MINISTRY OF PUBLIC HEALTH OF UKRAINE HIGHER STATE EDUCATIONAL ESTABLISHMENT OF UKRAINE «UKRAINIAN MEDICAL STOMATOLOGICAL ACADEMY»

## **BIOLOGICAL CHEMISTRY. COLLECTION OF TEST TASKS**

Textbook

Poltava - 2018

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ ВИЩИЙ ДЕРЖАВНИЙ НАВЧАЛЬНИЙ ЗАКЛАД УКРАЇНИ «УКРАЇНСЬКА МЕДИЧНА СТОМАТОЛОГІЧНА АКАДЕМІЯ»

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### BIOLOGICAL CHEMISTRY. COLLECTION OF TEST TASKS

Біологічна хімія. Збірник тестових завдань

Навчальний посібник

Textbook

Полтава – 2018

Poltava – 2018

#### UDC 577.1:378.14

It is recommended by the Academic Council of the Higher State Educational Establishment of Ukraine «Ukrainian Medical Stomatological Academy» as a textbook for English-speaking students of higher education institutions of the Ministry of Public Health of Ukraine (report № 3, 22.11.2017 y).

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Textbook «Biological chemistry. Collection of test tasks» for English-speaking students of higher medical educational institutions of the Ministry of Public Health of Ukraine. – Poltava, 2018. – 148 p. In English language.

Textbook «Biological chemistry. Collection of test tasks» for English-speaking students of higher educational institutions of the Ministry of Public Health of Ukraine was prepared in accordance with the program "Biological and biological chemistry", compiled by the staff of the supporting department of bioorganic and biological chemistry of the O.O. Bogomolets National Medical University. Test tasks are structured around the topics of practical training, which corresponds to the standards of training according to the principles of the credit-module system and contributes to improving the quality of student training.

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#### УДК 577.1:378.14

Рекомендовано вченою радою Вищого державного навчального закладу України «Українська медична стоматологічна академія» як навчальний посібник для англомовних студентів вищих навчальних закладів МОЗ України (протокол № 3 від 22.11.2017 року).

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Навчальний посібник «Біологічна хімія. Збірник тестових завдань» для англомовних студентів вищих навчальних закладів МОЗ України. – Полтава, 2018. – 148 с. Англійською мовою.

Навчальний посібник «Біологічна хімія. Збірник тестових завдань» для англомовних студентів вищих навчальних закладів МОЗ України підготовлено у відповідності з програмою «Біологічна та біоорганічна хімія», яка складена співробітниками опорної кафедри біоорганічної та біологічної хімії Національного медичного університету імені О.О. Богомольця. Тестові завдання структуровані за темами практичних занять, що відповідає стандартам навчання, згідно засад кредитно-модульної системи та сприяє підвищенню якості підготовки студентів.

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#### **Module II**

1. Control of initial level of knowledge. The subject and tasks of biochemistry. The aim and methods of biochemical research, its clinical and diagnostic value.

1. What qualitative reaction is used to determine the residues of  $\alpha$ -amino acids in the protein structure and the free  $\alpha$ -amino acids?

- A. Ninhydrin test
- B. Xanthoproteic test
- C. Lead-sulfide test
- D. Sakaguchi test
- E. Ehrlich test

2. In hydrolysis of proteins and peptides 20 different  $\alpha$ -L-amino acids are released that are called proteinogenic amino acids. Furthermore, in humans there are also some other amino acids which are not part of the proteins, select them:

- A. Alanine
- B. Ornithine
- C. Cysteine
- D. Methionine
- E. Serine

3. Protein molecules are biopolymers that enforce a number of important functions. The enzymatic function of proteins is:

- A. Catalysis of biochemical reactions
- B. Release of free chemical energy
- C. Protection against infection
- D. Formation of biological membranes
- E. Transport of oxygen

4. Proteins have several levels of structural organization. Hemoglobin is a complex protein which serves as an oxygen-transporting protein and has:

- A. Fibrillar structure
- B. α-structure
- C. Quaternary structure
- D. Structure similar to collagen
- E. Primary structure

5. Which class of proteins by the chemical structure hemoglobin belongs to?

- A. Chromoproteins
- B. Metalloproteins
- C. Phosphoproteins

- D. Glycoproteins
- E. Lipoproteins

6. Bioorganic high-molecular compounds that consist of residues of  $\alpha$ -L-amino acids and connected by amide (peptide) bonds are called:

- A. Nucleic acids
- B. Carbohydrates
- C. Lipids
- D. Proteins
- E. Heterocyclic compounds

7. What bioorganic compounds are aldehyde and ketone derivatives of polyhydric alcohols?

- A. Carbohydrates
- B. Proteins
- C. Heterocyclic compounds
- D. Lipids
- E. Nucleic acids

8. What class of bioorganic compounds has a distinctive feature of being soluble in the nonpolar solvents but insoluble in water and other polar solvents?

- A. Heterocyclic compounds
- B. Carbohydrates
- C. Proteins
- D. Nucleic acids
- E. Lipids

9. What are polymers of mononucleotides?

- A. Nucleic acids
- B. Proteins
- C. Carbohydrates
- D. Lipids
- E. Heterocyclic compounds

10. The cyclic compounds which in addition to carbon contain in the ring at least one atom of another element (heteroatom) are called:

- A. Proteins
- B. Heterocyclic compounds
- C. Carbohydrates
- D. Lipids
- E. Nucleic acids

11. What are the products of hydrolysis of trioleylglycerol?

A. Glycerol and three oleic acids

B. Glycerol and three palmitic acids

C. Water and carboxylic acid

- D. Glycerol and water
- E. Glycerol and base

12. Transfer RNAs play an important role in the biosynthesis of protein molecules on ribosomes. The tertiary structure of tRNA is:

- A. Globular
- B. Letter S
- C. Cloverleaf
- D. Fibrillar
- E. Helix

13. Which homopolysaccharide is the molecular form of glucose storage in the human body?

- A. Glycogen
- B. Cellulose
- C. Amylose
- D. Starch
- E. Dextran

14. Lipoproteins are particles that consist of noncovalently associated lipids and proteins. What is the main function of lipoproteins in the blood plasma?

- A. Regulatory
- B. Plastic
- C. Energy
- D. Transport
- E. Catalytic

15. Fatty acids are used for the synthesis of many biologically important compounds in human body. Some of them are not synthesized because mammals do not possess the enzymes for their biosynthesis. Which of the following fatty acids is an essential fatty acid?

- A. α-Linoleic acid
- B. Palmitic acid
- C. Oleic acid
- D. Stearic
- E. Butyric

16. A nucleotide is composed of:

- A. Nitrogenous base and phosphate
- B. Hexose, nitrogenous base and phosphate
- C. Nitrogenous base and pentose
- D. Hexose and phosphate
- E. Nitrogenous base, pentose and phosphate

17. What is the biological function of messenger RNA (mRNA)?

A. mRNA is a matrix for biosynthesis of proteins

- B. mRNA transports amino acids
- C. mRNA hydrolyzes proteins
- D. mRNA catalyzes peptide bonds formation
- E. mRNA activates rRNA
- 18. A nucleoside is composed of:
- A. Nitrogenous base and pentose
- B. Hexose, nitrogenous base and phosphate
- C. Nitrogenous base, pentose and phosphate
- D. Hexose and phosphate
- E. Nitrogenous base and phosphate

19. What branch of biochemistry studies a chemical composition of living organisms and a structure of bioorganic molecules, which are a part of living matter?

- A. Dynamic biochemistry
- B. Static biochemistry
- C. Functional biochemistry
- D. Medical biochemistry
- E. Enzymology

20. What branch of biochemistry studies transformation of substances that form in its entirety metabolism of living organisms?

- A. Dynamic biochemistry
- B. Static biochemistry
- C. Functional biochemistry
- D. Medical biochemistry
- E. Enzymology

21. What branch of biochemistry studies the biochemical reactions in various organs and tissues underlying the physiological functions?

- A. Dynamic biochemistry
- B. Static biochemistry
- C. Functional biochemistry
- D. Medical biochemistry
- E. Enzymology

22. What branch of biochemistry studies metabolic patterns in normal and pathological conditions (pathochemistry) in the human body?

- A. Clinical biochemistry
- B. Static biochemistry
- C. Dynamic biochemistry
- D. Functional biochemistry

E. Enzymology

23. Choose amino acids that are in a fraction of basic amino acids and have positively charged radicals according to the results of chromatography:

- A. Alanine, proline, tyrosine
- B. Aspartate, Glutamate
- C. Leucine, isoleucine, methionine
- D. Lysine, arginine, histidine
- E. Tryptophan, cysteine, glycine

24. Choose amino acids that are in a fraction of acidic amino acids and have negatively charged radicals according to the results of chromatography:

- A. Aspartate, Glutamate
- B. Lysine, arginine, histidine
- C. Leucine, isoleucine, methionine
- D. Alanine, proline, tyrosine
- E. Tryptophan, cysteine, glycine

### 2. Analysis of structure, physical and chemical properties of protein enzymes.

1. Five isoforms of lactate dehydrogenase were identified in human serum. Which property proves that marked isoenzyme forms are of the same enzyme?

- A. Catalyze the same reaction
- B. The same molecular weight
- C. Tissue localization
- D. The same physical and chemical properties
- E. The same electrophoretic mobility

2. Which enzymes catalyze the conversion of proline to hydroxyproline and lysine to hydroxylysine in the collagen molecule?

- A. Hydroxylases
- B. Hydrolases
- C. Dehydrogenases
- D. Oxidases
- E. Dehydratases

3. The enzyme oxidase of D-amino acids only catalyzes a deamination of D-amino acids. Which property of enzymes is shown in this case?

A. Stereochemical specificity

- B. Thermolability
- C. Relative specificity
- D. Dependence on pH

#### E. Absolute specificity

4. Azaserine is a structural analogue of glutamine. It is inhibitor of purine nucleotide biosynthesis. Which type of inhibition is characteristic of this drug?

- A. Irreversible
- B. Competitive
- C. Noncompetitive
- D. Incompetitive
- E. Allosteric

5. Metabolic acidosis was developed in the patient. An activity of enzymes was decreased, because of:

A. A charge of enzymes was changed

B. Activity of mitochondrial enzymes was inhibited and an increased activity of lysosomal enzymes led to the activation of metabolic processes

C. An activity of intracellular enzymes didn't change significantly

D. There was a total inhibition of tissue enzymes

E. There was a total activation of tissue enzymes

- 6. Specify an enzyme with optimal pH = 2.0:
- A. Pepsin
- B. Trypsin
- C. Chymotrypsin
- D.  $\alpha$ -Amylase
- E. Collagenase

7. The relative specificity of enzymes is only an ability to catalyze a conversion of:

- A. One metabolic process
- B. Specific stereoisomers

C. A group of substrates that have the same chemical structure

- D. One substrate
- E. Two substrates

8. The absolute specificity of enzymes is only an ability to catalyze a conversion of:

- A. One substrate
- B. One of stereoisomers
- C. One specific type of a chemical bond
- D. One specific group of substrates
- E. Many substrates

9. Specify an enzyme with optimal pH = 11.0: A. Arginase

- B. Catalase
- C. Lipase
- D. Pyruvate dehydrogenase
- E. Collagenase

10. A lot of enzymes consist of several subunits (protomers) that are joined by non-covalent bonds. What are they called?

- A. Oligomeric enzymes
- B. Coenzymes
- C. Apoenzymes
- D. Multienzyme complexes
- E. Isoenzymes

11. What is a region of an enzyme where substrate molecules bind and undego a chemical reaction called?

- A. Activator
- B. Allosteric Site
- C. Inhibitor
- D. Holoenzyme
- E. Active site

12. What is a membrane-bound multienzyme complex?

A. Specific enzymes are bound with the lipid bilayer of subcellular organelles

B. Specific enzymes are bound together by hydrogen bonds

C. Specific enzymes are not themselves bound

D. An enzyme is consisted of several protomers

E. Certain enzymes are bound together by covalent bonds

13. What is a non-protein part of enzyme called?

- A. Coenzyme
- B. Apoenzyme
- C. Activator
- D. Holoenzyme
- E. Inhibitor

14. What is a protein part of the enzyme called?

- A. Inhibitor
- B. Coenzyme
- C. Activator
- D. Apoenzyme
- E. Holoenzyme

15. What is a non-protein part of enzyme covalently binding with the protein part called?

- A. Coenzyme
- B. Prosthetic group
- C. Activator
- D. Inhibitor
- E. Holoenzyme

16. Enzymes speed up chemical reactions due to:

- A. Reduction of activation energy
- B. Increasing of activation energy
- C. Transition of molecules in an active state
- D. The formation of additional bonds
- E. The formation of covalent bonds

17. How does the increasing of enzyme concentration effect enzyme reaction rate?

- A. It proportionally increases
- B. It proportionally reduces
- C. It doesn't change
- D. It increases and then remains constant
- E. It decreases and then remains constant

18. What are substrates of proteolytic enzymes?

- A. Proteins
- B. Carbohydrates
- C. Vitamins
- D. Lipids
- E. Nucleic acids

19. What are enzymes?

A. Structural components of biological membranes

- B. Biocatalysts of protein nature
- C. Inorganic catalysts

D. Microelements that increase a rate of chemical reactions

- E. Organic molecules of a non-protein nature
- 20. What is a chemical nature of enzymes?
- A. Lipid
- B. Protein
- C. Polysaccharide
- D. Nucleic acid
- E. Vitamin

21. What are common properties between enzymes and inorganic catalysts?

- A. Specificity of action
- B. Their activity is dependent upon pH

C. They catalyse thermodynamically possible reactions only

- D. Dependence on an amount of substrate
- E. Dependence on an effector's action
- 22. What properties do enzymes have?
- A. Thermolability
- B. The small molecular weight
- C. Luminescence
- D. Resistance to the effects of heavy metal salts
- E. Thermostability

23. What are functions of enzymes connected with?

- A. Increasing of chemical reactions
- B. Decreasing of chemical reactions

C. Decrease in the pH optimum of the chemical reactions

D. Decrease in the temperature optimum of chemical reactions

E. Neutralization of products of chemical reactions

24. What is a role of an active site of an enzyme?

- A. Binding and conversion of substrate
- B. Attaching of enzymes to the membrane
- C. Regulation of enzyme's activity
- D. Interaction between enzymes
- E. Binding of allosteric effectors

25. What happens with enzymes by the action of a high temperature?

- A. Violation of a primary structure
- **B.** Hydrolysis
- C. Formation of an enzyme-substrate complex
- D. Blocking of an active site
- E. Denaturation

26. What determines a solubility of an enzyme?

A. Molar mass of the solvent

B. The ratio of hydrophobic and hydrophilic amino acid radicals in the structure of an enzyme

- C. Concentration of a solvent
- D. Atomic composition of a solvent
- E. The presence of a proper catalyst

27. What determines electrochemical properties of enzymes?

A. Qualitative and quantitative composition of amino acids

- B. Presence of a peptide bond
- C. Denaturation
- D. Renaturation
- E. Presence of protomers of protein molecules

28. At what temperature does an inactivation of enzymes begin as a result of their denaturation?

- A.  $50-60^{\circ}C$
- B.  $39^{\circ}_{\circ}C$
- C.  $80^{\circ}C$
- D.  $100^{\circ}C$
- E. 40 <sup>0</sup>C

#### 3. Measurement of enzymic activity. Units of catalytic activity of enzymes. Analysis of enzymic processes by the reaction type of main classes of enzymes.

1. The enzyme catalyzes the transfer of a functional group from one substrate to another one. Specify a class of the enzyme:

- A. Hydrolases
- B. Transferases
- C. Isomerases
- D. Oxidoreductases
- E. Ligases

2. Biogenic amines are produced by decarboxylases. What a class of enzymes decarboxylases belong to?

- A. Isomerases
- B. Lyases
- C. Oxidoreductases
- D. Hydrolases
- E. Transferases

3. Glucokinase catalyzes a reaction of a transfer of a phosphate group from ATP to glucose. What a class of enzymes glucokinase belongs to?

- A. Transferases
- **B.** Oxidoreductases
- C. Isomerases
- D. Hydrolases
- E. Lyases

4. Biological oxidation is a main energy molecular process. Which class of enzymes catalyzes this process?

- A. Oxidoreductases
- B. Hydrolases
- C. Lyases
- D. Ligases
- E. Transferases

5. Reactive oxygen species, including superoxide radical, are produced in the human body. Which enzyme is necessary for the inactivation of superoxide radical?

- A. Superoxide dismutase
- B. Catalase
- C. Glutathione
- D. Peroxidase
- E. Glutathione peroxidase

6. What class of the enzymes aerobic dehydrogenases belongs to?

- A. Oxidoreductases
- B. Lyases
- C. Transferases
- D. Hydrolases
- E. Ligases

7. What class of the enzymes protein kinases belongs to?

- A. Oxidoreductases
- B. Lyases
- C. Transferases
- D. Hydrolases
- E. Ligases

8. What class of the enzymes pepsin belongs to?

- A. Oxidoreductases
- B. Lyases
- C. Hydrolases
- D. Transferases
- E. Ligases

9. The activators of the enzymes are substances that:

- A. Increase the rate of a reaction
- B. Decrease the rate of a reaction
- C. Stimulate a denaturation of the enzymes
- D. Increase a reversibility of a reaction
- E. Cause enzymes' destruction

10. What are enzymes catalyzing reactions of an intramolecular transfer of groups or atoms called?

- A. Isomerases
- B. Ligases

- C. Hydrolases
- D. Transferases
- E. Oxidoreductases

11. What are enzymes catalyzing the splitting of the intramolecular bonds of organic substances by the use of water called?

- A. Hydrolases
- B. Ligases
- C. Lyases
- D. Oxidoreductases
- E. Transferases

12. The enzyme inhibitors are substances that:

- A. Decrease the rate of the reaction
- B. Increase the rate of the reaction
- C. Stimulate enzymes' denaturation
- D. Increase the reversibility of the reaction
- E. Cause enzymes' destruction

13. According to the type of a chemical reaction all enzymes are divided into:

- A. Seven classes
- B. Nine classes
- C. Five classes
- D. Seven subclasses
- E. Six classes

14. An international unit for an enzyme activity is katal, defined as an amount of enzyme that transforms:

- A. 1 mol of the substrate per 1 second
- B. 1 gram of the substrate per 1 second
- C. 1 gram of the substrate per 1 hour
- D. 1 mol of the product per 1 hour
- E. 1 µmol of the substrate per 1 second

15. Monooxygenases belong to the class of:

- A. Oxidoreductases
- B. Lyases
- C. Transferases
- D. Hydrolases
- E. Ligases

16. What principle is used to classify all enzymes into six classes?

- A. The type of the chemical reaction
- B. The type of bonds
- C. The type of the substrate
- D. Mechanism of an enzyme action
- E. The type of the product

17. What nomenclature is used to give a name to the enzymes in our days?

- A. Systematic
- B. Usual
- C. Common
- D. United
- E. The main

18. The enzymes of the cytochrome system participate in:

- A. Transfer of hydrogen atoms
- B. Transfer of electrons
- C. Transfer of oxygen atoms
- D. Transfer of proteins
- E. Transfer of molecules

19. How many numbers are in the enzyme code by the systematic nomenclature?

- A. Six
- B. Four
- C. Three
- B. Five
- E. Seven

20. Enzymes are placed in the cell in such way to ensure the performance of the functions of certain organelles. Which of the following enzymes are the lysosomal ones?

- A. Enzymes for the synthesis of urea
- B. Enzymes of protein synthesis
- C. Hydrolytic enzymes
- D. Fatty acid synthesis enzymes
- E. Glycogen synthesis enzymes
- 21. Peptidases catalyze the splitting of:
- A. Polypeptides
- B. Nucleic acids
- C. Polysaccharides
- D. Lipids
- E. Oligosaccharides
- 22. What enzyme belongs to peptidases?
- A. Urease
- B. ATP-ase
- C. RNA-polymerase
- D. Amylase
- E. Trypsin

23. The iron deficiency was established by a laboratory investigation. What enzyme activity is decreased in this case?

- A. Catalase
- B. Carbonic anhydrase

- C. Ceruloplasmin
- D. Carboxypeptidase
- E. Glutathione peroxidase

24. Pharmacological preparations which contain mercury, arsenic and other heavy metals inhibit enzymes which have a sulfhydryl group. What amino acids are used for the reactivation of these enzymes?

- A. Cysteine
- B. Isoleucine
- C. Histidine
- D. Aspartic acid
- E. Glycine

25. After applying the extract from pancreas into a tube with a solution of starch, it was observed a decline of blue staining in the sample with a solution of iodine, which indicates to hydrolysis of starch. Under the influence of what pancreatic enzyme it happens?

- A. α-Amylase
- B. Chymotrypsin
- C. Lipases
- D. Aldolases
- E. Trypsin

26. Specify the class of enzymes that uses ATP energy for the synthesis of new bonds:

- A. Isomerases
- B. Oxidoreductases
- C. Hydrolases
- D. Ligases
- E. Transferases

### 4. Analysis of the mechanism of enzymic action and kinetics of enzymic catalysis.

1. Saliva contains an enzyme that catalyses the hydrolysis of  $\alpha$ -1,4-glycosidic bonds of starch. What is the enzyme called?

- A. Peptidase
- B. Lactase
- C. Nuclease
- D. Lysozyme
- E. Amylase

2. It was revealed a significant decrease in pepsin activity in the analysis of the gastric juice of a patient with hypoacid gastritis. Indicate the possible biochemical mechanism of this phenomenon:

A. The absence of the intrinsic factor in the gastric juice

B. Denaturation of the enzyme molecule

C. Competitive inhibition of the enzyme

D. Decrease in the activation energy of the enzymatic reaction

E. Disruption of an enzyme formation from a proenzyme

3. An unknown substance was added to the enzyme-substrate system during studying the properties of an enzyme. As a result, the Michaelis constant was increased by 2 times. What phenomenon was observed?

A. Competitive inhibition

- B. Allosteric activation
- C. uncompetitive inhibition
- D. Noncompetitive inhibition
- E. Irreversible inhibition

4. Proteolytic enzymes of stomach and pancreas are synthesized in an inactive form as zymogens, and then activated in the digestive tract. What is a proteolytic enzyme of stomach synthesized in an inactive form called?

- A. Pepsin
- B. Trypsin
- C. Chymotrypsin
- D. Elastase
- E. Collagenase

5. Sulfonamide preparations inhibit the growth of bacteria. They are used for the treatment of the infectious diseases. What is the mechanism of their action?

A. Competitively inhibit the synthesis of folic acid

B. Allosteric inhibition of bacterial enzymes

C. Participate in oxidation-reduction processes

D. Inhibit the absorption of folic acid

E. Irreversibly inhibit the synthesis of folic acid necessary for the normal functioning of bacteria

6. The composition of saliva includes enzymes that break down carbohydrates. Specify saliva enzyme involved in hydrolysis of starch:

- A. Amylase
- B. Lactase

- C. Nuclease
- D. Maltose
- E. Peptidase

7. Sulfanilamide preparations were prescribed to the patients with angina. The antimicrobial effect of sulfanilamides is caused by the violation of the synthesis of folic acid. With what substance do sulfanilamides compete for the active site of the enzyme?

A. Para-aminobenzoic acid

- B. Glutamic acid
- C. Citrate
- D. Succinate
- E. Malate

8. Vomiting, flatulence and diarrhea were appeared in a newborn baby during the breast-feeding. The hereditary insufficiency of what enzyme is a cause of this state?

- A. Lactase
- B. Maltase
- C. Isomerase
- D. Oligo-1,6-glucosidase
- E. Pepsin

9. Biological oxidation and neutralization of xenobiotics is due to the heme-containing enzymes. Which metal is an obligatory component of these enzymes?

- A. Fe
- B. Zn
- C. Co
- D. Mg
- E. Mn

10. The buffer solution and an enzyme were incubated at  $80^{\circ}$ C for 30 minutes under modeling the biochemical process. The qualitative reaction is negative to the reaction product. What property of enzymes has led to the stop of the chemical reaction?

- A. Absolute specificity
- B. Denaturation of enzymes
- C. Stereospecificity
- D. Dependence on pH
- E. Relative specificity

11. A patient has a reduced gastric acidity and the violated digestion of proteins in the stomach. What is the enzymatic property observed in this case?

A. Specificity of the enzymes

B. The pH dependence of an enzymatic activity

C. Thermolability of enzymes

D. Denaturation of enzymes

E. Effect of inhibitors on an enzymatic activity

12. Methotrexate is a competitive inhibitor of dehydrofolate reductase. It is used for the bladder cancer treatment. On the interaction with which component is the mechanism of action of this drug based on?

- A. The active site of the enzyme
- B. Apoenzyme
- C. Allosteric site of the enzyme
- D. Prosthetic group
- E. Substrate

13. What phenomenon is the basis of the mechanism of enzyme's action?

A. Formation of an enzyme-substrate complex

B. Approximation of functional groups that enter the active site of the enzyme

C. Changing of the spatial configuration

D. Changing of the enzyme charge

E. Hydrolysis of the enzyme

14. The Michaelis constant is the substrate concentration when the velocity of the reaction is:

- A. Maximum
- B. Minimum
- C. A half of the maximum
- D. A half of the minimum
- E. One-third of the maximum

15. The absence of a change in the rate of the enzymatic reaction with increasing substrate concentration is associated with:

A. Blocking of the allosteric site

- B. Denaturation of the enzyme
- C. Saturation of allosteric site
- D. Saturation of an active site
- E. Increase in the temperature of the medium

16. Acetylcholinesterase is an enzyme that catalyses a breakdown of acetylcholine. Insecticides, pesticides and poisons with nervously-paralytic action based on fluorophosphates irreversibly inhibit acetylcholinesterase. Specify a mechanism of the inhibition: A. Inhibitors bind to serine residue in the active site of the enzyme

B. Inhibitors bind to histidine residue in the allosteric site

C. Inhibitors are the structural analogs of the substrate

D. Inhibitors form complex with acetylcholine

E. Inhibitors cause denaturation of the enzyme

17. Digestion of different food components occurs in the duodenum under the influence of pancreatic enzymes. Which of the following enzymes hydrolyses O-glycoside bonds of carbohydrates?

- A. Alpha-Amylase
- B. Carboxypeptidase
- C. Lipase
- D. Trypsin
- E. Urease

18. Saliva contains an enzyme that has bactericidal effect due to its ability to destroy the peptidoglycan of the bacterial cell wall. Name this enzyme:

- A. Lysozyme (muramidase)
- B. α-amylase
- C. Trypsin
- D. Phosphatase
- E. Ribonuclease

19. The structure of the active site of a simple enzyme contains only:

- A. Coenzymes
- B. Co-substrates
- C. Radicals of the allosteric site
- D. Amino acid radicals

E. Radicals of inhibitors in complex with ions of metals

20. In accordance with the Kosland theory, the substrate is able to induce changes in the configuration of an enzyme molecule in accordance with its structure and as a result, binding with the substrate molecule occurs in the active site of an enzyme. What is not a function of the active site?

- A. Interaction with effectors
- B. Formation of an enzyme-substrate complex
- C. Catalytic transformation of the substrate
- D. Specific binding to the substrate
- Е. ---

### 5. Analysis of regulation of enzymic processes.

1. A structural feature of regulatory enzymes is presence of an allosteric site. Specify its role:

- A. It changes a structure of a substrate
- B. It binds a substrate
- C. It binds a regulatory effector
- D. It promotes a dissociation of a coenzyme
- E. It binds a coenzyme

2. Organophosphorus compounds are highly toxic poisons with nervously-paralytic action based on an inhibition of an activity of acetylcholinesterase by forming covalent bonds with the OH groups of serine in the active site of an enzyme. What type of the inhibition is characteristic for this class of compounds?

- A. Irreversible
- B. Reversible
- C. Competitive
- D. Non-competitive
- E. Retroinhibition

3. Acetyl-CoA carboxylase is the key enzyme in the synthesis of fatty acids. One way to regulate the activity of Acetyl-CoA carboxylase is feedback inhibition by the final product palmitoyl-CoA. What kind of inhibition feedback inhibition belongs to?

- A. Allosteric inhibition
- B. Competitive inhibition
- C. Irreversible inhibition
- D. Covalent modification of the enzyme
- E. Non-competitive inhibition

4. Tabun, Sarin and diisopropylfluorophosphate organophosphorus are compounds. They are highly toxic poisons with nervously-paralytic action. Which of the following enzymes is inhibited by organophosphorus compounds?

- A. Acetylcholinesterase
- B. Phospholipase A<sub>2</sub>
- C. Angiotensin converting enzyme
- D. Tyrosine aminotransferase
- E. Cytochrome P450

5. Name the type of enzyme inhibition where the chemical structure of an inhibitor resembles the structure of the substrate:

- A. Competitive
- B. Non-competitive
- C. Uncompetitive
- D. Substrate
- E. The irreversible

6. Name the type of enzyme inhibition where the inhibitor binds at a site other than the enzyme's active site:

- A. Competitive
- B. Non-competitive
- C. Uncompetitive
- D. Substrate
- E. Allosteric

7. The anti-inflammatory drug that blocks the action of cyclooxygenase was used for treatment of a patient. What is an anti-inflammatory drug called?

- A. Aspirin
- B. Analgin
- C. Allopurinol
- D. Thiamine
- E. Creatine

8. The transformation of inactive proinsulin into an active one occurs by:

- A. Partial proteolysis
- B. Attachment of the regulatory subunit
- C. Changes in the tertiary structure
- D. Phosphorylation-dephosphorylation
- E. Attachment of C-peptide

9. The interaction of carbomoyl phosphate and aspartate is the first step in the synthesis of pyrimidine nucleotides in the E. coli cell, which is catalyzed by the enzyme aspartate carbamoyltransferase. The synthesis of pyrimidine nucleotides is stopped under the increasing of the concentration of UTP in the cell. Specify the type of regulation of aspartate carbamoyltransferase:

- A. Partial proteolysis
- B. Allosteric regulation
- C. Phosphorylation of an enzyme
- D. Effect of inhibitory proteins
- E. Cleavage of inhibitory proteins

10. A patient has an acute pancreatitis. What medications should a doctor prescribe to prevent a pancreatic autolysis?

A. Inhibitors of proteases

B. Activators of proteases

C. Trypsin D. Chymotrypsin

E. Amylase

11. A doctor prescribed trasylol (contrykal, gordox) to prevent attacks of acute pancreatitis, which inhibits the activity of:

- A. Trypsin
- B. Chymotrypsin
- C. Gastricin
- D. Carboxypeptidases
- E. Elastases

12. A patient suffering from tuberculosis was prescribed isoniazid. It is a structural analogue of nicotinamide and pyridoxine. What type of an inhibition by the mechanism of action isoniazid causes?

- A. Competitive
- B. Irreversible
- C. Non-competitive
- D. Allosteric
- E. Uncompetitive

13. ATP is an effector for the hexokinase that is a regulatory enzyme of glycolysis. As a result of their interaction with the enzyme, structural changes occur and hexokinase loses its catalytic activity. Which structural unit of the enzyme does ATP bind to?

- A. Apoenzyme
- B. Allosteric site
- C. Anchor part of the active site
- D. Catalytic part of the active site
- E. All of the above

14. Which part of an enzyme the regulators interact with changing enzyme's activity?

- A. Anchor part of the active site
- B. Allosteric site
- C. Catalytic part of the active site
- D. Proenzyme (zymogen)
- E. Parallosteric site

15. Salicylates are reversible non-competitive inhibitors of glutamate dehydrogenase. Choose a method that can be used to reduce a degree of an enzyme inhibition?

A. Reduce the substrate concentration

- B. Increasing substrate concentration
- C. To reduce the pH value of the medium
- D. Enter a structural analog of the substrate
- E. To reduce a concentration of an inhibitor

16. Which of the following substances activates conversion of pepsinogen into pepsin by a partial proteolysis?

- A. Bile acids
- B. Enterokinase
- C. NaCl
- D. ATP
- E. HCl

17. What type of inhibition is observed under the use of proserin that is an acetylcholinesterase inhibitor?

- A. Reversible
- B. Competitive
- C. Non-competitive
- D. Uncompetitive
- E. Allosteric

18. What is a competitive inhibitor of succinate dehydrogenase?

- A. Malonate
- B. Alanine
- C. Succinate
- D. Fumarate
- E. Alfa-ketoglutarate

19. When studying the composition of pancreatic juice, it was found that it contains a large number of enzymes. Some of them are secreted in an inactive form. What are these enzymes?

- A. Sucrase, amylase
- B. Nuclease, Pepsin
- C. Trypsinogen, chymotrypsinogen
- D. Catalase, lipase
- E. Nuclease, peptidase

20. In the human body chymotrypsin is secreted by pancreas and converted to an active chymotrypsin by a partial proteolysis in the lumen of the small intestine under the action of:

- A. Trypsin
- B. Enterokinases
- C. Pepsin
- D. Aminopeptidases
- E. Carboxypeptidases

21. One of the methods of treatment for methanol poisoning is that the patient is prescribed ethanol inside or intravenously in an amount that causes intoxication in a healthy person. Why is this treatment effective?

A. Ethanol competes with methanol for the active site of alcohol dehydrogenase

B. Ethanol binds the allosteric site of alcohol dehydrogenase, which is inactivated

C. Ethanol competes with methanol for the allosteric site of alcohol dehydrogenase

D. Ethanol blocks the enzyme alcohol dehydrogenase

E. Ethanol is split faster than methanol, resulting in less toxic products

22. In medical practice teturam is widely used for the prevention of alcoholism. Teturam is an inhibitor of acetaldehyde dehydrogenase. The increase of what metabolite in the blood, forming during the dehydrogenation of ethanol, causes an aversion to alcohol?

A. Methanol

- B. Acetoacetate
- C. Malondialdehyde
- D. Propionaldehyde
- E. Acetaldehyde

#### 6. Medical enzymology.

1. It was observed an increased hemolysis of erythrocytes in a 3-year-old child with an increased body temperature after aspirin taking. Congenital insufficiency of what enzyme causes hemolytic anemia?

- A. Glucose-6-phosphatase
- B. Glucose-6-phosphate dehydrogenase
- C. Glycogen phosphorylase
- D. Glycerolphosphate dehydrogenase
- E. γ-glutamyltransferase

2. It is found the dark spots on the diaper of a newborn. After identification it is established that it is homogentisinic acid. With the violation of the exchange of what substance is it related?

- A. Galactose
- B. Tyrosin
- C. Methionine
- D. Cholesterol
- E. Tryptophan

3. Dyspepsia is appeared in a newborn baby after the breast-feeding. The symptoms of dyspepsia disappear after the replacing of milk with glucose solution. The decreased activity of which enzyme is the cause of the indicated disorders?

- A. Sucrase
- B. Lactase
- C. Maltase
- D. Amylase
- E. Isomaltase

4. A 2-year-old child has lag of physical and mental development. The child's skin and hair is light, the concentration of catecholamines is reduced in the blood. The adding of a few drops of 5% solution of trichloroacetic iron to the fresh urine causes an appearance of the olive-green coloring. The disturbance of the metabolism of what amino acid is the cause of the indicated disorders?

- A. Phenylketonuria
- B. Alkaptonuria
- C. Tyrosinosis
- D. Albinism
- E. Cystinuria

5. Ultrasonic examination of a 10-year-old boy revealed the kidney stones. The concentration of all aliphatic amino acids was high in the blood. What was the most likely pathology?

- A. Cystinuria
- B. Alkaptonuria
- C. Fanconi syndrome
- D. Phenylketonuria
- E. Hartnup disease

6. A patient is diagnosed with alkaptonuria. The defect of what enzyme causes the pathology?

A. Homogentisate oxidase

- B. Phenylalanine hydroxylase
- C. Glutamate dehydrogenase
- D. Pyruvate dehydrogenase
- E. Pyruvate carboxylase

7. A sick child is diagnosed with the galactose-1-phosphate uridyltransferase deficiency. What is the most likely pathology?

- A. Galactosemia
- B. Fructosemia
- C. Hyperglycemia
- D. Hypoglycemia
- E. Hyperlactatacidemia

8. A 1-year-old child has lag of mental development. Vomiting, convulsions and loss of consciousness are observed in the morning. Hypoglycemia is revealed on an empty stomach. The deficiency of what enzyme is the cause of the indicated disorders?

A. Glycogen synthetase

- B. Phosphorylase
- C. Arginase
- D. Sucrase
- E. Lactase

9. Laboratory testing of a sick child's blood revealed a high amount of galactose and decreased concentration of glucose. Lag of mental development and cataract are observed in a child. What is the most likely disease?

- A. Diabetes mellitus
- B. Lactosemia
- C. Galactosemia
- D. Steroid diabetes
- E. Fructosemia

10. A patient is diagnosed with steatorrhea under a laboratory investigation. The deficiency of what enzyme is the cause of the indicated disorder?

- A. Chymotrypsin
- B. Amylase
- C. Pepsin
- D. Lactase
- E. Lipase

11. A patient was brought to the surgical department with a diagnosis of acute pancreatitis. Conservative therapy was started. The prescription of what drug is pathogenetically grounded?

A. Fibrinolysin

- B. Trypsin
- C. Chymotrypsin
- D. Pancreatin
- E. Contrykal

12. A 7-year-old boy was brought to a clinic with signs of mental and physical retardartion. The biochemical analysis showed an increased amount of phenylalanine in the blood. The deficiency of what enzyme is the cause of the indicated disorders?

- A. Glutamate decarboxylase
- B. Homogentisate oxidase

- C. Glutamintransaminase
- D. Aspartate aminotransferase
- E. Phenylalanine-4-monooxygenase

13. Parents of a 3-year-old child paid attention to the darkening of the color of child's urine in the air. Objectively: the temperature is normal, the skin is pink, clean and the liver is not enlarged. Indicate the most likely pathology:

- A. Alkaptonuria
- B. Hemolysis
- C. Cushing syndrome
- D. Phenylketonuria
- E. Gout

14. What protease inhibitor used to treat pancreatitis was first isolated from the salivary glands of cattle?

- A. Trasylol
- B. Allopurinol
- C. Kallikrein
- D. Amylase
- E. Lysozyme

15. Laboratory examination of a child revealed a high level of leucine, valine, isoleucine and their keto derivatives in the blood and urine. The urine had a characteristic odor of a maple syrup. The deficiency of what enzyme caused the disease?

- A. Dehydrogenase of branched amino acids
- B. Aminotransferase
- C. Glucose-6-phosphatase
- D. Phosphofructokinase
- E. Phosfofructomutase

16. Hydrogen cyanide and cyanides are strong poisons. Depending on the dose, death occurs within a few seconds or minutes. The inhibition of what enzyme causes the death?

- A. Cytochromoxydase
- B. Acetylcholinesterase
- C. ATP synthase
- D. Catalase
- E. Methemoglobinreductase

17. A patient complains of chronic fatigue and dizziness. He works at a chemical plant for the production of hydrocyanic acid. The disorder of what enzyme's function is the cause of the indicated symptoms? A. Cytochrome oxidase

- B. Lactate dehydrogenase
- C. Succinate Dehydrogenase
- D. Catalase
- E. Pyruvate dehydrogenase

18. A 38-year-old patient is observed an enhanced hemolysis after taking aspirin and sulfanilamides caused by the deficiency of glucose-6-phosphate dehydrogenase. The impaired formation of what coenzyme causes the pathology?

- A. NADPH<sub>2</sub>
- B. FADH<sub>2</sub>
- C. Pyridoxal phosphate
- D. FMNH<sub>2</sub>
- E. Ubiquinone

19. An 8-month-old child was observed vomiting and diarrhea after taking fruit juices. The hereditary deficiency of what enzyme causes the disorders?

- A. Fructokinase
- B. Fructose-1-phosphate aldolase
- C. Hexokinase
- D. Phosphofructokinase
- E. Fructose-1,6-diphosphatase

20. A high level of phenylpyruvate was found in the urine of a sick child. The content of phenylalanine is 350 mg / 1 (the norm is about 15 mg / 1). What is a probable pathology?

- A. Albinism
- B. Phenylketonuria
- C. Tyrosinosis
- D. Alkaponuria
- E. Gout

21. Under the treatment of a patient's wound surface of an oral mucosa with hydrogen peroxide, the blood was colored brown instead of foaming. The decrease of the concentration of what enzyme causes such disorders?

- A. Catalase
- B. Pseudocholinesterase
- C. Glucose-6-phosphate dehydrogenase
- D. Acetyltransferase
- E. Methemoglobin reductase

22. A mother noticed a dark staining of urine from her 5-year-old child. There were no bile pigments in the urine. The diagnosis is

alkaponuria. The defect of what enzyme causes this pathology?

- A. Decarboxylase of phenylpyruvate
- B. Phenylalanine hydroxylase
- C. Tyrosinase
- D. Oxydase of hydroxyphenylpyruvate
- E. Homogentisate oxidase

23. Secretory activity of parotid salivary glands is reduced with age. The activity of what salivary enzyme will be decreased sharply?

- A. Maltase
- B. Lysozyme
- C. Phosphatase
- D. Hexokinase
- E. Amylase

24. Organisms that in the process of evolution have not created protection against  $H_2O_2$ , can live only under anaerobic conditions. Which of the listed enzymes can destroy hydrogen peroxide?

- A. Peroxidase and catalase
- B. Oxygenases and hydroxylases
- C. Cytochrome oxidase, cytochrome B5
- D. Oxygenase and catalase
- E. Flavine-dependent oxidases

25. A 42 year-old man suffering from gout has increased concentration of uric acid in the blood. He was prescribed allopurinol to reduce the level of uric acid. The competitive inhibitor of what enzyme is allopurinol?

- A. Xanthine oxidase
- B. Adenosine deaminase
- C. Adenine phosphoribosyltransferase
- D. Hypoxanthine phosphoribosyltransferase
- E. Guanine deaminase

26. A 47-year-old man was removed a salivary gland under medical indications. The content of amylase in saliva sharply decreased after the operation. Which gland was removed?

- A. Submandibular
- B. Parotid
- C. The palatine
- D. Gingival
- E. Sublingual

27. Digestion of proteins in the stomach is the initial stage of protein digestion in the human

gastrointestinal tract. Name the enzymes involved in the digestion of proteins in the stomach:

- A. Enteropeptidase and elastase
- B. Trypsin and catheptins
- C. Chymotrypsin and lysozyme
- D. Pepsin and gastricin

E. Carboxypeptidase and aminopeptidase

28. A 50-year-old woman was brought to a clinic with diagnosis of myocardial infarction. The activity of what enzyme will be increased during the first two days of the disease?

- A. Aspartate aminotransferase
- B. Alanine aminotransferase
- C. Alanine aminopeptidase
- D. LDH<sub>4</sub>
- E. LDH<sub>5</sub>

29. The activity of lactate dehydrogenase in the patient's blood is increased in 6 hours after an acute myocardial injury. Which isoform of this enzyme is increased?

A. 1

- B. 6
- C. 3
- D. 4
- E. 5

30. A child suffering from Lesch-Nyhan syndrome has a severe form of hyperuricemia, accompanied by the appearance of tophi, urate stones in the urinary tract and severe neuropsychiatric disorders. A decrease in the activity of which enzyme is the cause of this disease?

A. Hypoxanthine-guanine phosphoribosyltransferase

- B. Xanthine oxidase
- C. Hydrofolate reductase
- D. Thymidylate synthase
- E. Carbomoyl phosphate synthetase

31. A 49-year-old patient suffering from acute pancreatitis has a threat of pancreonecrosis development, which was accompanied by the leaking of active pancreatic proteinases into the blood and tissues and the cleavage of tissue proteins. What protective factors of the body can inhibit these processes?

- A. A<sub>2</sub>-macroglobulin,  $\alpha_1$ -antitrypsin
- B. Immunoglobulins
- C. Cryoglobulin, interferon

D. Ceruloplasmin, transferrin

E. Hemoplexin, haptoglobin

32. Activity of a number of enzymes and their isoforms is determined in the blood for the biochemical diagnosis of myocardial infarction. Which enzyme test is considered the best to confirm or exclude the diagnosis of the myocardial infarction in the early period after the onset of chest pain?

- A. MB isoform of creatine phosphokinase
- B. MM isoform of creatine phosphokinase
- C. LDH<sub>1</sub> isoform of lactate dehydrogenase

D. LDH<sub>5</sub> isoform of lactate dehydrogenase

E. Cytoplasmic isoenzyme of aspartate aminotransferase

33. A study of a secretory function of the stomach revealed a decrease in the concentration of hydrochloric acid in the gastric juice. The activity of which enzyme is reduced in this case?

- A. Pepsin
- B. Amylase
- C. Lipase
- D. Dipeptidase
- E. Hexokinase

34. After taking milk diarrhea, bloating of the intestine were observed in a one-year-old child. What enzyme deficiency caused the symptoms in the baby?

- A. Lactase
- B. Maltase
- C. Aldolase
- D. Hexokinase
- E. Glycosidase

35. A patient has an acute pancreatitis. What drugs prevent the autolysis of the pancreas?

- A. Inhibitors of proteases
- B. Protease activators
- C. Trypsin
- D. Chymotrypsin
- E. Amylase

36. The increased activities of  $LDH_{1,2}$ , AST, MB-isoform of creatine phosphokinase were found in a patient's blood. In which of the following organs is a pathological process probably developed?

- A. Cardiac muscle
- B. Pancreas

C. The liver D. Kidneys E. Skeletal muscles

37. In the human body chymotrypsinogen is secreted by the pancreas and converted to an active chymotrypsin by the partial proteolysis in the lumen of the small intestine. What class of enzymes it belongs to?

- A. Hydrolases
- B. Lyases
- C. Isomerases
- D. Oxidoreductases
- E. Synthetases

## 7. Analysis of the role of cofactors and coenzyme vitamins $(B_2, PP, B_6)$ in the catalytic activity of enzymes.

1. The doctor prescribed pyridoxal phosphate for a patient according to the clinical indication. For the correction of what pathological processes was this medicine recommended?

A. Transamination and decarboxylation of amino acids

B. Oxidative decarboxylation of keto acids

C. Deamination of purine nucleotides

D. Synthesis of purine and pyrimidine bases

E. Synthesis of protein

2. A patient is diagnosed with pellagra. It is known that the patient ate corn and practically did not eat meat for a long time. Deficiency of which substrate led to this pathology?

A. Tryptophan

- B. Tyrosin
- C. Proline
- D. Alanin
- E. Histidin

3. A 47-year-old patient suffering from tuberculosis of the upper lobe of the right lung received isoniazid in the combined therapy. After a while, the patient began to complain of a muscle weakness, a decreased skin sensitivity, an impaired vision and coordination of movements. What vitamin should be used to eliminate these symptoms?

- A. Vitamin B<sub>6</sub>
- B. Vitamin A
- C. Vitamin D

D. Vitamin  $B_{12}$ 

E. Vitamin C

4. A 32-year-old patient is suffering from vitamin  $B_2$  hypovitaminosis. The cause of an occurrence of specific symptoms (defeat of the epithelium, mucous membranes, skin, cornea of the eye) is most likely a deficit of:

- A. Flavin coenzymes
- B. Cytochrome a<sub>1</sub>
- C. Cytochrome oxidase
- D. Cytochrome b
- E. Cytochrome c

5. Dermatitis, diarrhea and dementia are observed in a patient. When collecting an anamnesis, it has been turned out that he was a vegetarian. The deficiency of which vitamin caused indicated disorders?

- A. Vitamin PP
- B. Vitamin B1
- C. Vitamin B2
- D. Vitamin H
- E. Vitamin C

6. A doctor prescribed isoniazid for a 39-yearold patient suffering from tuberculosis of the lungs. The deficiency of what vitamin could be developed due to prolonged use of this drug?

- A. Pyridoxine
- B. Thiamine
- C. Cobalamin
- D. Biotin
- E. Folic acid

7. Dermatitis, diarrhea and dementia were revealed during medical examination of a patient. The absence of which vitamin caused such clinical symptoms?

- A. Nicotinamide
- B. Ascorbic acid
- C. Folic acid
- D. Biotin
- E. Rutin

8. The symptoms of pellagra (vitamin PP deficiency) are particularly pronounced in the patients obtaining a low protein diet, because one of the essential amino acids is a precursor of nicotinamide in the human body. What is this amino acid?

A. Tryptophan

B. Threonine

- C. Arginine
- D. Histidine
- E. Lysine

9. The activity of blood transaminases is determined for the diagnosis of certain diseases. Which vitamin is a cofactor of these enzymes?

- A. B<sub>6</sub>
- **B**. **B**<sub>2</sub>
- C. B<sub>1</sub>
- D. B<sub>12</sub>
- E. B<sub>c</sub>

10. The structural analogs of vitamin  $B_2$  (riboflavin) are prescribed for the patients suffering from malaria. Violations of the synthesis of what enzymes in plasmodium are caused by using of these drugs?

- A. FAD-dependent dehydrogenases
- B. Cytochrome
- C. Peptidase
- D. NAD-dependent dehydrogenases
- E. Aminotransferase

11. Which vitamin is the precursor of  $NAD^+$  and  $NADP^+$  coenzymes?

- A. PP
- $B. B_2$
- C. B<sub>12</sub> D. B<sub>3</sub>
- E. B<sub>1</sub>

12. The patient has a decreased appetite, diarrhea, pallor and dry skin, cyanosis of the lips, cheeks and hands. The tongue is shiny "lacquer", its edema is observed (teeth marks are visible around the edges). The deficiency of which vitamin is observed?

- A. PP
- $B. B_2$
- C. B<sub>1</sub>
- D. B<sub>3</sub>
- E. B<sub>12</sub>

13. Muscle weakness, irritability, skin lesions, hair loss and anemia are observed in a patient under the tuberculosis treatment with isoniazid. The deficiency of which vitamin caused the disorders?

A. B<sub>6</sub>

B. B<sub>2</sub>

- C. B<sub>12</sub>
- D.  $B_3$
- E.  $B_1$

14. Oxidoreductases are the first class of enzymes. What are their coenzymes?

- A. NAD, NADP, FAD, FMN
- B. Methylcobalamin, THF
- C. TGF, CoA, 4-phosphopantetein
- D. TPP, carboxibiotin
- E. TPP, pyridoxal-5-phosphate

15. These coenzymes are prosthetic groups of oxidoreductases, part of succinate dehydrogenase and xanthine oxidase. What are they?

- A. FAD, FMN
- B. NAD, NADP
- C. THF
- D. TPP
- E. CoA

16. This is the most important coenzyme in the metabolism of amino acids. It is a part of transaminases and decarboxylases of amino acids. What is the coenzyme called?

- A. Pyridoxal-5-phosphate
- B. NAD, NADP
- C. THF
- D. TPP
- E. CoA

17. This vitamin is involved in all types of metabolism. Funicular myelosis and megaloblastic anemia are developed under its absence. What is this vitamin?

- A. Thiamine
- B. Pyridoxine
- C. Riboflavin
- D. Biotin
- E. Cobalamin

## 8. Analysis of the role of cofactors and coenzyme vitamins $(B_3, B_c, B_1, B_{12}, H, lipoic acid)$ in the catalytic activity of enzymes.

1. Oxidative decarboxylation of  $\alpha$ -ketoglutaric acid is decreased as a result of vitamin B<sub>1</sub> deficiency. The synthesis of which of the following coenzymes is disordered in this case?

A. Coenzyme A

- B. Nicotinamide adenine dinucleotide
- C. Flavin adenine dinucleotide
- D. Lipoic acid
- E. Thiamine pyrophosphate

2. A patient is suffering from the disrupted absorption of vitamin  $B_{12}$  after operative removal of a part of stomach. Anemia has been developed in the patient. Which factor is necessary for the absorption of this vitamin?

- A. Castle's intrinsic factor
- B. Gastrin
- C. Hydrochloric acid
- D. Pepsin
- E. Folic acid

3. Concentration of pyruvate is increased in the patient's blood. A significant amount of it is excreted in the urine. The deficiency of what vitamin is developed in a patient?

- A.  $B_2$
- B. E
- $C. B_3$
- $D. B_6$
- E. B<sub>1</sub>

4. The cause of pellagra can be preferential feeding of corn and reduction in the diet of products of animal origin. Absence of which amino acid in the diet leads to this pathology?

- A. Tryptophan
- B. Tyrosine
- C. Proline
- D. Alanine
- E. Histidine

5. After the removal of the 2/3 of the patient's stomach it has been observed the decreased content of hemoglobin and red blood cells in the blood. The megaloblastic cells are appeared in the blood test. The deficiency of what vitamin leads to such changes?

- A. B<sub>12</sub>
- B. C
- C. P
- $D. \ B_6$
- E. PP

6. Cocarboxylase (thiamine pyrophosphate) is used for the treatment of many diseases, normalizing energy metabolism. Which process is activated?

A. Oxidative decarboxylation of pyruvate

- B. Deamination of glutamate
- C. Decarboxylation of amino acids
- D. Deamination of biogenic amines
- E. Detoxification of xenobiotics in the liver

7. Addison-Biermer disease is a malignant hyperchromic megaloblastic anemia. It is caused by the deficiency of vitamin  $B_{12}$ . Which microelement is a part of the vitamin?

- A. Cobalt
- B. Molybdenum
- C. Zinc
- D. Iron
- E. Magnesium

8. A worker of the poultry factory consuming 5 or more raw eggs every day complains of the weakness, drowsiness, pain in the muscles, hair loss and seborrhea. The deficiency of what vitamin is the cause of this state?

- A. H (biotin)
- B. C (ascorbic acid)
- C. A (retinol)
- D. B<sub>1</sub> (thiamine)
- E. B<sub>2</sub> (riboflavin)

9. Hyperpyruvatemia was revealed in the patient. The deficiency of what vitamin is observed in the patient?

- A.  $B_1$
- B. E
- C. B<sub>3</sub>
- D. B<sub>6</sub>
- E. B<sub>2</sub>

10. A 4-year-old child has been delivered to a hospital with symptoms of paresis of the lower limbs. It was revealed an anemia, high concentration of methylmalonate in the blood. The lack of what vitamin caused these symptoms?

- A. Cobalamin
- B. Pantothenic acid
- C. Vitamin A
- D. Niacin
- E. Biotin

11. A 55-year-old man suffering from alcoholic liver cirrhosis was diagnosed with megaloblastic anemia. The deficiency of what vitamin caused development of anemia? A. Lipoic acid

- B. Folate
- C. Biotin
- D. Riboflavin
- E. Pantothenic acid

12. Some amino acids, vitamin derivatives and phosphoric esters of ribose are involved in the biosynthesis of purine nucleotides. The coenzyme form of which vitamin is a carrier of one-carbon fragments in the synthesis of purine nucleotides?

- A. Folate
- B. Pantothenic acid
- C. Niacin
- D. Riboflavin
- E. Pyridoxine

13. A patient was diagnosed with seborrheic dermatitis associated with the deficiency of vitamin H (biotin). The reduced activity of which enzyme is observed in the patient?

- A. Acetyl-CoA carboxylase
- B. Pyruvate decarboxylase
- C. Alcohol dehydrogenase
- D. Aminotransferase
- E. Carbamoyl phosphate synthetase

14. A patient suffering from atrophic gastritis was diagnosed with megaloblastic anemia. The deficiency of which compound caused the development of anemia?

- A. Gastromucoprotein (Castle factor)
- B. Vitamin B<sub>6</sub>
- C. Vitamin B<sub>1</sub>
- D. Iron
- E. Erythropoietin

15. Steatosis is caused by an accumulation of triacylglycerols in hepatocytes. What lipotropic substances prevent the development of liver steatosis?

- A. Methionine,  $B_6$ ,  $B_{12}$
- B. Arginine, B<sub>2</sub>, B<sub>3</sub>
- C. Alanine, B<sub>1</sub>, PP
- D. Valine,  $B_3$ ,  $B_2$
- E. Isoleucine, B<sub>1</sub>, B<sub>2</sub>

16. Vitamins taking part in the biochemical processes of the body are synthesized by the normal microflora of the large intestine. What vitamins are synthesized primarily by microorganisms? A. E. PP

- B. A, C C. K, B<sub>12</sub> D. B<sub>1</sub>, B<sub>2</sub>
- $E. B_6, E$

17. What vitamins are necessary for the reactions of the Krebs cycle?

- A. B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, PP
- B.  $B_c$ ,  $B_{12}$ ,  $B_{15}$ , A
- C. D, K, C, B<sub>15</sub>
- D. E, P,  $B_{15}$
- E. C, B<sub>12</sub>, D, K

18. Which of the following vitamins is essential for fatty acid synthesis?

- A. Biotin
- B. Folate
- C. Niacin
- D. Ascorbic acid
- E. Cobalamine

19. Which of the following vitamins provides a cofactor for transfer of one-carbon units?

- A. Riboflavin
- B. Pyridoxine
- C. Niacin
- D. Folate
- E. Thiamin

20. Megaloblastic anemia has two most likely causes, deficiency of folate and deficiency of cobalamin. Often treatment of patients with cobalamin deficiency improves in terms of their hematologic features with treatment with folate but not in their neurologic symptoms. What is the most likely explanation for this?

A. Excess of folate blunts the trapping of folate as N5-methyltetrahydrofolate

B. Cobalamin deficiency is not serious

C. Folate in high concentrations can serve as a cofactor for the conversion of homocysteine to methionine

D. Excess of folate directly inhibits the destruction of red blood cells

E. Excess of folate stimulates erythropoietic tissues to synthesize cobalamin in situ

21. A patient was diagnosed with the vitamin H (biotin) deficiency. The reduced activity of which of the following enzymes is observed in the patient?

A. Pyruvate carboxylase

B. Pyruvate decarboxylase

- C. Alcoholdehydrogenase
- D. Aminotransferase
- E. Carbamoyl phosphate synthetase

## 9. Basic concepts of metabolism. Common catabolic pathways of proteins, carbohydrates and lipids.

1. Bioenergetics of the brain is significantly dependent upon oxygen supply. What substrate of oxidation is the main energy source for neurons?

- A. Glucose
- B. Fatty acids
- C. Ketone bodies
- D. Glycerol-3-phosphate
- E. Phosphoenolpyruvate

2. Exergonic metabolic reactions take place with:

- A. Energy release
- B. Energy absorption
- C. Heat generation
- D. Absorption of heat
- E. ATP absorption
- 3. Endergonic metabolic reactions take place with:
- A. Energy absorption
- B. Energy release
- C. Heat generation
- D. Absorption of heat
- E. ATP absorption

4. Indicate the category of metabolism, which is characterized by processes of synthesis of complex substances from simpler ones with energy absorption:

- A. Catabolism
- B. Anabolism
- C. Amphibolic pathway
- D. Dualism
- E. Anaplerotic reactions

5. Indicate the category of metabolism, which is characterized by processes of breakdown of complex substances to simpler ones with energy release:

- A. Anabolism
- B. Catabolism
- C. Amphibolic pathway
- D. Dualism

E. Anaplerotic reactions

6. Amphibolic process serves as a source of metabolites for:

- A. Anabolic processes
- B. Catabolic processes
- C. Both anabolic and catabolic processes
- D. Protein synthesis
- E. Anaplerotic reactions

7. What type of membrane transport requires ATP?

- A. Facilitated diffusion
- B. Simple diffusion
- C. Osmosis
- D. Filtration
- E. Active transport

8. In which cellular compartment does the third stage of catabolism occur?

- A. Mitochondria
- B. Nucleous
- C. Cytosol
- D. Lysosomes
- E. Golgi apparatus

9. What biochemical process of general pathway of catabolism of proteins, lipids and carbohydrates produces carbon dioxide as an end product of metabolism?

- A. Krebs circle
- B. Glycolysis
- C. Tissue respiration
- D. Gluconeogenesis
- E. Lipolysis

10. What biochemical process of general pathway of catabolism of proteins, lipids and carbohydrates produces water as an end product of metabolism?

- A. Tissue respiration
- B. Krebs circle
- C. Glycolysis
- D. Gluconeogenesis
- E. Lipolysis

11. How many percents of the chemical energy of the substance are transformed into ATP during its oxidation?

- A. 42
- B. 30
- C. 20
- D. 65

E. 70

12. Macroergic compounds are necessary for normal metabolism in the cells. Which of these components belongs to macroergic compounds?

- A. Phosphocreatine
- B. Creatine
- C. Creatinine
- D. Glucose-6-phosphate
- E. Adenosine monophosphate

13. Which of the following substances maximally promotes the utilization of inorganic phosphate during the oxidation? A. Palmitoyl-CoA

- B. Acetyl-CoA
- C. Glucose
- D. Succinate
- E. Glycerol

14. What is the maximal energy value of

aerobic oxidation of glucose? A. 38 ATP

- B. 12 ATP
- C. 2 ATP
- D. 24 ATP
- E. 50 ATP

15. How many ATP molecules are produced from palmitic acid oxidation?

- A. 50 ATP
- B. 12 ATP
- C. 2 ATP
- D. 147 ATP
- E. 130 ATP

16. What stage of catabolism releases maximum of energy?

- A. Third stage of catabolism
- B. Glycolysis
- C. First stage of catabolism
- D. Oxidation of pyruvate
- E.  $\beta$ -oxidation of fatty acids

17. What class of enzymes is involved in anabolism?

- A. Ligases
- B. Lyases
- C. Hydrolases
- D. Isomerases
- E. Transferases

18. What class of enzymes is involved in the first stage of catabolisn?

- A. Hydrolases
- B. Lyases
- C. Ligases
- D. Isomerases
- E. Transferases

19. What enzymes catalyze transfer of hydrogen from some metabolite to oxygen?

- A. Aerobic dehydrogenases
- B. Oxygenases
- C. Anaerobic dehydrogenases
- D. Dioxygenases
- E. Cytochromes

20. What enzymes oxidize a substrate by transferring the oxygen from molecular oxygen to it?

- A. Oxygenases
- B. Aerobic dehydrogenases
- C. Anaerobic dehydrogenases
- D. Dioxygenases
- E. Cytochromes

20. What are metal-containing enzymes of the respiratory chain of mitochondrial inner membrane called?

- A. Cytochromes
- B. Aerobic dehydrogenases
- C. Anaerobic dehydrogenases
- D. Dioxygenases
- E. Oxygenases

21. Flavin-containing coenzymes play an important role in catalysis being a part of the aerobic and anaerobic dehydrogenases. What are they?

A. FAD, FMN B. NAD<sup>+</sup> C. Carboxybiotin D. THF E. TPP

. IPP

22. What is a coenzyme of pyridinedependent enzymes?
A. THF
B. FAD, FMN
C. Carboxybiotin
D. NAD<sup>+</sup>, NADP
E. TPP

23. Which of these metabolites are universal?

- A. Acetyl-CoA and pyruvate
- B. Acyl-CoA and malate
- C. Stearoyl-CoA and citrate
- D. Palmitoyl CoA and isocitrate

E. Acetoacetyl-CoA and fumarate

### **10.** Metabolism of substances and energy. Analysis of the tricarboxylic acid cycle.

1. What is a central intermediate metabolite of protein, lipid and carbohydrate metabolism?

- A. Oxaloacetate
- B. Succinyl-CoA
- C. Acetyl-CoA
- D. Lactate
- E. Citrate

2. How many ATP may be synthesized during full oxidation of acetyl-CoA in the Krebs cycle?

- A. 3
- **B**. 1
- C. 5
- D. 8
- E. 12

3. The formation of oxaloacetate from pyruvate is an important anaplerotic reaction. What enzyme catalyzes this reaction?

A. Pyruvate carboxylase

- B. Citrate synthase
- C. Pyruvate dehydrogenase
- D. Malate dehydrogenase
- E. Pyruvate decarboxylase

4. Formation of oxaloacetate from pyruvate is an important anaplerotic reaction that is catalyzed by pyruvate carboxylase. What is a coenzyme of pyruvate carboxylase?

A. Carboxybiotin

- B. NAD<sup>+</sup>
- C. FAD
- D. THF
- E. TPP

5. Indicate an enzyme of the Krebs cycle which catalyzes the reaction of substrate-level phosphorylation:

A. Succinate thiokinase

- B. Citrate synthase
- C. Pyruvate dehydrogenase
- D. Malate dehydrogenase

E. Succinate dehydrogenase

6. Oxidation of  $\alpha$ -ketoglutarate in the Krebs cycle is catalyzed by multienzyme complex. Choose the coenzymes of the complex from the listed below:

A. NAD, FAD, HS-CoA, TPP, lipoic acid

- B. NADP, FMN, THF, TPP
- C. THF, FAD, lipoic acid, TPP
- D. FMN, NAD, TPP, HS-CoA, THF
- E. HS-CoA, THF, lipoic acid, FAD, NAD

7. What metabolites of the Krebs cycle are substrates of tissue respiration?

A. Isocitrate,  $\alpha$ -ketoglutarate, succinate, malate

- B. Succinate, citrate, malate, oxaloacetate
- C. Citrate, α-ketoglutarate, succinate, malate

D. Succinyl-CoA,  $\alpha$ -ketoglutarate, succinate, malate

E. Acetyl-CoA, citrate, malate, oxaloacetate

8. What metabolites of the Krebs cycle are sources of protons and electrons for the tissue respiration?

A. Isocitrate,  $\alpha$ -ketoglutarate, succinate, malate

- B. Succinate, citrate, malate, oxaloacetate
- C. Citrate, α-ketoglutarate, succinate, malate

D. Succinyl-CoA,  $\alpha$ -ketoglutarate, succinate, malate

E. Acetyl-CoA, citrate, malate, oxaloacetate

9. What enzyme of the Krebs cycle refers to flavin-depending dehydrogenases?

- A. Succinate dehydrogenase
- B. Isocitrate dehydrogenase
- C. Alpha-ketoglutarate dehydrogenase
- D. Malate dehydrogenase
- E. Succinate thiokinase

10. In which cellular compartment does the Krebs cycle occur?

- A. Matrix of mitochondria
- B. Nucleous
- C. Cytosol
- D. Lysosomes
- E. Golgi apparatus

11. What are the allosteric inhibitors of the Krebs cycle?

A. ATP,  $NADH_2$ 

B. ADP,  $NAD^+$ 

C. AMP, FAD D. ATP,  $NAD^+$ E. ADP, FMN

12. Which tricarboxylic acid cycle enzyme's activity is dramatically increased due to high concentration of ADP?

- A. Isocitrate dehydrogenase
- B. Succinate dehydrogenase
- C. Fumarase
- D. Malate dehydrogenase
- E. Succinate thiokinase

13. Which tricarboxylic acid cycle enzyme's activity is dramatically decreased due to high concentration of acyl-CoA?

- A. Citrate synthase
- B. Isocitrate dehydrogenase
- C. Fumarase
- D. Malate dehydrogenase
- E. Succinate thiokinase

14. What metabolite of the Krebs cycle provides its closed system?

- A. Oxaloacetate
- B. Isocitrate
- C. Fumarate
- D. Malate
- E. Succinate

15. Anaplerotic reactions replenish the intermediates in the citric acid cycle. Which amino acid is converted to oxaloacetate in the transamination reaction?

- A. Glutamate
- B. Isoleucine
- C. Glycine
- D. Leucine
- E. Aspartate

16. What are anaplerotic reactions?

A. They replenish the intermediates in the citric acid cycle

B. They can function both in catabolic mode and as a source of precursors for anabolic pathways

C. Chemical reactions that involve a transfer of electrons between two species

D. Chemical reactions that result in the breakdown of more complex organic molecules into simpler substances

E. Chemical reactions in which simpler substances are combined to form more complex molecules

17. Oxidation of  $\alpha$ -ketoglutarate in the Krebs cycle is catalyzed by multienzyme complex. Choose the vitamins that are included in the complex:

A.  $B_1$   $B_2$   $B_3$  PP lipoic acid B.  $B_{12}$   $B_2$   $B_3$  PP biotin C.  $B_1$   $B_2$  H PP lipoic acid D. H  $B_2$   $B_3$  PP lipoic acid E.  $B_1$   $B_2$   $B_3$  PP biotin

18. The main function of the Krebs cycle is energy (generation of hydrogen). Which coenzymes are acceptors of hydrogen as a result of one turn of the Krebs cycle?

- A. 3NADH+H and FADH<sub>2</sub>
- B. 2NADH+H and  $2FADH_2$
- C. NADH+H and3FADH<sub>2</sub>
- D. 2NADH+H and 2FMNH<sub>2</sub>
- E. 2NADPH+H and 2FADH<sub>2</sub>

19. Which metabolite integrates small (urea synthesis) and large (citric acid cycle) Krebs cycles?

- A. Fumarate
- B. Oxaloacetate
- C. Isocitrate
- D. Malate
- E. Succinate

20. How many carbon dioxide molecules are generated in the Krebs cycle?

- A. 1
- B. 3
- C. 10
- D. 2
- E. 12

### 11. Bioenergetics processes: biological oxidation, oxidative phosphorylation.

1. How many ATP molecules are produced during oxidation of NADH<sub>2</sub> in the respiratory chain?

A. 1 ATP B. 3 ATP C. 10 ATP D. 2 ATP E. 12 ATP 2. How many ATP molecules are produced during oxidation of  $FADH_2$  in the respiratory chain?

A. 12 ATP

- B. 1 ATP
- C. 10 ATP
- D. 3 ATP
- E. 2 ATP

3. What is the order of cytochromes in the respiratory chain?

- A.  $b-c_1-c-a-a_3$
- B. b-c- $c_1$ -a- $a_3$
- C. b-c-c<sub>1</sub>-a<sub>3</sub>-a
- D. b-c-a-c<sub>1</sub>-a<sub>3</sub>
- E. b- $c_1$ -c- $a_3$ -a

4. What is a coenzyme of NADH+Hdehydrogenase of the respiratory chain?

- A. TPP
- B. NAD
- C. NADP
- D. FMN
- E. THF

5. For which of the following substrates of the tissue respiration P/O ratio is equal to 3?

- A. Isocitrate
- B. Succinate
- C. Citrate
- D. Succinyl-CoA
- E. Acetyl-CoA

6. For which of the following substrates of the tissue respiration P/O ratio is equal to 2?

- A. Succinate
- B. Isocitrate
- C. Citrate
- D. Succinyl-CoA
- E. Acetyl-CoA

7. Transfer of electrons in the respiratory chain leads to the releasing of energy that is used for:

- A. Oxidative phosphorylation
- B. Substrate phosphorylation
- C. Microsomal oxidation
- D. Peroxidation

E. –

8. What are coenzymes of anaerobic dehydrogenases that involved in the biological oxidation of substrates?A. FAD, NADB. NAD, TPP

- C. NADP, FMN
- D. TPP, FAD
- E. THF, NAD

9. Which of the following components is a part of a complex I of the respiratory chain (NADH-coenzyme Q reductase)?

- A. NAD
- B. FMN
- C. NADP
- D. FAD
- E. Heme

10. Which of the following components is a part of a complex II of the respiratory chain (Succinate-coenzyme Q reductase)?

- A. FAD
- B. NAD
- C. NADP
- D. FMN
- E. Heme

11. Which of the following components is a part of complex I, II and III of the respiratory chain?

- A. Ubiquinone
- B. NAD
- C. NADP
- D. FMN
- E. Heme

12. What components of the respiratory chain are mobile and not fixed rigidly in the inner mitochondrial membrane?

- A. Ubiquinone, cytochrome c
- B. Cytochromes a and a<sub>3</sub>
- C. Cytochrome b, cytochrome c
- D. Cytochrome a, ubiquinone
- E. Cytochrome a, cytochrome b

13. Which complex of the respiratory chain carries out oxidative phosphorylation?

- A. II
- B. I
- C. V
- D. III E. IV

14. What enzymes catalyze the dehydrogenation reactions where oxygen is the acceptor?

- A. Aerobic dehydrogenases
- B. Cytochromes
- C. Anaerobic dehydrogenases
- D. Dioxygenases
- E. Oxygenases

15. Enzymes of the respiratory chain perform oxidation of substrates and transfer of reductive equivalents to oxygen with production of water molecules. Where are they located?

- A. On inner mitochondrial membrane
- B. On cytoplasmic membrane
- C. In cytoplasm
- D. On outer mitochondrial membrane
- E. In nucleus

16. What are flavin-containing coenzymes of anaerobic and aerobic dehydrogenases?

A. FAD, FMN

- B. NAD<sup>+</sup>
- C. Carboxybiotin
- D. THF
- E. TPP

17. Choose a coenzyme of pyridinedependent enzymes:

- $A. NAD^+$
- B. FAD
- C. Carboxybiotin
- D. THF
- E. TPP

18. Cytochromes are metal-containing enzymes. Which metal atom is in the structure of cytochrome b and cytochrome c?

- A. Fe
- B. Mo
- C. Cu
- D. Mg
- E. Zn

19. Choose the complexes of the electron transport chain where the coupling of biological oxidation and oxidative phosphorylation occurs:

- A. I
- B. III
- C. IV
- D. All of the above

Е. ---

# 12. Chemiosmotic theory of oxidative phosphorylation. Inhibitors and uncouplers of oxidative phosphorylation.

1. A forensic medicine expert performing postmortem of a 20-year-old girl's body has found that the cause of death was poisoning by cyanides. What enzyme activity was inhibited by cyanides in the greatest extent?

- A. Carbamoyl phosphate synthase
- B. Malate dehydrogenase
- C. Heme syntase
- D. Aspartate aminotransferase
- E. Cytochrome oxidase

2. A forensic medicine expert performing postmortem of a 20-year-old girl's body has found that the cause of death was poisoning by cyanides. What process disturbance is the most possible cause of the girl's death?

- A. Hemoglobin synthesis
- B. Tissue respiration
- C. Transport of oxygen by hemoglobin
- D. Synthesis of urea
- E. Hydrogen transport by means of malate-aspartate mechanism

3. Increased production of thyroid hormones  $T_3$  and  $T_4$ , weight loss, tachycardia and physic excitement are present at thyrotoxicosis. How do thyroid hormones effect the energy metabolism in the mitochondria of cells?

A. Uncoupling of oxidation and oxidative phosphorylation

- B. Activation of substrate phosphorylation
- C. Inhibition of substrate phosphorylation
- D. Inhibition of respiratory chain
- E. Activate oxidative phosphorylation

4. An instant death occurs with cyanides poisoning. What is the mechanism of cyanide action?

- A. They inhibit cytochrome oxidase
- B. They combine substances of Krebs cycle
- C. They block succinate dehydrogenase
- D. They inactivate oxygen
- E. They inhibit cytochrome b

5. The increased tolerance of winter swimmers to cold water is explained by the

synthesis of large amounts of hormones that induce the process of oxidation and heat production in mitochondrion by uncoupling the biological oxidation and oxidative phosphorylation in their organisms. What are these hormones (hormone)?

- A. Glucagon
- B. Adrenaline and noradrenaline
- C. Thyroid hormones
- D. Insulin
- E. Corticosteroids

6. What inhibitor blocks electron transport in complex I of the respiratory chain?

- A. Rotenone
- B. Carbone Monoxide
- C. Cyanides
- D. Antimycin
- E. Oligomycin

7. What is an inhibitor of ATP synthase?

- A. Antimycin
- B. Carbone Monoxide
- C. Cyanides
- D. Oligomycin
- E. Rotenone

8. What inhibitor blocks electron transport in complex III of the respiratory chain?

- A. Antimycin
- B. Carbone Monoxide
- C. Cyanides
- D. Oligomycin
- E. Rotenone

9. Which of the following substances uncouples electron transport from oxidative phosphorylation?

- A. 2,4-Dinitrophenol
- B. Carbone Monoxide
- C. Rotenone
- D. Antimycin
- E. Oligomycin

10. The coupling between electron transport and oxidative phosphorylation for ATP synthesis is carried out by:

A. Formation of chemiosmotic gradient

- B. Spontaneous processes
- C. Influence of electron transport inhibitors

D. Disorders of mitochondrial membrane integrity

E. The redox potentials of the enzymes of the respiratory chain

11. What is the driving force for ATP synthesis in the electron transport chain?

- A. Formation of chemiosmotic gradient
- B. Transport of protons of hydrogen

C. Influence of electron transport inhibitors D. Disorders of mitochondrial membrane

integrity

E. Changes in redox potential of respiratory chain enzymes

12. The uncouplers of oxidative phosphorylation cause uncontrolled mitochondrial respiration. What is the mechanism of their action?

- A. They collapse a chemiosmotic gradient
- B. They inhibit transport of hydrogen protons
- C. They inhibit electron transport

D. They violate the mitochondrial membrane integrity

E. They change redox potential of the respiratory chain enzymes

13. What components of the respiratory chain only transport electrons?

- A. Succinate dehydrogenase
- B. Cytochrome b
- C. Ubiquinone
- D. NADH+H- dehydrogenase
- E. ATP synthase

14. What is a specific acceptor of inorganic phosphate in the process of oxidative phosphorylation?

- A. AMP
- B. ADP
- C. ATP
- D. FAD
- E. NAD

15. What component of the respiratory chain is included in complexes I, II and III?

- A. Ubiquinone
- B. NAD
- C. NADP
- D. FMN
- E. Heme

16. The sequence of electron transfer in the respiratory chain is due to the difference in the redox potential of its components. Which

of the following components has the highest redox potential in the electron transport chain?

A. Cytochrome a<sub>3</sub> B. Cytochrome c<sub>1</sub>

C. NADH+H

D. FADH<sub>2</sub>

E. Cytochrome b

17. The sequence of electron transfer in the respiratory chain is due to the difference in the redox potential of its components. Which of the following components has the lowest redox potential in the electron transport chain?

A. NADH+H<sup>+</sup>

- B. Cytochrome c<sub>1</sub>
- C. Cytochrome a<sub>3</sub>
- D. FADH<sub>2</sub>
- E. Cytochrome b

18. What are metal-containing enzymes of the respiratory chain of mitochondrial inner membrane called?

A. Cytochromes

- B. Aerobic dehydrogenases
- C. Anaerobic dehydrogenases
- D. Dioxygenases
- E. Oxygenases

19. ATP synthase is an enzyme with a quaternary structure, which consists of several protomers combined into the regions. Select them:

- $A.\ F_0 \ and \ F_1$
- B. F and  $F_1$
- $C.\ F_2 \ and \ F_1$
- D.  $F_3$  and  $F_1$
- $E.\ F \ and \ F_2$

20. What inhibitors block electron transport in complex IV of the respiratory chain?

- A. Oligomycin
- B. Amytal
- C. Rotenone
- D. Antimycin
- E. Cyanides

21. The chemiosmotic hypothesis involves all of the following except:

A. Only proton transport is strictly regulated and other positively charged ions can diffuse freely across the mitochondrial membrane B. Membrane is impermeable to protons

C. Electron transport by the respiratory chain

pumps protons out of the mitochondria

D. ATP synthase activity is reversible

E. Proton flow into the mitochondria depends

on the presence of ADP and Pi

### **13.** Analysis of glycolysis – anaerobic oxidation of carbohydrates.

1. Name sequentially enzymes that convert glucose into two trioses:

A. Hexokinase, phosphoglucomutase, phosphofructokinase, fructose-1,6-bisphosphate aldolase

B. Hexokinase, glucose-6-phosphatase, fructose-6-phosphate-dehydrogenase

C. Glucokinase, glucose-6-phosphatedehydrogenase, phosphofructokinase, aldolase

D. Glucokinase, phosphohexoisomerase, fructose-1-phosphate-aldolase, triose phosphate isomerase

E. Hexokinase, phosphofructokinase, fructose-1,6-bisphosphate aldolase, dihydroxyacetone phosphate dehydrogenase

2. Anaerobic oxidation of glucose to lactic acid is regulated by certain enzymes. Which enzyme is the main regulator of this process?

- A. Aldolase
- B. Glucose 6-phosphate isomerase
- C. Phosphofructokinase
- D. Enolase
- E. Lactate dehydrogenase

3. Which of the following compounds is a substrate of glycolytic oxidoreduction?

- A. Lactate
- B. Glyceraldehyde-3-phosphate
- C. 1,3-Bisphosphoglycerate
- D. Fructose 1,6-bisphosphate
- E. Pyruvate

4. What is the final metabolite of anaerobic glycolysis?

- A. Water
- B. Acetyl-CoA
- C. Pyruvate
- D. Lactate
- E. Acyl-CoA

5. What of the following compounds inhibits phosphofructokinase?

- A. ATP, citrate
- B. ADP, lactate
- C. AMP, citrate
- D. Citrate, pyruvate
- E. Fructose 1,6-bisphosphate, ATP

6. What of the following compounds are activators of phosphofructokinase?

- A. Fructose-6-phosphate, AMP
- B. ADP, lactate
- C. ATP, citrate
- D. Citrate, pyruvate
- E. Fructose 1,6-bisphosphate, ATP

7. It is known that erythrocytes don't have mitochondria. Which compound is produced from pyruvate in the red blood cells?

- A. Isocitrate
- B. Carbon dioxide and water
- C. Citrate
- D. Acetyl-CoA
- E. Lactate

8. At the second stage of glycolysis formation of substances containing macroenergy bonds occurs as a result of:

- A. Kinase reactions
- B. Endergonic reactions
- C. Exergonic reactions
- D. Transferase reactions
- E. Dehydrogenase reactions
- 9. What is the Cori cycle?
- A. Glucose-lactate cycle
- B. Glucose-alanine cycle
- C. Glycine-lactate cycle
- D. Ornithine cycle
- E. Citrate cycle

10. What is the rate-limiting enzyme of glycolysis?

- A. Phosphofructokinase
- B. hexokinase
- C. Aldolase
- D. Enolase
- E. Lactate dehydrogenase

11. There are many metabolites of glucose oxidation in the cytoplasm of myocytes. Choose one of them that is directly converted to lactate:

- A. Oxaloacetate
- B. Pyruvate
- C. Glycerol-3-phosphate
- D. Glucose-6-phosphate
- E. Fructose-6-phosphate

12. After a sprint an untrained person develops muscle hypoxia. What metabolite accumulates in muscles under this state?

- A. Lactate
- B. Ketone bodies
- C. Acetyl CoA
- D. Oxaloacetate
- E. Glucose-6-phosphate

13. Under relative deficiency of oxygen lactate is accumulated during intense muscular work. What is its further fate?

A. It is included in the gluconeogenesis in the liver

B. It is used by tissues for the synthesis of ketone bodies

C. It is removed with the urine

D. It is used in the muscles for synthesis of amino acids

E. It is used in the tissues for the synthesis of fatty acids

14. Human red blood cells don't have mitochondria. What is the main pathway for ATP production in these cells?

- A. Anaerobic glycolysis
- B. Aerobic glycolysis
- C. Oxidative phosphorylation
- D. Creatine kinase reaction
- E. Cyclase reaction

15. Gluconeogenesis was activated in an athlete in some time after intense exercises. What is its main substrate?

- A. Glutamate
- B. Alpha-ketoglutarate
- C. Lactate
- D. Aspartate
- E. Phenylpyruvate

16. Lactate and energy are produced in anaerobic glycolysis. How many ATP molecules are made using anaerobic glycolysis?

- A. 4
- **B**. 2
- C. 36

D. 8 E. 12

17. Which one of the following statements about glycolysis in muscles is true?

A. It is activated at the first minute of muscle contraction

B. It is the only source of energy during prolonged muscle contraction

C. It is activated only during a long-term rhythmic contraction of the myofibrils

D. It is the last pathway included in the ATP resynthesis

E. This is the most advantageous energy pathway in comparison with other ones

18. Which organs, tissues and cells are characterized by high intensity of glycolysis? A. Red blood cells, muscles, atypical cells

A. Red blood cells, muscles, atypical cells (tumor)

B. Lymphocytes, liver, connective tissue

C. Bone and connective tissue, eye tissue

D. The liver, bone marrow, lymphoid tissue

E. The adipose and nervous tissues, leukocytes

19. What is the biological role of anaerobic glycolysis?

A. It is the only source of energy in the conditions of hypoxia

B. It supplies glucogenic amino acids for protein synthesis

C. It is the only way for rapid resynthesis of ATP in the muscle

D. It is the main way of energy production in uremia

E. It is the main way of energy formation in the nervous tissue

20. What are the key reactions of glycolysis?

A. Hexokinase, phosphofructokinase and pyruvate kinase

B. Hexokinase, succinylthiokinase and pyruvate kinase

C. Pyruvate kinase, phosphoglycerate kinase, and creatine kinase

D. Glucokinase, pyruvate kinase, creatine kinase

E. Phosphofructokinase, phosphoglycerate kinase and pyruvate kinase

21. What reactions of the anaerobic glycolysis require energy in the form of ATP?

- A. Glucokinase and phosphoglycerate kinase
- B. Hexokinase and phosphofructokinase

C. Glucokinase and succinylthiokinase

- D. Hexokinase and pyruvate kinase
- E. Glucokinase and creatine kinase

22. Choose reactions of the anaerobic glycolysis where ATP is produced:

C. Phosphoglycerate kinase and pyruvate kinase

- A. Hexokinase and pyruvate kinase
- B. Glucokinase and succinylthiokinase
- D. Glucokinase and creatine kinase

E. Glucokinase and phosphoglycerate kinase

23. What is the mechanism of ATP synthesis under anaerobic conditions?

- A. Substrate level phosphorylation
- B. Posttranslational phosphorylation
- C. Oxidative phosphorylation
- D. Covalent modification
- E. Reductive phosphorylation

24. What are causes of hyperlactatemia?

A. Hypoxia, hypovitaminosis, starvation, diabetes mellitus

B. Hypoxia, hypercholesterolemia, fasting, diabetes insipidus

C. Uremia, hypervitaminosis, kwashiorkor, Cushing's disease

D. Creatinuria, hypovitaminosis, hyperthyroidism, Addison's disease

E. Hypoosmia, hyponatremia, starvation, gigantism

25. What are the consequences of hyperlactatemia?

- A. Metabolic acidosis
- B. Respiratory acidosis
- C. Metabolic alkalosis
- D. Respiratory alkalosis
- Е. -

26. Where does anaerobic glycolysis occur in the cell?

- A. Cytosol
- B. Nucleus
- C. Mitochondrion
- D. Membrane
- E. Ribosome

27. What are the shuttle systems of glycolytic  $NADH_2$  oxidation?
- A. Malate-aspartate, glycerol phosphate
- B. Glycerol phosphate, glucose-lactate
- C. Glycerol phosphate, aspartate-lactate
- D. Malate-aspartate, glycine phosphate
- E. Citrate-malate, malate-aspartate

28. What is the inhibition of glycolysis reactions under conditions of active cellular respiration called?

- A. Pasteur effect
- B. Crabtree effect
- C. Koch effect
- D. Bohr effect
- E. Mechnikov effect

29. A person who was at hypodynamia state for a long time develops intensive ache in the muscles after physical work. What is the cause of this ache?

- A. Lactic acid accumulation in muscles
- B. Enhanced breakdown of muscle lipids
- C. Creatine accumulation in muscles
- D. Decrease in lipid contents of muscles
- E. Increase in ADP contents of muscles

30. Diseases of the respiratory system and circulatory disorders impair the transport of oxygen, thus leading to hypoxia. Under these conditions the energy metabolism is carried out by anaerobic glycolysis. As a result, the following substance is generated and accumulated in blood:

- A. Lactic acid
- B. Pyruvic acid
- C. Glutamic acid
- D. Citric acid
- E. Fumaric acid

#### 14. Analysis of aerobic oxidation of glucose.

1. Patient has been prescribed energy correctors due to the disorders of energy metabolism in the tissues. Specify the metabolites that improve energy metabolism:

- A. Succinate, NADH<sub>2</sub>, FADH<sub>2</sub>
- B. Pyruvate, fumarate, NADH<sub>2</sub>, FADH<sub>2</sub>
- C. α-ketoglutarate, succinyl-CoA, lipoic acid
- D. Succinate, malate, NADH<sub>2</sub>
- E. Lactate, oxaloacetate, vitamin E

2. Nicotinamide is widely used in the treatment of atherosclerosis. What

biochemical process is improved under the influence of this metabolite?

A. Aerobic oxidation of substrates of metabolism

- B. Synthesis of antiatherogenic lipoproteins
- C Activation of glucokinase reaction
- D. Inhibition of cholesterol synthesis
- E. Anaerobic oxidation of glucose

3. Which enzymes catalyze oxidative decarboxylation of pyruvic acid?

A. Pyruvate dehydrogenase, dihydrolipoyl dehydrogenase, dihydrolipoyl transacetylase

B. Pyruvate dehydrogenase, isocitrate dehydrogenase, succinate dehydrogenase

C. Pyruvate dehydrogenase, phosphofructokinase, aldolase

D. Pyruvate kinase, citrate synthase, fumarase E. Pyruvate dehydrogenase, dihydrolipoyl transacetylase, cytochrome oxidase

4. What are coenzymes of pyruvate dehydrogenase complex?

A. TPP, HS-CoA, lipoic acid,  $\ensuremath{\mathsf{NAD}^{+}}\xspace$  and FAD

B. NAD, FAD, pyridoxal phosphate, lipoic acid, HS-CoA

C. NAD, FAD, HS-CoA, lipoic acid, pyruvate kinase

D. Lipoic acid, NAD, FAD, HS-CoA, ions of  $Mg^{2+}$ 

E. NAD, FAD, cAMP, lipoic acid, pyruvate dehydrogenase

5. What is the role of acetyl-CoA and NADH in the oxidative decarboxylation of pyruvate?

A. They are allosteric inhibitors of pyruvate dehydrogenase complex

B. They are activators of the pyruvate dehydrogenase complex

C. They are end products of oxidative decarboxylation of pyruvate

D. They are intermediate products of oxidative decarboxylation of pyruvate

E. They activate pyruvate dehydrogenase complex

6. Which metabolite is produced at the second stage of carbohydrate, lipid and amino acid catabolism?

A. Ketone bodies

- B. Acetal-coA
- C. Pyruvate

D. Lactate

E. Citrate

7. Four pairs of hydrogen atoms are produced in the Krebs cycle. What are their further transformations?

A. NADH<sub>2</sub> and FADH<sub>2</sub> are oxidized by transfer of electrons and protons in the respiratory chain to molecular oxygen to form water

B. They included in the oxidative phosphorylation

C. They included in substrate level phosphorylation

D. They form water by reacting with oxygen

E. They provide accumulation of energy in macroenergy compounds

8. Complete oxidation of glucose molecule and its coupling with phosphorylation is equivalent to the following total amount of ATP molecules formation:

A. 8

B. 38

C. 12

- D. 2
- E. 58

9. What reaction allows to convert pyruvate into the component of TCA using pyruvate carboxylase enzyme?

A. The conversion of pyruvate into oxaloacetate

- B. The conversion of pyruvate into citrate
- C. The conversion of pyruvate into malate
- D. The conversion pyruvate into fumarate
- E. The conversion pyruvate into succinate

10. What substrates can be synthesized from the components of the citric acid cycle?

- A. Amino acids, glucose, heme
- B. Acetyl-CoA, pyruvate, fatty acids
- C. Acetyl-CoA, fatty acids, glycogen
- D. Amino acids, citric acid, heme
- E. Amino acids, fatty acids, glycerol

11. Choose the regulators of Krebs cycle: A. ATP/ADP ratio, NADH<sub>2</sub>/NAD<sup>+</sup>,

A. ATP/ADP ratio, NADH<sub>2</sub>/NAT FAD/FADH<sub>2</sub>

- B. The concentration of ATP in the cell,  $CO_2$
- C. ADP/AMP ratio, FADH<sub>2</sub>/FAD
- D. The concentration of pyruvate, lactate
- E. ADP/AMP ratio, NADH<sub>2</sub>/NAD<sup>+</sup>

12. Pneumonia caused the development of respiratory hypoxia in the patient. What process of carbohydrate metabolism is activated in this case?

A. Anaerobic oxidation of glucose to lactate B. Aerobic oxidation of glucose with the formation of  $CO_2$  and  $H_2O$ 

- C. Gluconeogenesis
- D. Synthesis of glycogen
- E. Breakdown of glycogen

13. At what stage of glycolysis are trioses formed such as dyhydroxyacetone phosphate and glyceraldehyde-3-phosphate?

- A. At the second stage
- B. At the first stage
- C. In the process of oxidative decarboxylation of pyruvate

D. In the process of substrate phosphorylation

E. In the process of the formation of phosphoenolpyruvate

14. Which of the following metabolites is the main substrate of gluconeogenesis?

- A. Maltose
- B. Sucrose
- C. Starch
- D. Glycogen
- E. Amino acids

15. Which of the following enzymes cleaves the disaccharide in the milk?

- A Lactase
- B. Hexokinase
- C. Maltase
- D. Pyruvate kinase
- E. Glucose-6-phosphatase

16. Which reaction is catalysed by lactate dehydrogenase?

A. The conversion of pyruvate into lactic acid B. The conversion of glucose into glucose 6phosphate

C. The conversion of succinate into fumarate

D. The conversion of isocitrate into alphaketoglutarate

E. The conversion of UDP-galactose into galactose

17. It has been found out that one of pesticide's components is sodium arsenate

that blocks lipoic acid. Which enzyme activity is impaired by this pesticide?

- A. Pyruvate dehydrogenase complex
- B. Microsomal oxidation
- C. Methemoglobin reductase
- D. Glutathione peroxidase
- E. Glutathione reductase

18. Oxidative decarboxylation of pyruvate is the second stage of aerobic oxidation of glucose. What is the main product of this process?

- A. Oxaloacetate
- B. Citrate
- C. Glutamate
- D. Acetyl-CoA
- E. Succinyl-CoA

19. The thiamine deficiency results in beriberi disease which is characterised by carbohydrate metabolism disturbances. What metabolite is accumulated in blood at this state?

- A. Pyruvate
- B. Lactate
- C. Succinate
- D. Citrate
- E. Malate

20. Treatment of many diseases involves using of cocarboxylase (thiamine pyrophosphate) for supplying cells with energy. What metabolic process is activated in this case?

- A. Oxidative decarboxylation of pyruvate
- B. Glutamate deamination
- C. Amino acid decarboxylation
- D. Decarboxylation of biogenic amines
- C. Detoxication of harmful substances in liver

## 15. Alternate pathways of monosaccharide metabolism. Metabolism of fructose and galactose.

1. What inherited disorder of galactose metabolism leads to mental retardation in a child?

- A. Aglycogenosis
- B. Glycogenosis
- C. Fructosemia
- D. Galactosemia
- E. Fructose intolerance

2. Fatty liver, galactosuria and aminoaciduria are observed in a newborn. Which substance must be excluded from the diet?

- A. Fatty acids
- B. Milk sugar
- C. Phenylalanine
- D. Cholesterol
- E. Sucrose

3. Which of the following biochemical processes metabolism of fructose interacts with?

- A. Glycogenolysis
- B. Gluconeogenesis
- C. Glycolysis
- D. glycogen synthesis
- E. Protein synthesis

4. What mechanism controls the intensity of the pentose phosphate pathway?

A. The ratio of NADP/NADPH<sub>2</sub> in the cell B. ATP/ADP ratio

C. The ratio of creatine and creatinine

D. The activity of the pyruvate dehydrogenase multienzyme complex

E. Partial proteolysis

5. What stage of the pentose phosphate pathway forms a large set of monosaccharides with different numbers of carbon atoms?

- A. Nonoxidative reversible stage
- B. Oxidative reversible stage
- C. Anabolic stage
- D. Catabolic stage
- E. Transketolase stage

6. What is the mechanism of hemolytic anemia development under inherited deficiency of glucose-6-phosphate dehydrogenase?

A. Decreased concentration of reduced glutathione in red blood cells

- B. Decreased content of hemoglobin
- C. Lack of fructose-6-phosphate
- D. Lack of ribose-5-phosphate
- E. Activation of glycolysis

7. What is the key regulatory enzyme of the pentose phosphate pathway called?

- A. Glucose-6-phosphate dehydrogenase
- B. Phosphorylase
- C. Glucokinase

- D. Pyruvate dehydrogenase
- E. Succinate dehydrogenase

8. Which one of the following biochemical processes supplies the cells by ribose-5-phosphate for the synthesis of nucleotides, nucleic acids and other pentose containing compounds?

- A. Glucuronate pathway
- B. Aerobic glycolysis
- C. Anaerobic glycolysis
- D. Microsomal oxidation
- E. Pentose phosphate pathway

9. Hemolytic anemia has been developed in a patient in result of using of antibiotics for treatment of pneumonia. Laboratory tests established deficiency of glucose-6-phosphate dehydrogenase. Which metabolic pathway is affected in erythrocytes of the patient?

- A. Pentose phosphate pathway
- B. Glycolysis
- C. Gluconeogenesis
- D. Lipolysis
- E. Phosphorylation of glucose

10. The child had vomiting and cramps after eating honey. It has been suspected a congenital intolerance to fructose. Which of the following enzyme's activity determination confirms the diagnosis?

- A. Fructose-1-phosphate aldolase
- B. Glycogen phosphorylase
- C. Fructokinase
- D. Hexokinase
- E. 6-phosphofructokinase

11. A newborn has good feeling after breastfeeding. Vomiting, abdominal ache, diarrhea and hypoglycemia appear after adding fruits and juices to the diet. What is the cause of such state?

- A. Ketosis
- B. Hereditary fructose intolerance
- C. Gierke's disease
- D. Glucosuria
- E. Hyperglycemia

12. Hexuronic acids play an important role in many biochemical processes. In which of the following pathways of glucose metabolism are they produced?

A. Glucuronate pathway

- B. Glucuroniltransferase reaction
- C. Pentose phosphate pathway
- D. Gluconeogenesis
- E. Glycogenolysis

13. It was revealed in the experiment that intolerance to fructose is associated with a hereditary deficiency of the enzyme fructose-1-phosphate aldolase. Which of the following products of fructose metabolism accumulates in this case?

- A. Fructose-1-phosphate
- B. Fructose-1,6-bisphosphate
- C. Fructose-6-phosphate
- D. Glucose-6-phosphate
- E. Glucose-1-phosphate

14. NADPH<sub>2</sub> is produced in the pentose phosphate pathway of glucose oxidation and used as a donor of reduced equivalents in anabolic reactions. What other processes actively occurring especially in the liver, require NADPH<sub>2</sub>?

- A. Phosphorylation
- B. Decarboxylation
- C. Transamination
- D. Detoxification
- E. Esterification

15. It is known that the nonoxidative phase of the pentose phosphate pathway of glucose oxidation has several transketolase reactions. What is the coenzyme of transketolase?

- A. TPP
- B. NADH<sub>2</sub>
- C. FADH<sub>2</sub>
- D. NADPH<sub>2</sub>
- E. Pyridoxal phosphate

16. Vomiting, diarrhea, general dystrophy, hepato- and splenomegaly were observed in a newborn. These symptoms decrease after exclusion of milk from the diet. Which main hereditary defect results in the pathology?

- A. Disturbance of galactose metabolism
- B. Disturbance of phenylalanine metabolism
- C. Hypersecretion of endocrine glands
- D. Disturbance of glucose metabolism

E. Deficiency of glucose-6-phosphate dehydrogenase

17. Glucose-6-phosphate dehydrogenase reaction is a key regulatory reaction of the

pentose phosphate pathway. Indicate the products of the reaction:

- A. 6-Phosphogluconolactone,  $NADPH_2$
- B. Fructose-1,6-bisphosphate, NADPH<sub>2</sub>
- C. 6- Phosphogluconolactone,  $HADH_2$
- D. Fructose-6-phosphate, NADPH<sub>2</sub>
- E. Ribose-5-phosphate,  $NADPH_2$

18. Reduced  $NADPH_2$  is generated in the oxidative phase of the pentose phosphate pathway. Which of the following vitamins is the precursor of NADP coenzyme?

- A. PP
- $B. \ B_c$
- $C. B_2$
- D. B<sub>1</sub>
- E. B<sub>12</sub>

19. What are the functions of reduced glutathione in red blood cells?

- A. It reduces oxidizing agents such as H<sub>2</sub>O<sub>2</sub>
- B. It produces NADPH
- C. It reduces methemoglobin to hemoglobin
- D. It reduces pyruvate to lactate
- E. It produces NADH

20. It is known that the rate of the pentose phosphate pathway is limited by NADP/NADPH<sub>2</sub> ratio in the cell. What key enzymes of oxidative phase are regulated by NADP and NADPH<sub>2</sub>?

A. Glucose-6-phosphate dehydrogenase, 6-phosphogluconate dehydrogenase

B. Glucose-6-phosphatase, hexokinase

C. Fructose-1,6-diphosphatase, phosphofructokinase

D. Lactonase, 6-phosphogluconate dehydrogenase

E. Galactose-1-phosphate-uridyltransferase, fructose-1-phosphate aldolase

## 16. Analysis of catabolism and biosynthesis of glycogen. Regulation of glycogen metabolism.

1. The conversion of glucose-6-phosphate into glucose is impaired under Von Gierke's disease which leads to the accumulation of glycogen in the liver. Which enzyme's deficiency causes the disease?

A. Glycogen synthase

B. Glucose-6-phosphatase

- C. Phosphorylase
- D. Hexokinase
- E. Aldolase

2. The degradation of glycogen in the liver is activated by glucagon. What second messenger is formed for the transmission of the hormonal signal in the hepatocytes?

A. cAMP

- B. cGMP
- C.  $IP_3$
- D. NO
- E. DAG

3. Glycogen is synthesized from active form of glucose. What is an immediate donor of glucose residues in the glycogenesis?

A. UDP-glucose

- B. Glucose-1-phosphate
- C. ADP-glucose

D. Glucose-6-phosphate

E. Glucose-3-phosphate

4. What hormones activate glycogenolysis?

A. Adrenaline, thyroxine, glucagon, growth hormone

B. Gonadotropin, glucagon, estradiol, thyroxine

C. Corticosteroids, calcitonin, parathyrin, growth hormone

D. Follicle stimulating hormone, growth hormone, ACTH

E. Glucagon, cortisol, testosterone, progesterone

5. Pompe disease is the second type of glycogenosis that accompanied by the accumulation of glycogen in muscles and liver. Which enzyme's deficiency causes the disease?

A. Glucokinase

- B. Glycogen phosphorylase
- C. Glucose-6-phosphatase
- D. Phosphoglucomutase
- E. Acid alfa-glucosidase

6. Cori disease is the type III of glycogenosis where breakdown of glycogen only occurs by linear bonds. Glycogen is stored in the liver and muscles. Which enzyme's deficiency causes the disease?

A.Amylo-1,6-glucosidase

B. Glycogen phosphorylase

- C. Phosphorylase kinase
- D. Phosphoglucomutase
- E. Glucokinase

7. Andersen disease is the type IV of glycogenosis that accompanied by the appearance of abnormal glycogen with linear structure type. Which enzyme's deficiency causes the disease?

- A. Glycogen branching enzyme
- B. Glycogen phosphorylase
- C. Phosphorylase kinase
- D. Phosphoglucomutase
- E. Amylo-1,6-glucosidase

8. Excessive accumulation of glycogen in the muscles, cramps and myoglobinuria are observed under McArdle's disease. Which enzyme's deficiency causes the disease?

- A. Liver glycogen phosphorylase
- B. Muscle phosphorylase
- C. Amylo-1,6-glucosidase
- D. Phosphoglucomutase
- E. Glycogen branching enzyme

9. Growth retardation and hepatomegaly are observed under Hers' disease. Increased cholesterol concentration and increased activity of aminotransferases are revealed during laboratory examination. Which enzyme's deficiency causes the disease?

A. Liver phosphorylase

- B. Alfa-1,4-glucosidase
- C. Glucose-6-phosphatase
- D. Amylo-1,6-glucosidase
- E. Glycogen branching enzyme

10. Which hormone activates glycogenesis?

- A. Cortisol
- B. Estradiol
- C. Calcitonin
- D. Insulin
- E. Glucagon

11. What are enzymes required for the synthesis of glycogen?

A. Glycogen synthase, Amylo-1,4-1,6transglycosylase

- B. Phosphorylase,  $\alpha$ -glucosidase, amylase
- C. Pyruvate carboxylase
- D. Glucose-6-phosphatase
- E. Phosphofructokinase, pyruvate carboxylase

12. What are enzymes required for the glycogenolysis?

A. Glycogen phosphorylase, glucose-6-phosphatase

- B. Glycogen synthase
- C. Phosphorylase kinase
- D. Phosphoglucomutase

E. Phosphofructokinase, pyruvate carboxylase

13. Where is the most of glycogen stored in the human body?

- A. Liver, muscles
- B. Liver, bones
- C. Bones, kidney
- D. The kidneys, muscles
- E. Kidneys, heart

14. What is a group of relatively rare genetic disorders associated with defects of the enzymes of glycogenolysis called?

- A. Glycogenosis
- B. Addison's disease
- C. Cushing's disease
- D. Steroid diabetes
- E. Graves' disease

15. What are the major organs where glycogen is accumulated under glycogenoses? A. Liver, muscles, kidneys

- B. Liver, kidneys, heart
- B. Liver, kidneys, heart
- C. Liver, kidney, bone
- D. Liver, kidneys, brain
- E. Liver, lungs, heart

16. The increase in glucose concentration in blood under the action of glucagon is connected with activation of the next enzyme: A. Glycogen phosphorylase

- A. Grycogen phosphor
- B. Hexokinase
- C. Glucokinase
- D. Aldolase
- E. Glycogen synthase

17. What types of bonds are present in the structure of glycogen?

A.  $\alpha$ -1,4 and  $\alpha$ -1,6 glycosidic bonds

- B.  $\alpha$ -1,4 glycosidic bonds
- C. α-1,6 glycosidic bonds
- D. N- glycoside bonds
- E. Phosphodiester bonds

18. What are the most common types of glycogenoses?

- A. Liver and muscle glycogenoses
- B. Muscle and bone glycogenoses
- C. Liver and bone glycogenoses
- D. Liver and heart glycogenoses
- E. Liver and kidney glycogenoses

19. What is the main function of glycogen in the human body?

- A. The support function
- B. Structural function
- C. Energy function
- D. The receptor function
- E. Regulatory function

20. Which hormone activates the breakdown of glycogen in the liver only?

- A. Glucagon
- B. Estradiol
- C. Calcitonin
- D. Cortisol
- E. Insulin

### 17. Gluconeogenesis.

1. Gluconeogenesis is essentially reversal of glycolysis pathway with the exception of three irreversible reactions, requiring bypass reactions. What are these reactions?

A. Hexokinase, phosphofructokinase and pyruvate kinase reactions

B. Pyruvate carboxylase, pyruvate kinase, and hexokinase reactions

C. Phosphorylase, hexokinase and phosphofructokinase reactions

D. Carboxylase, phosphofructokinase and glucokinase reactions

E. Hexokinase, pyruvate kinase and reaction of decarboxylation

2. Which organ is the most sensitive to a decrease in the intracellular glucose concentration?

- A. Kidneys
- B. Liver
- C. Muscles
- D. Bones
- E. Brain

3. What are the bypass reactions of gluconeogenesis providing conversion of pyruvate into glucose?

A. Conversion of pyruvate to phosphoenolpyruvate, the conversion of fructose-1,6-bisphosphate to fructose-6phosphate, conversion of glucose-6-phosphate into glucose

B. Conversion of pyruvate to acetyl-CoA, conversion of acetyl-CoA to pyruvate, conversion of fructose-1,6-diphosphate to glucose

C. Conversion of acetyl-CoA into pyruvate; conversion of glucose into glucose-6phosphate

D. Conversion of oxaloacetate to phosphoenolpyruvate; conversion of glucose into fructose-1,6-bisphosphate; conversion of fructose-6-phosphate into glucose

E. Convertion of glucose into fructose; convertion of citrate into isocitrate; conversion of oxaloacetate into pyruvate

4. What are the substrates for gluconeogenesis?

- A. Substrates of non-carbohydrate origin
- B. Lipids
- C. Nucleotides
- D. Glucose
- E. Metabolites of glucuronate pathway

5. Specify the process that supports normoglycemia in post-adsorption period after the exhaustion of reserves of carbohydrates:

- A. Glucuronate pathway
- B. Gluconeogenesis
- C. Pentose phosphate pathway
- D. Aerobic glycolysis
- E. Anaerobic glycolysis

6. What are amino acids used as the substrates for gluconeogenesis called?

- A. Glucogenic aminoacids
- B. Ketogenic amino acids
- C. Amines
- D. Sulfur-containing amino acids
- E. Negatively charged amino acids

7. What process plays an important role in maintaining of normoglycemia for the energy supply of neurons under conditions of complete starvation?

- A. Krebs Cycle
- B. Glycolysis
- C. Gluconeogenesis

D. Glycogenolysis

E. Lipolysis

8. What process prevents excessive accumulation of blood lactate during intensive muscle work?

- A. Aerobic glycolysis
- B. The glucose-lactate cycle
- C. Glycogenesis
- D. Glycogenolysis
- E. Anaerobic glycolysis

9. Gluconeogenesis is activated in an athlete after long intense physical activity and exhaustion of carbohydrates' reserves. What is the main substrate for gluconeogenesis in the athlete?

- A. Lactate
- B. Glutamic acid
- C. Acetoacetate
- D. Serine
- E. Aspartic acid

10. Indicate hormone that activates and induces biosynthesis of the key enzymes of gluconeogenesis:

- A. Cortisol
- B. Thyroxine
- C. Parathyroid hormone
- D. Insulin
- E. Dopamine

11. Indicate hormone that inhibits gluconeogenesis:

- A. Dopamine
- B. Glucagon
- C. Parathyroid hormone
- D. Cortisol
- E. Insulin

12. Indicate the metabolite that is the substrate for gluconeogenesis:

- A. Glycerol
- B. Alanine
- C. Oxalacetate
- D. Lactate
- E. All of the above

13. Which process Cori cycle refers to?

- A. Gluconeogenesis
- B. Aerobic glycolysis
- C. Glycogenesis
- D. Glycogenolysis

E. Anaerobic glycolysis

14. Indicate the metabolite that is the substrate for gluconeogenesis:

- A. Glycerol-3-phosphate
- B. Acetone
- C. Arachidonic acid
- D. Sedoheptulose-7-phosphate
- E. NADPH<sub>2</sub>

15. Phosphoenolpyruvate kinase is a key enzyme of gluconeogenesis. Which group of enzymes it belongs to?

- A. Inducible enzyme
- B. The enzyme of adenylate cyclase cascade
- C. Cobalamin-dependent enzyme
- D. Constitutive enzyme
- E. Krebs cycle enzyme

16. Indicate the mechanism of hormone's action providing the biosynthesis of the key enzymes of gluconeogenesis:

- A. Intracellular
- B. Membrane-intracellular
- C. Mediated by c-AMP
- D. Hormone-sensitive
- E. Membrane

17. Indicate the enzymes of the first bypass of the gluconeogenesis metabolic map:

A. Phosphoenolpyruvate carboxykinase, pyruvate carboxylase

B. Alanine aminotransferase, aspartate aminotransferase

C. Succinate dehydrogenase, malate dehydrogenase

- D. Phosphofructokinase, hexokinase
- E. All of the above

18. Choose the hormone that activates gluconeogenesis and inhibits glycolysis:

- A. Insulin
- B. Glucagon
- C. Parathyroid hormone
- D. Aldosterone
- E. Thyrotropin

19. Metabolic map of gluconeogenesis includes three bypass steps of glycolysis. Specify the total number of the reactions of these bypasses:

A. 4 B. 3 C. 2 D. 5

E. 6

20. There are two stages in the transformation of pyruvate into phosphoenolpyruvate in the process of gluconeogenesis. Each stage has a different cellular compartmentalization. What shuttle system is used for the transport of oxaloacetate from mitochondria into the cytosol?

- A. Citrate
- B. Aspartate
- C. Malate
- D. All of the above
- Е. -----

21. Indicate an enzyme of the second bypass of gluconeogenesis:

- A. Fructose-1,6-bisphosphatase
- B. Phosphoenolpyruvate carboxykinase
- C. Pyruvate carboxylase
- D. Phosphofructokinase
- E. Glucose-6-phosphatase

#### 18. Analysis of mechanisms of metabolic and hormone regulation of carbohydrate metabolism.

1. Utilization of glucose occurs by means of sugar transport from the extracellular matrix through the plasma membrane into the cell. What hormone stimulates this process?

- A. Insulin
- B. Glucagon
- C. Thyroxine
- D. Aldosterone
- E. Adrenaline

2. A patient with diabetes mellitus has been delivered to the hospital in the state of unconsciousness. Arterial pressure is low. The patient has acidosis. Indicate the substances, which accumulation in the blood results in these manifestations:

- A. Glucose
- B. Phenylalanine
- C. Palmitic acid
- D. Cholesterol esters
- E. Acetone

3. A patient with diabetes mellitus experienced loss of consciousness and convulsions after an injection of insulin. What might be the result of biochemical blood analysis for concentration of sugar?

- A. 1.5 mmol / L
- B. 8.0 mmol / L
- C. 10.0 mmol / L
- D. 3.3 mmol / L
- E. 5.5 mmol / L

4. Specify the biochemical effect of adrenalin that affects blood glucose concentration:

A. Activation of glycogen breakdown

B. Activation of glycogen synthesis in the liver

C. Activation of the pentose phosphate pathway

D. Activation of gluconeogenesis

E. The hypoglycemic effect

5. What is the effect of insulin on carbohydrate metabolism in the liver?

- A. It activates glycogenesis
- B. It activates glycogenolysis
- C. It activates gluconeogenesis
- D. Hyperglycemic effect
- E. It inhibits glycogenesis

6. What mechanisms determine the hypoglycemic effect of insulin?

A. Stimulation of glycogen synthesis in the liver and muscles, increase of glucose permeability for membranes of target cells

B. Inhibition of glycogen synthesis and glucose uptake into the cytosol of the cell

- C. Activation of gluconeogenesis
- D. Inhibition of glycolysis and glycogenesis

E. Inhibition of glucose transformation into neutral fats

7. Choose the reason for the development of hyperglycemia:

- A. Hypothyroidism
- B. Hyperinsulinism
- C. Hypofunction of the pituitary gland
- D. Hypofunction of the adrenal cortex
- E. Diabetes mellitus

8. Choose the reason for the development of hypoglycemia:

- A. Hyperfunction of the pancreatic  $\beta$ -cells
- B. Insulin insufficiency

C. Hyperfunction of the adrenal cortex

D. Hyperfunction of the pituitary gland

E. Hyperthyroidism

9. What is a blood sugar level in patients with hypoglycemic coma?

A. Below 1.0 mmol / L

B. Equal 3.5-4.0 mmol / L

C. Above 5.0 mmol / L

D. Above 6.0 mmol / L

E. Above the renal threshold for glucose

10. Which diagnostic test is used to confirm the diagnosis of diabetes mellitus in patients with blood glucose level from 5.6 to 6.1 mmol/l?

A. Oral glucose tolerance test

B. Non-glycosylated hemoglobin

C. Determination of C-peptide in the blood

D. Determination of glucagon in the blood

E. Staub-Traugott test

11. Specify one of the leading mechanisms of the development of hyperglycemia in diabetes mellitus:

A. Violation of glucose permeability into a target cell through a system of GLUT transporter

B. Glucosuria

C. Dehydration of the body

D. Activation of intracellular pathways of glucose metabolism

E. The increase of insulin concentration in the blood

12. What diagnostic criterion of diabetes mellitus allows evaluating changes in the blood glucose concentration retrospectively?

A. Insulin

B. Glucagon

C. Glycosylated hemoglobin

D. Glucose tolerance test

E. Kidney "threshold" for glucose

13. What of the following hormones are antagonists of insulin?

A. Glucagon, thyroxine

B. Adrenaline, testosterone

C. Estradiol, cortisol

D. Corticotrophin, thyrotropin

E. All of the above

14. A patient has diabetes mellitus that is accompanied by hyperglycemia of over 7.2 mmol / L on an empty stomach. What blood plasma protein level allows estimate the glycemia rate retrospectively (4-8 weeks before examination)?

A. Glycosylated hemoglobin

B. Ceruloplasmin

C. Fibrinogen

E. Albumin

D. C-reactive protein

15. A patient has symptoms of the dryness of skin and mucous membranes, lowering the tone of the eyeballs. There is a smell of acetone in the air of the chamber. What can cause such condition?

A. Diabetes insipidus

B. Ketosis

C. Glycogenosis

D. Dehydration

Е. -

16. What is the leading mechanism of the development of the diabetic hyperglycemic hyperosmolar coma?

A. Hyperglycemia and high blood osmotic pressure

B. Ketoacidosis, intoxication by ketone bodies

C. Ketosis, high blood osmotic pressure

D. Hyperpyruvatemia, high blood osmotic pressure

E. Hypoglycemia, cellular energy deficit

17. A patient complains of the dryness in the oral cavity, thirst, general weakness. Hyperglycemia, hyperketonemia were found during biochemical investigation. Ketone bodies and glucose were determined in the urine. What is a possible disease in the patient?

A. Acute pancreatitis

B. Diabetes mellitus

C. Diabetes insipidus

D. Ischemic heart disease

E. Alimentary hypoglycemia

18. What is the normal range of glycosylated hemoglobin in the blood of healthy person?A. 4-6 %B. 1-2 %C. 13-17 %

D. 7-9 % E. 10-12 %

19. What is the diagnostic value of the C-peptide measurement (determination) in the blood of the patient?

A. The most accurate indicator of the functional activity of pancreatic  $\beta$ -cells

B. The most accurate indicator of the functional activity of pancreatic  $\alpha$ -cells

C. The most accurate measure of the functional activity of the chromaffin cells of the adrenal medulla

D. It is used for the diagnostics of the diseases of the adenohypophysis

E. It is used for the diagnostics of the diabetes insipidus

20. The daily diuresis of a healthy person ranges from 1 to 2.5 liters. How will the excretion of urine be changed in patients with diabetes mellitus?

A. Diuresis increases according to the degree of glycosuria

B. Diuresis decreases, regardless of the degree of glycosuria

C. Diuresis does not change and does not depend on the degree of glycosuria

D. Diuresis reflects the degree of increase in the renal threshold figure with a maximum capacity at night

E. Diuresis decreases due to the decrease of glucose filtration through glomerulus of nephrons

# **19.** Analysis of catabolism and biosynthesis of triacylglycerols. Determination of molecular mechanisms of regulation of lipolysis.

1. Which of the following hormones reduces the rate of lipolysis in the adipose tissue?

- A. Growth hormone
- B. Adrenaline
- C. Hydrocortisone
- D. Insulin
- E. Norepinephrine

2. A 35-year-old man has been delivered to a hospital in the state of a stressful situation. Laboratory investigation revealed increased free fatty acids' level in the blood above

normal value. Which of the following processes has led to this state?

A. Breakdown of triacylglycerols in the adipose tissue

B. Synthesis of fatty acids

C. Breakdown of triacylglycerols in the gastrointestinal tract

D. Activation of lipoprotein lipase

E. Carnitine deficiency

3. Lipolysis is an enzymatic process of the hydrolysis of triacylglycerols to fatty acids and glycerol. How fatty acids are transported by the blood stream?

- A. Globulins
- B. Albumins
- C. HDL
- D. LDL
- E. Chylomicrons

4. A 36-year-old man was diagnosed with pheochromocytoma. Levels of epinephrine and the concentration of free fatty acids were increased in the blood. Which enzyme of lipolysis is activated under epinephrine influence?

- A. Triglyceride lipase
- B. Lipoprotein lipase
- C. Phospholipase A<sub>2</sub>
- D. Phospholipase C
- E. Cholesterol esterase

5. Which of the following hormones stimulates lipogenesis?

- A. Adrenaline
- B. Glucagon
- C. Insulin
- D. Thyroxine
- E. Testosterone

6. Which hormone activates triglyceride lipase by adenylate cyclase cascade mechanism?

- A. Testosterone
- B. Thyroxine
- C. Melatonin
- D. Vasopressin
- E. Adrenaline

7. The function of what endocrine glands is examined in patients with overweight?

A. Anterior pituitary, thyroid, adrenal cortex, gonads

B. Thymus, hypothalamus, the posterior pituitary

C. Posterior pituitary, pancreatic alphacells, adrenal gland

- D. Epiphysis, pancreas, parathyroid gland
- E. Gonads and adrenal medulla

8. Lipids are class of bioorganic compounds with very important functions. Specify them:

- A. Energy, regulatory, structural
- B. Protective, receptor, haemostatic
- C. Structural, antioxidant, receptor
- D. Digestive, excretory, regulatory
- E. Regulatory, digestive, haemostatic

10. What hormones stimulate lipolysis by the activation of c-AMP-dependent protein kinase?

- A. Adrenalin, glucagon
- B. Estradiol, growth hormone
- C. Vasopressin, insulin
- D. Insulin, oxytocin
- E. Insulin, corticotropin

11. Specify hormones that activate lipolysis in the adipose tissue:

- A. Growth hormone
- B. Sex hormones
- C. Adrenalin, glucagon
- D. Thyroxine
- E. All of the above

12. Indicate the mechanism of tissue triglyceride lipase activation, which leads to breakdown of triacylglycerols:

- A. Covalent modification
- B. Protein cleavage
- C. Feed-back inhibition
- D. Methylation
- E. All of the above

13. Under lipolysis the activation of adenylate cyclase cascade mechanism leads to an increase in the intracellular concentration of the secondary messenger during the transmission of the hormonal signal. Specify it:

- A. cAMP
- B. cGMP
- C.  $Ca^{2+}$
- D. Diacylglycerol
- E. Inositol-3-phosphate

14. It is known that the activity of the key enzyme of lipolysis of tissue triglyceride lypase is regulated by the covalent modification. What is the specific mechanism of this modification?

- A. Phosphorylation-dephosphorylation
- B. Protein cleavage
- C. Amination-deamination
- D. Methylation-demethylation
- E. Acetylation-deacetylation

15. What is a frequent reason of alimentary obesity?

A. Increasing supply of energy substrates with food and reducing of their using for energy purposes

B. Hypodynamia

C. Decrease in the supply of energy substrates with food and increase of their use for energy purposes

- D. Relevant gender
- E. Disturbance of digestive processes

16. Glycerol and fatty acids were obtained in result of hydrolysis reaction. What compound was hydrolysed?

- A. Sphingosine
- B. Cholesterol
- C. Phosphatidylcholine
- D. Cholic acid
- E. Triacilglycerol

17. A 30-year-old man has been delivered to the hospital in the state of the stress. Laboratory investigation revealed increased free fatty acids' level in the blood. Which of the following enzymes was activated in this case?

- A. Tissue triacylglycerol lipase
- B. Pancreatic triacylglycerol lipase
- C. Lipoprotein lipase
- D. Acetyl-CoA carboxylase
- E. Phospholipase  $A_2$

18. It is known that insulin inhibits lipolysis. Which type of the covalent modification of the tissue triglyceride lipase that is the key enzyme of the lipolysis used in this case?

- A. Acetylation
- B. Dephosphorylation
- C. Methylation
- D. Demethylation
- E. Phosphorylation

19. Contrainsulin hormones stimulate lipolysis by the activation of the cAMP-dependent protein kinases. What enzymes are activated by insulin causing the inhibition of lipolysis?

- A. Phosphodiesterase, protein phosphatase
- B. Phosphorylase, monoacylglycerol lipase
- C. Adenylate cyclase, protein kinase
- D. Diacylglycerol lipase, neuraminidase
- E. Transpeptidase, glutamate dehydrogenase

20. Glycerol is produced in the process of triacylglycerol mobilization. Specify the mechanism of glycerol activation:

A. Phosphorylation to form  $\alpha$ -glycerol phosphate

- B. Acetylation to form a glycerol-acetate
- C. Amination to form glycerol-amine
- D. Methylation to form methyl-glycerol
- E. Formylation to form formyl-glycerol

21. Specify metabolite that is a precursor in the biosynthesis of triacylglycerols in adipocytes promoting development of obesity:

- A. Malate
- B. Acetoacetate
- C. Succinate
- D. Oxalacetate
- E. Dihydroxyacetone phosphate

#### 20. Transport forms of lipids.

1. A 59-year-old man suffers from cerebral atherosclerosis. Hyperlipidemia is revealed under laboratory investigation. Which class of lipoproteins is most likely to be increased in the patient's serum?

- A. Low density lipoproteins
- B. High density lipoproteins
- C. Complex of fatty acids with albumin
- D. Chylomicrons
- E. Free cholesterol

2. A 68-year-old patient eats mainly eggs, bacon, butter, milk and meat. In the blood: cholesterol - 12.3 mmol / L, total lipids - 8.2 g/L, increased low-density lipoprotein fraction. What type of hyperlipoproteinemia is observed in the patient?

A. Hyperlipoproteinemia type IIa

- B. Hyperlipoproteinemia type I
- C. Hyperlipoproteinemia Type IIb
- D. Hyperlipoproteinemia type IV
- E. Hyperlipoproteinemia Type V

3. The level of anti-atherogenic lipoprotein fraction is increased in the patient's plasma after a course of the atherosclerosis treatment. The increased level of what class of lipoproteins confirms the effectiveness of the therapy of the disease?

- A. VLDL
- B. HDL
- C. IDL
- D. LDL
- E. Chylomicrons

4. An 11-year-old boy has the serum level of cholesterol up to 25 mmol / L. There is a hereditary familial hypercholesterolemia in the anamnesis caused by the disorder of receptor synthesis for:

- A. Low density lipoproteins
- B. High density lipoproteins
- C. Chylomicrons
- D. Very low density lipoproteins
- E. Intermediate density lipoproteins

5. The increased level of high density lipoproteins leads to the decreased risk of atherosclerosis. What is the mechanism of the anti-atherogenic action of high density lipoproteins?

A. Eliminate cholesterol from the tissues

B. Activate conversion of cholesterol to steroid hormones

C. Participate in the cholesterol breakdown

D. Activate conversion of cholesterol to the bile acids

E. Contribute to the absorption of cholesterol in the intestine

6. The level of cholesterol esters is low in the patient's blood, the serum is turbid. The deficiency of which enzyme causes such disorders?

- A. Lecithin-cholesterol acyltransferase
- B. Choline acetyltransferase
- C. Cholesterol esterase
- D. Lipoprotein lipase
- E. 7- Cholesterol hydroxylase

7. It was revealed an increased level of cholesterol of  $\beta$ -lipoprotein fraction in the blood serum. What are possible consequences of such disorders for the human body?

- A. Chronic renal failure
- B. Gallstone disease
- C. Obesity
- D. Hypertension
- E. Atherosclerosis

8. A 60-year-old patient has been admitted to the cardiology clinic with the diagnosis of ischemic heart disease. Laboratory examination of patient's blood revealed hyperlipoproteinemia, the content of LDL is 6.5 g/l, the triacylglycerols' level is 3 g/l. What is the type of hyperlipoproteinemia?

- A. Type I
- B. Type II
- C. Type III
- D. Type IV
- E. Type V

9. Concentration of low density lipoproteins is increased in the serum of a 45-year-old patient. The development of what disease could be expected in the patient?

- A. Gastritis
- B. Pyelonephritis
- C. Acute pancreatitis
- D. Atherosclerosis
- E. Pneumonia

10. The examination of the patient suffering from atherosclerosis revealed a reduced high density lipoprotein concentration and increased low density lipoprotein concentration in the blood. Cholesterol concentration is 11 mmol / L. The activity of which enzyme is reduced?

- A. Lecithin-cholesterol acyltransferase
- B. Choline acetyltransferase
- C. Cholesterol esterase
- D. Lipoprotein lipase
- E. 7-Cholesterol hydroxylase

11. Atherosclerosis is a disease manifested by the deposition of lipid structures (plaques) in the vascular wall. Cholesterol and its esters are the main components of plaques. Different classes of lipoproteins have different diagnostic value. What are atherogenic lipoproteins? A. Low density lipoproteins, very low density lipoproteins

- B. Chylomicrones
- C. Free fatty acids
- D. Intermediate density lipoproteins
- E. High density lipoproteins

12. Examination of a 16-year-old patient revealed symptoms xanthomas. of concentration pancreatitis, increased of chylomicrons in the blood serum, reduced activity of lipoprotein lipase, slightly elevated low density lipoproteins. verv Triacylglycerols' concentration is below 4.5 mmol / L. What is the type of hyperlipoproteinemia?

- A. Type III
- B. Type II
- C. Type I
- D. Type IV
- E. Type V

13. A patient has elevated cholesterol - 7.76 mmol / L and concentration of triacylglycerols is 1.5 mmol / L. There is also a high level of low density lipoproteins - 7.1 g/L. What is the type of hyperlipoproteinemia?

- A. Type II
- B. Type I
- C. Type III
- D. Type IV
- E. Type V

14. Abnormal VLDL were found in the patient's blood plasma, which contain particularly large amounts of triacylglycerols. Xanthomas are observed, manifestations of atherosclerosis, cholesterol and triacylglycerols ratio in the VLDL is more than 1/5, increased apoE in VLDL. What is the type of hyperlipoproteinemia?

- A. Type III
- B. Type II
- C. Type I
- D. Type IV
- E. Type V

15. Triacylglycerols and cholesterol concentrations are increased in the patient's blood plasma,  $apoC_2$  is decreased and  $apoC_3$  is increased. What is the type of hyperlipoproteinemia?

A. Type IV B. Type II C. Type III D. Type I E. Type V

16. Examination of a child suffering from obesity revealed increased concentrations of low density lipoproteins, chylomicrons and triacylglycerols in the blood serum. The serum is milky turbid on standing, the creamy layer is formed on the surface. What is the type of hyperlipoproteinemia?

- A. Type V
- B. Type II
- C. Type III
- D. Type IV
- E. Type I

17. What are antiatherogenic lipoproteins called?

- A. High density lipoproteins
- B. Low density lipoproteins
- C. Chylomicrons
- D. Very low density lipoproteins
- E. Intermediate density lipoproteins

18. What are atherogenic lipoproteins called?

- A. Low density lipoproteins
- B. High density lipoproteins
- C. Chylomicrons
- D. Albumins
- E. Globulins

19. What types of hyperlipoproteinemia are specific for patients with atherosclerosis?

- A. II, IV
- B. I, IV
- C. I, III
- D. IV
- E. IV, V

20. Which of the following lipoproteins will be elevated in the bloodstream about 2 hours after eating of a high fat meal?

- A. High density lipoproteins
- B. Chylomicrons
- C. Intermediate lipoproteins
- D. Low density lipoproteins
- E. Very low density lipoproteins

## 21. $\beta$ -oxidation of fatty acids. Analysis of metabolism of fatty acids and ketone bodies.

1. The concentration of ketone bodies increases in the blood under conditions of diabetes mellitus type I. It leads to metabolic acidosis development. What is the source of ketone bodies biosynthesis?

- A. Methylmalonyl-CoA
- B. Succinyl-CoA
- C. Propionyl-CoA
- D. Malonyl-CoA
- E. Acetyl-CoA

2. An aerobic oxidation of substrates is specific for the cardiac muscle. What is the main source of energy in the myocardium?

- A. Glucose
- B. Triacylglycerols
- C. Glycerol
- D. Fatty acids
- E. Amino acids

3. A process of fatty acid oxidation is associated with the process of ketone bodies biosynthesis. What pathology ketoacidosis is most often observed in?

- A. Diabetes mellitus type I
- B. Diabetes insipidus
- C. Non-steroidal diabetes
- D. Latent diabetes
- E. Diabetes mellitus type II

4. Carnitine was recommended to the athlete for the improving of his results. What process is activated by carnitine?

A. Transport of fatty acids into the mitochondria

- B. Synthesis of ketone bodies
- C. Synthesis of lipids
- D. Tissue respiration
- E. Synthesis of steroid hormones

5. What is a complication of an excessive accumulation of ketone bodies in the body?

A. It is accompanied by metabolic acidosis

B. It inhibits transport of substances across the cell membrane

C. It directly leads to the destruction of phospholipids of biomembranes

D. It increases biosynthesis of cholesterol and atherogenic lipoproteins

E. It causes decreasing of osmotic pressure in the blood

6. Specify the sequence of reactions of  $\beta$ -oxidation of fatty acids:

A. Activation under the participation of ATP, carboxylation to form malonyl-CoA, NADH<sub>2</sub>hydrogenation, dehydration, FADdehydrogenation, condensation

B. Hydration,  $FADH_2$  hydrogenation, condensation, carboxylation, hydrolysis to release acetyl-CoA

C. Enabling the participation of ATP and the HS-CoA, FAD-dehydrogenation, thiolysis to form acetyl-CoA

D. Condensation, ATP phosphorylation, isomerization, hydration, decarboxylation

E. Dehydrogenation, dehydration, FADdehydrogenation, esterification

7. Explain why using of insulin in the combination with glucose reduces the concentration of ketone bodies in the patients with diabetes mellitus:

A. It stimulates glucose utilization in the tissues by activating the citric acid cycle and preventing the accumulation of acetyl-CoA

B. It stops the activity of key enzymes in carbohydrate metabolism

C. It increases the mobilization and catabolism of triglycerides

D. It speeds up the process of gluconeogenesis

E. It increases cholesterol and low density lipoprotein biosynthesis

8. Ketone bodies are found in the patient's urine. What is the most likely pathology?

- A. Acute glomerulonephritis
- B. Diabetes mellitus
- C. Urolithiasis
- D. Tuberculosis of the kidney
- E. Renal infarction

9. Lipolysis is the enzymatic process of the hydrolysis of neutral fats into fatty acids and glycerol. Fatty acids go into the bloodstream and are transported by:

- A. Globulins
- B. Albumins
- C. High density lipoproteins

- D. Low density lipoproteins
- E. Chylomicrons

10. A 10-month-old child has been admitted to the hospital with the signs of damage of the limbs and trunk. Carnitine deficiency in muscles was detected after investigation. The biochemical basis for this disease is a disorder of the process:

A. Transport of fatty acids into the mitochondria

B. Regulation of  $Ca^{2+}$  levels in the mitochondria

- C. Substrate phosphorylation
- D. Utilization of lactic acid
- E. Synthesis of actin and myosin

11. Human body receives energy in the form of ATP during the oxidation of various substrates. Oxidation of which compound provides maximal utilization of an inorganic phosphate?

- A. Succinate
- B. Acetyl-CoA
- C. Glucose
- D. Glycerol
- E. Palmitoyl-CoA

12. What vitamins provide the dehydrogenation reactions in the  $\beta$ -oxidation of fatty acids?

- A. PP, B<sub>2</sub>
- B. B<sub>3</sub>, PP
- C. B2, C, B<sub>12</sub>
- D. Lipoic acid, B<sub>1</sub>
- E. B<sub>2</sub>, B<sub>6</sub>

13. Specify the energy value of the palmitic acid oxidation:

- A. 38 ATP
- B. 148 ATP
- C. 130 ATP
- D. 121 ATP
- E. 12 ATP

14. Specify metabolites that belong to ketone bodies:

A. Acetoacetate,  $\beta$ -hydroxybutyric acid, acetone

B. Acetone, malonyl-CoA, succinyl-CoA

C.  $\beta$ -hydroxybutyric acid, palmitoyl-CoA, acetone

D. Acetone,  $\beta$ -hydroxybutyric acid, acetyl-CoA

E.  $\beta$  -hydroxybutyric acid, 3aminopentanic acid, acetoacetate

15. Which ketone body is a precursor in the biosynthesis of two other ketone bodies?

- A. Acetyl-CoA
- B. Acetone
- C. β-hydroxybutyrate
- D. Acetoacetate
- E. Aminopentanedioic acid

16. A patient with high rate of obesity was advised to use carnitine as a food additive in order to enhance "fat burning". What is the role of carnitine in the process of fat oxidation?

A. Transport of free fatty acids from the cytosol to the mitochondria

B. Transport of free fatty acids from fat depots to the tissues

C. It takes part in one of the reactions of beta-oxidation of free fatty acids

D. Activation of free fatty acids

E. Activation of intracellular lipolysis

17. Choose the correct sequence of ketone bodies biosynthesis:

A. Acetyl-CoA + acetyl-CoA  $\rightarrow$  acetoacetyl-CoA  $\rightarrow$  beta-hydroxy-beta-methyl-glutaryl-CoA  $\rightarrow$  acetoacetate  $\rightarrow$  beta-hydroxybutyrate and acetone

B. Acetyl-CoA + acetyl-CoA  $\rightarrow$  acetoacetyl-CoA  $\rightarrow$  methylmalonyl-CoA  $\rightarrow$  betahydroxybutyrate and acetone

C. Acetyl-CoA + acetyl-CoA  $\rightarrow$  succinyl-CoA  $\rightarrow$  acetoacetate  $\rightarrow$  beta-hydroxybutyrate and acetone

D. Acetyl-CoA + acetyl-CoA  $\rightarrow$  propionyl-CoA  $\rightarrow$  succinyl-CoA  $\rightarrow$  acetoacetate  $\rightarrow$  beta-hydroxybutyrate and acetone

E. Acetyl-CoA + malonyl-CoA  $\rightarrow$ acetoacetyl-CoA  $\rightarrow$  beta-hydroxy-betamethyl-glutaryl-CoA  $\rightarrow$  acetoacetate  $\rightarrow$  betahydroxybutyrate and acetone

18. Select the cells that synthesize ketone bodies:

- A. Myocytes
- B. Hepatocytes
- C. Enterocytes
- D. Pancreocytes

E. Fibroblasts

19. Increased amount of free fatty acids is observed in the blood of patients with diabetes mellitus. It can be caused by:

A. Increased activity of triglyceride lipase in adipocytes

B. Storage of palmitoyl-CoA

C. Activation of a ketone bodies utilization

D. Activation of the biosynthesis of apolipoproteins

E. Decreased activity of phosphatidylcholine-cholesterol-

acyltransferase in the blood plasma

20. Regarding diabetic ketoacidosis, select the one false statement:

A. Ketone bodies are hydroxyacetic and acetoacetic acid

B. Overproduction of ketone bodies is caused by the breakdown of fats due to the lack of insulin

C. Ketoacidosis is a result of ketone bodies overproduction

D. Plasma level of K+ is often elevated

E. Administration of insulin and glucose is used for treatment of diabetic ketoacidosis

### 22. Biosynthesis of fatty acids.

1. Choose the main stages of the biosynthesis of saturated fatty acids:

A. Carboxylation of acetyl-CoA, condensation of malonyl-CoA with acetyl-CoA, followed by alternation of reduction of keto acid with NADPH<sub>2</sub> and condensation of fatty acid with malonyl-CoA

B. Condensation of acetyl-CoA, carboxylation, hydration, phosphorylation, condensation with acetyl-CoA

C. Condensation of acetyl-CoA molecules, decarboxylation, hydration, phosphorylation, condensation with malonyl-CoA

D. Condensation of mevalonic acid and acetyl-CoA, dehydration, reduction of NADH<sub>2</sub>, further condensation with acetyl-CoA

E. Condensation of acetoacetyl-CoA and malonyl-CoA, decarboxylation, hydration, dehydrogenation involving NADP, condensation with oxaloacetate 2. Specify the conditions required for the biosynthesis of fatty acids:

A. Acetyl-CoA, vitamins H, B<sub>3</sub>, PP, ATP, NADPH<sub>2</sub>, enzymatic Linen's complex

B. Vitamins  $B_2$ , C,  $B_1$ , glycerol, GTP, decarboxylase, dehydrogenases

C. Vitamins A, B, UTP, mevalonylpyrophosphate, alpha-ketoglutarate D. Ethanolamine, methionine, vitamins P, E, UTP

E. Lipoic acid, squalene, choline, sphingosine

3. Select the product of the key reaction of the fatty acid biosynthesis, vitamins and hormones that regulate the process:

- A. Malonyl-CoA, insulin, H, PP, B<sub>3</sub>
- B. Beta-HMG-CoA, somatotropin, B<sub>6</sub>
- C. Mevalonic acid, norepinephrine, B<sub>1</sub>, B<sub>2</sub>
- D. Mevalonylpyrophosphate, adrenaline, B<sub>12</sub>, C, P
- E. Phosphoric acid, cortisol, B<sub>2</sub>, A, E

4. It is found that the active form of dicarboxylic acid is the donor of two-carbon fragments in the biosynthesis of fatty acids. Name it:

- A. Methylmalonyl-CoA
- B. Malonyl-CoA
- C. Acetyl-CoA
- D. Stearoyl-CoA
- E. Palmitoyl-CoA

5. Formation of malonyl-CoA from acetyl-CoA is a key reaction in the biosynthesis of fatty acids. Specify the enzyme that catalyzes this reaction:

- A. Acetyl-CoA decarboxylase
- B. Malonyl-CoA decarboxylase
- C. Malonyl-CoA hydratase
- D. Acetyl-CoA dehydrogenase
- E. Acetyl-CoA carboxylase

6. Specify a substrate that is transported from the mitochondria to the cytosol by means of the shuttle system and it is a direct donor of acetyl-CoA in the biosynthesis of fatty acids: A Acetoacetyl CoA

A. Acetoacetyl-CoA

- B. Malonyl-CoA
- C. Citrate
- D. Methylmalonyl-CoA
- E. Palmitoyl-CoA

7. Which of the following substances is a donor of reduction equivalents in the biosynthesis of palmitate?

- A. NADPH<sub>2</sub>
- B. FADH<sub>2</sub>
- $C. \ NADH_2$
- D. FMN
- E. THF

8. Acetyl-CoA carboxylase reaction is a rate limiting in the control of the biosynthesis of fatty acids. Select the molecular mechanisms controlling the activity of acetyl-CoA carboxylase:

A. Allosteric regulation, covalent modification, changing of the synthesis of acetyl-CoA carboxylase

B. Reconstruction of operon, proteolysis, modification of the gene encoding the information about the structure of acetyl-CoA carboxylase

C. Changing of the penetration of gene, reversible inhibition, changes in the activity of the promoter region of the operon

D. Uncompetitive inhibition, partial proteolysis, decarboxylation of histidine residues in the structure of acetyl-CoA carboxylase

E. Irreversible inhibition, modification of the primary structure of the amino acid sequence of acetyl-CoA carboxylase

9. It is known that fatty acid synthase is a multienzyme complex. What is called?

- A. Linen
- B. Knoop
- C. Watson-Crick
- D. Krebs
- E. Krebs-Henseleit

10. Acyl carrier protein has two SHcontaining binding sites. Indicate their origin:

- A. Cysteine residue, 4-phosphopantetheine
- B. HS-CoA, methionine
- C. Cysteine residue, dephosphopantetheine
- D. Carboxybiotin, cysteine residue

E. Methionine, 4-phosphopantetheine

11. Oleic acid pool which is more than 50% of the total fatty acid composition of the human body formed by the system of:

A. Fatty acid desaturase

B. Dehydrogenation of fatty acids

- C. Carboxylation of fatty acids
- D. Elongation of fatty acids
- E. Deamination of fatty acids

12. Palmitic acid is a precursor in the formation of long-chain fatty acids ( $C_{18}$ - $C_{24}$ ). Two-carbon fragments connected to the palmitic acid. Specify the donors of two-carbon fragments:

- A. Malonyl-CoA, acetyl-CoA
- B. Methylmalonyl-CoA, acetyl-CoA
- C. HS-CoA, acetyl-CoA
- D. Stearoyl-CoA, carboxybiotin
- E. Palmitoyl-CoA, acetyl-CoA

13. Citrate shuttle system is used for the transport of acetyl-CoA from the mitochondria into the cytosol. Select an enzyme which directly participates in the release of cytosolic acetyl-CoA:

- A. Citrate dehydrogenese
- B. Citrate lyase
- C. Isocitrate dehydrogenese
- D. Triacylglycerol lipase
- E. Malate dehydrogenese

14. The increasing of the hydrocarbon chain in the palmitate synthase complex is a cyclical process and requires a sufficient amount of reducing equivalents in the form NADPH<sub>2</sub>. Specify the number of NADPH<sub>2</sub> consumed in one cycle of the complex:

- A. 1 molecule
- B. 2 molecule
- C. 3 molecules
- D. 4 molecule
- E. 6 molecules

15. A sufficient amount of reducing equivalents in the form  $NADPH_2$  is required for the synthesis of the fatty acids. What process plays a key role in the replenishing of  $NADPH_2$  pool?

- A. Lipogenesis
- B. Gluconeogenesis
- C. Glucuronate pathway
- D. Glycogenolysis
- E. Pentose phosphate pathway

16. Specify a key metabolite that inhibits fatty acid biosynthesis reactions by the mechanism of allosteric feedback inhibition (negative feedback):

- A. Palmitoyl-CoA
- B. Malonyl-CoA
- C. HS-CoA
- D. Acetyl-CoA
- E. Methylmalonyl-CoA

17. It is known that the activity of the key enzyme of fatty acid synthesis - acetyl-CoA carboxylase is regulated at a molecular level by a covalent modification. Specify the mechanism of this modification:

- A. Phosphorylation-dephosphorylation
- B. Proteolysis
- C. Deamination-amination
- D. Methylation-demethylation
- E. Acetylation-deacetylation

18. In addition to the fact that arachidonic acid performs an important structural function, it is still a precursor in the synthesis of biologically active substances. Indicate them:

- A. Prostaglandins
- B. Leukotrienes
- C. Thromboxanes
- D. Prostacyclin
- E. All of the above

19. Specify hormone that activates the biosynthesis of fatty acids:

- A. Insulin
- B. Glucagon
- C. Adrenaline
- D. Growth hormone
- E. Cortisol

20. Specify the stage of the pentose phosphate pathway which produces the greatest number of NADPH<sub>2</sub>, used for the fatty acids synthesis:

- A. Oxidation stage
- B. Substrate phosphorylation
- C. Formation of phosphotriose
- D. Glycogenolysis
- E. Formation of glucuronic acid

#### 23. Metabolism of complex lipids.

1. The methylation process is one of the stages is the endogenous synthesis of choline. Indicate vitamins, coenzyme forms of which are involved in this reaction:

A. Folic acid, B<sub>12</sub>

- B. B<sub>2</sub>, PP
- C. B<sub>6</sub>, B<sub>3</sub>
- D. H, C
- E. B<sub>1</sub>, lipoic acid

2. It is known that lipotropic factors are necessary for the synthesis of complex lipids in the body. Specify them:

- A. Choline
- B. Methionine
- C. Polyunsaturated fatty acids
- D. Vitamines  $B_6$ ,  $B_{12}$
- E. All of the above

3. Specify a substance which is a donor of methyl groups in the synthesis of phospholipids:

- A. Ascorbic acid
- B. Methionine
- C. Glucose
- D. Glycerol
- E. Citrate

4. The biological role of polyunsaturated fatty acids is as follows:

A. Structure of biological membranes; they are a source of synthesis of prostaglandins and they inhibit the deposition of cholesterol in the vascular wall

B. They regulate blood pressure, activate lipid peroxidation

C. They stabilize unsaturated bonds in the structure of vitamin A and activate lipolysis

D. They involved in the synthesis of phospholipids to inhibit cholesterol esterification

E. They contribute to the absorption of fat-soluble vitamins, inhibit lipolysis and stimulate the synthesis of cholesterol

5. The structure of phosphatidylcholine molecules includes:

A. Glycerol, fatty acids, choline, phosphoric acid

B. Choline, serine, mevalonic acid, methionine

C. Choline, cerebroside, sialic acid, galactose, phosphoric acid

D. Cholesterol, malonic acid, choline, mannose

E. Choline, sphingosine, lipoic acid, hexosamine and serine

6. Specify a substance which is a donor of methyl groups in the synthesis of phospholipids:

- A. Linoleic acid
- B. DOPA
- C. Cholesterol
- D. Acetoacetate
- E. Methionine

7. A 5-year-old child was diagnosed with Niemann-Pick disease. Medical examination revealed neurological disorders. Which lipids are accumulated in the central nervous system?

- A. Sphingomyelin
- B. Leukotriene
- C. Gangliosides
- D. Cerebrosides
- E. Cholesterol

8. Sphingolipidoses are enzyme pathologies developed due to the defects in the synthesis of certain hydrolytic enzymes that are involved in the catabolism of sphingolipids. What type of diseases includes this pathology?

- A. Lysosomal
- B. Mitochondrial
- C. Secondary-induced
- D. Heteronuclear
- E. X-linked recessive

9. A 2-year-old child suffering from a congenital defect of the enzyme glucocerebrosidase was revealed hepato- and splenomegaly and the symptoms of the central nervous system disorders. What is the pathology?

- A. Gierke disease
- B. Gaucher disease
- C. Tay-Sachs disease
- D. Gout
- E. Maroto-Lamy syndrome

10. Α 2-year-old child suffers from neurological disorders since the birth. Objectively: the signs of blindness. macrocephaly. The child's condition progressively worsens. The doctor suspected Tay-Sachs disease. The activity of which enzyme should be investigated? A. Hexosaminidase A

- B. β-Galactosidase
- C. Sphingomyelinase
- D. Gglycogen phosphorylase
- E. Glucocerebrosidase

11. A 65-year-old patient with signs of obesity and a risk of steatosis of the liver development is recommended a diet saturated with lipotropic factors. Specify it:

- A. Glucose
- B. Ascorbic acid
- C. Methionine
- D. Glycerin
- E. Citrate

12. What additional sources of energy are necessary for the synthesis of complex lipids in the human body?

- A. GTP
- B. CTP
- C. TPP
- D. UTP
- E. ATP

13. One of the stages of the endogenous synthesis of choline is the process of decarboxylation of serine with the formation of ethanolamine, which is controlled by vitamin  $B_6$ . What are coenzyme forms of vitamin  $B_6$ ?

A. PLP, PMP

- B. FAD, FMN
- C. NADP, NADPH<sub>2</sub>
- D. Cobalamin, THF
- E. HS-CoA, 4-phosphopantetheine

14. Under a clinical picture a pediatrician has suspected the development of Tay-Sachs disease in a 2-year-old child. It is known that this sphingolipidosis is a similar in clinical manifestations with gangliosidosis  $G_{M1}$ . The activity of what enzymes should be investigated for the differential diagnostics of the disease?

A. β-galactosidase and hexosaminidase A

B. Glucocerebrosidase and iduronsulfate sulfatase

C. Sphingomyelinase and heparan sulfate sulfatase

D. Arylsulfatase and glucocerebrosidase

E. Iduronidase and sphingomyelinase

15. Niemann-Pick disease is a sphingolipidosis characterized by an accumulation of sphingomyelin in the brain, liver and spleen. Indicate the defect of which of the listed enzymes leads to this pathology:

- A. Sphingomyelinase
- B. Glucocerebrosidase
- C.  $\beta$ -galactosidase
- D. Arylsulfatase
- E. Iduronidase

16. Indicate the coenzymes of the methylation process in the endogenous synthesis of choline:

- A. NADP, NADPH<sub>2</sub>
- B. FAD, FMN
- C. PLP, PMP
- D. Tetrahydrofolate, methylcobalamin
- E. HS-CoA, 4-phosphopantetheine

17. One of the stages of the endogenous synthesis of choline is the process of the decarboxylation of serine with the formation of ethanolamine. The coenzyme forms of which vitamin are involved in this reaction?

- A. B<sub>6</sub>
- $B. B_2$
- C. B<sub>12</sub>
- D. C
- E. B<sub>1</sub>

18. It is possible to obtain phosphatidylcholine from phosphatidylethanolamine during the interaction with the following compound:

- A. CTP
- B. Phosphatidic acid
- C. Choline
- D. S-adenosyl methionine
- E. Carboxybiotin

19. A group of polyunsaturated fatty acids are used in the biosynthesis of the complex lipids. Which of them has four double bonds in its structure?

- A. Arachidonic
- B. Linoleic
- C. Linolenic
- D. Oleic
- E. Palmitoleic

20. What substance is a common intermediate metabolite in the biosynthesis of phospholipids and triacylglycerols?

- A. Phosphatidic acid
- B. Diacylglycerol
- C. 1,3-biphosphoglycerate
- D. Mevalonate
- E. Glycerophosphate

21. Hepatic steatosis is developed in experimental rats being on protein-free diet due to the deficiency of methylating agents. The biosynthesis of which metabolite is disturbed in rats?

- A. Choline
- B. DOPA
- C. Cholesterol
- D. Acetoacetate
- E. Linoleic acid

### 24. Biosynthesis and biotransformation of cholesterol. Analysis of disorders of lipid metabolism: steatorrhea, atherosclerosis, obesity.

1. Specify the reaction of cholesterol biotransformation underlying the formation of its esters:

- A. Esterification of cholesterol
- B. Cholesterol hydroxylation
- C. Oxidation of cholesterol
- D. Amination of cholesterol
- E. Reduction of the side chain

2. What is bile acid formed as a result of cholesterol hydroxylation at 3th, 7th and 12th position of carbon atoms called?

- A. Cholic acid
- B. Lithocholic acid
- C. Chenodeoxycholic acid
- D. Deoxycholic acid
- E. Glycocholic acid

3. Which organs take part in the hydroxylation of cholesterol and formation of the active form of vitamin  $D_3$ ?

- A. Kidneys, intestine
- B. Liver, kidneys
- C. Liver, pancreas
- D. Gonads, kidneys
- E. Liver, intestine

4. Name a precursor in the biosynthesis of corticosteroids:

- A. Estradiol
- B. Pregnenolone
- C. Corticosterone
- D. Aldosterone
- E. Androgens

5. What is normal concentration of cholesterol in the human blood serum?

- A. 3.5 5.2 mmol / L
- B. 5.2 6.5 mmol / L
- C. 7.0 8.5 mmol / L
- D. 2.0 3.5 mmol / L
- E. 8 10 mmol / L

6. Specify the atherogenic lipoproteins:

- A. LDL, VLDL
- B. LDL, HDL
- C. VLDL, chylomicrons
- D. HDL, triacylglycerols
- E. LDL, cholesterol, free fatty acids

7. What are the main substrates of lipid metabolism accumulated in the foam cells?

- A. Cholesterol and its esters
- B. Phospholipids
- C. Triglycerides
- D. Unsaturated fatty acids
- E. Saturated fatty acids

8. What is a biological role of cholesterol?

A. Component of cell membranes, the source for the biosynthesis of physiologically active steroids

B. Component of biological membranes, involved in the synthesis of catecholamines

C. Synthesis of vitamin  $D_3$ , triacylglycerols

D. Synthesis of lipoproteins, vitamin D<sub>3</sub>

E. Synthesis of phospholipids, eicosanoids

9. What are the antiatherogenic lipoproteins?

- A. LDL
- B. VLDL
- C. HDL
- D. Chylomicrons
- E. Albumins

10. What is the key enzyme in the biosynthesis of cholesterol?

### A. Beta-hydroxy-beta-methylglutaryl-

- CoA reductase
- B. Monoamine oxidase
- C. Citrate synthase
- D. Acetyl-CoA carboxylase
- E. Malonyl-CoA transferase
- 11. Mevalonic acid is a precursor of:
- A. Sphingosine
- B. Phospholipids
- C. Saturated fatty acids
- D. Cholesterol
- E. Beta-hydroxy-methylglutaryl-CoA

12. Which class of lipoproteins containing apo-B-100 belongs to atherogenic ones?

- Á. IDL
- B. HDL
- C. LDL
- D. Chylomicrons
- E. Albumins

13. What is the main mechanism of cholesterol biosynthesis regulation?

- A. Receptor-mediated
- B. Competitive inhibition
- C. Partial proteolysis
- D. Lanosterol activation
- E. Condensation of isoprenoid units

14. What is the most accepted theory to explain the mechanism of atherosclerosis development?

- A. Autoimmune
- B. Immune
- C. Cholesterol

D. Systemic inflammatory response of the body

E. Damage of the endothelium

15. What are the most informative diagnostic criteria of atherosclerosis?

A. Concentration of the atherogenic lipoproteins, cholesterol and its esters

B. Concentration of HDL cholesterol, free fatty acids

C. Concentration of antiatherogenic lipoproteins, free fatty acids

D. Mevalonic acid concentration

E. Atherogenic coefficient

16. Which organ makes the greatest contribution to the endogenous biosynthesis of cholesterol?

- A. Connective tissue
- B. Skin
- C. Intestine
- D. Kidneys
- E. Liver

17. What is the main pathway of cholesterol excretion from the body?

A. In the composition of bile through intestine

- B. Sebaceous glands
- C. Urinary excretion
- D. Salivary glands
- E. Conversion of 7-dehydrocholesterol

18. What is the most hydrophobic compound in the human body?

- A. Cholesterol
- B. Phospholipids
- C. Triacylglycerols
- D. Sphingosine
- E. Mevalonic acid

19. What type of reaction is used for formation of squalene from isoprenoid units?

- A. Condensation reaction
- B. Isomerization reaction
- C. Cyclization
- D. Phosphorylation reaction
- E. Reduction reaction

20. What key enzyme of cholesterol biosynthesis is inhibited under the using of antiatherogenic drugs (statins)?

A. Beta-hydroxy-methylglutaryl-CoA reductase

- B. Monoamine oxidase
- C. Citrate lyase
- D. Acetyl-CoA carboxylase
- E. Malonyl-CoA transferase

21. Which of the following compounds directly inhibits an expression of the HMG-CoA reductase gene?

- A. Cholesterol
- B. HMG-CoA
- C. Lanosterol
- D. Isopentenyl pyrophosphate
- E. Squalene

### 25. Analysis of amino acid metabolism (transamination, deamination, decarboxylation).

1. A patient with a cranial trauma manifests repeated epileptoid seizures. The biosynthesis of what biogenic amine is disturbed in this clinical situation?

- A. Histamine
- B. GABA
- C. Adrenaline
- D. Serotonin
- E. Dopamine

2. What would be the products for the transamination reaction in which glutamate and pyruvate are substrates?

- A. Alfa-ketoglutarate and alanine
- B. Glutamine and lactate
- C. Alfa-ketoglutarate and acetyl-CoA
- D. Alfa-ketoglutarate and lactate
- E. Glutamine and acetyl-CoA

3. Examination of a patient suffering from cancer of urinary bladder revealed a high rate of serotonin and 3-hydroxyanthranilic acid. It is caused by an excess of the following amino acid in the organism:

- A. Tyrosine
- B. Alanine
- C. Histidine
- D. Methionine
- E. Tryptophan

4. In result of decarboxylation of histidine biogenic amine is formed that has a powerful vasodilatation effect. Name it:

- A. Histamine
- B. Serotonin
- C. Dioxyphenylalanine
- D. Noradrenalin
- E. Dopamine

5. A 7-year-old child was admitted to an emergency clinic in the state of allergic shock provoked by a wasp sting. High concentration of histamine was determined in the patient's blood. Which biochemical reaction leads to the production of this amine?

A. Deamination

- B. Hydroxylation
- C. Dehydration
- D. Decarboxylation

### E. Reduction

6. A patient diagnosed with carcinoid of bowels was admitted to the hospital. Analysis revealed high production of serotonin. It is known that this substance is formed from amino acid tryptophan. What biochemical mechanism underlies this process?

- A. Decarboxylation
- B. Deamination
- C. Microsomal oxidation
- D. Transamination
- E. Formation of paired compounds

7. In psychiatric practice biogenic amines and their derivatives are used for the treatment of certain diseases of the central nervous system. Name the substance which acts as an inhibitory mediator:

- A. Serotonin
- B. Histamine
- C. GABA
- D. Dopamine
- E. Taurine

8. A patient complained about dizziness, memory impairment and periodical convulsions. It was revealed that these changes were caused by a product of decarboxylation of glutamic acid. Name this product:

- A. GABA
- B. Pyridoxal phosphate
- C. Serotonin
- D. ATP
- E. Histamine

9. Pharmacological effects of antidepressants are connected with an inhibition of an enzyme catalyzing the oxidation of such biogenic amines as noradrenaline and serotonin in the mitochondrion of cerebral neurons. Which enzyme participates in this process?

- A. Monoamine oxidase
- B. Transaminase
- C. Decarboxylase
- D. Peptidase
- E. Lyase

10. Biogenic amines, namely histamine, serotonin and dopamine are very active substances that affect markedly various physiological functions of the organism. What biochemical process is the principal pathway for biogenic amines production?

- A. Decarboxylation of amino acids
- B. Deamination of amino acids
- C. Transamination of amino acids
- D. Oxidation of amino acids
- E. Reductive amination

11. Which of the following substances is an acceptor of amino groups in the reactions of amino acids transamination?

- A. Alfa-ketoglutarate
- B. Argininosuccinate
- C. Lactate
- D. Citrulline
- E. Ornithine

12. An unusually active amine, a mediator of inflammation and allergy, appears via decarboxylation of histidine. Specify it:

- A. Histamine
- B. Serotonin
- C. Dopamine
- D. Gamma-Aminobutyrate
- E. Tryptamine

13. The signs of skin depigmentation of a 19year-old patient are caused by the disorder of melanin biosynthesis. The disturbance of the metabolism of what amino acid is it caused by?

- A. Tryptophan
- B. Tyrosine
- C. Histamine
- D. Proline
- E. Lysine

14. A child manifests epileptic seizures caused by vitamin  $B_6$  deficiency. This is conditioned by the decrease of the gamma-aminobutyrate level in the nervous tissue which acts as an inhibiting neurotransmitter. The activity of which enzyme is decreased in this case?

- A. Glutamate decarboxylase
- B. Alanine aminotransferase
- C. Glutamate dehydrogenase
- D. Pyridoxal kinase
- E. Glutamate synthase

15. Decarboxylation of glutamate results in the formation of the inhibitory transmitter in the central nervous system. Name it:

- A. Serotonin
- B. Glutathione
- C. Histamine
- D. GABA
- E. Asparagine

16. Psychopharmacological drugs with antidepressant effect inhibit the oxidative deamination of noradrenaline and serotonin in brain by means of inhibition of enzyme:

- A. Monoaminoxidase
- B. Cytochrome oxidase
- C. Oxidase of L-amino acids
- D. Glutamate dehydrogenase
- E. Oxidase of D-amino acid

17. Pyridoxal phosphate was prescribed to the patient according to the clinical indices. Which processes are corrected using this preparation?

A. Transamination and decarboxylation of amino acids

B. Oxidative decarboxylation of alfa-keto acids

C. Deamination of amino acids

D. Synthesis of purine and pyrimidine nucleotides

E. Protein synthesis

18. The transaminase activity sharply increases in the blood plasma of patients with hepatitis and myocardial infarction. Point the possible cause:

A. Damage of cellular membrane and entering enzymes to the blood

B. The increase of enzymes activity by hormones

C. Deficiency of pyridoxine

D. The increase of amino acids synthesis velocity in tissues

E. The increase of amino acids degradation velocity in tissues

19. In diagnostics of an acute viral hepatitis estimation of the next enzymatic activity in the blood serum is the most valuable:

- A. Creatine kinase
- B. Glutathion peroxidase
- C. Alanine aminotransferase
- D. Amylase
- E. Lactase

20. In a child, consuming meal of plant origin for a prolong time, growth retardation, anemia, liver and kidney impairment were observed. The cause of such state is the deficiency in diet of the next nutrients:

A. Essential amino acids

B. Lipids

- C. Carbohydrates
- D. Mineral macroelements
- E. Carotene

21. As a result of tryptophan hydroxylation in the presence of tryptophan-5-monooxygenase and next decarboxylation is produced:

A. Adrenalin

- B. Histamine
- C. Dopamine
- D. Melanin
- E. Serotonin

22. An important reaction for the biosynthesis of amino acid from carbohydrate intermediates is transamination which requires the cofactor:

- A. Pyridoxal phosphate
- B. Riboflavin
- C. Niacin
- D. Thiamin
- E. Folic acid

23. Production of some toxic substances in large intestine occurs due to the decarboxylation of some amino acids. Indicate which substance is produced from ornithine:

- A. Scatole
- B. Putrescin
- C. Indole
- D. Cadaverine
- E. Phenol

24. What is a coenzyme of aminotransferases?

- A. Pyridoxal phosphate
- B. Thiamine pyrophosphate
- C. Biotin
- D. Riboflavin
- E. Pantothenic acid

25. What is a coenzyme of the decarboxylases of amino acids?

- A. Pyridoxal phosphate
- B. Thiamine pyrophosphate
- C. Biotin

- D. Riboflavin
- E. Pantothenic acid

### 26. Biosynthesis of glutathione and creatine.

1. Macroergic compounds are required for the normal metabolism of cells. Which of the compounds listed below refers to macroergic ones?

- A. AMP
- B. Creatine
- C. Creatinine
- D. Glucose-6-phosphate
- E. Creatine phosphate

2. The considerable increase of MB-form of creatine kinase activity was found in a patient's blood. Point a possible pathology:

- A. Myocardial infarction
- B. Hepatitis
- C. Rheumatism
- D. Pancreatitis
- E. Cholecystitis

3. The increase of urea and creatinine levels and the decrease of these parameters in the urine were revealed in a patient. Point possible causes of that state:

- A. Liver disease
- B. Renal disease
- C. Muscle disease

D. Disturbances of binding, transport and excretion of ammonia with urine

E. Disturbance of acid-base balance

4. A 46-year-old female has been suffering from progressive myodystrophy (Duchenne's disease) for a long time. The change of catalytic activity of what blood enzyme proves to be a diagnostic test for the disease?

- A. Creatine kinase
- B. Lactate dehydrogenase
- C. Pyruvate dehydrogenase
- D. Glutamate dehydrogenase
- E. Adenylate kinase

5. Methyl groups are used in organism for the synthesis of the important substances such as creatine, choline and adrenaline. The source of these groups is an essential amino acid: A. Valine

- B. Glycine
- C. Methionine
- D. Cysteine
- E. Arginine

6. A patient with serious damage of muscular tissue was admitted to the traumatology department. What biochemical urine index will be increased in this case?

- A. Mineral salts
- B. Lipids
- C. Glucose
- D. Creatinine
- E. Uric acid

7. The muscle dystrophy was diagnosed in an 18-year-old young male. The increased level of what substance in the blood serum is the most probable in this pathology?

- A. Creatine
- B. Myosin
- C. Myoglobin
- D. Lactate
- E. Alanine

8. Determination of which enzyme in the blood is the most informative in the first hours after the onset of myocardial infarction?

- A. Creatine phosphokinase
- B. Aspartate aminotransferase
- C. Alanine aminotransferase
- D. Lactate dehydrogenase
- E. Glutamate dehydrogenase

9. What is a daily urinary excretion of creatinine?

A. 2 - 3 g

- B. 1 2 g
- C. 3 4 g
- D. 0.5 1 g
- E. More than 4.0 g

10. In preparation for a trip to an area of India where malaria is endemic, a young man is given primaquine prophylactically. Soon thereafter, he develops a hemolytic condition. The most likely cause of the hemolysis is a less than normal level of which of the following compounds?

- A. Reduced form of glutathione
- B. Oxidized form of NAD
- C. Glucose 6-phosphate
- D. Ribose-5-phosphate

### E. Ribulose-5-phosphate

11. The lack of selenium in the body is manifested by the development of cardiomyopathy. The decreased activity of what selenium-containing enzyme is observed in this case?

- A. Lactate dehydrogenase
- B. Catalase
- C. Cytochrome oxidase
- D. Succinate dehydrogenase
- E. Glutathione peroxidase

12. Lipid peroxidation reactions are enhanced in a result of the decreased activity of antioxidant enzymes. The deficiency of what trace element leads to the decreased activity of glutathione peroxidase?

- A. Selenium
- B. Molybdenum
- C. Cobalt
- D. Magnesium
- E. Copper

13. Detoxication of xenobiotics (drugs, epoxides, arene oxides, aldehydes, etc.) and endogenous metabolites (estradiol, prostaglandins, leukotrienes) occurs in the liver by conjugation with:

- A. Glutathione
- B. Aspartic acid
- C. Glycine
- D. S-adenosylmethionine
- E. Phosphoadenosine

14. There is a peptide in a human body in which the formation of the gamma-carboxylic group of glutamate takes part. What is this peptide called?

- A. Oxytocin
- B. Carnosine
- C. Anserine
- D. Glutathione
- E. Vasopressin

15. What biochemical indicator is used to evaluate the glomerular ultrafiltration in the kidneys?

- A. Proteinuria
- B. Daily creatinine excretion in the urine
- C. Clearance of creatinine
- D. The daily excretion of urea in the urine
- E. Hematuria

16. The destruction of the membranes of the myocytes is caused by the deficiency of the vitamin E. The urinary excretion of what metabolite of muscle cells indicates to their damage?

- A. Creatine
- B. Glucose
- C. Pyruvate
- D. Ammonia
- E. Lactate

17. Long-term myocardial ischemia leads to the necrosis and hyperenzymemia. The determination of what enzyme activity in the blood is used in clinics to diagnose a myocardial infarction?

A. Creatine phosphokinase, AST, LDH<sub>1,2</sub>

- B. Succinate dehydrogenase, amylase, lipase
- C. Arginase, urease, maltase
- D. Nucleases, trypsine, chymotripsin

E. Glycogen phosphorylase, glucogen synthase, malate dehydrogenase

18. The synthesis of creatine proceeds in two steps. What organs are directly involved in this process?

- A. Kidney, liver
- B. Spleen, kidneys
- C. Liver, muscles
- D. Kidney, myocardium
- E. Kidney, muscles

19. Creatine phosphokinase (CK) is an enzyme that has an exceptional diagnostic value in many pathologies, specify its isoforms:

A. CK-MM, CK-MB, CK-BB

- B. CK<sub>1</sub>, CK<sub>2</sub>, CK<sub>3</sub>, CK<sub>4</sub>, CK<sub>5</sub>
- C. CK<sub>1</sub>, CK<sub>2</sub>, CK<sub>3</sub>

D. Cardiac-specific, liver-specific, bone-specific

E. All of the above

20. The amino acids involved in the biosynthesis of creatine are:

- A. Arginine, glycine, methionine
- B. Arginine, alanine, glycine
- C. Glycine, lysine, methionine
- D. Arginine, lysine, methionine
- E. Glycine, lysine, alanine

21. What is the chemical structure of glutathione?

- A Tetrapeptide
- B. Tripeptide
- C. Nonapeptide
- D. Derivative of 7-dehydrocholesterol
- E. Dipeptide

22. Amino acids are used for the synthesis of many biologically important compounds in the body. Which of the following amino acids is necessary for the synthesis of purine nucleotides, creatine, glutathione, paired bile acids?

- A. Glycine
- B. Arginine
- C. Lysine
- D. Methionine
- E. Cysteine

### 27. Analysis of ammonia detoxication and urea biosynthesis.

1. Ammonia is a very toxic substance, especially for nervous system. What substance takes the most active part in the ammonia detoxication in the brain tissue? A. Histidine

- A. HISUUI
- B. Lysine C. Proline
- D. Glutamic acid
- $\mathbf{D}$ . Olutallile actu
- E. Alanine

2. A citrulline and a high level of ammonia are determined in the urine of a newborn child. The formation of what substance is the most credible to be disturbed?

A. Creatine

- B. Uric acid
- C. Ammonia
- D. Creatinine
- E. Urea

3. The greater amount of nitrogen is excreted from the organism in the form of urea. Inhibition of urea synthesis and accumulation of ammonia in blood and tissues are induced by the decreased activity of the following liver enzyme:

A. Carbamoyl phosphate synthetase

- B. Aspartate aminotransferase
- C. Urease

D. Amylase E. Pepsin

4. A newborn child was found to have a reduced intensity of sucking, frequent vomiting and hypotonia. It was revealed an increased concentration of citrulline in urine and blood. What metabolic process is disturbed?

- A. Tricarboxylic acid cycle
- B. Ornithine cycle
- C. Glycolysis
- D. Glyconeogenesis
- E. Cori cycle

5. Hyperargininemia and argininuria are observed in a 25-year-old patient. The urea level is decreased in blood and urine. Which enzyme deficiency is observed?

- A. Arginase
- B. Glutamate dehydrogenase
- C. Ornithine carbamoyl transferase
- D. Argininosuccinate synthetase
- E. Tryptophan-5-monooxigenase

6. A patient has all signs of the hepatic coma such as loss of consciousness, absence of reflexes, cramps, convulsion, disorder of heart activity, recurrent (periodical) respiration. What cerebrotoxic substances are accumulated in blood under hepatic insufficiency?

- A. Urea
- B. Ammonia
- C. Necrosogenic substances
- D. Autoantibodies
- E. Ketone bodies

7. Toxicity of ammonia (especially for brain) is due to its capacity to disturb the functioning of the Krebs cycle as a result of the removal from the cycle of:

- A. Alfa-ketoglutarate
- B. Citrate
- C. Malate
- D. Succinate
- E. Fumarate

8. Glutamic acid plays the central role in the metabolism of amino acids in the nervous tissue. This is due to the fact that this amino acid:

A. It binds ammonia to form glutamine

- B. It is used for the synthesis of glucose
- C. It is used for the synthesis of lipids

D. It is used in the synthesis of neurospecific proteins

E. It is used for the synthesis of ketone bodies

9. Secondary orotic aciduria is revealed in a patient with hereditary hyperammonemia due to disorders of the ornithine cycle. The increase of the concentration of what metabolite of the ornithine cycle causes enhanced synthesis of orotic acid?

- A. Urea
- B. Ornithine
- C. Citrulline
- D. Carbamoyl phosphate
- E. Argininosuccinate

10. Disorders of the central nervous system are observed in a child. Hyperammonemia is revealed in the blood serum. The deficiency of what enzyme can cause such pathological condition?

- A. Ornithine transcarbamoylase
- B. Glutathione transferase
- C. Glycine transferase
- D. Alanine aminotransferase
- E. Glucuronyl transferase

11. Under metabolic acidosis acid products are neutralized by ammonia in the kidney and excreted in the form of salts of:

- A. Ammonium
- B. Potassium
- C. Calcium
- D. Sodium
- E. Magnesium

12. Which amino acid is an intermediate in the biosynthesis of urea in the liver and is cleaved to form ornithine and urea?

A. Citrulline

B. Arginine

C. Valine

D. Leucine

E. Tryptophan

13. Under hyperammonemia convulsions, vomiting and loss of consciousness are observed. Ammonia concentration is increased in the biochemical analysis of blood. What is the pathogenetic mechanism of seizures under this condition?

A. Decreased biosynthesis of GABA

B. Inhibition of  $\beta$ -oxidation of fatty acids

C. Inhibition of glycolysis

D. Inhibition of the pentose phosphate pathway

E. Uncoupling of oxidation and oxidative phosphorylation

14. Neurons are very sensitive to the energy deficiency that caused by the high concentration of ammonia stimulating reducing amination of  $\alpha$ -ketoglutarate and removing it from the following metabolic pathway:

A. The citric acid cycle

- B. The ornithine cycle
- C. Glycolysis
- D. Glycogenolysis
- E. Penthose phosphate pathway

15. A female neonate did well until approximately 24 hours of age when she became lethargic. A sepsis workup proved negative. At 56 hours, she started showing focal seizure activity. Hyperammonemia was found. Quantitative plasma amino acid levels marked revealed а elevation of argininosuccinate. Which one of the following enzymic activities is most likely to be deficient in this patient?

- A. Argininosuccinate lyase
- B. Arginase
- C. Argininosuccinate synthase
- D. Carbamoyl phosphate synthetase I
- E. Ornithine transcarbamoylase

16. After a serious viral infection a 3-year-old child has repeated vomiting, loss of consciousness, convulsions. Examination revealed hyperammonemia. What caused changes of biochemical blood indices of this child?

A. Disorder of ammonia neutralization in the ornithine cycle

B. Activated processes of amino acid decarboxylation

C. Disorder of biogenic amines neutralization

D. Increased degradation of proteins in intestine

E. Inhibited activity of transamination enzymes

17. Which enzyme deficiency of the urea cycle causes hyperammonemia type I?

- A. Carmamoyl phosphate synthetase I
- B. Arginase
- C. Argininosuccinate synthase
- D. Ornithine transcarbamoylase
- E. Argininosuccinate lyase

18. Investigation of the patient's blood and urine showed that the concentration of urea in the daily urine is 180 mmol / L and in the blood is 1.5 mmol / L. The disorder of what metabolic pathway causes such state?

A. The ornithine cycle

- B. Glycolysis
- C. The Krebs cycle
- D. Gluconeogenesis
- E. Pentose phosphate pathway

19. Ammonium cation excretion with urine is increased in the next condition:

- A. Respiratory alkalosis
- B. Metabolic acidosis
- C. Hyperlipidemia
- D. Hypoproteinemia
- E. Obesity

20. The urea content in the blood serum of a healthy person is:

- A. 3.3-8.3 mmol / L
- B. 3.8-5.8 mmol /L
- C. 10-20 mmol /L
- D. 33-83 mmol / L
- E. 333-585 mmol / L

21. According to blood analysis of a patient the residual nitrogen content is 48 mmol / L, urea -15.3 mmol /L. The disease of which organ may cause such results of the laboratory investigation?

- A. Kidneys
- B. Liver
- C. Stomach
- D. Spleen
- E. Intestine

22. There are several mechanisms of ammonia neutralization in humans. Which one takes place in the kidneys?

- A. Ureogenesis
- B. Ammoniogenesis
- C. Reductive amination of 2-oxoglutarate
- D. Synthesis of asparagine

## 28. Analysis of intermediate products of porphyrin biosynthesis and their accumulation at porphyrias.

1. Teeth fluoresce in the ultraviolet with a bright red color and red color of urine is observed in patients with erythropoietic porphyria (Gunther's disease). The deficiency of what enzyme causes the disease?

- A. Uroporphyrinogen cosynthase III
- B. Uroporphyrinogen synthase I
- C. The delta-aminolevulinate synthase
- D. Uroporphyrinogen decarboxylase
- E. Ferrochelatase

2. A 33-year-old patient has been suffering from the disease for 10 years. Periodically he complains of acute abdominal pain, cramps, disorder of vision. His relatives are observed similar symptoms. The urine has red color. The patient was hospitalized with the diagnosis of acute intermittent porphyria. The cause of the disease can be in the disorder of the synthesis of:

- A. Insulin
- B. Heme
- C. Bile acids
- D. Prostaglandins
- E. Collagen

3. Increased skin sensitivity to sunlight is observed in a patient. The urine acquires a dark red color after settling. Indicate the reason for such state:

- A. Porphyria
- B. Hemolytic jaundice
- C. Albinism
- D. Pellagra
- E. Homogentisuria

4. Under the action of sunbeams skin erythema, vesicular rash and itching are observed in a 5-year-old child. Laboratory investigation revealed the decrease of blood serum iron and increased urine excretion of uroporphyrinogen I. What is the most credible inhereditary pathology of the child?

- A. Erythropoietic porphyria
- B. Methemoglobinemia
- C. Hepatic porphyria

- D. Coproporphyria
- E. Acute intermittent porphyria

5. What is the key enzyme of the heme biosynthesis?

- A. Ala dehydrase
- B. Delta aminolevulinic acid synthase
- C. Uroporphyrinogen I synthase
- D. Uroporphyrinogen III synthase
- E. Uroporphyrinogen decarboxylase

6. Under the action of sunbeams blisters and increased skin pigmentation are revealed in a patient. The patient's urine becomes red in the opened air. Which of the following urine constituent's determination allows confirming the Gunther's disease?

- A. Uroporphyrinogen I
- B. Hemoglobin
- C. Bilirubin
- D. Creatinine
- E. Acetone

7. A 43-year-old workwoman of a chemical plant complains of general weakness, weight loss, apathy and somnolence. Chronic lead-poisoning is confirmed by laboratory tests – hypochromic anemia is revealed. In the blood the level of protoporphyrin is increased and the level of  $\delta$ -aminolevulinic acid is reduced, which testifies to the disorder of the synthesis of:

- A. RNA
- B. DNA
- C. Heme
- D. Protein
- E. Mevalonic acid

8. The decreased activity of the enzyme delta aminolevulinic acid synthase causes the disorder of the heme biosynthesis and development of anemia. What is a cofactor of delta aminolevulinic acid synthase?

A. Pyridoxal phosphate

- B. NAD<sup>+</sup>
- C. FAD
- D. FMN
- E. TPP

9. A 12-year-old boy has an acute intermittent porphyria. The increase of concentration of what substance in the urine confirms the diagnosis?

A Delta-aminolevulinic acid

- B. Total bilirubin
- C. Biliverdin
- D. Heme
- E. Indican

10. The ferrohelatase activity is drastically decreased in the liver cells of a patient as a result of poisoning by lead salts. The decrease of the synthesis of what substance is observed in the liver?

- A. Porphobilinogen
- B. Heme
- C. Uroporphyrinogen III
- D. Protoporphyrin IX
- E.  $\delta$  -aminolevulinic acid

11. A patient has hereditary erythropoietic porphyria as a result of the deficiency of uroporphyrinogen-III-cosyntase. Violation of the synthesis of what substance is observed in the patient?

A. Heme

- B. Protein
- C. AMP
- D. GMP
- E. Bile acids

12. A 64-year-old patient was a pilot in the past. In recent years, he worked with leaded petrol. Since that time, he has begun to notice a skin pigmentation of the hands. Periodically there are bubbles on the exposed parts of the body and limbs. Hepatomegaly and a disorder of the protein function of liver are observed too. The total protein in the blood is 100 g / l, albumin - 40 g / l globulin - 60 g / l. The iron content in the blood was reduced by 50%. Urine is of pink color with a high content of coproporphyrins. Specify possible а pathology:

- A. Homogentisuria
- B. Hemolytic jaundice
- C. Albinism
- D. Pellagra
- E. Porphyria

13. Which of the following proteins contains porphyrins?A. MyoglobinB. Collagen

- C. Globulins
- D. Actin

### E. Haptoglobin

14. Indicate a place of the porphyrin biosynthesis and their isomers in the human body:

- A. Spleen
- B. Kidneys
- C. Lymph nodes
- D. Muscular tissue
- E. Heart

15. Which precursors of the porphyrins have a diagnostic value?

- A. Succinic acid
- B. δ-aminolevulinic acid
- C. Glutamate
- D. β-keto-adipic acid
- E. Pyruvate

16. A patient has the following symptoms: enlarged spleen, hemolytic anemia, ulcers, scars, erythema of the skin, increased sensitivity to ultraviolet, leukocytosis. Urine is of red-orange color due to the presence of uroporphyrin I. What is the disease?

- A. Gunther's disease
- B. Hepatic porphyria
- C. Hurler syndrome
- D. Coproporphyria
- E. Acute intermittent porphyria

17. An increase in the concentration of what porphyrins in the urine is characteristic for the hepatic porphyria?

- A. Uroporphyrin III
- B. Copproporphyrin III
- C. Uroporphyrin I
- D. Coproporphyrin II
- E. Protoporphyrin IX

18. What is the main feature for the differential diagnostics is used to distinguish porphyrinuria from porphyria?

A. Decreased uroporphyrin III content in the urine

B. Anamnesis

C. The presence of porphobilinogen in the urine

D. Decreased coproporphyrin III content in the urine

E. Age

19. What diseases can be attributed to the porphyrinuria group?

A. Gastritis

- B. Hypovitaminosis
- C. Hypervitaminosis
- D. Chronic hepatitis
- E. Pancreatitis

20. Succinyl-CoA is one of the substrates for the heme biosynthesis. Which metabolic pathway is a supplier of this substance?

- A. Krebs cycle
- B. Tissue respiration
- C. Glycolysis
- D. Glucuronate pathway
- E. Pentose phosphate pathway

21. Increased photosensitivity is one of the clinical symptoms of porphyria. Activation of which processes is the basis for the development of photodermatitis in porphyria?

- A. Oxidation of heme
- B. Microsomal oxidation
- C. Mitochondrial oxidation
- D.  $\beta$ -Oxidation of fatty acids
- E. Free radical oxidation

22. What substance is a direct precursor of carbon atoms in the heme part of hemoglobin?

- A. Aspartate
- B. Histidine
- C. Alanine
- D. Carbon dioxide
- E. Succinyl-CoA

23. Which amino acid takes part in the biosynthesis of heme?

- A. Glycine
- B. Serine
- C. Leucine
- D. Tryptophan
- E. Alanine

24. Which enzyme deficiency is involved in the development of hereditary coproporphyria?

- A. Coproporphyrinogen oxidase
- B. Uroporphyrinogen I synthase
- C. Uroporphyrinogen III synthase
- D. Delta aminolevulinic acid synthase
- E. Uroporphyrinogen decarboxylase

### Module III

### 1. Structure and functions of nucleic acids.

1. The samples of the blood of a child and of a supposed father were directed for affiliation to the medical forensic examination. Which chemical components need to be identified in the explored samples of blood?

- A. DNA
- B. tRNA
- C. rRNA
- D. mRNA
- E. mnRNA

2. The body stores and transmits genetic information with the help of nucleic acids. Specify which type of RNA contains information about the order of amino acids in the protein:

A. mRNA

- B. tRNA
- C. 30s RNA
- D. 70s RNA
- E. 40s RNA

3. The nucleoli of the nuclei are damaged by an ionizing radiation in the tissue culture. The restoration of which organelles in the cytoplasm of cells becomes problematic?

- A. Ribosomes
- B. Lysosomes
- C. Endoplasmic reticulum
- D. Microtubules
- E. The Golgi complex

4. There are about 200 clusters of genes synthesizing RNA in the nucleolar organizers of 13-15, 21 and 22 chromosomes of humans. The information of what type of RNA is encoded in these regions of chromosomes?

- A. rRNA
- B. tRNA
- C. mRNA
- D. snRNA
- E. tRNA + rRNA

5. What is necessary for the formation of the transport form of amino acids and the realization of the adaptive function?A. tRNAB. RevertaseC. GTP

D. mRNA

E. Ribosomes

6. Marked radioactive thymine was introduced into the culture medium with the cells. In what organelles of the cells will be a marked thymine detected?

- A. Nucleus
- B. Ribosomes
- C. The Golgi apparatus
- D. Lysosomes
- E. Endoplasmic reticulum

7. Nitrogenous bases of the purine and pyrimidine series, phosphoric acid residues and pentoses were found in the investigated hydrolyzate. Which class of organic substances the compound containing all these components belongs to?

A. Chromoproteins

- B. Nucleotides
- C. Phosphoproteins
- D. Glycoproteins
- E. Lipoproteins

8. DNA and RNA contain specific nitrogen bases. Which of the listed acids includes the thymidylate nucleotide?

- A. DNA
- B. tRNA
- C. rRNA D. mRNA
- $\mathbf{D}$ . IIINNA
- E. hnRNA

9. Write the nucleotide sequence of one DNA strand, if the second chain has a sequence - ATG-CCG-TAT-GCA-TT-:

A. – TAC-GGC-ATA-CGT-AA-

- B. GAC-GGC-ATA-CGT-AA-
- C. CAC-GGC-ATA-CGT-AA-
- D. ATG-TCG-TAT-GCA-TT-
- E. TCA-GCT-ATA-CGT-AA-

10. Under the administration of 5-bromouracil the biosynthesis of one of the listed substances is blocked. Specify it:

- A tRNA
- B. Protein
- C. mRNA
- D. rRNA
- E. DNA

11. In modern biochemical studies so-called "DNA diagnostics" is used to diagnose hereditary diseases, to detect the presence of certain viruses (including HIV) in the body, to identify an individual (gene fingerprinting in forensic medicine). Which method is used for this purpose?

A. Polymerase chain reaction

- B. Chromatography
- C. Electrophoresis
- D. X-ray diffraction analysis
- E. Immune-enzyme analysis

12. According to the model of the DNA double helix proposed by Watson and Crick, it was established that one of the chains is preserved during replication, and the other is synthesized complementarily to the first one. What is this method of the replication called?

- A. Semiconservative
- B. Identical
- C. Dispersed
- D. Conservative
- Е. -

13. Synthesis of mRNA proceeds on the DNA template, taking into account the principle of complementarity. If triplets in DNA are the following - ATG-CGT, then the corresponding codons of mRNA will be:

- A. UAC-GCA
- B. UAG-CGU
- C. TAG-UGU
- D. ATG-CGT
- E. AUG-CGU

14. A researcher discovered on an electronic microphotograph a structure formed by an octomer of histone proteins and a region of a DNA molecule that produces about 1.75 revolutions around them. What structure did the researcher discover?

- A. Nucleosome
- B. Elementary fibril
- C. Semichromatide
- D. Chromatide
- E. Chromosome

15. Genetic information is stored in DNA, which does not participate directly in protein synthesis in the cell. What process provides the transformation of genetic information into amino acid sequence of polypeptide chain?

- A. Replication
- B. Transcription
- C. Translocation
- D. Translation
- E. Splicing

16. Nucleotides containing minor nitrogenous bases are most often found in the molecules of:

- A. tRNA
- B. hnRNA
- C. mRNA
- D. DNA
- E. rRNA

17. Replication is the basis for the conservatism of heredity and the preservation of specific features. It is the synthesis process of:

- A. DNA on the DNA template
- B. DNA on the protein matrix
- C. RNA on the DNA template
- D. DNA on the RNA matrix
- E. Protein on the RNA matrix

18. The transformation phenomenon discovered by F. Griffith in the study of the transformation of the non-pathogenic R-form of pneumococci into the pathogenic S-form in the interaction of the heat-killed S-form with the living R-form is determined by the transfer:

- A. DNA
- B. hnRNA
- C. mRNA
- D. tRNA
- E. rRNA

19. A spatial model of the structure of a DNA molecule in the form of a double helix was proposed on the basis of studies of the nucleotide composition and structural analysis of this molecule. Who discovered the DNA structure?

- A. D. Watson, F. Crick
- B. O. Every, K. Mac McLeod, M. McCarthy
- C. Chargaff
- D. M. Wilkins
- E. F. Griffith

20. Histones are positively charged proteins, which are concentrated in the nuclei of cells in the deoxyribonucleoproteins structure and

they play an important role in the regulation of gene expression, containing a large number of:

- A. Lysine and arginine
- B. Asparagine and glutamine
- C. Cysteine and methionine
- D. Arginine and histidine
- E. Lysine and histidine

21. A peculiarity of the primary structure of all eukaryotic mRNA molecules and some viruses is the presence at the 5'-end:

- A. 7-methylguanosine
- B. 1-methylguanosine
- C. 3-methylcytidine
- D. 1-methyladenosine
- E. 5-methylcytosine

22. Nucleic acids are characterized by a spatial configuration. The secondary structure of what of the nucleic acids looks like a leaf clover?

- A. Transport RNA
- B. Mitochondrial DNA
- C. Messenger RNA
- D. Nuclear DNA
- E. Ribosomal RNA

23. Nucleic acids include purine and pyrimidine nitrogen bases. Some nucleic acids contain minor nitrogenous bases. Which of the listed nitrogen bases belongs to minor ones?

- A. Uracil
- B. Thymine
- C. Adenine
- D. Guanine
- E. Methyladenine

24. The central dogma of a molecular biology is a realization of a hereditary information in the following direction:

- A. DNA  $\rightarrow$  RNA  $\rightarrow$  protein
- B. DNA  $\rightarrow$  protein  $\rightarrow$  RNA
- C. Protein  $\rightarrow$  RNA  $\rightarrow$  DNA
- D. RNA  $\rightarrow$  DNA  $\rightarrow$  protein
- E. RNA  $\rightarrow$  protein  $\rightarrow$  DNA

25. Eukaryotic ribosomes consist of two subunits:

A. 60S and 40S B. 50S and 30S C. 70S and 40S D. 60S and 30S E. 50S and 40S

26. The spatial configuration of DNA is stabilized by hydrogen bonds. How many hydrogen bonds in the DNA molecule are formed between adenine and thymine?

- A. 3
- B. 2 C 5
- D. 8
- E. 10

27. The spatial configuration of DNA is stabilized by hydrogen bonds. How many hydrogen bonds in the DNA molecule are formed between guanine and cytosine?

A. 3

B. 2

C 5

D. 8

E. 10

28. What is the specific nitrogenous base of ribonucleoproteins?

A. Uracil

B. Guanine

C. Adenine

- D. Thymine
- E. Cytosine

29. The double helix of DNA is stabilized by hydrogen bonds. Between which nitrogenous bases of the DNA are hydrogen bonds formed?

A. A-T

B. G-A

C. C-T

- D. U-A
- E. C-A

#### 2. Study of biosynthesis and catabolism of purine and pyrimidine nucleotides. Analysis of the end products of their metabolism.

1. An oncologist prescribed methotrexate for a patient. With the lapse of time the target cells of the tumor lost sensitivity to this preparation. Gene expression of which enzyme is observed in this case?

A. Dihydrofolate reductase

B. Folate decarboxylase

C Thiaminase

D. Folate oxidase

E. Desaminase

2. Allopurinol was administered to a patient with gout. What pharmacological property of allopurinol makes therapeutic effect in this case?

A. Competitive inhibition of xanthine oxidase B. Increase of velocity of nitrogen substances excretion

C. Acceleration of catabolism of pyrimidine nucleotides

D. Retardation of reutilization of pyrimidine nucleotides

E. Acceleration of nucleic acid synthesis

3. The patient suffering from gout has been admitted to the clinic. What biochemical analysis should be performed to clarify the diagnosis?

A. Determination of the level of uric acid in the blood and urine

B. Determination of urea concentration in the blood and urine

C. Determination of the level of creatine in the blood

D. Determination of uricase activity in the blood

E. Determination of the concentration of amino acids in the blood

4. A 50-year-old patient complains of joint pain, which is impaired by the weather change. The increase in the concentration of uric acid was revealed in the blood. The increased breakdown of what substance is the most likely cause of these changes?

A. CMP B. AMP C. UTP D. UMP E. TMP

5. A 6-year-old boy has signs of child cerebral paralysis. Laboratory investigation revealed an increased concentration of uric acid in the blood serum. Lesch-Nyhan syndrome is diagnosed. The genetic defect of which enzyme is the cause of such pathology?

A. Hypoxantine guanine phosphoribosyl transferase
- B. UDP-glycosyl transferase
- C. Hyaluronidase
- D. Lactate dehydrogenase
- E. UDP-glucuronyl transferase

6. A 60-year-old man had been operated on for prostate cancer. After 3 months he was given a course of radiation therapy and chemotherapy. The complex of drugs included 5-fluorodeoxyuridine that is the inhibitor of thymidylate synthase. The synthesis of what substance is primarily blocked by the action of this drug?

- A. Protein
- B. mRNA
- C. rRNA
- D. tRNA
- E. DNA

7. A 63-year-old man, suffering from gout, complains of pain in the region of kidneys. The presence of renal stone was discovered on ultrasonic examination. What process causes the renal stone to be formed?

- A. Degradation of purine nucleotides
- B. Catabolism of protein
- C. Ornithine cycle
- D. Degradation of a heme
- E. Reduction of cysteine

8. Pterine derivatives – aminopterine and methotrexate are competitive inhibitors of dihydrofolate reductase, as result of which they depress tetrahydrofolic acid formation from dihydrofolate. These drugs lead to inhibition of single-carbon group transport. Which nucleotide biosynthesis is depressed?

- A. AMP
- B. UMP
- C. dTMP
- D. Carbamoyl phosphate
- E. IMP

9. Patient complains of the pain in small joints. Joints are enlarged. It is an increased level of urates in the blood serum. Which substances metabolism is disordered?

- A. Purines
- B. Disaccharides
- C. Amino acids
- D. Pyrimidines
- E. Glycerol

10. Child shows delay of growth and psychic development, high amount of orotic acid is excreted with urine. This disease is observed as a result of the disorder of:

A. Pyrimidine nucleotide synthesis

B. Pyrimidine nucleotide breakdown

C. Purine nucleotide synthesis

D. Purine nucleotide breakdown

E. Convertion of ribonucleotides into deoxyribonucleotides

11. A protein thioredoxine participates in the reaction of ribose transformation to deoxyribose in course of deoxyribonucleotide production for DNA biosynthesis. It contains two SH groups, which in course of reaction are oxidized. What coenzyme is used in the restoration of a reduced form of thioredoxine? A. Glutathione

- B. NADPH<sub>2</sub>
- C. Coenzyme Q
- D. NADH<sub>2</sub>
- E. AMP

12. Physical and mental underdevelopment is observed in a child. Large quantity of orotic acid is excreted in the urine. This hereditary disease is a result of the next metabolic disorder:

- A. Pyrimidine nucleotides synthesis
- B. Pyrimidine nucleotides breakdown
- C. Purine nucleotides synthesis
- D. Purine nucleotides breakdown
- E. Ornithine cycle of urea production

13. The decrease of uric acid concentration and the accumulation of xanthine and hvpoxanthine were found in the blood of a 12-year-old boy. The genetic defect of the synthesis of what enzyme does it testifies to?

- A. Xanthine oxydase
- B. Arginase
- C. Urease
- D. Ornithine carbamoyltransferase
- E. Glycerol kinase

14. A 69-year-old woman complains of pain in joints, restriction of movement in joints. The joints are swollen, looking as enlarged knots. An increased concentration of uric acid is detected in the blood and urine. What disease is characterized by these symptoms? A. Alkaptonuria B. Pellagra

C. Gout

D. Thyrosinosis

E. Liver cirrhosis

15. In a 1-month-old newborn baby an enhanced content of orotic acid in urine is detected. The child has a diminished weight gain. What treatment must be undertaken in order to correct metabolic disorders?

A. Injections of uridine

- B. Injections of adenosine
- C. Injections of guanosine
- D. Injections of thymidine
- E. Injections of histidine

16. Methotrexate is prescribed for the treatment of malignant tumors. It is a structural analogue of folic acid, which is a competitive inhibitor of dihydrofolate reductase. The synthesis of what compounds is suppressed by the using of this drug?

- A. Nucleotides of DNA
- B. Fatty acids
- C. Monosaccharides
- D. Glycerophosphatides
- E. Glycogen

17. For the treatment of gout a patient was administered allopurinol that is a structural analogue of hypoxanthine. It has led to an increase in the excretion of the hypoxanthine with urine. What process is blocked with this treatment?

A. Formation of uric acid

B. The main way of synthesis of purine nucleotides

C. Synthesis of urea

D. Catabolism of pyrimidine nucleotides

E. Salvage pathway for the synthesis of purine nucleotides

18. The biosynthesis of the purine ring occurs with the participation of ribose-5-phosphate by gradually building up of atoms of nitrogen, carbon, and ring closure. The source of ribose-5-phosphate is:

A. Lipolysis

- B. Glycolysis
- C. Gluconeogenesis
- D. Glycogenolysis
- E. Pentose phosphate pathway

19. A 50-year-old man is diagnosed with gout. Hyperuricemia is noted in biochemical blood analysis. Which of the following enzymes is involved in the formation of uric acid?

- A. Xanthine oxidase
- B. Pyruvate dehydrogenase
- C. Succinate dehydrogenase
- D. Epimerase
- E. Transaminase

20. Gout is a disease developed due to the impaired exchange of nucleotides and the accumulation in the body of:

A. Urea

- B. Uric acid
- C. β-alanine
- D. Homogentisic acid
- E. Phenylpyruvic acid

21. Thymidylate nucleotides are required for the normal replication process. Their synthesis occurs with the participation of thymidylate synthase. What is a coenzyme of thymidylate synthase?

- A. Methylenetetrahydrofolate
- B. Carboxybiotin
- C. Thiamine diphosphate
- D. Pyridoxal phosphate
- E. Nicotinamide adenine dinucleotide

22. Formation of deoxyribonucleotides of the purine series is derived from the corresponding ribonucleotides by:

- A. Reduction of ribose into deoxyribose
- B. Decarboxylation
- C. Transamination
- D. Hydroxylation
- E. Phosphorylation

23. Some amino acids, derivatives of vitamins and phosphoric esters of ribose take part in the synthesis of purine nucleotides. The coenzyme form of which vitamin is the carrier of one-carbon fragments in the synthesis of purine nucleotides?

- A. Pantothenic acid
- B. Pyridoxine
- C. Riboflavin
- D. Folic acid
- E. Nicotinic acid

24. Orotic aciduria is a hereditary disease

characterized by a severe metabolic anemia and the deposition of orotic acid crystals in the organs and tissues. What drug should be prescribed in this case?

- A. Glutamine
- B. Adenosine
- C. Guanosine
- D. Asparagine
- E. Uridine

#### 3. DNA replication and RNA transcription.

- 1. Name the nucleotides of DNA:
- A. dAMP, dTMP, dGMP, dCMP
- B. AMP, TMP, GMP, CMP
- C. dUMP, dGMP, dCMP, dAMP
- D. Adenine, guanine, cytosine, thymine
- E. Deoxyadenosine, deoxyguanosine, deoxycytidine, deoxythymidine
- 2. The primary transcript is:

A. Heteronuclear RNA that has not undergone posttranscriptional modification

B. DNA synthesized by a semiconservative method

C. RNA, obtained as a result of modification of the ends of the molecule

D. Connection of RNA with a protein in the cytoplasm with the formation of ribonucleoprotein E. Matrix of DNA

E. Matrix of DNA

3. The DNA molecule does not contain a nitrogenous base:

- A. Uracil
- B. Thymine
- C. Deoxyribose
- D. Guanine
- E. Adenine

4. Posttranscriptional processing includes:

A. Modification of 5- and 3-ends of mRNA, splicing

B. Modification of 5- and 3-ends of DNA, excision of intrones, joining of introns

C. Modification of nitrogenous bases, modification of rRNA

D. DNA repair, exon splicing

E. DNA repair, splicing, and cross-linking of RNA introns

5. What is a process of synthesis of RNA on a DNA matrix called?

- A. Replication
- **B.** Transcription
- C. Translation
- D. Reparation
- E. Recognition

6. The spatial correspondence of nitrogenous bases to each other in nucleic acid molecules is carried out according to the principle:

- A. Complementarity
- B. Cooperativity
- C. Coplanarity
- D. Collinearity
- E. Induced correspondence

7. In case of poisoning by amanitine, a deathcap mushroom toxin, RNA-polymerase II is blocked. This leads to the blockage of:

A. Synthesis of mRNA

B. Synthesis of tRNA

- C. Reverse transcription
- D. Synthesis of primers
- E. Processing of mRNA

8. mRNA is delivered in the granular endoplasmic reticulum to the ribosomes, containing both exons and introns. What process did not happen in the cell?

- A. Replication
- **B.** Translation
- C. Prolongation
- D. Transcription
- E. Processing

9. For the treatment of urogenital infections, fluoroquinolones, inhibitors of the DNA-gyrase enzyme, are used. Indicate the process that is disrupted by quinolones:

- A. DNA replication
- B. DNA repair
- C. Amplification of genes
- D. Recombination of genes
- E. Reverse transcription

10. It has been established that toxins of fungi and some antibiotics can suppress the activity of RNA polymerase. What process is disrupted in the cell in case of inhibition of this enzyme?

A. Transcription

B. Processing

C. Replication

- D. Translation
- E. Reparation

11. What is tha process of synthesis of a new DNA molecule on a matrix of maternal DNA called?

- A. Reparation
- B. Replication
- C. Transcription
- D. Processing
- E. Splicing

12. Antibiotic rifamycin, which is used for tuberculosis treatment, influences to the several biochemical processes. Point them:

A. Inhibits RNA-polymerase at the initiation stage

B. Inhibits DNA-polymerase at the initiation stage

C. Inhibits DNA-ligase

D. Inhibits amino-acyl-tRNA-synthetase

E. Inhibits the protein factors action at the protein synthesis

13. During replication DNA-polymerase forms Okazaki fragments on the lagging polynucleotide chain of the "replicative fork". Name the enzyme, which stitches these fragments into a single chain:

A. DNA-ligase

- B. Primase
- C. Exonuclease
- D. RNA-polymerase
- E. DNA-polymerase

14. RNA of the human immunodeficiency virus (HIV) has penetrated into the leukocyte and with the help of the enzyme revertase (reverse transcriptase) it performs synthesis of the viral DNA in the cell. This process is based on:

- A. Reverse transcription
- B. Depression of the operon
- C. Reverse translation
- D. Inverse replication
- E. Repression of the operon

15. The complementary RNA transcript is synthesized on the DNA template in the process of transcription in the nucleus of the cell. Which enzyme catalyzes this process? A. DNA-dependent RNA polymerase B. Primase C. DNA-ligase

- D. DNA-polymerase
- E. DNA-ase

16. Oncogenic viruses use the reverse transcription process to transfer their information from RNA to DNA. Indicate by which enzyme the hybrid RNA-DNA is formed:

- A. Revertase
- B. RNA-polymerase
- C. Transcriptase
- D. DNA-synthetase
- E. Ribonuclease

17. 5-Fluorouracil is a medication used to treat cancer. It acts as a competitive inhibitor of enzymes that participate in the synthesis of DNA. Specify which enzyme is blocked in this process:

- A. Thymidylate synthase
- B. Uracil synthetase
- C. Adenine synthetase
- D. Guanosine synthase
- E. Cytosine synthase

18. In case of a random use of death cap mushrooms (Amanita phalloides), containing the toxin  $\alpha$ -amanitin, the inhibition of the following enzyme occurs:

- A. RNA polymerase II
- B. DNA-polymerase
- C. DNA-synthetase
- D. Peptidyltransferase
- E. Translocase

19. The medicinal preparation specifically inhibits the activity of reverse transcriptase. What is pharmacological action of the substance?

- A. Antineoplastic
- B. Antiviral
- C. Antimicrobial
- D. Immunosuppressive
- E. Radioprotective

20. A patient suffering from tuberculosis was prescribed an antibiotic rifampicin. Inhibition of what biochemical process underlies the therapeutic effect of the drug?

A. Initiation of transcription

B. Termination of transcription

- C. Elongation of transcription
- D. Replication
- E. Initiation of translation

21. An antibiotic rifampicin using to treat tuberculosis has the following pharmacological properties:

A. It inhibits RNA-polymerase at the initiation stage

B. It inhibits DNA-polymerase at the initiation stage

- C. It inhibits DNA-ligase
- D. It inhibits aminoacyl-tRNA synthetase

E. It inhibits the effect of protein translation factors

22. According to the model of a double DNA helix that was suggested by Watson and Creek, it was established that one of chains would not be lost during replication and the second chain would be synthesized complementary to the first one. What way of replication is it?

- A. Conservative
- B. Analogous
- C. Identical
- D. Dispersed
- E. Semiconservative

23. A number of hereditary diseases are caused by mutations in the areas of genes that determine the beginning or the end of introns. Which process removes introns, and then binds exons?

- A. Transcription
- B. Splicing
- C. Recombination
- D. Replication
- E. Translation

24. A patient is recommended to make DNA investigation to precise the diagnosis. Synthetic primers are known to be used, which contain:

- A. Amino acids
- B. Desoxypibonucleotides
- C. Ribonucleotides
- D. Pyrimidine nucleotides
- E. Purine nucleotides

25. Pterine derivatives – aminopterine and methotrexate are competitive inhibitors of dihydrofolate reductase, as result of which

they depress tetrahydrofolic acid formation from dihydrofolate. These drugs lead to inhibition of single-carbon group transport. The biosynthesis of which polymer is inhibited?

- A. Protein
- B. DNA
- C. Homopolysaccharide
- D. Ganglioside
- E. Glycosaminoglycan

26. The doubling of the DNA molecule, preceding mitosis, occurs according to the mechanism:

- A. Semiconservative replication
- B. Conservative replication
- C. Polymerization
- D. Disperse replication
- E. Esterification

27. What enzyme is involved in the process of repair in prokaryotes?

A. DNA-polymerase II

- B. DNA-polymerase III
- C. DNA-ligase
- D. DNA-polymerase I
- E. DNA-gyrase

### 4. Biosynthesis of proteins on ribosomes. Initiation, elongation and termination in the synthesis of polypeptide chain. Inhibitory action of antibiotics.

1. Examination of a patient revealed a reduced content of magnesium ions that are necessary for the attachment of ribosomes to the granular endoplasmatic reticulum. It is known that it causes disturbance of protein biosynthesis. What stage of protein biosynthesis will be disturbed?

- A. Transcription
- B. Amino acid activation
- C. Termination
- D. Replication
- E. Translation

2. Marked amino acids alanine and tryptophan were administered to a mouse in order to study localization of protein biosynthesis in its cells. Around what organelles will the accumulation of marked amino acids be observed?

- A. Ribosomes
- B. Golgi apparatus
- C. Agranular endoplasmic reticulum
- D. Nucleus
- E. Lysosomes

3. Indicate the sequence of stages of protein synthesis:

A. Initiation, elongation, termination, posttranslational modification

B. Termination, elongation, initiation, transcription

C. Translation, initiation, elongation, termination

D. Transcription, activation, elongation, posttranslational modification

E. Elongation, initiation, termination, posttranscriptional processing

4. The translation of mRNA into the amino acid sequence of a polypeptide in prokaryotes is terminated at the end of the message by one of the three stop codons in the mRNA chain. The stop codon is recognized by:

- A. A specific protein
- B. A specific uncharged tRNA
- C. A specific aminoacyl-tRNA
- D. A specific ribosomal RNA
- E. A specific ribosomal subunit

5. The inherited information is saved in DNA, though directly in the synthesis of protein in a cell it does not participate. What process provides the realization of the inherited information in a polypeptide chain?

- A. Transcription
- B. Translation
- C. Translocation
- D. Replication
- E. Transformation

6. Degeneration of the genetic code is the ability of more than one triplet to encode a single amino acid. Which amino acid is encoded by only one triplet?

- A. Lysine
- B. Serine
- C. Alanine
- D. Leucine
- E. Methionine

7. Specify the function of aminoacyl-tRNA synthetases:

- A. It binds aminoacyladenylate with tRNA
- B. It activates the amino acid with GTP
- C. It binds aminoacyl-t-RNA with ribosome

D. It forms peptide bonds between amino acids

E. It transfers aminoacyl-t-RNA into ribosomes

8. Redundancy of the genetic code means that:

A. A given base triplet can code for more then one amino acid

B. There is no punctuation in the code sequences

C. The third base in a codon is not important in coding

D. A given amino acid can be coded for by more then one base triplet

E. Codons are not ambiguous

9. Patient with inflammation is recommended to use erythromycin, which binds with 50S subunit of ribosome and blocks translocase. Inhibition of protein synthesis in prokaryotes occurs at the stage of:

- A. Elongation
- B. Amino acids activation
- C. Termination
- D. Posttranslational protein modification
- E. Initiation

10. What is necessary for the formation of the transport form of amino acids during protein synthesis on ribosomes?

- A. tRNA
- B. Revertase
- C. GTP
- D. mRNA
- E. Ribosome

11. A cell of granular endoplasmatic reticulum is at the stage of translation, when mRNA advances to the ribosomes. Amino acids get bound by peptide bonds in a certain sequence thus causing polypeptide biosynthesis. The sequence of amino acids in a polypeptide corresponds with the sequence of:

- A. mRNA codons
- B. tRNA nucleotides
- C. tRNA anticodons
- D. rRNA nucleotides
- E. rRNA anticodons

12. One of the protein synthesis stages is recognition. The first mRNA triplet starts with UAU triplet. What is complementary triplet found in tRNA?

- A. AUA
- B. AAA
- C. GUG
- D. UGU
- E. CUC

13. Infectious diseases are treated with antibiotics (streptomycin, erythromycin, chloramphenicol). They inhibit the following stage of protein synthesis:

- A. Translation
- B. Transcription
- C. Replication
- D. Processing
- E. Splicing

14. Some triplets of mRNA (UAA, UAG, UGA) do not encode any amino acids, but are terminators in the process of reading of information, so they can stop the translation. What are these triplets called?

- A. Stop codons
- B. Operators
- C. Anticodons
- D. Exons
- E. Introns

15. What amino acid is encoded by the triplet AUG?

- A. Methionine
- B. Serine
- C. Tyrosine
- D. Cysteine
- E. Valine

13. A 5-year-old child with a sore throat and high fever was admitted to a clinic. A diagnosis of diphtheria was established. It is known that the causative agent of diphtheria releases an extremely virulent exotoxin. Specify the mechanism of its action:

- A. It inhibits the elongation factor eEF-2
- B. It causes translation errors
- C. It modifies the translocation protein factor
- D. It disrupts the binding of aminoacyl-tRNA to amino acids
- E. It Inhibits termination

17. Genetic information of a nuclear DNA is transmitted to the site of protein synthesis by: A. mRNA

- B. rRNA
- C. tRNA
- D. Polysomes
- E. DNA

18. Eukaryotes have defined cells, which exhibit the next structural peculiarity:

A. Genetic information is stored in DNA, organized as nuclear chromatin

B. The cell possess a cell wall

C. The cell contains specific particles, responsible for cell respiration

D. Genetic information is stored in DNA, uniformly distributed throughout the cytoplasm

E. Genetic information is stored in a messenger RNA

19. Out of 200 different amino acids form in nature the number of amino acids present in proteins:

- A. 20
- B. 25
- C. 40
- D. 35
- E. 100

20. Proteins are biopolymers of a principal significance in a cell building. They are composed from amino acids as monomers, which are connected into chain by the next main type of chemical bond:

- A. Peptide bond
- B. Phosphodiester bond
- C. Ionic bond
- D. Hydrogen bond
- E. Glycosidic bond

21. In which of the following molecules would you find an anticodon?

- A. Transfer RNA
- B. Messenger RNA
- C. Ribosomal RNA
- D. Small nuclear RNA
- E. Heterogenous RNA

22. Endemic goiter was diagnosed in a patient. What type of post-translational modification of thyroglobuline is damaged in a patient?

- A. Glycosylation
- B. Phosphorylation
- C. Methylation
- D. Acetylation
- E. Iodination

23. It is known that the genetic code is degenerate and has a triplet nature. What nucleotide can be changed in the coding triplet without losing its sense?

- A. Third
- B. First
- C. Second
- D. Second and third
- E. First or second

24. Polypeptide which has been synthesized on the ribosome includes 54 amino acids. How many codons does mRNA have in this case?

- A. 54
- B. 27
- C. 108
- D. 162
- E. 44

25. Under the influence of mutagen the composition of some triplets in a gene was changed but the cell continued the synthesis of the same protein. What characteristics of the genetic code can it be connected with?

A. Degeneracy

- B. Universality
- C. Triplet nature
- D. Specificity
- E. Collinearity

26. The P-site in the translation is associated with:

- A. Peptidyl-RNA
- B. DNA
- C. Aminoacyl-RNA
- D. Ribosome
- E. Protein

27. A-site in the translation is associated with:

- A. Aminoacyl-RNA
- B. DNA
- C. Peptidyl-RNA
- D. Ribosome
- E. Protein

### 5. Regulation of gene expression.

1. What are fragments of DNA containing one or several genes and a control element that can move from one part of the genome to another called?

- A. Transposons
- B. Exons
- C. Introns
- D. Plasmids
- E. Promoters

2. In the tryptophan operon of E. coli the end product of biochemical pathway, tryptophan, binds to the repressor protein which then binds to the:

A. Operator to inhibit transcription

B. Promoter to accelerate transcription

C. Promoter to inhibit transcription

D. Operator to accelerate transcription

E. Repressor gene to accelerate transcription

3. According to the Jacob-Monod model of gene regulation, inducer substances in bacterial cells probably:

A. Combine with repressor proteins, inactivating them

B. Combine with operator regions

C. Combine with structural genes, stimulating them to synthesize messenger RNA

D. Combine with promoter regions, activating RNA polymerase

E. Combine with nucleoli, triggering production of more ribosomes

4. In the lactose operon system in E. coli, the repressor is:

- A. A protein
- B. A product of a structural gene
- C. Bound to the promoter sequence
- D. Lactose
- E. A short length of DNA

5. What is the function of the regulatory gene of bacterial operon?

- A. It codes for repressor proteins
- B. It codes for  $\beta$ -galactosidase

C. It acts as an on-off switch for the structural genes

D. It is a binding site for RNA polymerase

6. What is the function of the promoter region of a bacterial operon?

- A. It is binding site for RNA polymerase
- B. It codes for repressor proteins
- C. It codes for inducer substances
- D. It codes for corepressor substances
- E. It is a binding site for inducers

7. The next technique is used for multiple amplification of distinct and selected segment of DNA:

- A. Polymerase chain reaction
- B. DNA fingerprint analysis
- C. Southern blot analysis
- D. Northern blot analysis

E. Restriction fragment length polymorphism analysis

8. Which gene families encode information on the structure of light chains of immunoglobulins?

- A. D, J, C
- B. V, J, C
- C. V, D, C
- D. V, D, J
- E. L, V, D

9. Which gene families encode information on the structure of heavy chains of immunoglobulins?

A. D, J, C, H

- B. V, D, J, H
- C. D, J, C, L
- D. V, D, J, C
- E. V, D, L, C

10. In modern biochemical investigations for diagnostics of inherited diseases, detection of certain viruses (for example HIV), authentication of individual (gene dactylography in forensic medicine) so called "DNA-diagnostics" is employed. What method is used in these investigations?

- A. Polymerase chain reaction
- B. Chromatography
- C. Electrophoresis
- D. X-ray-structural analysis
- E. Electron microscopy
- 11. Amplification of genes is:
- A. Increase in the number of copies of genes

B. Correction of altered genes

- C. Changing of the sequence of genes to the opposite
- D. The loss of several consecutive genes
- E. Gene insertion

12. Mercury ions were incorporated into human body. This led to the increase in the rate of transcription of the gene, responsible for detoxification of heavy metals. What protein gene amplification is in the background of this process?

- A. Metallothioneine
- B. Ceruloplasmin
- C. Interferone
- D. Transferrin
- E. Ferritin

13. What analytical technique is used for the identification of a father of a child?

A. Polymerase chain reaction

B. Northern blot analysis

C. Restriction fragment length polymorphism analysis

D. DNA fingerprint analysis

E. Southern blot analysis

14. The samples of blood of a child and of a supposed father were directed for affiliation to medical forensic examination. Which chemical components need to be identified in the explored samples of blood?

- A. DNA
- B. tRNA
- C. rRNA
- D. mRNA
- E. Protein

15. A young man has been diagnosed with HIV-infection by the polymerase chain reaction. What is the main principle of this reaction?

- A. Gene amplification
- B. Genetic recombination
- C. Transcription
- D. Gene mutation
- E. Chromosome mutation

16. A repressor protein was found in the cell.Which gene encodes the amino acid sequence of this protein?A. Regulator

B. Terminator

C. Promoter

D. Modifier

E. Operator

17. What is an operone called?

A. Complex of genetic elements responsible for the regulation of gene modification

B. Complex of factors of translation

C. A protein-synthesizing complex

D. Complex of genetic elements responsible for the coordinated synthesis of a group of functionally related proteins

E. Combination of triplets of nucleotides, which are responsible for the operative recombination of genes

18. The structural genes of the lac operon are responsible for the synthesis of the following enzymes:

A. Galactosidase, galactoside permease, galactoside trans-acetylase

B. Lactoside transferase, galactosidase, galactoside trans-acetylase

C. Lactase, galactosidase, galactoside permease

D. Galactokinase, lactase, galactosidase

E. Galactose-1-phosphate-uridyltransferase, galactosidase, lactase

19. Structural genes are the region of the operone that contains information about:

A. The primary structure of polypeptides that are transcribed from this operone

B. The primary structure of protein-repressor

C. The primary structure of protein regulators

D. Primary structure of RNA polymerase II

E. Primary structure of DNA polymerase I

20. An operone consists of:

A. Promoter, operator, structural genes

B. Terminator, operator, promoter

C. Regulator, structural genes, promoter

D. Modifier, structural genes, promoter

E. Operator, promoter, regulatory gene

21. The control sites of the operone are:

A. Operator, promoter

B. Terminator, promoter

C. Regulator, promoter

D. Modifier, operator

E. Promoter, regulatory gene

22. A promoter is a region of DNA that interacts with:

- A. RNA polymerase
- B. Repressor protein
- C. Regulator
- D. DNA polymerase
- E. Ribosome

23. The operator is a region of DNA that specifically binds to:

A. Repressor

B. Terminator

C. The regulator

- D. The modifier
- E. Promoter

24. The CAP protein interacts with a specific site in the structure of:

- A. Promoter
- B. Terminator
- C. Regulator

D. Modifier

E. Repressor

# 6. Analysis of mutation mechanisms, DNA reparation. Principles of synthesis of recombinat DNA, transgenic proteins.

1. Restriction endonucleases are useful in the recombinant DNA technique because they:

A. Cut DNA at specific sites

B. Restrict the number of nucleotides that can be removed at one time

C. Restore the bonds in the DNA backbone

D. Synthesize cDNA from RNA

E. Can be used to locate genes for mapping

2. Restriction endonucleases have a bacterial origin, which are used in recombinant DNA technology. They belong to the next class of enzymes:

- A. Oxidoreductases
- B. Hydrolases
- C. Transferases

D. Lyases

E. Isomerases

3. What enzyme is used for synthesis of genes from template RNA or DNA in gene engineering? (This enzyme was discovered in some RNA containing viruses) A. Revertase B. Exonuclease

C. Endonuclease

D. Topoisomerase I

E. Helicase

4. From nitrates, nitrites and nitrosamines in the body is produced nitrous acid, which causes oxidative deamination of nitrogeneous bases of nucleotides. This may lead to a point mutation by change of cytosine to one of the next base:

- A. Uracil
- B. Thymine
- C. Adenine
- D. Guanine
- E. Inosine

5. Skin of the patients with xeroderma pigmentosum is very sensitive to sunrise, cancer of skin can develop. The reason is a hereditary deficiency of enzyme UV-endonuclease. This defect leads to the disturbance of:

- A. DNA repair
- B. Transcription
- C. DNA replication
- D. Translation
- E. Reverse transcription

6. Worker of the chemical factory as result of infringement of prevention of accidents regulations is influenced by nitrite acid and nitrites, which causes the cytosine deamination in DNA molecule. Which enzyme starts the repair cascade?

- A. Uracil-DNA-glycosidase
- B. DNA-dependent-RNA-polymerase
- C. CTP-synthetase
- D. Amino-acyl-tRNA-synthetase
- E. Glucose-6-phosphate dehydrogenase

7. To precise the diagnosis a patient is recommended to make DNA investigation. Synthetic primers are known to be used containing:

- A. Ribonucleotides
- B. Deoxyribonucleotides
- C. Amino acids
- D. Pyrimidine nucleotides
- E. Purine nucleotides

8. Abnormal hemoglobin M appears as a result of change at the  $\beta$ -chain of globin

amino acid valine to glutamate at the 67 position. Which type of mutation is in DNA?

- A. Missense mutation
- B. Deletion of one nucleotide
- C. Insertion of one nucleotide
- D. Deletion of three nucleotides
- E. Insertion of three nucleotides

9. An experiment proved that UV-radiated cells of patients with xeroderma pigmentosum restore the native DNA structure slower than the cells of healthy individuals as a result of the reparation enzyme defection. What enzyme helps in this process?

- A. Endonuclease
- B. DNA polymerase III
- C. DNA hyrase
- D. RNA ligase
- E. Primase

10. What are enzymes involved in the DNA repair?

- A. DNA-polymerase, DNA-ligase
- B. RNA-ase and DNA-ase
- C. DNA-dependent RNA-polymerase
- D. Peptidyltransferase and peptidyltranslosase
- E. Nucleosidase and nucleotidase

11. On the African continent, sickle-cell anemia is common, in which the erythrocytes have the shape of a sickle due to the replacement of the amino acid glutamate with valine in the hemoglobin molecule. What is the cause of this disease?

- A. Gene mutation
- B. Transduction defect

C. Violation of mechanisms for the implementation of genetic information

- D. Crossover fault
- E. Genomic mutation

12. Under the influence of various physical, chemical and biological factors, damage of the DNA structure can occur. What is the ability of cells to repair such damage called?

- A. Reparation
- B. Transcription
- C. Replication
- D. Transduction
- E. Transformation

13. Molecular analysis of the hemoglobin of a patient with anemia revealed a substitution of

glutamic acid for valine in the 6th position of the  $\beta$ -chain of globin. What is the molecular mechanism of this pathology?

- A. Gene mutation
- B. Chromosomal mutation
- C. Genomic mutation
- D. Amplification of genes
- E. Gene transduction

14. What are quantitative and qualitative changes in the genotype called?

- A. Mutation
- B. Reparation
- C. Amplification
- D. Induction
- E. Reversion

15. Spontaneous mutations include those that are caused by:

- A. Natural factors
- B. Transduction
- C. Short-range factors
- D. Artificial factors
- E. Reversion

16. Induced mutations are caused by:

- A. Artificial factors
- B. Transduction
- C. Short-range factors
- D. Natural factors
- E. Reversion

17. What are mutations caused by the changes in the amount of a complete set of chromosomes or individual chromosomes in a diploid set called?

- A. Genomic
- B. Haploid
- C. Polyploid
- D. Chromosomal
- E. Gene

18. At what kind of chromosomal mutation is there the transfer of a site of one chromosome to another, not homologous to it?

- A. Transposition
- B. Translocation
- C. Inversion
- D. Deletion
- E. Duplication

19. At what kind of chromosomal mutation is the sequence of genes reversed?

- A. Inversion
- B. Translocation
- C. Transposition
- D. Deletion
- E. Duplication

20. At what kind of chromosome mutation is there a loss of certain areas of the chromosome?

- A. Deletion
- B. Translocation
- C. Transposition
- D. Inversion
- E. Duplication

21. At what kind of chromosomal mutation is a doubling of certain areas of chromosomes?

- A. Duplication
- B. Translocation
- C. Transposition
- D. Inversion
- E. Deletion

22. At what kind of gene mutation is the purine nitrogen base replaced by purine?

- A. Transition
- B. Transversion
- C. Inversion
- D. Deletion
- E. Insertion

23. At what kind of gene mutation is the purine nitrogen base replaced by pyrimidine? A. Transversion

- B. Transition
- C. Inversion
- D. Deletion
- E. Insertion
- 7. Study of molecular cellular mechanisms of action of peptide and protein hormones on target cells. Hormones of hypothalamus and hypophysis.

1. Indicate a substance which serves as a secondary messenger and increases  $Ca^{2+}$  ion concentration:

- A. Inositol-1,4,5-triphosphate
- B. Inositol-3,6-bisphosphate
- C. Phosphatidyl-inositol-4,5-bisphosphate
- D. Inositol-6-phosphate
- E. Free inositol

2. All of the following are known to be a part of a signal transduction cascade except:

A. Phosphorylation of fibronectin

B. Dissociation of the components of a heterotrimeric G-protein

C. Enzymatic breakdown of phosphatidyl inositol bisphosphate

D. Elevation of intracellular  $Ca^{2+}$ 

E. Activation of cGMP phosphodiesterase

3.  $Ca^{2+}$  ions constitute one of the most ancient evolutionary second messengers. They are activators of glycogenolysis in case of reacting with:

- A. Calmodulin
- B. Calcitonin
- C. Calciferol
- D. Kinase of myosin light chains
- E. Phosphorylase C

4. Second messengers diacylglycerol and inositol triphosphate are produced from subsequent phospholipid of plasma membrane due to the activity of the following enzyme:

- A. Phosphodiesterase
- B. Phospholipase A<sub>1</sub>
- C. Phospholipase  $A_2$
- D. Phospholipase D
- E. Phospholipase C

5. Adrenalin is a water soluble hormone, its effect is mediated by second messengers, which are:

- A. cAMP
- B.  $NAD^+$
- C. ATP
- D. Acetylcholine
- E. Cytochrome c

6. Which of the following enzymes is activated by cAMP?

- A. Tyrosine kinase
- B. Protein kinase A
- C. Phospholipase C
- D. Phosphodiesterase
- E. Adenylyl cyclase
- 7. G-proteins act as:
- A. Hormone carriers
- B. Hormone receptors
- C. Second messengers

- D. Signal transducers
- E. Enzyme carriers

8. The formation of second messengers is obligatory in a membrane-intracellular mechanism of hormone action. Point out the substance that is unable to be a second messenger:

- A. cAMP
- B. Diacylglycerol
- C. Inositol-3,4,5-triphosphate
- D. Glycerol
- E.  $Ca^{2+}$

9. Ions of calcium may function as a second messenger. They are activators of many processes if they react with:

- A. Calmodulin
- B. Calcitonin
- C. Calciferol
- D. Myosin
- E. Phosphorylase

10. Degeneration of glycogen in the liver is stimulated by glucagon. What second messenger is thus formed in the cell?

- A. cAMP
- B. cGMP
- C. CO
- D. NO
- E. Triacylglycerol

11. An emotional stress induces activation of hormone-sensitive triglyceride lipase in the adipocytes. What secondary mediator takes part in this process?

- A. cAMP
- B. cGMP
- C. AMP
- D. Diacylglycerol
- E. Calcium ions

12. There are intracellular receptors for the following hormones:

- A. ACTH
- B. Follicle stimulating hormone (FSH)
- C. Oxytocin
- D. Insulin
- E. Thyroxine

13. What hormone is secreted from posterior pituitary gland?A. Vasopressin

- B. Thyrotropic hormone
- C. Prolactin
- D. Adrenocorticotropic hormone
- E. Growth hormone

14. The number of amino acids in human growth hormone is:

- A. 191
- **B**. 19
- C. 151
- D. 291
- E. 391

15. Acromegaly results due to an excessive release of:

- A. Insulin
- B. Growth hormone
- C. Glucagon
- D. Thyroxine
- E. Oxytocin

16. The receptors of which of the following hormones are not associated with G-protein?

- A. Aldosterone
- B. TSH
- C. Epinephrine
- D. Vasopressin
- E. Glucagon
- 17. ACTH induces rise in:
- A. cAMP
- B. cGMP
- C. Calcium
- D. Magnesium
- E. Sodium

18. The number of amino acids in the hormone oxytocin is:

- A. 9
- B. 7
- C. 14
- D. 18
- E. 20

19. TSH stimulates the synthesis of:

- A. Thyroxine
- B. Adrenocorticoids
- C. Epinephrine
- D. Insulin
- E. Glucagon

20. What hormone stimulates the reabsorption of water in kidney tubules?

- A. Vasopressin
- B. Parathyroid hormone
- C. Calcitonin
- D. Aldosterone
- E. Atrial natriuretic peptide

21. A 50-year-old patient complaints of thirst, polyuria, taking plenty of water. The blood glucose is 4.8 mmol / L. There is neither glucose nor acetone in the urine. The urine is colorless. Its relative density is 1002-1004. What caused the patient's polyuria?

- A. Lack of vasopressin
- B. Aldosteronism
- C. Lack of insulin
- D. Hypothyroidism
- E. Thyrotoxicosis

22. A 26-year-old woman complains of general weakness, loss of weight (18 kg), absence of menses. She has been ill for one year after a difficult delivery. Objectively: body height -168 cm, weight -50 kg, hypoglycaemia and atrophy of muscles. The failure of which gland is the loss of body weight connected with?

- A. Adenohypophysis
- B. Parathyroid
- C. Thyroid
- D. Sex glands
- E. Adrenal cortex

23. After a brain hemorrhage that led to the damage of hypothalamic nuclei, diabetes insipidus was developed in a 67-year-old patient. What was the reason of polyuria in this case?

- A. Decrease of water reabsorption
- B. Decrease of potassium ions reabsorption
- C. Acceleration of glomerular filtration
- D. Hyperglycemia
- E. Hypoglycemia

24. Cushing's disease, which is characterized by obesity, hypertension and elevated blood glucose level, is caused by a disorder in the production and secretion of the next hormones:

A. ACTH and glucocorticoids overproduction

B. Insulin insufficiency

C. ACTH and glucocorticoids insufficiency

- D. Thyroxine insufficiency
- E. Estriol overproduction

25. Melanocyte stimulating hormone is secreted by:

- A. Intermediate lobe of pituitary gland
- B. Anterior lobe of pituitary gland
- C. Posterior lobe of pituitary gland
- D. Pineal gland
- E. Thyroid gland

26. Biologically active substances, especially hormones, are products of hydrolysis and modification of certain proteins. From which of the listed below proteins do lipotropin, cortcotropin, melanotropin and endorphins appear in hypophysis?

- A. Proopiomelanocortin
- B. Neuroalbumins
- C. Neurostromin
- D. Neuroglobulin
- E. Thyreoglobulin

27. A 47-year-old woman complains for persistent feeling of thirst, rapid fatigue, a loss of weight. Daily diuresis is 3-4 liters. Blood glucose level is 4.8 mmol / L, there is no glucose in urine. In this case it is reasonable to investigate blood content of:

- A. Aldosterone
- B. Estrogens
- C. Vasopressine
- D. Cortisole
- E. Thyroxine

28. For analgesia a certain substance which imitates the physiological properties of morphine but is synthesized inside the human brain can be used. Name this substance.

- A. Somatoliberin
- B. Oxytocin
- C. Vasopressin
- D. Calcitonin
- E. Endorphine

29. A 23-year-old patient complains of a headache, change of appearance (increase in feet and wrists size, face features distortion). His voice grew harsh, the memory worsened. The disease set in three years ago without apparent causes. The analysis of the urine is without special changes. A possible cause of this status can be:

- A. Overproduction of somatotropin
- B. Deficiency of glucagon
- C. Deficiency of thyroxine
- D. Deficiency of aldosterone
- E. Overproduction of corticosteroids

30. A 10-year-old boy was brought to a hospital for the inspection of the cause of growth retardation. He had grown only by three centimeters in the last two years. What hormone's deficiency is the cause of such state?

- A. Somatotropin
- B. Corticotropin
- C. Gonadotropin
- D. Thyrotropin
- E. Parathormone

31. A 13-year-old girl is observed a hypotension and polyuria. Preliminary diagnosis is diabetes insipidus. It is caused by the deficiency of:

- A. Vasopressin
- B. Aldosterone
- C. Adrenalin
- D. Cortisol
- E. Oxytocin

## 8. Study of molecular cellular mechanisms of action of steroid hormones on target cells. Steroid hormones.

1. What is the precursor of steroid hormones synthesis and the types of reactions that take place at different stages of their synthesis:

A. Cholesterol; hydroxylation, reduction, oxidation, reduction, condensation, isomerization

B. Triglycerides; hydroxylation, condensation, isomerization

C. Pregnenolone; isomerization, phosphorylation, oxidation, reduction, condensation, deamination

D. Calcitriol, hydroxylation, methylation, reduction, condensation, isomerization

E. Sphingosine; oxidative hydroxylation, methylation, reduction, condensation

- 2. What are the groups of corticosteroids?
- A. Glucocorticoids, mineralacorticoids
- B. Glucocorticoids, estrogens
- C. Mineralocorticoids, androgens

- D. Corticosteroids, androgens
- E. Glucocorticoids, progestogens

3. What is the most active glucocorticoid in humans?

- A. Cortisol
- B. Progesterone
- C. Aldosterone
- D. Corticosterone
- E. Pregnenolone

4. What is the main biochemical mechanism of carbohydrate metabolism regulation in glucocorticoid action:

- A. Activation of gluconeogenesis
- B. Activation glycogenesis
- C. Activation of glycolysis
- D. Inhibition of gluconeogenesis
- E. Activation of the pentose phosphate pathway

5. Where specific steroid hormone receptor is located and what is the mechanism of steroid hormones interaction with target cells?

A. In the cytosol, where the hormone-receptor complex translocates to the nucleus and interacts with sensitive sites of nuclear chromatin DNA, activating the transcription of genes of relevant effector protein enzymes

B. On the surface of the plasma membrane of cells, where after the formation of hormone-receptor complex proteins signal through the transducers is transmitted to the secondary information mediators that ultimately leads to a change in the activity of the relevant enzyme systems

C. In the cytosol, where, after the activation of existing enzymes realized corresponding biochemical response

D. In the cell nucleus, where upon the interaction of hormones with sensitive sites activated enzyme DNA molecules leading to the activation of relevant biochemical processes

E. In the cytosol, there is a biochemical reaction wherein the hormonal signal after interaction with secondary signaling molecules

6. What is the mechanism of an antiinflammatory action of glucocorticoids?

A. Inhibition of the activity of phospholipase  $A_2$ 

B. Activation of antioxidant protection

C. Activation of synthesis of proinflammatory cytokines

D. Catabolic effect on the metabolism of proteins

E. The activation of phospholipase A<sub>1</sub>

7. The main biological role of mineralocorticoid is:

A. Regulation of water-salt metabolism

B. Regulation of carbohydrate metabolism

- C. Regulation of lipid metabolism
- D. Regulation of defense mechanisms

E. Regulation of free radical oxidation processes

8. Which biologically active substance activates the synthesis and secretion of aldosterone?

- A. Insulin
- B. Renin
- C. Proopiomelanocortin
- D. Somatostatin
- E. Cortisol

9. What is the effect of inhibitors of angiotensin-converting enzyme on blood pressure?

A. Increase blood pressure by activating the formation of angiotensin II

B. Decrease blood pressure by inhibiting the formation of angiotensin II

C. Increase blood pressure by enhancing diuresis

D. Decrease blood pressure by activating the secretion of aldosterone

E. Increase blood pressure by intensifying the renin secretion

10. Which group of steroid hormones is regulated by the system "corticotroliberin-corticotropin"?

- A. Glucocorticoids
- B. Mineralocorticoid
- C. Estrogens
- D. Androgens
- E. Cholecalciferol

11. Increase of glucose concentration in the blood, decreased glucose tolerance, increased body mass index, hypertension and increased secretion of corticotrophin were found in a patient. What is the name of the pathological state?

- A. Cushing's disease
- B. Hyperaldosteronism
- C. Cushing's syndrome
- D. Addison's disease
- E. Androsteroma

12. How is the production of hormones of the adrenal cortex and medulla layer changed under the influence of stress factors?

A. Increased synthesis and secretion of glucocorticoids and catecholamines

B. Increased synthesis and secretion of indolamine

C. Increased synthesis of progesterone and pregnenolone

D. Increased synthesis of aldosterone

E. Increased synthesis of histamine

13. Some forms of pathology of the adrenal cortex are characterized by hyperpigmentation of the skin, general muscle weakness and wasting?

A. Hypofunction (Addison's disease)

B. Goiter

C. Hyperaldosteronism (Conn's disease)

D. Cushing's Disease

E. Increased synthesis and secretion of catecholamines

14. Specify the pathology of the adrenal gland which is accompanied by hyponatremia and hyperkalemia:

A. Decreased mineralocorticoid production

B. Increased mineralocorticoid production

- C. Inhibition of glucocorticoid synthesis
- D. Hyperaldosteronism
- E. Increased androgen synthesis

15. Which hormone concentration is determined for the diagnosis of Addison's disease?

A. Corticotropin, cortisol, aldosterone

- B. Corticotropin, androgens, thyroxine
- C. Corticotropin-releasing factor, aldosterone
- D. Cortisol, angiotensin
- E. Corticotropin, electrolytes

16. How does an excess of glucocorticoids affect the bone tissue?

A. Inhibition of collagen synthesis and mineralization

B. Activation of collagen synthesis and protein

- C. Activation of fibroblasts
- D. Activation of bone mineralization
- E. Inhibition of the activity of osteoclasts

17. What is the action of glucocorticoids on the immune system?

A. Inhibition of the synthesis of antibodies and phagocytic activity of leukocytes

B. Activation of the synthesis of antibodies and phagocytic activity of leukocytes

C. Increasing of the cellular mechanisms of immune defense

D. Do not affect the immune system

E. Activation of the availability of amino acids for immunoglobulins

18. What are the main mechanisms controlling aldosterone synthesis?

A. Potassium concentration and activation of the renin-angiotensin system

- B. Low levels of cortisol in the blood
- C. Corticoliberin, corticotropin

D. Blood pressure and hypothalamic mechanisms

E. Concentration of calcium in the blood

19. What is the effect of glucocorticoids on lipid metabolism?

- A. Activation of lipogenesis in adipose tissue
- B. Activation of lipolysis in adipose tissue
- C. Increase of triglycerides in adipose tissue and blood
- D. They potentiate the effects of insulin
- E. They decrease blood levels of free fatty acids

20. What kind of violation of adrenal hormones production is indicated by high blood pressure, hypokalemia and hypernatremia?

- A. Hyperaldosteronism (Conn's disease)
- B. Hypofunction (Addison's disease)
- C. Hyperactivity
- D. Cushing's Disease
- E. Increased synthesis and secretion of catecholamines

21. A patient suffering from weakness, fatigue, nausea and vomiting was found to have low blood concentrations of Na<sup>+</sup> and Cl<sup>-</sup> and high levels of serum K<sup>+</sup>. Physical examination revealed a deep tanning of both exposed and unexposed parts of the body and dark pigmentation inside the mouth. The hyperpigmentation in this patient most likely resulted from which of the following?

A. Increased secretion of ACTH

B. Prolonged exposure of the patient to ultraviolet radiation

C. Excessive ingestion of  $\beta$ -carotenecontaining foods

D. Activation of melanocytes caused by medication side effects

E. Inhibition of plasma membrane  $Na^+$ ,  $K^+$ -ATPase

22. Metyrapone is used to block the mitochondrial  $11-\beta$ -hydroxylase in the corticosteroid synthetic pathway and is administered to evaluate hypothalamic-pituitary-adrenal axis function. Which of the following results is most likely from this overnight diagnostic test in a healthy individual?

A. Increase in the levels of cortisol precursors

B. Feedback inhibition of cortisol biosynthesis

C. Decrease in ACTH levels

D. Inhibition of adenylate cyclase activity in adrenal cortical cells

E. Inhibition of pituitary function

## 9. Study of role of thyroid hormones and biogenic amines in regulation of metabolic processes.

1. A patient consulted a doctor with complaints of dizziness, memory impairment, periodic convulsions. It was revealed that the cause of such changes is the decarboxylation product of glutamic acid. Name it:

- A. GABA
- B. Histamine
- C. Serotonin
- D. Tryptamine
- E. Dopamine

2. The patient has an allergic reaction, accompanied by itching, swelling and reddening of the skin. The concentration of which biogenic amine is increased in the tissues?

- A. Histamine
- B. Serotonin
- C. Tryptamine
- D. Dopamine
- E. Gamma-aminobutyric acid

3. The content of serotonin is sharply increased in the blood of the patient suffering from malignant carcinoid. What amino acid is used to produce this biogenic amine?

- A. Tryptophan
- B. Alanine
- C. Leucine
- D. Threonine
- E. Methionine

4. A 9-month-old child feeds on artificial mixtures that are not balanced by the content of vitamin  $B_6$ . The child has pellagra-like dermatitis, convulsions and anemia. Violation of the synthesis of what substance led to the development of seizures?

- A. GABA
- B. Histamine
- C. Serotonin
- D. DOPA
- E. Dopamine

5. What is the precursor of serotonin?

- A. Tyrosine
- B. 5-Hydroxytryptophan
- C. Histidine
- D. Phenylalanine
- E. Serine

6. Depression, emotional disorders are a consequence of a lack of norepinephrine, serotonin and other biogenic amines in the brain. The increase of their content in the synapses can be achieved due to antidepressants which inhibit the activity of the enzyme:

- A. Monoamine oxidase
- B. Diaminoooxidase
- C. L-amino acid oxidase
- D. D-amino acid oxidase
- E. Phenylalanine-4-monooxygenase

7. During the decarboxylation of histidine, a biogenic amine is formed that has a potent vasodilating action. Specify it:

- A. Dopamine
- B. Serotonin
- C. DOPA
- D. Norepinephrine
- E. Histamine

8. What is the result of glutamate decarboxylation?

- A. GABA
- B. Glutathione
- C. Histamine
- D. Serotonin
- E. Asparagine

9. Epileptiform convulsions are observed in an infant caused by the deficiency of vitamin  $B_6$ . It is a result of the deficiency of neurotransmitter -  $\gamma$ -aminobutyric acid. The activity of which enzyme is reduced?

- A. Glutamate decarboxylase
- B. Alanine aminotransferase
- C. Glutamate dehydrogenase
- D. Pyridoxalkinase
- E. Glutamatsynthethase

10. Which reaction are biogenic amines produced?

- A. Transamination
- B. Deamination
- C. Amination
- D. Decarboxylation
- E. Hydroxylation

11. Which reaction does neutralize biogenic amines?

- A. Deamination
- B. Decarboxylation
- C. Amination
- D. Transamination
- E. Hydroxylation

12. This compound increases secretion of gastric acid, hydrochloric acid, tone of smooth muscle and blood pressure. For which biogenic amine are the above-mentioned effects?

- A. Histamine
- B. Dopamine
- C. GABA
- D. Serotonin

E. Epinephrine

13. The releasing of this biogenic amine in the human body regulates emotional stability and improve mood, so it is called "the hormone of good mood" and "hormone of happiness." For which biogenic amine are the abovementioned effects?

- A. Dopamine
- B. Serotonin
- C. Histamine
- D. Epinephrine
- E. GABA

14. The deficiency of which biogenic amine is one of the factors in the depression development, obsessive-compulsive disorder and severe migraines?

- A. Serotonin
- B. Dopamine
- C. Histamine
- D. GABA
- E. Epinephrine
- 15. Which enzyme breaks down serotonin?
- A. Monoamine oxidase
- B. Creatine phosphokinase
- C. Lactate dehydrogenase 1,2
- D. Gamma-glutamyltransferase
- E. Lactate dehydrogenase 4,5

16. Which of these biogenic amines is a catecholamine?

- A. GABA
- B. Indolamine
- C. Histamine
- D. Serotonin
- E. Epinephrine

17. Which of biogenic amines is a mediator of inflammation and allergy?

- A. Histamine
- B. Dopamine
- C. GABA
- D. Norepinephrine
- E. Epinephrine

18. The concentration of which biogenic amine is increased at such pathological processes as anaphylactic shock, burns, frostbite, fever, allergic reactions?

- A. Histamine
- B. Dopamine

- C. GABA
- D. Norepinephrine
- E. Epinephrine

19. Which of these biogenic amines is a catecholamine?

- A. Dopamine
- B. Indolamine
- C. Histamine
- D. Serotonin
- E. GABA

20. Under hyperthyroidism there is weight loss and fever. What biochemical processes are activated at this state?

- A. Catabolism
- B. Anabolism
- C. Gluconeogenesis
- D. Lipogenesis
- E. Oxidative phosphorylation

21. Physical and mental retardation are observed in a 5-year-old boy. Reduced secretion of what hormone can be assumed?

- A. Thyroxine
- B. Insulin
- C. Growth hormone
- D. Prolactine
- E. Aldosterone

22. Constant weakness, sweating, tachycardia, exophthalmos are observed in a patient. What biochemical tests are necessary to confirm the diagnosis?

A. Determination of T3, T4 concentration in blood

B. Determination of the daily urinary excretion of 17-keto steroids

C. Determination of the insulin concentration in the blood

D. Definition of the blood PTH concentration

E. Determination of blood glucagon concentration

23. The thyroid hormones T3 and T4 are synthesized in the follicular cells of the thyroid gland. From which of the following essential amino acids are the thyroid hormones synthesized?

- A. Phenylalanine
- B. Lysine
- C. Methionine

- D. Isoleucine
- E. Valine

### **10.** Hormones of pancreas. Hormones of the digestive tract.

1. The patient is in a state of hypoglycemic coma. An overdose of which of the following hormones can lead to this condition?

- A. Insulin
- B. Progesterone
- C. Cortisol
- D. Growth hormone
- E. Corticotropin

2. Dysfunction of pancreatic islets of Langerhans leads to a decreased production of:

- A. Glucagon and insulin
- B. Thyroxine and calcitonin
- C. Insulin and adrenalin
- D. Kallikrein and angiotensin
- E. Parathyroid hormone and cortisol

3. Which hormone stimulates glucose transport from the extracellular space through the plasma membrane into the cell?

- A. Insulin
- B. Glucagon
- C. Thyroxine
- D. Aldosterone
- E. Adrenaline

4. A patient is complaining of dryness of the mouth, blood plasma glucose is 8 mmol / L. An increased secretion of what hormone stimulates the development of hyperglycemia?

- A. Glucagon
- B. Insulin
- C. Thyroxine
- D. Triiodothyronine
- E. Aldosterone

5. It is known that patients suffering from diabetes mellitus often have inflammatory processes, reduced regeneration and impaired wound healing. The reason for this is:

- A. Inhibition of protein synthesis
- B. Activation of lipolysis
- C. Activation of gluconeogenesis
- D. Activation of lipogenesis

6. A 15-year-old patient complains of constant thirsting, frequent urination, increased appetite, itching and weakness. In the blood: glucose is 16 mmol / L, ketone bodies - 100 mmol / L. What is the disease developed in the patient?

- A. Insulin-dependent diabetes mellitus
- B. Insulin-independent diabetes mellitus
- C. Steroid diabetes
- D. Diabetes insipidus
- E. Thyrotoxicosis

7. After injection of insulin the glucose level is reduced within a few seconds. What process is activated in this case?

A. Transport of glucose into the cells from the extracellular space

- B. Glycolysis
- C. Synthesis of glycogen
- D. Synthesis of lipids
- E. Pentose phosphate pathway

8. A patient suffering from diabetes mellitus after insulin injection lost consciousness, convulsions appeared. What was the result of the biochemical blood test for glucose?

- A. 2.5 mmol / L
- B. 3.3 mmol / L
- C. 8.0 mmol / L
- D. 10.0 mmol / L
- E. 5.5 mmol / L

9. A 46-year-old patient complains of dry mouth, frequent urination and a general weakness. Biochemical analysis revealed hyperglycemia and hyperketonemia. Glucose and ketone bodies are detected in urine. The diffuse changes in the myocardium are observed on the electrocardiogram. What is the diagnosis in the patient?

- A. Diabetes mellitus
- B. Alimentary hyperglycemia
- C. Acute pancreatitis
- D. Diabetes insipidus
- E. Coronary heart disease

10. A patient has been delivered to a hospital in a coma. The patient has lost consciousness during the marathon. The development of what kind of coma can be assumed? A. Hypoglycemic

- B. Hyperglycemic
- C. Renal
- D. Hepatic
- E. -

11. The patient's blood glucose level on an empty stomach is 4.65 mmol / L, in 1 hour after glucose loading is 6.55 mmol / L, and after 2 hours is 3.2 mol / L. These figures are typical for:

- A. Healthy state
- B. Latent diabetes mellitus
- C. Noninsulin-dependent diabetes mellitus
- D. Insulin-dependent diabetes mellitus
- E. Thyrotoxicosis

12. The patient's blood glucose level on an empty stomach is 5.6 mmol / L, one hour after sugar loading is 13.8 mmol / L, and in 3 hours is 9.2 mmol / L. These figures are typical for:

- A. Latent diabetes mellitus
- B. Cushing's Disease
- C. Acromegaly
- D. Thyrotoxicosis
- E. Healthy state

13. A 40-year-old woman complaining of thirst and polyuria was delivered to the endocrinology department with a diagnosis of diabetes mellitus. What pathological components are identified in laboratory investigation of patient's urine?

- A. Glucose, ketone bodies
- B. Protein, amino acids
- C. Protein, creatine
- D. Bilirubin, urobilin
- E. Blood

14. An examination of a patient's blood revealed that glucose was 16 mmol / L, ketone bodies were 1.2 mmol / L. Polyuria, glycosuria, and ketonuria were observed. What disease can be assumed?

- A. Diabetes mellitus
- B. Diabetes insipidus
- C. Steroid diabetes
- D. Cushing's Syndrome
- E. Cushing's Disease

15. After eating the food there is alimentary (food) hyperglycemia, which stimulates the secretion of: A. Insulin

- B. Adrenaline
- C. Norepinephrine
- D. Cortisol
- E. Glucagon

16. During the examination of a 58-year-old man the signs of the activation of lipogenesis were identified, which are caused by the increased secretion of:

- A. Insulin
- B. Sex hormones
- C. STH
- D. Adrenaline
- E. Thyroxine

17. Ketonuria is observed in a patient. What disease is the cause of ketone bodies appearance in the urine?

- A. Diabetes mellitus
- B. Acute glomeluronefritis
- C. Urolithiasis
- D. Tuberculosis of the kidney
- E. Renal infarction

18. What is the main stimulus for the release of glucagon?

- A. Hypoglycemia
- B. Hyperglycemia
- C. Ketosis
- D. Hypercholesterolemia
- E. Hyperlipoproteinemia

19. What is the main stimulus for insulin release?

- A. Hyperglycemia
- B. Hyperpiruvatemia
- C. Hypoglycemia
- D. Ketoacidosis
- E. Lactic acidosis

20. A 27-year-old man has been rushed to the emergency room following his sudden collapse and entry into a state of unconsciousness. Examination of personal belongings revealed the patient is an insulindependent diabetic. A rapid decline in which of the following humoral factors likely triggered the sudden collapse of the patient?

- A. Glucose
- B. Glucagon
- C. Fatty acids
- D. Insulin
- E. Triglyceride

21. Which of the following is least likely to contribute to the hyperglycemia associated with an uncontrolled type I diabetes?

- A. Increased skeletal muscle glycogenolysis
- B. Decreased adipose lipogenesis
- C. Increased adipose lipolysis
- D. Increased hepatic gluconeogenesis
- E. Decreased skeletal muscle glucose uptake

22. Which of the following changes in hepatic metabolism explains the increased incidence of ketoacidosis observed in type I diabetes?

- A. Increased  $\beta$ -oxidation
- B. Increased protein synthesis
- C. Increased lipoprotein synthesis
- D. Increased glucose uptake
- E. Increased glycogen breakdown

23. Increased amount of free fatty acids is observed in the blood of patients with diabetes mellitus. It can be caused by:

A. Increased activity of triglyceride lipase of adipocytes

B. Storage of palmitoyl-CoA

C. Activation of the ketone bodies utilization

D. Activation of the synthesis of the apolipoproteins

E. Decreased activity of phosphatidylcholine-cholesterol-

acyltransferase in blood plasma

### 11. Hormonal regulation of calcium homeostasis.

1. What are the mechanisms determining the calcium homeostasis in the body?

A. Calcium deposition in the bones, calcium absorption in the small intestine, reabsorption of calcium ions in the tubules of nephrons

B. Inhibition of hepatocytes, intestinal absorption of calcium, calcium reabsorption in the renal tubules

C. Bone resorption by osteoclasts, calcium excretion in the feces, calcium reabsorption in the renal tubules

D. Calcium binding to plasma proteins, calcium absorption in the small intestine, excessive excretion by the kidneys

E. Inhibition of phosphatase activity, synthesis activation calcitonin

2. What are the main regulators of the calcium balance in the body?

A. Parathyroid hormone, calcitriol, calcitonin

B. Parathyroid hormone, calcitriol, calmodulin

C. Parathyroid hormone, thyroxine, Cabinding proteins

D. Parathyroid hormone, calcitriol, aldosterone

E. Calcidiol, calcitonin, 7dehydrocholesterol

3. What is the mechanism of calcitriol action?

A. Interaction with the receptor  $\rightarrow$  translocation to the nucleus  $\rightarrow$  transcription of the gene expression  $\rightarrow$  synthesis of Cabinding and transporting proteins

B. Interactions with the receptor protein  $\rightarrow$  activation of synthesis of cholecalciferol from dehydrocholesterol in the skin  $\rightarrow$  transport to the liver

C. Biotransformation of cholesterol into calcitriol in the kidney by enzymatic hydroxylation reactions

D. Biotransformation of cholesterol in the liver and kidneys under the influence of parathyroid hormone controls the hydroxylation reaction

E. Transformation of calcidiol in hepatocytes into calcitriol with  $\alpha$ 1-hydroxylase

4. What is the main biological function of calcitriol?

A. Stimulation of  $Ca^{2+}$  absorption in the intestine and phosphates, through the activation of Ca-binding proteins

B. Stimulation of transferrin synthesis of the blood and mineralization of bone

C. Regulation of sodium and potassium excretion by the kidneys

D. Reduction of calcium concentration in blood and bone resorption inhibition

E. Inhibition of calcium secretion in the nephron and bone resorption

5. What is the main characteristic of the biological effect of parathyroid hormone?

- A. Hypercalcemic
- B. Hypocalcemic
- C. Hyperphosphatemic
- D. Hypophosphatemic

E. Hyperglycemic

6. What is the main effect of calcitonin on calcium homeostasis?

A. Hypocalcemic effect, inhibition of resorption of bone organic matrix

B. Hypocalcemic effect, increased resorption of the organic matrix of bone tissueC. Hypercalcemic effect, increased bone resorption

D. Hypercalcemic effect, inhibition of bone resorption

E. Increasing of calcium and phosphate reabsorbtion in the kidney

7. What is the cause of rickets in children?

A. Deficiency of vitamin  $D_3$ 

- B. Excess of vitamin  $D_3$
- C. Vitamin A deficiency
- D. Hyperparathyroidism
- E. Hypoparathyroidism

8. What changes in calcium-phosphorus metabolism are characteristic of hyperparathyroidism?

A. Increasing of serum calcium and phosphorus concentrations

B. Decreasing of serum calcium and phosphorus concentrations

C. Decreasing of calcium concentration and increase the phosphorus concentration in the blood

D. Increasing of potassium and sodium concentrations in the blood

E. Decreasing of potassium and sodium concentrations in the blood

9. What component is produced during bone mineralization forming the basis of the inorganic structure of the skeleton?

- A. Hydroxyapatite
- B. Calcium citrate
- C. Calcium phosphate
- D. Carbonate apatite
- E. Chlorapatite

10. Osteoporosis is the most common disorder of bone metabolism. What is the definition of this pathology?

A. It is systemic skeletal disease characterized by a reduction of bone mass per unit of volume, and its microarchitectural violation B. It is systemic skeletal disease characterized by the violation of the organic matrix of bone mineralization

C. It is the softening of bone tissue due to lack of calcium and phosphorus

D. It is excessive bone mineralization

E. It is Loss of bone trabecular part

11. Specify a normal serum calcium concentration in adults:

- A. 2.25 2.75 mmol / L
- B. 2.5 3.5 mmol / L
- C. 1.5 2.0 mmol / L
- D. 1.0 2.25 mmol / 1
- E. 2.0 4.0 mmol / L

12. In which organ is the most active form of vitamin  $D_3 - 1.25$ -dihydroxycholecalciferol synthesized?

- A. In the kidneys
- B. In the liver
- C. In the intestine
- D. In the skin
- E. In the salivary glands

13. What is the universal messenger of intracellular effects of calcium ions with which its complexes are formed called?

- A. Calmodulin
- B. c-AMP
- C. c-GMP
- D. Diacylglycerol
- E. Inositol-1,4,5-triphosphate

14. What is a biochemical indicator of vitamin  $D_3$  deficiency?

- A. 1,25-dihydroxycholecalciferol
- B. Level of calcium in the saliva
- C. Blood phosphorus
- D. Content of mineral salts in the bone tissue
- E. Binding of calcium complex of Ca<sup>2+</sup> calmodulin

15. What is the main mechanism for hypercalcemic effects of PTH?

A. Mobilisation of calcium and phosphorus from bone tissue by activation of osteoclast acid phosphatase

B. Inhibition of absorption of calcium and phosphorus in the intestine

- C. Increases of urinary calcium
- D. Deficiency of vitamin D3
- E. Increases of urinary phosphorus

16. What are the main symptoms of hyperparathyroidism?

- A. Hypercalcemia, osteoporosis
- B. Hypercalcemia, hyperphosphatemia
- C. Hypocalcemia, hypophosphatemia
- D. Hypocalcemia, osteodystrophy
- E. Hypophosphatemia, skeletal deformity

17. What are the symptoms of hypoparathyroidism?

A. Hypocalcemia, hyperphosphatemia

- B. Hypercalcemia, hyperphosphatemia
- C. Hyperphosphatemia, osteomalacia
- D. Hypercalcemia, decrease the synthesis of vitamin D3

E. Deficiency of vitamin  $D_2$ , hypophosphatemia

18. What is the main clinical sign of hypoparathyroidism?

- A. Tonic convulsions, up to the tetanus
- B. Atony of muscles
- C. Hypophosphaturia, nephrocalcinosis
- D. Osteoporosis, osteodystrophy
- E. Reduced neuromuscular excitability

19. Patient's blood calcium is 2.1 mmol / L, hyperphosphatemia is observed. What endocrine pathology is characterized by these changes?

- A. Hypoparathyroidism
- B. Hyperparathyroidism
- C. Alkalosis
- D. Hypervitaminosis of D<sub>3</sub>
- E. Hypervitaminosis of D<sub>2</sub>

20. What is a precursor of active form of vitamin  $D_3$  - 1,25-dihydroxycholecalciferol?

- A. 7-dehydrocholesterol
- B. PTH
- C. Calcitonin
- D. Alpha-ketoglutarate
- E. Citrate

21. A patient has the sudden decrease of  $Ca^{2+}$  content in blood. What hormone secretion will increase?

- A. Thyrocalcitonin
- B. Parathormone
- C. Aldosterone
- D. Vasopressin
- E. Somatotropin

22. A one-year-old child has enlarged head and belly, retarded cutting of teeth, destruction of enamel structure. What hypovitaminosis causes these changes?

- A. Hypovitaminosis D
- B. Hypovitaminosis C
- C. Hypovitaminosis A
- D. Hypovitaminosis  $B_1$
- E. Hypovitaminosis B<sub>2</sub>

23. What bioregulators are regulators of calcium homeostasis?

- A. Calcitonin, parathyroid hormone
- B. Adrenalin, glucagon
- C. Thyroxine, insulin
- D. Cortisol, aldosterone
- E. Testosterone, estrogen

#### 12. Physiologically active eicosanoids.

1. Aspirin has anti-inflammatory effects by inhibiting an activity of cyclooxygenase. The concentration of what substances will be reduced in this case?

- A. Prostaglandins
- B. Catecholamines
- C. Biogenic amines
- D. Saturated fatty acids
- E. Cholesterol

2. What compound is a precursor in the synthesis of prostaglandins in the body?

- A. Arachidonic acid
- B. Palmitic acid
- C. Linolenic acid
- D. Oleic acid
- E. Linoleic acid

3. A 42-year-old man suffering from rheumatoid arthritis was prescribed aspirin that is an inhibitor of prostaglandin synthesis. Which acid is used for prostaglandins synthesis?

- A. Arachidonic
- B. Neuraminic
- C. Linolenic
- D. Linoleic
- E. Propionic

4. Doctor prescribed prostaglandin  $E_2$  for the augmentation of labor. From what substance is it synthesized?

- A. Glutamic acid
- B. Phosphatidic acid
- C. Palmitic acid
- D. Stearic acid
- E. Arachidonic acid

5. Long-term use of large doses of aspirin causes inhibition of prostaglandin synthesis by reducing the activity of the enzyme:

- A. Cyclooxygenase
- B. Peroxidase
- C. 5-Lipoxygenase
- D. Phospholipase A<sub>2</sub>
- E. Phosphodiesterase

6. For the prevention of atherosclerosis, coronary heart disease and cerebral circulatory disorders people should get 2-6 grams of essential polyunsaturated fatty acids. These acids are essential for the synthesis of:

- A. Bile acids
- B. Prostaglandins
- C. Steroids
- D. Vitamin D
- E. Neurotransmitters

7. Prednisolone has an anti-inflammatory effect due to the inhibition of the arachidonic acid release. What are the biologically active substances synthesized from arachidonic acid called?

- A. Prostaglandins
- B. Cholesterol
- C. Uric acid
- D. Heme
- E. Urea

8. Arachidonic acid is a precursor of eicosanoids. Which group of substances it belongs to?

- A. Saturated fatty acids
- B. Keto acids
- C. Polyunsaturated fatty acids
- D. Monounsaturated fatty acids
- E. Amino acids

9. Which type of fat-soluble vitamins arachidonic acid belongs to?

- A. D
- B. F

- C. E
- D. A
- E. K

10. Which group of eicosanoids has a non-cyclic structure?

- A. Leukotrienes
- B. Thromboxanes
- C. Prostaglandins
- D. Prostacyclin
- E. All of them

11. What is the metabolic pathway for the synthesis of prostaglandins called?

- A. Cyclooxygenase
- B. Pentose phosphate pathway
- C. Glucuronate
- D. Lipoxygenase
- E. Glycolytic

12. What is the metabolic pathway for the synthesis of leukotrienes called?

- A. Lipoxygenase
- B. Pentose phosphate pathway
- C. Glucuronate
- D. Cyclooxygenase
- E. Glycolytic

13. Glucocorticoid hormones inhibit enzyme eliminating arachidonic acid from phospholipids. What is the name of the enzyme?

- A. Phospholipase A<sub>2</sub>
- B. Phospholipase A<sub>1</sub>
- C. Phospholipase B
- D. Phospholipase C
- E. Phospholipase D

14. Which group of eicosanoids is called "slow-reacting substance of anaphylaxis"?

A. Leukotriene  $C_4$  Leukotriene  $E_4$  Leukotriene  $D_4$ 

B. Prostacyclin, prostaglandin  $E_2$ , prostaglandin  $F_{2\alpha}$ 

C. Prostaglandin  $F_{2\alpha}$ , prostaglandin  $D_2$ , thromboxane  $A_2$ 

D. Leukotriene  $A_4$ , prostaglandin  $E_2$ , prostaglandin  $F_{2\alpha}$ 

E. Thromboxane  $A_2$ , thromboxane  $B_2$ , leukotriene  $B_4$ 

15. The coxibs, including celecoxib (Celebrex), are a recently developed class of

nonsteroidal anti-inflammatory drugs (NSAIDs). The coxibs show antiinflammatory action without affecting platelet function. These effects of the coxibs are best attributed to selective inhibition of which of the following?

A. The cyclooxygenase activity of the "inducible" prostaglandin H synthase isoform (PGHS-2)

B. The cyclooxygenase activity of the "basal" prostaglandin H synthase isoenzyme (PGHS-1)

C. The cytosolic isoenzyme of phospholipase  $A_2$  (cPLA2)

D. The microsomal isoenzyme of prostaglandin E synthase (mPGES-1)

E. Prostacyclin (PGI2) synthase (PGIS)

16. Prostaglandins comprise a family of oxygenated lipid signaling molecules derived from polyunsaturated fatty acids such as arachidonic acid. They are involved in the regulation of a number of cellular processes. Some of the prostaglandins act to increase vasodilation and levels of cAMP in cells. whereas others increase vasoand bronchoconstriction and smooth muscle contraction. In the conversion of arachidonic acid to prostaglandins, the oxygenation step is accomplished by the enzyme that synthesizes which of the following compounds?

- A. Prostaglandin H<sub>2</sub>
- B. Prostaglandin E<sub>2</sub>
- C. Prostaglandin  $F_{2\alpha}$
- D. Prostaglandin D<sub>2</sub>
- E. Prostaglandin I<sub>2</sub>

17. Most of physiologically active eicosanoids are synthesized from:

- A. Arachidonic, alpha- and gamma-linolenic acid
- B. Arachidonic and palmitic acids
- C. Palmitoleic and stearic acids
- D. Arachidonic and palmitoleic acid
- E. Alpha, gamma-linolenic and linoleic acids

18. Specify the eicosanoid, promoting adhesion and platelet aggregation:

- A. Thromboxane  $A_2$
- B. Prostacyclin I<sub>2</sub>
- C. Prostaglandin  $F_{2\alpha}$
- D. Leukotriene  $C_4$
- E. Leukotriene  $A_4$

## 13. Study of digestion of nutrients: proteins, carbohydrates in the digestive tract.

1. Fats, proteins, carbohydrates, vitamins, mineral salts and water must be present in the daily diet of an adult healthy person. Indicate the amount of protein that provides a normal vital activity of the body:

A. 70-100 g

B. 50-60 g

C. 10-20 g

- D. 40-50 g
- E. 180-200 g

2. A 4-year-old child was delivered to the hospital with the signs of prolonged protein starvation such as edema, anemia, growth and mental retardation. What is the cause of edema development in a child?

A. Decreased synthesis of albumins

B. Decreased synthesis of globulins

C. Decreased hemoglobin synthesis

D. Decreased synthesis of lipoproteins

E. Decreased synthesis of glycoproteins

3. Violation of the digestion of proteins was diagnosed in a patient suffering from acute pancreatitis. The decreased synthesis and release of what enzyme caused such state?

- A. Trypsin
- B. Pepsin
- C. Lipase
- D. Dipeptidase
- E. Amylase

4. Coagulation of milk occurs in the stomach of infants. Which enzyme is involved in this process?

- A. Rennin
- B. Pepsin
- C. Gastrin
- D. Secretin
- E. Lipase

5. Megaloblastic anemia is developed in a woman after subtotal resection of the stomach. The urinary excretion of what substance confirms the diagnosis?

A. Methylmalonate

- B. Ketone bodies
- C. Glucose
- D. Urea

E. Uric acid

6. Negative nitrogen balance was revealed during the examination of a 45-year-old patient being a long time on a vegetarian diet. What feature of the diet caused this state?

- A. Insufficient amount of proteins
- B. Insufficient amount of fats
- C. A large amount of water
- D. A large number of carbohydrates
- E. Insufficient amount of vitamins

7. A 40-year-old man was hospitalized to the hospital. He was diagnosed with chronic gastritis. Infringement of digestion of what nutrients in stomach is a characteristic sign of this pathology?

- A. Proteins
- B. Phospholipids
- C. Starch
- D. Lactose
- E. Triglycerides

8. A patient complains of weight loss and pain in the stomach after eating. The overall acidity is sharply reduced (hypoaciditis) in the analysis of gastric juice. Digestion of what food components is disturbed in the patient? A. Proteins

- B. Phospholipids
- C. Neutral fats
- D. Oligosaccharides
- E. Starch

9. Under conditions of chronic pancreatitis there is a decrease in the synthesis and secretion of trypsin. What kind of digestion has been disrupted?

- A. Proteins
- B. Polysaccharides
- C. Lipids
- D. Nucleic acids
- E. Fat soluble vitamins

10. Digestion of proteins in the stomach is the initial stage of protein digestion in the human digestive tract. Specify the enzymes that take part in the digestion of proteins in the stomach:

A. Pepsin and gastricin

- B. Trypsin and catheptins
- C. Chymotrypsin and lysozyme
- D. Enteropeptidase and elastase

E. Carboxypeptidase and aminopeptidase

11. The patient has a bad appetite and belching. The total acidity of the gastric juice is 10 units. What pathological state is the cause of such condition?

- A. Hypoacidic gastritis
- B. Hyperacidic gastritis
- C. Acute pancreatitis
- D. Hyperacidity
- E. Stomach ulcer

12. The activation of which process in the cells of the stomach tumor is the most reliable reason for the appearance of lactic acid in the gastric juice?

A. Glycolysis

- B. Pentose phosphate pathway
- C.  $\beta$ -oxidation of fatty acids
- D. Aerobic oxidation of glucose
- E. Gluconeogenesis

13. Lactate has been revealed in the gastric juice of a patient. What is the cause of its appearance?

- A. Insufficiency of HCl
- B. Excess of HCl
- C. Pepsin deficiency
- D. Insufficiency of gastricsin
- E. Rennin deficiency

14. The digestion of proteins has been disrupted in the stomach and small intestine of the patient. The deficiency of what enzymes caused the disorder?

- A. Peptidases
- B. Glycosidases
- C. Lipases
- D. Dehydrogenases
- E. Transferases

15. During the investigation of the secretory function of the patient's stomach it has been revealed the decreased concentration of hydrochloric acid in the gastric juice. The activity of which of the following enzymes has been decreased in this state?

- A. Pepsin
- B. Lipase
- C. Hexokinase
- D. Amylase
- E. Carboxypeptidase

16. In the human body chymotrypsinogen is secreted by the pancreas and converted into active chymotrypsin in the intestine by the partial proteolysis as a result of an action of the following enzyme:

- A. Trypsin
- B. Lipase
- C. Pepsin
- D. Aminopeptidase
- E. Carboxypeptidase

17. The initial digestion of proteins occurs in the stomach. Which of the following enzymes splits the proteins of the connective tissue?

- A. Pepsin A
- B. Gastricsin
- C. Rennin
- D. Pepsin B
- E. Enterokinase

18. Hydrochloric acid has a lot of functions in the stomach. Which function is not typical for hydrochloric acid?

A. It hydrolyses the peptide bonds of dicarboxylic amino acids

B. It provides swelling and denaturation of food proteins

C. It stimulates the secretion of enterokinase by the enterocytes of the duodenum

D. It promotes the conversion of pepsinogen into pepsin

E. It provides antibacterial properties of gastric juice

19. All proteolytic enzymes are divided into exo- and endopeptidases. What are exopeptidases?

A. Carboxypeptidase, aminopeptidase

- B. Elastase, collagenase
- C. Pepsin, trypsin
- D. Chymotrypsin, carboxypeptidase
- E. Aminopeptidase, elastase

20. Pancreatic juice contains a full set of enzymes that are necessary for the digestion of proteins, lipids, carbohydrates. Choose the proteolytic enzymes of the pancreatic juice? A. Chymotrypsin, trypsin, carboxypeptidases

- B. Chymotrypsin, elastase, pepsin
- C. Elastase, carboxypeptidases, gelatinase
- D. Carboxypeptidases, rennin, lipase
- E. Trypsin, chymotrypsin, rennin

21. The activity of intestinal microorganisms ensures the breakdown of amino acids with the formation of toxic substances. Hydrogen sulphide and methyl mercaptan are formed due to the breakdown in the intestine of the following amino acids:

- A. Cystine, cysteine, methionine
- B. Tyrosine, tryptophan, phenylalanine
- C. Glycine, threonine, lysine
- D. Arginine, histidine, glycine
- E. Proline, isoleucine, leucine

22. Pepsin refers to proteolytic enzymes of gastric juice. The most optimal hydrolytic effect of this endopeptidase is on:

- A. Denatured proteins
- B. Protamines
- C. Mucoproteins
- D. Keratins
- E. Histones

23. The patient is diagnosed with an increased total gastric acidity. What is the normal total gastric acidity?

- A. 40 60 mmol / L
- B. 20 40 mmol / L
- C. 30 50 mmol / L
- D. 10 20 mmol / L
- E. 60 80 mmol / L

24. Which of the following enzymes hydrolyses peptide bonds formed by carboxyl groups of aromatic amino acids?

- A. Trypsin
- B. Chymotrypsin
- C. Procarboxypeptidase B
- D. Enterokinase
- E. Gastricin

25. Examination revealed lactic acid in the gastric juice of a patient. What method was used to determine lactic acid?

- A. Uffelmann's reaction
- B. Benzidine sample
- C. The urease method
- D. Reaction with resorcin
- E. Fehling test

26. Disaccharides are formed during the hydrolysis of polysaccharides. What kind of them is formed during the hydrolysis of starch?

A. Maltose

- B. Cellulose
- C. Lactose
- D. Sucrose
- E. Glycogen

### **14. Study of digestion of nutrients: lipids in the digestive tract.**

1. A patient complains of nausea and heartburn after eating fatty foods. Steatorrhea has been revealed. What is the cause of such state?

- A. Insufficiency of bile acids
- B. Increased release of lipase
- C. Violation of the synthesis of trypsin
- D. Amylase deficiency
- E. Violation of the synthesis of phospholipase

2. The patient complains of discomfort after eating fatty foods. Undigested drops of fat are present in the stool. The cause of this state is the deficiency of:

- A. Bile acids
- B. Fatty acids
- C. Chylomicrons
- D. Triglycerides
- E. Phospholipids

3. Examination revealed congestion of bile in the liver and stones in the gallbladder. Specify the main component of gallstones forming in this state:

- A. Cholesterol
- B. Triglycerides
- C. Phospholipids
- D. Protein
- E. Mineral salts

4. A patient complains of weight loss and frequent diarrhea, especially after eating fatty foods. Laboratory investigation revealed steatorrhoea, hypocholic stool. What it the most likely cause of the state?

A. Obstruction of the biliary tract

B. Inflammation of the small intestinal mucosa

- C. Lipase insufficiency
- D. Impaired phospholipase activity
- E. Unbalanced diet

5. A patient complains of nausea and weakness after eating fatty foods. The signs

of steatorrhea have been revealed. The cholesterol concentration in the blood is 9.2 mmol / L. The cause of this state is the deficiency of:

A. Bile acids

- B. Triglycerides
- C. Fatty acids
- D. Phospholipids
- E. Chylomicrons

6. A patient suffering from cholelithiasis has been diagnosed with jaundice caused by the obstruction of the bile ducts. The disturbance of digestion of what substances has been observed in this state?

A. Lipids

- B. Polysaccharides
- C. Proteins
- D. Nucleic acids
- E. Disaccharides

7. A 27-year-old patient has dermatitis, poor wound healing and poor eyesight for a long time. The patient did not eat fat with food but received a sufficient amount of carbohydrates and proteins. What is the possible cause of metabolic disorders in this case?

A. Insufficient intake of polyunsaturated fatty acids and fat-soluble vitamins

B. Low calorie diet

C. Insufficient intake of oleic acid and vitamins PP and C

D. Insufficient intake of saturated fatty acids

E. Insufficient intake of vitamins of group B

8. Insufficient secretion of which enzyme contributes to incomplete digestion of fats in the gastrointestinal tract and the appearance of a large number of neutral fats in feces?

- A. Pancreatic lipase
- B. Phospholipase
- C. Enterokinase
- D. Monoacylglycerol lipase
- E. Pepsin

9. Coprological examination of a patient's feces revealed the presence of drops of neutral fat. The stool is acholic. The most reliable cause for such pathological changes is a violation of:

A. Bile flow to the intestine

B. Secretion of intestinal juice

C. Secretion of hydrochloric acid in the stomach

D. Secretion of pancreatic juice

E. Intestinal absorption processes

10. What are the risk factors for cholelithiasis development?

A. Hypercholesterolemia, a decrease in the concentration of bile acids and phospholipids in bile, congestion of bile

B. Hypersecretion of epinephrine, increased concentration of high-density lipoproteins, increased thiolase and lipase activities, increased concentration of bile acids

C. Hypersecretion of thyroxine, an increase in the concentration of chylomicrons, a decrease in the activity of phospholipase and triglyceride lypase, an increase in the concentration of lecithin in the blood

D. An increase in the rate of biotransformation of cholesterol in bile acids, hypocholesterolemia, hypersecretion of adrenaline and thyrotropin

E. Reduction of the concentration of very low density lipoproteins, hypersecretion of sex hormones, decreased activities of biotin carboxylase and lipoprotein lipase

11. Which of the following indicators characterizes the lithogenic properties of bile and indicates the high risk for stone formation?

- A. The bile salt-cholesterol ratio
- B. Cholesterol of bile
- C. Bile acids
- D. Billirubin of bile

E. Phospholipids

12. A patient suffering from chronic hepatitis has the signs of impaired digestion of fats (steatorrhea). What is the mechanism of its occurrence?

A. Decreased synthesis and secretion of bile acids

B. Decreased synthesis and secretion of cholesterol

C. Decreased trypsin activity

D. Malabsorption syndrome

E. Deficiency of fat-soluble vitamins

13. A 40-year-old patient has been diagnosed with obstruction of biliary tract. What kind of food causes steatorrhea in a patient?

- A. Absence of proteins
- B. Predominantly proteins
- C. Fat deficiency
- D. Preferably carbohydrates
- E. Predominantly fats

14. A patient suffering from liver failure has been diagnosed with disruption of the formation and secretion of bile acids. The violation of absorption of which of the following vitamins occurs in the patient?

- A. Vitamin C
- B. Vitamin E
- C. Vitamin B<sub>6</sub>
- D. Vitamin H
- E. Vitamin B<sub>12</sub>

15. Due to prolonged consumption of fatty foods alimentary hyperlipidemia has been developed in a patient caused by the increased content in the diet of:

- A. Triglycerides
- B. Cholesterol
- C. Glycolipids
- D. Chylomicrons
- E. Phospholipids

16. After the intake of fats, they are digested and absorbed in the intestine. What products of hydrolysis of fats are absorbed in the intestine?

- A. 2-monoacylglycerols, fatty acids
- B. Amino acids, fatty acids
- C. Polypeptides, fatty acids
- D. Monosaccharides, fatty acids
- E. Lipoproteins, fatty acids

17. To digest fatty foods, one of the digestive secrets is needed. Which component directly takes part in the emulsification of fats?

- A. Bile
- B. Intestinal juice
- C. Pancreatic juice
- D. Saliva
- E. Gastric juice

18. How can lipase activity be evaluated?

A. By the number of fatty acids formed as a result of hydrolysis

B. By the amount of pyruvic acid formation C. By the ability of the enzyme to hydrolyze peptide bonds D. By the ability to inhibit the reduction of fatty acids

E. By the ability to decolorize methylene blue upon reduction with aldehyde

19. A patient has been diagnosed with an acute pancreatitis. What drugs should a doctor prescribe to avoid the autolysis of pancreas?

- A. Protease activators
- B. Protease inhibitors
- C. Trypsin
- D. Chymotrypsin
- E. Amylase

## 15. Study of functional role of fat-soluble vitamins in the metabolism and realization of cell functions.

1. Many vegetables contain carotenes. Deficiency of which vitamin is eliminated by these plant pigments?

- A. Retinol
- B. Naphthoquinone
- C. Riboflavin
- D. Tocopherol
- E. Calciferol

2. The patient has hemeralopia (night blindness). Which of the following substances should be prescribed to correct this state?

- A. Carotene
- B. Keratin
- C. Creatine
- D. Carnitine
- E. Carnosine

3. A patient has dry mucous membranes and hemeralopia. Deficiency of which vitamin leads to the appearance of such symptoms:

- A. C
- B. D
- C. A
- D. B
- E. E

4. An ophthalmologist has revealed an increased time of adaptation of the eyes to darkness and xerophthalmia in a patient. The deficiency of what vitamin caused such state?

- A. A
- **B**. E

C. C

D. K E. D

5. Vitamin A in complex with specific cytoreceptors penetrates into the nucleus, inducing transcription processes, stimulating the growth and differentiation of cells. This function is realized by the following form of vitamin A:

A. Trans-retinoic acid

- B. Trans-retinal
- C. Cis-retinal
- D. Retinol
- E. Carotene

6. A doctor prescribed applications of vitamin A for a patient suffering from paradontosis. The activation of what process provides a therapeutic effect?

- A. Growth and differentiation of cells
- B. Hydroxylation of proline
- C. Carboxylation of glutamic acid
- D. Visual adaptation
- E. Colored vision

7. Calcitriol maintains physiological concentrations of calcium and phosphate in the blood plasma, ensuring the mineralization of bone tissue. What is the molecular mechanism of its action?

A. It causes the expression of genes for the synthesis of  $Ca^{2+}$  -binding and transporting proteins

B. It activates calcitonin synthesis in the thyroid gland

C. It activates the processing of proparathyroid hormone

D. It activates osteoblasts, leading to the mineralization of tissues

E. It activates the synthesis of cholecalciferol

8. The doctor revealed decreased mineralization of bone tissue in a child during the medical examination. The deficiency of which vitamin caused such state?

A. Calcipherol

- B. Riboflavin
- C. Tocopherol
- D. Folic acid
- E. Cobalamin

9. The signs of rickets have been revealed in a child during medical examination. The

deficiency of which vitamin caused the disease?

- A. 1,25-Dihydroxycholecalciferol
- B. Biotin
- C. Tocopherol
- D. Naphthoquinone
- E. Retinol

10. A 4-month-old child has signs of rickets. Digestive disorders are not observed. The child gets enough sun. Within 2 months, the child received vitamin  $D_3$  (cholecalciferol), but the rickets has been progressed. What is the cause of rickets in a child?

A. Impaired synthesis of calcitriol

B. A violation of the synthesis of parathyroid hormone

C. Violation of calcitonin synthesis

- D. Violation of the synthesis of thyroxine
- E. Disturbance of insulin synthesis

11. The processes of  $Ca^{2+}$  absorption through the intestinal wall has been violated in a patient after cholecystectomy. The prescription of which vitamin will stimulate this process?

- A. D<sub>3</sub>
- B. PP
- C. C
- D. B<sub>12</sub>
- Е. К

12. The signs of rickets have been revealed in a 4-year-old child suffering from hereditary kidney disorder. The concentration of vitamin D in the blood is normal. What is the most likely cause of the rickets in a child?

A. Violation of calcitriol synthesis

- B. Increased calcium excretion from the body
- C. Hyperfunction of the parathyroid glands
- D. Hypofunction of the parathyroid gland
- E. Calcium deficiency in food

13. Due to post-translational changes in some blood clotting proteins, in particular prothrombin, they acquire the ability to bind calcium. What vitamin is involved in this process?

- A. A
- B. C
- С. К
- $D. B_1$
- $E. B_2$

14. Hemorrhagic syndrome has been developed in a newborn child. The medical examination revealed the hypovitaminosis of vitamin K. What is the biological role of vitamin K?

A. It is a cofactor of gamma-glutamate-carboxylase

B. It is a cofactor of prothrombin

C. It is a specific inhibitor of antithrombin

D. It affects the proteolytic activity of thrombin

E. It inhibits the synthesis of heparin

15. Blood clotting factors undergo the posttranslational modification involving vitamin K. It is a cofactor that participates in gammacarboxylation of blood clotting factors, which leads to an increase in the affinity of their molecules for calcium ions. Which amino acid is carboxylated in these proteins?

A. Glutamic acid

- B. Valine
- C. Serin
- D. Phenylalanine
- E. Arginine

16. Inhibition of blood coagulation is observed in a patient suffering from obstruction of the biliary tract. The insufficient absorption of which vitamin causes this state?

- A. K
- **B**. E
- C. C
- D. D
- E. A

17. It has been revealed decreased level of prothrombin in a patient taking anticoagulants of indirect action. What is the most likely cause of this state?

- A. Deficiency of vitamin K
- B. Deficiency of vitamin  $B_{12}$
- C. Decrease in the concentration of  $Ca^{2+}$
- D. Reduced amount of blood globulins
- E. Deficiency of vitamin C

18. The activation of prooxidant systems increases the concentration of reactive oxygen species, which leads to the destruction of cell membranes. Antioxidants are used to prevent

this damage. What is the most powerful natural antioxidant?

- A. Alfa-tocopherol
- B. Glucose
- C. Vitamin D
- D. Fatty acids
- E. Glycerol

19. A pregnant woman has several miscarriages in the anamnesis. She has been prescribed a therapy including vitamin preparations. Indicate the vitamin that must be prescribed without fail:

- A. Alpha-tocopherol
- B. Folic acid
- C. Cyanocobalamin
- D. Pyridoxine
- E. Rutin

20. An antioxidant of natural origin is used in the treatment of periodontal disease. What is it?

- A. Tocopherol
- B. Thiamin
- C. Gluconate
- D. Pyridoxine
- E. Choline

21. Some vitamins ensure the stability of biological membranes. What are they?

- A. Tocopherol, retinol
- B. Thiamin, folic acid
- C. Biotin, cobalamin
- D. Pantothenic acid, riboflavin
- E. Riboflavin, ascorbic acid

22. The deficiency of which vitamin can cause the activation of lipid peroxidation process?

- A. Vitamin E
- B. Vitamin D
- C. Vitamin K
- D. Vitamin B<sub>12</sub>
- E. Vitamin  $B_6$

23. Arachidonic acid is an essential component of food. It is a precursor in the synthesis of biologically active substances. What compound is synthesized from arachidonic acid?

- A. Prostaglandin E<sub>1</sub>
- B. Norepinephrine
- C. Choline

D. Ethanolamine

E. Triiodothyronine

24. The deficiency of linoleic and linolenic acids in the body leads to immunodeficiency, skin damage, hair loss, delayed wound healing, thrombocytopenia and etc. The impaired synthesis of what biologically active substances most likely causes these symptoms?

- A. Eicosanoids
- B. Interleukins
- C. Interferons
- D. Catecholamines
- E. Corticosteroids

25. As a result of intoxication the synthesis of beta-lipoproteins has been disrupted in the patient. The absorption of what vitamin is impaired in this case?

- A. Vitamin C
- B. Vitamin E
- C. Vitamin B<sub>6</sub>
- D. Vitamin H
- E. Vitamin B<sub>12</sub>

### 16. Study of blood plasma proteins: proteins of acute phase of inflammation, own enzymes and indicator enzymes.

1. Paper electrophoresis is widely used in clinical practice to separate blood plasma proteins into fractions. What are they?

A. Albumins,  $\alpha_1$ -globulins,  $\alpha_2$ -globulins,  $\beta$ -globulins,  $\gamma$ -globulins

B. Albumins, fibrinogen,  $\alpha_2$ -globulins,  $\beta$  - globulins,  $\gamma$  -globulins

C. Albumins,  $\alpha_2$ -macroglobulins,  $\beta$  - globulins,  $\gamma$  -globulins

D. Albumins, haptoglobin,  $\alpha_1$  -globulins,  $\alpha_2$  -globulins,  $\gamma$  -globulins

E. Albumins, immunoglobulins, transferrin,  $\beta$  -globulins,  $\gamma$  -globulins

2. What are the main physiological functions of albumins?

A. They maintain blood oncotic pressure and carry out the transport function

B. They perform protective function

C. They inhibit proteinases and regulate vascular tension

D. They provide a non-specific resistance of the organism

E. They provide antioxidant defense of the body

3. A patient is diagnosed with the liver failure. Edemas are observed. What is the underlying mechanism of their formation?

A. The violation of albumin synthesis in hepatocytes, reduced blood oncotic pressure, the transition of water from vessels to the tissues and the development of oncotic edema

B. Increased blood oncotic pressure, the transition of water from vessels to the tissues and the development of oncotic edema

C. Reduced albumin synthesis in hepatocytes increases oncotic pressure and causes oncotic edema development

D. Violation of globulin synthesis in hepatocytes increases the flow of water into the tissues and causes the development of edema

E. Activation of albumin synthesis in hepatocytes

4. What are the acute phase proteins referring to the components of the system of nonspecific resistance of the organism?

A. C-reactive protein,  $\alpha_1$ -antitrypsin,  $\alpha_2$ macroglobulin, cryoglobulin, proteins of the complement system, haptoglobin and ceruloplasmin

B. Albumins, complement system proteins, ceruloplasmin

C. Albumins, lipoproteins, proteins of the complement system and transferrin

D. Fibrinogen, C-reactive protein, aminoacids and proteins of the complement system

E. Albumin, phospholipids, cryoglobulin, haptoglobin

5. What acute-phase protein performs a major role in the inhibition of proteolytic enzymes under the condition of the inflammatory process development?

- A. Haptoglobin
- B.  $\alpha_2$ -macroglobulin
- C. Fibronectin
- D. Ceruloplasmin
- E.  $\alpha_1$ -antitrypsin

6. Which component of the kallikrein - kinin system is the most strong vasodilator?

- A. Lysine
- B. Kallidin
- C. Kallikrein
- D. Prekallikrein
- E. Bradykinin

7. Bradykinin is a mediator of inflammation. What are the symptoms of inflammation caused by the excessive formation of bradykinin?

A. Vasodilation, redness and pain

B. Decrease in blood pressure, pain, vasoconstriction

C. Inhibition of inflammation, increasing of blood pressure and vascular permeability

D. Activation of proteinase inhibitors, pain

E. Increase in blood pressure, pain, decreased vascular permeability

8. A patient has been diagnosed with myocardial infarction. What is the most sensitive enzyme signaling of the cardiomyocytes damage in 2 hours after the onset of chest pain?

- A. Creatine kinase-BB
- B. Creatine kinase -MB
- C. Aspartate aminotransferase
- D. Lipase
- E. Gamma-glutamyltransferase

9. The activity of which organ-specific enzyme is investigated for the diagnostics of acute pancreatitis?

- A. Alpha-amylase
- B. Alanine aminotransferase
- C. Aspartate aminotransferase
- D. Creatine phosphokinase
- E. Collagenase

10. What proteins of blood plasma are antibodies?

- A. Kinins
- B. Cryoglobulins
- C. C-reactive protein
- D. Immunoglobulins
- E. Haptoglobin

11. What is a normal value of albumin / globulin ratio? A. 1.5 - 2.0

- B. 1.5 3.0 C. 10.0 – 15.0 D. 8.0 – 10.0
- E. –

12. Level of C-reactive protein is increased in the blood of a patient. What is the diagnostic value of this indicator?

- A. Level of the inflammatory process
- B. Assessment of renal function
- C. Diagnostics of immune deficiency
- D. Diagnostics of hyperproteinemia
- E. Diagnostics of paraproteinemia

13. Estimate the indexes of blood plasma: total protein is 47 g / L and albumins are 30 g/L:

A. Total protein and albumins are decreased

- B. Total protein and albumins are increased
- C. Normal values of blood plasma indexes
- D. Excess of dietary proteins
- E. Dysproteinemia

14. What is the most likely cause of severe hypoproteinemia?

- A. Diseases of the liver
- B. Diseases of the connective tissue
- C. Mild infections
- D. Hypothyroidism
- E. Excessive protein intake

15. How does the protein ratio change in liver disease?

- A. It decreases
- B. It increases
- C. It does not change
- D. It exceeds the index of 1.5 2.0
- Е. -

16. What is the biological role of transferrin and ceruloplasmin?

- A. Transport  $Fe^{2+}$  and  $Cu^{2+}$
- B. Transport of  $K^+$  and  $H^+$
- C. Transport of  $Ca^{2+}$
- D. Antibacterial action
- E. Factors of immune resistance

17. Estimate the indexes of blood plasma in the patient suffering from chronic renal failure, if the total protein content is 48 g / L and albumins are 28 g / L:

- A. Hypoproteinemia
- B. Dysproteinemia

- C. Hyperproteinemia
- D. Increased blood oncotic pressure
- E. Paraproteinemia

18. Laboratory investigation of patient's blood revealed paraprotein and Bence-Jones protein in the patient's urine. What disease is characterized by these changes?

- A. Multiple myeloma
- B. Acute pyelonephritis
- C. Chronic nephritis
- D. Liver failure
- E. Hypoxia

19. Laboratory investigation of a patient's blood revealed that albumin content is moderately decreased,  $\beta$ -globulins are increased,  $\gamma$ -globulins are significantly increased. What group of diseases is this proteinogram characteristic for?

- A. Chronic inflammation
- B. Acute inflammation
- C. Renal failure
- D. Liver failure
- E. Multiple myeloma

20. A 5-year-old child with signs of durative protein starvation has been admitted to the hospital. The signs were as follows: growth inhibition, anemia, edema, mental deficiency. What is the most likely cause of edema development?

- A. Reduced synthesis of albumins
- B. Reduced synthesis of globulins
- C. Reduced synthesis of hemoglobin
- D. Reduced synthesis of lipoproteins
- E. Reduced synthesis of glycoproteins

21. What enzymes are the most informative for the diagnosis of myocardial infarction?

A. Creatine kinase, aspartate aminotransferase, lactate dehydrogenase

B. Glutamate dehydrogenase, aspartate aminotransferase, glucokinase

C. Glucose-6-phosphate dehydrogenase, aspartate aminotransferase

D. Alpha-amylase, creatine kinase

E. Lipase,  $\alpha$ -amylase, aspartate aminotransferase

### 17. Study of acid-base state of blood and respiratory function of erythrocytes. Pathological forms of hemoglobins.

1. Hypoxia been developed in a child during the first three months after birth manifested by dyspnea and cyanosis of the skin. The cause of this state is a violation of the replacement of fetal hemoglobin by:

- A. Hemoglobin A
- B. Hemoglobin F
- C. Glycosylated hemoglobin
- D. Methemoglobin
- E. Hemoglobin M

2. A 19-year-old patient complains of general weakness, dizziness and fast fatigue. Hemoglobin of blood is 80 g / L, erythrocytes of a modified form are detected microscopically. What is the most likely cause of the state?

- A. Sickle cell anemia
- B. Hepatocellular jaundice
- C. Porphyria
- D. Obstructive jaundice
- E. Addison's disease

3. Hemolysis of erythrocytes is developed after snake bite. The action of toxic snake venom leads to:

- A. The formation of lysolecithin
- B. Acidosis
- C. Polyuria
- D. Development of alkalosis
- E. The formation of triglycerides

4. The consumption of contaminated vegetables and fruit for a long time has led to the nitrates poisoning of a patient and the formation of blood derivative of hemoglobin:

- A. Hb-Met
- B. HbCO
- C.  $HbO_2$
- D. HbCN
- E. HbCO<sub>2</sub>

5. A driver has been delivered to the hospital with symptoms of exhaust gas poisoning after the repair of the car in the garage. The concentration of what hemoglobin derivative is elevated in the blood?

- A. Carboxyhemoglobin
- B. Methemoglobin
- C. Carbhemoglobin
- D. Oxyhemoglobin
- E. Glycated hemoglobin

6. Under the action of oxidizing agents (such as hydrogen peroxide, nitric oxide and etc.) hemoglobin containing  $Fe^{2+}$  is converted into a compound containing  $Fe^{3+}$  that is not able to carry oxygen. What is this compound called?

- A. Methemoglobin
- B. Carboxyhemoglobin
- C. Carbhemoglobin
- D. Oxyhemoglobin
- E. Glycated hemoglobin

7. A patient with severe polytrauma was connected to the artificial respiration apparatus. After repeated studies of the parameters of acid-base balance, a decrease in the content of carbon dioxide in the blood and an increase in its release were established. What is the disturbance of acid-base balance in the patient?

- A. Respiratory alkalosis
- B. Respiratory acidosis
- C. Metabolic alkalosis
- D. Metabolic acidosis
- E. Acid-base balance is not changed

8. A patient with croupous pneumonia has very fast breathing. Skin is with a cyanotic shade. Blood pH is 7.3; the concentration of carbon dioxide in the blood is increased; acid excess (BE) is equal to - 3.4 mmol / L. What is acid-base disorder in the patient?

- A. Respiratory acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Metabolic alkalosis
- Е. -

9. A doctor revealed severe complication in a patient with type 1 diabetes mellitus accompanied by violation of the acid-base balance. What metabolites cause the disorder in the patient?

- A. Ketone bodies
- B. Lactic acid
- C. Hexuronic acids
- D. Acidic phosphates
- E. Citric acid

10. What is the major type of hemoglobin in adults?

- A. Hb A<sub>1</sub>
- B. Hb S
- C. Hb  $A_2$
- D. Hb F
- E. Hb C

11. The determination of what type of hemoglobin in the blood is used for the diagnosis of diabetes mellitus?

- A. Hb A<sub>1C</sub>
- B. Hb A<sub>1</sub>
- C. Hb F
- D. Hb M
- E. Hb S

12. What is the most important blood plasma buffer system in the regulation of acid-base homeostasis?

- A. Bicarbonate buffer
- B. Protein buffer
- C. Hemoglobin buffer
- D. Phosphate buffer
- E. Sulphate buffer

13. What is a normal pH value of blood?

- A. 7.35-7.45
- B. 7.30-7.35
- C. 7.00-7.30
- D. 7.50-7.55
- E. 7.60-7.65

14. What form of acid-base disorder is characteristic for metabolic acidosis developed in a patient under hypoxic condition?

- A. Accumulation of organic acids in the body
- B. Accumulation of alkalis in the body
- C. Violation of CO<sub>2</sub> emission
- D. Reduction of carbonic acid content
- E. Loss of acidic compounds

15. A 2-year old child was admitted to an emergency clinic with signs of poisoning by nitrates such as persistent cyanosis, shortness of breath, convulsions. What is the pathogenetic mechanism of symptoms in this case?

- A. Formation of methemoglobin
- B. Formation of glycated hemoglobin
- C. Formation of carboxyhemoglobin
- D. Formation of carbhemoglobin

16. A patient has decreased blood pH and bicarbonate ions content (decrease in blood alkaline reserve), the high content of lactic and pyruvic acid in the blood and urine. What is the type of acid-base disorder developed in the patient?

- A. Metabolic acidosis
- B. Respiratory acidosis
- C. Metabolic alkalosis
- D. Respiratory alkalosis
- E. Respiratory alkalosis

17. Carbon monoxide poisoning typically occurs from breathing in too much carbon monoxide. The transport of oxygen by hemoglobin is disturbed from the lungs to the tissues. What is the derivative of hemoglobin formed in this case?

- A. Carboxyhemoglobin
- B. Oxyhemoglobin
- C. Methemoglobin
- D. Carbhemoglobin
- E. Glycated hemoglobin

18. A worker of the manufacture of nitro compounds came to a doctor with complaints of dyspnea and rapid fatigue. Cyanosis of the lower extremities was revealed during the examination. What is the most probable cause of this state?

- A. Enhanced methemoglobin formation
- B. Vitamin C deficiency
- C. Hypervitaminosis A
- D. Fatty liver disease
- E. Avitaminosis of B-complex vitamins

19. In the lungs carbonic acid  $(H_2CO_3)$  is converted to form water and  $CO_2$ , which is eliminated in the expired air. Which enzyme catalyzes this reaction?

- A. Catalase
- B. Carbonic anhydrase
- C. Peroxidase
- D. Cytochrome oxidase
- E. Cytochrome P-450

20. As a result of improper feeding, severe diarrhea has been developed in an infant caused loss of bicarbonate. What form of disturbance of acid-base balance occurs in this case?

- A. Metabolic acidosis
- B. Metabolic alkalosis
- C. Respiratory acidosis
- D. Respiratory alkalosis

E. There will be no disturbances in the acidbase balance

21. Activation of  $\beta$ -oxidation of fatty acids caused ketosis development in a patient suffering from diabetes mellitus. What acid-base disorder may be developed due to the excessive accumulation of ketone bodies in the blood?

- A. Metabolic alkalosis
- B. Metabolic acidosis

C. There will be no disturbances in the acid-base balance

- D. Respiratory acidosis
- E. Respiratory alkalosis

22. As a result of an exhausting muscular work, the buffer capacity of blood has significantly decreased in a worker. The cause of this condition is the increase of acid in the blood: The accumulation of what acid is the cause of this state?

- A. Lactate
- B. Pyruvate
- C. 1,3-biphosphoglycerate
- D. Alpha-ketoglutarate
- E. 3-phosphoglycerate

23. A patient with double pneumonia has the following changes of acid-base balance: pH is 7.32;  $pCO_2$  of blood plasma is 53 mm Hg.; SB concentration is 18 mmol / L. What type of acid-base imbalance developed in the patient?

- A. Respiratory acidosis
- B. Metabolic acidosis
- C. Metabolic alkalosis
- D. Respiratory alkalosis
- E. Acid-base balance is not changed

24. A patient suffering from renal failure has the following changes of acid-base balance: blood pH is 7.31, SB is 16 mmol / L, BE is "-" 3.4. What type of acid-base imbalance developed in the patient?

- A. Metabolic acidosis
- B. Respiratory acidosis
- C. Metabolic alkalosis
- D. Respiratory alkalosis

25. What type of the acid-base imbalance is characteristic for the uncompensated diabetes mellitus complicated by ketonemia and ketonuria?

- A. Metabolic acidosis
- B. Respiratory acidosis
- C. Metabolic alkalosis
- D. Respiratory alkalosis
- E. Acid-base balance is not changed

26. Which of the following pH values is characteristic for acidosis?

- A. pH 7.30
- B. pH 7.49
- C. pH 7.36
- D. pH 7.45
- E. pH 7.6

27. What metabolite plays the key role in the development of acidosis under hypoxic conditions?

- A. Lactic acid
- B. Fatty acids
- C. Succinic acid
- D. Ketone bodies
- E. Glutamic acid

28. The release of oxygen from hemoglobin is enhanced when the pH is lowered, or when the hemoglobin is in the presence of an increased partial pressure of  $CO_2$ . What is the name of this effect?

- A. Bohr effect
- B. Pasteur effect
- C. Warburg effect
- D. Danysz effect
- E. All-or-none effect

#### 18. Study of nitrogen balance and nonprotein nitrogen containing components of blood – end products of heme catabolism.

1. The biochemical analysis of the blood is as follows: residual nitrogen - 48 mmol / L, urea - 15.3 mmol / L. Which organ is affected in this case?

- A. Brain
- B. Kidneys
- C. Liver
- D. Intestine

E. Spleen

2. What components of residual nitrogen fraction predominate in the blood under the conditions of productive azotemia?

- A. Amino acids, nitrogen of ammonia
- B. Lipids, carbohydrates
- C. Ketone bodies, proteins
- D. Porphyrins, bilirubin
- E. Uric acid, choline

3. The process of urea synthesis has been disrupted in a patient. The pathology of which organ caused a disorder?

- A. Gall bladder
- B. Kidneys
- C. Brain
- D. Muscles
- E. Liver

4. What components of residual nitrogen fraction predominate in the blood under the conditions of retention azotemia?

- A. Urea, creatinine
- B. Lipids, carbohydrates
- C. Amino acids, urea
- D. Porphyrin, bilirubin
- E. Uric acid, choline

5. Which component of residual nitrogen is the most stable and clearly reflects the severity of renal failure?

- A. Urea
- B. Indicane
- C. Creatinine
- D. Uric acid
- E. Creatine

6. After a course of treatment, the general condition and the biochemical parameters of urine of a patient suffering from chronic renal failure have been improved. Which biochemical indicator is the most informative for such conclusion?

- A. Creatinine
- B. Uric acid
- C. Bilirubin
- D. Sodium
- E. Protein

7. The content of which component of the residual nitrogen is the greatest one and

sharply increases under conditions of renal failure?

- A. Peptides
- B. Urea
- C. Uric acid
- D. Indicane
- E. Bilirubin

8. Which of the following compounds is direct conjugated bilirubin called?

- A. Bilirubin glucuronide
- B. Verdoglobin
- C. Bilirubin albumin complex
- D. Urobilinogen
- E. Sterkobilinogen

9. What metabolite is necessary for the formation of conjugated bilirubin in hepatocytes?

- A. Albumin
- B. Fructose
- C. Glucose
- D. Glucuronate
- E. Glycine

10. The main part of nitrogen is excreted in the form of urea in humans. The decreased activity of what enzyme in the liver leads to inhibition of urea synthesis and the accumulation of ammonia in the blood and the tissues?

- A. Carbamoyl phosphate synthetase
- B. Aspartate aminotransferase
- C. Urease
- D. Amylase
- E. Pepsin

11. Ammonia is a very toxic substance, especially for the nervous system. What substance is actively involved in the detoxification of ammonia in the brain tissue?

- A. Lysine
- B. Glutamic acid
- C. Proline
- D. Histidine
- E. Alanine

12. A 49-year-old patient complains of a sharp pain in small joints of the lower extremities. Objectively: local edema and fever. It was revealed an elevated level of C-reactive protein and  $\alpha_1$ -proteinase inhibitor in

the blood. What biochemical blood test is required to clarify the diagnosis?

- A. Determination of uric acid
- B. Determination of urea
- C. Determination of creatinine
- D. Determination of creatine
- E. Determination of hexuronic acids

13. What is a normal value of urea in the blood?

- A. 3.3 8.3 mmol / L
- B. 3.0 4.0 mmol / 1
- C. 8.4 12.2 mmol / L
- D. 10.0 13.0 mmol / L
- E. More than 10.0 mmol / 1

14. The following biochemical parameters in the blood were revealed in a patient suffering from chronic glomerulonephritis for 5 years: urea concentration - 49 mmol / L, creatinine -0.68 mmol / L, potassium - 6.1 mmol / L, glucose - 3.2 mmol / L. There is a smell of ammonia from the oral cavity. The arterial pressure is 215/115 mm Hg. What pathology can the most probably be suspected in this case?

- A. Chronic renal failure
- B. Hyperammonemia
- C. Hyperkalemia
- D. Hypertension
- E. Hypoglycemic coma

15. What is the daily creatinine excretion in the urine?

- A. 1 2 g
- B. 2 3 g
- C. 3 4 g
- D. 0,5 1 g
- E. Over than 4.0 g

16. A patient with signs of gout has been admitted to a hospital. What biochemical analysis should be used to clarify the diagnosis?

A. Determination of uric acid in the blood and urine

B. Determination of urea in the blood and urine

C. Determination of creatinine in the blood and urine

D. Determination of indican in the blood

E. Determination of amino acids in the blood

17. The clearance of which of the following substances is determined in the clinic?

- A. Creatinine
- B. Creatine
- C. Glycerol
- D. Glucose
- E. Phenylalanine

18. A 50-year-old patient complains of vomiting and strong weakness. The residual nitrogen is 45 mmol / L. There is no disorder of the kidney function. What type of azotemia is the most likely be suspected in the patient?

- A. Productive azotemia
- B. Latent azotemia
- C. Retention decompensated azotemia
- D. Retention subcompensated azotemia
- E. Retention compensated azotemia

19. The concentration of urea in the blood is much lower than normal. Which organ pathology is most likely be suspected in this case?

- A. Heart
- B. Liver
- C. Intestine
- D. Kidneys
- E. Stomach

20. A patient with extensive burns complains of vomiting and strong weakness. The residual nitrogen is 55 mmol / L. What type of azotemia is the most likely be suspected in the patient?

- A. Productive azotemia
- B. Latent azotemia
- C. Retention decompensated azotemia
- D. Retention subcompensated azotemia
- E. Retention compensated azotemia

21. A high content of indican has been revealed in the patient's blood and urine that is an indicator of the activation of the putrefaction of proteins in the intestine. Which amino acid is the source of the indicane?

- A. Tryptophan
- B. Tyrosine
- C. Proline
- D. Tyrosine
- E. Phenylalanine

22. Jaundice has been developed in a 50-yearold woman suffering from cholelithiasis. In this case, the urine became dark, and the feces were discolored. The concentration of what substance has been increased in the patient's blood serum?

- A. Conjugated bilirubin
- B. Unconjugated bilirubin
- C. Biliverdin
- D. Verdoglobin
- E. Urobilinogen

23. Laboratory investigation revealed increased content of conjugated and unconjugated bilirubin in the blood plasma. There is a sharp decline in the content of stercobilinogen in the feces and urine. What type of jaundice is it?

- A. Hepatocellular jaundice
- B. Hemolytic jaundice
- C. Obstructive jaundice
- D. Newborn jaundice
- E. Gilbert's disease

24. When a venomous snake bites a person can develop hemolytic jaundice. Which of the biochemical indicators is sharply increased in this case?

- A. Unconjugated bilirubin
- B. Conjugated bilirubin
- C. Uric acid
- D. Urea
- E. Free amino acids

25. It was observed yellow discoloration of skin and mucus membrane in a patient after the blood transfusion. The content of total and unconjugated bilirubin is increased in the blood plasma. Stercobilin is increased in the feces. What type of jaundice is in the patient?

- A. Hemolytic
- B. Congenital
- C. Obstructive
- D. Hepatocellular
- E. Newborn jaundice

26. Brain injury caused increased production of ammonia. What amino acid is involved in the process of the temporary neutralization of ammonia?

- A. Lysine
- B. Tyrosine
- C. Valine

E. Glutamic acid

# **19.** Biochemical patterns of realization of immune processes. Immunodeficiency states.

1. In order to prevent rejection of the transplant after organ transplantation, it is mandatory to conduct a course of hormone therapy for immunosuppression. What hormones are used for this purpose?

- A. Mineralocorticoids
- B. Glucocorticoids
- C. Sex hormones
- D. Thyroid hormones
- E. Catecholamines

2. Bruton's disease was diagnosed in a 5year-old child. In the blood: absence of Blymphocytes and plasma cells. What changes will be observed in immunoglobulin content in the blood serum of the child?

- A. Reduction of IgA, IgM
- B. Increase of IgD, IgE
- C. Increase of IgA, IgM
- D. Reduction of IgD, IgE
- E. There will be no changes

3. A boy often began to suffer from respiratory diseases, stomatitis, pustular skin lesions in the second year of life. Even minor damage of the gums and mucous membranes complicated by a long flowing inflammation. It was revealed that all classes of immunoglobulins are practically absent in the blood. The decrease in the functional activity of which cell population underlies the described syndrome?

- A. B-cells
- B. NK-lymphocytes
- C. T-lymphocytes
- D. Neutrophiles
- E. Macrophages

4. Protective function is one of the functions of saliva, in particular, providing the formation of local immunity of the mucous membrane due to the release of protein by parotid glands. What is the protein called?

- A. Albumin
- B. Collagen

- C. Elastin
- D. Fibrinogen
- E. Secretory immunoglobulin

5. In humans universal antiviral agents are synthesized by lymphocytes and other cells in response to the virus entry. What are protein factors called?

- A. Cytokines
- B. Interleukin-2 and  $1\beta$
- C. Interferons
- D. Interleukin-4 and 6
- E. Tumor necrosis factors

6. 6-Mercaptopurine is administered to prevent transplant rejection. What mechanism of its action?

A. Inhibition of nucleic acid synthesis by immune cells

B. Inhibition of nucleic acid synthesis by cells of transplants

C. Inhibition of immunoglobulin synthesis by plasma cells

D. Inhibition of protein synthesis by cells of transplants

E. Inhibition of ATP synthesis in immune cells

7. A patient came to a doctor with complaints of exercise-induced dyspnea. Clinical examination revealed anemia and the presence of paraprotein in the gammaglobulin zone. What substance should be determined in the patient's urine to confirm multiple myeloma diagnosis?

- A. Antitrypsin
- B. Bilirubin
- C. Hemoglobin
- D. Ceruloplasmin
- E. Bence Jones protein

8. Electrophoretic study of the blood serum of a patient suffering from pneumonia showed an increase in one of the protein fractions. Determine it:

- A. Gamma-globulins
- B. Albumin
- C. Alpha1-globulins
- D. Alpha2-globulins
- E. Beta-globulins

9. What type of immunoglobulin dominates in the composition of saliva forming local immunity of the oral cavity?

- A. Secretory immunoglobulin A
- B. Immunoglobulin E
- C. Immunoglobulin A
- D. Immunoglobulin M
- E. Immunoglobulin E

10. What fraction of globulins of blood plasma provides humoral immunity playing the role of antibodies?

- A.  $\gamma$  -globulins
- B.  $\beta$  -globulins
- C.  $\alpha_1$ -globulins
- D. Cryoglobulins
- E.  $\alpha_1$ -macroglobulin

11. HBsAg was detected in the serum. Which disease this antigen is marker for?

- A. Viral hepatitis
- B. Tuberculosis
- C. AIDS
- D. Syphilis
- E. Mononucleosis

12. Numerous plasma cells were found in the blood of a 16-year-old girl suffering from an autoimmune inflammation of the thyroid gland. The proliferation and differentiation of what blood cells caused increased number of plasma cells?

- A. B cells
- B. T-killers
- C. Tissue basophils
- D. T-suppressors
- E. T-helper

13. Passive specific transplacental immunity is provided by:

- A. Immunoglobulin G
- B. Immunoglobulins M
- C. Immunoglobulin A
- D. Immunoglobulin D
- E. Immunoglobulin E

14. What components of saliva and gingival fluid provide the local immunity of the oral cavity?

- A. Lysozyme, immunoglobulins, leukocytes
- B. Lactate dehydrogenase, glucuronidase
- C. Lactic acid, urea, ammonia
- D. Alkaline and acid phosphatase

E. Hyaluronidase, cathepsin D

15. A 70-year-old patient with diagnosis of malignant tumor of the cecum complains of weakness, headache and fatigue. It is known that immunity is decreased in patients suffering from cancer. It is associated with an inhibition of adenilate desaminase activity in lymphocytes of patients. What process takes place with the participation of the enzyme?

- A. Catabolism of the purine nucleotides
- B. Catabolism of pyrimidine nucleotides
- C. Synthesis of pyrimidine nucleotides
- D. Synthesis of purine nucleotides
- E. Reutilization of purine bases

16. A 12-year-old child has a high fever, a sore throat while swallowing, enlarged submandibular lymph nodes. The pediatrician diagnosed acute tonsillitis. What cytokines are involved in the countering of the inflammatory process?

- A. g-immune IFN
- B. Interleukin-2
- C. a-leukocyte IFN
- D. Tumor necrosis factor-a
- E. Interleukin-3

17. A patient has been delivered to the neurological department with cerebellar ataxia type. There was a complete absence of IgA and a low level of IgG in the patient's blood. Which congenital immunodeficiency state is in the patient?

- A. Louis-Bar syndrome
- B. DiGeorge Syndrome
- C. Dissymunoglobulinemia
- D. Bruton's disease
- E. Swiss type agammaglobulinemia

18. A 3-month-old boy has congenital hypoplasia of the thymus gland, which is accompanied by frequent infections due to violations of the T-cell population, tetralogy of Fallot and cleft palate. What is this pathology called?

- A. DiGeorge syndrome
- B. Louis-Bar Syndrome
- C. Dissymunoglobulinemia
- D. Bruton's disease
- E. Swiss type agammaglobulinemia

19. A 12-year-old patient was admitted to a hospital with diagnosis of infectious pneumonia. Frequent catarrhal diseases are in the anamnesis, which were characterized by a heavy course. A significant reduction of IgG concentration and a lack of B-lymphocytes were revealed in the patient's blood. What is the pathology in the patient?

- A. Bruton's disease
- B. Louis-Bar Syndrome
- C. Dissymunoglobulinemia
- D. DiGeorge syndrome
- E. Swiss type agammaglobulinemia

20. It has been obtained two positive results of the enzyme-linked immunosorbent assay (ELISA) during medical examination of a patient with AIDS. Which method should be used to avoid false-positive AIDS results?

- A. Western blotting
- B. Radioimmunoassay
- C. Luminescent analysis
- D. Immunofluorescence
- E. Molecular hybridization

21. Variability of immunoglobulins is determined by:

- A. Recombination of DNA
- B. DNA methylation
- C. Repression of genes
- D. Recombination of mRNA
- E. Recombination of proteins

22. In humans immunoglobulins realize a humoral immune response to the entry of antigens. According to the chemical nature of the non-protein part, they refer to:

- A. Lipoproteins
- B. Glycoproteins
- C. Nucleoproteins
- D. Chromoproteins
- E. Metalloproteins

23. It was observed a significant decrease in the concentration of antibodies (IgG in 10 times, IgA and IgM in 100 times), some populations of lymphocytes and plasma cells in the patient's serum. What is the presumptive diagnosis?

- A. B-cell insufficiency
- B. T-cell insufficiency
- C. Pathology of phagocytic cells
- D. Pathology of the complement system

E. Secondary immunodeficiency

24. A 25-year-old patient is diagnosed with AIDS. What cell populations are the most sensitive to the human immunodeficiency virus?

- A. T helper cells
- B. Hepatocytes
- C. Endothelial cells
- D. Epitheliocytes
- E. B-Lymphocytes

25. It is known that human immunodeficiency virus belongs to the family of retroviruses. Specify the main feature that characterizes this family:

A. The presence of the enzyme reverse transcriptase

- B. Containing of minor RNA
- C. Simple viruses infecting humans only
- D. Nucleic acid is not integrated into the host genome
- E. Containing DNA

26. Using skin allergy tests it was established the sensitization by an allergen of poplar fluff in a patient with bronchial asthma. Which factor of the immune system plays a main role in the development of bronchial asthma?

- A. IgD
- B. IgE
- C. IgM
- D. Interferon alpha
- E. IgG

27. Antigen presentation disfunction of immune cells was identified in a patient with clinical signs of primary immunodeficiency disorder. The defect in the structure of what cells can be assumed?

- A. Macrophages, monocytes
- B. T-lymphocytes
- C. B-lymphocytes
- D. Fibroblasts
- E. Lymphocytes

### 20. Biochemistry of liver. Pathobiochemistry of jaundices.

1. Toxicity of ammonia (especially for brain) is due to its capacity to disturb the functioning

of Krebs cycle as a result of the removal from cycle of:

- A. Succinate
- B. Citrate
- C. Malate
- D. Alfa-Ketoglutarate
- E. Fumarate

2. Jaundice is developed in neonates during 5-6 days after birth. The insufficient activity of what enzyme is a cause of this disorder?

- A. UDP-glucuronyl transferase
- B. Porphobilinogen synthase
- C. Aminolevulinate synthease
- D. Heme oxygenase
- E. Biliverdin reductase

3. A congenital liver disease was diagnosed in a patient, which is accompanied with high bilirubinemia due to an increase in free (nonconjugated) bilirubin. It was detected a trace activity of glucuronyl transferase using liver biopsia. What disease can be recognized?

- A. Crigler-Najjar syndrome
- B. Gilbert syndrome
- C. Physiological jaundice
- D. Dubin-Johnson syndrome
- E. Wilson disease

4. After a serious viral infection a 3-year-old child has repeated vomiting, loss of consciousness, convulsions. Examination revealed hyperammonemia. What may have caused changes of biochemical blood indices in the child?

A. Disorder of ammonia neutralization in the ornithine cycle

B. Activated processes of amino acid decarboxylation

C. Disorder of biogenic amine neutralization

D. Increased putrefaction of proteins in intestine

E. Inhibited activity of transamination enzymes

5. A patient suffering from rheumatism was administered glucocorticoid therapy. What changes of carbohydrate metabolism in the liver can be expected?

- A. Stimulation of glycogenesis
- B. Stimulation of gluconeogenesis
- C. Stimulation of glycogen hydrolysis

D. Stimulation of glycogen phosphorolysis

E. Increase of glycogen phosphorylase activity

6. A patient has yellow skin colour, dark urine, dark-yellow feces. The concentration of what substance will be increased in the blood serum of the patient?

- A. Unconjugated bilirubin
- B. Conjugated bilirubin
- C. Mesobilirubin
- D. Verdoglobin
- E. Biliverdin

7. A 46-year-old woman suffering from cholelithiasis developed jaundice. Her urine became dark-yellow and feces became colourless. Blood serum will have the highest concentration of the following substance:

- A. Conjugated bilirubin
- B. Unconjugated bilirubin
- C. Biliverdin
- D. Mesobilirubin
- E. Urobilinogen

8. It was detected a block in the transformation of bilirubin to bilirubin diglucuronide in a patient with jaundice. The concentration of indirect bilirubin in blood was markedly increased. What pathology can be suggested in a patient?

- A. Pre-hepatic jaundice
- B. Hepatic jaundice
- C. Post-hepatic jaundice

D. Tumor of pancreas and occlusion of bile duct

E. Addison's disease

9. Investigation of a patient indicated on inflammatory processes in gall bladder, alteration of colloidal stability and high risk of bile stones formation. What substance from listed below favors the formation of bile stones?

- A. Oxalates
- B. Urates
- C. Phosphates
- D. Cholesterol
- E. Lecithine

10. A hereditary liver pathology was expected in 14-year-old patient. It was detected a high content of direct bilirubin in blood, deposition of melanin in liver due to alteration of bilirubin excretion to bile by liver cells. This state is characteristic to the next disease:

- A. Dubin-Johnson syndrome
- B. Crigler-Najjar syndrome
- C. Gilbert disease
- D. Physiological jaundice
- E. Wilson disease

11. A man is resting after intensive physical effort. Which pathway of glucose metabolism is the most active at this time?

- A. Glycogenolysis
- B. Glycolysis
- C. Gluconeogenesis from lactate
- D. Breakdown of glycogen to glucose
- E. Gluconeogenesis from amino acids

12. Fatty liver develops owing to the dietary deficiency or insufficient production of endogenous lipotropic factors in humans. What substances from listed below can be considered as lipotropic factor?

- A. Choline
- B. Fatty acids
- C. Bilirubin
- D. Triacylglycerols
- E. Cholesterol

13. Which of the following indicators characterizes the lithogenic properties of bile and indicates the onset of stone formation?

- A. Holato-cholesterol coefficient
- B. Cholesterol of bile
- C. Bile acids
- D. Bilirubin of bile
- E. Phospholipids

14. A diet enriched with lipotropic factors was recommended to obese patient with a risk of a fatty liver development. What nutritional component is the most important in the diet?

- A. Glucose
- B. Cholesterol
- C. Vitamin C
- D. Glycine
- E. Methionine

15. A 40-year-old man was diagnosed with viral hepatitis. A blood test showed an increase in the activity of all of following enzymes, except:

- A. Creatine kinase
- B. Aspartate aminotransferases
- C. Lactate dehydrogenase
- D. Sorbitol dehydrogenase
- E. Alanine aminotransferase

16. Edema is observed in a 39-year-old patient after a severe hepatitis. It was found in the patient's blood serum: albumins - 32%, globulins - 68%. What factor caused the development of edema?

- A. Decreased oncotic blood pressure
- B. Decrease in blood pressure
- C. Violation of vascular permeability
- D. Enhancement of proteolysis
- E. Decreased synthesis of procoagulants

17. Examination of a patient revealed that hypoplasia dental was caused by а hypovitaminosis of vitamins A and D. These vitamins were administered perorally but they didn't have any medicinal effect. What is the probable cause of disturbed vitamin assimilation?

- A. Achlorhydria
- B. Hypochlorhydria
- C. Hyperchlorhydria
- D. Achylia
- E. Bile acid deficiency

18. What digestive process is altered in case of obstruction of bile duct and arrest of bile excretion to intestines?

- A. Hydrolysis of triglycerides
- B. Absorption of carbohydrates
- C. Hydrolysis of proteins

D. Hydrolysis of complex sugars and polysaccharides

E. Absorption of amino acids

19. What metabolite is used in hepatocytes for the synthesis of ketone bodies?

- A. Glucose
- B. Amino acids
- C. Fatty acids
- D. Acetyl-CoA
- E. Glycerol

20. What type of reaction is used for the transformation of indirect bilirubin into direct bilirubin?

- A. Conjugation
- B. Oxidation

C. Hydrolysis D. Reduction E. Methylation

21. The yellowness of a skin and mucous membranes are observed in a patient after hemotransfusion. The increased levels of total and indirect bilirubin in blood, urobilin in urine and stercobilin in feces are found. What is the type of jaundice in the patient?

- A. Hemolytic
- B. Hereditary
- C. Obstructive
- D. Parenchymatous
- E. Neonatal jaundice

22. A 20-year-old man was diagnosed with hereditary deficiency of UDP-glucoronyl transferase. The increased level of what blood index confirms the diagnosis?

A. Animal indican

- B. Conjugated bilirubin
- C. Urobilin
- D. Stercobilinogen
- E. Unconjugated bilirubin

23. A patient suffering from chronic hepatitis has a positive galactose test. The content of glucose in the blood is 3.0 mmol / L. The violation of what biochemical mechanisms caused these changes?

A. Isomerization reactions of monosaccharides

- B. Gluconeogenesis
- S. Glycolysis
- D. Glycogenolysis
- E. Storage of glycogen

24. A patient suffering from chronic hepatitis has signs of impaired digestion of fats (steatorrhea). What is the mechanism of its occurrence?

A. Decreased synthesis and secretion of bile acids

- B. Decreased cholesterol synthesis
- C. Decreased synthesis of lipase

D. Decreased absorption of triacylglycerols

E. Insufficiency of fat-soluble vitamins

25. The deficiency of which group of vitamins occurs under the conditions of chronic liver failure?

A. Fat-soluble vitamins

- B. Vitamin B complex
- C. Water-soluble vitamins
- D. Vitamins A, C, E
- E. Vitamin H

26. What is the leading mechanism of the hepatic encephalopathy development?

- A. Elevated level of ammonia in the blood
- B. Decreased synthesis of prothrombin
- C. Insufficient synthesis of plasma proteins
- D. Decreased synthesis of urea
- E. Increased indole formation

27. A patient complains of frequent diarrheas, especially after consumption of food, rich in fat, weight loss. Laboratory examination revealed steatorrhea; the feces were hypocholic. What might have caused such condition?

A. Lack of pancreatic lipase

B. Inflammation of mucous membrane of small intestine

- C. Obstruction of biliary tracts
- D. Lack of pancreatic phospholipase
- E. Unbalanced diet

28. What components of bile in a result of the damage of hepatocytes contribute to the development of inflammation of the oral mucosa (stomatitis, gingivitis)?

- A. Bilirubin
- B. Bile acids
- C. Phospholipids
- D. Cholesterol
- E. Calcium

29. After a long unbalanced diet steatosis of liver has been developed in a patient. What was the leading factor of its development?

- A. Lack of lipotropic factors
- B. Increased intake of neutral fats
- C. Reduced VLDL synthesis

D. Insufficiency of secretion of fat-mobilizing hormones

E. Reduced synthesis of glycogen

30. A doctor prescribed a diet for the patient, enriched with products with a high content of lipotropic factors. The synthesis of what lipids is optimized by such diet?

- A. Phospholipids
- B. Triacylglycerides
- C. Cholesterol

D. Unsaturated fatty acids

E. Saturated fatty acids

31. What form of enzymopathy often forms the basis of hemolytic jaundice?

A. Deficiency of glucose-6-phosphate dehydrogenase

B. Deficiency of alkaline phosphatase

- C. Deficiency of aldolase
- D. Alanine aminotransferase deficiency
- E. Acid phosphatase deficiency

32. What metabolite is needed for the formation of direct bilirubin in hepatocytes?

- A. Glycine
- B. Fructose
- C. Glucose
- D. Albumin
- E. Glucuronic acid

33. Which protein transports hemoglobin to the reticuloendothelial system of the liver?

- A. Transferrin
- B. Albumin
- C. Feritin
- D. Haptoglobin
- E. Ceruloplasmin

34. The patient was diagnosed with cirrhosis of the liver. Study of which of the listed substances that are excreted in the urine, can characterize the state of the antitoxic function of the liver?

- A. Hippuric acid
- B. Ammonium salts
- C. Creatinine
- D. Uric acid
- E. Amino acids

35. It was revealed that bilirubin content (indirect bilirubin) is increased in the blood of a newborn child and feces were intensively colored (the enhanced level of stercobilin). Bilirubin is not found in urine. Which type of jaundice is it?

- A. Neonatal physiologic jaundice
- B. Hemolytic
- C. Obstructive
- D. Inherited
- E. Hepatocellular

### 21. Study of processes of biotransformation of xenobiotics and endogeneous toxins. Microsomal oxidation, cytochrome P-450.

1. A patient with alcohol-induced liver injury has an impairment of biotransformation of xenobiotics and endogenous toxic compounds. These changes are likely to be caused by hypoactivity of the following chromoprotein:

- A. Cytochrome P-450
- B. Hemoglobin
- C. Cytochrome oxidase
- D. Cytochrome b
- E. Cytochrome  $c_1$

2. Neutralization of xenobiotics (drugs, epoxide, arenes, aldehydes, nitroderivatives and endogenous metabolites of estradiol, prostaglandins, leukotrienes) is realized in the liver by their conjugation with:

- A. Glutathione
- B. Aspartic acid
- C. Creatine
- D. S-adenosylmethionine
- E. Phosphoadenosine

3. The universal biological system of the nonpolar substance oxidation (many of drugs, toxic substances, steroid hormones, cholesterol) is a microsomal oxidation. What cytochrome is included to the composition of the microsomal oxidation chain?

- A. Cytochrome P-450
- B. Cytochrome a<sub>3</sub>
- C. Cytochrome b
- D. Cytochrome c
- E. Cytochrome a

4. Biological oxidation and neutralization of xenobiotics occurs due to heme-containing enzymes. Which metal is an indispensable component of these enzymes?

- A. Fe
- B. Mg
- C. Zn
- D. Co
- E. Pb

5. What is amino acid used for detoxification of benzoic acid to form hippuric acid in liver called?

A. Glycine

- B. Alanine
- C. Serine
- D. Glutamic acid
- E. Valine

6. What is an active form of sulphuric acid used in conjugation step of xenobiotics detoxification in liver called?

- A. 3'-Phosphoadenosin-5'-phosphosulfate
- B. UDP-sulfate
- C. Sulfuryl-CoA
- D. Guanosine sulfate
- E. Thionyl chloride

7. Study of conversion of a food coloring agent revealed that neutralization of this xenobiotic takes place only in one phase that is microsomal oxydation. Name a component of this phase:

- A. Cytochrome oxidase
- B. Cytochrome b
- C. Cytochrome c
- D. Cytochrome a
- E. Cytochrome P-450

8. A 50-year-old patient with the food poisoning is on a drip of 10% glucose solution. It not only provides the body with necessary energy, but also performs the function of detoxification by the production of a metabolite that participates in the following conjugation reaction:

- A. Sulfation
- B. Glucuronidation
- C. Methylation
- D. Glycosylation
- E. Hydroxylation

9. A part of food protein is not digested in the gastrointestinal tract and is decomposed by bacterial enzymes in large intestine. This is defined as a putrifaction of protein. What substance detection in urine may serve as an indicator of the intensity of a putrifaction processes?

- A. Urea
- B. Protein
- C. Animal indican
- D. Creatine and creatinine
- E. Urates

10. Patient with encephalopathy was admitted to the neurological department. Correlation of

an increasing of encephalopathy and substances absorbed by the bloodstream from the intestine was revealed. What substances that are created in the intestine can cause endotoxemia?

- A. Ornithine
- B. Butyrate
- C. Acetacetate
- D. Biotin
- E. Indole

11. Anti-alcohol drug "teturam" is an inhibitor of aldehyde dehydrogenase. It is widely used in medical practice for prevention of alcoholism. The increasing of what metabolite in the blood causes aversion to alcohol?

- A. Methanol
- B. Ethanol
- C. Malondialdehyde
- D. Acetone
- E. Acetaldehyde

12. Monooxygenase systems of liver cell endoplasmic reticulum contain cytochrome P-450, NADPH<sub>2</sub> cytochrome P-450 reductase, FAD and FMN-dependent enzymes. All these enzymes catalyze the following type of chemical reaction:

- A. Hydroxylation
- B. Acylation
- C. Dehydrogenation
- D. Methylation
- E. Conjugation

13. Development of resistance to drugs (drug tolerance) appears due to the following process:

A. Increase in the activity of microsomal oxidation

B. Decrease in the activity of mitochondrial oxidation

C. Increase in the activity of mitochondrial oxidation

D. Decrease in activity of microsomal oxidation

E. Activation of peroxide oxidation

14. Cytochrome P-450 belongs to the next class of enzymes:

- A. Transferases
- B. Oxidoreductases
- C. Hydrolases

- D. Lyases
- E. Isomerases

15. Glucuronic acid used for conjugation reaction in detoxification of xenobiotics exists in the next active form:

- A. UDP-glucuronate
- B. Glucuronyl pyrophosphate
- C. AMP-glucuronate
- D. CDP-glucuronate
- E. Glucuronyl-CoA

16. Examination of a chemical plant worker who had a poisoning revealed an increase in total bilirubin concentration at the expense of indirect fraction. Feces and urine are characterized by high stercobilin concentration. The level of direct bilirubin in the blood plasma is normal. What is type of jaundice in this case?

- A. Obstructive
- B. Hemolytic
- C. Hepatic
- D. Addison's disease
- E. Neonatal physiologic jaundice

17. A patient suffers from hepatocirrhosis. State of antitoxic liver function can be characterized by the examination of the following substance excreted by urine:

- A. Hippuric acid
- B. Ammonium salts
- C. Creatinine
- D. Uric acid
- E. Amino acids

18. A 2-day-old baby has yellowish skin and mucous membranes. This might be caused by the temporary deficiency of the following enzyme:

- A. UDP-glucuronil transferase
- B. Sulfotransferase
- C. Heme synthetase
- D. Hemoxygenase
- E. Biliverdine reductase

19. Jaundice treatment involves administration of barbiturates inducing the synthesis of UDP-glucuronyl transferase. A medicinal effect is caused by the production of:

- A. Heme
- B. Indirect bilirubin

- C. Biliverdin
- D. Protoporphyrin
- E. Direct bilirubin

20. Which of the following reactions is used for the inactivation of cadaverine and putrescine in hepatocytes?

- A. Hydroxylation
- B. Reduction
- C. Conjugation with glucuronic acid
- D. Conjugation with glycine
- E. Oxidation

21. What substance serves as a donor of hydrogen in reactions of microsomal oxidation?

- A. NADPH<sub>2</sub>
- B. Ascorbic acid
- C. Glucuronic acid
- D. FAD
- E. FMN

## **22.** Study of normal components of urine. Study of pathological components of urine.

1. After a person had drunk 1.5 liters of water, the amount of urine increased significantly, and its relative density decreased to 1.001. These changes are developed as a result of decreased water reabsorption in the distal nephron portion due to reduced secretion of:

- A. Vasopressin
- B. Aldosterone
- C. Angiotensin II
- D. Renin
- E. Prostaglandins

2. A 25-year-old patient complains of morbid thirst and polyuria (up to 10 litres daily). Glucose concentration in blood is normal and it is absent in urine. The patient has been diagnosed with diabetes insipidus. What hormonal drug is the most appropriate for management of this disorder?

- A. Vasopressin
- B. Cortisol
- C. Thyroxin
- D. Oxytocin
- E. Insulin

3. A child with renal insufficiency exhibits delayed teeth eruption. This is most likely

caused by the abnormal formation of the following substance:

- A. 1,25 (OH)<sub>2</sub>D<sub>3</sub>
- B. Glycocyamine
- C. Glutamate
- D. Alfa-ketoglutarate
- E. Hydroxylysine

4. Glucose concentration in a patient's blood is 15 mmol / L (reabsorption threshold is 10 mmol /L). What effect can be expected?

- A. Glucosuria
- B. Diuresis reduction
- C. Reduced glucose reabsorption
- D. Reduced vasopressin secretion
- E. Reduced aldosterone secretion

5. A patient has an insufficient blood supply to the kidneys, which has caused the development of pressor effect due to the constriction of arterial resistance vessels. This is the result of the vessels being greatly affected by the following substance:

- A. Angiotensin II
- B. Angiotensinogen
- C. Renin
- D. Catecholamines
- E. Norepinephrine

6. Due to the use of poor-quality measles vaccine for preventive vaccination, a 1-yearold child developed an autoimmune renal injury. The urine was found to contain macromolecular proteins. What process of urine formation was disturbed?

- A. Filtration
- B. Reabsorption
- C. Secretion
- D. Reabsorption and secretion
- E. Secretion and filtration

7. A 65-year-old man suffering from gout complains of kidney pain. Ultrasonic examination revealed kidney stones. An increased concentration of a certain substance can cause kidney stones formation. Name this substance:

- A. Uric acid
- B. Cholesterol
- C. Bilirubin
- D. Urea
- E. Cystine

8. What index allows evaluate renal glomerular filtration?

- A. Clearance of creatinine
- B. Daily creatinine excretion in the urine
- C. Proteinuria
- D. The daily excretion of urea in the urine
- E. Hematuria

9. A 55-year-old patient was diagnosed with acute glomerulonephritis. What is the basic mechanism of anemia development in this case?

- A. Diminishing of erythropoetin production
- B. Diminishing of glomerular filtration
- C. Diminishing of kidney prostaglandines synthesis
- D. Retentional azotemia
- E. Diminishing of reabsorption in canaliculus

10. A patient with serious damage of muscular tissue was admitted to the traumatological department. What biochemical urine index will be increased in this case?

- A. Creatinine
- B. Lipids
- C. Glucose
- D. Mineral salts
- E. Uric acid

11. What is the average range of fluctuations in the specific gravity of urine for healthy person being on normal diet?

- A. 1016 1020
- B. 1008 1010
- C. 1010 1012
- D. 1013 1015
- E. 1001 1008

12. It was revealed that blood glucose level in a patient is over the renal threshold. Polyuria is observed, as well as acidosis and ketonuria. What pathological state can be suggested?

- A. Diabetes mellitus
- B. Hypercorticism
- C. Starvation
- D. Addison disease
- E. Hyperthyreosis

13. The darkening of sclera, mucous membranes and ear bowels are observed in a suckling child. The urine is also developing a dark color after exposure on air.

Homogentisic acid is detected in blood and urine. What pathology can be suggested?

- A. Alcaptonuria
- B. Porphyria
- C. Albinism
- D. Cystinuria
- E. Hemolytic anemia

14. Excretion of ammonium cations with urine is increased in the next condition:

- A. Metabolic acidosis
- B. Respiratory alkalosis
- C. Hyperlipidemia
- D. Hypoproteinemia
- E. Obesity

15. A 15-year-old boy was diagnosed with alkaptonuria. After standing, his urine changes to a black color. This disease is a hereditary disorder of:

- A. Tyrosine metabolism
- B. Alanine metabolism
- C. Urea synthesis
- D. Uric acid biosynthesis
- E. Cysteine metabolism

16. A child has an acute renal failure. What biochemical factor found in saliva can confirm this diagnosis?

- A. Increase in urea concentration
- B. Increase in glucose concentration
- C. Decrease in glucose concentration
- D. Increase in concentration of fatty acids
- E. Decrease in nucleic acid concentration

17. Osteoporosis has been developed in a patient suffering from chronic renal failure. What vitamin's metabolism infringement promotes this disorder?

- A. Vitamin D
- B. Vitamin E
- C. Vitamin A
- D. Vitamin K
- E. Vitamin F

18. A therapeutist has an appointment with a 40-year-old patient complaining of recurrent pain attacks in his hallux joints and their swelling. Urine analysis revealed its marked acidity and pink colour. What substances can cause such changes in the urine?

- A. Uric acid salts
- B. Chlorides

- C. Ammonium salts
- D. Calcium phosphate
- E. Magnesium sulfate

19. According to the results of glucose tolerance test a patient has no disorder of carbohydrate tolerance. Despite that glucose is detected in the patients' urine. The patient has been diagnosed with renal diabetes. What renal changes cause glucosuria in this case?

A. Decreased activity of glucose reabsorption enzymes

B. Increased activity of glucose reabsorption enzymes

C. Exceeded glucose reabsorption threshold

- D. Increased glucose secretion
- E. Increased glucose filtration

20. Atria of an experimental animal were super distended with blood, which resulted in decreased reabsorption of  $Na^+$  and water in renal tubules. This can be explained by the influence of the following factor on kidneys:

- A. Natriuretic hormone
- B. Aldosterone
- C. Renin
- D. Angiotensin
- E. Vasopressin

21. What is the daily urinary excretion of creatinine?

- A. 1 2 g
- B. 2 3 g
- C. 3 4 g
- D. 0,5 1 g
- E. More than 4,0 g

22. What symptom indicates to the increased permeability of the glomerular membrane?

- A. Proteinuria
- B. Glucosuria
- C. Aminoaciduria
- D. Alkaptonuria
- E. Pyuria

23. A 30-year-old woman has face edemata. Examination revealed proteinuria (5.87 g / L), hypoproteinemia, hyperlipidemia. What condition is the set of these symptoms typical for?

- A. Nephrotic syndrome
- B. Nephritic syndrome

- C. Chronic pyelonephritis
- D. Acute renal failure
- E. Chronic renal failure

24. A patient who had been continuously taking drugs blocking the production of angiotensin II developed bradycardia and arrhythmia. A likely cause of these disorders is:

- A. Hyperkalemia
- B. Hypokalemia
- C. Hypernatremia
- D. Hypocalcemia
- E. Hypercalcemia

25. A patient has oliguria caused by an acute renal failure. What daily amount of urine corresponds with this symptom?

- A. 100-500 ml
- B. 1500-2000 ml
- C. 1000-1500 ml
- D. 50-100 ml
- E. 500-1000 ml

26. Arterial pH is 7,4; primary urine - 7,4; final urine - 5,8. Decrease in the pH of final urine is the result of the secretion of the following ions in the nephron tubules:

- A. Hydrogen ions
- B. Potassium ions
- C. Hydrogen carbonate ions
- D. Urea
- E. Creatinine

27. The content of which component of the residual nitrogen sharply increases under the conditions of renal failure?

- A. Urea
- B. Peptides
- C. Uric acid
- D. Indicane
- E. Bilirubin

28. Complete obstruction of the common bile duct was revealed in a patient. What changes will be observed in the urine?

- A. The appearance of direct bilirubin
- B. Accumulation of indirect bilirubin
- C. Absence of urobilin
- D. The appearance of sterbilin
- E. The appearance of fatty acids

29. What specific gravity of urine indicates to hypersthenuria?

A. 1028 - 1030 B. 1010 - 1012 C. 1016 - 1020 D. 1020 - 1022 E. 1012 - 1015

30. Specify the normal rate of creatinine clearance:

- A. 80-120 ml / min
- B. 40-60 ml / min
- C. 120-140 ml / min
- D. Less than 40 ml / min
- E. 60-80 ml / min

31. A patient came to a doctor with complaints of frequent and excessive urination and thirst. Daily diuresis is 19 litres, density of urine is 1,001. What pathology can be suggested?

- A. Diabetes insipidus
- B. Steroid diabetes
- C. Diabetes mellitus
- D. Thyrotoxicosis
- E. Addison's disease

32. Argininemia and argininuria are revealed in a patient. The amount of urea in the blood and urine is reduced. Deficiency of which enzyme is observed?

- A. Arginase
- B. Glutamate dehydrogenase
- C. Ornithine carbamoyltransferase
- D. Argininosuccinate synthetase
- E. Tryptophan-5-monooxygenase

33. A 57-year-old patient has been suffering from chronic glomerulonephritis for 5 years. The biochemical analysis of the blood is as follows: urea is 29 mmol / L, creatinine is 0.68 mmol / L, potassium is 6.1 mmol / L, glucose is 3.2 mmol / L. There is a smell of ammonia from the mouth. The arterial pressure is 215/115 mm Hg. Choose the form of violation for which these indicators are characteristic for?

- A. Renal failure
- B. Hyperammonemia
- C. Hyperkalemia
- D. Hypertension
- E. Hypoglycaemic coma

34. What test would you offer to determine the concentrating power of the kidney?

A. Zimnitsky test

B. Determination of urea excretion in the urine

- C. Determination of urea in the blood
- D. Determination of creatinine in the blood
- E. Daily diuresis

35. Persistent arterial hypertension is observed in a patient suffering from chronic pyelonephritis. What biologically active substance initiates the development of the hypertension?

- A. Renin
- B. Erythropoietin
- C. Endothelin
- D. Norepinephrine
- E. Aldosterone

#### 23. Biochemistry of muscle tissue.

1. The intensive muscular work induced the significant decrease in the blood buffer capacity of the worker. Which metabolite induced this condition?

- A. Pyruvate
- B. 1,3-Diphosphoglycerate
- C. Alfa-Ketoglutarate
- D. 3-Phosphoglycerate
- E. Lactate

2. A patient suffering from progressive muscular dystrophy was administered the biochemical examination of urine. The presence of the large amount of what compound in urine can confirm the muscular pathology in this patient?

- A. Urea
- B. Hippuric acid
- C. Porphyrins
- D. Creatine
- E. Creatinine

3. The change in the concentration of ions in the intracellular fluid occurs during the contraction and relaxation of muscles. The increased level of which of the cytosol ions of myocytes serves as a signal for muscle contraction?

- A.  $Ca^{2+}$
- B.  $Mg^{2+}$

- C.  $Na^+$
- D.  $K^+$
- E. Cl<sup>-</sup>

4. Long physical work leads to overfatigue. This condition is accompanied by rigidity of the muscles. The lack of what substance in the muscles contributes to their rigidity?

A. ADP

- B. ATP
- C. AMP
- D. Glucose
- E. Glycogen

5. For muscles, which rapidly contracted, glycolysis is a quick way to generate energy (ATP) under oxygen deficiency. In how many seconds since the beginning of muscle contraction, the rate of glycolysis reaches a maximum?

- A. 40 50
- B. 20 30
- C. 30 40
- D. 60 70
- E. 10 20

6. What effect of magnesium ions on the muscular tissue causes the wide use of the magnesium-containing drugs in clinical practice?

- A. It decreases calcium concentration
- B. It activates troponin complex
- C. It increases calcium concentration

D. It enhances the nervous impulses transfer in the synapses

E. It increases ATP and phosphate concentration

7. Skeletal muscles and myocardium use different blood compounds as the substrates of oxidation. Which of the following compounds is utilized in myocardium but is not used by skeletal muscles?

- A. Lactate
- B. Glucose
- C. Glycogen
- D. Fatty acids
- E. Ketone bodies

8. The patient complains of acute chest pain. The doctor diagnosed myocardial infarction. An increase in the activity of which enzyme in the serum will confirm this diagnosis?

- A. MB-Creatine phosphokinase
- B. MM-Creatine phosphokinase
- C. BB-Creatine phosphokinase
- D. Amylase
- E. Alanine aminotransferase

9. After short distance run untrained people develop delayed onset muscle soreness, resulting from lactate accumulation in muscles. The enhanced activity of what biochemical process in the organism may be associated with this condition?

- A. Glycogenesis
- B. Glycogenesis Glycolysis
- C. Penthose phosphate pathway
- D. Gluconeogenesis
- E. Lipogenesis

10. A 50-year-old man has been suffering from Duchenne muscular dystrophy for a long time. The change in the catalytic activity of what blood enzyme proves to be a diagnostic test for the disease?

- A. Creatine kinase
- B. Lactate dehydrogenase
- C. Pyruvate dehydrogenase
- D. Glutamate dehydrogenase
- E. Adenylate kinase

11. A 50-year-old driver complains about unbearable constricting pain behind the breastbone irradiating to the neck. The pain arose 2 hours ago. Objectively: the patient's condition is grave. He is pale. Heart's tones are decreased. Laboratory studies revealed high activity of creatine kinase and LDH<sub>1</sub>. What disease are these symptoms typical for?

- A. Acute myocardial infarction
- B. Acute pancreatitis
- C. Stenocardia
- D. Cholelithiasis
- C. Diabetes mellitus

12. Long-term myocardial ischemia leads to necrosis and hyperenzymemia. Determining the activity of which enzymes in the blood is used in the clinic to diagnose myocardial infarction?

A. Creatine phosphokinase MB-isoform, AST, LDH  $_{1,2}$ .

- B. Succinate dehydrogenase, amylase, lipase
- S. Arginase, urease, maltase
- D. Nuclease, trypsin, chymotrypsin

E. Glycogen phosphorylase, glycogen synthase, malate dehydrogenase

13. The excessive intake of vitamin A is accompanied by an increased membrane permeability or membrane destruction with the release of the acid proteases and acid phosphatase from the lysosomes. The excretion of what muscular cell metabolite is indicative for their damage?

- A. Lactate
- B. Creatine
- C. Pyruvate
- D. Creatinine
- E. Glucose

14. Muscle contraction is provided by myofibrils of myosytes. What is the functional unit of myofibrils?

- A. Sarcomer
- B. Sarcoplasma
- C. Sarcolema
- D. Mitochondria
- E. Sarcoplasmic reticulum

15. Change in cytoplasm calcium ion concentration is the main biochemical regulator of the muscular contraction and relax. What component of the troponin system is activated by the increased calcium concentration?

- A. Troponin I
- B. Myosin
- C. Actin
- D. Troponine T
- E. Troponin C

16. What is the main energy source for the cardiac muscle?

- A. Fatty acids
- B. Amino acids
- C. Lactic acid
- D. Pyruvic acid
- E. α-Ketoglutaric acid

17. A 40-year-old man ran 10 km within 60 minutes. What changes of the energetic metabolism will occur in muscles?

- A. The rate of fatty acid oxidation will increase
- B. Proteolysis will increase
- C. Gluconeogenesis will increase
- D. Glycogenolysis will increase

18. A suckling child was delivered to the clinic with signs of the damage of the muscles of the limbs and trunk. The examination evaluated carnitine deficiency in muscles. The disturbance of what process is the biochemical background for this pathology?

- A. Fatty acids transport to mitochondria
- B. Regulation of  $Ca^{2+}$  level in mitochondria
- C. Substrate phosphorylation
- D. Lactate utilization
- E. Actin and myosin synthesis

19. Which of the following clinical signs are not typical for the muscular tissue pathology?

- A. Myoglobulinuria
- B. Glucosuria
- C. Creatinuria
- D. Decrease of cAMP

E. Significant decrease of the content of carnosine and anserine

20. Myofibrillar proteins are the proteins providing muscular contractions. Which of the following proteins exert ATP-ase activity?

- A. Myosin
- B. Actin
- C. Troponin T
- D. Troponin I
- E. Troponin C

21. The large quantity of the MB-isoform of creatine kinase is evaluated in the blood of a patient with destructive changes of the muscular tissue. What is the most evident diagnosis?

- A. Myocardial infarction
- B. Muscular atrophy
- C. Muscular dystrophy
- D. Polymyositis
- E. Duchenne disease

22. It has been revealed that intense physical exercise caused activation of gluconeogenesis in liver of experimental rats. Which substance is glucose precursor in this case?

- A. Palmitate
- B. Glycogen
- C. Pyruvate
- D. Urea
- E. Stearic acid

### 24. Biochemistry of connective tissue.

1. What class of glucosaminoglycans, due to the large number of carboxyl groups, binds large amounts of water and supports tissue turgor?

- A. Hyaluronic acid
- B. Dermatan sulfate
- C. Keratan sulfate
- D. Heparin
- E. Chondroitin sulphate

2. A 60-year-old woman has the symptoms of a rheumatic arthritis. The increased level of which of the below mentioned indexes is the most considerable for confirmation of the diagnosis?

- A. Common glucosaminoglycans
- B. Lipoproteins
- C. Acidic phosphatase
- D. Total cholesterol
- E. Alanine aminotransferase

3. It is known, that sinovial fluid diminishes abrasion of surfaces of joints. At rheumatic disease or arthritis its viscosity decreases owing to depolymerisation (breaking down) of:

- A. Hyaluronic acid
- B. Glycogen
- C. Collagen
- D. Heparin
- E. Albumine

4. What hormones inhibit synthesis of proteoglycans and collagen in the connective tissue?

- A. Androgens
- B. Somatomedins
- C. Somototropin
- D. Insulin
- E. Glucocorticoids

5. Increased content of hydroxyproline in the blood and urine with lesions of joints and bones is observed due to increased catabolism of:

- A. Hyaluronic acid
- B. Collagen
- C. Glycosaminoglycans
- D. Proteoglycans
- E. Elastin

6. Influence of hypovitaminosis of vitamin C on the structure of collagen fibers caused by decreased activity of enzymes:

- A. Lysyl hydroxylase, prolyl hydroxylase
- B. Lysyl oxidase
- C. Glycosil transferase
- D. Procollagen peptidase
- E. Collagenase

7. Hydroxyproline is an important amino acid for the collagen biosynthesis. Indicate vitamin which participates in the formation of this amino acid by hydroxylation of proline:

- A. D
- B. C
- $C. \ B_1$
- $D. \ B_2$
- E.  $B_6$

8. Disturbance of the collagen structure occurs during the deficiency of vitamin C due to the fact that this vitamin is a cofactor of:

- A. Lysyl hydroxylase, prolyl hydroxylase
- B. Lysyl hydroxylase and collagenase
- C. Glycosyltransferase
- D. Procollagen peptidase
- E. Collagenase

9. Insolubility of collagen and its metabolic resistance to various agents is caused by the amino acid composition and a special structure of the protein. Indicate amino acids that quantitatively dominate in the structure of collagen:

- A. Glycine, proline
- B. Methionine, serine
- C. Phenylalanine, tyrosine
- D. Cysteine, threonine
- E. Arginine, histidine

10. Collagen and elastin are fibrillar elements of connective tissue. Specify the amino acid, which is a component only of the collagen and its determination is used to diagnose several disorders of connective tissue:

- A. Hydroxyproline
- B. Cysteine
- C. Glycine
- D. Lysine
- E. Hydroxylysine

11. A scar was formed after wound healing. What is the main component of this type of connective tissue?

- A. Collagen
- B. Elastin
- C. Hyaluronic acid
- D. Chondroitin sulfate
- E. Keratan sulfate

12. It was revealed an increased concentration of hydroxyproline in the blood and urine in a 63-year-old woman suffering from rheumatism. What is the main reason of this state?

- A. Degradation of collagen
- B. Activation of prolyl hydroxylase
- C. Renal impairment
- D. Activation of cathepsins
- Е. –

13. A patient with burn disease is at the risk of blood clots formation. Thrombus formation may also take place in other diseases such as atherosclerosis, hypertension and myocardial infarction. What polysaccharide is used to prevent formation of blood clots?

- A. Starch
- B. Amylose
- C. Heparin
- D. Hyaluronic acid
- E. Chondroitin-4-sulfate

14. A patient has symptoms of active form of rheumatism. Clinical examination did not confirm this diagnosis. It should be also emphasized that rheumatism is the connective tissue damage, due to the destruction of heteropolysaccharides within glycoproteins. What biochemical blood and urine tests may be carried out to clarify the diagnosis?

- A. Determine aminosugars, sialic acids
- B. Determine glycoproteins, total nitrogen
- C. Determine glucose, albumin, globulins
- D. Glucocorticoids, 17-ketosteroids
- E. Determine ketone bodies

15. For the resorption of keloids hyaluronidase is used for the resorption of keloids. What biochemical process causes advantages of enzymotherapy?

- A. Cleavage of collagen
- B. Cleavage of heparin
- C. Cleavage of chondroitin sulfate

- D. The synthesis of glucosaminoglycans
- E. Cleavage of hyaluronic acid

16. Mucopolysaccharidoses are hereditary diseases that manifested by pathological changes during bones and joints formation. What urine index indicates this disease?

A. Excessive excretion of glucosaminoglycans

- B. Excessive excretion of amino acids
- C. Excessive excretion of lipids
- D. Excessive excretion of glucose
- E. Excessive excretion of proteins

17. A patient was hospitalized with an impaired vascular permeability. Specify the protein of connective tissue which is disturbed at such conditions:

- A. Tropomyosin
- B. Myoglobin
- C. Albumin
- D. Collagen
- E. Ceruloplasmin

18. The process of destruction of connective tissue due to collagenosis was observed. What laboratory tests should be assigning to a patient with a chronic form of collagenosis?

A. Content of hydroxyproline and hydroxylysine in blood serum and urine

- B. The activity of LDH isoenzymes
- C. The level of urates in the blood
- D. C-reactive protein
- E. Transaminase activity

19. A 34-year-old patient has a history of periodontitis. As a result of increased collagen degradation, there is a significantly increased urinary excretion of one of the amino acids. Specify it:

- A. Serine
- B. Valine
- C. Alanine
- D. Glycine
- E. Hydroxyproline

20. Osteolaterism is characterized by a decrease in collagen strength caused by much less intensive formation of crosslinks in collagen fibrils. This phenomenon is caused by the low activity of the following enzyme:

- A. Lysyl oxidase
- B. Monoamine oxidase

- C. Prolyl hydroxylase
- D. Lysyl hydroxylase
- E. Collagenase

21. Examination of a patient revealed typical presentations of collagenosis. This pathology is characterized by an increase of the following urine index:

- A. Glucose
- B. Arginine
- C. Hydroxyproline
- D. Mineral salts
- E. Ammonium salts

22. Inherited diseases, such as mucopolysaccharidoses, are manifested in metabolic disorders of the connective tissue, bone and joint pathologies. The sign of this disease is the excessive urinary excretion of the following substance:

- A. Glycosaminoglycans
- B. Amino acids
- C. Glucose
- D. Lipids
- E. Urea

23. A 53-year-old patient is diagnosed with Paget's disease. The concentration of hydroxyproline in daily urine is sharply increased, which primarily means intensified disintegration of:

- A. Collagen
- B. Keratin
- C. Albumin
- D. Hemoglobin
- E. Fibrinogen

24. Increased breaking of vessels, enamel and dentine destruction in scurvy patients are caused by a disorder of collagen maturing. What stage of modification of procollagen is disordered in this avitaminosis?

- A. Hydroxylation of proline
- B. Formation of polypeptide chains
- C. Glycosylation of hydroxylysine residues

D. Removal of C-ended peptide from procollagen

E. Detaching of N-ended peptide

25. Examination of a patient suffering from frequent haemorrhages in the inner organs and mucous membranes revealed proline and lysine being included in collagen fibers.

Impairment of their hydroxylation is caused by the lack of the following vitamin:

- A.K
- B. E C. C
- D. A
- D. A E. D
- E. D

26. Procollagen is a protein synthesized by fibroblasts of connective tissue. Then glycosylation process occurs. What carbohydrates bind to procollagen?

- A. Galactose, glucose
- B. Fructose, mannose
- C. Ribose, deoxyribose
- D. Arabinose, sucrose
- E. Ribulose, xylulose

27. A 10-year-old girl often experiences acute respiratory infections with multiple spotty hemorrhages in the places of clothes friction. What hypovitaminosis is present in the girl?

- A. A
- B. C
- $C. \ B_6$
- $D. \ B_2$
- E. B<sub>1</sub>

28. What amino acids by polarity are few in elastin?

- A. Polar
- B. Nonpolar
- C. Middle polar
- D. Acidic
- E. Alkaline

29. The insufficiency of which vitamin causes premature termination of bone growth associated with the impaired synthesis of chondroitin sulfate?

- A. Vitamin C
- B. Vitamin D
- C. Vitamin E
- D. Vitamin K
- E. Vitamin A

## 25. Biochemistry of bone tissue. Risk factors of osteoporosis.

1. Extremities fractures due to bone fragility were observed in the organism of a 9-year-old boy. Function of which endocrine organ is disturbed?

- A. Parathyroid gland
- B. Thyroid gland
- C. Epiphysis
- D. Adrenal gland
- E. Pancreas

2. What form of bone tissue metabolism disorder develops in hypergonadism?

- A. Osteopetrosis
- B. Osteoporosis
- C. Osteomalacia
- D. Osteosclerosis
- E. All of the above

3. Parathyroid hormone stimulates calcium absorption in the intestine through the effect on the biosynthesis of calcitriol, which is an activator of calcium absorption. What is the molecular mechanism of calcitriol action?

A. It activates gene expression of  $Ca^{2+}$  binding protein's synthesis

B. It activates synthesis of calcitonin in the thyroid gland

C. It activates processing pro-parathyroid hormone in parathyroid hormone

- D. It activates synthesis of cholecalciferol
- E. It activates alkaline phosphatase

4. Parathyroid hormone regulates the level of calcium in the blood. Which of these effects implemented by hormone are characteristic for the bone tissue?

- A. It promotes the formation of citric acid
- B. Reducing the synthesis of organic compounds
- C. Inhibition of the citric acid cycle
- D. Activation of acidic phosphatase
- E. All of these

5. Specify metabolites that initiate periodontal bone mineralization:

A. Hydroxylysine, carboxyglutamate, phosphoserine

B. Glycine, alanine, valine

C. Triacylglycerols, cholesterol, sphingosine

D. Pyruvic acid, lactic acid

E. Phosphatidylcholine,

phosphatidylethanolamine

6. What bioregulators are calcitropic hormones?

- A. Calcitonin, parathyroid hormone
- B. Adrenalin, glucagon
- C. Thyroxine, insulin
- D. Cortisol, aldosterone
- E. Testosterone, estrogen

7. There is osteoporosis in a patient with chronic renal failure. What vitamin's metabolism infringement promotes this disorder?

- A. Vitamin E
- B. Vitamin D
- C. Vitamin A
- D. Vitamin K
- E. Vitamin B<sub>1</sub>

8. The mineralization and demineralization of bone tissue is controlled by hormones:

- A. Calcitonin, parathyroid hormone
- B. Insulin, glucagon
- C. Thyroxine, cortisol
- D. ACTH, growth hormone
- E. Eicosanoids

9. Which hormone causes mineralization of bone tissue under hypercalcemia?

- A. Calcitonin
- B. Melatonin
- C. Insulin
- D. Glucagon
- E. Parathyroid hormone

10. What vitamins promote bone mineralization?

- A. ACD
- B. A K B<sub>6</sub>
- C.  $A B_3 C$
- D. AHD
- $E. \quad B_1 C E$

11. High level of what hormone leads to osteoporosis?

- A. Glucagon
- B. Calcitonin
- C. Melatonin
- D. Insulin
- E. Parathyroid hormone

12. What hormone's high level leads to osteoporosis?

- A. Cortisol
- B. Calcitonin
- C. Melatonin

- D. Insulin
- E. Glucagon

13. The softening of bones in rickets is caused by the deficiency of:

- A. Cholecalciferol (D<sub>3</sub>)
- B. Pantothenic acid
- C. Nicotiamide
- D. Parathyroid hormone
- E. Riboflavin

14. In case of insufficiency of which vitamin observed premature termination of bone growth that is associated with the impaired synthesis of chondroitin sulfate:

- A. Vitamin E
- B. Vitamin D
- C. Vitamin A
- D. Vitamin K
- E. Vitamin C

15. When the primary osteoporosis is developing at?

- A. Menopause
- B. Cushing's disease
- C. Diabetes mellitus
- D. Hyperparathyroidism
- E. Cushing's syndrome

16. The cause of secondary osteoporosis in Cushing's disease is:

A. Excess of cortisol that inhibits proteosynthesis, which leads to proteolysis of osteoid

B. Excess of cortisol and disruption of cholecalciferol activation

C. Excess of cortisol and activation of proteosynthesis in osteoid

D. Excess of cortisol and increased urinary calcium excretion

E. Excess of cortisol and violation of calcium absorption

17. What form of bone tissue metabolism disorder develops in rickets?

- A. Osteopetrosis
- B. Osteomalacia
- C. Osteosclerosis
- D. Osteoporosis
- E. All of the above

18. What form of bone tissue metabolism disorder develops in hyperparathyroidism?

- A. Osteoporosis
- B. Osteomalacia
- C. Osteopetrosis
- D. Osteosclerosis
- E. All of the above

19. What form of bone tissue metabolism disorder develops in Cushing's disease?

- A. Osteoporosis
- B. Osteomalacia
- C. Osteopetrosis
- D. Osteosclerosis
- E. All of the above

20. Parodontitis is treated with calcium preparations and a hormone that stimulates tooth mineralization and inhibits tissue resorption. What is the hormone called?

- A. Thyroxine
- B. Parathormone
- C. Adrenalin
- D. Aldosterone
- E. Calcitonin

21. What enzyme is activated by parathyroid hormone in the kidney?

- A. Alfa-1-hydroxylase of calcidiol
- B. Alfa-24-hydroxylase of calcidiol
- C. Alfa-25-hydroxylase of calcidiol
- D. Alfa-25-hydroxylase of calciol
- E. Alfa-24-hydroxylase of calciol

#### 26. Biochemistry of nervous tissue.

1. What tissue has the highest sensitivity to the insufficient supply of oxygen?

- A. Bone
- B. Muscle
- C. Adipose
- D. Epithelial
- E. Nervous

2. What metabolite is the main source of energy for brain?

- A. Fatty acids
- B. Glucose
- C. Amino acids
- D. Glycerol
- E. Glycogen

3. What are the possible consequences of insulin overdose and a decrease in blood glucose to 2.5 mmol / L or lower?

- A. Hypoglycemic coma
- B. Hyperosmolar coma
- C. Hyperketonemic coma
- D. Hypoxic coma
- E. –

4. What type of complex lipids is neurospecific?

- A. Gangliosides
- B. Unsaturated fatty acids
- C. Phosphatidylcholine
- D. Phosphatidylserine
- E. Saturated fatty acids

5. What amino acids are the most widely represented in the structure of the nervous tissue?

- A. Glutamic acid, aspartic acid
- B. Glycine, proline
- C. Histamine, tyrosine
- D. Valine, Isoleucine
- E. Phenylalanine, threonine

6. Which of the following functions of the brain needs the largest energy supply?

- A. Generation and transmission of nerve impulses
- B. Reduction of neurofilament
- C. Synthesis of neurospecific lipids
- D. Neutralization of ammonia
- E. Synthesis of biogenic amines

7. What amino acid is used in the nervous tissue for ammonia neutralisation?

- A. Leucin
- B. Glutamic acid
- C. Proline
- D. Valine
- E. Glutamine

8. Which inhibitory neurotransmitter is synthesized in the nervous tissue during decarboxylation of glutamic acid?

- A. Gamma-aminobutyric acid (GABA)
- B. Taurine
- C. Glycine
- D. Glutamine
- E. Enkephalin

9. What amino acid is a source of the catecholamines formation?

- A. Glutamine
- B. Tryptophan
- C. Glutamic acid
- D. Tyrosine
- E. Methionine

10. Which enzyme hydrolyses a neurotransmitter in the cholinergic synapses?

- A. Acetylcholinesterase
- B. Monoamine oxidase
- C. Histaminase
- D. Ceruloplasmin
- E. Xanthine oxidase

11. A neurological disorder Parkinson's disease is associated with the underproduction of the following neurotransmitter:

- A. Serotonin
- B. Dopamine
- C. GABA
- D. Acetylcholine
- E. Histamine

12. Which of the neurotransmitters is used as an anti-stress factor?

- A. Gamma-aminobutyric acid
- B. Glutamine
- C. Norepinephrine
- D. Dopamine
- E. Acetylcholine

13. Which of the neuropeptides has morphine-like activity?

- A. Enkephalin
- B. Norepinephrine
- C. Dopamine
- D. Substance P
- E. Neurotensin

14. What changes in the neurotransmitter balance are characteristic for stressful influences?

A. Increased synthesis and secretion of catecholamines

- B. Increased synthesis of acetylcholine
- C. Inhibition of catecholamine synthesis
- D. Inhibition of endorphins synthesis
- E. Inhibition of glycine synthesis

15. Which enzyme catalyzes the oxidative deamination of catecholamines?

- A. Glutaminase
- B. Glutamyltransferase
- C. Cholinesterase
- D. Acetylcholinesterase
- E. Monoamine oxidase

16. What is a neurochemical basis of using antidepressants in the treatment of depressive conditions?

A. Inhibition of monoamine oxidase activity

B. Increased concentration of acetylcholine in brain synapses

C. Increased concentration of GABA in brain synapses

D. Inhibition of cholinesterase activity in brain synapses

E. Increased activity of monoamine oxidase

17. What is the main pathway of brain metabolism providing it with energy?

- A. Aerobic oxidation of glucose
- B. Anaerobic oxidation of glucose
- C. Gluconeogenesis
- D. Oxidation of fatty acids
- E. Oxidation of ketone bodies

18. What structures of the brain are characterized by the highest intensity of gas exchange?

- A. Cerebral cortex
- B. White matter
- C. Sympathetic nervous system
- D. Parasympathetic parts of the nervous system
- E. Synapses

19. A patient with a craniocerebral trauma has regular epileptic seizures. The formation of what biogenic amine is violated in this condition?

- A. Histamine
- B. GABA
- C. Adrenaline
- D. Serotonin
- E. Dopamine

20. Biogenic amines are used in psychiatry for treatment of a number of diseases. Which drug is the main inhibitory neurotransmitter?

- A. Gamma-aminobutyric acid
- B. Histamine
- C. Serotonin
- D. Dopamine

21. The patient came to the doctor with complaints of dizziness, worsening of memory and periodic convulsions. It was found that the cause of such changes is the product of glutamic acid decarboxylation. Name it:

A. TPP

- B. GTP
- C. GABA D. ATP
- E. THF

22. Sense of fear in humans is caused by the synthesis of dioxiphenylalanine (DOPA) in the limbic system of the brain. What substance is DOPA formed from?

- A. Tyrosine
- B. Glutamic acid
- C. Tryptophan
- D. Lysine
- E. 5-hydroxytryptophan

23. The pharmacological effects of antidepressants are associated with the inhibition of an enzyme that catalyzes the breakdown of such biogenic amines as norepinephrine serotonin and in the mitochondria of neurons of the brain. Which enzyme is involved in this process?

- A. Monoamine oxidase
- B. Transaminase
- C. Decarboxylase
- D. Peptidase
- E. Lyase

24. Depression and emotional disorders are the result of the deficiency of dopamine, norepinephrine, serotonin and other biogenic amines in the brain. An increase in their content in synapses can be achieved due to antidepressants, which inhibit the enzyme:

- A. Monoamine oxidase
- B. Diaminooxydase
- C. L-amino acid oxidase
- D. D-amino acid oxidase
- E. Phenylalanine-4-monooxygenase

25. Brain injury caused increased production of ammonia. What amino acid is involved in the removal of ammonia from this tissue? A. Lysine

- B. Tyrosine
- C. Valine
- D. Tryptophan
- E. Glutamic acid

26. Which neurotransmitter is synthesized from acetyl-CoA and cholin?

- A. Acetylcholine
- B. Serotonine
- C. Dopamine
- D. GABA
- E. Norepinephrine

27. A newborn has been observed epileptic seizures caused by a deficiency of vitamin  $B_6$ . This is due to a decrease of inhibitory neurotransmitter gamma-aminobutyric acid in the nervous tissue. Which enzyme's activity is reduced in this case?

- A. Glutamate decarboxylase
- B. Alanine aminotransferase
- C. Glutamate dehydrogenase
- D. Pyridoxal kinase
- E. Glutamin synthetase

28. Which substances can be used like a source of energy in the brain if the level of glucose is low in the blood?

- A. Fructose
- B. Glucose
- C. Ketone bodies
- D. Phospholipids
- E. Fatty acids

29. A patient has acute viral meningitis. What are changes of the protein composition in the liquor?

- A. Increasing of the protein content
- B. Reduction of the protein content
- C. Protein content is unchanged
- D. Advantageously increase of albumins
- E. Increasing in the globulin content

### TESTS «BIOCHEMISTRY OF ORGANS OF ORAL CAVITY»

#### Biochemistry of the dental tissue.

1. A child has abnormal formation of tooth enamel and dentin as a result of a low concentration of calcium ions in the blood. Such abnormalities might be caused by a deficiency of the following hormone:

- A. Triiodothyronine
- B. Thyrocalcitonin
- C. Thyroxin
- D. Somatotropin
- E. Parathormone

2. A one-year-old child has enlarged head, retarded cutting of teeth and destruction of enamel structure. What hypovitaminosis causes these changes?

- A. Hypovitaminosis C
- B. Hypovitaminosis D
- C. Hypovitaminosis A
- D. Hypovitaminosis B<sub>1</sub>
- E. Hypovitaminosis B<sub>2</sub>

3. What type of apatite has the largest part of the mineral component of human teeth?

- A. Hydroxyapatite
- B. Fluorapatite
- C. Carbonate apatite
- D. Strontium apatite
- E. Chlorapatite

4. What is the main source of calcium and phosphorus for tooth enamel?

- A. Blood plasma
- B. Gingival liquid
- C. Oral liquid
- D. Extracellular liquid
- E. Pulp

5. Which of the following biochemical processes provides the highest resistance of enamel to caries?

- A. Synthesis of fluorapatite
- B. Synthesis of hydroxyapatite
- C. Synthesis chlorapatite
- D. Synthesis of collagen
- E. Synthesis of carbonate apatite

6. The organic enamel matrix consists of the following proteins:

- A. Enamelin, amelogenin
- B. Collagen, elastin
- C. Elastin, glycoprotein
- D. Proteoglycans, globulins
- E. Albumins, globulins

7. Specify the optimal pH of the oral liquid for mineralization and remineralization of dental tissues:

- A. 6.8 7.2
- B. 7.3 7.5
- C. 6.4 6.6
- D. 5.8 6.0
- E. 6.2 6.4

8. What is the main source of minerals for the formation of dental subgingival plaque?

- A. Oral liquid
- B. Gingival liquid
- C. Saliva
- D. Blood plasma
- E. Serum

9. What apatite of tooth enamel is more resistant to the action of cariogenic factors?

- A. Fluorapatite
- B. Hydroxyapatite
- C. Clorapatite
- D. Carbonate apatite
- E. Strontium apatite

10. What apatite of tooth enamel is the least resistant to the action of organic acids?

- A. Carbonate apatite
- B. Hydroxyapatite
- C. Clorapatite
- D. Fluorapatite
- E. Strontium apatite

11. Which amino acid of the organic matrix of mineralized tissues is phosphorylated by the action of alkaline phosphatase?

- A. Proline
- B. Glycine
- C. Alanine
- D. Valine
- E. Serine

12. What hard tooth tissue is the least mineralized?A. Cementum

- B. Enamel
- C. Dentin
- D. Secondary dentin
- E. Tertiary dentin

13. Which glycosaminoglycan plays an important role in the mineralization of dentine and cementum?

- A. Chondroitin sulfate
- B. Hyaluronic acid
- C. Dermatan sulfate
- D. Keratan sulfate
- E. Heparin

14. The biggest part of dentin organic phase is the following protein:

- A. Osteonectin
- B. Enamelin
- C. Amelogenin
- D. Collagen
- E. Osteopontin
- 15. Which protein is not found in the enamel?
- A. Collagen
- B. Enamelin
- C. Amelogenin
- D. Ameloblastin
- E. Taftelin

16. Mineralizated tooth tissues have the same structure of apatite crystals which differ in size. Which tooth tissue has the largest hydroxyapatite crystals?

- A. Enamel
- B. Cementum
- C. Dentin
- D. Secondary dentine
- E. Tertiary dentin

17. Mineralizated tooth tissues have the same structure of apatite crystals which differ in size. Which tooth tissue has the smallest hydroxyapatite crystals?

- A. Cementum
- B. Enamel
- C. Dentin
- D. Secondary dentine
- E. Tertiary dentin

18. The synthesis of adhesive glycans is one of the stages of dental plaque formation. What enzyme is involved in their synthesis?A. Glycosyltransferase

- B. Collagenase
- C. Transaminase
- D. Lysyl oxidase
- E. Prolyl hydroxylase

19. What kind of hard tooth tissue is formed by dental pulp odontoblasts after their irritation?

- A. Cementum
- B. Tertiary dentin
- C. Primary dentin
- D. Secondary dentin
- E. Enamel
- 20. Peripherical pulp layer contains the cells:
- A. Odontoblasts
- B. Cementoblasts
- C. Cementocytes
- D. Osteoblasts
- E. Anameloblasts

21. What is the initial stage of the dental plaque formation called?

- A. Cuticle
- B. Dental plaque
- C. Pellicle
- D. Plaque
- E. Supragingival stone

22. The excessive intake of what trace element causes the development of fluorosis?

- A. Fluorine
- B. Chlorine
- C. Ferrum
- D. Bromine
- E. Copper

23. The main method to increase the resistance of enamel is the fluoridation of water. The mechanism of the anticaries action of fluorine is related to:

- A. Synthesis of fluorapatite
- B. Synthesis of hydroxyapatite
- C. Tooth demineralization
- D. Tooth mineralization
- E. Synthesis of carbonate apatite

24. The disturbance of the mineralization processes and appearance of opaque white patches on the enamal were revealed in a child. What microelement exchange is disturbed in this case? A. Fluorine

- B. Chlorine
- C. Ferrum
- D. Bromine
- E. Copper

### **Biochemistry of saliva.**

1. What are the consequences of the shifting of pH of the oral fluid to the acidic side (less than 6.4-6.2)?

A. It promotes enamel demineralization and caries

B. It increases intake of calcium and phosphorus ions to dental hard tissue

C. It reduces the formation of organic acids in the mouth

D. It worsens oral hygiene

E. It participates in the formation of the protective function of the oral cavity

2. What proteins of mixed saliva are represented in the largest number among organic substances?

A. Mucin, amylase, lysozyme, secretory Immunoglobulin A

B. Mucin, free amino acids, lysozyme

C. Amylase, lactate, lysozyme, pyruvate, amylase

D. Mucin, lysozyme, pyruvate, amylase

E. Mucin, urea, lysozyme, amylase

3. Which component of saliva gives it a dense mucous character?

- A. Kalikrein
- B. Proteinase inhibitors
- C. Mucin
- D. Catalase
- E. Alpha-amylase

4. What enzyme of saliva has high antibacterial properties?

- A. Kallikrein
- B. Alkaline phosphatase
- C. Superoxide dismutase
- D. Alpha amylase
- E. Lysozyme

5. What saliva protein plays a protective role and determines the local immunity of the oral cavity?

- A. sIg A
- B. Ig A

- C. Ig D
- D. Ig E
- E. Ig M

6. What hormone of parotid glands promotes mineralization of teeth and bones?

- A. Calcitonin
- B. Parotin
- C. Calcitriol
- D. Insulin
- E. Nerve growth factor

7. What saliva hormones are indicators of stress reaction of the body?

- A. Cortisol, adrenaline
- B. Thyroid hormones
- C. Testosterone, estradiol
- D. Calcitonin, parathyroid hormone
- E. Insulin, parotin

8. Which of the following components inhibiting proteolytic enzymes are synthesized by salivary glands?

- A. Acid-proteinase inhibitor
- B. Alpha<sub>2</sub> macroglobulin
- C. Alpha<sub>2</sub>- antitrypsin
- D. Antithrombin
- E. Pepsin

9. Which cations of mixed saliva are present in the same concentration as in blood plasma?

- A. Calcium and magnesium
- B. Sodium and potassium
- C. Sodium and calcium
- D. Potassium and calcium
- E. Magnesium and sodium

10. What enzymes of saliva have the antioxidant properties?

- A. Superoxide dismutase, catalase
- B. Lipase, acid phosphatase
- C. α -amylase, alkaline phosphatase
- D. Proteinases, maltase
- E. Acidic phosphatase, lipase

11. The degree of activation of free radical processes in the oral cavity tissues evaluated by the free radical oxidation products that promote tissue damage. What are these products?

- A. Hydroperoxides, malondialdehyde
- B. Albumins, globulins
- C. Amylase, seromucoid

- D. Proteinase, lipase
- E. Peroxidase, nuclease

12. The development of what pathology of the dentoalveolar apparatus may be caused by hyposalivation?

- A. Multiple caries
- B. Periodontitis
- C. Gingivitis
- D. Dental plaque
- E. Dental calculus

13. What is the leading mechanism of the influence of parotin on the biochemical processes in the oral cavity?

A. It activates processes of hard tissues mineralization of the oral cavity

B. It activates antioxidant protection of the oral cavity tissues

C. It activates resorption of the alveolar process of the jaw bones

D. It increases the secretion of saliva

E. It increases the humoral immune defense

14. Which of the following substrates is hydrolysed by the salivary  $\alpha$ -amylase?

- A. Cholesterol
- B. Lipids
- C. Glucose
- D. Proteins
- E. Starch

15. What is the concentration of phosphorus in the oral fluid in comparison with blood plasma?

A. It is above the blood plasma level

B. It is below the plasma level

C. Equal concentration of blood plasma

D. Trace quantities as compared to the content in the blood plasma

E. –

16. What is normal Ca/P ratio in the oral fluid?

- A. 1.67
- B. 2.00
- C. 1.35
- D. 1.55
- E. 2.45

17. What hormone regulates the processes of mineralization of dental tissues?

- A. Calcitonin
- B. Cortisol
- C. Thyroxine
- D. ACTH
- E. Estrodiol

18. What is the main source of metabolites for tooth enamel after eruption?

- A. Oral fluid
- B. Gingival fluid
- C. Blood plasma
- D. Lymphatic fluid
- E. Intercellular fluid

19. Which of these components is the most informative for the evaluation of local immunity of the oral cavity?

- A. Ig G
- B. Ig E
- C. Ig D
- D. sIgA
- E. IgA

20. Which of the following biochemical processes has a pathogenic effect on the tissues of the oral cavity?

- A. Activation of free radical processes
- B. Activation of tissue respiration
- C. Activation of oxidative phosphorylation
- D. Activation of glucogenogenesis
- E. Activation of protein synthesis

21. What is the difference between the calcium content in the oral fluid in comparison with the blood plasma?

- A. It is higher or equal to plasma content
- B. Lower concentration than in blood plasma
- C. Trace amounts compared to blood plasma
- D. It equals to the level in blood plasma

E. It exceeds the level in the blood plasma by at least in two times

### Biochemical mechanisms of the main stomatological diseases development.

1. An activity of acid phosphatase and hyaluronidase of saliva are increased in a patient with periodontitis. What do these changes indicate?

A. Activation of biomolecules catabolism in the periodontal tissues

B. Increased excretion of saliva enzymes.

C. Violation of the hormonal regulation of periodontal tissue metabolism

D. Activation of free radical processes

E. Insufficient protection function of periodontal tissues

2. A 20-years-old man, who took part in the liquidation of the consequences of the Chernobyl nuclear power plant accident, fell ill with periodontitis. What is the most important etiologic factor in the development of this pathology?

- A. Emotional stress
- B. Iron deficiency
- C. Malnutrition
- D. Increase physical activity
- E. Oral microflora

3. How is the process of dental hard tissues mineralization changed in a patient with sialolithiasis?

- A. It is decreased
- B. It doesn't change
- C. It is increased

D. There is violation in the ratio of mineral components of saliva

E. –

4. The excessive intake of what trace element causes the development of fluorosis?

- A. Copper
- B. Chlorine
- C. Ferrum
- D. Bromine
- E. Fluorine

5. The chemical composition of saliva and teeth is changed with many systemic diseases. Multiple dental caries is observed at:

- A. Obesity
- B. Diabetes mellitus
- C. Atherosclerosis
- D. Pneumonia
- E. Gout

6. Excess glucose concentration in the oral fluid of patients with diabetes mellitus leads to the development of:

- A. Multiple caries
- B. Enamel hyperplasia
- C. Enamel hypoplasia
- D. Fluorosis
- E. Enhanced enamel calcification

7. High fluorine content in the drinking water (more than 1.5 mg / L) leads to the development of:

- A. Endemic fluorosis
- B. Multiple caries
- C. Enamel hyperplasia
- D. Enamel hypoplasia
- E. Periodontitis

8. The fluoridation of drinking water is one of the main ways to increase the resistance of enamel to caries development. The mechanism of the anticaries action of fluorine is related to:

- A. Synthesis of fluorapatite
- B. Synthesis of hydroxyapatite
- C. Tooth demineralisation
- D. Tooth mineralization
- E. Synthesis of carbonate apatite

9. Which hormone is a stimulator of the tooth mineralization and inhibitor of bone resorption?

- A. Dopamine
- B. Insulin
- C. Adrenaline
- D. Calcitonin
- E. Thyroxine

10. Hypovitaminosis C leads to a decrease in the formation of an organic matrix, a delay in the processes of remineralization, a violation of collagen synthesis, because this vitamin takes part in the following process:

- A. Hydroxylation of proline and lysine
- B. Carboxylation of proline
- C. Carboxylation of lysine
- D. Hydroxylation of proline
- E. Hydroxylation of lysine

11. Special pastes containing fat-soluble vitamins A and D are used in dental practice. This is due to the fact that:

A. These vitamins regulate the exchange of heteropolysaccharides in the tissues of the tooth and promote the deposition of calcium salts

B. These vitamins promote conversion of procollagen to collagen, leading to remineralization

C. These vitamins activate the energy metabolism in the tissues of the tooth

D. They promote the replacement of strontium apatite with hydroxyapatite

E. They provide antioxidant properties of dental tissues

12. The normal pH of saliva is from 6.4 to 7.8. The change of the pH of saliva to acidic side (less than 6.2) leads to:

- A. Enamel demineralization and caries
- B. Tooth tissue calcification
- C. Fluorosis
- D. Mineralization of tooth tissue
- E. Periodontitis

13. The normal pH of saliva is from 6.4 to 7.8. The change of the pH of saliva to alkaline side (more than 7.8) leads to:

- A. Formation of tartar
- B. Demineralization of enamel
- C. Calcium release from tooth tissues

D. The release of phosphorus from tooth tissues

E. Decrease in firmness of tooth tissues to the action of cariogenic factors

14. The child is diagnosed with chronic renal failure. What biochemical parameters of saliva can confirm the diagnosis?

A. Increased level of residual nitrogen

B. Increased concentration of secretory immunoglobulin A

- C. Reduced activity of alkaline phosphatase
- D. Increased activity of amylase
- E. Increased concentration of phosphorus

15. Hypersalivation is observed in the patient. As a result, there is an excess supply of saliva with slightly alkaline pH in the stomach, causing partial neutralization of hydrochloric acid. The hydrolysis of what substances will be disturbed in this case?

A. Lipids

- B. Carbohydrates
- C. Nucleic acids
- D. Proteins
- E. Carbohydrates and lipids

16. The patient has progressive demineralization of enamel. The pH of oral fluid is 6.0. What kind of food should be limited in this case?

A. Highly refined carbohydrates

B. Animal proteins

C. Food enriched with microelements

D. Food enriched with vitamins

E. Food enriched with polyunsaturated fatty acids

17. The micelle-like structure of saliva plays an important role in the processes of mineralization of the tooth tissues in the oral cavity. Which of the following factors protects the saliva micelles from aggregation? A. Mucin

- B. Lysozyme
- C. Pyruvate
- D. Lactate
- E. Citrate

18. The deformity of the skeleton has been revealed in the child. The child's deciduous teeth have insufficiently mineralized enamel and the presence of keratan sulfate has been established in the urine. What kind of hereditary disease is observed in the child?

- A. Mucopolysaccharidosis
- B. Collagenosis
- C. Glycogenosis
- D. Sphingolipidosis
- E. Mucolipidosis

19. During dental prophylactic examination of pupils, some children have been found dense deposits of tartar on the teeth. What substrates are involved in its formation?

- A. Calcium phosphate
- B. Calcium oxalate
- C. Urates
- D. Cholesterol
- E. Pigments

20. A one-year-old child has enlarged head and belly, retarded cutting of teeth, destruction of enamel structure. What hypovitaminosis causes these changes?

- A. Hypovitaminosis A
- B. Hypovitaminosis C
- C. Hypovitaminosis D
- D. Hypovitaminosis B<sub>1</sub>
- E. Hypovitaminosis B<sub>2</sub>

21. A patient complains of feeling pain in the temporomandibular joints during chewing food. It has been revealed enlarged and painful small joints of upper and lower extremities during palpation. Serum urates are increased. The metabolism of which substances is disturbed?

- A. Purines
- B. Albumins
- C. Cholesterol
- D. Phenylalanine
- E. Hemoglobin

22. The initial stage of caries has been revealed in a child. What food should prevail in the patient's diet?

A. Animal proteins, vitamins C, E, A and minerals

B. Fats and fat-soluble vitamins

C. Water-soluble vitamins and carbohydrates

D. Nucleic acids and microelements

E. Vegetable proteins, water-vitamins and minerals

23. The patient has a marked bleeding of the gums. What vitamins should be assigned to the patient?

- A. Vitamins C, K
- B. Vitamins  $B_1$ ,  $B_2$
- C. Vitamins A, E
- D. Vitamin PP
- E. Biotin, pantothenic acid

24. During medical examination of the patient it has been revealed hypoplasia of the teeth caused by hypovitaminosis A and D. Vitamins were prescribed orally, but the therapeutic effect has not been achieved. What is the possible reason for the deficiency of vitamins?

- A. Obstruction of bile duct
- B. Reduced gastric acidity
- C. Increased acidity in the stomach
- D. Destruction of vitamins in the intestine
- E. Absence of carrier proteins

25. Analysis of the saliva of the patient with periodontitis indicates a decrease in catalase activity. Which process is activated in this patient?

- A. Free-radical oxidation
- B. Microsomal oxidation
- C. Substrate phosphorylation
- D. Mitochondrial oxidation
- E. Anaerobic oxidation

26. A patient suffering from scurvy has been revealed disturbed processes of connective tissue formation leading to the loss of teeth. The decreased activity of which enzyme causes these symptoms?

- A. Lysyl hydroxylase
- B. Glycosyl transferase
- C. Elastase
- D. Procollagen peptidase of N-terminal peptide
- E. Procollagen peptidase of C-terminal peptide

27. A 17-year-old guy needs to carry out extirpation of the tooth in a few days. A decrease in the indices of the blood clotting system was found in the coagulogram. The dentist has appointed a synthetic analogue of an antihemorrhagic vitamin. Specify it:

- A. Vikasol
- B. Dicoumarol
- C. Warfarin
- D. Allopurinol
- E. Cobalamin

28. Tocopherol is used in the complex treatment of periodontitis. What effect determines the therapeutic properties of this drug?

- A. Anti-inflammatory
- B. Antioxidant
- C. Allergy
- D. Osteotrophic
- E. Prooxidant

29. What component of the oral fluid significantly increases the frequency of tooth decay development in the patients with diabetes mellitus?

- A. Urea
- B. Amino acids
- C. Glucose
- D. Residual nitrogen
- E. Ammonia

30. Periodontitis is accompanied by the activation of proteolysis in the periodontal tissues. The increase of which component of the oral fluid indicates activation of proteolysis?

- A. Amino Acids
- B. Organic acids
- C. Glucose

- D. Biogenic amines
- E. Cholesterol

31. A child has disturbed enamel and dentine formation as a result of a decreased content of calcium ions in his blood. What hormone deficiency may cause such changes?

- A. Parathormone
- B. Somatotropin
- C. Thyroxin
- D. Thyreocalcitonin
- E. Triiodothyronine

32. Up to 50% of world population aged above thirty is affected by paradontosis. The leading role in the pathogenesis of this disease belongs to:

A. Neurodystrophic factor

B. Damage of periodontal tissues by kallikrein

C. Damage of periodontal tissues by active cells

- D. Dental calculus caused by microflora
- E. Immune damage of tissues

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Answers to the test tasks of the module II
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## Answers to the test tasks of the module III

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Biochemistry tiss	of the dental sue	Biochemistry	of the saliva	Biochemical mechanisms of the main stomatological diseases development						
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17	А	17	А	17	А					
18	А	18	А	18	А					
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21	С	21	А	21	А					
22	А			22	А					
23	А			23	А					
24	А			24	А					
				25	А					
				26	А					
				27	А					
				28	В					
				29	С					
				30	А					
				31	А					
				32	А					