absorption of carbohydrates. Fructolysis and Leloir pathway. The function of the liver in carbohydrate metabolism.

15.	Glycogen exchange: glycogenesis and glycogenolysis. Substrates, products, regulation by hormones. The role of glycogen exchange in the body. Glycogen storage disease
16.	Anaerobic glycolysis. Tissues, condition, regulation, substrates, products. LDH reaction. ATP output. The fate of lactate
17.	Aerobic glycolysis. Place, condition, regulation, substrates, products. ATP output. The fate of pyruvate. Comparison with anaerobic glycolysis.
18.	Gluconeogenesis. Substrates of gluconeogenesis. Condition, regulation. Function of gluconeogenesis. Glucose-lactate cycle (Cori cycle) and glucose-alanine cycle, their physiological function
19.	Pentose phosphate pathway. Physiological condition, regulation, substrates, products. The fate of the products. The function of pentose phosphate pathway.
20.	Blood glucose. Normal range of glucose in blood. Ways of glucose entry into the blood, ways of its use. Regulation of blood glucose by hormones. Hypoglycemia: causes, consequences. Causes of hyperglycemia. The effect of hyperglycemia on the body. Glucose tolerance test
21.	Classification and functions of lipids. Dietary fats; daily consumption rate, digestion, absorption of digestion products. Resynthesis of fats in intestinal cells. Chylomicrons, structure, significance, metabolism. Limits of changes in the concentration of fats in the blood.
22.	Oxidation of glycerol and fatty acids. The sequence of reactions. Relationship of β-oxidation with the Krebs cycle and the electron transport chain. Physiological significance of fatty acid oxidation depending on the rhythm of nutrition and muscle activity.
23.	Lipolysis and lipogenesis. Significance, localizations, sequence of reactions.. Dependence of lipogenesis on the rhythm of nutrition and food composition. Regulation of lipolysis and lipogenesis. Transport and use of fatty acids formed during fat mobilization.
24.	Fatty acid biosynthesis. Place in the cell, condition, regulation, substrates, products. The fate of the products.
25.	Acetyl-CoA. Ways of its formation and use. Changes in the use of acetyl-CoA depending on the conditions (energy supply) in the cell. Ketone bodies: chemical structure, synthesis of ketone bodies. Role in the body. Ketosis, its causes and consequences
26.	Cholesterol: synthesis (substrates of synthesis), function in the body. Regulation of synthesis. Factors contributing to the level of blood cholesterol. Atherosclerosis: causes, diagnosis, prevention
27.	Lipoproteins: classification and composition of different types. Metabolism of chylomicrons and VLDL. Change in the ratio of lipoproteins in atherosclerosis, atherogenic and antiatherogenic forms
28.	Amino acids and proteins. Peptide bond. Functions of protein and non-protein amino acids, peptides and proteins in the body. Daily protein requirement. Digestion of proteins. Regulation of protein digestion. Pathology of digestion and absorption of proteins.
29.	Sources of amino acids and ways to use them. Essential and non-essential amino acids. Biosynthesis of non-essential amino acids by using glucose. Sources of nitrogen for amino acids. Gluconeogenesis from amino acids: regulation, physiological significance.
30.	Decarboxylation of amino acids. Biogenic amines as products of amino acids decarboxylation. Examples of such amines, their function.

31.	Deamination of amino acids, types of deamination. Transamination of amino acids. specificity of aminotransferases. Significance of transamination reactions. Indirect deamination of amino acids: sequence of reactions, enzymes, biological significance.
32.	Formation and uses of ammonia. Biosynthesis of urea: sequence of reactions, regulation. Hyperammonemia.
33.	Metabolism of phenylalanine and tyrosine. Hereditary disorders of phenylalanine and tyrosine metabolism. The value of serine, glycine and methionine.
34.	Creatine synthesis: the sequence of reactions, the value of creatine phosphate. Physiological creatinuria. The significance of creatine kinase and creatinine in the medicine.
35.	Nucleic acids structure. Nitrogen-containing bases, nucleosides and nucleotides structure. ATP as an example of such nucleotides. Functions of nucleotides, the special role of ATP in metabolism. Digestion of nucleoproteins. The fate of nitrogenous bases in cells.
36.	Catabolism of purine and pyrimidine bases. Hyperuricemia. Gout.
37.	Biosynthesis of purine and pyrimidine nucleotides. Biosynthesis of deoxyribonucleotides. regulation of these processes.
38.	DNA replication: mechanism and biological significance. DNA damage, repair of damage and DNA replication errors.
39.	Types of RNA: structural features, size and variety of molecules, localization in the cell, functions. Biosynthesis of RNA (transcription). The structure of ribosomes and polyribosomes. Synthesis of aminoacyl-tRNA. Substrate specificity of aminoacyl-tRNA synthetases.
40.	The main components of the protein synthesis system. protein biosynthesis. Mechanism. The adapter function of tRNA and the role of mRNA in this process.
41.	Regulation of protein biosynthesis. Induction and repression of protein synthesis on the example of the functioning of the lactose operon of Escherichia coli. Matrix biosynthesis inhibitors: drugs, viral and bacterial toxins.
42.	Hemoglobin. Structure. Synthesis and breakdown of hemoglobin. forms of bilirubin. Ways of excretion of bilirubin and other bile pigments. Jaundice.
43.	Blood plasma proteins. Functions of plasma proteins. Hypo- and hyperproteinemia, the causes of these conditions. Individual proteins of blood plasma, their functions. Proteins of inflammation
44.	Residual blood nitrogen. Hyperazotemia, its causes. Uremia.
45.	Basic biochemical functions and features of the liver.
46.	Interrelation of metabolism of fats, carbohydrates and proteins.
47.	Biochemistry of regulation. Hierarchy of regulatory systems. Classification of intercellular regulators. Central regulation of the endocrine system: the role of releasing factors, statins and tropic hormones.
48.	The concept of receptors. The mechanism of action of hormones through intracellular receptors and receptors of plasma membranes and second mediators (general characteristics).
49.	Insulin. Chemical structure, endocrine gland, regulation of hormone secretion, target tissues, biochemical effects, biological function, diseases..
50.	Diabetes. Pathogenesis. Metabolic disorders in diabetes mellitus. Determination of glucose tolerance in the diagnosis of diabetes mellitus.

51.	Growth hormone, glucagon and other peptide hormones. Chemical structure, regulation of hormone secretion, target tissues, biological function. Disorders.
52.	Glucocorticoids. Chemical structure, endocrine gland, regulation of hormone secretion, target tissues, biochemical effects, biological function, diseases. Use steroid hormones in medicine
53.	Thyroid hormones. Chemical structure, endocrine gland, regulation of hormone secretion, target tissues, biochemical effects, biological function, diseases.
54.	Catecholamines. Chemical structure, endocrine gland, regulation of hormone secretion, target tissues, biochemical effects, biological function, diseases
55.	Water-salt balance. Functions of water. Antidiuretic hormone. Chemical structure, endocrine gland, regulation of hormone secretion, target tissues, biochemical effects, biological function, diseases
56.	Water-salt balance. Functions of minerals. Aldosterone and atrial natriuretic peptide. Chemical structure, endocrine gland, regulation of hormone secretion, target tissues, biochemical effects, biological function, diseases. Biochemical mechanisms of development of renal hypertension.
57.	Calcium and phosphate regulation. Parathyroid hormone, calcitonin and calcitriol. Chemical structure, endocrine gland, regulation of hormone secretion, target tissues, biochemical effects, biological function, diseases
58.	Hormones derived from fatty acids. Synthesis. Functions.
59.	Vitamin A. Chemical structure, biological role. β-carotene. Symptoms of vitamin A deficiency.
60.	Vitamin E. The chemical structure and biological role of the vitamin. Symptoms of vitamin deficiency. Vitamin K. Chemical structure of the vitamin, its biological role. Hypo- and hypervitaminosis
61.	Vitamins B1 and B2. The chemical structure of vitamins, their active forms. Participation of vitamins in biological oxidation reactions. Flavoproteins and their participation in the metabolism of fatty acids and amino acids. Signs of vitamin deficiency
62.	Vitamins B6. The chemical nature and role of these vitamins in metabolism. Vitamin PP (nicotinic acid and its amide). Active forms of the vitamin. Participation of vitamin in biological oxidation, metabolism of fatty acids, carbohydrates and amino acids, signs of vitamin PP deficiency
63.	Vitamin C. Chemical nature, participation in metabolism. Signs of hypovitaminosis. Vitamin P (rutin) and its relationship with vitamin C. Scurvy.
64.	Biotin (vitamin H) and pantothenic acid. The chemical nature and role of these vitamins in metabolism
65.	Folic acid. The chemical nature of the vitamin, its participation in metabolism. Vitamin B12. Structural features, assimilation of the vitamin in the digestive tract. Participation in metabolism, signs of vitamin deficiency