FEDERAL STATE BUDGET EDUCATIONAL
HIGHER EDUCATION INSTITUTION
"ROSTOV STATE MEDICAL UNIVERSITY"
MINISTRY OF HEALTH OF THE RUSSIAN FEDERATION

FACULTY OF TREATMENT AND PREVENTION

Appraisal Fund

in the discipline "Biochemistry"

Specialty 05/31/01 General Medicine

2023

1. Interim certification form

2nd semester-*test with grade,*3rd semester -*test*, 4th semester -*exam*

2. Type of intermediate certification–

2nd semester- in the test form, a "grade" is given based on the sum of points of the current and midterm control, in accordance with the scale for converting points into numerical grades.
3rd semester - According to the intermediate certification in the test form, a "credit" is given in the amount points of current and milestone control, which must be at least 60 points. *4th semester* –Interim certification in the form of an exam involves examination procedure -*ticket interview*and is estimated from 60-100 points (check sheet).

The sum of points based on the results of current and midterm control is taken into account in the individual rating of the teacher. The examination grade represents the student's final rating in the discipline and is assigned based on the average score (current, midterm control and intermediate certification) in accordance with the scale for converting points into numerical grades.

3. List of competencies formed by the discipline or in the formation of which the discipline participates in

Code competencies	Content of competencies (results of mastering OOP)	Contents of competency elements, in the implementation of which he participates discipline
OK-1	ability for abstract thinking, analysis, synthesis	
OPK-7	readiness To use main physico-chemical, mathematical and other natural science concepts and methods for solving professional problems;	

4. Stages of formation of competencies in the process of developmenteducational program

Competence	Disciplines	Semester
OK-1	Chemistry	1
	Anatomy	12
	Histology, embryology	12
	Physiology	3, 4
OPK-7	Chemistry	1
	Biology	1.2

5. Stages of developing competencies in<u>process of mastering the discipline</u>

Sections of the discipline	Codes of formed competencies	
	OK-1	OPK-7
Semester 2		
Section 1	+	
Section 2	+	+
Section 3	+	+
Semester 3		
Section 4	+	
Section 5	+	+
Section 6	+	+
Semester 4		
Section 7	+	+
Section 8	+	+
Section 9	+	+

6. Forms of assessment tools in accordance with the competencies being developed

Semester 2 – test with assessment - Semester 3: test

Code competencies	Forms of assessment tools	
	Current certification	Milestone certification
OK-1 PK-7	Oral survey Colloquium	Testing

4th semester: exam

Code competencies	Forms of assessment tools	
	Current / milestone certification	Interim certification
OK-1 PK-7	Oral survey Colloquium Testing	Interview

7.

Current control

Survey:

2nd semester:

Test questions for the section: General metabolic pathways.

1. Scheme of catabolism of proteins, carbohydrates and lipids. Specific and general pathways of catabolism. The significance of the reactions of common catabolic pathways.
2. Scheme of oxidative decarboxylation reactions.
3. Reactions of the Krebs cycle that occur with the participation of stereospecific enzymes.

4. Redox reactions of the Krebs cycle.
5. Scheme of the Krebs cycle (KTC). Localization, stages, substrates, enzymes. Limiting reaction of the Krebs cycle. Its regulation.
6. Connection of the TCA cycle with the chain of respiratory enzymes. Reactions of the Krebs cycle leading to energy production in the form of NADH + $H^+$and $FADN_2$. Energy function of the TCA. Substrate phosphorylation reaction of the Krebs cycle.
7. Regulation of general catabolic pathways: regulatory allosteric enzymes, their activators and inhibitors.
8. The concept of metabolism: anabolic and catabolic processes and their relationship;
9. General and specific metabolic pathways. Principles of metabolism: unification and convergence.
10. Macroergic compounds. ATP is a universal battery and source of energy in the body. ATP-ADP cycle. Energy charge of the cell.
11. The role of oxygen in metabolism. The concept of oxygen toxicity.
12. Macroergic compounds in the body: their structure and significance. Examples
13. Principles of coupling endo and exergic processes.
14. Pathways for ATP synthesis in the body. Substrate phosphorylation. Example.
15. Respiratory chain of electron transport in mitochondria. Principles of organization.
16. Oxidative phosphorylation in mitochondria.
17. Mechanisms of coupling reactions of oxidation and phosphorylation.
18. Mitchell's chemiosmotic theory.
19. Formation and use of electrochemical potential.
20. Conditions for ATP synthesis. Phosphorylation coefficient. R/O.
21. Respiratory control. Separation of respiration (oxidation) and phosphorylation (free oxidation).
22. Inhibitors of oxidative phosphorylation and respiration.
23. Formation of toxic forms of oxygen in the CPE and their neutralization.

3rd semester:

Test questions for the section: Regulatory systems of the body.

1. Hierarchical principle of regulation of homeostasis and adaptation in the human body. Concept of the endocrine system. Hormones, classification by chemical structure and functions, Basic mechanisms for transmitting hormonal signals to target cells. The role of hormones in the body. Relationship between hormones and the central nervous system.
2. Insulin; localization and stages of biosynthesis, chemical nature, target cells, mechanism of action of insulin on the metabolism of carbohydrates, proteins, lipids in the liver, muscles, adipose tissue and brain. Diabetes. Insulin catabolism.
3. Glucagon: localization of biosynthesis, chemical nature, target cells, mechanism of action on the metabolism of carbohydrates, lipids in adipose tissue and liver. Impaired glucagon biosynthesis. Glucagon catabolism.
4. Adrenaline: localization and stages of biosynthesis, chemical nature, target cells, mechanism of action on the metabolism of carbohydrates, lipids and proteins in muscles, liver and adipose tissue. Catabolism of adrenaline.
5. Thyroid hormones: localization of biosynthesis stages, chemical nature, target cells, mechanism of action on the metabolism of proteins, lipids, carbohydrates and tissue respiration. Violation of the biosynthesis of thyroid hormones (hypo- and hyperfunction). Catabolism of thyroid hormones.
6. Hormones of the adrenal cortex, chemical nature, localization and stages of biosynthesis, mechanism of action of glucocorticoids. Cortisol: target cells, mechanism of action on the metabolism of carbohydrates, proteins, lipids in the liver, muscles, connective tissue and on the immune system, disruption of glucocorticoid biosynthesis.

7. Sex hormones: female sex hormones (follicles and corpus luteum), chemical nature, stages of biosynthesis, cyclical action on the woman's body. The role of hormones in the regulation of reproductive function. Consequences of hormonal dysfunction in a woman's body. Catabolism of hormones.
8. Sex hormones: male sex hormones, chemical nature, stages of biosynthesis, effect on metabolism in the body. Catabolism of hormones.

4th semester:

Test questions on the topic: Nucleic acids.

1. Scheme of nucleoprotein digestion in the gastrointestinal tract.
2. Synthesis of purine nucleotides: scheme, enzymes, regulation, spare pathways of synthesis.
3. Decay of purine nucleotides: diagram, enzymes. Disorders of purine nucleotide metabolism.
4. Biosynthesis of pyrimidine nucleotides: scheme, enzymes, regulation, disorders.
5. Decomposition of pyrimidine nucleotides: diagram, enzymes.
6. Replication - DNA synthesis: template, primer, substrates, cofactor, enzymes and replication proteins.
7. Transcription - RNA synthesis: substrates, stages, transcription factors, enzymes. Transcriptons.
8. Translation - protein biosynthesis. The main stages of the functioning of the protein synthesizing system: activation of amino acids - synthesis of aminoacyl-tRNA: initiation, elongation, termination.

Colloquium – survey on tickets (include theoretical questions and a situational task)

Example of questions from the section "Lipid metabolism"::

1. Digestion and absorption of dietary fats. Resynthesis of fats in intestinal cells, transport by blood, absorption by tissues. The role of bile in the digestion and absorption of lipids.
2. β-oxidation of fatty acids: sequence of reactions, biological significance, regulation, connection with the TCA cycle and CPE.
3. Biosynthesis of fatty acids: sequence of reactions, regulation, dependence on nutritional rhythm, biological role.
4. Synthesis of fats from carbohydrates in the liver and adipose tissue, biological role, hormonal regulation.
5. Mobilization of fats from adipose tissue, biological role, hormonal regulation.
6. Synthesis and use of ketone bodies: sequence of reactions, biological significance. Causes and consequences of ketonemia.
7. Cholesterol: structure, functions, balance in the body. synthesis (sequence of reactions leading to mevalonic acid), regulation of synthesis. The role of AchAT.
8. Hypercholesterolemia: causes, consequences. Biochemical basis of the pathogenesis of atherosclerosis and basic approaches to treatment.
9. Bile acids: structural features, functions, synthesis, enterohepatic circulation. Cholelithiasis.
10. Chylomicrons (CM): formation, composition, functions, metabolic pattern. Hyperchylomicronemia.

11. Very low density lipoproteins (VLDL): functions, education, composition, metabolic pattern. Hypertriglycerolemia.
12. Low-density lipoproteins (LDL): metabolism. education, composition, functions, scheme Hypercholesterolemia.
13. High density lipoproteins (HDL): metabolism. education, composition, functions, scheme The role of LHAT.

Situational tasks:

No. 1

What metabolic changes will result from a mutation in muscle carnitine? acyltransferase I, in which the mutant protein loses its affinity for malonyl-CoA but retains its catalytic activity? To answer please indicate:

A) in what process does the enzyme carnitine acyltransferase I take part? B) what effect does malonyl-CoA have on its activity;

C) how does the level of transported substrates change?

Brief answer:

A) transport of IVF from the cytosol to the mitochondrial □□ oxidation; matrix for B) inhibits carnitine acyltransferase I

B) does not change, because due to the cessation of inhibition of transport, IVF are constantly oxidized and synthesized - an idle cycle occurs.

No. 2

The patient developed a condition characterized by progressive muscle weakness and painful muscle spasms. Fasting, exercise, and fatty foods worsened symptoms. A sample homogenate from a patient's skeletal muscle oxidized the added oleate more slowly than control homogenates consisting of muscle samples from healthy individuals. When carnitine is added to a muscle homogenate, the rate of carnitine oxidation is equal to the rate in the control homogenate. The patient was diagnosed with carnitine deficiency.

A) Why does the addition of carnitine increase the rate of oleate oxidation in the patient's muscle homogenate?

B) Why did fasting, exercise, and fatty foods worsen the patient's symptoms? C) Suggest two possible causes of carnitine deficiency in such a person. *Brief answer:*

A) Carnitine is involved in the transport of IVF and determines the rate of their oxidation process;

B) These factors enhance the oxidation of IVFA;

C) A defect in one of the enzymes involved in the synthesis of carnitine or a deficiency of its precursor, lysine.

No. 3

If the amount of acetyl-CoA formed during the process of -oxidation in the liver exceeds the capacity of the tricarboxylic acid cycle, then ketone bodies are formed from its excess. This occurs during fasting and uncontrolled diabetes: since the tissues cannot use glucose, fatty acids are instead oxidized in large quantities. Although Acetyl-CoA is not toxic, mitochondria must convert acetyl-CoA into ketone bodies.

A) What substances are grouped under the general name: "ketone bodies"? B) Write a diagram of their metabolism in the body.

Q) What problem would arise if acetyl-CoA could not be converted into ketone bodies?

Brief answer:

A) acetoacetate, –hydroxybutyrate, acetone. B) see Lecture.

B) Reducing the level of HSCoA and slowing down oxidation.

Digestion and absorption of dietary fats. Resynthesis of fats in intestinal cells, transport by blood, absorption by tissues. The role of bile in the digestion and absorption of lipids.

14. β-oxidation of fatty acids: sequence of reactions, biological significance, regulation, connection with the TCA cycle and CPE.
15. Biosynthesis of fatty acids: sequence of reactions, regulation, dependence on nutritional rhythm, biological role.
16. Synthesis of fats from carbohydrates in the liver and adipose tissue, biological role, hormonal regulation.
17. Mobilization of fats from adipose tissue, biological role, hormonal regulation.
18. Synthesis and use of ketone bodies: sequence of reactions, biological significance. Causes and consequences of ketonemia.
19. Cholesterol: structure, functions, balance in the body. synthesis (sequence of reactions leading to mevalonic acid), regulation of synthesis. The role of AchAT.
20. Hypercholesterolemia: causes, consequences. Biochemical basis of the pathogenesis of atherosclerosis and basic approaches to treatment.
21. Bile acids: structural features, functions, synthesis, enterohepatic circulation. Cholelithiasis.
22. Chylomicrons (CM): formation, composition, functions, metabolic pattern. Hyperchylomicronemia.
23. Very low density lipoproteins (VLDL): functions, education, composition, metabolic pattern. Hypertriglycerolemia.
24. Low-density lipoproteins (LDL): metabolism. education, composition, functions, scheme Hypercholesterolemia.
25. High density lipoproteins (HDL): metabolism. education, composition, functions, scheme The role of LHAT.

Situational tasks:

No. 1

What metabolic changes will result from a mutation in muscle carnitine?

acyltransferase I, in which the mutant protein loses its affinity for malonyl-CoA but retains its catalytic activity? To answer please indicate:

A) in what process does the enzyme carnitine acyltransferase I take part? B) what effect does malonyl-CoA have on its activity;

C) how does the level of transported substrates change?

Brief answer:

A) transport of IVF from the cytosol to the mitochondrial □□ oxidation; matrix for B) inhibits carnitine acyltransferase I

B) does not change, because due to the cessation of inhibition of transport, IVF are constantly oxidized and synthesized - an idle cycle occurs.

No. 2

The patient developed a condition characterized by progressive muscle weakness and painful muscle spasms. Fasting, exercise, and fatty foods worsened symptoms. A sample homogenate from a patient's skeletal muscle oxidized the added oleate more slowly than control homogenates consisting of muscle samples from healthy individuals. When carnitine is added to a muscle homogenate, the rate of carnitine oxidation is equal to the rate in the control homogenate. The patient was diagnosed with carnitine deficiency.

A) Why does the addition of carnitine increase the rate of oleate oxidation in the patient's muscle homogenate?

B) Why did fasting, exercise, and fatty foods worsen the patient's symptoms? C) Suggest two possible causes of carnitine deficiency in such a person. *Brief answer:*

A) Carnitine is involved in the transport of IVF and determines the rate of their oxidation process;

B) These factors enhance the oxidation of IVFA;

C) A defect in one of the enzymes involved in the synthesis of carnitine or a deficiency of its precursor, lysine.

No. 3

If the amount of acetyl-CoA formed during the process of □ -oxidation in the liver exceeds the capacity of the tricarboxylic acid cycle, then ketone bodies are formed from its excess. This occurs during fasting and uncontrolled diabetes: since the tissues cannot use glucose, fatty acids are instead oxidized in large quantities. Although Acetyl-CoA is not toxic, mitochondria must convert acetyl-CoA into ketone bodies.

A) What substances are grouped under the general name: “ketone bodies”? B) Write a diagram of their metabolism in the body.

Q) What problem would arise if acetyl-CoA could not be converted into ketone bodies?

Brief answer:

A) acetoacetate, –hydroxybutyrate, acetone. B)

see Lecture.

B) Reducing the level of HSCoA and slowing down oxidation.

Frontier control:

Test control

1.1.Test control

List of test tasks for intermediate certification with standard answers

Level A

1. Intermediate carbohydrate metabolism includes the following processes

1) biosynthesis and breakdown of glycogen

2) aerobic and anaerobic glycolysis

3) ornithine cycle of urea formation

4) synthesis of ketone bodies

5) synthesis of non-essential amino acids

2. Phosphorylation of glucose is carried out by the enzyme:

1) phosphorylase

2) amylase

3) hexokinase

4) glucokin

5) phosphatase

3. Aerobic catabolism of glucose to CO2 and H2O:

1) includes the general pathway of catabolism

2) proceeds with the consumption of ATP

3) not associated with CPE

4) inhibited by hypovitaminosis RR, B_2, IN_1

5) occurs only in the cytosol of the cell

4. Aerobic oxidation of glucose is accompanied by:

1) acidosis

2) lactate formation

3) splitting to CO2 and H2O

4) accumulation of ketone bodies

5) the formation of 38 ATP molecules

5. During the preparatory stage of glycolysis, glucose:

1) oxidizes to acetyl-CoA

2) phosphorylated

3) phosphotriose is split into two molecules

4) oxidizes to 2 lactate molecules

5) is reduced to lactate

6. The reactions of substrate phosphorylation in glycolysis are the transformation of:

1) fructose-6-phosphate in PHA and DAP

2) 1,3-DPG to 3-phosphoglycerate

3) glucose into glucose-6-phosphate

4) PHA in 1,3-DPG

5) PEP to pyruvate

Level B

7. Functions of carbohydrates in the human body:

1) catalytic

2) storage of genetic information

3) transport

4) energy

5) plastic

6) osmoregulatory

8. Anaerobic glycolysis: allows the synthesis of ATP when there is a lack of oxygen in tissues, especially in:

1) malignant tumor cells

2) brain

3) muscles in the first minutes of muscle contraction

4) liver in the absorptive stage of digestion

5) red blood cells that do not have mitochondria

6) renal cortex

9. NADPH dehydrogenase syndrome is characterized by:

1) hereditary defect of glucose-6-phosphate dehydrogenase

2) increased LPO in erythrocytes

3) hemolytic anemia

4) glucosuria

5) hypoglycemia

6) hyperglycemia

10. NADPH+H+used for synthesis

1) glucose

2) cholesterol

3) DRC

4) bile acids

5) proteins

6) peptides

8. Interim certification:

2nd semester:-For intermediate certification in the form of a test, a “grade” is given based on the average score of the current and midterm control.

3rd semester:-

"Test" -according to the average score of the current and midterm control.

Evaluation criteria for the test

Mark in the record book	Description
passed	Mark "PASSED" is estimated answer, revealing a strong knowledge of the basic processes of the subject area being studied, distinguished by the depth and completeness of the topic; mastery of terminology; the ability to explain the essence of phenomena, processes, events, draw conclusions and generalizations, give reasoned answers, give examples; fluency in monologue speech, logic and consistency of response. However, one or two inaccuracies in the answer are allowed.
not accepted	Mark "NOT PASSED" is estimated answer, detecting ignorance processes of the studied subject area, characterized by shallow coverage of the topic; ignorance of the basic issues of theory, unformed skills in analyzing phenomena and processes; inability to give reasoned answers, poor command of monologue speech, lack of logic and consistency. Serious errors in the content of the answer are allowed.

Exam -*Ticket interview includes theoretical questions and situational tasks.*

List of questions:

1. Features of enzymes as protein catalysts.
2. Active center of the enzyme: definition, characteristics, properties.
3. Specificity of enzyme action: absolute, stereospecificity. group,
4. Nomenclature and classification of enzymes.
5. The structure of enzymes: one-, two-component, apoenzyme, cofactor, prosthetic group, their role.
6. Mechanism of action of enzymes. Basics of the kinetics of enzymatic reactions: units of expression of enzyme activity, dependence of the reaction rate on the enzyme concentration.
7. The influence of temperature and pH of the environment on the activity of enzymes.
8. The influence of substrate concentration on the rate of enzymatic reaction. Michaelis-Menten equation.
9. Inhibition: definition, classification.
10. Types of inhibition of enzyme activity: reversible, competitive, non-competitive, irreversible.
11. Regulation of the rate of enzymatic reactions: by changing the number of enzyme molecules in the cell; availability of substrate and coenzyme molecules; localization of enzymes in a specific compartment of the cell (compartmentalization).
12. Regulation of enzyme activity: using protein-protein interactions; allosteric regulation, partial (limited proteolysis), by phosphorylation/ dephosphorylation.
13. Enzymopathies. Enzymodiagnostics. Isoenzymes.
14. Scheme of catabolism of proteins, carbohydrates and lipids. Specific and general pathways of catabolism. The significance of the reactions of common catabolic pathways.
15. Scheme of oxidative decarboxylation reactions.
16. Reactions of the Krebs cycle occurring with the participation of stereospecific enzymes.
17. Redox reactions of the Krebs cycle.
18. Scheme of the Krebs cycle (KTC). Localization, stages, substrates, enzymes. Limiting reaction of the Krebs cycle. Its regulation.
19. Connection of the TCA cycle with the chain of respiratory enzymes. Reactions of the Krebs cycle leading to energy production in the form of NADH + $H^+$and $FADN_2$. Energy function of the TCA. Substrate phosphorylation reaction of the Krebs cycle.
20. Regulation of general catabolic pathways: regulatory allosteric enzymes, their activators and inhibitors.
21. The concept of metabolism: anabolic and catabolic processes and their relationship;
22. General and specific metabolic pathways. Principles of metabolism: unification and convergence.
23. Macroergic compounds. ATP is a universal battery and source of energy in the body. ATP-ADP cycle. Energy charge of the cell.
24. The role of oxygen in metabolism. The concept of oxygen toxicity.
25. Macroergic compounds in the body: their structure and significance. Examples
26. Principles of coupling endo and exergic processes.
27. Pathways for ATP synthesis in the body. Substrate phosphorylation. Example.
28. Respiratory chain of electron transport in mitochondria. Principles of organization.
29. Oxidative phosphorylation in mitochondria.

30. Mechanisms of coupling reactions of oxidation and phosphorylation.
31. Mitchell's chemiosmotic theory.
32. Formation and use of electrochemical potential.
33. Conditions for ATP synthesis. Phosphorylation coefficient. R/O.
34. Respiratory control. Separation of respiration (oxidation) and phosphorylation (free oxidation).
35. Inhibitors of oxidative phosphorylation and respiration.
36. Formation of toxic forms of oxygen in CPE and their neutralization.
37. Carbohydrates of food, animal and plant origin: norms and principles of rationing their daily needs.
38. Digestion of carbohydrates in the gastrointestinal tract: process enzymes, stages. The importance of fiber and pectins.
39. Absorption of monosaccharides through the wall of the gastrointestinal tract.
40. Glucose transporters: types, structural features, functions. Insulin-dependent GLUT-4.
41. The formation of glucose-6-phosphate is the first reaction of various pathways for the conversion of glucose in the cell.
42. The fate of glucose-6-phosphate in tissue cells of the human body: liver, brain, cardiac and skeletal muscles, red blood cells, adipose tissue.
43. Scheme of glycogen biosynthesis.
44. Scheme of glycogen breakdown. Differences in glycogen breakdown in the liver and skeletal muscles.
45. Regulation of glycogen synthesis and breakdown.
46. Pentose phosphate pathway (PPP) of glucose oxidation in cells: localization of the process, two branches, overall reaction, energy effect, significance in the human body.
47. Scheme of reactions of the oxidative branch of the pentose phosphate pathway of glucose oxidation: stages, enzymes, biological significance.
48. The total reaction of the non-oxidative branch of PPP, biological significance.
49. Metabolism of fructose and galactose. Fructosemia, galactosemia.
50. Routes of entry and expenditure of blood glucose.
51. Protein metabolism.
52. Proteins, peptides, amino acids. Protein nutrition, daily requirement, complete and incomplete proteins. Replaceable and essential amino acids.
53. Digestion of proteins in the gastrointestinal tract: process enzymes, their activation. Absorption of amino acids and their fate in the body. Meaning the process of protein digestion in the gastrointestinal tract.
54. The main pathways of intermediate metabolism of amino acids in the body: direct and indirect oxidative deamination, transamination, reductive amination, decarboxylation. Substrates, enzymes, coenzymes, products of these processes. Biological significance.
55. Decarboxylation of amino acids in tissues and intestines. The role of biogenic amines. Rotting of proteins (amino acids) in the large intestine. Enzymes of the process. The role of FAFS UDFGK. Neutralization of biogenic amines and rotting products in the large intestine.
56. Terms of functioning of proteins in the human body. The main reasons for the breakdown of proteins in the body; enzymes of the process, localization in subcellular structures. Update times for various proteins.
57. Ways of formation and neutralization ammonia in the body. Biosynthesis urea in the liver; stages, their localization, enzymes of the process, energy costs, connection with the Krebs cycle. Daily amount of urea, Determination of the amount of urea in blood serum. Uremia.
58. Disorders of protein metabolism in the human body: impaired digestion and absorption, dysproteinemia (nutritional and pathological).

Hereditary (congenital) disorders of amino acid metabolism in the body: hyperglycinemia, Hartnup disease, hyperargininemia, albinism, alkaptonuria, phenylketonuria.

59. Changes in the activity of protein metabolism enzymes in blood serum: aspartate aminotransferase (AST), alanine aminotransferase (ALT), creatine phosphokinase. The importance of determining these indicators in the diagnosis of diseases of the heart, liver, skeletal muscles. Proteins, amino acids, peptides as drugs.
60. Hierarchical principle of regulation of homeostasis and adaptation in the human body. Concept of the endocrine system. Hormones, classification according to chemical structure and functions, Basic mechanisms for transmitting hormonal signals to target cells. The role of hormones in the body. Relationship between hormones and the central nervous system.
61. Insulin; localization and stages of biosynthesis, chemical nature, target cells, mechanism of action of insulin on the metabolism of carbohydrates, proteins, lipids in the liver, muscles, adipose tissue and brain. Diabetes. Insulin catabolism.
62. Glucagon: localization of biosynthesis, chemical nature, target cells, mechanism of action on the metabolism of carbohydrates, lipids in adipose tissue and liver. Impaired glucagon biosynthesis. Glucagon catabolism.
63. Adrenaline: localization and stages of biosynthesis, chemical nature, target cells, mechanism of action on the metabolism of carbohydrates, lipids and proteins in muscles, liver and adipose tissue. Catabolism of adrenaline.
64. Thyroid hormones: localization of biosynthesis stages, chemical nature, target cells, mechanism of action on the metabolism of proteins, lipids, carbohydrates and tissue respiration. Violation of the biosynthesis of thyroid hormones (hypo- and hyperfunction). Catabolism of thyroid hormones.
65. Hormones of the adrenal cortex, chemical nature, localization and stages of biosynthesis, mechanism of action of glucocorticoids. Cortisol: target cells, mechanism of action on the metabolism of carbohydrates, proteins, lipids in the liver, muscles, connective tissue and the immune system, impairment of glucocorticoid biosynthesis.
66. Sex hormones: female sex hormones (follicles and corpus luteum), chemical nature, stages of biosynthesis, cyclical action on the woman's body. The role of hormones in the regulation of reproductive function. Consequences of hormonal dysfunction in a woman's body. Catabolism of hormones.
67. Sex hormones: male sex hormones, chemical nature, stages of biosynthesis, effect on metabolism in the body. Catabolism of hormones.
68. Biochemistry of blood: general characteristics, volume, components, functions in the body. Quantitative content of the main blood components and their biological role.
69. Biochemistry of erythrocytes: catabolism of glucose in erythrocytes. Glycolysis and pentose phosphate pathway of glucose conversion, their role in the functioning of erythrocyte enzyme systems.
70. Respiratory function of blood. Trigger mechanism for oxygen transfer. Allosteric and cooperative properties of hemoglobin. Hemoglobin affinity for oxygen (Bohr effect, influence of 2,3-diphosphoglycerate). Difference in affinity for oxygen.

71. Hemoglobin, oxyhemoglobin, methemoglobin. Variations in the primary structure and properties of human hemoglobin. Hemoglobinopathies. Thalassemia. Hypoxia. Types of hypoxia.
72. Blood proteins: albumins, globulins, fibrinogen. Methods for their separation. Biological role. Blood peptides. Methods for their determination, biological significance. Use of these indicators in medicine. Clinical significance of biochemical blood test.
73. External mechanism of blood coagulation, stages, cascade mechanisms of activation of blood coagulation factors (partial proteolysis and allosteric regulation). Role of Ca^{2+}. Hemophilia. Types of them.
74. Internal mechanism of blood coagulation. Coagulation factors, stages, cascade mechanisms of activation of blood coagulation factors (partial proteolysis and allosteric regulation). Role of Ca^{2+}.
75. Anticoagulant systems: antithrombin, antithromboplastin, fibrinolytic. The role of heparin, plasmin, antithrombin III. Antivitamins K as a therapeutic and prophylactic agent for anticoagulant action.
76. Iron metabolism in the body. Absorption, transport form, deposition of iron in the liver. Synthesis theme. Stages and enzymes of the process, removing iron from the body.
77. Biochemical mechanism of disseminated intravascular coagulation syndrome (DIC).
78. Functions of the liver in the human body
79. Features of carbohydrate metabolism in the liver
80. Features of protein and amino acid metabolism in the liver
81. The role of the liver in ammonia metabolism
82. Features of liver lipid metabolism
83. Metabolism of lipoproteins in the liver
84. The role of the liver in iron metabolism
85. Detoxification function of the liver: microsomal oxidation (stages, enzymes, reaction products).
86. Detoxification function of the liver: substrate conjugation (enzymes, reactions, reaction products)
87. The role of the liver in bilirubin metabolism
88. . Bilirubin metabolism disorder. General understanding of jaundice and its variants (hemolytic, obstructive, parenchymal; jaundice of newborns). Diagnostic value of determining bilirubin and other bile pigments in blood and urine.
89. Metabolism of alcohol in the liver and its effect on the body
90. Biochemical mechanisms of development of hepatic cell failure and hepatic coma
91. Biochemical methods for diagnosing liver damage

92. Peculiarities of the kidney structure. Functions of the kidneys in the body. Mechanism of urine formation; glomerular filtration, reabsorption, secretion. Regulation of reabsorption in the kidneys by the central nervous system and hormonal factors.
93. Acid-base state in the body. Buffer systems of the body. The role of the kidneys in maintaining CBS. Acidosis, alkalosis, causes of their occurrence, correction.
94. General properties of urine. Chemical composition of urine: organic and inorganic components of urine. Pathological components of urine. The design of the artificial kidney apparatus, its use in medicine. Physico-chemical basis of extracorporeal hemosorption and its use in kidney diseases (CKD, nephrosis, nephritis, etc.).

95. Muscular textile, kinds her V body, peculiarities chemical composition. Squirrels myofibrils (contractive And regulatory), squirrels stroma, enzyme proteins, myoglobin, non-protein nitrogenous substances muscles. Their biological role. Intermediate position of the myocardium.
96. Biochemical mechanisms muscular abbreviations. Stages, role of calcium ion gradient in contraction. The structure of the sarcomere. Biochemical mechanisms of muscle relaxation.
97. Features of energy metabolism in skeletal muscles and myocardium. Sources of energy during muscle contraction, Creatine phosphate. Resynthesis of ATP in muscle tissue (creatine kinase and myokinase pathways),
98. Biochemistry of the cardia. Features of cardia metabolism; aerobic mio nature, consumed substrates, ATP consumption. Disorders of big substance metabolism during ischemia, heart attack, dystrophy. myocardium Enzymodiagnostics at myocardial pathology (MC_2/LDP, AST), express method.
99. Connective tissue: features of chemical composition and structure. Biochemistry of the intercellular matrix. Proteins (collagen, elastin, fibronectin), glycosaminoglycans, proteoglycans; functions of connective tissue in the body. The role of glycosaminoglycans in the exchange of cations and water.
100. Collagen: features of amino acid composition, primary and spatial structure, stages of biosynthesis, the role of ascorbic acid in hydroxylation reactions. Collagen catabolism, collagenesis. Functions of collagen in the body, Formation of collagen fibers.
101. Pathology of connective tissue. Manifestation of vitamin C deficiency (scurvy), copper ions (and the biosynthesis of lysine eminoxmdase), fibronectin biosynthesis (tumor metastasis). Changes in connective tissue during aging, collagenosis, wound healing. Hydroxyprolinuria in collagenosis. Action of glucuronidase and collagenase in bacteria.

Situational tasks:

Task No. 1

A drop of a solution containing a mixture of amino acids gly, al, glu, arg, and gis was applied to the middle of electrophoretic paper, moistened with pH 6.0 buffer, and an electrical voltage was applied. Indicate in which direction (to the cathode, anode, or remain at the start) individual amino acids will move.

To answer:

1.Remember the classification of amino acids.

2.Remember what the isoelectric point of amino acids is.

Short answer : Movement towards the anode – glutamate; to the cathode - lysine, arginine, histidine; remain at the start - alanine, glycine.

Problem No. 2

The enzyme trypsin is capable of breaking down the peptide bonds of proteins. Why processing does trypsin lead to inactivation of many enzymes? To justify your answer, remember:

1.What are enzymes?

2.What class of enzymes does trypsin belong to?

Short answer : Enzymes are proteins and trypsin acts on the peptide bonds, resulting in inactivation of the enzymes.

Task No. 3

Glucose penetrates into skeletal muscles slowly and its concentration in them is low. – about 0.01 – 0.1 mmol. Why is the enzyme hexokinase rather than glucokinase preferred for activating glucose under these conditions?

To substantiate your answer, remember: 1. What reaction do these enzymes catalyze?

2.What is the Michaelis constant?

3. In what tissues does glucokinase work?

Short answer : Glucokinase works in the liver, hexokinase in the muscles. They are isoenzymes with different affinities for glucose. For hexokinase it is higher, and therefore it works at low glucose concentrations.

Problem No. 4

In an experiment with isolated mitochondria, the intensity of the Krebs cycle was determined by the accumulation of NADH. Will the operation of the Krebs cycle change if the outflow of reduced equivalents from it stops?

To justify your answer, remember:

1. In what reactions of the Krebs cycle is NADH formed?

2.What enzymes catalyze these reactions?

3.What determines the speed of the Krebs cycle?

Short answer : The intensity of the Krebs cycle will decrease, since reduced NAD is an inhibitor of isocitrate dehydrogenase, a key enzyme of the Krebs cycle.

Problem No. 5

With severe viral hepatitis, patients may develop hepatic coma, caused, in particular, by the toxic effect of ammonia on brain cells. What is the reason for such a significant accumulation of ammonia in the blood?

To justify your answer, remember:

1.What happens to ammonia in the liver of a healthy person?

2.Write a diagram of this process.

Short answer : In viral hepatitis, the functions of hepatocytes are disrupted. The synthesis of urea is inhibited, which leads to the accumulation of ammonia.

Description of indicators and criteria for assessing competencies at the stages of their formation, description of assessment scales

	Levels of competency development		
	Threshold	***Sufficient***	***High***

Criteria	Competence formed. Demonstrated threshold, satisfactory sustainable level practical skill	Competence formed. Demonstrated enough level independence, sustainable practical skill	Competence formed. Demonstrated high level independence, high adaptability practical skill

Competency assessment indicators and rating scales

Grade "unsatisfactory" (not accepted) or absence formation competencies	Grade "satisfactorily" (passed) or satisfactory (threshold) level of development competencies	Rated "good" (passed) or sufficient level development competencies	Excellent rating (passed) or high level development competencies
failure to student on one's own demonstrate knowledge when solving assignments, lack independence in application of skills. Absence confirmation availability formation competencies indicates negative development results academic discipline	student demonstrates independence in application of knowledge skills and abilities to solve educational tasks in full According to sample given teacher, by tasks, solution of which there were shown teacher, it should be considered that competence formed on satisfactory level.	student demonstrates independent application knowledge, skills and skills at solving tasks, similar samples that confirms Availability formed competencies for higher level. Availability such competence on sufficient level indicates sustainable fixed practical skill	student demonstrates ability to full independence in choosing a method solutions non-standard assignments within disciplines with using knowledge, skills and skills, received as in development progress given disciplines and adjacent disciplines should be considered competence formed at a high level.

Criteria for evaluating forms of control:

Interviews:

Mark	Descriptors		
	strength of knowledge	**ability to explain the essence of phenomena, processes, do conclusions**	**logic and subsequence answer**
Great	strength of knowledge, knowledge of basic processes of the studied subject area, the answer is different depth and completeness disclosure of the topic; possession terminological apparatus; logic and consistency answer	high skill explain the essence phenomena, processes, events, do conclusions and generalizations, give reasoned answers, give examples	high logic and subsequence answer
Fine	solid knowledge main processes subject matter being studied area, different depth and completeness disclosure of the topic; possession terminological apparatus; free possession monologue speech, however one is allowed - two inaccuracies in the answer	ability to explain essence, phenomena, processes, events, draw conclusions and generalizations, give reasoned answers, give examples; however one or two inaccuracies in the answer are allowed	logic and subsequence answer
satisfy flax	satisfactory process knowledge subject matter being studied areas, answer, different insufficient depth and completeness of disclosure Topics; knowledge of basic questions theory. Allowed several errors in content of the answer	satisfactory ability to give reasoned answers and provide examples; satisfactorily formed analysis skills phenomena, processes. Allowed several errors in content of the answer	satisfactory logic and subsequence answer
dissatisfy strictly	poor knowledge of the subject area being studied, shallow opening Topics; poor knowledge main issues theories, weak skills analysis of phenomena,	inability to give reasoned answers	absence logic and sequences answer

	processes. Allowed serious mistakes in content of the answer		

Test control grading scale:

percentage of correct answers	Marks
91-100	Great
81-90	Fine
71-80	satisfactorily
Less than 71	unsatisfactory

Situational tasks:

Mark	**Descriptors**			
	understanding Problems	**analysis situations**	**skills solutions situations**	**professional thinking**
Great	complete implication problems. All requirements, declared task, completed	high benefit analyze situation, draw conclusions	high benefit select method solutions problems faithful solution skills situation	high level professional thoughts
Fine	complete implication problems. All requirements, declared task, completed	benefit analyze situation, draw conclusions	benefit select method solutions problems faithful solution skills situation	residual level professional thoughts. one goes down - there are inaccuracies in reply
satisfy flax	astastic implication problems. majority requirements declared task, completed	please satisfy nyaya benefit analyze situation, draw conclusions	satisfactory new skills solutions situation	residual level professional thoughts. falls more a bunch of inaccuracies in reply
dissatisfy strictly	misunderstanding problems. legs requirements, declared task, not completed. No	izkaya benefit analyze situation	insufficient solution skills situation	missing

	Tveta. Did not have experiments to solve hello			

Checklist for the examination procedure

No.	Certification event	Grade
1	Theoretical question	from 2 to 5
2	Theoretical question	from 2 to 5
3	Theoretical question	from 2 to 5
4	Situational task	from 2 to 5
	Average score	**from 2 to 5**