Appendix to the working program

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/PRACTICE

BIOLOGICAL CHEMISTRY

Training program (specialty): **33.05.01 PHARMACY**

Department: **BIOCHEMISTRY named after G.Ya. GORODISSKAYA**

Mode of study **FULL-TIME**

Nizhniy Novgorod
2023

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

This Bank of Assessment Tools (BAT) for the discipline "Biological chemistry" is an integral appendix to the working program of the discipline " Biological chemistry". 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 1-23	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	Colloquium 1-5	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
4	Workbook 1-3	A didactic complex designed for independent work of the student and allowing to assess the level of mastering study materials	Workbook sample
5	Interview 1-3	A tool of control organized as a special conversation between the teacher and the student on topics related to the discipline being studied, and designed to clarify the amount of knowledge of the student on a specific section, topic, problem, etc.	Questions on topics/sections of the discipline

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
GPC-1, GPC-2	Current	**Section 1** Structure and function of proteins and amino acids	Control work 1, Workbook sample 1
GPC-1, GPC-2	Current	**Section 2** Enzymes	Control work 2, Control work 3, Control work 4, Interview 1, Questions for colloquium 1

GPC-1, GPC-2	Current	**Section 3** Introduction to the metabolism. Biological oxidation. Oxidative phosphorylation. Cycle of di- and tricarboxylic acids.	Control work 5, Control work 6, Interview 2, Questions for colloquium 2
GPC-1, GPC-2	Current	**Section 4** Hormones	Control work 7
GPC-1, GPC-2	Current	**Section 5** Metabolism of proteins and amino acids	Control work 8, Control work 9, Control work10, Interview 3, Questions for colloquium 3
GPC-1, GPC-2	Current	**Section 6** Nucleoprotein metabolism. Protein synthesis.	Control work 11
GPC-1, GPC-2	Current	**Section 7** Metabolism of carbohydrates.	Control work 12, Control work 13, Control work 14, Questions for colloquium 4, Workbook sample 2
GPC-1, GPC-2	Current	**Section 8** Metabolism of lipids.	Control work15, Control work 16, Control work 17, Control work 18, Interview 4, Questions for colloquium 5, Workbook sample 3
GPC-1, GPC-2	Current	**Section 9** Biochemistry of blood.	Test 1
GPC-1, GPC-2	Current	**Section 10** Biochemistry of the liver.	Test 2, Control work 19
GPC-1, GPC-2	Current	**Section 11** Pharmaceutical biochemistry	Control work 20
GPC-1, GPC-2	Current	**Section 12** Biochemistry of connective and muscle tissue	Control work 21, Control work 22, Interview 5
GPC-1, GPC-2	Current	**Section 13** Biochemistry of the nervous system	Control work 23
GPC-1, GPC-2	Mid-term	**All sections of the discipline**	Exam

* - *not provided for postgraduate programs*

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

4.1. Test for the assessment of competence " GPC-1, GPC-2"

Test 1. "Biochemistry of blood"

C A R D № 1

№ №	QUESTIONS	ANSWERS	
1.	What kinds of hemoglobin are contained in the human erythrocytes?	1. Hb A_1 2. Hb A_2 3. HbL	4. HbF 5. HbC 6. HbN

2.	Which of the following substances belong to the class of heme proteins?	1. Myoglobin 4. Transferrin 2. Cytochromes 5. Hemoglobin 3. Catalase 6. Peroxidase
3.	The dependecy between the extent of a hemoglobin saturation and pO_2 is graphically characterized by a	1. hyperbola 4. right line 2. S-like curve 3. parabola
4.	Choose the post-translational modifications of hemoglobin.	1. Glycosylated Hb 5. Caboxyhemoglobin 2. Phosphorylated Hb 6. Sulfated Hb 3. Methemoglobin 4. Complex with glutathione
5.	αβ-subunits of hemoglobin are bound by	1. hydrophobic bonds 3. ionic bonds (salt bridges) 2. disulfide bonds 4. hydrohen bons
6.	The phenomenon of *paraproteinemia* is	1. an appearance of abnormal proteins in blood 2. an increase of the blood protein concentration 3. an appearance of the Bence-Jones protein in blood 4. a decrease of the blood protein concentration
7.	Which of the following oligomeric combinations is characteristic for the fetal hemoglobin?	1. $\alpha_2\gamma_2$ 3. $\beta_2\gamma_2$ 2. $\alpha_2\beta_2$ 4. $\alpha_2\alpha_2$
8.	In the synthesis of heme succinyl CoA interacts with glycine and is transformed into	1. γ-aminobutyrate 4. oxaloacetate 2. acetoacetate 5. β-aminopropionate 3. δ-aminolevulinate 6. α-oxibutyrate
9.	The ability of hemoglobin to bind oxygen depends on	1. pH 3. pO_2 2. temperature 4. presence of 2,3-diphosphoglycerate
10.	A central cavity of deoxygenated hemoglobin contains	1. CO_2 3. 2,3-diphosphoglycerate 2. bicarbonate 4. Cl^- anion

C A R D № 2

№ №	QUESTIONS	ANSWERS
1.	Which of the following oligomeric combinations are characteristic for HbA1, HbA2, and Hb F?	1. $\alpha_2\beta_2$ 4. $\beta_2\gamma_2$ 2. $\alpha_2 s_2$ 5. $\alpha_2\delta_2$ 3. $\alpha_2\gamma_2$ 6. $\alpha_2\alpha_2$
2.	The maintaining of blood osmotic pressue is carried out by	1. Na^+ cathions 3. albumins 2. Cl^- anions 4. blood concentration of cyclic nucleotides
3.	What is a source of the ferrous ions for the synthesis of heme?	1. Cytochromes 4. Catalase 2. Myoglobin 5. Peroxidase 3. Ferritin
4.	The fraction of α_1-globulins contains the following proteins:	1. ceruloplasmin 4. thyroxin-binding protein 2. haptoglobin 5. transcortin 3. antitrypsin 6. transferrin
5.	Choose the organospecific (marker) enzymes of blood which may be determined to diagnose the liver disorders.	1. Lactate dehydrogenase (isoenzymes LDH1 and LDH2) 2. Lactate dehydrogenase (isoenzymes LDH_4 and LDH_5) 6. Creatine kinase 3. Amidinotransferase 7. Arginase 4. Alanine aminotransferase 5. Aspartate aminotransferase
6.	Which of the following properties of hemoglobin and the erythrocytes are alterated in the sickle cell anemia (sicklemia)?	1. A solubility in water decreases 2. An affinity to oxygen increases 3. Deformation of an erythrocyte 4. A solubility in water increases 5. An affinity to oxygen decreases
7.	Hemoglobin fulfils the following	1. a transport of oxygen from the lung to the tissues

	functions:	2. a transport of oxygen inside the cell to the mitochondria 3. an accumulation of oxygen in the tissue 4. a transport of CO_2 from the tissue to the lung 5. a maintenance of pH of blood (buffer function) 6. a formation of tissue pigments
8.	β-globulins contain the following proteins:	1. transferrin 4. albumins 2. hemopexin 5. immunoglobulins 3. Low density lipoproteins (LDL)
9.	On a deoxygenated state the iron ion of heme is situated	1. in the plane of a heme ring 2. 0.06 nm over the plane of a heme ring 3. in any point of a hemoglobin molecule 4. none of the above
10.	On oxygenated state the iron ion of heme is situated	1. in the plane of a heme ring 2. 0.06 nm over the plane of a heme ring 3. in any point of a hemoglobin molecule 4. none of the above

C A R D № 3

№ №	QUESTIONS	ANSWERS
1.	The ability of hemoglobin to bind oxygen depends on the following factors	1. pH 4. concentration of ATP 2. temperature 5. concentration of ADP 3. pO_2 6. pCO_2
2.	The transport of CO_2 from the tissues to the lung is carried out by	1. solubilization of CO_2 in blood plasma 2. temporary formation of carbohemoglobin 3. temporary formation of a complex compound with plasma albumin 4. temporary formation of blood plasma bicarbonates 5. temporary formation of a complex compound with transferrin
3.	Hyperproteinemia is developed as a result of	1. diarrhea (a loss of water through the intestine) 2. cirrosis of the liver 3. burn of the body (a loss of water through the skin) 4. vomitting (a loss of water with gastric juice)
4.	Which of the following blood plasma proteins are mainly synthesized in the liver?	1. Albumins 4. β-globulins 2. α_1-globulins 5. γ-globulins 3. α_2-globulins
5.	Which of the following blood plasma proteins are synthesized in the spleen and lymphoid tissue?	1. Albumins 4. β-globulins 2. α_1-globulins 5. γ-globulins 3. α_2-globulins
6.	Which of the following disturbances occur in thalassemia?	1. The synthesis of α or β chains of a hemoglobin molecule is affected 2. A cooperativity of an oxyen binding is dissappeared 3. A total blood hemoglobin concentration decreases 4. A solubility of hemoglobin decreases
7.	Which of the following subtances are used for heme synthesis?	1. alanine 3. acetyl CoA 2. glycine 4. succinyl CoA 3. valine 5. acetoacetyl CoA
8.	The main function of ceruloplasmin is:	1. a transport of Fe^{2+} ions 2. a transport of Cu^{2+} ions 3. a transport of Zn^{2+} ions 4. a transport of Mg^{2+} ions

9.	The main function of transferrin is:	1. a transport of Fe^{2+} ions 2. a transport of Cu^{2+} ions 3. a transport of Zn^{2+} ions 4. a transport of Mg^{2+} ions
10.	Haptoglobin is a blood plasma protein responsible to a transport of:	1. free heme 3. free hemoglobin 2. free bilirubin 4. free Fe^{2+} ions

C A R D № 4

№ №	QUESTIONS	ANSWERS
1.	The phenomenon of *disproteinemia* is	1. an appearance of abnormal proteins in blood 2. an increase of the blood protein concentration 3. a disturbance of the normal ratio between blood plama proteins 4. a decrease of the blood protein concentration
2.	Choose the abnormal fragment of a β-chain in the structure of HbS	1. val-his-leu-tre-pro-val-glu-lys 2. val-his-leu-tre-pro-glu-glu-lys 3. val-his-leu-ala-pro-glu-glu-lys 4. val-his-leu-tyr -pro-glu -glu-lys
3.	What kinds of hemoglobins are contained in the human erythrocytes?	1. Hb A_1 4. HbF 2. Hb A_2 5. HbC 3. HbL 6. HbN
4.	In the synthesis of heme succinyl CoA interacts with glycine and is transformed into	1. γ-aminobutyrate 4. oxaloacetate 2. acetoacetate 5. β-aminopropionate 3. δ-aminolevulinate 6. α-oxibutyrate
5.	A central cavity of deoxygenated hemoglobin contains	1. CO_2 3. 2,3-diphosphoglycerate 2. bicarbonate 4. Cl^- anion
6.	The maintaining of the osmotic pressue of blood is carried out by	1. Na^+ cathions 3. albumins 2. Cl^- anions 4. blood concentration of cyclic nucleotides
7.	Hemoglobin fulfils the following functions:	1. a transport of oxygen from the lung to the tissues 2. a transport of oxygen inside the cell to the mitochondria 3. an accumulation of oxygen in the tissue 4. a transport of CO_2 from the tissue to the lung 5. a maintenance of pH of blood (buffer function) 6. a formation of tissue pigments
8.	The ability of hemoglobin to bind oxygen depends on the following factors	1. pH 4. concentration of ATP 2. temperature 5. concentration of ADP 3. pO_2 6. pCO_2
9.	Which of the following blood plasma proteins are mainly synthesized in the liver?	1. Albumins 4. β-globulins 2. α_1-globulins 5. γ-globulins 3. α_2-globulins
10.	Which of the following blood plasma proteins are synthesized in the spleen and lymphoid tissue?	1. Albumins 4. β-globulins 2. α_1-globulins 5. γ-globulins 3. α_2-globulins

C A R D № 5

№ №	QUESTIONS	ANSWERS
1.	Which of the following substances belong to the class of heme proteins?	1. Myoglobin 4. Transferrin 2. Cytochromes 5. Hemoglobin 3. Catalase 6. Peroxidase
2.	The dependecy between the extent of a hemoglobin saturation and pO_2 is graphically characterized by a	1. hyperbola 4. right line 2. S-like curve 3. parabola
3.	Which of the following oligomeric	1. $\alpha_2\gamma_2$ 3. $\beta_2\gamma_2$

	combinations is characteristic for the fetal hemoglobin?	2. $\alpha_2\beta_2$ 4. $\alpha_2\alpha_2$
4.	The fraction of α_1-globulins contains the following proteins:	1. ceruloplasmin 4. thyroxin-binding protein 2. haptoglobin 5. transcortin 3. antitrypsin 6. transferrin
5.	On a deoxygenated state the iron ion of heme is situated	1. in the plane of a heme ring 2. 0.06 nm over the plane of a heme ring 3. in any point of a hemoglobin molecule 4. none of the above
6.	The ability of hemoglobin to bind oxygen depends on the following factors	1. pH 4. concentration of ATP 2. temperature 5. concentration of ADP 3. pO_2 6. pCO_2
7.	Hyperproteinemia is developed as a result of	1. diarrhea (a loss of water through the intestine) 2. cirrosis of the liver 3. burn of the body (a loss of water through the skin) 4. vomitting (a loss of water with gastric juice)
8.	Which of the following blood plasma proteins are mainly synthesized in the liver?	1. Albumins 4. β-globulins 2. α_1-globulins 5. γ-globulins 3. α_2-globulins
9.	Which of the following blood plasma proteins are synthesized in the spleen and lymphoid tissue?	1. Albumins 4. β-globulins 2. α_1-globulins 5. γ-globulins 3. α_2-globulins
10.	The main function of ceruloplasmin is:	1. a transport of Fe^{2+} ions 2. a transport of Cu^{2+} ions 3. a transport of Zn^{2+} ions 4. a transport of Mg^{2+} ions

Test 2. "Biochemistry of the liver"

C A R D № 1

№ №	QUESTIONS	ANSWERS
1.	Which of the following functions are carried out by the liver?	1. Homeostatic 4. Excretory 2. Digestive 5. Antitoxic 3. Storage 6. Contractive
2.	Bilirubin glucuronide is marked as	1. conjugated bilirubin 4. hemobilirubin 2. "direct" bilirubin 5. choleic bilirubin 3. "indirect" bilirubin 6. unconjugated bilirubin
3.	The maximal blood total bilirubin level of healthy adult people is	1. 20.5 mM/L 4. 42.5 mM/L 2. 42.5 microM/L 5. 20.5 microM/L 3. 5.5 microM/L 6. 5.5 mM/L
4.	Determine the type of a jaundice in the patient who has the following results of the analysis: -total blood bilirubin---80 microM/L, -"direct"/"indirect" ratio-----1:3, -"di"/"mono" ratio------1:10, -bilirubin glucuronyltransferase activity in blood --------decreased -urine bilirubin----------present, -urine urobilinogen-------present -fecal stercobilinogen----traces	1. hepatic (hepatocellular) 2. prehepatic (hemolytic) 3. posthepatic (obstructive)
5.	Choose the metabolic pathways which belong to homeostatic function of the liver in carbohydrate metabolism.	1. Synthesis and mobilization of glycogen 2. Gluconeogenesis 3. Synthesis of bile acids 4. Synthesis of urea 5. Glucose-lactate cycle

6.	The rapid toxic effects of the endogenous toxins and xenobiotics are the following:	1. Mutagenic effect 4.Tumorigenic effect 2. Inhibition of enzymes 5. Alteration of pH 3. Effect of denaturation 6. Blocking of the cell Receptors
7.	Choose the examples of a non-microsomal oxidation of toxic substances	1. Oxidation of biogenic amines by MAO and DAO 2. Hydroxylation of xenobiotics 3. Decomposition of hydrogen peroxide with catalase and peroxidase 4. Syntesis of bilirubin diglucuronide
8.	The oxidation of ethanol with alcohol dehydrogenase leads to the formation of	1. acetyl CoA 4. $NADH_2$ 2. acetaldehyde 5. pyruvate 3. free acetate 6. $NADPH_2$
9.	Bilirubin formed in the reticulo-endothelial system (RES) and entered the blood is called	1. bilirubin glucuronide 6. hemobilirubin 2. bilirubine-albumine 7. conjugated bilirubin 3. choleic bilirubin 8. unconjugated bilirubin 4. "direct" bilirubin 9. biliverdin 5. "indirect" bilirubin 10. verdoglobin
10.	The sequence of the chemical transformations of bilirubin in the intestine is the following:	1. bilirubin→ stercobilinogen→ mesobilinogen →mesobilirubin 2. bilirubin→ mesobilinogen→ mesobilirubin → stercobilinogen 3. bilirubin→ mesobilirubin→ mesobilinogen → stercobilinogen 4. bilirubin→ mesobilinogen→ stercobilinogen → mesobilirubin

C A R D № 2

№ №	QUESTIONS	ANSWERS
1.	Which of the following substances are excreted by the liver?	1. sterols 4. urea 2. bile acids 5. uric acid 3. bile pigments 6. some of xenobiotics
2.	Which of the following reactions are catalyzed by bilirubin glucuronyltransferase?	1. Bilirubin + UDP-glucuronate→Bilirubine monoglucuronide + UDP 2. Bilirubine monoglucuronide + UDP-glucuronate→Bilirubin diglucuronide +UDP 3. Bilirubin + glucuronate→Bilirubine monoglucuronide 4. Bilirubine monoglucuronide + glucuronate→Bilirubin diglucuronide
3.	The normal value of the ratio "direct":"indirect" bilirubin in blood is approximately	1. 1:10 4. 1:3 2. 1:1 5. 4:1 3. 10:1 6. 5:1
4.	Determine the type of a jaundice in the patient who has the following results of the analysis: -total blood bilirubin---80 microM/L, -"direct"/"indirect" ratio-----3:1, -"di"/"mono" ratio------4:1, -bilirubin glucuronyltransferase activity in blood --------normal -urine bilirubin----------present, -urine urobilinogen-------absent -urine stercobilinogen----absent -fecal stercobilinogen----absent	1. hepatic (hepatocellular) 2. prehepatic (hemolytic) 3. posthepatic (obstructive)
5.	Choose the metabolic pathways which belong to homeostatic function of the	1. Gluconeogenesis 2. Synthesis of non-essential fatty acids

	liver in lipid metabolism.	3. Synthesis of ketone bodies 4. Synthesis of cholesterol 5. Synthesis of bile acids 6. Pentose cycle
6.	The slow toxic effects of the endogenous toxins and xenobiotics are the following:	1. Mutagenic effect 5. Tumorigenic effect 2. Inhibition of enzymes 6. Alteration of pH 3. Effect of denaturation 7. Blocking of the 4. Teratogenic cell receptors
7.	Which of the following reactions is marked as *conjugation*?	1. Attachment of oxygen to a toxic substance 2. Attachment of protons and electrons to a toxic substance 3. Binding of one or several molecules of endogenous hydrophylic residues to a toxic substance 4. Any reactions of a synthesis
8.	Ethanol can be oxidized by	1. alcoholdehydrogenase way only 2. catalase way only 3. microsomal oxidation olnly 4. all three above presented ways 5. non above presented ways
9.	The chemical transformations of bilirubin in the bile excretory system and in the intestine procceed with	1. the digestive enzymes 2. the bacterial enzymes 3. the both digestive and bacterial enzymes 4. a non ezymatic mechanism
10.	Which of the following components are involved into a microsomal respiratory chain?	1. Cyctochrome a_3 5. Flavoprotein 2. $NADH_2$ 6. Cytochrome c_1 3. $NADPH_2$ 4. Cytochrome P_{450}

C A R D № 3

№ №	QUESTIONS	ANSWERS
1.	The verdoglobin formation reaction	1. is catalyzed by heme oxygenase 2. requires FADH2 and O2 3. requires NADPH2 and O2 4 requires NADH2 and O2 5. leads to formation of CO2 6. leads to formation of CO
2.	Conjugated bilirubin formed in the hepatocites is secreted into	1. the blood capillaries 2. the bile capillaries 3. lymphatic capillaries
3.	Jaundices are classified into	1. prehepatic 4. malignant 2. posthepatic 5. hepatic 3. iInflammatory 6. inherited
4.	Choose the metabolic pathways which belong to homeostatic function of the liver in protein metabolism.	1. Synthesis of non-essential fatty acids 2. Synthesis of non essential amino acids 3. Synthesis of bile acids 4. Synthesis of urea 5. synthesis of blood plasma proteins 6. Gluconeogenesis
5.	The conjugation of bilirubin in the liver requires which of the following substances?	1. S-adenosyl methionine 2. 3'-phosphoadenosine-5'-phosphosulfate 3. UDP-glucuronate 4. HS-CoA 5. Glutathione-SH
6.	What the hepatocyte compartments do the oxidative transformations of toxic substances proceed in?	1. Lysosomes 2. Mitochondria 3. Endoplasmic reticulum

		4. Peroxisomes 5. Cytosol 6. Plasmatic membrane
7.	The reaction: R-OH + UDP-glucuronate→ →R-O-glucurunate + UDP is marked as	1. microsomal oxidation 2. non-microsomal oxidation 3. conjugation 4. microsomal reduction
8.	Which of the following endogenous biologically active substances can be detoxified in the liver?	1. Caffeine 5. Neurotransmitters 2. Metanol 6. Strong oxidizig agents 3. Steroid hormones 7. Vitamin D 4. Bilirubin 8. Free ammonia
9.	Stercobilinogen undegoes to a partial reabsorption in the	1. stomach 2. proximal portion of the small intestine 3. distal portion of the small intestine 4. proximal portion of the large intestine 5. distal portion of the large intestine 6. gallbladder
10.	The sequence of the chemical transformations of bilirubin in the intestine is the following:	1. bilirubin→ stercobilinogen→ mesobilinogen →mesobilirubin 2. bilirubin→ mesobilinogen→ mesobilirubin → stercobilinogen 3. bilirubin→ mesobilirubin→ mesobilinogen → stercobilinogen 4. bilirubin→ mesobilinogen→ stercobilinogen → mesobilirubin

C A R D № 4

№ №	QUESTIONS	ANSWERS
1.	What is the colour of verdoglobin and biliverdin?	1. Red 3. Green 2. Yellow 4. Light brown
2.	Bilirubin glucuronide is marked as	1. conjugated bilirubin 4. hemobilirubin 2. "direct" bilirubin 5. choleic bilirubin 3. "indirect" bilirubin 6. unconjugated bilirubin
3.	What is the colour of bilirubin?	1. Red 3. Green 2. Blue 4. Light brown
4.	Bilirubin formed in the reticulo-endothelial system (RES) and entered the blood is called	1. bilirubin glucuronide 6. hemobilirubin 2. bilirubine-albumine 7. conjugated bilirubin 3. choleic bilirubin 8. unconjugated bilirubin 4. "direct" bilirubin 9. biliverdin 5. "indirect" bilirubin 10. verdoglobin
5.	Mesobilinogen undegoes to a partial reabsorption in the	1. stomach 2. small intestine 3. large intestine 4. gallbladder
6.	Which of the following components are involved into a microsomal respiratory chain?	1. Cyctochrome a_3 5. Flavoprotein 2. $NADH_2$ 6. Cytochrome c_1 3. $NADPH_2$ 4. Cytochrome P_{450}
7.	The reaction: R-OH + PAPS→R-OSO_3H +PAP is marked as	1. glucuronate conjugation 2. sulfate conjugation 3. thiolytic break down 4. glutation conjugation
8.	A process of a detoxication of toxic substances in the liver includes which of the following two phases?	1. Oxidation, reduction or hydrolysis + conjugation with hydrophylic substances 2. Oxidation, reduction or hydrolysis + conjugation with hydrophobic substances

		3. Oxidation, reduction or hydrolysis + polymerization of the products and their excretion with bile 4. Oxidation, reduction or hydrolysis + conjugation with hydrophylic or hydrophobic substances
9.	Which of the following substances are excreted by the liver?	1. sterols 4. urea 2. bile acids 5. uric acid 3. bile pigments 6. some of xenobiotics
10.	Conjugated bilirubin formed in the hepatocites is secreted into	1. the blood capillaries 2. the bile capillaries 3. lymphatic capillaries

C A R D № 5

№ №	QUESTIONS	ANSWERS
1.	Bilirubin formed in the reticulo-endothelial system (RES) and entered the blood is called	1. bilirubin glucuronide 6. hemobilirubin 2. bilirubine-albumine 7. conjugated bilirubin 3. choleic bilirubin 8. unconjugated bilirubin 4. "direct" bilirubin 9. biliverdin 5. "indirect" bilirubin 10. verdoglobin
2.	The sequence of the chemical transformations of bilirubin in the intestine is the following:	1. bilirubin→ stercobilinogen→ mesobilinogen →mesobilirubin 2. bilirubin→ mesobilinogen→ mesobilirubin → stercobilinogen 3. bilirubin→ mesobilirubin→ mesobilinogen → stercobilinogen 4. bilirubin→ mesobilinogen→ stercobilinogen → mesobilirubin
3.	Determine the type of a jaundice in the patient who has the following results of the analysis: -total blood bilirubin---80 microM/L, -"direct"/"indirect" ratio-----1:10, -"di"/"mono" ratio------3:1 -urine bilirubin----------absent, -urine urobilinogen-------absent -urine stercobilinogen----present -fecal stercobilinogen----present	1. hepatic (hepatocellular) 2. prehepatic (hemolytic) 3. posthepatic (obstructive)
4.	Stercobilinogen undegoes to a partial reabsorption in the	1. stomach 2. proximal portion of the small intestine 3. distal portion of the small intestine 4. proximal portion of the large intestine 5. distal portion of the large intestine 6. gallbladder
5.	Which of the following functions belong to a microsomal respiratory chain?	1. Oxidative phosphorylation 2. Hydroxylation of steroid hormones 3. Oxidation of drugs 4. Oxidation endogenous toxic substances 5. Oxidation of xenobiotics 6. Generation of a proton membrane potential
6.	A reductase microsomal chain consists of	1. $NADPH_2$, flavoprotein, cytochrome b_5, cytochrome a_3 2. $NADPH_2$, flavoprotein, cytochrome b_5, cytochrome P_{450} 3. $NADH_2$, flavoprotein, cytochrome b_5, cytochrome P_{450} 4. $NADPH_2$, flavoprotein, cytochrome b_5,

		cytochrome c
7.	The reaction: R-OH + CH_3-COS-CoA→ →R-O-$COCH_3$ + HS-CoA is marked as	1. glucuronate conjugation 2. sulfate conjugation 3. acetyl conjugation 4. glutation conjugation
8.	Which of the following substances are xenobiotics?	1. Caffeine 2. Alcohols 3. Residual pesticides of food 4. Food carbohydrates 5. Dioxines
9.	Which of the following functions are carried out by the liver?	1. Homeostatic 4. Excretory 2. Digestive 5. Antitoxic 3. Storage 6. Contractive
10.	The maximal blood total bilirubin level of health adult people is	1. 20.5 mM/L 4. 42.5 mM/L 2. 42.5 microM/L 5. 20.5 microM/L 3. 5.5 microM/L 6. 5.5 mM/L

4.2. Control work for the assessment of competence " GPC-1, GPC-2"

Control work 1. "STRUCTURE AND PROPERTIES OF PROTEINS".

1. Proteins as the class of organic compounds and a structural-functional component of the body. A variety of proteins and their functions.
2. Amino acids as structural units of a protein molecule, their structures, classification, nomenclature. Essential and non-essential amino acids.
3. A peptide theory of a protein structure. Proteins - genetically determined polymers. Levels of the protein structural organization. The protein primary structure and its informational role.
4. Secondary and tertiary structures: formation, types of bonds involved in their formation, kinds.
5. A quaternary structure of proteins. Protomer conformation cooperative changes. Examples of the oligomeric proteins structure and function: hemoglobin, allosteric enzymes. Supramolecular protein complexes, their composition, biological significance.
6. Chaperones - a class of proteins that protect other proteins from denaturation under cellular conditions and facilitate the formation of their native conformation. Denaturation of proteins, the reversibility of denaturation. Protein folding.
7. Proteomics as a new direction in the study of the proteins structure and functional characteristics.
8. Biological functions of proteins. A protein selective interaction with ligands as a basis for performing their functions. Types of natural ligands, especially their interaction with proteins. Drugs as ligands.

Control work 2. "ENZYMES, THEIR STRUCTURE. SPECIFICITY OF ENZYME ACTION ".

1. The definition of the term "enzymes". The main differences of enzymes from inorganic catalysts.
2. The active centre of an enzyme. Its structure. Sites of the active centre. Amino-acids included in the active centre.
3. Theories of substrate-enzyme interaction (Fisher, Koshland).
4. Specificity of the enzyme action. Kinds of specificity. The importance of this property for metabolism.
5. Nomenclature and classification of enzymes. Description of each class.
6. Units of the enzyme activity: katal and international units (IU). The principles of the quantitative determination of the enzyme activity.
7. The concept of multienzyme complexes and multifunctional enzymes.
8. Application of enzymes in medicine.

Control work 3. "ENZYMES. VITAMINS AS PARTICIPANTS OF ENZYMATIC REACTIONS".

1. Classification and nomenclature of vitamins. Biological functions of vitamins. Lipid-soluble and water-soluble vitamins.

2. Chemical structure of liposoluble vitamins: vitamins A, D, E, K, F and their biological role.

3. Cofactors and coenzymes. Cofactor functions of vitamins.

4. Metalloenzymes and enzymes activated by metals. Water-soluble vitamins (thiamine, riboflavin, nicotinamide, pyridoxine, pantothenic acid, cobalamins, folic acid, biotin), as precursors of coenzymes. Pro-vitamins, active forms of vitamins A and D.

5. Hypovitaminosis and hypervitaminosis, pathological manifestations of these states.

6. Vitamin-like substances, the concept of antivitamins.

7. Participation of vitamins in metabolism.

8. Vitamins as drugs.

Control work 4. "REGULATION OF ENZYME ACTIVITY".

1. Kinetics of enzymatic reactions. The Michaelis-Menten equation and graph. The Lineweaver-Burk transformation.

2. Ways of regulation of enzyme activity, specific and non-specific regulation. The dependence of enzyme activity on substrate concentration, enzyme concentration, temperature and pH.

3. Enzyme inhibitors: reversible and irreversible, competitive and noncompetitive. Medications which are enzyme inhibitors.

4. Allosteric enzymes, their structure. Regulation of the allosteric enzymes action: allosteric inhibitors and activators. Cooperative conformational changes of protomers.

5. Chemical modification of enzymes: phosphorylation and dephosphorylation. Regulation of enzyme activity by partial proteolysis. Examples. Feedback inhibition.

6. Isoenzymes. Organ-specific enzymes. Enzymodiagnostics and enzyme therapy. Protein inhibitors of enzymes. Enzyme inhibitors as drugs. Hereditary enzymopathies.

Control work 5. "ENERGY METABOLISM. TRICARBOXYLIC ACID CYCLE. DISORDERS OF ENERGY METABOLISM".

1. The significance of the Krebs cycle to the metabolic processes in the body.

2. Reaction of the acetyl-CoA entry to the Krebs cycle. Enzymes, the role of acetyl-CoA and oxaloacetate in the regulation of this process.

3. The importance of NADH formation in the citric acid cycle. The reaction; call the enzymes and vitamins, included in the cofactors structure.

4. The decarboxylation reaction in the Krebs cycle. Enzymes, their regulation. Name cofactors and vitamins.

5. Role of the succinate oxidation in the Krebs cycle. The reaction. Enzyme, cofactor and vitamin included in its structure. Regulation of the enzyme activity.

6. The rate-limiting reaction of the Krebs cycle. Effectors regulating this reaction.

7. Substrate level phosphorylation in the Krebs cycle. Give a definition, write a reaction, and call an enzyme. Explain the mechanism of substrate phosphorylation.

8. Oxidative decarboxylation of the pyruvic acid. The structure of the pyruvate dehydrogenase complex. The significance of this process and its regulation.

9. Energy effect of the pyruvate and acetyl-CoA oxidation in the cycle.

Control work 6. " BIOLOGICAL OXIDATION. OXIDATIVE PHOSPHORYLATION. MITOCHONDRIAL DISEASES".

1. Modern concept of biological oxidation. Characterization of oxidoreductases involved in this process. Mitochondria as the center of the tissue respiration, their role in the regulation of cell metabolism.

2. Tissue respiration and its value.

3. Redox potential as a factor determining the movement of electrons along the respiratory chain and energy production.

4. Distribute the following redox couples ascending the redox potential: NAD+ / NADH, cyt. c Fe3+ / Fe2 +, KoQ / KoQH2, FMN+ / FMNH2, cyt. a Fe3+ / Fe2+, fumarate / succinate.

5. Assign the following redox couples from the decrease of the redox potential: NAD+ / NADH, cyt. c Fe3+ / Fe2 +, KoQ / KoQH2, FMN+ / FMNH2, cyt. a Fe3 + / Fe2 +, fumarate / succinate.

6. Structural organization of the mitochondrial respiratory chain, the names of enzyme complexes, localization in mitochondria. Paths of the electrons in the respiratory chain.

7. List the compounds in the order in which they are involved in the transfer of isocitrate ē on O2 in the respiratory chain. Choose from the list: NAD+, FMN+, FAD+, H+-ATP synthase, ubiquinone, oxygen, and cytochromes a, a3, b, c, c1.

8. Dehydrogenase of mitochondrial respiratory chain. The structure of the oxidized and reduced forms of FAD+ (FMN). The major substrates of flavin dehydrogenases.

9. Flavinic (FMN- and FAD-containing) dehydrogenase. The origin of the substrates of these enzymes. The structure of the oxidized and reduced forms of FMN.

10. Structure of ubiquinone and its role in the respiratory chain.

11. Structure and catalytic function of the heme-containing enzyme complexes of the respiratory chain. Energy value.

12. Regulation of electron transport in the respiratory chain: the conditions required for electron transport, inhibitors of enzymes of the tissue respiration.

13. Relationship between the Krebs cycle and the transport chain of electrons and protons. Physiological regulation of the transport of electrons and protons in the respiratory chain.

14. Definition of the oxidative phosphorylation. A modern concept of the mechanism of the oxidative phosphorylation.

15. H+-ATP synthase, structure, reaction performing. Conditions necessary for the synthesis of ATP.

16. Regulation of oxidative phosphorylation. Uncoupling of the tissue respiration and oxidative phosphorylation, examples of uncouplers. Thermoregulatory function of the energy metabolism in the brown adipose tissue.

17. Concept of energy-rich compounds of the body. Structure, energy characteristics, the way of ATP formation and use.

18. Disorders of energy metabolism. The concept of mitochondrial diseases.

Control work 7 "Biochemistry of hormones".

Card 1.

1. General concept of hormones. Synthesis and transport of hormones. characteristics of the receptors. Hormone inactivation.

Card 2.

1. Classification of hormones by chemical nature. Give examples.

Card 3.

1. Intracellular mechanism of action of hormones. Characterization of receptors, properties and examples of the corresponding hormones. hormonal effect.

Card 4.

1. Membrane mechanism of action of hormones, its cascading. hormonal effect. The role of cyclic nucleotides in the mechanism of hormonal regulation. Give an example of the corresponding hormone.

Card 5.

1. Membrane mechanism of action of hormones, its cascading. hormonal effect. The role of calcium ions, diacylglycerol and inositol triphosphate in the mechanism of hormonal regulation. Give an example of the corresponding hormone.

Card 6.

1. The main systems of intercellular communication are endocrine, paracrine and autocrine. Examples of hormones

Card 7.

1. Hierarchy of action of hormones. An example of a hierarchy of regulation.

Card 8.

1. Insulin receptor and insulin mechanism of action. Functions in the body and pathologies associated with them.

Control work 8. "DIGESTION OF PROTEINS".

1. Protein digestion in the stomach. Characterization of enzymes, their activation.
2. Enzymes of the pancreatic juice. Ways of their activation.
3. Exo- and endo- peptidases.
4. Role of the hydrochloric acid in the digestion of proteins.
5. Indicators of gastric acidity. Pathology.

Control work 9. "TISSUE TRANSFORMATION OF AMINO ACIDS".

1. With an aspartic acid, get alanine by transamination, write a reaction involving a cofactor. Characterize the enzyme, cofactor, determine its connection with vitamin. the significance of the determination of the enzyme in clinic practice.
2. Characteristics of the process of amino acids oxidative deamination. oxidases peculiarities. The chemistry of oxidative deamination of the glutamic acid. Characteristics of the glutamate dehydrogenase.
3. Decarboxylation of amino acids in animal tissues. Name and characteristics of the enzyme. The products of decarboxylation. Write the reactions of histamine, serotonin and gamma aminobutyric acid /GABA/ formation and indicate their role in the regulation of functions. The role of MAO and DAO in the inactivation of biogenic amines.
4. Characterization of the indirect deamination (transdeamination), it difference from the direct deamination. Chemistry of reactions of indirect deamination. The biological significance of the process. Participation of enzymes and their cofactors.
5. Biologically active compounds, which are formed in the metabolism of tyrosine and their physiological function. Write chemistry reactions of catecholamines formation from tyrosine.
6. Tyrosine interstitial catabolism in the liver. The sequence of reactions, enzymes, intermediates and final products. Metabolic abnormalities in the process of degradation and their clinical manifestations.
7. Hereditary enzymopathies of phenylalanine and tyrosine metabolism (metabolic defect and major clinical manifestations). Reactions that can be blocked. Enzymes that catalyze these reactions. Write their chemistry.

Control work 10. "END PRODUCTS OF PROTEIN METABOLISM".

1. The sources of nitrogen in the urea. The normal content of urea in blood, normal and daily excretion with urine.
2. Glucose-alanine cycle. The biological significance.
3. Participation of glutamic and aspartic acids in reactions of ammonia temporary neutralization in the cell. Products and their fate.
4. Content of the index "residual nitrogen of blood," components` origin. The significance of determination of residual nitrogen in the clinical practice. The reasons of azotemia.
5. The urea synthesis reactions with energy consumption. Enzymopathies, their clinical manifestations.
6. Reactions of creatine and phosphocreatine synthesis. Enzymes. In which organs synthesis occurs. The biological significance of creatine and phosphocreatine.
7. The final products of the decomposition of ammonia in the body. Hyperammonemia. Violations of the processes of synthesis and excretion of urea as the main cause for various types of hyperammonemia.

Control work 11. "Nucleotide metabolism".

1. Digestion of nucleoproteins in the gastrointestinal tract. Enzymes and transformation products. Absorption of the degradation products.
2. The formation of 5-phosphoribosyl 1-pyrophosphate, it’s role.
3. Compounds which are sources of nitrogen and carbon in the synthesis of purine and pyrimidine rings.
4. Ways of reutilization of adenine and guanine in the biosynthesis of nucleotides, peculiarities of the biosynthesis of deoxyribonucleotides.
5. Degradation of nucleic acids. Degradation of purine nucleotides and nucleosides. The chemistry of the conversion of adenine and guanine. Enzymes and final products. Violations of purine metabolism.

6. Degradation of the pyrimidine nucleotides and nucleosides. Chemistry of cytosine and uracil reactions. Enzymes and final products.

7. General characteristics of nucleic acids, the chemical composition. Differences between DNA and RNA. The structure of a nucleoside, nucleotide.

8. Structure and stages of a spatial organization of DNA.

9. Structural organization of DNA in chromosomes. Characteristic of the protein component, the DNA-proteins.

10. Primary, secondary, tertiary structure of RNA. RNA kinds.

11. DNA biosynthesis. Characteristic of the replication process. Reparation. Enzymes that ensure these processes.

12. Transcription (RNA synthesis). The redundancy of the DNA genome (introns, exons). Post-transcriptional processing.

13. Sequence of nucleotides in a polynucleotide chain as a method of information recording. DNA as a source of genetic information in the cell.

14. Characterization of the genetic code and its properties.

15. Characteristics of a DNA genome. The concept of the gene.

16. General idea of the theory of the matrix protein synthesis.

17. Translation.

18. Regulation of protein biosynthesis. The theory of Jacob and Monod.

19. Antibiotics as inhibitors of protein synthesis.

20. Object and purpose of genomics and proteomics.

21. Principles and methods of gene therapy and genetic engineering.

Control work 12. "MAIN CARBOHYDRATES OF THE BODY. SYNTHESIS AND DESTRUCTION OF GLYCOGEN"

Card 1 Common character of carbohydrates. Their classification and structure.

Card 2 Basic dietary carbohydrates. Digestion and absorption of carbohydrates.

Card 3 The role of liver in blood glucose level maintaining.

Card 4 The glycogen synthesis in the liver. The energy and enzyme provision of the process. Regulation.

Card 5 The ways of a glycogen mobilization: amylolytic and phosphorolytic. Regulation of glycogen decomposition.

Card 6 The glycogen synthesis in liver. The energy and enzyme provision of the process.

Card 7 Proteoglycans and glycoproteins. Glucosaminoglycans. Classification. The principle structure of a glucosaminoglycan monomer.

Control work 13. “Glycolysis. Pentosephosphat pathway”

Card 1.

1. Write the reaction, catalyzed by glucose 6-phosphate dehydrogenase. The role of NAPH2 formation.

2. Write the reactions of the first phase of glycolysis, call the substrates, enzymes and products of these reactions. Regulation.

Card 2.

1. Write the reaction, catalyzed by 6-phosphogluconate dehydrogenase. The role of NAPH2 formation.

2. Glucose 6-phosphate as the main metabolite of the carbohydrate metabolism. It's formation and utilization.

Card 3

1. Write the reaction, catalyzed by lactonase. The role of pentoses formation.

2. Glycolytic oxidoreduction, the metabolic role of this process.

Card 4

1. Write the reactions of the ribulose 5-phosphate transformation into other pentoses. The role of pentoses formation.

2. Substrate level phosphorylation of the glycolysis. The energy effect of the anaerobic glycolysis and glycogenolysis.

Card 5

1. Non-oxidative stage of the pentose phosphate pathway (without formulas). The role of the pentose phosphate pathway.

2. The formation of the hexose phosphoesters in the glycogenolysis. Write the substrates, enzymes and the products of those reactions.

Card 6

1. Write the reactions of the formation of NADPH2 The role of NAPH2 formation.

2. The energy effect of glucose oxidation to carbon dioxide and water.

Card 7

1. Write the reaction, catalyzed by 6-phosphogluconate dehydrogenase. The role of NAPH2 formation.

2. The formation of the end product in the aerobic and anaerobic glycolysis, write the reactions. Lactate as the end metabolite. The regulation of the lactate dehydrogenase.

Control work 14. "GLUCONEOGENESIS. REGULATION OF CARBOHYDRATE METABOLISM"

Card 1.

1. Write the reaction of formation of oxaloacetate from pyruvate. Regulation.

2. The role of the liver in maintaining a blood glucose level

Card 2.

1. Write the reactions, catalyzed by mitochondrial and cytoplasmic malate dehydrogenase.

2. The role of the nervous system in the regulation of a blood glucose level.

Card 3.

1. Write the reaction of the fructose 6-phosphate formation in gluconeogenesis. Its regulation with insulin and glucagon.

2. The hormone regulation of a blood glucose level. The role of cyclic AMP.

Card 4.

1. Write the reaction of transformation fructose 1,6-diphosphate into fructose-6 phosphate. Regulation of this reaction.

2. Participation of epinephrine and glucagon in the regulation of carbohydrate metabolism. Role of fructose-2,6-diphosphate in transduction of hormones signal.

Card 5.

1. Pyruvate carboxylase reaction in the gluconeogeneis.

2. The influence of glucocorticoids on carbohydrate metabolism.

Card 6.

1. Write the reaction of the fructose 6-phosphate formation in gluconeogenesis. Its regulation by fructose 2,6-bisphosphate.

2. The role of insulin in maintaining a blood glucose level. The insulin receptor structure. Insulinresistance.

Card 7.

1. Write the reactions of the formation of phosphoenolpyruvate from pyruvate.

2. The influence of ATP and ADP concentration on the main pathways of carbohydrate metabolism.

Card 8.

1. Write the reactions, catalyzed by mitochondrial and cytoplasmic malate dehydrogenase.

2. Disorders of carbohydrate metabolism (starvation, diabetes mellitus, glycogen storage diseases).

Card 9.

1. Write the reaction of the fructose 6-phosphate formation in gluconeogenesis. Its regulation by fructose 2,6-bisphosphate.

2. A sugar tolerance. The method of investigation of a sugar tolerance for revealing the disorders of carbohydrate metabolism.

Control work 15. “MAIN LIPIDS OF THE BODY. LIPID DIGESTION.”

Card 1.

1. The main lipids of the body. Classification of lipids. Structure of triacylglycerols, glycerophospholipids (phosphatidylcholine, phosphatidylserine, phosphatidylethanolamine).

2. VLDL. Their role in the fat and cholesterol metabolism.

Card 2.

1. Dietary lipids, their digestion. Role of bile acids in lipid digestion in the intestine. Lipid absorption in the intestine, factors affecting the absorption; feces lipids, steatorrhea.

2. LDL. Their role in the fat and cholesterol metabolism.

Card 3.

1. Resynthesis of neutral fat in enterocytes. Formation of chylomicrons.

2. Free fatty acids. The significance of polyunsaturated fatty acids. Eicosanoids.

Card 4.

1. The biological function of lipids.

2. The transport blood lipoproteins, specificity of their structure, composition, and function.

Card 5.

1. The structure and function of sphingolipids and sterane derivatives.

2. CM. Their role in the fat and cholesterol metabolism.

Card 6.

1. Role of bile acids in lipid digestion in the intestine. Lipid absorption in the intestine, factors affecting the absorption; feces lipids, steatorrhea.

2. HDL. Their role in the fat and cholesterol metabolism.

Control work 16. «Lipid catabolism»

1. Lipolysis. The hormonal control of this process.

2. Glycerol oxidation to glyceralaldehyde-3-phosphate. ATP yield from glycerol oxidation to carbon dioxide and water.

3. Oxidation of fatty acids. The role of carnitine. The pathway of β-oxidation, the reaction equations, the stoichiometry of β-oxidation, the net ATP yield.

4. Biosynthesis of ketone bodies.

5. The reactions of ketone bodies activation. Ketone bodies oxidation. The net energy yield of ketone bodies oxidation.

6. Ketonemia, ketonuria, their reasons.

Control work 17. «Lipid anabolism»

Card 1

Fatty acid synthesis.

Card 2

Neutral fat synthesis.

Card 3

Glycerophospholipid synthesis.

Card 4

Synthesis of cholesterol.

Control work 18. “Membrains. LPO”

Card 1

1. Structural organization of a biological membrane. The liquidomosaic model of the membrane structure. The role of phospholipids and cholesterol in the membrane structure.

2. Reactive oxygen species (ROS). Physical and chemical mechanisms of their formation.

Card 2

1. The common character of membrane proteins. The biological functions of biological membranes.

2. Physiological and pathological role of LPO.

Card 3

1. Different kinds of transport through the membrane.

2. The interaction of carbohydrate and lipid metabolism. The scheme of the trannsformation of glucose into neutral fat.

Card 4

1. The peculiarities of membrane metabolism.

2. Lipid peroxidation (LPO). The stages of LPO: initiation, propagation, termination.

Card 5

1. The common character of membrane proteins. The biological functions of biological membranes.

2. Regulation of LPO: the natural antioxidants and the antioxidant enzymes (superoxide dismutase, catalase, glutathione peroxidase, and glutathione reductase).

Control work 19. «BIOCHEMISTRY OF THE LIVER»

Card 1.

The role of the liver in protein, lipid and carbohydrate metabolism.

Card 2.

The most important mechanisms of detoxication of poisoning substances in the liver.

Card 3.

The microsomal oxidation of endogenous toxins and xenobiotics.

Card 4.

The unmicrosomal oxidation of toxic substances.

Card 5.

The reactions of conjugation in the liver.

Card 6.

The degradation of heme. The formation of bilirubin and bilirubin glucuronide.

Card 7.

The ways of bilirubin and other bile pigments excretion.

Card 8.

The significance of bile pigments determination for a diagnosis of the liver diseases, bile duct obstruction, and blood hemolysis.

Control work 20. «Pharmaceutical biochemistry»

1. Neutralization of xenobiotics, drugs and endogenous toxic substances in the liver: two stages.

2. Microsomal oxidation chain involving cytochromes b5 and P450.

3. The role of cytochrome P450 in the neutralization of xenobiotics. Inductors and repressors of cytochrome P450 synthesis. Drug addiction effect.

4. Neutralization of xenobiotics by conjugation. Types of conjugations. The value of glucuronide and sulfate conjugation in the inactivation of biogenic amines and the neutralization of endogenous toxic substances.

5. Bioactivation. Examples of prodrugs that are converted into an active substance in the liver.

6. Ethanol decontamination pathways. Changes in metabolism with prolonged ethanol consumption.

7. The influence of various factors on the metabolism of drugs.

Control work 21. "Biochemistry of muscle tissue".

1. Myofibrillar and sarcoplasmic proteins of muscle tissue and their significance.
2. Characteristics of myosin. Features of the structure and molecular organization.
3. Characteristics of actin. Features of the structure and molecular organization.
4. A biochemical mechanism of muscle contraction and relaxation.
5. Chemical composition and metabolism of the heart muscle.
6. The role of calcium ions and ATP in the regulation of muscle contraction.

Control work 22. "Biochemistry of connective tissue".

1. The structural organization of collagen. The basic structural unit of collagen.
2. Participation of vitamin C in collagen maturation.
3. Elastin, its properties, chemical composition and molecular structure.
4. Comparative characteristics of collagen and elastin, basic proteins of connective tissue.
5. Proteoglycans are basic proteins of the intercellular substance of connective tissue, their structural organization. Glycosaminoglycans, structure and function.

Control work 23. “BIOCHEMISTRY OF THE BRAIN”

1. General chemical composition of the brain (water, dense rest, proteins, lipids, low molecular mass substances).
2. Brain proteins (especially brain markers). Neurohormones.
3. Brain peptides (neuropeptides), their physiological role.
4. Brain amino acids (glutamate, aspartate, their acetylated forms, glycine, tyrosine, glutamine).
5. Brain lipids (glycerol- and sphingophospholipids, cholesterol).
6. Brain carbohydrates. Glucose as the main metabolic fuel of the brain.
7. The peculiarities of brain metabolism: transport of metabolites through the blood/brain barrier, aerobic character of brain metabolism, absence of stored energy sources, pathways of energy use.

4.3. Questions for colloquiums, interviews for "GPC-1, GPC-2"*:*

4.3.1. Questions for interviews

Interview 1. «ENZYMES. VITAMINS AS PARTICIPANTS OF ENZYMATIC REACTIONS. VITAMINS AND ANTIVITAMINS AS MEDICAL AGENTS.»

1. Classification and nomenclature of vitamins. Biological functions of vitamins. Lipid-soluble and water-soluble vitamins.
2. Chemical structure of liposoluble vitamins: vitamins A, D, E, K, F and their biological role.
3. Cofactors and coenzymes. Cofactor functions of vitamins.
4. Metalloenzymes and enzymes activated by metals. Water-soluble vitamins (thiamine, riboflavin, nicotinamide, pyridoxine, pantothenic acid, cobalamins, folic acid, biotin), as precursors of coenzymes. Pro-vitamins, active forms of vitamins A and D.
5. Hypovitaminosis and hypervitaminosis, pathological manifestations of these states.
6. Vitamin-like substances, the concept of antivitamins.
7. Participation of vitamins in metabolism.
8. Vitamins as drugs.

Interview 2. "BIOLOGICAL OXIDATION. OXIDATIVE PHOSPHORYLATION. MITOCHONDRIAL DISEASES.»

1. Modern concept of biological oxidation. Characterization of oxidoreductases involved in this process. Mitochondria as the centre of the tissue respiration, their role in the regulation of cell metabolism.
2. Structural organization of the respiratory chain. Redox potential as a factor determining the movement of electrons along the respiratory chain and energy production.
3. Structural organization of the initial portion of the respiratory chain, transporting electrons and protons. The name of the complex, designate their composition, functions. The energy value of the site, its regulation.
4. Flavinic (FMN- and FAD-containing) dehydrogenase. The structure of the oxidized and reduced forms of a coenzyme, the role of riboflavin. Characterization of substrates, examples of catalyzed reactions.
5. NADH-dehydrogenase. Characteristics of the enzyme complex, composition, structural organization, performing reaction. The structure of the oxidized and reduced forms of prosthetic groups, the role of vitamin, regulation. The biological significance.
6. Succinate dehydrogenase. Characteristics of the enzyme complex, composition, structural organization, performing reaction. The structure of the oxidized and reduced forms of prosthetic groups, the role of vitamin, regulation. The biological significance.
7. Structural organization of the electron carriers of the mitochondria inner membrane. The energy value of this part of the respiratory chain, its regulation. The effect of high concentrations of smoke carbon monoxide on tissue respiration.
8. Regulation of electron transport in the respiratory chain: the conditions required for electron transport, enzyme inhibitors of tissue respiration. The effect of high concentrations of smoke carbon monoxide on tissue respiration.
9. The relationship between Krebs cycle and tissue respiration, regulation of electrons and

protons transport in the respiratory chain and the Krebs cycle.

10. Definition of oxidative phosphorylation. A modern concept of the mechanism of oxidative phosphorylation. The structure of the proton ATP synthase (H^+-ATPase), reaction. Conditions necessary for the synthesis of ATP.
11. The concept of energy-rich compounds of the body. Structure, energy characteristics, the way of ATP formation and use. Endergonic and exergonic reactions in living cells.
12. Coupling of tissue respiration and oxidative phosphorylation in the respiratory chain. Indicators of coupling. Uncoupling of respiration and oxidative phosphorylation, examples of uncouplers. A thermoregulatory function of energy metabolism in the brown adipose tissue.
13. Regulation of tissue respiration and oxidative phosphorylation. A physiological role.
14. Disorders of energy metabolism. The concept of mitochondrial diseases.

Interview 3. «TISSUE TRANSFORMATION OF AMINO ACIDS. HEREDITARY DISORDERS OF AMINO ACID METABOLISM».

1. Transamination of amino acids: donors and acceptors of NH_2 group, characteristic of transaminases (non-protein part structure, its relationship with vitamins, participation in transamination reactions), the biological significance of the process, the diagnostic value of transaminases determination.
2. Oxidative deamination of amino acids (direct deamination). Amino acid oxidases, and their characteristics.
3. Transdeamination (indirect deamination). The sequence of reactions, enzymes. characteristic of glutamat dehydrogenase, the biological significance of the process.
4. Decarboxylation of amino acids and the formation of biogenic amines, chemistry and significance of the process. formation of biogenic amines: histamine, serotonin, GABA. The role of biogenic amines in the regulation of functions. Inactivation of biogenic amines by the enzymes MAO and DAO.
5. Metabolism of phenylalanine and tyrosine. Their use for the synthesis of catecholamines, melanin, thyroxine.
6. Interstitial conversion of phenylalanine and tyrosine, degradation up to fumaric and acetoacetic acids. Chemistry of the process.
7. Hereditary metabolic disorders of phenylalanine and tyrosine. Phenylketonuria, alkaptonuriya, tyrosinosis, albinism.
8. The concept of glucogenic and ketogenic amino acids.

Interview 4. «MEMBRANE METABOLISM. LIPID PEROXIDATION».

1. Structural organization of metabolic membranes.
2. Role of lipids in the membrane construction.
3. Proteins involved in the construction of membranes.
4. Biological functions of membranes, membrane basic properties.
5. Types of transport through the membrane.
6. Membrane metabolism.
7. Free radical oxidation. Reactive oxygen species. Lipid peroxidation and its stages. Indicators of lipid peroxidation.
8. Regulators of peroxidation in the cell (pro-oxidants, anti-oxidants).

Interview 5. «BIOCHEMISTRY OF CONNECTIVE AND MUSCLE TISSUES»

1. General information about the structure of collagen proteins. Fibril formative collagens are connective tissue specific proteins. Peculiarities of chemical composition. Structural organization. Participation of vitamin C in collagen maturation. The excretion of hydroxyproline as the indicator of the rate of collagen degradation.
2. Elastin, its properties, chemical composition and molecular structure.
3. Proteoglycans as basic proteins of the intercellular substance of connective tissue, their role, structural organization. Glycosaminoglycans, structure and function. Metabolism of glycosaminoglycans.

4. Myofibrillar, sarcoplasmic proteins and proteins of muscle tissue stroma; their significance. Characteristics of myosin, actin, troponin, tropomyosin. Features of their 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.
6. Sources of ATP resynthesis in muscle tissue. The role of creatine kinase mechanism for ATP regeneration during muscular work.
7. Chemical composition and metabolism of heart muscle.

4.3. Questions for colloquiums

Questions for colloquium 1. "STRUCTURE, PROPERTIES, FUNCTIONS OF PROTEINS AND ENZYMES."

1. Amino acids as the structural protein molecules. Their structure and properties. Classification of amino acids. Examples. Essential and nonessential amino acids. The role of amino acids in the formation of the native protein and the formation of intramolecular bonds.
2. Stages of the structural organization of the globular protein.
3. The primary structure of the protein. Tetrapeptide, highlight peptide bonds. The dependence of the conformation and properties of proteins on the primary structure. Example.
4. The secondary structure of the protein, bonds stabilizing. Write two tripeptide and connect them by hydrogen bonds.
5. The tertiary structure of the molecule as a higher level of a monomeric proteins organization, bonds stabilizing. The concept of domains and clusters. The concept of protein folding. Participants of folding (enzymes and accessory proteins). Participation of foldases and chaperones.
6. The quaternary structure of the protein molecule as a higher level of an oligomeric proteins organization, bonds stabilizing. Provide examples of proteins having a quaternary structure.
7. The classification of proteins. Examples. Biological functions of proteins. The concept of proteomics.
8. Protein-ligand and protein-protein interactions. The selectivity of the interaction. Types of natural ligands and the characteristics of their interaction with proteins. Examples. Role in the formation of intermolecular complexes.
9. Physical and chemical properties of proteins. The isoelectric point. Effect of pH on the charge of proteins.
10. Stability factors of protein molecules in solution. Denaturation of the protein: reversible and irreversible, applications in science and medicine.
11. Biological catalysis. Thermodynamic aspects of the action of enzymes (the energy barrier, the energy of activation). The dependence of the catalytic properties of the enzyme on reaction temperature and pH. The temperature and pH of the medium as non-specific factors for regulation of the enzyme activity.
12. The main differences between the properties of enzymes and inorganic catalysts. The specificity of the enzyme action. Kinds of specificity, its importance for the organism. Principles of quantitative determination of enzymes. Units of the enzyme activity.
13. The active site of the enzyme, its structure. Formation of the enzyme-substrate complex. The interaction of the enzyme and substrate on the basis of hard and induced states of the active site (Fisher's theory and Koshland`s theory).
14. Enzymes, their molecular organization. Apoenzyme and cofactor (coenzyme and prosthetic group). Nomenclature and classification of enzymes. Vitamins and metal ions as cofactors of enzymes.
15. Fundamentals of enzyme kinetics. The dependence of the enzymatic reaction rate on the concentration of substrate and enzyme. Michaelis-Menten equation. Michaelis constant, its physical meaning. Substrate inhibition.
16. Inhibition of enzymes: competitive, non-competitive. Features of enzyme kinetics. Examples.

17. Types of inhibition of the enzyme activity: reversible, irreversible, specific, non-specific. Action of chemical components of tobacco smoke on the activity of enzymes of the mouth (amylase, lactate dehydrogenase, aspartate aminotransferase).

18. Regulation of the enzyme activity by chemical and structural modifications.

19. Allosteric regulation of oligomeric enzymes. Kinetics of their actions. The phenomenon of cooperativity.

20. Multiple molecular forms of enzymes. Isoenzymes. Characteristics and their regulatory role using the example of lactate dehydrogenase. The clinical significance of their determination. The concept of multienzyme complexes and multifunctional enzymes.

Questions for colloquium 2. "STUDY OF METABOLISM. THE KREBS CYCLE. BIOLOGICAL OXIDATION. OXIDATIVE PHOSPHORYLATION."

1. Characteristics of the pyruvate dehydrogenase complex. The total reaction, process steps, characteristic of enzymes, relationship with vitamins. Regulation, the significance of oxidative decarboxylation of pyruvate.

2. Substrate phosphorylation in the Krebs cycle, determination, reaction, mechanism. Difference from the oxidative phosphorylation.

3. Pyridine-linked (NAD+-containing) dehydrogenases of the Krebs cycle, catalyzed reactions. The structure of oxidized and reduced forms of coenzyme, the role of vitamin, regulation. The biological significance of dehydrogenation reactions.

4. Dehydrogenation reaction in the Krebs cycle and their physiological significance.

5. Decarboxylation reactions in the tricarboxylic acid cycle. Characterization of enzymes, regulation, significance.

6. Krebs cycle, the sequence of reactions in tricarboxylic acids part, enzymes involved and their regulation.

7. Krebs cycle. The reaction sequence in the dicarboxylic acids part, enzymes, their regulation.

8. Mechanisms of the Krebs cycle regulation. Write regulatory reactions of the cycle.

9. Biological significance of the tricarboxylic acid cycle, confirm with the reactions equations. Write reactions replenishing the citrate cycle.

10. Energy effect of complete oxidation of pyruvic acid to CO2 and H2O (confirm with chemical reactions).

11. Modern concept of biological oxidation. Characterization of oxidoreductases involved in this process. Mitochondria as the center of the tissue respiration, their role in the regulation of cell metabolism.

12. Structural organization of the respiratory chain. Redox potential as a factor determining the movement of electrons along the respiratory chain and energy production.

13. Structural organization of the initial site of the respiratory chain, transporting electrons and protons. The name of the complexes, their composition and functions. The energy significance of this site, its regulation.

14. NADH dehydrogenase. Characteristics of the enzyme complex, composition, structural organization, reaction performed. The structure of the oxidized and reduced forms of the prosthetic groups, the role of vitamin, regulation. The biological significance.

15. Flavinic (FMN and FAD-containing) dehydrogenases. The structure of the oxidized and reduced forms of a coenzyme, the role of riboflavin. Characterization of substrates, examples of reactions catalyzed.

16. Structural organization of electron carriers in the inner membrane of mitochondria. The energy effect of this site of the respiratory chain, its regulation. The effect of high concentrations of smoke carbon monoxide on the tissue respiration.

17. Regulation of electron transport in the respiratory chain: the conditions required for electron transport, enzyme inhibitors of the tissue respiration. The effect of high concentrations of smoke carbon monoxide on the tissue respiration.

18. Relationship of the Krebs cycle and tissue respiration, regulation of electrons and protons transport in the respiratory chain and the Krebs cycle.

19. Definition of the oxidative phosphorylation. The modern concept of the mechanism of the oxidative phosphorylation. H+-ATP synthase, structure, reaction performed. Conditions necessary for the synthesis of ATP.

20. Coupling of the tissue respiration and oxidative phosphorylation in the respiratory chain. Indicators of coupling. Uncoupling of respiration and oxidative phosphorylation, examples of uncouplers. A thermoregulatory function of the energy metabolism in the brown adipose tissue.

21. Regulation of the tissue respiration and oxidative phosphorylation. The physiological role.

22. Concept of metabolism, metabolic pathways, central metabolite. Reaction of catabolism and anabolism and their relationship. Endoergic and exoergic reactions in living cells. Stages of the catabolism of the nutrients.

23. Concept of energy-rich compounds of the body. Structure, energy characteristics, the way of ATP production and use. Violations of the energy exchange. The concept of mitochondrial diseases.

Questions for colloquium 3. "PROTEIN AND AMINO ACID METABOLISM."

1. Nitrogen balance of the body. Biological significance of proteins.
2. Digestion of proteins:

-digestion of proteins in the stomach, the conversion of the proenzyme into an enzyme, pepsin, the significance of the hydrochloric acid in the protein digestion,

-digestion in the intestine by the action of pancreatic and intestinal juices enzymes (trypsin, chymotrypsin, carboxypeptidase A and B, elastase, aminopeptidase, dipeptidase).

3. Amino acids absorption from the intestine.
4. Protein rotting in the gut.
5. Parietal digestion.
6. Transamination of amino acids: donors and acceptors of NH2 group, characteristic of transaminases (non-protein part structure, its relationship with vitamins, participation in transamination reactions), the biological significance of the process, the diagnostic value of transaminases determination.
7. Oxidative deamination of amino acids (direct deamination). Amino acid oxidases, and their characteristics.
8. Transdeamination (indirect deamination). The sequence of reactions, enzymes. Characteristic of glutamat dehydrogenase, the biological significance of the process.
9. Decarboxylation of amino acids and the formation of biogenic amines, chemistry and the significance of the process. Formation of biogenic amines: histamine, serotonin, GABA, di- poly-amines. The role of biogenic amines in the regulation of functions. Inactivation of biogenic amines.
10. Metabolism of phenylalanine and tyrosine. Their use for the synthesis of catecholamines, melanin, thyroxine.
11. Interstitial conversion of phenylalanine and tyrosine, degradation up to fumaric and acetoacetic acids. Chemistry of the process.
12. Hereditary metabolic disorders of phenylalanine and tyrosine. Phenylketonuria, alkaptonuria, tyrosinosis, albinism.
13. Concept of glucogenic and ketogenic amino acids.
14. End products of nitrogen metabolism formation: ammonium salts and urea. Biosynthesis of urea, reaction sequence. Daily urea excretion. Hyperammonemia. enzymopathies of the ornithine cycle enzymes.
15. Important tissue mechanisms of temporary ammonia binding: formation of the glutamic acid, glutamine, transreamination, glucose-alanine cycle.
16. Glutamine degradation in tissues.
17. Central role of the glutamic acid in amino acid metabolism.
18. Creatine synthesis, chemistry of reactions.
19. Phosphocreatine, its formation and role in metabolism. Creatine phosphokinase and its isoenzymes.
20. Creatinine formation and clinical significance of its quantitative determination in urine.

21. Residual nitrogen in blood, the quantitative significance of its determination. Average levels of residual nitrogen in blood serum.

22. Formation and metabolism of nitric oxide. A metabolic and regulatory action of nitric oxide. Nitric oxide synthase and its isoforms.

Questions for colloquium 4. "CARBOHYDRATE METABOLISM"

1. Carbohydrates of the human body, their classification, structure of individual representatives. Characteristics of proteoglycans and glycoproteins (structure of carbohydrate components). Significance of proteoglycans and glycoproteins in the body.
2. Dietary carbohydrates. Dietary fibers. Digestion and absorption of carbohydrates. Characteristics of enzymes cleaving di- and polysaccharides. Localization of the enzymes in digestive juices. Parietal digestion of carbohydrates and absorption of carbohydrates. Transport of glucose into cells.
3. Synthesis of glycogen in the liver. Energy and enzymes of the process. Characteristic of glycogen synthase. Hormonal regulation of the process. Effect of insulin, glucagon, epinephrine. Glycogen storage diseases.
4. Phosphorolysis as a way of glycogen mobilization. Characteristic of phosphorylase, its regulation. "Cascade" mechanism of hormonal signal transduction in to a target cell as a factor of regulatory effect amplification.
5. Formation of hexose phosphate esters in glycolysis and glycogenolysis. Energy yield of processes, the enzymes involved, regulation of their activity.
6. Oxidation of 3- phosphoglyceraldehyde in glycolysis. Characteristics of enzymes catalyzing this process. Further conversion of the reaction products in aerobic and anaerobic conditions, glycolytic oxidoreduction. Energy effect.
7. Substrate level phosphorylation in glycolysis. Mechanism of the process. Reactions, enzymes, substrates and products of reactions.
8. Reactions of glycolysis with ATP consumption. Enzymes catalyzing these processes and their regulation. Energy effect of complete oxidation of glucose molecule to the final products: carbon dioxide and water.
9. Reactions of glycolysis, leading to the formation of high-energy bonds in phosphotrioses. The mechanism of processes, their enzymes. Energy effect of aerobic and anaerobic glycolysis.
10. Lactate dehydrogenase reaction and its regulation; lactate utilization in the body, Cori cycle. Lactic acidosis.
11. Pentose phosphate pathway of glucose oxidation as a source of $NADPH_2$. The equations of corresponding reactions. Significance of pentose phosphate pathway.
12. Oxidative part of the pentose phosphate pathway. Chemistry and significance of the process.
13. CO_2 formation in pentose phosphate pathway, its utilization in the carbohydrates metabolism (an example).
14. Pentose phosphate pathway of glucose oxidation as a source of pentoses. Reactions, enzymes. Significance of the pentose pathway of glucose oxidation. Glucose-6-phosphate dehydrogenase deficiency.
15. Formation of fructose-6-phosphate and glucose in gluconeogenesis. Reactions, enzymes. Regulation of the process. Role of fructose-2,6-bisphosphate in regulation of the glycolysis and gluconeogenesis.
16. Mitochondrial and cytoplasmic stages of phosphoenolpyruvate formation in gluconeogenesis. Effect of glucocorticoids (cortisol), reactions of the process.
17. Glucose-6-phosphate as the main metabolite. Its formation and possible ways of transformation.
18. Blood glucose and its origin. Regulation of blood glucose level. Role of protein kinases in the regulation of glycogen synthesis and degradation.
19. Role of insulin in the regulation of a blood glucose level. Insulin receptor, formation of hormone-receptor complex, mechanism of action, insulin resistance.
20. Sugar load (oral glucose tolerance test) and its clinical and diagnostic value. Types of "sugar" curves, characteristic of normal and diabetic "sugar" curve.
21. Hyperglycemia and hypoglycemia, their reasons. Glycosuria. Diabetes mellitus.

22. Metabolism of fructose and galactose.

Questions for colloquium 5. "BIOCHEMISTRY OF LIPIDS"

1. The most important lipids of human tissues. Classification of lipids. Characteristics of the individual groups.
2. Dietary fats. Essential lipid factors of food. The role of omega-3 polyunsaturated fatty acids in the prevention of atherosclerosis.
3. Digestion of lipids. Role of bile acids in the digestion and absorption of lipids. Enterohepatic circulation of bile acids.
4. Beta-oxidation of long chain fatty acids. Localization of the process. Activation of fatty acid, transport, carriers. Characteristics of enzymes.
5. Beta-oxidation of long chain fatty acids. Reactions: dehydrogenation, hydration and thiolysis. Characteristics of dehydrogenases. The relationship with the respiratory chain.
6. Energy effect of fatty acid oxidation for palmitic, stearic, palmitoleic and oleic acids. General equation of the process.
7. Specifics character of monounsaturated fatty acids beta-oxidation.
8. Synthesis of saturated fatty acids. Localization of the process. Initial molecules. Transport of acetyl-CoA from the mitochondria to the cytoplasm.
9. Structure of fatty acid synthase complex. Formation of malonyl-CoA and its role in fatty acid synthesis.
10. Synthesis of saturated fatty acids. Fatty acid synthesis stages: condensation reaction, reduction, dehydration and hydrolysis. The role of pentose phosphate pathway as NADPH2 donor.
11. Classification of serum lipoproteins by their density and ability to electrophoresis. Characteristics of each class.
12. Formation and metabolism of VLDL and LDL. Role of HDL and lipoprotein lipase in VLDL metabolism.
13. Lipoproteins of blood plasma, their structure and function of individual fractions. Atherogenic and anti-atherogenic lipoprotein fraction.
14. HDL. Features of their structure and their role in the metabolism of cholesterol. Enzyme lecithin-cholesterol acyltransferase (LCAT), its role.
15. Resynthesis of fats in the intestine. Formation and metabolism of chylomicrons. Role of lipoprotein lipase in chylomicron metabolism. Regulation of enzyme activity.
16. Role of lipids in the structural organization and functioning of membranes. Changing of physical and chemical properties of the lipid component. The role of cholesterol.
17. Cell membranes and their functions. Liquid-crystal mosaic theory of the structure of biological membranes.
18. Membrane metabolism. Reactive oxygen species as activators of membrane lipid peroxidation. Indices of lipid peroxidation (LPO).
19. Regulators of lipid peroxidation in the cells. Pro-oxidants and antioxidants.
20. Mechanism of substances transport through the membrane: simple diffusion, active transport: primary (Na+/K+ - ATPase), secondary, exo- and endocytosis.
21. The scheme showing the relationship of carbohydrate and lipid metabolism. Formation of neutral fat from glucose. Role of pentose phosphate pathway.
22. Deposition and mobilization of lipids in adipose tissue. Hormonal regulation of lipolysis: the role of hormone sensitive lipase, insulin, glucagon and epinephrine.
23. Synthesis of ketone bodies (ketogenesis). Excessive formation of ketone bodies. Role of carbohydrate deficiency in this process. Ketonemia and ketonuria.
24. Utilization of ketone bodies in the peripheral tissues. Ways of acetoacetate activation. Energy effect of acetoacetate and beta-hydroxybutyrate complete oxidation in the tissues.
25. Cholesterol synthesis in the body, regulation of the process. Cholesterol as a source of biologically active compounds. Drugs – inhibitors of HMG-CoA reductase.
26. Role of acetyl-CoA in lipid metabolism (the scheme).
27. Ways of glycerol usage. Glycerol as the substrate for oxidation: draw oxidation scheme up to CO_2 and water. Energy effect of glycerol complete oxidation in the tissues.

28. Phosphatidic acid as a common precursor for synthesis of neutral fats and glycerophospholipids. Lipotropic substances that prevent liver fatty degeneration.

29. Breakdown of glycerophospholipids. Characteristics of enzymes. Role of phospholipase C in inositol-3-phosphate and diacylglycerol formation. Importance of phospholipase A2 in the formation of prostaglandins. Application of drugs suppressing eicosanoids synthesis.

30. The scheme of phosphatide synthesis. Characteristics of enzymes.

4.4 Workbook for the assessment of competence " GPC-1, GPC-2"

Workbook sample 1 «STRUCTURE AND PROPERTIES OF PROTEINS».

Fill in the tables using the lecture material and the textbook

Functions of proteins

Functional classes of proteins	Biological functions	Examples

Levels of protein organization

Organization level	Bond type	Molecule shape

Workbook sample 2 «BASIC CARBOHYDRATES OF THE BODY. CARBOHYDRATE DIGESTION. RESERVE CARBOHYDRATES».

Fill the table on the basis of textbooks, lectures, practicals and additional literature:

The main differences between glycoproteins and proteoglycans

Characteristic	Glycoproteins	Proteoglycans
Protein/ carbohydrate ratio		
Type of carbohydrates		
Localization		

Function		

Workbook sample 3 LIPID TRANSPORT. ATHEROGENIC LIPOPROTEINS.
Fill the table:

Comparative characteristics of lipases

Condition	Pancreatic lipase	Lipoprotein lipase	Hormone sensitive lipase
Place of enzyme synthesis			
Reaction localization			
Reaction activators			
Reaction substrates			
The main products of reaction			
The fate of the reaction products			

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

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

The content of the assessment tool is questionsand cases.

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. The link is https://sdo.pimunn.net/course/view.php?id=4662.

5.1 The list of control tasks and other materials necessary for the assessment of knowledge, skills and work experience *(the teacher indicates only those tasks and other materials that are used within the framework of this discipline)*

5.1.1. Questions for the discipline exam BIOLOGICAL CHEMISTRY

Case	Competence code (according to the WPD)
1. Proteins, their types and classification. Amino acids as monomers of a protein molecule. Their kinds. The primary structure of proteins and its informational role. Proteins, peptides and amino acids as drugs.	GPC-1, GPC-2
2. The conformation of protein molecules (secondary and tertiary structures), types of bonds involved in their formation, kinds. Clusters and domains and their role in the functioning of proteins. Protein folding. The concept of chaperones. Protein denaturation, its use in medicine and pharmacy. Quaternary structure of proteins. Cooperative changes in the conformation of protomers. Features of the structure and functioning of oligomeric proteins by the example of hemoglobin. Polyenzyme complexes.	GPC-1, GPC-2
3. Quaternary structure of proteins. Cooperative changes in the conformation of protomers. Features of the structure and functioning of oligomeric proteins by the example of hemoglobin. Polyenzyme complexes. 4. Selective interaction with the ligand as the basis for the biological functions of all proteins. Conditions for interaction of proteins with ligands, types	GPC-1, GPC-2

of ligands. Use of ligands as drugs.	
5. Features of enzymatic catalysis. Enzyme specificity. Classification and nomenclature of enzymes. Structural organization of enzymes. Enzyme cofactors. Coenzyme functions of vitamins and metal ions. Vitamins as medicines. The use of enzymes in medicine and pharmacology. Examples of enzymes as analytical reagents. Enzymes as medicines.	GPC-1, GPC-2
6. Kinetics of enzymatic reactions. Dependence of the rate of enzymatic reactions on temperature, pH, enzyme and substrate concentration. Principles for the quantification of enzymes. The units of activity of modern pharmaceuticals. Application of the properties of thermolability of enzymes in pharmacy.	GPC-1, GPC-2
7. Regulation of enzyme activity. Enzyme inhibitors: reversible, irreversible, competitive, non-competitive. Medicines as enzyme inhibitors. Enzyme activation.	GPC-1, GPC-2
8. The structure of allosteric enzymes, regulation of their action: allosteric inhibitors and activators, cooperative changes in the conformation of protomers. 9. Chemical modification of enzymes: regulation of enzyme activity by phosphorylation and dephosphorylation. Partial proteolysis, its significance.	GPC-1, GPC-2
10. The origin of blood enzymes. Isoenzymes (for example, lactate dehydrogenase and creatine kinase), their physiological role. Hereditary enzymopathies. Determination of enzymes in the blood for the purpose of diagnosing diseases.	GPC-1, GPC-2
11. The concept of metabolism, metabolic pathways. Interrelation of metabolic processes. Endergonic and exergonic reactions in a living cell. The concept of catabolism and anabolism. Macroergic compounds. Catabolism of basic nutrients - carbohydrates, fats, proteins. The concept of specific pathways of catabolism (before the formation of pyruvate and acetyl-CoA) and the general pathway of catabolism. 12. Pyridine-dependent (NAD- and NADP-) dehydrogenases and flavin (FMN- and FAD) dehydrogenases. The structure of the oxidized and reduced forms of NAD and FAD. The most important substrates of dehydrogenases.	GPC-1, GPC-2
13. Structural organization of the mitochondrial respiratory chain, composition and catalytic function of oligoenzyme complexes of the respiratory chain. Inhibitors of the transfer of protons and electrons, examples of drugs. 14. Oxidative phosphorylation. R/O ratio. Transmembrane electrochemical potential as an intermediate form of energy during oxidative phosphorylation. Dissociation of tissue respiration and phosphorylation. Medicines with a disconnecting effect.	GPC-1, GPC-2
15. Oxidative decarboxylation of pyruvic acid. The structure of the PDG complex. The significance of this process and its regulation. Medicines to improve the efficiency of the PDH-complex.	GPC-1, GPC-2
16. Citrate cycle (cycle of di- and tricarboxylic acids, Krebs cycle): sequence of reactions, characteristics of enzymes, role of vitamins. The relationship between the common pathway of catabolism and the chain of transport of electrons and protons. The mechanism of regulation of the citrate cycle. Functions of the cycle.	GPC-1, GPC-2
17. The main carbohydrates of the food. Digestion of carbohydrates, disorders. The role of dietary fiber and its use as pharmaceuticals.	GPC-1, GPC-2
18. The main carbohydrates of the body, their classification, biological role. Glucose as the most important metabolite of carbohydrate metabolism: general scheme of sources and ways of glucose consumption in the body.	GPC-1, GPC-2
19. Aerobic breakdown is the main pathway for glucose catabolism. The sequence of reactions to the formation of pyruvate (aerobic glycolysis), then schematically. Physiological significance of aerobic breakdown of glucose.	GPC-1, GPC-2
20. Anaerobic breakdown of glucose (anaerobic glycolysis). Sequence of reactions. Glycolytic oxidoreduction, pyruvate as a hydrogen acceptor. Substrate phosphorylation in glycolysis. Physiological significance of anaerobic breakdown	GPC-1, GPC-2

of glucose.	
21. Biosynthesis of glucose (gluconeogenesis): possible precursors, sequence of reactions. The relationship of muscle glycolysis and gluconeogenesis in the liver (Cori cycle). Regulation of gluconeogenesis.	GPC-1, GPC-2
22. Pentose phosphate pathway for glucose conversion. Oxidative stage, its meaning. Localisaition and physiological role.	GPC-1, GPC-2
23. Glycogen is a reserve polysaccharide, its distribution in body tissues. Glycogen biosynthesis. Mobilization of glycogen. Regulation of these processes.	GPC-1, GPC-2
24. Regulation of blood glucose concentration. Formation of glucose from glycogen. Influence of insulin, glucagon, adrenaline, cortisol on blood glucose levels. Hypo- and hyperglycemia, the reasons for their occurrence. Glucose tolerance test (GTT). Medicines used in the treatment of type I and II diabetes mellitus.	GPC-1, GPC-2
25. Lipid classification. The most important lipids in the body. Reserve lipids. Basic phospholipids and glycolipids of human tissues. The concept of biosynthesis and catabolism of these compounds. Functions of phospholipids and glycolipids. Synthesis and breakdown of phospholipids. Lipotropic factors as pharmaceuticals.	GPC-1, GPC-2
26. Dietary fats, daily intake, digestion, absorption of digested products. Resynthesis of fats in intestinal cells. The use of drugs for disoders of lipid digestion.	GPC-1, GPC-2
27. Composition and structure of transport blood lipoproteins. The role of apoproteins in chylomicrons. Lipoprotein lipase. Biosynthesis of fats from carbohydrates in the liver, packaging in VLDL and transport.	GPC-1, GPC-2
28. Reservation and mobilization of neutral lipids in the adipose tissue: regulation of synthesis and mobilization of fats. The role of insulin, adrenaline and glucagon. Synthesis of fats in adipose tissue. Modern medicines for weight loss.	GPC-1, GPC-2
29. Beta-oxidation of fatty acids. Relationship with the Krebs cycle and the respiratory chain. Physiological significance. Modern drugs for the activation of beta-oxidation of fatty acids. Biosynthesis and use of ketone bodies as energy sources. Ketonemia and ketonuria, the causes of their occurrence.	GPC-1, GPC-2
30. Biosynthesis of fatty acids, characteristics of palmitoylsynthase, sequence of reactions, regulation of the process, physiological significance.	GPC-1, GPC-2
31. Cholesterol as a precursor to a number of other steroids. Cholesterol synthesis: the sequence of reactions to the formation of mevalonic acid, a sceem of the further stages of the synthesis. Regulation of cholesterol synthesis. LDL and HDL as a transport forms of cholesterol in the blood, their role in its metabolism. Modern drugs to lower cholesterol synthesis.	GPC-1, GPC-2
32. Types of cell membranes and their functions. General properties of membranes: fluidity, lateral asymmetry, selective permeability. Fluid-mosaic model of biological membranes. The role of the main components (lipids, proteins) in the structural organization and functioning of membranes. Membrane proteins - peripheral, integral, transmembrane, their structural organization and functions. The mechanism of transfer of substances through membranes: passive transport, active transport (Na+/K+-ATP-ase). Na+/K+-ATPase inhibitors in the form of drugs. Endo- and exocytosis.	GPC-1, GPC-2
33. Oxygen toxicity: formation of reactive oxygen species. Metebolism of membranes. Lipid peroxidation. Protection against the toxic effects of oxygen: antioxidants, defense enzymes. Antioxidants as medicines.	GPC-1, GPC-2
34. Protein digestion: features of proteolytic enzymes. Proteinases - pepsin, trypsin, chymotrypsin. The conversion of a proenzyme into an enzyme. Exopeptidase and endopeptidase. Absorption of amino acids. Essential and nonessential amino acids. The concept of nitrogen balance. The diagnostic value of the analysis of gastric juice. The use of drugs in violation of protein digestion.	GPC-1, GPC-2
35. Transamination of amino acids. Specificity of transaminases. Significance	GPC-1, GPC-2

of transamination reactions. Diagnostic value of transaminases determination. Amino acid catabolism. Oxidative deamination of amino acids (direct deamination). Glutamate dehydrogenase. Indirect deamination of amino acids, sequence of reactions, enzymes, biological significance.	
36. Metabolism of phenylalanine and tyrosine. The use of tyrosine for the synthesis of catecholamines, thyroxine, melanin. Catabolism of tyrosine to fumaric and acetoacetic acids. Hereditary metabolic disorders of phenylalanine and tyrosine. Drugs for the correction of these pathologies.	GPC-1, GPC-2
37. Decarboxylation of amino aicids and the formation of biogenic amines: chemistry and significance of the process. The role of biogenic amines in the regulation of functions: histamine, serotonin, GABA. Inactivation of biogenic amines with the participation of MAO and DAO enzymes. Modern medicines regulating the synthesis and inactivation of biogenic amines.	GPC-1, GPC-2
38. Nitric oxide as a metabolic product of animal cells. Its physicochemical characterization, formation, characterization of NO-synthetases. The mechanism of the regulatory action of nitric oxide. Medicines as sources of NO and their metabolic effects.	GPC-1, GPC-2
39. The main sources of ammonia in the body. Important tissue mechanisms of temporary ammonia binding.The central role of glutamic acid in the neutralization of ammonia. Glutamine as a transport form of ammonia and an amide group donor in the synthesis of a number of compounds. Glutamate as a drug.	GPC-1, GPC-2
40. Formation of creatine and creatine phosphate. Creatinine as one of the end products of nitrogen metabolism. Diagnostic significance of determination of compounds of the creatine pool in biological fluids.	GPC-1, GPC-2
41. Formation of end products of nitrogen metabolism: ammonium salts and urea. Urea biosynthesis. The connection of the ornithine cycle with the transformations of fumaric and aspartic acids; the origin of urea nitrogen atoms. Violations of the synthesis and excretion of urea. Residual nitrogen. Hyperammonemia.	GPC-1, GPC-2
42. Compounds which are sources of nitrogen and carbon in the synthesis of purine rings and the role of phosphoribosyl pyrophosphate (PRPP). Purine nucleotide catabolism. Hyperuricemia and gout. The role of allopurinol in the treatment of gout.	GPC-1, GPC-2
43. Biosynthesis and catabolism of pyrimidine nucleotides. Biosynthesis of deoxyribonucleotides. Biosynthesis inhibitors as drugs, their use in chemotherapy.	GPC-1, GPC-2
44. The place of hormones in the system of regulation of metabolism and organ function. Classification of hormones by chemical structure. Central regulation of the endocrine system: the role of liberins, statins, tropic hormones. Application of hormones and their synthetic analogs in medicine. Eicosanoids, their biological role. Non-steroidal and steroidal anti-inflammatory drugs, their mechanism of action.	GPC-1, GPC-2
45. The mechanism of transmission of the hormonal signal into the cell: membrane and intracellular. 46. The role of hormone messengers (cyclic nucleotides, Ca2+, inositol phosphates, diacylglycerols) in the implementation of the hormonal effect.	GPC-1, GPC-2
47. The most important proteins of the extracellular matrix: collagen, elastin. Post-translational changes in collagen, the formation of fibrillar structures. Participation of vitamin C in collagen synthesis.	GPC-1, GPC-2
48. Proteoglycans of connective tissue as protein-carbohydrate complexes. The fundamental structure of non-protein components of proteoglycans - glycosaminoglycans, their functions. Medicines for the treatment of connective tissue pathologies.	GPC-1, GPC-2
49. The most important mechanisms for the neutralization of substances in the liver: microsomal and non-microsomal oxidation, conjugation reactions.	GPC-1, GPC-2

Biotransformation of medicinal substances in the body. The role of the endoplasmic reticulum of the liver in the biotransformation of drugs. 50. Stages of biotransformation of medicinal substances in the liver. Wide and narrow spectrum inductors. The mechanism of addiction to drugs. Bioactivation of xenobiotics. The influence of external conditions of the environment, nutrition, physiological state on the biotransformation of drugs.	
51. Heme breakdown. Formation of bilirubin and bilirubing glucuronide. Excretion of bilirubin and other bile pigments. The value of determining bile pigments for the diagnosis of diseases of the liver, biliary tract, blood.	GPC-1, GPC-2
52. Protein fractions of blood plasma. Albumin and their function. Globulins, fractions, functions. Blood plasma medications.	GPC-1, GPC-2
53. Hemoglobin is the main protein in erythrocytes. Its structure and function. Hemoglobin polymorphism. Hemoglobinopathy. Heme synthesis, its regulation. The role of iron preparations in the synthesis of hemoglobin.	GPC-1, GPC-2
54. The most important proteins of myofibrils: myosin, actin, tropomyosin, troponin. Their molecular organization and role in muscle contraction. The chemistry of muscle contraction and relaxation, the role of calcium ions in the implementation of these processes. Energy supply of muscle contraction. Features of the heart muscle.	GPC-1, GPC-2

5.1.2 Cases for the discipline exam BIOLOGICAL CHEMISTRY

Case	Competence code (according to the WPD)
1. Proteins transporting molecules or ions through membranes are termed as transmembrane proteins. These proteins have a special region of their structure incorporated into a membrane lipid bilayer, and some regions oriented either to the cytosol or to the extracellular matrix. Try to propose, which amino acids ought to predominate in various regions of the transmembrane proteins using the information of the amino acid classification (according to the polarity of their radicals).	GPC-1, GPC-2
2. Determine what zone of pH scale the value of the point isoelectric (pI) of the following polypeptide arg-his-glu-cys is located at. What direction will this peptide move during electrophoresis in the solution with the neutral value of pH to? How will the peptide electric charge and electrophoretic direction change when arginine is changed into leucine.	GPC-1, GPC-2
3. The resistance of two different enzymes (hexokinase and ribonuclease) to high temperature has been studied. The experiment indicated when both enzymes are heated at 50^{o}C for 15 minutes, hexokinase lost 70% of its original activity, whereas ribonuclease lost only 30%. Structural analysis established ribonuclease to contain 4 disulfide bones in its structure. Using the data explain the difference in stability of both enzymes to temperature denaturation.	GPC-1, GPC-2
4. If ATP and the glycogen synthase kinase enzyme are added in an incubation medium containing an active form of enzyme glycogen synthase, glycogen synthase loses its activity. What is the reason for decrease in enzyme activity? What is the way to restore glycogen synthase activity?	GPC-1, GPC-2
5. Methanol is a very toxic substance. Oral intake of 30 ml of methanol can result in death. The toxicity is due to the toxic action of formaldehyde, the product of methanol transformation. Methanol is oxidized by the liver enzyme, alcohol dehydrogenase. One of the methods of treatment for methanol poisoning is that	GPC-1, GPC-2

ethanol is administrated intravenously to a patient in doses that induce intoxication in a healthy person. Explain why such treatment is effective? 6. Explain why drugs containing calcium in combination with vitamin D are more effective to compensate calcium deficiency in the body than the drugs containing calcium alone.	
7. Dietary intake of fresh eggs is known to induce hypovitaminosis H. The special protein *avidine*, which can interact with vitamin H and prohibit its absorption in the gastrointestinal tract, is present in fresh eggs. Explain why boiled eggs do not have these properties.	GPC-1, GPC-2
8. Explain why the velocity of the TCA cycle is elevated in hard muscle work. Write the chemical equations of the reactions, the rate of which increases in this situation. What is the mechanism of the phenomenon?	GPC-1, GPC-2
9. The low energy state developed in a patient after severe disease. A doctor recommended the patient to take vitamins B. Explain the reason for doctor`s recommendation.	GPC-1, GPC-2
10. The action of antimycine A and rotenone on the experimental animals was analyzed. Both substances are very toxic for the animals. Using the application sites of antimycine A and rotenone in the electron transfer chain enzymes, explain, what the reasons for their toxicity are.	GPC-1, GPC-2
11. In a normal state the body temperature is higher than the environmental temperature (36.6^{o}C versus 20^{o}C). Explain what the temperature difference is due to. What is the role of mitochondria in this phenomenon?	GPC-1, GPC-2
12. Suppose mitochondria can oxidize succinate in the presence of rotenone. Explain your assumption.	GPC-1, GPC-2
13. A woman suffered from sleeplessness. The doctor prescribed her soporific drug – aminobarbital. The woman had taken the drug for a long time. As a result she suffered from fatigue and acute muscular weakness. Can you explain the reasons and mechanisms for the complications?	GPC-1, GPC-2
14. A man had been rescued from a burning house. He was not burnt and did not get any injuries, but he was unconscious. Due to resuscitation the patient's life was saved. What is the reason for severe condition of the saved man? What measures were taken by the doctor?	GPC-1, GPC-2
15. Some healthy experimental rats were kept for a long time on an artificial protein diet free of ***tryptophan***. Will nitrogen balance of the animals change as a result of the diet? If it changes, answer ***how and why*** it will happen. Describe the character of nitrogen balance.	GPC-1, GPC-2
16. Long time artificial protein diet (without ALANINE and ASPARTATE) was used for healthy rats. Will the nitrogen balance change in these animals? If it changes, then HOW and WHY? Give a description of the nitrogen balance.	GPC-1, GPC-2
17. In the biochemical analysis of blood and urine of a patient revealed the daily renal urea excretion to be 15 g (the normal range is up to 30 g/day), urine blood concentration2.0 mM/l (the normal range is 3.3-6.6 mM/l). Explain the cause of these abnormalities. Illustrate your answer by the scheme of the metabolic pathway affected in the patient.	GPC-1, GPC-2
18. Black discoloration of newborn child urine in its contact with air was observed. Explain, the accumulation of which product the phenomenon can be due	GPC-1, GPC-2

to. The metabolism of what amino acid is affected in this pathological state? Name the disease. Write the scheme of the metabolic process affected.	
19. Vitamin B_6 (pyridoxine) is often prescribed in pathological states in case of catecholamine insufficiency (parkinsonism, neuritis, depressive states). Explain, what action of pyridoxine is based on. For that: a) write the scheme of the synthesis of catecholamines; b) indicate the reaction which requires vitamin B_6.	GPC-1, GPC-2
20. A patient does not have the protection mechanisms against ultraviolet radiation, he is subjected to sun burns, and suntan does not appear. What is the pathological state? Show its causes. 1. Answer: the synthesis of what substance is affected in the body of such people? 2. Write the scheme of its formation in normal conditions. 3. Name the enzyme which defect induces the above mentioned symptoms.	GPC-1, GPC-2
21. 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?	GPC-1, GPC-2
22. What disaccharides can form from glycogen as a result of its digestion in the gastrointestinal tract? Write the structures of the disaccharides.	GPC-1, GPC-2
23. A person was found in the street and taken to hospital with suspected hungry syncope or diabetic coma. 1. What laboratory tests should be carried out for diagnosis? 2. Choose the symptoms that are typical for: A. Fasting B. Diabetes C. Both cases mellitus D. Neither 1. Hyperglucosemia 2. Ketonemia 3. Hypoglucosemia 4. Glucosuria 5. Polyuria 6. Alkalosis 7. Acidosis	GPC-1, GPC-2
24. Describe how the following parameters are altered under the insulin influence: -glucose blood level, -glycolysis, -glycogen decomposition, -glycogen synthesis.	GPC-1, GPC-2
25. 30 minutes after the intake of 100 g of sugar, the blood glucose level increased by 1.5 times, but 30 minutes after the intake of bread, containing the same amount of carbohydrates, the glucose level did not change essentially. Explain the revealed difference. The limited production of what hormone controlling blood glucose level should be observed in the second case? 26. Steatorrhea is characterized by undigested triacylglycerols in feces and the state can be due to two causes: insufficient secretion of bile acids or a lack of pancreatic lipase. Why can these reasons result in impaired lipid digestion? How can two types of steatorrhea be revealed by feces analysis?	GPC-1, GPC-2

27. Before a significant competition the blood glucose level in an athlete rose up to 6.5 mM/l and blood fatty acids elevated up to 1.2 mM/l (normal range – 0.4-0.9 mM/l). What was the reason for those changes?	GPC-1, GPC-2
28. If a man consumed 1.0-1.5 g of dietary cholesterol, the cholesterol synthesis in his body will decrease because of the decreased activity and in the amount of enzymes taking part in the cholesterol synthesis. Explain the mechanism of the phenomenon.	GPC-1, GPC-2
29. The action of toxic substances, e.g. intake of alcohol for a long time, can result in liver fat dystrophy. Methionine is one of the drugs used to treat the pathological state. Create the scheme of the synthesis of triglycerides and phospholipids and explain the mechanism of fat liver dystrophy. What is the role of methionine in protection of the liver against the development of this pathology?	GPC-1, GPC-2
30. When consuming about 300 g of carbohydrates and lie down to relax for 2 hours, which process, synthesis or decomposition of neutral fat will be activated? Argue your answer and write the scheme of a metabolic pathway of lipid metabolism chosen by you. Indicate what hormone will stimulate this pathway. How can the hormone do it?	GPC-1, GPC-2
31. Taking a large dose of alcohol may develop hypoglycemia in humans. What are the causes of hypoglycemia? When replying, specify: a) what compound is formed in the body of ethanol? Follow the further path of transformation of this substance in the body; b) is it possible to synthesize glucose from it? Confirm explanation with the schemes.	GPC-1, GPC-2
32. A patient suffered from the pain in the liver area. In several days his skin and sclera became yellow in colour. Feces were colorless and urine had the colour of strong tea. What pathological state can be associated with these signs? What clinical tests should be done in this case? How can you explain feces discoloration and dark color of urine? How did the ratio between direct and indirect reacting bilirubin change in the pathological state?	GPC-1, GPC-2
33. The patient took sleeping pills – amytal (barbiturate). After a while she felt that the effect of the drug disappeared more quickly and became less active, however, when the dosage was increased, the effect appeared again. In addition, steroid preparations, which she took, in former concentrations also became ineffective. Why did the time and extent of exposure of the medicines change? Knowing the mechanism of biotransformation of barbiturates and steroids, explain the reason for such changes.	GPC-1, GPC-2
34. Why is the bleeding of small vessels observed in hypovitaminosis C?	GPC-1, GPC-2

6. Criteria for evaluating learning outcomes

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	The minimum acceptable level of knowledge. A	The level of knowledge in the volume	The level of knowledge in the volume

Learning outcomes	Assessment of competence developed			
	unsatisfactory	**satisfactory**	**good**	**excellent**
	requirements. There were bad mistakes	lot of light mistakes were made	corresponding to the training program. A few light mistakes were made	corresponding to the training program, without 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__